CRRT 2012
SEVENTEENTH INTERNATIONAL CONFERENCE ON CONTINUOUS RENAL REPLACEMENT THERAPIES
FEBRUARY 14-17, 2012 HILTON SAN DIEGO BAYFRONT SAN DIEGO, CALIFORNIA

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CONFERENCE DESCRIPTION AND LEARNER OBJECTIVES

The CRRT conference is designed to provide an up-to-date review of the latest developments and research in the field of ICU medicine, acute kidney injury and CRRT. The conference is structured to promote multidisciplinary interaction among specialists in nephrology, critical care, nursing support personnel and industry involved in the care of the critically ill patient. A combination of invited lectures, lively debates, panel discussions, interactive workshops, oral and poster presentations will be presented at the conference.

At the end of this conference attendees should be able to:
1. Discuss the pathophysiology of critical illness and acute kidney injury.
2. Describe the principles and practice of CRRT techniques and their application.
3. Recognize key features for fluid management, hemodynamic monitoring and resuscitation for critically ill patients.

NEEDS ASSESSMENT

Acute kidney injury (AKI) is a common, heterogeneous and detrimental clinical condition that has significant attributable morbidity and mortality. Despite major advances in understanding the epidemiology, pathogenesis and outcomes of AKI, the preventive measures remain inadequate and therapeutic approaches (except for renal replacement therapy) have largely proven futile so far. Recent publications from several international consensus conferences including the Acute Kidney Injury network (AKIN) (CJASN May 2008 vol. 3 no. 3 887-894)); the American Thoracic Society (ATS), European Respiratory Society (ERS), European Society of Intensive Care Medicine (ESICM), Society of Critical Care Medicine (SCCM), and the Société de Réanimation de Langue Française (SRLF) (Am J Respir Crit Care Med. 2010 May 15;181(10):1128-55) have highlighted several gaps in our knowledge particularly in the following areas:

1. Pathophysiology and diagnosis of AKI in critically ill patients
2. Management strategies for prevention, treatment and follow up of patients with AKI
3. Optimal strategies for initiating and delivering dialysis with continuous renal replacement therapies (CRRT), intermittent hemodialysis (IHD) and peritoneal dialysis (PD) for the support of patients with AKI and multiple organ failure

The 17th International CRRT conference addresses these needs focusing on the recent advances in our understanding of mechanisms, pathways of AKI and its effects on other organs, pathophysiology of critical illness, acute kidney injury, emerging strategies in the management of sepsis, multiorgan failure, development and use of biomarkers, technical advances in CRRT and the appropriate utilization of these techniques.

TARGET AUDIENCE

The CRRT target audience includes: MD/DOs, NP/PA/Nurses, Dieticians, Industry, Pharmacists, Residents and Fellows. Specialties include: Anesthesiology, Cellular & Molecular Medicine, Critical Care, Emergency Medicine, Family & Preventive Medicine, Geriatrics, and Internal Medicine.

ACCREDITATION STATEMENT

This activity has been planned and implemented in accordance with the Essential Areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of the University of California, San Diego School of Medicine and CRRT, Inc. The University of California, San Diego School of Medicine is accredited by the ACCME to provide continuing medical education for physicians.

The University of California, San Diego School of Medicine designates this live activity for a maximum of 35 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

BRN: For the purpose of recertification, the American Nurses Credentialing Center accepts 35 AMA PRA Category 1 Credits™ issued by organizations accredited by the ACCME. For the purpose of relicensure, the California Board of Registered Nursing accepts 35 AMA PRA Category 1 Credits™ (report up to 35 hours of credit and list “CME Category 1” as the provider number).

CULTURAL AND LINGUISTIC COMPETENCY

This activity is in compliance with California Assembly Bill 1195 which requires continuing medical education activities with patient care components to include curriculum in the subjects of cultural and linguistic competency. Cultural competency is defined as a set of integrated attitudes, knowledge, and skills that enables health care professionals or organizations to care effectively for patients from diverse cultures, groups, and communities. Linguistic competency is defined as the ability of a physician or surgeon to provide patients who do not speak English or who have limited ability to speak English, direct communication in the patient’s primary language. Cultural and linguistic competency was incorporated into the planning of this activity. Additional resources on cultural and linguistic competency and information about AB1195 can be found on the UCSD CME website at http://cme.ucsd.edu.

CME ACTIVITIES

The following Workshops, Plenary Sessions and Luncheons qualify for CME Credit:

TUESDAY
WORKSHOPS
PW1 Changing Paradigms in AKI & HW1 Fundamentals of CRRT
GROUP 1 - SIMULTANEOUS WORKSHOPS

WEDNESDAY
GROUP 2 - SIMULTANEOUS WORKSHOPS
GROUP 3 - SIMULTANEOUS WORKSHOPS
OPENING SESSION 1: PATIENT CHARACTERISTICS
Nursing Forum Luncheon

THURSDAY
GROUP 4 - SIMULTANEOUS WORKSHOPS
SESSION II: EMERGING CONCEPTS IN AKI & CRITICAL CARE
Nursing Forum Luncheon 2 and "Late Breaking Trials" Luncheon

FRIDAY
SESSION III: TECHNIQUE CHARACTERISTICS
SESSION IV: FUTURE TRENDS IN CRRT AND CRITICAL CARE
WORKSHOPS
HW3: Pediatric Hands-On Workshop.
HW4: Hemodynamic Monitoring and Use of Drugs
HW5: Essentials for Developing, Nurturing and Growing a CRRT Program
HW6: Introduction to Critical Care Ultrasonography
It is the policy of the University of California, San Diego School of Medicine to ensure balance, independence, objectivity and scientific rigor. All persons involved in the selection, development and presentation of content are required to disclose any real or apparent conflicts of interest. All conflicts of interest will be resolved prior to an educational activity being delivered to learners through one of the following mechanisms: 1) altering the financial relationship with the commercial interest, 2) altering the individual's control over CME content about the products or services of the commercial interest, and/or 3) validating the activity content through independent peer review. All persons are also required to disclose any discussions of off label/unapproved uses of drugs or devices. Persons who refuse or fail to disclose are disqualified from participating in the CME activity. Participants will be asked to evaluate whether the speaker's outside interests reflect a possible bias in the planning or presentation of the activity. This information is used to plan future activities.

As of February 9, 2012, the following has been disclosed. An updated Disclosure Summary will be provided onsite.

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<th>Nature of Relevant Relationship</th>
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Co-chairs: John A. Kellum, MD
Peter Pickkers, MD, PhD

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The Liver - Robert Schrier, MD

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Nephrologists vs Intensivists
Moderator: Noel Gibney, MB FRCP(C)
Nephrology Team:
Intensivists Team:

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James Tumlin, MD

THURSDAY AFTERNOON, FEBRUARY 16

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Bruce A. Molitoris, MD

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Co-chairs: Emmanuel Burdmann, MD, PhD  
Jorge Cerda, MD, FACP, FASN

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*Myocardial Stunning and Brain Edema: Acute Effects of Dialysis*  
Nick Selby, MD

4:15-4:30  
*Therapeutic Drug Monitoring During Dialysis Support*  
Jeffrey Lipman, MD

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*Cutting it Short: Implications of Drug Shortages in the ICU*  
Linda Awdishu, PharmD, MAS

4:45-5:00  
*CRRT and ECMO: Techniques and Outcomes from the ELSO Registry*  
David Askenazi, MD

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Sean Bagshaw, MD, MSc, FRCPC

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Eric Adler, MD

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Jeffrey Lipman, MD

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Co-chairs: Zhi-Hong Liu, MD
           Bruce A. Mueller, PharmD, FCCP, FASN

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Hiroyuki Hirasawa, MD
David M. Ward, MD, FRCP
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Dinna Cruz, MD, MPH
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Emmanuel Burdman, MD, PhD
Oliver Joannes-Boyau, MD
Ashita Tolwani, MD
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B18 Fluid Management
Ravindra L. Mehta, MBBS, MD, DM, FACP,
Didier Payen, MD
Principles of volume assessment, fluid removal and fluid regulation with different CRRT equipment

C19 Acid Base and Electrolyte Problems in the Critically Ill 1
John A. Kellum, MD
Mitchell H. Rosner, MD
Principles for evaluating and managing acid base and electrolyte problems in critically ill patients using case studies.

D20 Extracorporeal Techniques for Sepsis 1: Pathophysiology and Targets
Patrick M. Honoré, MD
Martin Matejovic, MD
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Experimental models for high permeability membranes, HVHF, VHVHF and hybrid therapies

E21 Heart Failure and Cardio-renal Syndrome 1: Pathophysiology
Alan Maisel, MD
Claudio Ronco, MD
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F22 Ensuring Patient Safety and Quality Measures for RRT in AKI 1:
Water Standards, Infection Control
Thomas A. Golper, MD
Eileen Lischer, MA, BSN, RN, CNN
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G23 Pediatric CRRT: The Basics
Geoffrey Fleming, MD
Scott Sutherland
Jordan M. Symons, MD
Michael Zappitelli, MD, MSc
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Peter Brindley, MD
Patty Graham, RN, MS, CCRN, CS
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NURSING FORUM LUNCHEON
Communication in Crisis: Improving Our "Verbal Dexterity"

Peter Brindley MD
Wednesday, February 15

**Educational Objectives:**
1) outline the importance of suboptimal communication as a source of preventable medical error during acute medical crisis
2) share practical lessons from other high risk industries that hold great potential to improve care
3) provide a practical curriculum for crisis management

**Content Description:**
Numerous studies have outlined that Human Factors are the number one source of medical error in acute care situations. Of these Human Errors, errors in communication and errors in teamwork appear to predominate. Infact just as the "family conference may be the most dangerous procedure in ICU", "verbal dexterity" (as opposed to factual knowledge or nimble hands) may be our most important skill.

Using the quote that "meant is not said; said is not heard; heard is not understood and understood is not done" (Rall and Gaba 2007) we will present numerous practical strategies that while not indigenous to medicine (nor to this speaker) could increase patient safety and teamwork.

This session is intended to be shamelessly practical and unapologetically lighthearted.

**Suggested Reading:**
Brindley and Reynolds J Crit Care 2011
Brindley Crit Care 2010
M Gladwell. Outliers
A Gawande. The Checklist Manifesto
Handbook of Communication in Anaesthesia and Critical Care. Cyna 2011
Sepsis and AKI: Bidirectional and Synergistic Relationship?

Martin Matejovic MD
1:15-1:30
Wednesday, February 15

Educational Objectives:
1. Describe the meaning of cross-talk between AKI and sepsis
2. Discuss the mutual impact of sepsis and AKI on clinical outcomes
3. Discuss the current understanding of the bidirectional relationship between AKI and sepsis

Content Description:
AKI in sepsis is associated with poor outcome and independently predicts increased mortality. Sepsis-associated AKI may therefore serve as a biomarker of adverse physiological events that portends worse outcome. In the other direction, the important role of sepsis among ICU patients with primarily non-septic AKI has increasingly been recognized. Indeed, sepsis represents a significant contributing factor to the overall mortality and incomplete recovery of kidney function in subjects who developed non-septic AKI. Because AKI portends such an ominous prognosis in sepsis and vice versa, there has been a surge of interest in elucidating mechanisms underlying complex and bidirectional nature of interconnection between AKI, sepsis and multiorgan dysfunction. Accumulating data indicate that AKI can trigger several immune, metabolic and humoral pathways, thus potentially contributing to distant organ dysfunction and overall morbidity and mortality. Further research is needed to address more rigorously all potentially modifiable factors to reduce this burden to patients and health care system. Better insights into bidirectional and synergistic pathways linking sepsis and AKI might open the window for new therapeutic approaches that interrupt this vicious circle. This lecture will discuss the rationale for and current understanding of the bidirectional relationship between AKI and sepsis.

Suggested Reading:
Nutritional Support in ICU Patients: Does Timing and Route Matter?

Miet Schetz MD, PhD
1:45-2:00
Wednesday, February 15

Educational Objectives:
1. present the results of a large RCT on the timing of parenteral in addition to insufficient enteral nutrition in ICU patients
2. explain potential mechanisms underlying the results

Content Description:
A large randomized trial in 4640 ICU patients compared early versus late addition of parenteral nutrition to insufficient enteral nutrition. Late initiation of parenteral nutrition was associated with shorter ICU and hospital stay, faster recovery of organ failure, fewer (mainly infectious) complications and reduced costs. Mortality was not different. Potential mechanisms will be discussed.

Suggested Reading:
Microcirculatory Alterations: Potential Mechanisms and Implications for Therapy

Daniel De Backer MD
2:00-2:15
Wednesday, February 15

Educational Objectives:
To understand the critical role of the microcirculation in fine tuning tissue perfusion.
To discuss what is the microcirculation, how it is regulated.
To discuss the potential mechanisms implicated in microcirculatory alterations and how this may impact therapy.

Content Description:
Multiple experimental studies have shown that sepsis is associated with alterations microcirculatory perfusion. These alterations are characterized by heterogeneity of perfusion with capillaries with stop flow in close vicinity to well perfused capillaries. This pattern has been observed in endotoxic models as well as in models with live bacteria, in various species and in various organs. Different mechanisms have been implicated in the development of these alterations including loss of communication between vascular segments, impaired endothelial vasoreactivity, alterations in red and white blood cells rheology, alteration in endothelial glycocalyx, platelet aggregation and microthrombosis. In addition to the alterations in microvascular perfusion, alteration in microvascular endothelium is associated with activation of coagulation and inflammation, reactive oxygen species generation and permeability alterations.

How to manipulate the microcirculation? Increasing flow without recruiting the microcirculation is ineffective, according classical hemodynamic resuscitation has minimal impact on the microcirculation.

Suggested Reading:
The Endothelial Glycocalyx: A New Target in Critical Illness

Can Ince PhD
2:15-2:30
Wednesday, February 15

Educational Objectives:

Discuss the morphology, composition and physiology of the endothelial glycocalyx

Present methods of assessing the presence of the glycocalyx

Discuss the how the glycocalyx is compromised, its pathophysiological consequences and the factors which contribute to its shedding.

Content Description:

The endothelial glycocalyx is an intraluminal layer of about 0.2µm covering the endothelial cells of blood vessels. It is a compressible gel-like layer consisting of a web-like structure of membrane-bound glycoproteins and proteoglycans.

The endothelial glycocalyx exerts a wide array of protective effects for the vasculature via inhibition of coagulation and leucocyte adhesion, contributing to anti-oxidant compounds, contributing to the vascular permeability barrier and by mediating shear stress-induced NO release. Demonstrating its presence and its compromise has been technically very challenging which why its presence and significance has only recently come to light. Its compromise is detected under vital or electron microscopy or by the presence of components of the shredded glycocalyx in plasma. Its degradation is partially sensitive to reactive oxygen species and disease states associated with activation of oxidative stress such as diabetes and sepsis as well probably a host of other diseased states where inflammatory activation and oxidative stress are present. The appreciation of its presence and physiological function has led to a re-appraisal of the view of fluid resuscitation as a means of treating hypovolemia and maintaining intraluminal volume. In this respect there has been a reappraisal of the understanding of Starlings principle in describing the effects of colloids. It is clear that future will be focused on protective strategies aimed at the glycocalyx as well as novel fluid taking the importance the glycocalyx into account. Methods under development using high resolution vital microscopy to assess the presence of the glycocalyx at the bedside may prove useful in this respect.

Suggested Reading:


SPECIAL LECTURE
Engineering Critical Care Medicine: A New Way to Protect Our Patients

Peter Brindley MD
3:00-3:25
Wednesday, February 15

Educational Objectives:
Explore how principles of process engineering (W Dunn and D Angus) might be applied to Critical Care Medicine with the goal of increasing safety; modernizing our "accidental curriculum" and increasing patient-focused care.

Gain better understanding of complexity of critical care and the role of safeguards

Understand a central role for crisis management training

Understand the benefits and perils of our current approach to error reduction

Content Description:
A long standing argument in medicine is whether what we do is better described as an "art" or as a "science". While it is likely both, it is also useful to understand how principles of engineering also apply (personal communication D Angus). This is especially if there is an increasing focus on patient safety. This idea will be discussed and numerous examples presented. The limits of this analogy will also be explored with the hopes of retaining the best of medicine while eradicating the worst.

Suggested Reading:
A Gawande. The Checklist Manifesto 2009
M Gladwell Outliers 2008
C Chabris and D Simons. The Invisible Gorilla 2010
M Heffernan. Willful Blindness 2011
Dunn WF Chest 2010.
Minimizing the Renal Toxicity of Iodinated Contrast

Peter A. McCullough MD, MPH
4:15-4:30
Wednesday, February 15

Educational Objectives:
1) Review the pathophysiology of contrast-induced AKI (CI-AKI)
2) Understand the published data on risk prediction AKI
3) Review the results of major recent trials and meta-analyses on the prevention of CI-AKI

Content Description:
CI-AKI is an important complication after the intravascular administration of iodinated contrast as discussed above (3,4,6). The definition of CI-AKI implies impairment in renal filtration function occurring within 48 to 72 hours after the procedure, in the absence of alternative etiologies. Past clinical trials have suggested that a rise in serum creatinine of 0.5 mg/dl or a 25% increase from the baseline value indicates occurrence of CI-AKI (5,7). Serum creatinine concentrations generally peak on day two or three after contrast exposure and typically return to baseline values within two weeks. (5) In 2007, the Acute Kidney Injury Network proposed the definition to a rise in serum creatinine ?0.3 mg/dl with oliguria (<0.5 mL/kg/hour for > 6 hours), which is compatible with the older definitions. It is expected that in addition to this signal of reduced filtration function, markers of acute tubular injury in the blood and urine will be used to establish a diagnosis of CI-AKI in the near future.

Future approaches include large planned studies of oral and intravenous antioxidants (including a moderate labile iron chelator, deferiprone) and intrarenal infusions of renal vasodilators (fenoldopam, natriuretic peptides) using flow directed catheters. Trials examining the effects of using forced hydration with a balancing pump causing marked elevations of urine output, thereby reducing the transit time of iodinated contrast in the renal tubules, will are underway. Novel, hopefully less toxic forms of radio-opaque contrast agents are a source of future interest and development. The medical community awaits more definitive, unbiased results of future large clinical trials to help guide safer and more effective strategies for CKD patients at risk for CI-AKI is predictable and is partially preventable. Reasonable steps should be taken to minimize risk. Novel diagnostic and therapeutic approaches are needed to manage the ever-increasing numbers of patients undergoing interventions using iodinated contrast media (48).

Suggested Reading:


Distant Organ Responses in AKI

Hamid Rabb MD
5:15-5:30
Wednesday, February 15

Educational Objectives:
1. Describe scope of the clinical problem of distant organ dysfunction during AKI
2. Present the evidence supporting kidney-distant organ cross-talk in acute kidney injury
3. Describe newly recognized mechanisms and pathways that underlie this syndrome

Content Description:
Acute lung injury (ALI) requiring mechanical ventilation is commonly associated with AKI, and lung dysfunction is highly correlated with death in the patient with AKI. Astute clinicians have recognized that pulmonary symptoms occur frequently with renal failure, and that the degree of pulmonary dysfunction appears to exceed that purely attributable to fluid overload. Despite the close clinical linkage of ALI and AKI, there is little mechanistic information regarding how these organs interact in the critically ill patient. Recent data has unveiled a role for inflammatory mediators and electrolyte transporter abnormalities in accentuating the vicious cycle of kidney-lung injury. Furthermore, injurious lung ventilation strategies likely predispose the kidney to additional insults by amplifying inflammatory and pro-apoptotic pathways. AKI also has a direct effect on brain function as well as effects on liver and heart. An improved understanding of the mechanisms and pathways that mediate AKI induced distant organ dysfunction is important so that we can develop dialysis as well as other strategies to improve the high morbidity and mortality during AKI.

Suggested Reading:
Do Vasoactive Drugs and Fluids Improve Renal Perfusion?

Daniel De Backer MD
9:45-10:00
Thursday, February 16

Educational Objectives:
To understand the determinants of renal vascular response to fluids and vasoactive agents, in normal conditions as well as in sepsis.
To illustrate how renal Doppler may help to better evaluate the renal response to hemodynamic interventions.

Content Description:
Vasopressor agents are frequently used to correct hypotension, hoping that restoration of perfusion pressure would result in an improvement in renal perfusion. Correction of severe hypotension (<60-65 mmHg) is associated with an improved urine output and creatinine clearance, however increasing mean arterial pressure above these values is not associated with an improved renal perfusion in most patients, even though individual variability exists. The use of renal ultrasounds with Doppler evaluation of interlobar arteries has enabled to identify which patients respond to these interventions. The renal response to the various vasopressor agents is quite similar and no specific agent can be recommended as specifically nephroprotective.
Fluids may also improve renal perfusion but positive fluid balance is associated with poor outcome.
Identification of the patients who respond to fluids is thus important. Use of renal Doppler may also be used to identify patients who will improve renal perfusion.

Suggested Reading:
Saline is Really Bad for You. Hard to Believe. Impossible to Ignore!

John A. Kellum MD
10:00-10:15
Thursday, February 16

Educational Objectives:
To describe underlying mechanisms of hyperchloremic acidosis
To review existing evidence for the effect of hyperchloremia on innate immunity
To review existing evidence for the effect of hyperchloremia on clinical outcomes

Content Description:
Metabolic acidosis induces cytokine expression and immunomodulation
Fluid resuscitation with hyperchloremic solutions causes metabolic acidosis and a potentially important consequence of acidosis is its effect on the immune response. Several studies from our laboratory and elsewhere have documented the effects of decreased extracellular pH on the synthesis and release of inflammatory mediators. Different degrees of metabolic acidosis have been shown to cause induction of inflammatory markers such as Nitric oxide (NO), interleukins (IL-6 and IL-10). Hyperchloremia have been shown to induce tumor necrosis factor (TNF) synthesis and release, as well as nuclear factor kappa-B (NF-κB) DNA binding, suggesting that the overall effects of hyperchloremia appear to be pro-inflammatory. Jensen and colleagues exposed macrophages to lactic acid and found that TNF secretion was increased secondary to increased gene transcription. In addition acidosis induces inflammatory response through its effect on catecholamine synthesis.

Metabolic acidosis adversely influences survival
Although it is currently uncertain whether there is a true cause-effect relation between HCA and adverse clinical outcomes, metabolic acidosis in critically ill patients is a powerful marker of poor prognosis. Metabolic acidosis may increase inducible nitric oxide synthase (iNOS), and this may lead to vasodilation and shock. We have previously demonstrated that HCA, induced by hydrochloric acid infusion, significantly reduced systemic mean arterial pressure in normotensive, septic animals. In a study using an endotoxic shock model in rats, we demonstrated that saline resuscitation was associated with a significantly shorter survival time compared to a more physiologic fluid containing starch in a balanced electrolyte solution. Furthermore, survival time was correlated with the decrease in pH and negatively correlated with the increase in serum chloride following initial resuscitation. Hyperchloremia associated with saline-based solutions has been shown to cause hypotension, decrease splanchnic mucosal perfusion, glomerular filtration, and cause coagulopathy. Emerging data suggest that hyperchloremia aggravates AKI though mechanisms are unclear.

Suggested Reading:
Blood Transfusions are Important for the Resuscitation of the Critically Ill Patient

Can Ince PhD
11:00-11:15
Thursday, February 16

Educational Objectives:

To explain the importance of red blood cells and their hemorheological factors which determine optimal delivery of red blood cells to the microcirculation.

Explain the importance of convective and diffusive transport of oxygen and the importance of viscosity in this respect.

To explain that hypovolemia can indeed be corrected by fluid resuscitation but that lowering the hematocrit can compromise the distribution and oxygen transport to the tissues.

Content Description:

When shock or hemodilution leads to a limitation in the oxygen carrying capacity of the circulation, blood transfusions are warranted. Blood transfusions are affective in transporting oxygen to the tissues. Not only because of improved oxygen carrying capacity due to the presence of haemoglobin, but because of its viscosity, important in recruiting the microcirculation. Red blood cells (RBC) also have an important role in vascular regulation. Recent studies have shown that in the presence of hypoxia RBCs release vasodilator substances such as nitric oxide and ATP. Various reports have indicated that storage of RBCs can have deleterious effects on their ability to transport oxygen to the tissues. Indeed recent clinical trials seem to corroborate these earlier findings. In animal studies we had shown that citrate based storage media could adversely affect the oxygen carrying properties of stored blood when transfused in vivo and that the use of more modern storage fluids such as SAGM did not suffer from such effects. It should be noted that recent trials reporting that transfusion of aged RBCs are associated with adverse clinical outcomes have used non-leuco-depleted stored blood. In clinical studies we have performed using SAG-M stored leuco-depleted blood we have shown that blood transfusion in cardiac surgery and anaemic hematological patients lead to improvement in red blood cell availability in the microcirculation and improvement in tissue oxygenation. Nevertheless maintaining physiological hematocrit and [Hb] by blood transfusions using leuco-depleted has been show in a recent German trial to lead to improved outcome, organ function and length of stay. These results suggest that when storage conditions are optimized, blood transfusions for increasing oxygen delivery to the tissues are an essential procedure in the hemodynamically compromised critically ill patient.

Suggested Reading:


Thinking Outside of the Box: A Novel Strategy to Prevent Shock Induced AKI

Todd Costantini MD
11:30-11:45
Thursday, February 16

Educational Objectives:
1. Describe the role of tight junction proteins in maintaining epithelial barrier function.
2. Define the anti-inflammatory properties of efferent vagal nerve signaling.
3. Describe the ability of vagal nerve stimulation to limit shock-induced acute kidney injury.

Content Description:
Acute Kidney Injury (AKI) is a common clinical consequence of shock which is associated with increased morbidity and mortality in the critically ill population. Tubular epithelial cells play an important role in driving the inflammatory response of the kidney, which is characterized by pro-inflammatory cytokine secretion and an innate immune response which further drives AKI. Vagal nerve stimulation (VNS) has been shown to exert potent anti-inflammatory effects in multiple models of shock. We have recently demonstrated that VNS prevents intestinal barrier failure and gut inflammation after injury through modulation of intestinal epithelial tight junction proteins. We hypothesized that VNS may represent a novel strategy to limit shock-induced AKI. This series of experiments demonstrates the ability of VNS to limit kidney inflammation and prevent injury-induced changes in epithelial tight junction protein expression.

Suggested Reading:
Educational Objectives:
To outline the pathophysiology, principles and practical aspects of fluid resuscitation and management in the critically ill.

Content Description:
Do Vasoactive Drugs and Fluids Improve Renal Perfusion. Daniel Debacker MD.

Saline is Really Bad for You. Hard to Believe. Impossible to Ignore! John A. Kellum, MD

What Blood Pressure Should We Target for Patients with AKI? Ravindra L. Mehta, MD

What We Do in the OR When You're Not Looking!? Andrew Shaw, MB FRCA FCCM

Water, Water, Everywhere: Sodium and Water Balance and the Injured Brain. Didier Payen, MD

Blood Transfusions are Important for the Resuscitation of the Critically Ill Patient. Can Ince, PhD

Fluid Management in the Critically Ill: The “5B” Approach. Claudio Ronco, MD

Thinking Outside of the Box: A Novel Strategy to Prevent Shock Induced AKI. Raul Coimbra, MD PhD FACS

SPECIAL LECTURE: Fluid Management in the Critically Ill: Is the Kidney at Risk? Robert Schrier, MD
Nursing Forum 2 Luncheon
Benchmarking for CRRT: Which Parameters Should We Use?

Eileen Lischer MA, BSN, RN, CNN
Thursday, February 16

Educational Objectives:
1. State the importance of establishing benchmarks for acute RRT.
2. Identify three domains of nurse sensitive indicators
3. Identify three indicators to establish benchmarking data.

Content Description:
Establishing benchmarks for acute renal replacement therapy is necessary to establish best practice, advance the quality of care and improve patient outcomes. Additional benefits may be to the institution in providing more cost effective care. This luncheon presentation will review the history of benchmarking, identify current initiatives in acute care and provide an interactive discussion to identify areas in acute RRT that need prioritizing.

Suggested Reading:
   Describes the origins of CalNOC from planning through research and partnerships. A potential source for thinking about how to build benchmarking. See also: CalNOC.org
   Things to think about when creating a benchmark: defining categories and the “need for conscientious selection of numerators and denominators.”
   ANA proprietary database of nursing-sensitive quality indicators that produces unit-level reports for quality improvement.
   Describes creation of MilNOD – a database of nursing-sensitive indicators for the Military Nursing Outcomes Database – and the routine collection and reporting of data.

Maureen Craig MSN, RN, CNN

Educational Objectives:
1. Explore patient measures as benchmarks or quality of a CRRT/SLEDD program.
2. Identify nurse sensitive quality indicators as benchmarks for a CRRT /SLEDD program.

Content Description:
Benchmarking is the meaningful comparison of individual program performance metrics to best practices in a particular industry. Benchmarks within CRRT/SLEDD programs are forming as individual programs expand continuous quality improvement programs. We will explore some of the patient measures and nursing quality indicators associated with CRRT/SLEDD programs. We will look at narrowing the focus and look to launch a national database for all intersted CRRT/SLEDD programs to participate in establishing benchmarks.

Suggested Reading:

"LATE BREAKING TRIALS" LUNCHEON
Diagnostic and Prognostic Stratification in the Emergency Department Using Biomarkers of Intrinsic Acute Kidney Injury (AKI)

Jonathan Barasch and Kai Schmidt-Ott MD
Thursday, February 16

Educational Objectives:
1. Introduce current tools to diagnose acute kidney injury (AKI) in the emergency department, their limitations and the potential of novel biomarkers of nephron damage

2. Report on the rationale, design, and results of a recent multicenter study to evaluate five urinary biomarkers of intrinsic AKI

3. Outline future biomarker-aided diagnostic strategies and their potential therapeutic implications in the emergency department

Content Description:
Acute kidney injury (AKI) associated with nephron damage (intrinsic AKI) at the time of hospital admission frequently results in poor clinical outcomes during hospitalization. Currently, the diagnosis of intrinsic AKI is challenging, because it usually relies on complex clinical information and serial measurements of a late functional marker, serum creatinine, and its response to therapy. Urinary biomarkers of nephron damage may facilitate an earlier and more accurate diagnosis of intrinsic AKI at the time of hospital admission and thereby enable early risk stratification. We performed a multicenter prospective cohort study in two countries. We enrolled 1635 unselected emergency department patients in the process of being admitted to the hospital. Five urinary biomarkers (neutrophil gelatinase-associated lipocalin, uNGAL; kidney injury molecule 1, uKIM-1; liver-type fatty acid binding protein, uL-FABP; interleukin 18, uIL-18; and cystatin C, uCysC) were measured on presentation and analyzed for their ability to identify patients with intrinsic AKI and predict an unfavorable course in the hospital. We found that all biomarkers were elevated in patients with intrinsic AKI. uNGAL was the most effective biomarker in diagnosing intrinsic AKI with a specificity of 81% and a sensitivity of 68% at a 104 ng/ml cutoff. uNGAL also displayed the closest correlation with the peak severity and duration of AKI. uNGAL and uKIM-1 most effectively predicted a composite in-hospital outcome of dialysis requirement or death. Importantly, both uNGAL and uKIM-1 independently predicted the outcome when adjusted for known predictors, including serum creatinine. Further analyses showed that the addition of either uNGAL or uKIM-1 to conventional prediction strategies markedly improved net risk classification by up to 26% when compared with serum creatinine-based prediction alone. More than 220 patients with low creatinine levels were upgraded to an intermediate-risk category based on elevated biomarker levels. In addition, biomarkers sub-classified patients with elevated creatinine levels into intermediate-risk and high-risk cases. Hence, urinary biomarkers of intrinsic AKI significantly improve the diagnostic and prognostic stratification of patients undergoing triage in the emergency department. Future studies will need to evaluate algorithms to implement renal biomarkers into clinical decision-making.

Suggested Reading:


Biomarkers in AKI: Current Status and Needs

Lakhmir S. Chawla MD
2:00-2:15
Thursday, February 16

Educational Objectives:
1. Identify the most validated AKI biomarkers in AKI and their advantages and disadvantages
2. Discuss the performance of AKI biomarkers for diagnosis, prognosis, and recovery of renal function and death
3. Describe the areas of need for contemporary biomarkers of AKI

Content Description:
Acute kidney injury (AKI) is common in hospitalized patients and is independently associated with morbidity and mortality. Novel biomarkers of AKI have shown the capacity to diagnose AKI earlier than serum creatinine. Promising diagnostic injury markers include neutrophil gelatinase-associated lipocalin (NGAL), kidney injury molecule 1 (KIM-1), interleukin 18 (IL-18) and liver-type fatty acid binding protein (L-FABP). Each of these biomarkers along with newer biomarkers will be discussed with their capacity to diagnose, stage, and prognosticate AKI.

Suggested Reading:

Goldstein SL.


Differential Diagnosis of AKI: Can Biomarkers Help?

Zoltan Endre MD, PhD
2:30-2:45
Thursday, February 16

Educational Objectives:
1. Outline the ADQI Conclusions regarding the use of Specific and Contextual Biomarkers in the Differential Diagnosis of AKI
2. Highlight that pre-renal AKI is not purely a functional injury
3. Outline Cause and Phase-Specificity of Structural Biomarkers

Content Description:
After re-defining AKI as a matrix of structural injury and functional change, there was consensus in proposing the use of biomarkers in differentiating cause and type of renal injury. Increases in urinary or serum biomarkers of cellular injury predict poor outcomes even in the apparent absence of renal functional change.

Recent evidence shows that injury biomarkers are increased in pre-renal AKI and that this condition is not a unique functional injury without adverse consequences, but is rapidly reversible because it represents the milder end of a continuum of renal injury. The term “pre-renal” should be confined to a cause of AKI.

Some biomarkers may be cause-specific and facilitate differential diagnosis of AKI. However, history and contextual biomarkers such as ultrasound, urine microscopy and markers of systemic inflammation or sepsis, renal histology, and the biomarkers of other concurrent or contributing disease processes are also important in differentiating a specific causal pathway.

In addition to defining cause, we need to determine the phase of injury in order to link the pathophysiology of early AKI to particular biomarker profiles. Phase-specific biomarkers that localize injury and define renal pathophysiology in real time may be more critical in suggesting patient-specific treatment than the detection of injury itself. Some phase-specific biomarkers are already available. We postulate that these and newer biomarkers will allow a mechanistic differential diagnosis that will define and individualise future treatment.
Physiological and Imaging Markers of AKI

Mark D. Okusa MD
3:00-3:15
Thursday, February 16

Educational Objectives:
To describe the importance of physiological biomarkers of AKI
To describe different imaging methods to study GFR, renal blood flow and kidney oxygenation in AKI.

Content Description:
The Acute Dialysis Quality Initiative (ADQI) Consensus Conference on “Acute Kidney Injury Biomarkers” was held in Dublin, Ireland, in August 2011 (www.adqi.net), attended by an international group of experts, focusing on an objective scientific review of the current literature, developing a consensus of opinion, with evidence where possible, on best practice, and articulating a research agenda to focus on important unanswered questions. Four breakout groups focused on the use of biomarkers in AKI. This presentation will focus on the role of imaging and physiological markers for the study of human AKI. This presentation will summarize the current state-of-the-art of the available techniques for monitoring kidney oxygenation, perfusion and metabolism at the bedside, and potentially illuminate a road map to provide a reliable and quantifiable platform for the measurement of renal physiological biomarkers related to oxygenation.

Suggested Reading:


Myocardial Stunning and Brain Edema: Acute Effects of Dialysis

Nick Selby MD
4:00-4:15
Thursday, February 16

Educational Objectives:
1. Understand how the circulatory stress of dialysis can affect tissue perfusion
2. Discuss the impact of dialysis induced hypoperfusion on the heart and brain
3. Review possible interventions to ameliorate these processes

Content Description:
Dialysis patients are subject to hugely elevated rates of cardiovascular mortality. The haemodynamic perturbation of haemodialysis, in particular intradialytic hypotension, may contribute to adverse clinical outcomes through hypoperfusion of critical vascular beds. Dialysis patients are particularly susceptible to such injury due to a variety of processes that include reductions in coronary flow reserve. The evidence that dialysis can lead to subclinical ischaemic insults to the myocardium will be reviewed. Important clinical determinants of this process will be elucidated in addition to examining the longer term effects of repetitive dialysis-induced ischaemic injury. Potential therapeutic interventions in terms of the delivery of dialysis will also be discussed. How these processes may also impact on other target organs, in particular the brain will also be reviewed.

Suggested Reading:


Therapeutic Drug Monitoring During Dialysis Support

Jeffrey Lipman MD
4:15-4:30
Thursday, February 16

Educational Objectives:
1. Understanding how pharmacokinetics of antibiotics differ in the critically ill
2. Understand the different clearances of antibiotics in CRRT
3. Understand what therapeutic drug monitoring means and its value in such circumstances

Content Description:
Maximising effectiveness (not underdosing) whilst minimising toxicity (not overdosing) of antimicrobial agents should be the goal for treating infections.

Before being released onto the open market antimicrobial dosing is tested in non-ICU patients (Phase 2 and 3 drug trials). These patients have relatively normal cardiovascular systems with normal organ blood flow. The ICU patients that need antimicrobials often have significant systemic inflammation (leaky capillaries), need significant fluid resuscitation, with or without inotropic support. It is not surprising then that the critically ill patient has altered pharmacokinetics. Yet we often give the same dose to these patients as the “package insert” The volume of distribution of antimicrobials is increased, hence necessitating large loading doses. Hypoaluminemia often complicates protein binding thereby making dosing even more difficult. Organ dysfunction will decrease clearances yet dialysis removes some drugs.

The systems and technology for Intermittent HemoDialysis (IHD) across the world have been relatively well defined, as have the prescriptions for the patient with chronic renal failure (CRF). Drug dosing during IHD has a relatively well validated set of rules. The various modalities in which CRRT have been used (CVVH vs CVVHD vs CVVHDF vs SLED) makes a “one size fits all” cookbook recipe impossible to prescribe due to differing blood flow, filter characteristics, effluent rates and time on filter.

Drug levels (hence indirectly therapeutic drug monitoring) are often available for aminoglycosides and vancomycin largely due to toxicity. The safety of beta-lactams is wide and hence there has been little such drug monitoring. TDM can be used to personalize dosing without allowing toxicity, yet preventing resistance and treatment failure. With easier technology available for the measurement of the beta-lactams, TDM will become more common.

With the altered PK of antimicrobials in the ICU and particularly with the difficult to measure clearances of such in CRRT, TDM will allow better optimisation of antibiotic administration. We have shown significant underdosing and overdosing of such drugs in the ICU.

TDM serves as an accurate method of dose adjustment of antimicrobial agents in difficult to predict circumstances.

Suggested Reading:
Cutting it Short: Implications of Drug Shortages in the ICU

Linda Awdishu PharmD, MAS
4:30-4:45
Thursday, February 16

Educational Objectives:
1. Define the framework for drug shortages in the United States
2. Review of the process of drug manufacturing and list the factors that lead to shortages
3. Apply knowledge of drug shortage analysis to a case

Content Description:
The number of drug shortages has increased dramatically over the last 5 years. Drug shortages most commonly impact generic injectable agents since these drugs are complex to manufacture and generally manufactured by a single company. Common classes of drugs impacted by shortages are anti-neoplastic agents, anesthetics, anti-infectives and supplements. The consequences of drug shortages include a rise in medical errors related to the shortage, increased labor hours to manage shortages and overall increased costs of care. Legislation to mitigate risks of shortages is necessary and FDA action plans are in place. This session will review the implications of drug shortages to patient care and outline a plan to mitigate risks.

Suggested Reading:
CRRT and ECMO: Techniques and Outcomes from the ELSO Registry

David Askenazi MD
4:45-5:00
Thursday, February 16

Educational Objectives:
1. Discuss how RRT is performed in critically ill patients on ECMO
2. Review the incidence and outcomes in ECMO patients with AKI / RRT.
3. Assess if AKI and RRT provision are independently associated with mortality

Content Description:
Extracorporeal Membrane Oxygenation (ECMO) is a lifesaving procedure used in neonates, children, and adults who have severe, reversible, cardiopulmonary failure. Based on single center studies of subgroups of patients, the incidence of acute kidney injury (AKI) occurs in 70-85% of ECMO patients. Those with AKI, and those who require renal replacement therapy (RRT) are at high risk for mortality, independent of potentially confounding variables. RRT to maintain fluid balance and metabolic control is common in some but not all center. RRT on ECMO can be performed via an in-line hemofilter or by incorporating a standard continuous renal replacement machine into the ECMO circuit. Both of these methods require specific technical considerations to provide safe and effective RRT. This review summarizes the available epidemiologic data and how it applies to our understanding of the relationship of ECMO and AKI pathophysiology, and reviews technical elements for RRT application in the setting of ECMO. Specific research focused questions will need to be answered in order to improve outcomes in this at-risk population.

Suggested Reading:
Comparing RRT Modalities: Does it Matter What You Use if the Job is Done?

Sean Bagshaw MD, MSc, FRCPC
5:00-5:15
Thursday, February 16

Educational Objectives:
1. Describe the azotemic, metabolic and volume homeostasis of available RRT modalities.
2. Describe the mortality associated with RRT modality in critically ill patients with AKI.
3. Describe the epidemiology of renal recovery associated with RRT modality in critically ill patients with AKI.

Content Description:
Acute kidney injury (AKI) commonly afflicts critically ill patients and generally portends an increased morbidity and mortality. What is more, a majority of patients with severe AKI require, at least provisionally, a period of extracorporeal RRT. Despite extensive use of RRT in this population, there remains controversy and debate about whether the initial type of RRT, either conventional IHD or CRRT, can impact survival or recovery of kidney function. This is important given the resource implications and infrastructure needed for delivery of both types of RRT in critically ill patients.

Several trials have shown a higher occurrence of hemodynamic instability prompting intervention, and greater fluid accumulation for those receiving conventional IHD compared with CRRT. Observational data also suggest achievement of fluid balance goals are more likely to occur with CRRT compared with IHD. On the other hand, rather than use of conventional IHD or CRRT, newer hybrid modalities such as slow low-efficiency dialysis (SLED) may prove advantageous in such circumstances. SLED shares the benefits of both CRRT and IRRT and thus, can enable adequate dose delivery, fewer hemodynamic complications and be greater likelihood of achieving fluid balance goals. To date, no randomized trials of SLED that incorporate survival or renal recovery as outcomes have been performed.

Thus, the uncertainty on the ideal selection of initial RRT modality in critically ill patients with AKI for optimizing outcomes, reducing treatment-related complications and conserve health resources has remains. There is a wide-spectrum of patients who are critically ill and there clinical course is often not static. Accordingly, the selection of RRT modality, similar to decisions for when to initiate RRT, is strongly influenced by numerous patient-specific, clinician-specific and organizational factors. Instead, it is probably that the selection of RRT modality should center around when to prescribe a particular RRT modality, based on the real-time individual needs of the critically ill patient.

Suggested Reading:
Management of Severe Heart Failure: A Role for Ultrafiltration?

Eric Adler MD
5:15-5:30
Thursday, February 16

Educational Objectives:
1. Develop tools for identifying patients with stage D heart failure
2. Learn management strategies for the severely congested patient with heart failure.
3. Learn about the newest options for providing mechanical circulatory support for such patients.

Content Description:
Heart Failure remains the number one reason for hospitalization among patients over 65 years of age. The majority of patients are admitted for congestion and, surprisingly remain congested at the time of discharge. We will discuss options for the patients with advanced heart failure, including aquapheresis and mechanical circulatory support.

Suggested Reading:
1. Treatment of congestion in heart failure with diuretics and extracorporeal therapies: effects on symptoms, renal function, and prognosis.
   Costanzo MR, Jessup M. Heart Fail Rev. 2011 May 11.

Telemedicine in the ICU: The Future is Here

Jeffrey Lipman MD
5:30-5:45
Thursday, February 16

Educational Objectives:
1. Understanding what telemedicine for remote Intensive Care Units can provide
2. Review of current data on telemedicine services
3. Demonstrate how care via a targeted individual consultative service can improve outcomes

Content Description:
Telemedicine (audiovisual technologies) is increasingly being used to assist ICUs unable to be staffed by intensivists. Here I discuss recent data evaluating these services and their potential role in managing ICU patients. Finally I provide some data on a targeted individual consultative service we have set up with a regional ICU. Models of care range from complete remote 24-hour surveillance requiring direct video observation to a consultation liaison service only requiring conventional telephone links. Early work suggests savings in terms of cost and length of stay with an improvement in compliance with care protocols. However, later work is not as supportive, possibly related to differing care infrastructures and the organisation of individual units. The key task is to ascertain the most appropriate service requirements that would assist in care for a given patient circumstance. Bundaberg Base is a regional 200-bed hospital serving a population near 45,000 with the closest tertiary centre 400 kilometres. They have no intensive care specialist. In 2009 daily ward rounds were undertaken by an intensive care specialist Monday-Friday via a mobile wireless web-camera as part of a computer videoconferencing system.
The telemedicine program reviewed near 220 patients per year in around 500 consultations. While the total number of annual admissions (522-590) increased during the study period, illness severity (APACHE II 15.2-15.9) and the proportions of deaths (8-9%) and transfers (11-13%) remained unchanged. ICU length of stay increased by 30 hours and SMRs fell (57% APACHE III-J, 20% APACHE II and 14% SAPS II). Increased local nursing resources were needed for the increased LOS.
There is conflicting evidence as to the benefit of an objective improvement in care and even less that formally reviews the impact and contribution of ICU telemedicine to processes of care, the effects on unit staffing, hospital organisation and the health care region. However, the technology is available and being embraced by some, especially to deal with the tyranny of distance.

Suggested Reading:
1. Boots R, Singh S, Tereblanche M, Widdecombe N, Lipman J. Remote Care for an ICU - many models of care can be effective Curr Opin Crit Care 2011;17:634-640
Avoiding Anticoagulation for CRRT: An Update on Emerging Membranes

Patrick M. Honoré MD
5:45-6:00
Thursday, February 16

Educational Objectives:
1) To show the great capabilities of New Membranes that are already on the Market.
2) Show the potential advantages but also the limitations of these new membranes.
3) Discuss the available literature regarding these most recent data about these new membranes.

Content Description:
Types of New Available Membranes in 2011:
New High Cut-Off Membranes:
Eg: Membranes exhibiting large pores such as SepteX® from Gambro™ & others..
New Adsorptive Membranes:
Eg: Special focus on new membranes that could be run without anticoagulation.

Summary

These new membranes where heparin has been grafted instead of adsorbed or soaked do exhibit a much higher ability to extend their filter life in the absence of any form of anticoagulation.
We will review the available membranes and data regarding this very important issue.

Suggested Reading:


Rediscovering Urine Electrolytes for Differential Diagnosis and Prognosis of AKI

Etienne Macedo MD, PhD
7:30-7:45
Friday, February 17

Educational Objectives:

1. Describe the factors affecting the sensitivity and specificity of urine electrolytes to determine reversibility of acute kidney injury.
2. Discuss the interpretation of urine electrolytes in acid-base imbalances.
3. Propose the use of SIDu to monitor tubular acidifying capacity in AKI.

Content Description:

Urine electrolytes are usually used for the differential diagnosis of natremia disorders and pre-renal versus acute tubular necrosis. In AKI, the classic clinical use of urinary biochemistry is to differentiate a reversible renal dysfunction with acute tubular necrosis as a parameter to guide fluid resuscitation. However, nearly all studies of spot chemistries in AKI have been performed at a single time relatively late in the course of the syndrome. Since AKI is a dynamic process, the evaluation of serial data is crucial to determine the probability of reversibility. Prolonged cell injury may result in loss of tubular cell polarity and altered tubular function; therefore, the urine chemistries are dependent on the phase of the course in which they were obtained. The frequent caveats associated with the use of spot urine chemistry as a diagnostic tool to evaluate the likelihood of reversibility have discouraged their use. The promise of new biomarkers of kidney injury and the lack of useful information with urinary electrolytes decreased the clinical value of these markers.

During the past few years, a novel approach based on the assessment of the strong ion difference (SID) has been used to evaluate metabolic acidosis and alkalosis. The novel physicochemical approach proposed by Stewart and modified by Figge, includes urine electrolytes as a useful tool in the interpretation of acid-base imbalances. SIDu could be used to monitor tubular acidifying capacity, signaling an early inability of urinary acidification in AKI. Evaluating urinary electrolytes and SIDu may help to alert the clinician to the presence of some degree of kidney dysfunction, perhaps before classical parameters are altered.

Suggested Reading:

Improving Outcomes from AKI: Lessons from the UK?

Andrew Lewington MD
8:00-8:15
Friday, February 17

Educational Objectives:
1. Describe what are the current outcomes from acute kidney injury in the UK
2. Describe the National programme that has been set up to improve outcomes from acute kidney injury in the UK
3. Describe the progress that has been made in the UK to date in raising awareness of acute kidney injury

Content Description:
In 2009 the National Confidential Enquiry into Patient Outcomes and Death (NCEPOD) reported that only 50% of patients had died from a diagnosis of acute kidney injury received good care. This prompted questions in Parliament and the formation of a Department of Health acute kidney injury delivery board. The delivery board has commissioned a number of pieces of work to help raise the awareness of acute kidney injury in the UK. This includes the development of a core competency document for acute kidney injury. There has been the development of acute kidney injury patient pathways to facilitate the immediate treatment and movement of patients to specialist centres when appropriate. Increased funding has been awarded for translational research into acute kidney injury. The cost of acute kidney injury has been estimated that £400-£600 million per annum in the UK. An acute kidney injury consensus conference will be held at the Royal College of Physicians of Edinburgh in November 2012. The government has commissioned the National Institute of Health and Clinical Excellence (NICE) to produce acute kidney injury guidelines and quality standards for intravenous fluid therapy.

Suggested Reading:
Combined CRRT-bilirubin Adsorption System for Liver Failure

Zhi-Hong Liu MD
8:15-8:30
Friday, February 17

Educational Objectives:
1. Overview the usually used artificial liver support systems
2. Discuss the mechanisms of toxins removal in liver support systems
3. Introduce a novel system: combined CRRT-bilirubin adsorption system

Content Description:
Liver failure is a severe complication presented in critically ill patients, often with high mortality. Artificial liver support (ALS) usually serves to replace part of liver’s detoxication function by elimination of toxins accumulated in body after liver failure from circulation, and bridges patients to liver function recovery or transplantation. The ALS modalities include biological ALS, non-bio ALS, and hybrid ALS. Among them, non-bio ALS is the most commonly used one. Protein-bound toxins like bilirubin are the major targets for removal by ALS. Molecular adsorption recycling system (MARS) removes bilirubin using albumin as dialysate, through a process limited by bilirubin dissociation and diffusion, with a clearance rate around 14 ml/min. Fractionated plasma separation and adsorption (Prometheus) system removes bilirubin using an albumin-leakage filter as dialyzer, through a process limited by albumin diffusion, with a clearance rate around 20ml/min. Herein we reported a novel system for liver support: combined CRRT-bilirubin adsorption system. In this system, a fraction plasma separator is used and albumin convection process is employed. A plasma-based water-exchange system is integrated into it for removal of water-soluble toxins. With this system, a clearance rate for bilirubin around 25-30ml/min can be reached.

Suggested Reading:
The Changing Face of AKI: Snapshots from Around the World
Brazil, India, Japan, Canada, Australia, USA

Zoltan Endre MD, PhD
8:30-9:30
Friday, February 17

Educational Objectives:
1. Highlight the complexity of AKI in Australia

Content Description:
Two cases of AKI will be described. Neither resulted from ischemia-reperfusion injury. Even ischemic injury on our population tends to occur in patients with significant comorbidity.

Vishnu Bhotla Sivakumar MD, DM, DNB, FISN.FR

Educational Objectives:
1) PRESENTATION OF CLINICAL DETAILS OF A PATIENT OF ACUTE KIDNEY INJURY FOLLOWING HAIR DYE INGESTION
2) TO DISCUSS THE PATHOGENESIS
3) MANAGEMENT

Content Description:
ACCIDENTAL OR INTENTIONAL INGESTION OF HAIR DYE IS INCREASING IN CERTAIN PARTS OF AFRICA AND INDIA. THE IMPORTANT TOXIC COMPONENT IDENTIFIED IN HAIR DYE POISONING IS PARAPHENYLENEDIAMINE (PPD). FOLLOWING INGESTION IT RESULTS IN SWELLING OF ORAL CAVITY, TONGUE, AND CERVICAL REGION. THIS RESULTS IN DIFFICULTY IN SWALLOWING AND BREATHING. THIS OFTEN NECESSITATES VENTILATORY SUPPORTS AND TRACHEOSTOMY. THIS ALSO RESULTS IN PAINFUL SWELLING OF THE LIMBS DUE TO RHABDOMYOLYSIS. SOMETIMES SHOCK ALSO ACCOMPANIES. CARDIOTOXICITY LEADS TO ARYTHMIAS, MYOCARDITIS AND FAILURE.

HYPOTENSION, MYOGLOBINURIA, HEMOLYSIS AND DIRECT TOXICITY RESULT IN ACUTE KIDNEY INJURY. IT ALSO PRODUCES HEPATIC INJURY. MANAGEMENT INCLUDES GENERAL SUPPORTIVE MEASURES, RENAL REPLACEMENT IN ACUTE KIDNEY INJURY, AND VENTILATORY SUPPORT FOR RESPIRATORY DIFFICULTY. PPD IS DIALYSABLE AND HD WAS REPORTED TO BE MORE EFFICIENT OVER PERITONEAL DIALYSIS. RENAL LESION REPORTED ARE ACUTE TUBULAR NECROSIS, ACUTE INTERSTITIAL NEPHRITIS AND MESANGIAL PROLIFERATION IN SOME REPORTS.

Suggested Reading:
1) HAIR DYE POISONING IN BUNDELKHAND REGION - JAPI 2011, VOL 59 415-419
Educational Objectives:
1. AKI induced by sepsis in a patient with acute emphysematous cholecystitis.
2. Blood purification therapy to this patient.

Content Description:
A seventy-one year old male who developed AKI (s-Creatinine 5.5 mg/dl) and DIC induced by acute emphysematous cholecystitis. Direct hemoperfusion with polymixin-B coated textile (PMX-DHP) and CRRT for this patient were so effective.

Suggested Reading:
Current standard therapy to AKI with sepsis in Japan is shown.

Sean  Bagshaw MD, MSc, FRCPC

Educational Objectives:
1. Describe a typical case of AKI encountered in a Canadian ICU

Content Description:
This presentation will describe and discuss the profile and course of a critically ill patients developing AKI typical of academic/tertiary ICU practice in Canada.

Suggested Reading:
Alkaline Phosphatase

Peter Pickkers MD, PhD
9:30-9:45
Friday, February 17

Educational Objectives:
1. Provide information related to the 2 trials conducted with alkaline phosphatase to prevent AKI in septic patients.
2. Describe new data related to an innate immune response localized within the kidney.
3. Describe new data concerning the role of dephosphorylation of LPS and ATP by alkaline phosphatase to exert its beneficial renal effects.

Content Description:
At present, therapeutic modalities to prevent or treat AKI are extremely limited and the search for novel therapeu- tic interventions for sepsis-induced AKI is an area of intense investigation. Alkaline phosphatase is an endogenous dephosphorylation enzyme that is depleted in the kidney during an ischemic or inflammatory insult. Administration of exogeneous alkaline phosphatase in animal models of sepsis attenuates the inflammatory response and improves survival.

The results of two small phase 2 human clinical trials that investigated the safety and efficacy of AP in septic patients with and without evidence of AKI will be discussed. The effects of administration of alkaline phosphatase on the systemic inflammatory response, urinary excretion of markers of tubular injury and renal function in septic patients with acute kidney injury will be presented.

Both endotoxin (lipopolysaccharide, LPS) and ATP can be dephosphorylated by alkaline phosphatase. Dephosphorylated LPS is not biologically active and actually acts as a Toll-like receptor antagonist, thereby attenuating the innate immune response. Dephosphorylation of the pro-inflammatory ATP to ADP, AMP and eventually to the tissue-protective adenosine may also exert beneficial effects in the kidney. These two mechanisms of action are now being investigated to unravel the kidney-protective effects of alkaline phosphatase during systemic inflammation. New, unpublished, animal data will be presented, in which evidence of an innate immune response within the kidney and the role of adenosine metabolism will be presented.

Suggested Reading:
Recent Trials in the Prevention of Contrast-Induced AKI: Importance of Emerging Biomarkers

Peter A. McCullough MD, MPH
9:45-10:00
Friday, February 17

Educational Objectives:
1) Review a recent study of multiple novel AKI markers in acute emergency conditions
2) Understand the published data on rise in NGAL and Cystatin C after contrast exposure
3) Review the results of the ENCINO study

Content Description:
Nickolas et al JACC 2012 Abstract

OBJECTIVES:
This study aimed to determine the diagnostic and prognostic value of urinary biomarkers of intrinsic acute kidney injury (AKI) when patients were triaged in the emergency department.

BACKGROUND:
Intrinsic AKI is associated with nephron injury and results in poor clinical outcomes. Several urinary biomarkers have been proposed to detect and measure intrinsic AKI.

METHODS:
In a multicenter prospective cohort study, 5 urinary biomarkers (urinary neutrophil gelatinase-associated lipocalin, kidney injury molecule-1, urinary liver-type fatty acid binding protein, urinary interleukin-18, and cystatin C) were measured in 1,635 unselected emergency department patients at the time of hospital admission. We determined whether the biomarkers diagnosed intrinsic AKI and predicted adverse outcomes during hospitalization.

RESULTS:
All biomarkers were elevated in intrinsic AKI, but urinary neutrophil gelatinase-associated lipocalin was most useful (81% specificity, 68% sensitivity at a 104-ng/ml cutoff) and predictive of the severity and duration of AKI. Intrinsic AKI was strongly associated with adverse in-hospital outcomes. Urinary neutrophil gelatinase-associated lipocalin and urinary kidney injury molecule 1 predicted a composite outcome of dialysis initiation or death during hospitalization, and both improved the net risk classification compared with conventional assessments. These biomarkers also identified a substantial subpopulation with low serum creatinine at hospital admission, but who were at risk of adverse events.

CONCLUSIONS: Urinary biomarkers of nephron damage enable prospective diagnostic and prognostic stratification in the emergency department.

ENCINO Abstract
Background. Neutrophil gelatinase associated lipocalin (NGAL, siderocalin) is a protein secreted by the kidney in the setting of acute kidney injury in an attempt to regulate and bind the release of catalytic iron from injured cells. We sought to evaluate the relationships between baseline NGAL, renal filtration function, and the degree of injury reflected by further increases in NGAL.

METHODS. This study was a prospective, blinded assessment of blood samples taken from patients with estimated glomerular filtration rate <75 ml/min/1.73 m2 undergoing non-urgent coronary angiography and intervention using iodinated contrast. Renal transplant recipients, dialysis patients, and administration of iodinated contrast in the prior 30 days were exclusion criteria. Blood plasma NGAL was measured using the Alere™ assay. Plasma
creatinine (Cr) was measured using calibrated methods at a core laboratory. Samples were obtained at baseline, 1, 2, 4, 6, 12, 24, and 48 hours after contrast administration.

Results. A total of 63 subjects were enrolled with a mean age of 69.4±9.1 years, 73% male, 35% with diabetes, and a mean eGFR of 47.82±15.46 ml/min/1.73 m2. The correlation between eGFR and NGAL was r=-0.61, 95% CI -0.74 to -0.44, p<0.001. When stratified by baseline NGAL tertile, the peak NGAL observed for each group occurred at 29.0±22.2 hours and there was a two-fold increase in the mean and peak change in NGAL across the tertiles. NGAL began to rise six hours after contrast exposure and followed a similar course to serum Cr. Only two patients sustained a rise in Cr of > 25% or > 0.5 mg/dl. Multivariate regression revealed that baseline NGAL (p<0.001) and not eGFR (p=0.95) was independently associated with the NGAL value at 48 hours.

Conclusions. Baseline NGAL is strongly correlated with eGFR in patients with reduced renal filtration function undergoing coronary angiography. The magnitude of rise in NGAL is positively associated with the baseline value and is analogous to the time course of Cr in blood after contrast exposure. NGAL and not eGFR is an independent predictor of changes in the post-procedure NGAL. A baseline NGAL level is necessary for the interpretation of NGAL levels as indicative of CI-AKI.

Suggested Reading:
Simulation: Success or Failure Within Ten Years

Peter Brindley MD
11:25-11:40
Friday, February 17

Educational Objectives:
An updated discussion of simulation and what it can offer not just to the learner, but more specifically to the system

Better understand the myriad benefits of simulation

How to promote simulation as a "patient safety laboratory" for the modern hospital

Content Description:
Simulation has been widely promoted as a risk-free way to improve training, education and practise readiness. However, despite great strides, many practitioners have had limited exposure to simulation. Furthermore, its role beyond education (i.e. in terms of testing and improving the system) have yet to be widely realized. This talk wishes to update attendees on the larger role that could be played by simulation. This talk also outlines findings from a number of ICU simulation studies. The point will be made that it says a great deal about where we are going as a system based upon whether we do or do not make these changes in the next decade.

Suggested Reading:
Gaba DM. The future vision of simulation in healthcare. Simul Healthc 2007
Brindley PG. Patient Safety and Acute Care Medicine. Crit Care 2010
Surveillance and Early Recognition of AKI: Does it Make a Difference?

Nick Selby MD
11:40-11:55
Friday, February 17

Educational Objectives:
1. Understand the potential role of electronic recognition systems for AKI
2. Discuss the methodology of electronic AKI recognition
3. Evaluate the impact of AKI reporting on clinical outcomes

Content Description:
Acute Kidney Injury (AKI) is common, harmful and preventable. Failure to recognise AKI in hospitals can lead to significant shortfalls in standards of care. The majority of patients with AKI are looked after by non-specialists who may lack current training and knowledge in this area. This session will review methods to tackle this issue, concentrating on the methodology and effectiveness of electronic reporting systems for AKI to improve early recognition and diagnosis. Data on recent experience will be presented and the impact on clinical outcomes will also be discussed.

Suggested Reading:


Critical Care Nephrology: Literature Review

Noel Gibney MB FRCP(C)
12:25-12:55
Friday, February 17

Educational Objectives:
To review interesting publications on critical care nephrology, nephrology and critical care medicine over the last 12 months

Content Description:
Publications will be summarized

Suggested Reading:


CRRT 2012
Educational Objectives:

- Discuss the physiology of the microcirculation and the parameters which defines its function in different organs. Discuss the physiological determinants of perfusion and oxygenation of the microcirculation and how these can be measured in the clinical scenario.
- Discuss the latest developments in the bedside assessment of the microcirculation and their meaning in terms of prognosis and response to therapy.
- Practical demonstration of the use of sublingual SDF imaging.

Content Description:

In this lecture we will discuss the (patho)physiological significance of microcirculatory alterations in clinical states of sepsis, shock and resuscitation and how its monitoring at the bedside has played a central role in identifying its significance. Besides the clinical background of microcirculatory, the methods both in terms of hardware and analysis methods will be discussed. Following this recent improvements in the techniques of monitoring and interpretation of microcirculatory alterations in critical illness as measured by direct sublingual microcirculation observation. We will present our new developed software which gives instant evaluation of the images as well as improvements in the devices for reducing pressure artefacts. A new improved imaging device will be presented. Next a new internet platform will be presented for allowing international exchange of images and setting the scene for multi-central intervention trials with as goal the improvement of the microcirculation to be held. In this context the progress of epidemiological survey of microcirculatory alterations (perfusion as well oxygenation) in the critically ill patients will be presented.

Suggested Reading:


Educational Objectives:
1. Discuss the different methods for evaluating the microcirculation
2. To review the different scores available for microcirculation analysis, and which measurements should be included.
3. Discuss how monitoring of the microcirculation may help us at the bedside

Content Description:
Microvascular perfusion plays an important role in the development of organ failure in hospitalized patients.
Although microcirculation is the primary site of oxygen and nutrient exchange, microvascular oxygen delivery cannot be predicted from global hemodynamic measurements. Hemodynamic assessment has been limited to measurements of cardiac output and oxygen delivery, which are indirect measurements of microcirculation. However, several observational studies and randomized controlled trials trying to improve these parameters based on information derived from pulmonary artery catheter have shown no benefits in outcomes.

In critically-ill patients improvement in microvascular perfusion should be to one of the major therapeutic goals. Recent advances in technology have allowed direct visualization of the microcirculation. The octagonal polarization spectral (OPS) and the side stream dark field (SDF) imaging devices provide high contrast images of the microvasculature. Experimental studies have shown alterations in the microcirculation common to different pathological processes such as: sepsis, painful crises in sickle cell disease, bacterial infection in cirrhosis, leukostasis in patients with chronic myeloid leukemia, and changes in the volume status of hemodialysis patient. It has also been used to assess the effect of different therapies on microcirculation in experimental animal models and in septic patients. Additionally, in critically-ill patients with sepsis and septic shock, recent studies have correlated microcirculatory flow abnormalities with hemodynamics, oxygen transport and survival.

The introduction of OPS and SDF imaging has opened challenging new perspectives in in vivo research of microcirculatory alterations, and has highlighted the importance of microcirculatory alterations in multiple organ failure and sepsis.

Suggested Reading:
Assessing the Microcirculation

Rolando Claure MD
4:00-5:30
Tuesday, February 14

Educational Objectives:
1. Discuss the different methods for evaluating the microcirculation
2. To review the different scores available for microcirculation analysis, and which measurements should be included.
3. Discuss how monitoring of the microcirculation may help us at the bedside

Content Description:
Microvascular perfusion plays an important role in the development of organ failure in hospitalized patients. Although microcirculation is the primary site of oxygen and nutrient exchange, microvascular oxygen delivery cannot be predicted from global hemodynamic measurements. Hemodynamic assessment has been limited to measurements of cardiac output and oxygen delivery, which are indirect measurements of microcirculation. However, several observational studies and randomized controlled trials trying to improve these parameters based on information derived from pulmonary artery catheter have shown no benefits in outcomes.

In critically-ill patients improvement in microvascular perfusion should be to one of the major therapeutic goals. Recent advances in technology have allowed direct visualization of the microcirculation. The octagonal polarization spectral (OPS) and the side stream dark field (SDF) imaging devices provide high contrast images of the microvasculature. Experimental studies have shown alterations in the microcirculation common to different pathological process. OPS and SDF imaging have been used to assess microvascular alterations in many disease processes such as: sepsis, painful crises in sickle cell disease, bacterial infection in cirrhosis, leukostasis in patients with chronic myeloid leukemia, and changes in the volume status of hemodialysis patient. It has also been used to assess the effect of different therapies on microcirculation in experimental animal models and in septic patients. Additionally, in critically-ill patients with sepsis and septic shock, recent studies have correlated microcirculatory flow abnormalities with hemodynamics, oxygen transport and survival.

The introduction of OPS and SDF imaging has opened challenging new perspectives in in vivo research of microcirculatory alterations, and has highlighted the importance of microcirculatory alterations in multiple organ failure and sepsis.

Suggested Reading:


Critical Care Pharmacology: Vasopressors, and Inotropes

Peter Pickkers MD, PhD
4:00-5:30
Tuesday, February 14

Educational Objectives:
1. Provide an understanding of what inotropic agents and vaspressors are
2. Understand the various syndromes in which vasopressors and inotropes need to be used
3. Review current literature on vasopressors and inotropic agents, of both established and new agents.

Content Description:
Preload is the stretch of a muscle immediately prior to contraction. In the context of human pathophysiology, preload is the left ventricular end diastolic fibre length which is proportional to left ventricular end diastolic volume (LVEDV). This in turn is proportional to LVEDP. Clinically this sometimes is measured by venous pressures (JVP or CVP). The famous Starling curve relates an increase in preload to an increase in force of contraction (increasing LVEDV increases cardiac output).

Afterload is the pressure developed in the myocardium wall during systole. A decrease in afterload (vasodilatation) will increase the cardiac output, and often vice versa.

A positive inotropic agent will increase force of contraction independent of preload and afterload. A vasopressor agent is one that will increase vascular tone and hence increase blood pressure.

It is important to conceptually differentiate these two phenomena, but in the clinical situation one agent may have both effects.

Shock can be defined as inadequate tissue oxygenation. The various causes of shock have been divided into 4 categories:- hypovolaemic, distributive, cardiogenic and obstructive. (Note, clinically there may sometimes be overlap or a combination). Distributive shock is most often from sepsis. The most common use of vasopressors in ICU is in septic shock, as it is for the use of inotropic agents.

Whilst there is no ideal inotropic agent, many have been used for septic shock. This holds too for vaspressor agents too. The various agents used clinically will be reviewed as will their “side effects”.

It is probably safe to say most commonly dobutamine and norepinephrine are used in septic shock, but clinical data of new drugs is becoming available. Apart from the conventional agents, mechanism of action and clinical effects of vasopressin, potassium channel blockers and levosimendan will be presented.

Suggested Reading:

73
Educational Objectives:
1. Highlight that biomarker performance is modified by context and cause
2. Discuss the use of phase specific biomarkers to triage to treatment

Content Description:
The EARLYARF trial was the first to utilize urinary biomarkers to triage patients to an intervention. The intervention (high dose erythropoietin) did not modify outcome, despite randomizing patients to treatment within 6 hours of entry to the intensive care unit. Possible reasons for lack of success include failing to commence therapy within 6 hours of onset of injury and inadequate enrichment with AKI patients because of the brief profile of the specific pre-formed biomarker (a combination of gammaglutamyl transpeptidase and alkaline phosphatase).

The trial will be used to highlight problems with current randomized controlled trial design and in particular to illustrate how biomarker performance varies with etiology of AKI, duration of AKI, baseline GFR (before injury), severity and duration of AKI and stage and phase of AKI.
Educational Objectives:
1. Understand the genesis of hyperdynamic circulation that occurs with portal hypertension.
2. Describe how renal response to the hyperdynamic circulation and relative cardiac dysfunction contribute to acute kidney injury in cirrhosis.
3. Apply understanding of mechanisms of functional renal failure in end stage liver disease to current therapeutic strategies.

Content Description:
Hepatorenal syndrome (HRS), first described by Flint in 1963 (Am J Med Sci 1963;45:306-39), is a functional renal failure caused by severe intra-renal vasoconstriction. This occurs in the setting of circulatory dysfunction with increased plasma rennin activity, over-activity of the sympathetic nervous system, and increased anti-diuretic hormone. The ability of the kidneys to excrete sodium and free water is severely diminished and presentation with dilutional hyponatremia is common. Extra-renal arterial vasodilatation occurs mainly in the splanchnic vascular bed, whereas other vascular beds, such as those that supply the brain and the liver, may be vasoconstricted. These vascular derangements may contribute to the development of hepatic encephalopathy and decline in hepatocellular function observed in HRS. Cardiac output in HRS may be low, normal, or high but is insufficient because of reduced peripheral vascular resistance. The contribution of diminished cardiac output to hepatorenal physiology is a more recent concept in this syndrome. It is hypothesized that a hyperdynamic circulation is essential to maintenance of central blood volume and renal perfusion in cirrhosis. When cardiac output decreases, effective hypovolemia occurs, leading to renal hypoperfusion and HRS. The mechanism(s) leading to impaired or insufficient cardiac output in patients developing HRS is unknown. HRS can be triggered by a number of events including infection, bleeding, and large volume paracentesis (LVP) without administration of IV albumin. The most common trigger for HRS is bacterial infection, particularly spontaneous bacterial peritonitis (SBP). Type-1 HRS occurs in about 25% of patients with SBP despite rapid resolution of the infection with administration of non-nephrotoxic antibiotics. The annual incidence among patients with cirrhosis and ascites is estimated at 8% and is associated with poor prognosis. Patients with the rapidly progressive Type-1 HRS have a median survival of 2 weeks and a hospital survival of less than 10% whereas patients with the more insidious Type-2 HRS have a median survival of 6 months. Kidney function can be improved with prompt medical treatment in patients with HRS and is associated with improved survival. Treatment of HRS is designed to increase the central blood volume by simultaneously increasing total plasma volume and reducing intense peripheral vasodilatation.

Suggested Reading:


F06
Competency Assessment in CRRT

Eileen Lischer MA, BSN, RN, CNN
4:00-5:30
Tuesday, February 14

Educational Objectives:
1. The participant will be able to identify two components of a competency
2. The participant will be able to discuss three validation methods for competency.
3. The participant will be able to identify how a continuous quality assurance program is integral to continuing competency assessment.

Content Description:
What defines competence? How are we sure our patients are receiving safe quality care from competent nurses? The presentation discusses the components of a competency and various levels of competence. Competency models are presented as well as evaluation tools for specific types of competencies. The UCSD mentorship program is presented and benefits identified. The participant will have tools identified that will help to formulate their institutions competency program. Continuous quality monitoring will be presented as important component of maintaining quality patient care.

Suggested Reading:


G07
Fluids and Solutions in the Critically Ill 1
Daniel De Backer MD
4:00-5:30
Tuesday, February 14

Educational Objectives:
To explain what is the safest way to administer fluids
To understand how to identify patient who respond and tolerate fluids
To discuss the different types of fluids and how relevant this could be for patient outcomes

Content Description:
Fluids are a key element of hemodynamic resuscitation. Fluids can improve tissue perfusion but a positive fluid balance is associated with a poor outcome. It is thus important to identify, and if possible to predict, which patients respond to fluids. It is also important to ensure that fluids are tolerated when administered. The fluid challenge technique should thus be used to evaluate the response to fluids (not just fluid filling).
The type of fluid has also been amply debated for many years. The plasma expansion volume is larger with colloids than crystalloids. No solution is perfect, and each carries some benefit/risk/cost profile and this balance can even vary according to patients conditions (sepsis, AKI,...). A large scale randomized trial reassured on the safety of human albumin. Some trials suggested that starches may increase the risk to develop AKI but several large scales RCT are ongoing (results expected next few months).

Suggested Reading:
Educational Objectives:

1. to discuss the reactions which occur when blood passes through the extracorporeal circuit
2. the effects of different anticoagulants
3. factors which affect intravascular volume and tone during dialysis treatments

Content Description:

Hypotension during treatment with an extracorporeal circuit typically occurs either due to a loss of vascular tone or due to a reduction in effective circulating volume. As such patient factors are an important determinant, with these reactions occurring more commonly in patients with reduced systemic vascular resistance (acute liver failure, severe sepsis), hypovolaemia and reduced cardiac output (cardiogenic shock).

Hypotensive reactions can be divided into those which occur at the start or shortly after connecting the patient to the extracorporeal circuit and those towards the end of the session. Early reactions are subdivided into acute anaphylactoid reactions to anticoagulants and sterilising agents, and extracorporeal reactions secondary to anaphylotoxin production (C3a & C5a), bradykinin formation and nitric oxide generation.

Later episodes of hypotension are typically associated with reduction in the effective plasma volume, either due to changes in vascular tone or an imbalance between ultrafiltration rate and plasma refilling rate, or cardiac causes, predominantly arrhythmias. Excessive ultrafiltration rates may stem from inaccurate clinical assessment and prescription of fluid orders, staff errors in terms of machine programming or over riding machine alarms leading to unrecognised changes in ultrafiltration rates, and machine errors. Plasma refilling rate depends upon plasma osmolality, and vascular tone is affected by temperature.

Suggested Reading:

2. Davenport A. Sudden collapse during haemodialysis due to immune mediated heparin induced thrombocytopenia. Nephrol Dial Transplant 2006;21: 1721-1724
A09
Vascular Access /Membrane and Circuit

Luis Juncos MD
8:15-9:45
Wednesday, February 15

Educational Objectives:
1. To describe the fundamentals of hemodialysis catheters and their importance in maintaining adequate blood flow and circuit patency during CRRT.
2. To describe the basic characteristics of hemofiltration membranes and the different mechanisms by which they clear solutes from the blood.
3. To describe a typical CRRT circuit and discuss the practical issues related to the circuits during the different CRRT modalities.

Content Description:
To obtain maximum benefit of CRRT, one must achieve the therapeutic goals including the delivery of an appropriate dose. However, delivery of the prescribed dose of CRRT is frequently not accomplished for a variety of reasons. These include the frequent existence of a large amount of down time because of premature clotting or failure of the extracorporeal circuit, as well as the presence of suboptimal blood flows (which not only can decrease clearance, but also contributes to premature clotting). Moreover, frequent clotting/failure of the CRRT circuit not only leads to decreased dose delivery, but has many other important implications such as blood loss, irregular clearance that can cause suboptimal dosing of medications (e.g. antibiotics), and increase costs. Consequently, it is important to identify the cause of premature circuit failure and suboptimal dosing so that the cause can be specifically addressed. In this respect it is important to note that while insufficient anticoagulation is commonly assumed to be the most frequent cause of premature clotting, suboptimal blood flow mechanics within the circuit due to a poorly functioning/placed hemodialysis access is often (if not most often) the culprit. Thus, in order to better identify and address the cause of premature/frequent circuit clotting, it is essential that one understands the fundamentals of the CRRT circuit and membrane, and how they interact. This presentation will describe the fundamental concepts of the structure and function of dialysis catheters, CRRT circuits and membranes, as well as their interactions in determining the function of CRRT.

Suggested Reading:
2. Schwab SJ, Beathard G. The hemodialysis catheter conundrum: Hate living with them, but can’t live without. Kidney International Vol 56 (1999); 1-17.
7. Parienti JJ, Thirion M, Mégarbane B, Souweine B, Ouchikhe A, Polito A, Forel JM, Marqué S, Misset B, ...


A09
Vascular Access / Membrane and Circuit

Emil P. Paganini MD, FACP, FRCP
8:15-9:45
Wednesday, February 15

Educational Objectives:
identify options of access
review complications of percutaneous catheter placement
discuss functional shortcomings of various formats
B10
Dialysis Dose Prescription and Delivery

Rolando Claure MD
8:15-9:45
Wednesday, February 15

Educational Objectives:
1. Discuss the importance of measuring delivered dose of dialysis.
2. To review the different methods to assess dialysis dose in AKI.
3. Discuss and identify the gaps in current practice and propose an approach ensure delivering a prescribed dose.

Content Description:
Assessing and delivering dialysis dose in acute kidney injury (AKI) has emerged as an important issue in the management of critically ill patients. There is ongoing debate on how dose of dialysis should be expressed and measured. Most studies have focused on clearance of small molecules (blood urea nitrogen) as a marker of delivered dose and for establishing dose–outcome relationships. Recent evidence has shown that other markers may also be important to consider, as acid–base balance and fluid overload have emerged as important factors contributing to outcomes. In this workshop, we will provide an evaluation of current approaches to prescribing and delivering dialysis dose in AKI, identify gaps in practice and propose an integrated approach to optimize dose delivery in dialysis with a goal to improve outcomes.

Suggested Reading:


Educational Objectives:
- Nutritional impact of sepsis and CRRT
- Amino-Acid, vitamins and trace elements needs with and without CRRT
- Amino-Acid, vitamins and trace elements management during CRRT

Content Description:
Continuous renal replacement techniques as sepsis have an impact on nutritional status of patients in ICU. It is important to know the exact removal power of hemofiltration on amino-acids and trace elements and how we can counter this. There are some articles and small studies in the literature that focus on this subject, but with low level results and few recommendations. In the IVOIRE study amino-acids and trace elements were dosed at different times to follow the level of removal of these along time and to try to find simple tips to avoid nutritional deficit in the future. For septic patients, antibiotics are also crucial and we know that CRRT has a high potential of removal for these molecules. A review of literature and the results from IVOIRE study will be presented with new recommendations for good antibiotic given procedures in the future.

Suggested Reading:
C11
Critical Care Management: Nutrition Assessment and Delivery

Miet Schetz MD, PhD
8:15-9:45
Wednesday, February 15

Educational Objectives:
1. to explain the weak evidence underlying current nutrition guidelines
2. to discuss the results of recent observational and randomized trials

Content Description:
Critically ill patients present with or develop malnutrition during their ICU stay. Current guidelines suggest starting nutrition early, preferring enteral (EN) over parenteral nutrition (PN) and performing efforts to reach the nutritional target. European and American guidelines disagree on the timing to start PN in addition to insufficient EN. The evidence for early feeding in ICU patients is very weak. The available randomized trials indeed suggest reduced complications with PN compared with EN. Although some observational trials suggest that increased caloric input improves outcomes, there is, on the other hand, accumulating evidence that underfeeding might be beneficial in ICU patients. This is confirmed by the recent EPaNIC trial comparing early versus late addition of PN to insufficient EN. This trial is the first adequately powered RCT in the field of ICU nutrition and shows no survival benefit and increased morbidity and costs with early PN.

Suggested Reading:
Educational Objectives:
1. Describe the use of Specific and Contextual Biomarkers in the Differential Diagnosis of AKI
2. Outline Cause and Phase-Specificity of Structural Biomarkers

Content Description:
What really matters in AKI is developing the ability to individualise patient care. Increases in urinary or serum biomarkers of cellular injury predict poor outcomes even in the apparent absence of renal functional change. It is therefore postulated that early detection of AKI using injury biomarkers might lead to successful intervention in AKI.

Some biomarkers may be cause-specific and facilitate differential diagnosis of AKI. However, history and contextual biomarkers such as ultrasound, urine microscopy and markers of systemic inflammation or sepsis, renal histology, and the biomarkers of other concurrent or contributing disease processes are also important in differentiating a specific causal pathway.

Recent evidence shows that injury biomarkers are increased in pre-renal AKI and that this condition is not a unique functional injury without adverse consequences, but is rapidly reversible because it represents the milder end of a continuum of renal injury. The term “pre-renal” should be confined to a cause of AKI.

In addition to defining cause, we need to determine the phase of injury in order to link the pathophysiology of early AKI to particular biomarker profiles. Phase-specific biomarkers that localize injury and define renal pathophysiology in real time may be more critical in suggesting patient-specific treatment than the detection of injury itself. Some phase-specific biomarkers are already available. We postulate that these and newer biomarkers will allow a mechanistic differential diagnosis that will define and individualise future treatment.
Educational Objectives:
1. Discuss the utility of using biomarkers for risk assessment and AKI diagnosis
2. Describe recent relevant studies on the use of biomarkers for risk assessment and AKI diagnosis
3. Discuss the factors affecting the performance of biomarkers for AKI diagnosis

Content Description:
Over the recent year, there has been an increasing number of studies on the use of biomarkers for AKI diagnosis. In this presentation, we will highlight the utility of using biomarkers for risk assessment and AKI diagnosis. We will also review the most recent relevant studies on biomarkers for AKI diagnosis, such as the ones from the TRIBE-AKI consortium. More importantly, we will discuss the factors affecting the performance of these new biomarkers for AKI diagnosis, and briefly review some studies on the use of combined biomarkers for AKI diagnosis.
E13
Liver and the Kidney 2: Principles of Extracorporeal Hepatic Support

Andrew Davenport MD, FRCP
8:15-9:45
Wednesday, February 15

Educational Objectives:

1. to understand why clotting occurs in extracorporeal circuits in patients with liver failure
2. to understand why some therapies can be complicated by hypoglycaemia
3. to understand the limitation of lactate and citrate as anionic buffers in patients with hyperacute liver failure

Content Description:

Patients with hyperacute liver failure are at increased risk of cerebral oedema and intracranial hypertension. Conventional haemodialysis leads to an acute fall in plasma urea and other small solute concentrations during the first hour of treatment. This rapid fall in osmolality leads to a gradient between the plasma and the brain, as water moves twenty times faster than urea, such that water can flow along a concentration gradient from the plasma into the brain, so increasing cerebral oedema, and resulting in brain stem coning in severe cases. Thus slower therapies such as CRRT are preferable in cases of hyperacute liver failure. However the Achilles heel of continuous dialysis/haemofiltration circuits is circuit clotting, so that they become intermittent therapies rather than continuous. In acute liver failure, the liver fails to synthesise some of the natural anticoagulants (antithrombin, proteins S & C), and hepatic necrosis leads to inflammatory reaction and increased release of tissue factor. So although these patients often have abnormal prothrombin times, they are often procoagulant, with increased risk of extracorporeal circuit clotting.

Patients with acute liver failure may be unable to maintain glucose homeostasis and are at risk of hypoglycaemia. Thus to prevent hypoglycaemia, dialysates and or replacement solutions should contain glucose. Traditional aemofiltration and dialysates for CRRT have been lactate based, or more recently citrate has been introduced as an anticoagulant. Lactate and citrate are then indirectly converted through to bicarbonate and so correct metabolic acidosis. However if the rate of metabolism through to bicarbonate is reduced due to hepatic insufficiency, then the patient will become acidic if the continued losses of bicarbonate and lactate/citrate by the dialyzer/haemofilter exceed the rate of conversion through to bicarbonate. Thus in cases of hyperacute liver failure bicarbonate based dialysates and reinfusion fluids are often required.

Suggested Reading:


F14
Therapeutic Modalities: IHD, SLED, PD

Vishnu Bhotla  Sivakumar MD, DM, DNB, FISN,FR
8:15-9:45
Wednesday, February 15

Educational Objectives:

1) TO PRESENT THE ROLE OF PERITONEAL DIALYSIS IN THE MANAGEMENT OF ACUTE KIDNEY INJURY AND TO DISCUSS ITS ADVANTAGES AND LIMITATIONS

2) TO COMPARE WITH INTERMITTENT HEMODIALYSIS AND CRRT

3) TO PRESENT THE ROLE OF PERITONEAL DIALYSIS IN SEVERE SHOCK WITH AKI

Content Description:

IN DEVELOPING COUNTRIES CONTINUOUS PD REMAINS AN IMPORTANT MODALITY OF RENAL REPLACEMENT THERAPY BECAUSE OF ITS LOWER COSTS AND EASE OF ADMINISTRATION. IN THE RECENT LITERATURE PD HAS BEEN SHOWN TO BE EFFECTIVE IN HYPERCATABOLIC STATE ALSO. IT HAS SEVERAL ADVANTAGES SUCH AS RELATIVE SAFETY IN PATIENTS WITH HEMODYNAMIC DISTURBANCE, THROMBOCYTOPENIA AND BLEEDING TENDENCY. THIS REQUIRES MINIMAL TRAINED STAFF AND LITTLE INFRASTRUCTURE. EQUAL OUTCOMES HAVE BEEN DESCRIBED WHEN PD IS COMPARED WITH IHD AND CVVHDF.

Suggested Reading:

1) COMPARING CONTINUOUS VENOVENOUS HEMODIALYSIS AND PERITONEAL DIALYSIS IN CRITICALLY ILL PATIENTS WITH ACUTE KIDNEY INJURY: A PILOT STUDY. PERT DIAL INT 2009;31:422-429

2) IS PERITONEAL DIALYSIS ADEQUATE FOR HYPERCATABOLIC ACUTE RENAL FAILURE IN DEVELOPING COUNTRIES? KIDNEY INT 2002;61:747-57

3) CONTINUOUS PERITONEAL DIALYSIS COMPARED WITH DAILY HEMODIALYSIS IN PATIENTS WITH ACUTE KIDNEY INJURY. PERT DIAL INT 2009;29(SUPPL 2):S62-71

**Educational Objectives:**
1. Describe the composition of solutions for CRRT
2. Describe the spectrum of solute not replaced during CRRT
3. Describe the complications associated with solution for CRRT

**Content Description:**
Solutions for CRRT can be either custom (i.e. compounded in local pharmacy) or commercially prepared. Commercially prepared solutions are generally safer; however, may be more expensive. There is no practice differences in the composition of fluids for either replacement and dialysate solutions, except in specific circumstances (i.e. use of regional citrate anticoagulation [RCA]). In general, CRRT solutions are isotonic and balanced. The sodium [Na] concentration found in CRRT solutions is generally maintained within the normal physiologic range, often with varying quantities of additional electrolytes added (i.e. potassium, magnesium, chloride). The [Na] concentration may need to be adjusted; however, when using RCA or if critically ill patients receiving CRRT have severe disorders of [Na] balance (i.e. hyponatremia/hypernatremia). Current evidence preferentially supports the use of bicarbonate [HCO3] as base buffer over lactate or acetate-based solutions. Several additional electrolytes (i.e. phosphate, glucose), amino acids (i.e. glutamine), trace elements (i.e. thiamine) can be readily depleted during CRRT and may require supplementation.

**Suggested Reading:**
Educational Objectives:
1. Review learning points from experienced CRRT/SLEDD programs, including adaptations for pediatric and infant patients, citrate toxicity, calculating UFR's and meaningfully documenting fluid balance, adding phosphorus to dialysis solutions, and antibiotic management on CRRT.

Content Description:
Experienced acute dialysis programs continue to face challenges in delivering CRRT/SLEDD and IHD. Underdosing antibiotics with today's more efficient filters can lead to therapeutic failure and breakthrough resistance. Connecting with pharmacotherapy resources can help you adjust antibiotics with confidence. Umbilical catheters can be used for infant CRRT with flows of 10-50 ml/min. The infant CRRT circuit may best be anticoagulated with regional citrate anticoagulation. Citrate toxicity can occur, but can be modified by increases in dialysis flow rates. When a patient's size requires a blood-primed circuit, packed red blood cells can be combined with saline to prime the circuit effectively.
Adjusting the ultrafiltration rate in a constantly changing ICU patient environment can be challenging if documentation is not simplified so that adjustments can be made at any time of the hour. Documentation can be simplified so the ICU nurse is always maintaining the ideal ultrafiltration rate; balancing the fluid goals for the patient with the patient's response to treatment.
Serum phosphorus values can fall during CRRT/SLEDD treatments. Adding phosphorus to dialysis solutions can protect the patient against hypophosphatemia.

Suggested Reading:

Brett H. Heintz, Gary R. Matzke, William E. Dager
Antimicrobial dosing concepts and recommendations for critically ill adult patients receiving continuous renal replacement therapy or intermittent hemodialysis.
Anticoagulation: Mechanisms and Techniques

Oliver Joannes-Boyau MD
10:00-11:30
Wednesday, February 15

Educational Objectives:
1) Discuss the interest of anticoagulation.
2) Describe use and regimen of heparin and LMWH.
3) Implication of Antithrombin (AT).

Content Description:
Thrombosis and clotting filter stay a major concern during hemofiltration and the choice of the best anticoagulant is always a terrible dilemma. Even if bad anticoagulation is not the primary reason of clotting problems it is an obligatory part of the good operation of hemofiltration treatment.

Most of clotting circuit are the results of mechanical problems (50%) with the catheter, the site of catheter insertion, the nursing of the patients and others. The anticoagulation is responsible of less than 40% of clotting problems. However the misuse of anticoagulation is a capital point who must be to improve.

The unfractionated heparin (UFH) is the anticoagulant that is the most widely used in hemofiltration because it is usable, low cost, measurable in blood and its possible complete inhibition by protamine. But there are two major concern with UFH, bleeding problems (less than 10%) and heparin induced thrombocytopenia (HIT).

The regional anticoagulation has been presented in the past like the absolute solution, currently this way is near completely abandoned except the citrate.

The low molecular weight heparin is still widely used in chronic hemodialysis but less and less used in acute cases. It is more expensive than UFH, there is not antidote available, monitoring is difficult and there is 10% of cross reaction for HIT with UFH.

The Antithrombin (AT) is the mandatory co-factor for heparin efficacy and its level activity is often reduced in sepsis and in that case the efficacy of heparin decrease dramatically.

High doses of At has been used in the past to treat the sepsis, as APC does, but without beneficial effect. But some articles have demonstrated an increase of mortality rate in case of AT deficiency and supplementation with low doses of AT should be beneficial.

We have conducted a study to show if supplementation should be the good way to avoid the problem of early thrombosis of the circuit. We have followed 28 patients in two centers to show the impact AT on filter lifespan and the interest of AT supplementation in that case and we have also compared two different methods for supplementation management: continuous infusion and bolus.

The critical level of AT activity seems to be 60% and below this point the filter lifespan is twice reduced. A simple supplementation in AT increase filter longevity from 15 h to 33 h. The continuous infusion is a better method than bolus one.

In summary, anticoagulation is not the only parameter to avoid the thrombosis problems during hemofiltration but it is simple to improve it. Heparin stay the first anticoagulant in ICU but other ways are possible. AT level may be an important concern during hemofiltration with heparin using.

Suggested Reading:
Educational Objectives:
1. Discuss the mechanism of citrate anticoagulation and metabolic consequences.
2. Discuss the composition of commercially available citrate solutions.
3. Discuss citrate circuit options and protocols for CVVH, CVVHD, CVVHDF, and SLED

Content Description:
This presentation describes the use of regional citrate anticoagulation for CRRT using a case-based approach. Several published citrate protocols for each CRRT modality will be discussed in detail, including the description of the technique, components, circuit, target parameters and dialyzer patency rates. Metabolic complications of citrate, including citrate toxicity, will be discussed.

Suggested Reading:
B18
Fluid Management

Ravindra L. Mehta MBBS, MD, DM, FACP
10:00-11:30
Wednesday, February 15

Educational Objectives:

1. Describe the goals of fluid management in critically ill patients and identify complications of fluid resuscitation.
2. Discuss the principles of fluid management with CRRT techniques and discuss the practical issues in developing a strategy for using CRRT as a fluid regulatory device.
3. Describe the practical issues related to fluid regulation with CRRT based on different modalities and pumps.

Content Description:

Volume support is frequently required in critically ill patients exhibiting hypovolemia particularly in the setting of shock, systemic inflammatory response syndrome (SIRS) and sepsis. Often volume management results in a fluid overloaded state requiring diuresis or dialytic intervention. Achieving an appropriate level of volume management requires knowledge of the underlying pathophysiology, evaluation of volume status, selection of an appropriate solution for volume repletion and maintenance and modulation of the tissue perfusion and cellular injury. In the presence of a failing kidney, fluid removal is often a challenge and it is often necessary in this setting to institute dialysis for volume control rather than metabolic control. CRRT techniques offer a significant advantage over intermittent dialysis for fluid control, however, if not carried out appropriately it can result in major complications. In order to utilize these therapies for their maximum potential it is necessary to recognize the factors which influence fluid balance and have an understanding of the principles of fluid management with these techniques. This workshop will describe the current concepts of volume management in shock states and discuss the basic methods for fluid management with CRRT and provide an approach to targeted intervention in critically ill patients. We will use case studies to describe various approaches for fluid removal and regulation with CRRT.

Suggested Reading:

(1-19) (4, 5, 20-32)

C19
Acid Base and Electrolyte Problems in the Critically Ill 1

Mitchell H. Rosner MD
10:00-11:30
Wednesday, February 15

Educational Objectives:
1. Understand the treatment of patients with severe hyponatremia
2. Recognize overcorrection of hyponatremia and how to manage this problem
3. Understand the concept of free water clearance and how to apply this to patient care.
4. Understand the treatments for severe hyperkalemia in the patient with kidney disease

Content Description:
This session will focus on common electrolyte problems encountered in patients admitted to the intensive care unit. The session is case-based and interactive with presentation of cases that cover such problems as hyponatremia, hyperkalemia, and acid-base abnormalities. In all cases, a practical approach is stressed that is based upon physiological principles that can be applied to other cases that the clinician may encounter in the ICU setting.

Suggested Reading:
4. Blumberg et al. Kid Int 1992; 41: 369
Educational Objectives:
To understand the relationship between the various methods of evaluating acid-base physiology
To appreciate the difference between independent and dependent variables in determining acid-base balance
To become familiar with terms and concepts of physical chemistry as they relate to clinical acid-base analysis

Content Description:
Acid-base disorders are common in the critically ill and injured. There is no evidence that one method of acid-base analysis is superior to another and as such, personal preference and training largely dictate what method is used. Most intensivists use base excess along with bicarbonate-based analysis and more commonly in recent years, they have integrated physical chemical approaches into their clinical practice. This approach is in marked distinction to what is advocated by much of the nephrology community where discussions center around what is the “correct approach”. However, this controversy misses the point. The various approaches to acid-base analysis are not mutually exclusive and the savvy clinician uses all the tools at his or her disposal, particularly when the situation is critical. Indeed the modern approach to acid-base analysis combines various methodologies.

Suggested Reading:
Educational Objectives:
1. Describe the model characteristics, the advantages and limitations of the model and how the models can be best optimized.
2. Describe the end-points for defining success of these methods.

Content Description:
The uncontrolled and deregulated systemic inflammatory response to infection plays a central role in the pathophysiology of sepsis. This response is mediated by a broad spectrum of endogenous mediators leading to dysfunction in multiple organs remote from the primary infectious site. The failure of numerous clinical trials aimed at eliminating a single mediator stimulated the research to focus on non-selective removal of excessively produced mediators of sepsis. This "detoxification" forms the theoretical basis and biological rationale for the use of hemopurification therapies as an adjunctive treatment of sepsis. While high-quality human data are lacking, much of the evidence originates from experimental studies. However, a multitude of emerging strategies that have been found effective in experimental models, failed to show any benefit in clinical studies. One of the reasons for the failure to translate the results from animals to humans could be attributed to animals models and experimental setting that do not fully mimic clinical scenario. Majority of experimental studies investigating the effectiveness of blood purification methods in the treatment of sepsis utilized hypodynamic, unresuscitated models of endotoxicosis and the treatment was started before or very early after the insult. By contrast, only a few studies were performed in hyperdynamic septic shock models aimed at replicating typical features of adequately resuscitated human septic shock. In addition, many unanswered questions remain, including the best surrogate markers to assess the efficacy of hemopurification methods and relevant biological targets.

Suggested Reading:
Educational Objectives:

Special Focus on New Membranes for High Permeability Hemofiltration and New Hybrid Therapy especially highly adsorptive membranes.

Patrick M HONORE, MD

Educational Objectives

1) Describe the New Possibilities given with the New Membranes for High permeability hemofiltration (HPHF) that do offers to the clinician especially with the combined use of high volume hemofiltration (for Synergic action) a new tool in order to try to effectively combat septic shock with acute kidney injury (AKI). Previous studies did show that HPHF especially with combined HVHF can removed much large quantities of mediators.

2) Describe the new possibilities given with the New Membranes for Hybrid Therapies regarding High Adsorptive Hemofiltration doing at the same time, Endotoxin Adsorption and Cytokine Adsorption.

3) Describe the rationale of attenuating the SIRS occurring during Bypass surgery with his related remoted organ damages.

Content Description:

1) Reviewing the latest informations regarding High Permeability Hemofiltration and Hybrid Therapy for Experimental and Animal studies.

2) Concept of Synergy between High Permeability Hemofiltration and High Volume Hemofiltration.

3) Evaluating information regarding a newly highly adsorptive membrane.

4) Describe the rationale of attenuating the SIRS occurring during Bypass surgery with his related remoted organ damages.

Suggested Reading:


3) DiCarloJV,AlexanderSR:Hemofiltration for cytokine-driven illnesses:


Educational Objectives:
Understand the problems that lead to errors in patient safety
Understand the infrastructure and processes to ensure patient safety
Understand the timeless communication skills that best promote safety now and for the future

Content Description:
This session will focus on several safety issues with water quality and infection control two themes. We will go into some detail on water processing and surveillance of water quality and we will discuss the most common infection control issue, that of the access to the blood stream.

We will also focus on principles of safety assurance thinking. How do we make patient safety a permanent cultural norm? This requires insight into the nature of common problems, but importantly involves interpersonal communication skills and disciplines.
Educational Objectives:
1. The participant will be able to identify mandated hepatitis B screening tests for the acute dialysis patient.
2. The participant will be able to describe isolation precautions for the HBV positive patient.
3. The participant will be able to identify screening for Hepatitis C in the dialysis population.

Content Description:
Comprehensive infection control in the dialysis population with Hepatitis B Virus (HBV) is essential to prevent the outbreak and spread of HBV to other acutely ill patients. Since RRT may be done by a variety of nursing specialties, it is paramount that all caregivers involved in the care of dialysis patients have a thorough understanding of the CDC stringent isolation procedures for this population. This course will review the mandated Hepatitis B screening for dialysis patients, and discuss interpretation of the results. Isolation procedures for the HBV positive patient mandated by the CDC will be reviewed and clarified. Additional information on the incidence and prevalence of HBV, HCV will be presented.

Suggested Reading:
References
1. CDC. Recommendation for preventing transmission of infections among chronic hemodialysis patients. MMWR2001; 50(no.RR-5)1-43.
Pediatric CRRT: The Basics

Jordan M. Symons MD
10:00-11:30
Wednesday, February 15

Educational Objectives:
Faculty:

Geoffrey Fleming
Scott Sutherland
Jordan Symons
Michael Zappitelli

Objectives:
1. Recognize epidemiology of acute kidney injury and the indications for CRRT in pediatric patients
2. Discuss the special technical considerations for pediatric CRRT and how they differ from adults
3. Understand the predicted outcomes for children who receive CRRT

Content Description:
The critically ill child who requires continuous renal replacement therapy (CRRT) presents challenges that differ from those encountered with adult patients. Children can vary in size from less than one kilogram to greater than 100 kg in weight, have a broad range of cognitive and developmental capabilities, and may have different medical problems from those of adults. Further, devices and techniques are generally developed for the adults, rather than for the pediatric patient. Despite these challenges, CRRT has gained strong support as a useful tool to care for the critically ill child with acute kidney injury. Our session will present information on the epidemiology of acute kidney injury in children, the indications for the use of CRRT, technical issues and approaches unique to the care of the pediatric patient receiving CRRT, and the outcome of CRRT for children. Session faculty welcome interaction and discussion during our presentation – we look forward to having all participants share ideas and experience.

Suggested Reading:
Educational Objectives:
Explore what the term "patient-centered care in ICU" appears to mean using the example of Cardiopulmonary Resuscitation.
Further explore ideas such as autonomy vrs paternalism, the limits of technology-based care
Explore what all this might mean given the extent to which End Of Life Care has become a core competence for ICUs.

Content Description:
Patient-centered care (PCC) is typically described as care that centers on communication, partnership; and includes what the patient values (both voiced and unvoiced). It is contrasted with care that is either technology-centered, doctor-centered, or hospital centered. It is also described as the sort of care that we would want our loved ones to receive. Regardless, it should be clear that while this is a noble goal it can also be difficult to acheive (without deliberate efforts) in the ICU settings. Given the importance of resuscitation as a core competence for ICU we will explore whether we currently achieve PCC in resuscitation, and what could be done to move closer to this important goal.

Suggested Reading:
Brindley P.G. et al. CMAJ 2002
Kutsogiannis D.J. et al CMAJ 2011
Misak C Am J Resp CCM 2004
Misak C Chest 2010
Bryce et al Med Care 2004
Drug Management in CRRT

Bruce A. Mueller PharmD, FCCP, FASN
8:00-9:30
Thursday, February 16

Educational Objectives:
1. Understand that CRRT encompasses different modalities and is not standardised across centres
2. Understand that drug elimination across the artificial kidney can be predicted, but due to differing CRRT modalities in the ICU is not always accounted for and often difficult to quantify.
3. Understand the factors in the critically ill relating to drug movement across membranes

Content Description:
The systems and technology for Intermittent Hemodialysis (IHD) across the world have been relatively well defined, as have the prescriptions for the patient with chronic renal failure (CRF). What happens in one place is relatively similar to that in another.

The basic principles of movement of drugs across the artificial kidney include membrane characteristics, drug size and the sieving co-efficient of the drug for that circuit. Drug dosing before and after IHD has a relatively well validated set of rules.

Whilst drug and patient variables tend to be constant in the populations with CRF neither is the circuitry nor are the patients in the ICU similar.

Importantly pharmacokinetic variables in the critically ill patient such as volume of distribution and protein binding complicate any prescription and this is particularly important for antibiotic prescriptions where drug cannot be titrated to a measurable endpoint like blood pressure or heart rate.

The various modalities in which CRRT have been used (CVVH vs CVVHD vs CVVHDF vs SLED) makes a one size fits all cookbook recipe impossible to prescribe.

Until we can routinely use therapeutic drug monitoring the best we have are predictive models for drug prescribing. Only by understanding critical illness pathophysiology, drug pharmacokinetics and artificial membrane characteristics we can we expect to improve the accuracy of these models. Unless there is titratable endpoint of a drug during CRRT currently the best cookbook recipe we have are complicated predictive algorithms.

Suggested Reading:
Starting and Stopping RRT for AKI: Principles and Practice

Etienne Macedo MD, PhD
8:00-9:30
Thursday, February 16

Educational Objectives:
1. Describe the factors affecting timing of initiation and stopping of RRT in critically ill patients.
2. Discuss the principles and evidence for early intervention with RRT in the ICU
3. Describe various approaches and practical aspects for initiating and stopping RRT

Content Description:
Several randomized studies have tried to delineate the best modality or the optimal dialysis dose to manage acute kidney injury (AKI), with inconsistent results. One important and still controversial aspect of the management of critically ill patients is the timing of initiation and cessation of renal replacement therapy (RRT). The lack of consensus on what parameters should guide the decision to start dialysis has led to a wide variation in dialysis initiation. A contributing factor is the lack of contemporary studies evaluating the relationship of timing of dialysis initiation and outcomes. Although listed as one of the top priorities in research on AKI, timing of dialysis initiation has not been included as a factor in large, randomized controlled trials in this area. Similarly, cessation of RRT has received little attention and has not been studied extensively. This workshop will utilize cases to illustrate the principles for determining optimal time for intervention and a strategy for stopping RRT in critically ill patients

Suggested Reading:
C27
Acid Base and Electrolyte Problems in the Critically Ill 2

Andrew Lewington MD
8:00-9:30
Thursday, February 16

Educational Objectives:
1. Real clinical cases will be used to demonstrate a range of acid-base and electrolyte problems in the critically ill patient
2. There will be an opportunity to work through the cases in a systematic way encouraging the audience to develop their own answers
3. Provide the attendees with the knowledge on how to diagnose acid-base electrolyte problems in patients and their institutions

Content Description:
There will be a series of case presentations that will demonstrate a whole range of acid-base and electrolyte problems in the critically ill patient.
The lecturers will present the cases in a systematic way to enable a good level of understanding. Following the lecture the attendees will have frameworks to enable them to approach acid-base and electrolyte problems in their institutions.

Suggested Reading:
1. Up-to-date
C27
Acid Base and Electrolyte Problems in the Critically Ill 2

Mitchell H. Rosner MD
8:00-9:30
Thursday, February 16

Educational Objectives:
1. Understand the treatment of patients with severe hyponatremia
2. Recognize overcorrection of hyponatremia and how to manage this problem
3. Understand the concept of free water clearance and how to apply this to patient care.
4. Understand the treatments for severe hyperkalemia in the patient with kidney disease

Content Description:
This session will focus on common electrolyte problems encountered in patients admitted to the intensive care unit. The session is case-based and interactive with presentation of cases that cover such problems as hyponatremia, hyperkalemia, and acid-base abnormalities. In all cases, a practical approach is stressed that is based upon physiological principles that can be applied to other cases that the clinician may encounter in the ICU setting.

Suggested Reading:
4. Blumberg et al. Kid Int 1992; 41: 369
D28
Extracorporeal Techniques for Sepsis 2

Oliver Joannes-Boyau MD
8:00-9:30
Thursday, February 16

Educational Objectives:
- Knowing the different techniques of blood purification
- The rational for the use of blood purification in sepsis
- New blood purification techniques in sepsis

Content Description:
The use of blood purification techniques are developing rapidly in the whole world, but the knowledge about these techniques remains low. A quick presentation of all the techniques currently available and the future in the field will be presented. We will also review the potential interest of specific technique of blood purification in sepsis. And we will finish by the last results and current researches.

Suggested Reading:
Educational Objectives:

1) Review briefly the rationale of Hybrid therapy in sepsis regarding experimental issues. Special focus on Hybrid therapy regarding large bore membranes and highly adsorptive membranes.

2) Describe the New Possibilities given with the New Membranes for High permeability hemofiltration (HPHF) that do offers to the clinician especially with the combined use of high volume hemofiltration (for Synergic action) a new tool in order to try to effectively combat septic shock with acute kidney injury (AKI). Previous studies did show that HPHF especially with combined HVHF can removed much large quantities of mediators.

3) Describe the new possibilities given with the New Membranes for Hybrid Therapies regarding High Adsorptive Hemofiltration doing at the same time, Endotoxin Adsorption and Cytokine Adsorption.

4) Review all clinical data regarding this issue.

5) Try to see which clinical situation could fit the best with those new types of membranes.

Content Description:
Clinical use day by day for bedside intensivists need to be further established. Although some data can be show about safety issues regarding the use of some membranes.

A step by step approach will be needed before routine implementation. Nevertheless, some clinical scenarios can be outlined so far.

Briefly, we should describe new insides regarding the “New Active Transportation between two Asymmetric Compartments” Hypothesis and New Insights into Rationale & Potential Mechanisms. Pro-mediators as well as mediators are removed at interstitial and tissue levels, following removal from the blood compartment, until a so-called threshold point is reached at which some pathways and cascades are stopped. At this level, the cascades are interrupted and no further harm can be done to the tissues. Until recently, this mechanism was taught to be a passive transportation pathway. As said in the introduction, effectiveness through only a passive transportation mechanism remains elusive. Indeed as demonstrated before and knowing that the surface of the central blood compartment (CEBC) is about 30 m², which is much smaller than the surface of the capillary blood compartment (CABC) which is about 300 m² and therefore passive transport between these two asymmetric compartments will not yield the same elimination rate on both sides. As a consequence, when a given technique is able to remove 40% of the mediators of the CEBC side, it will only represents 4% of the removal into the CABC side if the removal is only a passive mechanism. It is therefore easy to understand, that an other mechanism has to take place and this should be this time, an active transportation mechanism. Previous studies did show that HPHF especially with combined HVHF can removed much large quantities of mediators. A preliminary study called the HICOSS study (High Cut-off in Septic Shock) was looking as pilot study in order to compare in 80 patients with Septic Shock plus AKI. 40 patients were assigned with conventional membrane and 40 patients were assigned with an hyperpermeable membrane (septex). Those patients were in septic shock plus AKI but also in multiple organ failure (MODS). The mode chosen was CVVD for 5 consecutive days. The principal aim was to evaluate the safety regarding albumin losses (cut-off of 60 kDa) and a 50% reduction in catecholamine requirements. Mortality was a secondary end point. The results shows a excellent safety as the membrane was not loosing albumin more than a classical membrane. Nevertheless, regarding vasopressors free days as well length of ICU stay and mortality, no differences could be seen between the two groups. This may be due the fact that the mode
was only CVVD and perhaps the results would be very different if we were using CVVH at 35 ml/kg/h plus HPHF. Description will be done also regarding data for new adsorptive membranes. Attenuation of SIRS post-Bypass will be also evaluated in order to see whether therapy aiming at reducing it might improved related organ remoted damages.

Experimental studies and clinical evaluation are still under way. Those studies will need mechanistic steps, small RCT’s and large RCT’s at some point.

In conclusion, the hyperpermeable membrane (septex) is safe and could be a important therapeutic tool in the future when associated with HVHF. Potential effect of highly adsorptive membranes need to be evaluated.

As said and although further evaluation need to be done, some specific clinical scenarios can be identified in order to delineate the current use in clinical conditions of these new hybrid therapies by the bedside clinician.

**Suggested Reading:**

Suggested Readings:


4.- Honoré PM, Zydney AL, Matson JR. High volume and high permeability haemofiltration in sepsis. The evidences and the key issues. Care Crit Ill 2003;3:69-76


E29
Heart Failure and Cardio-Renal Syndrome 2: Management Strategies and Case Studies

Emil P. Paganini MD, FACP, FRCP
8:00-9:30
Thursday, February 16

Educational Objectives:
identify appropriate patient population
review the current data on effectiveness and safety
describe an appropriate "team" for implementation of the therapy

Content Description:
The most important issues here are to have a better understanding of volume excess and its morbidity associated with ongoing state of volume expansion. Thus, methods of fluid loss, either by drug or mechanical are extremely important.

Identifying the appropriate population and having the ability to intervene early are the most important issues that are currently under consideration. By establishing a method for control of volume and having the ability to cut through the delays in referrals or the "turf" wars which frequently exist in institutions can make a world of difference in both effectiveness as well as financial gains.

Assuring the diminution of the risk of therapy and helping increase its overall effect on patient survival and well being are the most important goals of this approach to patient care, inside or outside of the ICU, inside or outside of the acute care hospital.
Educational Objectives:
1. The participants will be able to identify the components of a PDSA project.
2. The participant will be able to identify three data collection points for a CRRT program.
3. The participant will be able to state the role of performance improvement in continuing quality patient care in a CRRT program.

Content Description:
In order to ensure safe quality care, every RRT program needs to constantly assess the care that is provided, monitor the care delivery process, nurse competencies and patient outcomes. This presentation will review the components of a PDSA project and discuss how the cycle promotes continuous quality improvement. A multidisciplinary approach to quality care will be presented. Tools to initiate a performance improvement process will be shared and indicators for tracking and threshold performance levels will be discussed.

Suggested Reading:
1. Institute for Health Care Improvement; www.ihi.org.
Educational Objectives:
1. Define the goals of CRRT.
2. Describe the key processes involved in meeting these goals, from the initial CRRT prescription writing by the physician to initiation of therapy by the nurse.
3. Discuss ways to implement and monitor quality measures during each of these processes to ensure achievement of the CRRT goals and reduction of errors.

Content Description:
Providing safety and quality measures for CRRT requires answering the following questions:
1. What are the goals of CRRT (ie solute clearance, volume control, time on the machine, safety)?
2. What are the processes involved in delivering therapy from the initial written prescription to the actual administration of CRRT by the nurse?
3. How can these processes be monitored and improved to ensure optimal delivery of CRRT and achievement of the CRRT goals?

Maintaining high quality and reducing error in the overall CRRT process requires a team approach of the physician, pharmacist, and nurse. In this portion of the workshop, I describe the approach used by the University of Alabama at Birmingham (UAB) to answer these questions.
Educational Objectives:
Faculty:
David Askenazi
Jordan Symons

1. Describe the epidemiology of acute kidney injury in neonates and the indications for CRRT in the newborn
2. Discuss the special technical considerations for neonatal CRRT
3. Understand the unique issues associated with performing CRRT for newborn patients

Content Description:
For many years any form of dialysis support was considered too difficult for neonates; for those centers that would provide renal replacement, peritoneal dialysis was considered the only viable modality. In fact, CRRT was first used for neonates almost thirty years ago and its use has expanded since that time.

Performing CRRT for newborn patients presents unique challenges. There are significant technical barriers to performing CRRT in neonates and risks may be magnified when devices and materials designed for use in adults are adapted to the care of very small patients. This session will discuss the epidemiology of acute kidney injury in the newborn, indications for CRRT, technical and pragmatic approaches to the procedure with emphasis on the differences from therapy as used in older children and adults, and some distinctive clinical circumstances for the use of CRRT. We look forward to an interactive session where members of the audience will share their own experiences, allowing all participants to gain further knowledge.

Suggested Reading:
H32
Withdrawing & Withholding Support for AKI: Ethical Issues in the ICU

Rolando Claure MD
8:00-9:30
Thursday, February 16

Educational Objectives:
1. Describe the main bioethical problems associated with withholding and withdrawing renal replacement therapies in critically ill patients.

2. Discuss the use of moral principles to guide difficult decisions.

3. Present some differences among different regions in the approach of this issue, from the patient, the family and the physician perspective.

Content Description:
Renal replacement therapy (RRT) has always had a strict connection with bioethics. Information and consent for a life-saving therapy like dialysis has strong connection with bioethics. Whether or not to offer dialysis and when to withdraw dialysis is one of the many choices physicians face in daily clinical practice. Withholding or withdrawing renal replacement therapy is a complex decision and depends on many interacting factors, which are unique for each patient and their families and for the care team. An evidence-based guideline with nine specific recommendations for managing patients has been available however is infrequently employed to help clinical decision making. In this workshop, we will discuss the important issues affecting decisions to withhold or withdraw dialysis in acute kidney injury patients and provide an approach for making these decisions for patient management.

Suggested Reading:


Educational Objectives:
To provide perspective on end of life care in critical care units.
To outline principles for decision making in withholding and withdrawing life support technologies in the critically ill.
Using case histories to outline process of decision making in end of life care of critically ill patients with AKI.

Content Description:
Although there are major differences across regions and countries, in general, the vast majority of patients who die in critical care units do so after either the withholding or withdrawal of life support therapies. Observational studies documenting physician behavior have noted changes in the modes of patient deaths and an earlier abandonment of life-sustaining treatments. Limitations are associated with patient age, diagnoses, ICU stay, and geographic and religious factors. In North America, medicine has moved from a paternalistic model to one that promotes autonomy and self-determination.

Patient expectations and preferences now help shape end-of-life practices, limiting the use of technologies that may prolong dying rather than facilitate recovery. In other geographic regions, patient-physician relationships are still somewhat paternalistic. This can be difficult for patients, families and health care professionals. On the other extreme, active shortening of life is practiced in a small number of countries. Seriously ill patients and family members have defined the importance of various elements related to quality end-of-life care. The most important elements related to trust in the treating physician, avoidance of unwanted life support, effective communication, continuity of care and life completion.

Variation in the perception of what matters the most indicates the need for customized or individualized approaches to providing end-of-life care. There are established guidelines for withholding or withdrawal of renal replacement therapy in patients with AKI. These include estimating prognosis and addressing the issues of advance directives and patient and family preferences through the process of shared decision-making to clarify appropriate strategies for clinical management and interventions. Time-limited trials of dialysis may be an invaluable tool in this process.

Suggested Reading:


CRRT 2012
CRRT APPLICATIONS

1. Etiology And Outcome Of Acute Renal Failure In 147 Children: A Single Center Experience

Rainer Büscher, Janet Atinga, Anja K Büscher, Udo Vester, Anne-Margret Wingen, Christian Dohna-Schwake, Peter F Hoyer

Pediatrics II, Pediatric Nephrology, Pediatrics I, Intensive Care Unit

**Background:** Acute renal failure (ARF) is common in critically ill children and characterized by a sudden but reversible increase of serum creatinine and nitrogenous waste products and by the inability of the kidney to regulate fluid and electrolyte homeostasis appropriately. The incidence in children seems to be increasing and the etiology of ARF has shifted from primary renal disease to multifactorial causes. Therapeutic strategies and prognosis depend on the underlying disease.

**Objectives:** The aim of this retrospective study was to define etiology and clinical features of ARF in 147 children and to evaluate prognostic factors and the outcome after renal replacement therapy. Patients and

**Methods:** Between 21 and 211, 147 pediatric patients (66 females, 81 males), were admitted to our hospital for ARF. Out of those, 26 (17.6 %) were newborns (median age 4 days, range 1-22 days) and 121 patients (82.4%) were children older than 1 month (median 3.21 years, range 1 month–18 years).

Causes of ARF, accompanying medical conditions, pediatric-modified RIFLE criteria, treatment, indications and mode of dialysis as well as patient outcome were retrospectively analyzed.

Descriptive statistics are presented as mean±SD and univariable levels were analyzed using a multivariable regression model. **Results:** While haemolytic uremic syndrome (n=42; 35%), sepsis (n=36; 3%) and dehydration (n=34; 28%) were the most common causes of ARF in children older than 1 month, renal vein thrombosis (n=11; 42%) as well as shock and asphyxia (n=1; 38%) were predominant reasons in newborns. Dialysis was performed in 12.5% (n=3, all CVVHD) of newborns and 55% (n=66, 37 CVVHD, 29 CVVHF) of children older than 1 month. Overall mortality was 23% (n=34) and was predominantly observed in the group of septic children following bone marrow transplantation (BMT; n=3, 88%). All BMT patients underwent dialysis treatment. Out of 66 dialyzed patients restitution could not be achieved in 15 cases (22.7%) and chronic dialysis treatment became necessary. **Conclusions:** Our overall results suggest a favorable outcome of ARF in children regardless the necessity of dialysis. In contrast, ARF in children following BMT and sepsis is associated with a 1% mortality rate. Improved understanding of the pathophysiology, early biomarkers of AKI, and better classification are required to optimize successful therapeutic efforts.

2. Correction Rate of Hyponatremia via Continuous Veno-venous Hemodialysis: A Formula Based on Dialysis Dose

Sevag Demirjian, George Thomas, Jonathan Taliercio, Surafel Gebreselassie

Cleveland Clinic, Cleveland, Ohio

Hyponatremia is a prevalent electrolyte disturbance in hospitalized patients, and particularly when water excretion is hindered by renal impairment. Rapid
correction of serum sodium may result in the development of osmotic
demyelination, typically noted at rates of
correction that exceed 12 mmol per liter
in 24 hrs or 19 mmol per liter in 48
hours. {Adrogue, 2 #322} In this study,
we examined the effect of dialysis
intensity on the rate of rise in serum
sodium in patients with acute kidney
injury initiated on continuous
venovenous hemodialysis (CVVHD).
Methods: Retrospective study of 35
critically ill patients with acute kidney
injury and serum sodium less than 13
mmol/L at initiation of CVVHD.
Results: Mean age was 64±13 years; 2
(56%) were male and 16 (44%) had
baseline kidney disease. APACHE II
score on ICU admission was 2±1, 23
(64%) were on mechanical ventilation
and 2 (56%) were on vasopressor
support. Serum sodium at time of
CVVHD initiation was 125±4 mmol/L,
creatinine 4.6±2 mg/dl, and BUN 91±32.
In simple linear regression model, a 1
ml/kg/hr increase in dialysis dose
(assessed by effluent rate) was
associated with 4.5 mmol/L increase in
serum sodium over twenty four hours
(p=.9). Gender or baseline weight did
not alter the above parameter estimate or
the p value in a multivariable model.
Conclusion: CVVHD can correct low
serum sodium levels in a safe, effective,
and controlled manner. Each 1 ml/kg/hr
increase in dialysis intensity results in a
4.5 mmol/L rise in serum sodium.

3. Acute Kidney Injury; The
Experience From The Other Side
Of The World
Che Rosle D, Farez Safhan Mn, Mohd
Ramli S, Norasmiza Am, Azrel Shahreez
Ag, Khairul Anuar H
International Islamic University
Malaysia, Hospital Tengku Ampuan
Afzan, Kuantan, Malaysia
Introduction: AKI is commonly
diagnosed and the mortality rate was
extremely high. At least a third of AKI
patients required dialysis however,
CRRT is not widely available especially
in under-developed countries. Hence,
conventional hemodialysis was the only
available option. Objectives: To define
the clinical approach and determine the
outcomes of our AKI patients. Method:
This is a single centre, sub-urban
satellite hospital's experience in the
management of AKI patients. The 3-
days mortality rate and renal outcomes
were estimated and prognostic factors
associated with clinical outcomes were
also identified. Results: 75 patients were
reviewed and their mean age was 52.9
+/- 14.5 years-old. Two-third were males
and 75% were Malays followed by 16% Chinese and 9% Indians. Twelve %s had concurrent coronary heart disease, more than half had hypertension and 48 %s had diabetes. 53.3 % were referred from intensive wards with pre- and intra-renal AKI noted in 21.3 and 73.3 %s respectively. Sepsis was diagnosed in 78.7 % and the pathogens were identified in 42.3 % of them. At the start of dialysis, the urea and creatinine were 3.4 (IQR 2.3) mmol/L and 474 (IQR 398) mmol/L respectively. Metabolic acidosis was noted in 76 % and oliguria in 38.7 %. At least 85.3 % required dialysis and conventional HD was the most commonly prescribed while 22.7 % of the patients were started on CRRT. The 3-days mortality rate was 28 % and duration of ward stay was 11.5 (IQR 7) days. Patients referred from the intensive wards had higher mortality rate (37.5 versus 17.1 %s). They were also frequently started on dialysis (39 versus 25 cases, p=.1). Of those treated with dialysis, 68.8 %s survived and complete renal recovery was noted in 31.3 %s of them. Seventeen patients had partial recovery and seven were dialysis-dependent. CRRT had associated with shorter hospital stay (1 versus 3 days, p=.4) but not with better clinical outcomes.

**Conclusion:** The overall 3-days mortality rate was 28 % and higher in the intensive wards. Referral from intensive wards was the only factor associated with poor clinical outcomes and CRRT was not associated with an improved prognosis in our AKI patients.

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Vanderbilt University School of Medicine, University of Alabama Birmingham, Cincinnati Children's Hospital Medical Center, Emory University, University of Michigan School of Medicine, McGill University

Background: Literature on Renal Support Therapy (RST) on ECMO is limited to single center experiences. This study’s goal was to obtain background data from worldwide centers regarding RST practices during ECMO support.

Design and Methods: A cross-sectional survey of center practices with regards to RST during ECMO. The study was carried out with IRB approval via electronic survey using REDCap Survey (Vanderbilt University School of Medicine, Nashville TN). The 29 question survey was distributed to medical directors via the ECLSNet ListServe eclsnet@rufus.origenbio.com.

Results: A total of 65 of 21 international ELSO centers responded of which 8% were US sites, 4.6% were Canadian, 1.8% were European and 4.6% were from Australia or New Zealand. 94% of centers reported caring for neonatal or pediatric patients but only 4% cared for adults on ECMO. 46% of centers reported both cardiac and respiratory indications for ECMO, 27.7% reported cardiac support only, 24.6% reported respiratory support only. With regards to RST interface with ECMO, 23% reported not using any RST during ECMO, 31.5% only used an in-line hemodiafilter, 5.8% only used a RST machine connected to the ECMO circuit and 4.6% used both methods.

The treatment or prevention of fluid overload (FO) was the most frequent indication for RST reported comprising 59% of the cohort. There was a non-significant trend (p>.5) toward non-US centers reporting acute kidney injury (AKI) as the primary indication for RST.

RST indication differed by indication for ECMO with AKI predominating (42%) in the group on ECMO for cardiac support. The predominant clearance method utilized was convective (SCUF 43% + CVVH 18%) and was dependent upon RST interface (in-line filter vs machine). Nephrology was the most common author of RST prescription (63%) as compared to critical care, and was significantly different (p<.1) between US centers (83%) and non-US centers (11%).

Conclusions: Despite a 5% prevalence of AKI on ECMO by current definitions, nearly 25% of centers do not use RST during ECMO. Fluid overload is the
predominant indication for RST during ECMO in this cohort, with AKI most prominent in non-US centers and those performing primary cardiac support. Nephrology is the primary author of RST prescriptions worldwide but most markedly in US centers. Further work by this group hopes to elucidate more specific details regarding FO and AKI in this population and the association with outcomes.

5. **Continuous Veno-Venous Haemofiltration (CVVH) In Infants in PICU Using The Proprietary Prismaflex® Device And HF20 Haemofilter And Circuit**

*Glenda Fleming, Barry Wilkins, David Harper*

*Children's Hospital at Westmead*

CVVH in infants is difficult because there is little available technology allowing low extracorporeal circuit volume. We started a programme using the Prismaflex® hemofiltration machine and HF2® filter/circuit (extracorporeal volume 6 mL) in infants. 14 infants, age 1 week to 19 months (3.5-11 kg), were treated over 3 months from June 29 to December 21, 1 for acute renal failure and 4 for inborn errors of metabolism. We monitored negative fluid balance; fall in plasma urea/creatinine/ammonia/organic acids, circuit life, circuit pressures. Vascular access was through peripheral cannulation in 12 patients via an ECMO circuit in two patients. 112 treatment sessions, were performed over 99 patient-days (range 1-25 sessions, mean 8, and 1-24 days of treatment, mean 6.7 days per patient). Heparin was used as anticoagulant in all patients. We also changed two patients to citrate. Blood flow was 3-8.3 ml/kg/min (2 ml/min minimum). CVVH with prefiltre replacement fluid was standard. Effluent was 2% of blood flow. Negative or neutral fluid balance was always achieved and plasma creatinine, urea, ammonia and organic acid values fell to steady-state within 3 hours. Access pressure, filter pressure, venous return pressure and trans-membrane pressure were always within acceptable ranges. Reasons for changing circuits included routine at 72 hours, other interventions, clotting in the access pressure pod (31 cases), rising TMP (2 cases), scale malfunction, extended power failure and cracked filter (1 case each). One adverse clinical event of and intra cerebral haemorrhage occurred during treatment with CVVH. 7 patients died from their primary disease. The Prismaflex HF2 circuit is efficacious in infants as small as 3.5 kg. Filter life is comparable to reports in older children and adults.

6. **Continuous Veno-Venous Haemofiltration (CVVH) In Infants and Children In PICU Using The Proprietary Prismaflex® Device And ST60 Haemofilter And Circuit**

*Glenda Fleming, Barry Wilkins, David Harper*

*Children's Hospital at Westmead*

Continuous Renal Replacement Therapy in infants and small children is difficult because there is little available technology allowing low extracorporeal circuit volume. We started a program using the Prismaflex® hemofiltration machine and ST6® filter/circuit (extracorporeal volume 93 mL) in infants and small children. 1 infants and children, aged 9 months to 8 years (8-28
kg), were treated over 3 months from June 29 to December 21. 8 patients were treated with CVVH and 2 with CVVHDF. Four patients had an admitting diagnosis of sepsis, four patients had liver failure, one patient had respiratory distress post bone marrow transplantation and the tenth patient had Langerhans Histocytosis. Effectiveness of treatment was measured by negative fluid balance, fall in plasma urea/creatinine/ammonia/organic acids, circuit life, circuit pressures. Eight patients had a peripherally inserted double lumen vascular access device and two patients were connected to an Extra Corporeal Membrane Oxygenation (ECMO) circuit. 52 treatment sessions were performed over 61 patient-days (range 1-26 sessions, mean 5.2, with 1-27 days of treatment, mean 6.1 days per patient). Heparin was used as anticoagulant for all patients, however, one patient was changed to citrate. Blood flow was 2.5 – 6.1 ml/kg/min. CVVH with prefilter replacement fluid was standard. Effluent was 2% of blood flow. Negative or neutral fluid balance was always achieved and plasma creatinine, urea, ammonia and organic acid values fell to steady-state within 3 hours. Access pressure, filter pressure, venous return pressure and transmembrane pressure were always within acceptable ranges. Reasons for changing circuits included routine change at 72 hours, filter clotting with rising TMP or cessation of treatment to facilitate a scan or surgical procedure. No adverse clinical events occurred as a result of CVVH. The Prismaflex ST 6 circuit is efficacious in infants as small as 8 kg. Mean circuit life for all reasons was 22.45 hours.

7. Outcomes of Patients with End Stage Renal Disease (ESRD) Under Chronic Hemodialysis Requiring Continuous Renal Replacement Therapy (CRRT) and Patients without ESRD in Acute Renal Failure Requiring CRRT

Yeon Soon Jung, Jin Hee Park, Sung Bin Kim, Ho Sik Shin, Hark Rim
Kosin University College of Medicine

Purpose: The purpose of this study were to (1) evaluate short-term patient survival and (2) compare the survival of conventional hemodialysis (HD) patients needing CRRT with the survival of non-end stage renal disease (ESRD) patients in ARF requiring CRRT.

Methods: We evaluated adults (> 18 years) requiring CRRT who were treated in the intensive care unit (ICU) of Kosin University Gospel Hospital, Busan, Korea from January 1, 29 to December 31, 21. A total of 1 (24 ESRD, 76 non-ESRD) patients received CRRT during the study period. Patients were divided into two major groups: patients with ESRD requiring chronic dialysis and patients without ESRD (non-ESRD) with ARF. Predictors of all-cause death were examined using Kaplan-Meier analysis and Cox proportional hazards analyses in both treatment groups.

Results: Across all patients, the median survival time was 56 days, and the 9-day survival rate was 44.6%. For non-ESRD patients, the 9-day survival rate was 41.6%. For ESRD patients, the 9-day survival rate was 55.3%. Multivariate Cox proportional hazards analyses demonstrated that conventional HD was not a significant predictor of mortality [hazard ratio (HR) .334, 95% confidence interval (CI) .63–1.763, P = .196], after adjustment for age, gender, presence of sepsis, APACHE score, use of
vasoactive drugs, number of organ failures, ultrafiltration rate and arterial pH. **Conclusion:** The survival rates of non-ESRD and ESRD patients requiring CRRT did not differ, and conventional HD may be not a significant predictor of mortality.

<table>
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<th>ESRD (n=24)</th>
<th>Non-ESRD (n=76)</th>
<th>P value</th>
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<tr>
<td>Age, years</td>
<td>53.6 ± 31.6</td>
<td>49.5 ± 28.2</td>
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<tr>
<td>Admission to CRRT, day</td>
<td>6.4 ± 8.5</td>
<td>8.4 ± 28.7</td>
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<td>APACHE II score</td>
<td>89.2 ± 34.9</td>
<td>89. ± 32.5</td>
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<td>Medical setting (%)</td>
<td>2 (83.3)</td>
<td>54 (71.1)</td>
<td>.293</td>
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<tr>
<td>No. of organ failure</td>
<td>1.4 ± .8</td>
<td>1.8 ± .9</td>
<td>.131</td>
</tr>
<tr>
<td>Serum BUN (mg/dL)</td>
<td>59.2 ± 33.9</td>
<td>53.2 ± 28.5</td>
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<td>Serum creatinine (mg/dL)</td>
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<td>Leukocyte (× 13/μL)</td>
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<td>Hemoglobin (g/dL)</td>
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<td>Platelet (× 13/μL)</td>
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<td>15.6 ± 82.2</td>
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<td>Serum albumin (g/dL)</td>
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<tr>
<td>Sepsis (%)</td>
<td>12 (5)</td>
<td>48 (63.2)</td>
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<tr>
<td>Cardiac dysfunction (%)</td>
<td>14 (57)</td>
<td>3 (38)</td>
<td>.91</td>
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<tr>
<td>Death (%)</td>
<td>1 (41.7)</td>
<td>43 (56.6)</td>
<td>.22</td>
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**8. Correction of Severe Hypernatremia With Continuous Renal Replacement Therapy Using Regional Citrate Anticoagulation**

Bethany Karl, Eileen Lischer, Amber P Sanchez

University of California San Diego

A 27 years old pregnant woman with systemic lupus erythematosis was admitted at 33 weeks gestation with chest pain, headache, and vomiting and diagnosed with eclampsia. Her neurologic status deteriorated rapidly and an emergent cesarean section was performed. Imaging revealed a large left-sided intra-parenchymal hemorrhage with mass effect and she returned to the OR for evacuation where a large ruptured arterio-venous malformation was discovered. For neurologic protection, hypertonic saline was intermittently administered to keep the serum sodium 155-16mmol/L. Creatinine was .9mg/dL on admission and rose to 2.57 by hospital day 7. As her renal function declined, she was less able to regulate her sodium balance and the serum sodium rose to 18’s by hospital day 13 and was refractory to hypotonic fluids. In order to bring the serum sodium down in a controlled fashion, continuous renal replacement therapy (CRRT) was initiated on day 16 with regional citrate for anticoagulation (RCA). Initial dialysate was custom-made to contain a sodium concentration of 147meq/L (versus the standard sodium concentration of 117meq/L). Trisodium citrate was kept at a constant rate of 15 ml/hour to avoid variability in sodium delivery. After 2 hours, the sodium had decreased from 18 to 176. At 3 hours, the sodium dropped to 173 and the replacement solutions were modified to contain a sodium concentration of 174meq/L (Normal
ABSTRACTS FROM 17TH INTERNATIONAL CONFERENCE ON CRRT, SAN DIEGO, FEB 14-17, 2012

saline + 2meq of NaCl). After an additional two hours, the sodium fell further to 167mmol/L, and replacement fluids were adjusted to contain 184meq/L of sodium, the dialysate was modified to contain a sodium of 172meq/L, and the patient was given 2mL of 3% saline. The serum sodium then increased to 172mmol/L and remained 172-174 for the next 1 hour. The sodium content of the dialysate and replacement fluids were adjusted down on a daily basis in order to reduce the serum sodium slowly over the next 7 days. Intracranial pressure and cerebral perfusion pressures were monitored continuously and remained within target. On day 7 of CRRT, serum sodium had reached 147, however she had no neurologic improvement and the decision was made by the family to withdrawal care. While ultimately the patient’s underlying neurologic injury was devastating, this case demonstrates that in the setting of severe hypernatremia, sodium can be safely reduced in a controlled manner with custom-made hypertonic dialysate and replacement solutions.

9. Clinical parameters to determine the optimal timing of CRRT in critically ill patients with acute kidney injury

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Department of Internal Medicine, Seoul National University Bundang Hospital

Purpose: The aim of this study was to evaluate the clinical parameters to determine the optimal time for continuous renal replacement therapy (CRRT) in critically ill patients with severe acute kidney injury (AKI).

Methods. A single center retrospective study was performed using data from 166 AKI patients who received CRRT in intensive care unit (ICU) between October 27 and January 21. We compared mortality rate at 9 days after the initiation of CRRT, ICU-free and CRRT-free days between “early CRRT” and “late CRRT” groups stratified by blood urea nitrogen (BUN), serum creatinine, urine output and RIFLE criteria. Results: The 9-day mortality rate was significantly lower in the early group compared with the late group when stratified by median value of BUN at the start of CRRT and mean hourly urine output during 6 h, 12 h, and 24 h before CRRT. In addition, the 9-day mortality rate was also significantly lower in patients who received CRRT in the “injury” stage of RIFLE criteria compared with those in “failure” or “loss” stage. ICU-free and CRRT-free days during the first 28 days were significantly longer in the early group when stratified by median level of BUN. However, in terms of creatinine, ICU-free and CRRT-free days were significantly shorter in the early group compared with the late group. CRRT-free days during the first 28 days were also longer in early group stratified by median value of mean hourly urine output during 6 h, 12 h before CRRT. After adjusting for covariates, 9-day mortality was independently lower in the early group defined by median level of BUN (OR=1.65 (1.1-2.47), p=.15) and mean hourly urine output during 12h before CRRT (OR=1.56 (1.5-2.33), p=.27). Conclusion: Our data suggest that early CRRT may have a survival benefit in critically ill patients with severe AKI, and BUN and urine output...
at the initiation of CRRT may be important parameters to determine the optimal time for CRRT.

10. Identifying Predictors of Outcome Following CRRT Discontinuation in Pediatric ICU Population
Rebecca M Lombel, Heather A Lesage-Horton, Neal B Blatt, David T Selewski, Theresa A Mottes, Kassandra L Messer, Peter X Song, Debbie S Gipson, Michael Heung
University of Michigan, Ann Arbor, MI,

Background: In critically ill pediatric patients, renal replacement therapy (RRT) improves short-term survival in severe acute kidney injury (AKI), yet there remains little consensus regarding timing of initiation or discontinuation of RRT. Only two studies have specifically examined predictors of successful discontinuation of continuous RRT (CRRT), and neither study included pediatric patients. We sought to determine if several readily-available clinical parameters could predict clinical outcomes following CRRT discontinuation. Methods: Retrospective single-center study of 115 children who required CRRT in the PICU from July 26 to March 211. Data collection included degree of fluid overload (FO) at CRRT initiation and discontinuation; duration of therapy and urine output (UOP) prior to CRRT discontinuation. The primary endpoint was patient outcome following CRRT discontinuation, defined as dialysis dependence, dialysis independence or death. ANOVA was used for normally distributed data and Kruskal-Wallis tests for non-normally distributed data. Multiple logistic regression modeling was performed. Results: Outcomes following CRRT discontinuation were as follows: 32 (28%) patients died, 21 (18%) required intermittent dialysis and 62 (54%) did not require dialysis. In unadjusted analyses, there were significant differences between the 3 outcome groups when comparing mean values of FO at discontinuation (p=.5), age (p=.3) and length of CRRT (p=.4). Of 6 clinical parameters, only urine output in the 8 hours prior to discontinuation produced significant results following adjustment; for 1 mL/kg/hour increase in UOP, the OR of dialysis independence compared to death was 2. (95% CI 1.2-3.4). Conclusions: Our study represents a first step in understanding the characteristics of pediatric patients with severe AKI that predict post-CRRT survival and need for ongoing renal replacement. We identified that urine output in the 8 hours preceding CRRT discontinuation was associated with dialysis-independent patient survival. Although preliminary, this finding suggests that readily-available clinical parameters can inform clinical decision-making about the timing of CRRT discontinuation, and provides the rationale for prospective clinical trials.

11. Pharmacodynamic Properties of Imipenem in Continuous Venovenous Hemodialysis (CVVHD)
Milen Amde, Seth R Bauer, Michael J Connor, Charbel A Salem, William H Fissell
Cleveland Clinic, Emory University

Background: Sepsis is the leading cause of death in acute renal failure and recent publications highlight the survival benefit of early appropriate antimicrobial therapy. We hypothesized that dialytic clearance of antibiotics might undermine
effective antimicrobial therapy. In an IRB-approved observational study, we measured imipenem levels in critically ill patients receiving continuous hemodialysis. **Methods:** Inclusion: Adult patients with acute or chronic renal failure receiving CVVHD in the ICU. Exclusion: ESLD, pregnancy. Patient data including age, gender, current and admission weight, and CVVHD dose were recorded. Sampling: After the fourth dose of antibiotic during uninterrupted CRRT, trough, 3 minute post infusion peak and second trough blood and effluent samples were drawn. **Drug analysis:** Free and effluent imipenem levels were measured by RP-HPLC. Data analysis: Imipenem levels and patient data were used for PK and PD calculations. The pharmacodynamic parameter of interest was %T > MIC, where MIC is defined by CLSI breakpoints for imipenem (Sensitive 1 ug/ml; Intermediate 2 ug/ml; Resistant > 4ug/ml for Enterobacteraceae). The probability of target attainment for >5%T > 4xMIC was calculated for each breakpoint. Statistical testing was performed using JMP 9. Parameters with a p-value less than .3 on univariate analyses were included in multivariate linear regression analyses. Results: Complete data was available from 17 subjects dialyzed with the NxStage Express (n=6) or Gambro Prismaflex (n=11). Probability of Target Attainment was 88% for an MIC of 1ug/ml, 29% for an MIC of 2 ug/ml, and % for MICs of 4 and above. Univariate analyses suggested a relationship between %T > MIC and CVVHD dose (either total or weight-based), gender and weight gain since admission, but not severity score. A multivariate linear regression incorporating weight change, gender and CRRT dose demonstrated a significant and negative relationship between CRRT dose and %T > MIC, which was preserved for %T > 2ug/ml, 4ug/ml and 8 ug/ml. Discussion: Our data suggest that not all critically ill subjects treated with concomitant CRRT and imipenem achieve a conservative pharmacodynamic target for susceptible Enterobacteraceae, and only 29% achieve target for intermediate-susceptibility organisms. The significant negative association between CVVHD dose and pharmacodynamic parameters suggests the potential for intensive dialytic therapies to undermine antimicrobial therapy.

**12. Citrate Kinetics in Septic Shock Patients with Liver Dysfunction During Continuous Venovenous Hemodiafiltration**

*Filippo Mariano, Maurizio Morselli, Zsuzsanna Hollo, Daniela Bergamo, Sandro Scella, Ciro Tetta, Ambrogio Dellavalle, Maurizio Stella, Giorgio Triolo*

Department of Medicine Area, Nephrology and Dialysis Unit, CTO Hospital, Turin, Italy, Department of Medicine Area, Clinical Pathology Unit, CTO Hospital, Turin, Italy, Western Europe Scientific Coordination, Fresenius Medical Care, Bad Homburg, Germany, Department of Emergency, Intensive Care Unit, CTO Hospital, Turin, Italy, Department of Plastic Surgery, Burns Unit, CTO Hospital, Turin, Italy

**Background:** Citrate anticoagulation is more and more popular in continuous renal replacement therapies. However, few data are available on citrate kinetics in patients with septic shock. In order to study whether citrate accumulates in septic shock patients with liver
impairment, we studied plasma and ultrafiltrate levels during continuous veno-venous hemodiafiltration (CVVHD). **Methods:** A routine determination of citrate in plasma and dialysate using a modular analyser (Architect c8, Abbott Italia) was set up by adapting a commercial citrate lyase method. This method was modified by lowering the sample volume, with a curve linear up to 4 mmol/L. Citrate concentrations were measured undiluted in systemic plasma (range .1-.4 mmol/L) and with 1:2 sample dilution in circuit plasma or ultrafiltrate (range .2-.8 mmol/L). In vitro we studied the distribution of blood citrate between intra- and extracellular compartments. Ex vivo we studied citrate levels in systemic and circuit plasma and in ultrafiltrate (at .5, 1, 3, 6, 9, 12, 24, 48 and 72 hrs) of 12 septic shock patients with liver dysfunction on CVVHDF. **Results:** In order to evaluate blood distribution of citrate between intra- and extracellular compartments, we found in vitro a significant correlation (r .9997, y = .66 + 1.2x, n 36) between the plasma measured and the predicted citrate concentrations for an exclusive extracellular distribution (taking into account the hematocrit value). Ex vivo median systemic citrate levels were .9 (.6-.12) mmol/L (time) and .23 (.18-.31) mmol/L during CVVHDF. Median sieving coefficient for citrate was .95 (.88-1.2), and did not change with different blood flow (from 1 to 15 ml/min) and effluent volume (from 135 to 51 ml/hour). Net citrate removal by filter significantly correlated with the effluent volume (r .85). Median citrate load entering in patient bloodstream was as low as 13.6 (9.1-19.6, n 68) mmol/hour. Citrate tests in systemic blood increased daily cost of citrate anticoagulation from 2.96 to 3.51 Euro. However, due to longer filter survival and reduced hemorrhagic complications saving costs could be potentially relevant if test availability allowed a more extended use of citrate anticoagulation. **Conclusion:** Kinetics study demonstrated that citrate did not accumulate in septic shock patients with liver dysfunction, where citrate losses in the ultrafiltrate can be efficiently modulated by increasing the effluent volume.

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13. Fulminant Wilson’s crisis: plasmapheresis vs. Mars
Prince Mohan, Abdallah Geara, Richard Kronfol, Jason Long, Jai Radhakrishnan, Amay Parikh
Columbia University

**Introduction:** Wilson’s disease presents with chronic hepatic and neurologic dysfunction. In rare cases, it can present with fulminant liver failure and multiple organ dysfunction (including renal failure, hemolytic anemia, coagulopathy). Patients have blood high levels of copper and the initial therapy of fulminant Wilson’s crisis is directed at decreasing copper levels. Since copper is albumin bound, we evaluated 2 modalities of extra-corporeal copper clearance: Molecular Adsorbant Recirculating System (MARS) and plasmapheresis. This case report will explore the efficacy of copper clearance utilizing both modalities. **Methods:** A 25-year-old woman with known Wilson’s disease on trientine dihydrochloride presented with fulminant Wilson’s crisis due to medication noncompliance for the previous 1 year (acute hemolytic anemia, fulminant liver failure, acute kidney injury). Both MARS and plasmapheresis
were utilized for copper clearance. Blood Copper, Haptoglobin, and Ceruloplasmin levels were monitored before and after each treatment.

**Results:** Treatments alternated between MARS and plasmapheresis. MARS sessions consisted of 8 hours of albumin dialysis each followed by CVVHDF. Plasmapheresis sessions replaced 1.2 times the plasma volume with fresh frozen plasma. Copper reduction ratios for each modality are shown in the table. Hemolytic anemia did not improve until after 3 total treatment sessions (2 MARS and 1 plasmapheresis). The patient was bridged to liver transplantation following a total of 5 sessions (3 MARS and 2 plasmapheresis). In this case, average copper reduction ratios were MARS vs. plasmapheresis were similar (18.6% vs. 26.9%, p=.5).

**Conclusion:** Both MARS and Plasmapheresis can be used to for copper clearance in Wilson’s crisis. Side effects of FFP replacement in plasmapheresis are not seen with MARS. Either modality can be used as a bridge to liver transplant.

<table>
<thead>
<tr>
<th></th>
<th>1st M</th>
<th>2nd M</th>
<th>3rd M</th>
<th>1st PP</th>
<th>2nd PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper pre-therapy (mcg/dL)</td>
<td>183</td>
<td>115</td>
<td>86</td>
<td>154</td>
<td>81</td>
</tr>
<tr>
<td>Copper post-therapy</td>
<td>154</td>
<td>85</td>
<td>74</td>
<td>115</td>
<td>58</td>
</tr>
<tr>
<td>Copper Reduction Ratio</td>
<td>15.8%</td>
<td>26.1%</td>
<td>13.9%</td>
<td>25.3%</td>
<td>28.3%</td>
</tr>
</tbody>
</table>

14. Comparison of Electrolyte Replacements with and without Prismasol® Replacement Fluid

*Kari Mount, Samir Parikh, Ganesh Shidham*
meq/L of K and 12 received 4 meq/L of K. Those with the lower concentration of K required 52 mEq K replacement/day versus 7 mEq K replacement/day with the higher concentration (p<.1) [overall Prismasol® average 31mEq]. The mean number of replacement fluid changes with Prismasol® was 1.4 per CRRT course compared to 5.38 with standard therapy (p<.1). Conclusion: Providing a more physiologic replacement fluid such as Prismasol® significantly decreases the number of electrolyte replacements required. Utilizing the higher K Prismasol® product significantly reduces K replacements specifically as compared to a lower K product. Additionally, the number of replacement fluid orders was diminished by using Prismasol® potentially decreasing physician, nursing, and pharmacy work load and allowing for less fluctuation in electrolytes and acid-base status for the patient.

<table>
<thead>
<tr>
<th></th>
<th>Standard Therapy (n=26)</th>
<th>Prismasol® (n=26)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>K replacement/day</td>
<td>63 mEq</td>
<td>31 mEq</td>
<td>&lt;.1</td>
</tr>
<tr>
<td>Mg replacement/day</td>
<td>1.8 grams</td>
<td>.84 grams</td>
<td>.3</td>
</tr>
<tr>
<td>Ca replacement/day</td>
<td>1.25 grams</td>
<td>.62 grams</td>
<td>.17</td>
</tr>
<tr>
<td>Phos replacement/day</td>
<td>4.11 mmol</td>
<td>5.22 mmol</td>
<td>.6</td>
</tr>
</tbody>
</table>

15. Pharmacokinetics of Meropenem in Children Receiving Continuous Renal Replacement Therapy
Edward J Nehus, Alexander A Vinks, Stuart L Goldstein
Cincinnati Children’s Hospital Medical Center, Cincinnati

Purpose: Meropenem (MP) is a broad-spectrum antibiotic frequently prescribed in children receiving continuous renal replacement therapy (CRRT). Comorbid conditions present in critically ill children alter pharmacokinetic (PK) profiles and are associated with subtherapeutic antibiotic dosing. Furthermore, the low molecular weight and small volume of distribution of MP permit extensive extracorporeal removal. The purpose of this study was to evaluate target attainment of standard MP dosing in critically ill children receiving CRRT. Methods: Estimates of essential PK parameters (volume of distribution, renal clearance, metabolic clearance, and sieving coefficient) were extracted from published literature and used to generate an in silico MP PK model (MW/Pharm, Mediware, Groningen, the Netherlands). The prospective pediatric CRRT (ppCRRT) database was used to provide realistic clinical covariates including patient weight, residual renal function, and dialysis dose. Target attainment was defined as 8% time above the minimum inhibitory concentration (T > MIC) at 4 µg/ml (MP susceptibility breakpoint for P. aeruginosa). T > MIC for median and upper quartile (Q3) effluent rates were evaluated at the adult dose of 2 mg/kg (max of 1 mg) every 12 hours. Results: 31 patients from the ppCRRT database had complete data sets available for evaluation. The patients were divided into 5 age groups (< 1, 1-5, 5-1, 1-15, and > 15 years of age).
Median estimated glomerular filtration rate based on serum creatinine (updated Schwartz formula) ranged from 19 – 24 ml/min/1.73m², and median effluent rate ranged from 1832 – 2877 ml/min/1.73m² (Q3 of 2327 – 497 ml/min/1.73m²) between age groups. T > MIC was decreased in younger age groups, but adequate for children above 15 years of age. Q3 effluent rates caused a 6 -14% reduction in T > MIC. (See table). Conclusion: Extracorporeal clearance and high effluent rates may render MP dosing recommendations of 2 mg/kg inadequate for younger age groups receiving CRRT. These in silico PK/PD models will need to be verified prospectively in children receiving MP and CRRT.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Median Weight (kg)</th>
<th>T &gt; MIC (median effluent rate)</th>
<th>T &gt; MIC (Q3 effluent rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 year</td>
<td>3.6</td>
<td>38%</td>
<td>28%</td>
</tr>
<tr>
<td>1-5 years</td>
<td>13.8</td>
<td>58%</td>
<td>52%</td>
</tr>
<tr>
<td>5-1 years</td>
<td>24.2</td>
<td>62%</td>
<td>52%</td>
</tr>
<tr>
<td>1-15 years</td>
<td>45.</td>
<td>88%</td>
<td>74%</td>
</tr>
<tr>
<td>&gt; 15 years</td>
<td>59.9</td>
<td>94%</td>
<td>82%</td>
</tr>
</tbody>
</table>

16. Evaluation of the Potential Adverse Effects Associated with Calcium Carbonate Precipitate During Continuous Veno-Venous Hemofiltration (CVVH)

David S Pantaleone, Benjamin Brooks, Justin Daller, Jerome Gass, Jeffrey McKee, Paul Zieske, Paola Mussi, Benoit Moreaux

Baxter Healthcare Corporation

Purpose: This study evaluated the potential adverse effects associated with exposure to calcium carbonate precipitate in Accusol 35 Solution (Accusol 35) during CVVH. The clinical use of Accusol 35 has been associated with occasional formation of calcium carbonate precipitate in the tubing set during therapy. Methods: 14 dogs were anesthetized, instrumented, and received CVVH with the test (6) or negative control article (8) for 6 hr. The test article was Accusol 35 with induced precipitate formation prior to CVVH, containing visible particles and sub-visible particles 36X higher than the maximum concentration specified in European Pharmacopoeia (EP). The negative control article was Accusol 35 conforming to EP specification. One-half the dogs in the negative control article group received a central venous injection of Sephadex G-5 beads (1 mg/kg) following CVVH as positive control. Select cardiovascular (CV) parameters (systemic and pulmonary arterial pressures, central venous pressure, heart rate and cardiac output) were monitored continuously, and stroke volume and systemic and pulmonary vascular resistances were calculated at pre-determined times throughout CVVH. Arterial samples were obtained for blood gas analysis. Samples of the test and negative control articles were obtained hourly during CVVH for determination...
of pH and subvisible particles. Dogs were euthanized and lung tissue samples were examined histologically. **Results:** All CV parameters remained stable and no differences were observed between the test and negative control articles. Sephadex beads caused an increase (p<.1) in mean pulmonary arterial pressure due solely to a similar increase (p<.1) in pulmonary vascular resistance. No differences in blood gases were observed between the test and negative control articles. Sephadex beads caused a decrease (p>.5) in PO2 and an increase (p>.5) in PCO2. No differences in lung histology were observed between the test and negative control articles. The lungs from all dogs given Sephadex beads contained multiple intravascular particles in large caliber blood vessels. **Conclusion:** CVVH performed on anesthetized dogs for 6 hr using Accusol 35 containing visible and sub-visible particles 36X higher than the maximum concentration specified in EP, resulted in no adverse effects on CV parameters, blood gases, and lung histology as compared with Accusol 35 containing no visible particles and sub-visible particles that were within EP specification.

17. Carboplasmapheresis and Continuous Renal Replacement Therapy (CRRT) in the Treatment of Amanita Phalloides Poisoning

**Roumen I Penkov, Spasena Hristova, Pavel Angelov**

**Military Medical Academy**

**Introduction:** Amanita phalloides poisoning is the most common cause of lethal mushroom poisoning (lethality > 2% in adults and > 4% in children). Carbohaemoperfusion is a routine treatment in mushroom poisoning for many years already. We have applied carboplasmapheresis (CPP), aiming at extracting the aminitine toxins from patient’s plasma. We have performed continuous vein-venous high flux haemodiafiltration (CVVHDF) for the sake of prevention from hepatic and renal failure. **Methods:** We have carried out an early carboplasmapheresis in four patients with amanita phalloides intoxication, which poisoning has been proven by clinical and toxico-chemical tests. In addition to carboplasmapheresis we have carried out CVVHDF for 12 hours per day. We have performed the procedures via a system for continuous renal replacement therapy (CRRT). We have performed plasma separation via plasma filter Haemoselect M ,3, and subsequently plasma has been conducted via carbofilter ADSORBA 3 C. We have utilized the same system and high flux Diacap Acute filters for the performance of CVVHDF. **Results:** Upon the first course of carboplasmapheresis, there has been observed clinical and laboratory detoxication in two of our patients and no hepatic failure observed. Two more CVVHDF procedures have added to the favorable outcome. There has been observed an early hepatic failure in the other two patients, so we had to apply three more carboplasmapheresis and CRRT therapies. The patients have been released from the hospital at the 7th or 18th day, following clinical remission. Upon control monitoring at first month after release from hospital, those two patients with early hepatic failure have proven to be clinically healthy and the results from their laboratory tests to be within the reference range. **Conclusions:** Carboplasmapheresis treatment in cases of mushroom poisoning is a modern therapy, which several studies report to be successful when applied in clinical practice. This
treatment main advantage, as compared to classic carboperfusion, is sparing the thrombocytes from the damaging influence of active charcoal, and more effective extraction of aminitine toxins from patient’s plasma.

18. Clinical Profile of Patients with AKI requiring CRRT in a Tertiary Care Multispecialty Hospital in Southern India

Care Hospital, Hyderabad, Andhra Pradesh, India

Aim: To study the clinical profile in patients with AKI undergoing CRRT

Inclusion criteria: hemodynamically unstable patients with AKI requiring multiple ionotropic support.

Exclusion criteria: hemodynamically stable patients with AKI

Study: single centre prospective study of 14 patients with AKI requiring CRRT

Sample size: 14

Mean age: 59.63 +/- 29.37 males: 67

Mean age 62.57 +/- 39.43 females: 37

Mean age 53.5 +/- 31.95

Speciality wise admission aetiology of AKI:

Sepsis/crs/leptospirosis/pregnancy

Mean creatinine at admission: 2.49 +/- 1.97

Mean sofa score: 12.8 +/- 3.26

Indications for initiation of CRRT

Mean CRRT days: 2.63 +/- 1.51

Average blood flow: 97.6 ml/min

Average dialysate flow: 998.1 ml/hour

Average replacement fluid flow: 992 ml/hour

Anticoagulation: heparin/citrate/

No heparin mean average circuit life: 2.6 +/- 2.1 days

Outcomes dependent/dialysis free complications of CRRT

Mean creatinine at admission in mg/dl: 2.49 +/- 1.97

Mean creatinine @ discharge in mg/dl: 2.79 +/- 1.99

Mean hospital stay in days: 13.1 +/- 12.9

Mean ICU stay in days: 9.13 +/- 8.88

Mean CRRT duration in days: 2.63 +/- 1.51

19. Efficacy of continuous haemodiafiltration using a polymethylmethacrylate membrane haemofilter (PMMA-CHDF) in the treatment of sepsis and acute respiratory distress syndrome (ARDS)

Masahito Sakai
Shintakeo hospital, Japan

Objective: CHDF using with a polymethylmethacrylate membrane is currently widely applied for non-renal indications in Japan, this technique is used in the treatment not only of patients with sepsis but also of those with cytokine-induced critical illness such as ARDS and pancreatitis. The main underlying mechanism governing cytokine removal through PMMA-CHDF is the adsorption of cytokines to the hemofilter membrane and this characteristic was not observed in the other membrane material.
This study aimed to investigate the clinical efficacy of PMMA-CHDF in the treatment of a patients with sepsis and ARDS. **Methods:** Thirty-five patients diagnosed with sepsis (ARDS[n=1], Pyelonephritis [n=5], Cholangitis [n=5], Tsutugamusi in Scrub typhus disease[n=1], Snake Manushi bitten[n=1], haemophagocytic syndrome[n=1], anti neutrophil cytoplasmic antibody(ANCA )lung disease[n=1], beriberi heart disease[n=1] and unknown causes[n=8]) were enrolled in this study between August 21 and November 21. The common cause for ARDS in elderly patients aspiration pneumonia in elderly patients. Our study group composed 15 men and 2 women, aged 35–85 years (median age 68 years). **Results:** Before initiating treatment with the PMMA-CHDF, the average APACHE II score of these patients was 17.5±3.6, whereas the average SOFA score was 6.5±1.3. The duration of PMMA-CHDF treatment was 5.2±2.3 days. Following initiation of PMMA-CHDF treatment, early improvement of haemodynamics was observed along with an increase in the urine output. The average survival rates of patients were 75.6%. The low survival rate among diseases 35% belonged to the Unknown group. The highest survival rate for patients with ARDS was 95%. Moreover, the urine output significantly increased in survival group. **Conclusion:** The present study suggests that cytokine-oriented critical care using PMMA-CHDF might be effective the treatment of sepsis and ARDS, particularly in the treatment of ARDS associated with aspiration pneumonia in elderly patients.

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**20. Prophylactic Peritoneal Dialysis Improves Clinical Outcomes in Children Following Open-Heart Surgery with Cardiopulmonary Bypass**

*William C Sasser III, David J Askenazi, Ashley Moellinger, Santiago Borasino, Kristal Hock, Robert J Dabal, James K Kirklin, Jeffrey A Alten*

University of Alabama at Birmingham, Birmingham, AL, USA

**Purpose:** To investigate the impact of prophylactic peritoneal dialysis (PD) on clinical outcomes after open-heart surgery in children with complex congenital heart disease. We hypothesize that compared to passive peritoneal drainage and diuretic therapy, prophylactic PD will lead to improved clinical outcomes including shorter duration of mechanical ventilation (primary endpoint). **Methods:** We performed a prospective before-and-after cohort study of 52 consecutive children at high risk for post-cardiopulmonary bypass (CPB) fluid overload. 27 patients that received diuretic therapy and passive peritoneal drainage (PD) before Jan 211 were compared to 25 patients that did not receive diuretics and were initiated on prophylactic PD (+PD) within the first 6 hours of admission (per new CICU protocol starting Jan 211). **Results:** There was no difference in demographics, CPB time, surgical diagnoses, lactate or hemodynamic variables between groups. +PD demonstrated significantly less positive fluid balance after CICU admission at both 24 hours (+PD -24.3 mL/kg (IQR -6.2, 3) vs. -PD 17.5 mL/kg (IQR -24.8, 61.7), p = .3) and 48 hours (+PD -88 mL/kg (IQR -132.1, -54.2 vs. -PD -45.8 mL/kg (IQR -82.3, -12.4), p = .4). 24 hr urine output was similar between groups but higher in -PD at 48 hours [+PD
7.3mL/kg (IQR 44.8,16.9) vs. -PD 172.6mL/kg (145.3,216.2), p=<.1]. 24hr PD output was similar between groups but greater in +PD at 48hrs [ +PD 223.5mL/kg (IQR 194,274.1) vs. -PD 128.3mL/kg (IQR 98.5,146.5), p=<.1]. +PD had less fluid intake at 24hrs [+PD 176.4mL/kg (IQR 142.5,245.6) vs. -PD 231mL/kg (IQR 188.8,29.1), p=.6]. The mean inotrope score over first 24hrs was lower in +PD (13±4 vs. 17±7, p=.5). Chest closure occurred sooner in +PD [24hrs (IQR 2,4) vs. 63hrs (IQR 44,72), p=< .1] and mechanical ventilation tended to be shorter in +PD [71hrs (IQR 49,135) vs. 125hrs (IQR 7,195), p=.1]. Incidence of acute kidney injury, as measured by doubling of baseline serum creatinine, was 44% +PD vs. 26% -PD (p=.25). There was no difference in incidence hyperglycemia or electrolyte abnormalities between groups. There was one episode of suspected peritonitis in +PD. **Conclusions:** Following CPB, prophylactic PD was well tolerated and associated with lower inotrope and fluid requirements during the first 24hrs. It improved fluid balance, safely facilitating improved outcomes such as earlier chest closure and possibly shorter duration of mechanical ventilation.

**21. Efficacy of direct hemoperfusion using polymyxin B-immobilized fiber in children under 1kg**

Mariko Sawada, Shinichi Watabe, Tomohiro Hayashi, Masamichi Kubota, Akihito Takahashi, Yoshinobu Nishida, Mitsuhiro Fujiwara, Kenji Waki, Katsuji Kuwakado, Yoshio Arakaki Kurashiki Central Hospital, Kurashiki, Okayama, JAPAN

**Background:** We evaluated the efficacy of direct hemoperfusion using polymyxin B-immobilized fiber (PMX-DHP) in low-body-weight children.

There are few reports of PMX-DHP for low-body-weight children because PMX-DHP is technically difficult to perform and there are no appropriate tools for these children. We report our experience of PMX-DHP in children under 1 kg with unstable circulatory dynamics and the efficacy of PMX-DHP in these children. **Methods:** Nine children (age, days-3 months; body weight, 1.2 to 6.6 kg) admitted to a single institution and treated with PMX-DHP from June 24 to June 212 were included. Underlying diseases were septic shock in 5 children and bowel perforation in 4 children. We used PMX-2R and PMX-5R and the dialysis machines KM-87 and TR-525, and set the blood flow (QB) at 2 to 4 mL/min. The period of treatment was 1 to 2 doses, 2 to 24 h per section. We evaluated the following parameters before and after treatment: mean arterial pressure (MAP), catecholamine index (CAI), ratio of the arterial partial pressure of oxygen to the fraction of inspired oxygen (P/F ratio), urine volume, pediatric logistic organ dysfunction (PELOD) score, and predicted mortality rate. Outcomes of interest were compared using the χ2 test for categorical data and Student t test for continuous data. Statistical analyses were performed using EXCEL21 and SPSS. **Results:** There were some complications, namely, hypothermia, intracircuit clot formation, and decrease in platelet count. No PMX-related deaths occurred. MAP values elevated from 34 ± 12.2 mmHg to within 2 h. The CAI decreased by >5% in 3 cases. No trend was observed for urine volume and P/F ratio. The PELOD score and predicted mortality rate significantly decreased from 43.2 ± 1.9 to 24.8 ± 6.1 and from 9.4% ± 22.9% to 37.7% ± 22.2%,
respectively. The prognosis at 28 days was as follows: alive, 6 patients and dead, 3 patients. **Conclusion:** PMX was safely performed in low-body-weight children. PMX could elevate their body pressure and improve their prognosis. Early induction of PMX might help in elevating the survival rate of low-body-weight children with poor prognosis.

**22. Fluid Overload and Fluid Removal in Pediatric Patients on Extracorporeal Life Support Requiring Continuous Renal Replacement Therapy**

David T Selewski, Timothy T Cornell, Theresa Mottes, Neal B Blatt, Yong H Han, Mallika Kommareddi, Gail A Annich, David B Kershaw, Thomas P Shanley, Michael Heung

Department of Pediatrics & Communicable Diseases, Division of Nephrology, C.S. Mott Children's Hospital, University of Michigan, Ann Arbor, MI, USA, Department of Pediatrics & Communicable Diseases, Division of Critical Care, C.S. Children's Hospital, University of Michigan, Ann Arbor, MI, USA, Department of Internal Medicine, Division of Nephrology, University of Michigan, Ann Arbor, MI, USA

**Background:** Extracorporeal life support (ECLS) is a life-saving therapy for pediatric patients with severe cardiac and respiratory failure. For patients on ECLS, the development of acute kidney injury (AKI), including fluid overload (FO), is associated with increased mortality. Continuous renal replacement therapy (CRRT) is frequently used to manage AKI in these patients, however, the optimal time to initiate CRRT, and the role of CRRT to remove fluid remains undefined. **Objective:** Determine the impact of FO at CRRT initiation and discontinuation on mortality in pediatric patients concurrently receiving CRRT and ECLS. We also examined the kinetics of CRRT-mediated fluid removal as a potential predictor of outcomes. We hypothesized that the ability to remove fluid and restore fluid balance with CRRT would be associated with improved survival. **Design/Methods:** Retrospective chart review of all ECLS patients requiring CRRT from July 26 to September 21. The degree of FO was determined using ICU admission weight, weight upon CRRT initiation, daily weights while on CRRT and weight at CRRT discontinuation. **Results:** Overall ICU survival was 34% for 53 patients during the study period. Median FO at CRRT initiation was significantly lower in survivors compared to non-survivors (24.5 vs. 38%, p=.6), as was median FO at CRRT discontinuation (7.1 vs. 17.5%, p=.35). After adjusting for % FO at CRRT initiation, age and severity of illness, the change in FO at CRRT discontinuation was not significantly associated with mortality (OR per 1% decrease in FO was .96, 95% CI .89-1.3). Further models incorporating the rate of fluid removal did not find this to be a significant predictor of mortality. Conversely, FO at CRRT initiation remained a significant predictor of mortality in all models. **Conclusions:** In pediatric ECLS patients with AKI requiring CRRT, FO at CRRT initiation significantly correlates with increased mortality, and this relationship appears to be independent of the ability to remove fluid while on CRRT. These results suggest that interventions(such as CRRT initiation) prior to the development of significant FO may lead to better outcomes than attempting fluid
removal after significant FO has already developed. Our findings underscore the need for prospective clinical trials to determine if fluid restriction strategies or earlier initiation of CRRT may lead to improved patient outcomes in pediatric patients on ECLS.

23. Recurrent Encephalopathy in a Patient with End-Stage Renal Disease Following Excess Consumption of Energy Drink: Management with Continuous Renal Replacement Therapy
Seok Joon Shin, Sungjin Chung, Young Ok Kim, Eui Jin Choi
The Catholic University of Korea, Seoul, South Korea
Introduction: Most of energy drinks generally contain mixtures of caffeine, taurine, thiamine, riboflavin, pyridoxine, nicotinamide, and inositol. The potential dangers of these energy drinks remain undetermined especially in patients with renal dysfunction. We describe here a patient with end-stage renal disease (ESRD) undergoing maintenance hemodialysis, who had recurrent decreased mentality following excessive consumption of energy drinks and have been treated with continuous renal replacement therapy (CRRT). Case: A 53-year-old woman was referred to emergency room with sudden onset of seizure-like motion and decreased mentality. For 7 years, she had been on hemodialysis because of ESRD due to hypertension. According to the witness, the patient consumed 6 bottles of a caffeinated energy drink just before losing consciousness. On admission, her general examination was significant for hypertension and sinus bradycardia. There were neither mineral and electrolyte abnormalities in blood tests nor pulmonary edema on chest film. The brain MRI was normal except for small old infarctions in cerebellum. An initial EEG showed a sharp wave in left frontal area, which was a finding suggestive of a partial seizure disorder arising from left frontal area. She was treated with hemodialysis immediately, however, decreased mentality and seizure-like movement continued. CRRT was started, and her mentality became clear after 4 days of CRRT. The follow-up EEG revealed intermittent slow waves in both frontal areas without epileptic form discharges. The patient was discharged with instructions to abstain from the energy drinks. About 19 months later, she was brought to the emergency room again with drowsy mentality after a hemodialysis session at a private clinic. CRRT was applied for 3 days, and she recovered her mentality. Later, the patient stated that she had consumed 4 bottles of the energy drink right before her unconsciousness. Conclusion: We successfully treated an ESRD patient with recurrent encephalopathy following excessive ingestion of caffeinated energy drinks using CRRT. Although the pathogenic mechanism of encephalopathy following excessive consumption of caffeinated energy drinks has not been defined yet, questions regarding the optimal dose of energy drinks and proper CRRT treatment in patients with renal insufficiency should be raised.

24. Effects on Timing of High-volume Hemofiltration In Elderly Patients With Septic Shock
Wang Shouhong, Li Hanbiao, Qin Tiehe, Guo Weixin, Li Jie
GICU of Guangdong Geriatric Institute, Guangdong Academy of Medical Sciences, Guangdong General Hospital

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Background: High-volume hemofiltration (HVHF) may improve the prognosis of patients by non-selective removal of inflammatory mediators and cytokines and reducing the systemic inflammatory response on organ damage. Since the timing of HVHF may impacts on the prognosis of the patients, early intervention of HVHF is very crucial. Objective: To assess the effects of the timing of HVHF on the elderly patients with septic shock.

Methods: 21 cases of elderly patients with septic shock (mean age 78 ± 6.8 years) were observed. According to the timing of HVHF (the rate of UF was 6ml/kg/hr ), those patients were divided into two groups, Group A (n = 8) treated with HVHF during early 6 hours resuscitation and Group B (13 cases) treated with HVHF after early 6 hours resuscitation. The effects to be studied of HVHF were the changes of vital signs, the difference of APACHE-II score, SOFA score, the dosage of vasoactive drugs in h, 24h, 48h, 72h and the survival cases of 28 days. Results: Treated with HVHF after 24h, 48h, 72h, APACHE-II score in group A and group B were (23.5 ± 4.8,18.5 ± 4.,18.1 ± 4.3) and 26.8±4.2, 24.3±3.8, 23.8±5.1) (P <.5) SOFA score (14.5 ± 2.8,13.5 ± 2.,12.1 ± 2.8) and (16.8 ± 2.6,15.3 ± 2.7,14.8 ± 3.1) (P <.5), the amount of vasoactive drugs [dopamine ug/kg/min] (1.5 ± 2.1,7.5 ± 1.8,6.1 ± 2.5) and (13.8 ± 2.,13.3 ± 2.,12.8 ± 3.1) (P <.5) respectively. In 28 days, the survival cases in group A and B were 3 and 4 (p>.5), and the death cases in group A and B were 5 and 9 (P>.5). Conclusions: Early HVHF may significantly lower the scores of APACHE-II and SOFA and reduce the amount of vasoactive drugs, but not improve the short-term (28 days) survival prognosis. This suggested that early HVHF treatment can significantly improve the hemodynamics effects and reduce the amount of positive inotropic drugs to protect organ function in elderly patients with septic shock. In this study, the number of cases was small, so further study and observation of much more elderly patients should be done to find out more impacts on elderly septic shock patients with the timing of HVHF and the implementation process of inflammatory mediators, and to optimize the treatment of HVHF to improve the survival prognosis of the elderly septic shock patients.

25. CRRT experiences in ICU: A single center study in Korea.
Young Ki Son, Won Suk An, Seong Eun Kim, Ki Hyun Kim
Dong-A University, Korea

Background: AKI in the ICU is a serious complication can affect the patient outcome. After development of continuous renal replacement therapy (CRRT), it has been widely used for treating critically ill patients with AKI in ICU. The aim of this study was to evaluate clinical characteristics and prognostic factors in ICU patients with AKI requiring CRRT. Methods: Our cohort included 185 patients who received CRRT admitted to ICU at Dong-A University Hospital from January 28 to November 211. We retrospectively analyzed the demographic, clinical, and laboratory data. Results: The average age of the 185 patients was 59. ± 16.4 years and 96 patients were male (51.9%). The treatment duration of CRRT was 64 ± 47.7 hours. The overall mortality rate was 69.2%. 27 patients (14.5%) were AKI on CKD and 49 patients (26.4%) were diabetes. The mechanical
ventilation rate was 73.2%, vasoactive drug was 63.8%. The average SAPS3 was 78.4 ± 15.9 and the average APACHE II score was 26.5 ± 4.3. The variables influencing mortality on univariate analysis were SAPS3 and BNP, the number of organ dysfunction.

**Conclusion:** Very important prognostic factors were SAPS3 and the elevation of BNP in this study. Large scaled, prospective randomized multi-center trials are needed to confirm the prognostic factor.

**26. Citrate in a Small Intensive Care Unit (ICU) in the Netherlands; The Better Way for Dialysis?**

Els L Van Assche
Elkerliek Ziekenhuis

**Background:** Renal replacement therapy (RRT) is performed in order to prevent and treat complications of acute kidney injury. Small ICU’s are challenged to optimize the procedures. Since regional citrate anticoagulation is proven an effective and safe method for continuous RRT, we replaced the heparin protocol and introduced citrate as the new anticoagulants.

**Methods:** We conducted a retrospective observational study to compare the citrate and heparin protocol. We studied mortality, filter survival time, transfusion of packed cells (PC) frequency and other complications during dialysis. We reviewed the medical records of the 63 patients who had continuous RRT from January 27 until September 211. We used our patient data management system to compare the data from the citrate group to the data from the heparin group. 18 patients were excluded with insufficient data and 22 filters which were interrupted intentionally were also excluded.

**Results:** A total of 45 patients were included in this study, 21 in the heparin group and 24 in the citrate group. In the patients who received heparin, 112 filters were used, with a mean of 5 filters per patient and median filter time of 13 hours. In patients who received citrate, 66 filters were used, with a mean of 4 filters per patient and median filter time of 56 hours. In the heparin group 86 transfusions were needed in 18 patients, 7 patients needed more than 2 PC during dialysis treatment. In the citrate group 26 transfusions were given to 11 patients; 3 patients needed more than 2 transfusions. Only the heparin protocol was interrupted, 8 times, for complications. The mortality in the ICU was worse in the citrate group; 54% compared to 26 % in the heparin group.

**Conclusions:** Although mortality was higher in the citrate group, we found no complications so we consider citrate a safe anticoagulants for RRT. The higher mortality can be explained by the higher Apache scores. The median filter time proves citrate to be superior to heparin.

**27. Ultrafiltration in Continuous Renal Replacement Therapy: Is Prescribed Delivered ?**

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Stony Brook University, Stony Brook, NY

**Background:** Hypervolemia from aggressive fluid resuscitation in critically ill patients with acute kidney injury (AKI) may contribute to adverse outcomes. Continuous renal replacement therapy (CRRT) can effectively achieve fluid management goals in hemodynamically unstable patients with AKI.

**Methods:** We collected data on physician prescription orders compared to actual delivered treatments to assess the delivered CRRT therapy in critically ill patients with AKI. 18 patients (mean age 53 ± 17 years (SD); 12 males, 6
females), admitted to the Intensive Care Unit (ICU) from February to November, 211 with AKI requiring CRRT were monitored up to 5 consecutive days. All patients received CRRT using Prisma M1 set with AN69 hemofilter on citrate anticoagulation with an effluent rate of 25-3 ml/kg/hr. Data, including admission weight (WT), daily WT and daily fluid balance calculations, were obtained from electronic medical records and ICU flowsheets which were compared to physician prescription orders. **Results:** The mean pre-CRRT WT (99. + 25.6 kg) was markedly increased when compared to the mean admitting WT (8.2 + 24.9 kg). Mean net negative fluid balance achieved during the first 48 hours of CRRT was 36 mL, with a decrease in mean WT to 98+ 23.1 kg, however this was not statistically significant. By day 5, a mean reported fluid loss of 3.2 liters was associated with a significant mean weight reduction to 92.9+ 25.3 kg (p = .1). The mean prescribed ultrafiltration (UF) rate was 35.3+ 28.4 mL/hr while delivered UF rate was 52.7+ 48.6 mL/h(p=.2). On day 2, the mean fluid removal set on the Prisma machine was 6.5 L/day while mean net fluid removal was 6. L/day which was significantly lower (p=.3). In conclusion, actual delivered UF during CRRT treatments exceeded physician prescription orders. UF goals still need to be optimized.

**Objective:** Continuous veno-venous hemofiltration(CVVH) can affect the serum concentrations of usually used biomarkers to indicate renal function, like creatinine(Cr), urea(UN) and cystatin C(Cys-C). In this study we investigate to what extent CVVH affects the concentrations of Scr,BUN and Cys-C independent on renal function change. **Methods:** Eleven patients with oliguric acute kidney injury (AKI) requiring CVVH were enrolled. Four of them received CVVH at dose of 2L/hr and 7 received CVVH at dose of 4L/hr. Samples were obtained from the afferent and efferent lines of the extracorporeal circuit and from the ultrafiltrate line at 4 different time points,(4,12 and 24h) for measurement of Cr, UN and Cys C. **Results:** Concentrations of Scr, BUN and Cys-C before CVVH (2 L/hr) were 4.84±2.51, 57.35±31.33mg/dl and 4.34±1.33 mg/L. Levels of Scr, BUN and Cys-C at 4,12 and 24h during CVVH (2 L/hr) gradually decreased from the baseline values. The decreases of Scr, BUN and Cys-C were 49.7%,42.5% and 28.1%(all P>.5). The mean sieving coefficient of Scr,BUN and Cys-C were .89, .78 and .32;the mean clearance of Scr, BUN and Cys-C were 29.7, 26 and 1.7mL/min. Concentrations of Scr,BUN and Cys-C before CVVH (4 L/hr) were 6.9±4.13, 94.3±57.4 mg/dl and 3.7±1.4 mg/L. Levels of Scr, BUN and Cys-C at 4,12 and 24h during CVVH (4L/hr) were gradually decreased from the baseline values. The maximum decreases of Scr,BUN and Cys-C were 57.8%( P=.39),51.% and 26.6%(all P>.5). The mean the sieving coefficient of Scr, BUN and Cys-C were .82, .97and .51;the mean clearance of Scr,BUN and Cys-C were 29.7, 26 and 1.7mL/min. Conclusion: Compared with Scr and
BUN, the alteration of levels of CysC caused by CVVH is slight, which suggests that it can be used to indicate the patient’s renal function change in some extent during CVVH.

AKI, urine AKI biomarkers may improve our ability to detect an injury early in the disease process. **Objectives:** To identify urine biomarkers that predict acute kidney injury (AKI) in term infants with perinatal depression (Apgar score \( \leq 7 \) at 5 minutes) **Study Design:** A nested case-control study was performed to comparing eight candidate urine AKI biomarkers between infants with and without AKI. **Methods:** After prospective data collection, 9 term infants were identified with AKI (rise in SCr of at least .3 mg/dl, or persistent elevation of SCr \( \geq 1.5 \) for 3 days). Similar infants (N=24) who had at least 2 SCr levels, but had no AKI served as controls. Urine collected during the first 3 days of life was analyzed for Neutrophil-Associated Gelatinase Lipocalin (NGAL), Osteopontin (OPN), Cystatin C (Cys C), Albumin, Beta 2 microalbumin, epithelial growth factor (EGF), uromodulin (UMOD), and Kidney Injury Molecule 1 (KIM-1). As gestational age can affect urine biomarker levels (regardless of AKI status), regression analysis was conducted to exclude gestational age as a confounder of both AKI and biomarker concentration. **Results:** Infants with AKI had higher urine Cys C levels compared to those without AKI [1123 (95% CI = 272, 4635) vs. 9 (39, 25) \( p < .4 \); AUC ROC = .82], Infants without AKI had higher UMOD [26.2 (95% CI = 17.4, 39.4) vs. 11. (5.7, 21.4) vs. \( p < .3 \); AUC ROC = .77] and higher EGF levels [17.4 (95% CI = 12.7, 23.8) vs. 6.7 (4., 11.3) \( p = .3 \); AUC ROC = .82] than those with AKI. After controlling for gestational age, urine Cys C, EGF, and UMOD continued to be predictive of AKI.

**RESEARCH IN AKI**

**29. Urine Biomarkers Predict Acute Kidney Injury in Term Neonates with Perinatal Depression**

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**Background:** Acute kidney injury (AKI) is an independent risk factor for mortality in neonatal, pediatric and adult critically ill populations. As serum creatinine (SCr) is not ideal to diagnose
Although not statistically significant, there appears to be differences in NGAL, KIM-1, OPN and albumin at different days between those with AKI and those without AKI. **Conclusions:** Urinary biomarkers can predict AKI term neonates with perinatal depression independent of gestational age.

### 30. Prevention of Acute Kidney Injury in Hospitalized Children with Cystic Fibrosis

**David Askenazi, Adam W Scott, LaCrecia J Britton, Hector Gutierrez, Raymond Lyrene**

**University of Alabama at Birmingham**

**Introduction:** Aminoglycosides (AGs) are commonly used to treat cystic fibrosis (CF) related lung infections. AGs are nephrotoxic and are an important risk factor for acute kidney injury (AKI) in hospitalized CF patients.

In June 29, a new clinical protocol was implemented to reduce the incidence of AKI by standardizing monitoring and AG treatment in all CF patients admitted to Children’s Hospital of Alabama for pulmonary exacerbations. **Hypothesis:** We hypothesized that the incidence of AKI in hospitalized children with CF would decrease after the implementation of this clinical protocol. **Methods:** A retrospective chart review was performed using data from the UAB/Children’s of Alabama’s Cystic Fibrosis Center database and hospital records for all admissions of CF patients with pulmonary exacerbations from July 27 to April 211. These data include demographics, co-morbidities, and serum creatinines (Scr). Hospitalized costs were obtained from the Children’s of Alabama for cost analysis. AKI was defined as a rise in Scr of .3 mg/dl or 5% rise from a baseline value, according to the 211 Kidney Disease Improving Global Outcomes (KDIGO) AKI definition. Data analysis was performed using SPSS® software. IRB approval for the study was obtained. **Results:** The incidence of AKI was lower in the pre-protocol group 96/631 (15.2%) compared to the post-protocol group 113/475 (23.8%) (p<.1). Children in the pre-protocol group had less Scr values performed than those in the post-protocol group (2.1 vs. 5.4; p<.1). Length of stay for the two groups was similar (n.s.). The median hospital cost was higher for AKI vs. no AKI in the pre-protocol ($68,77 vs. $61,55 p<.5) and the post AKI eras ($7,378 vs. $8,816; p<.5). **Conclusions:** Despite protocols to decrease AG toxicity, the incidence of AKI in CF patients admitted for pulmonary exacerbations is alarmingly high. Our protocol, though designed to reduce the rates of AKI in this population, appears to have illuminated the problem and suggest that the incidence of AKI is higher than what is reported in the literature. Through increased screening with Scr, CF patients with AKI can be more readily identified, prevention of severe AKI can be avoided, and complications of AKI can be better managed. Studies are needed to find preventive strategies to reduce AKI, thereby decreasing...
morbidity, and assess the cost-benefit ratio of such screening.

31. Microsample Analysis of Serum and Urine Creatinine Measurements
David J Askenazi, Rajesh Koralkar, John F Moore, Stephanie Clevenger, Jon D Sharer
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Background: Measurement of serum creatinine in newborns can be problematic for several reasons. In infants born with very low birth weight, volume loss from blood draws can account for significant blood loss limiting clinical and research measurements. In addition, bilirubin (known to be high in neonates) and medications can interfere with creatinine measurement by the Jaffe reaction.
Purpose: We evaluated the differences in laboratory sampling between different methodologies (Mass Spectrometry (MS) vs. Jaffe). In addition, we evaluated the ability to reliably replicate results with variations in time from lab draw to sample measurement (immediate (within 2 hours), at 24 hours, and at 3 days). Finally we assessed how measurements may be influenced by the type of storage (Refrigeration -4 degree C vs. Freezer -8 degree C). Methods: We performed a prospective laboratory analysis using whole blood and fresh voided urine from 6 healthy adults who had neither kidney or liver disease, and were not taking medications known to interfere with creatinine determination. Each samples was processed using only 2 mcL of sample. The first method (MS) involved tandem Mass Spectrometry using multiple reaction monitoring and quantitated via stable isotope dilution. The second used Jaffé methodology on a Beckman machine. Results: There was a very high correlation (r= .996) between MS and Jaffé samples and a mean % differences between samples of 5.15 + 23.49 ng/dl. There was good correlations and limited % difference between measurement times and storage type in both MS and Jaffee. (Table 1).

<table>
<thead>
<tr>
<th>Method</th>
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<th>Correlation</th>
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<td></td>
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</tr>
<tr>
<td>Refrigerated</td>
<td>MS</td>
<td>-5.27 + 6.67</td>
</tr>
<tr>
<td>Immediate vs. 24 hr</td>
<td>MS</td>
<td>-7.43 + 9.34</td>
</tr>
<tr>
<td>Freezer</td>
<td>MS</td>
<td>-11.36 + 9.95</td>
</tr>
<tr>
<td>Immediate vs. 3 day</td>
<td>Jaffé</td>
<td>2.89 + 12.68</td>
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<tr>
<td>Refrigerated</td>
<td>Jaffé</td>
<td>-.24 + 2.34</td>
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<tr>
<td>Immediate vs. 3 day</td>
<td>Jaffé</td>
<td>7 + 17.15</td>
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<tr>
<td>Freezer</td>
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Conclusions: Although variations exist between creatinine measurements using Jaffé and Mass Spectrometry there is a high degree of correlation even when performing these tests using microsamples. Samples were relatively unaffected after 24 hours in a refrigerator, freezing for 1 day or freezing for 3 days.

32. The Effect of Poly (ADP-Ribose) Polymerase Inhibition on Aminoglycoside-Induced Acute Kidney Injury in Rats
ABSTRACTS FROM 17TH INTERNATIONAL CONFERENCE ON CRRT, SAN DIEGO, FEB 14-17, 2012

Alexander Biro, Hananya Vaknine, Zipora Matas, Asora Fux, Leticia Schreiber, Mona Boaz, Zvi Burbea, Relu Cernes, Alexander Brilliant, Ze’ev Katzir Nephrology Institute, E Wolfson Medical Center, Israel, Pathology Institute, E Wolfson Medical Center, Israel, Biochemistry Laboratory, E Wolfson Medical Center, Israel, Epidemiology Unit, E Wolfson Medical Center, Israel

**Background:** Aminoglycosides cause nephrotoxicity in 1-2% of patients by generating reactive oxygen species (ROS), leading to DNA destruction and activation of poly(ADP-ribose) Polymerase (PARP). The ensuing decline in nicotinamide adenine dinucleotide (NAD) causes diminished cellular energetic capacity and necrotic tubular cell death. **Methods:** The effect of PARP inhibition on gentamicin-induced nephrotoxicity was studied in 2 female Wistar-Kyoto rats divided into treatment groups: control (no treatment or PARP-inhibitor-treated [3-amino benzamine, 3AB]); gentamicin-treated; and gentamicin+3AB treated. Kidney function, protein and gentamicin levels and urinary trypsin inhibitory activity (TIA) were measured. Tissue microscopic examination and immunohistochemical study for Proliferative Cell Nuclear Antigen (PCNA) were determined. **Results:** The following results were obtained: Urea was 41.±5.8, 88.3±5.3 and 48.5±12.7 mg/dL in control, gentamicin and gentamicin+3AB-treated rats, respectively (p=.2). The number of macronuclei per 1mm2 was significantly higher in gentamicin-treated rats than in gentamicin+3AB treated rats (218±11.8 vs. 41.7±36.2. p=.4). The number of PCNA positive nuclei was marginally significantly higher in the gentamicin-treated rats than in gentamicin+3AB treated rats (3585±2215.3 vs. to 626.7±236.9, p=.7). **Conclusions:** The effect of PARP inhibitor on the bactericidal activity of gentamicin was assessed, no effect was observed. This study illustrates that PARP inhibitor significantly attenuates gentamicin-induced nephrotoxicity in rats with no effect on its bactericidal activity.

33. Plasma NGAL Is An Early Biomarker Of Graft Function, Calcineurin Inhibitor Nephrotoxicity And Tubular Regeneration In Kidney Transplantation From Extended Criteria Donors

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**Background:** Delayed graft function (DGF), defined as the need for dialysis in the first week after kidney transplantation (KT), has been increasing for the use of kidneys from extended criteria donors (ECD). Plasma Neutrophil Gelatinase-Associated Lipocalin-2 (NGAL) has been proposed as early biomarker of DGF. **Aims:** The aims of this study were to evaluate: 1) NGAL in 5 patients in the first 24h after
KT from ECD; 2) the relationship between NGAL and DGF, slow graft function (SGF) and immediate graft function (IGF); 3) the trend of serum creatinine (sCr) and plasma NGAL in the first 5 days after KT; 4) NGAL before and after the introduction of calcineurin inhibitors (CNI); 5) the in vitro role of NGAL in tubular regeneration. Methods: Fifty patients were enrolled in the study (immunosuppression with basiliximab, MMF and steroids: CNI introduced when sCr <2.5 mg%). Patients were divided in 3 groups: DGF, SGF (sCr >3 mg% at day 6 after KT) and IGF (sCr <3 mg% at day 6 after KT). Plasma NGAL levels were measured by a fluorimetric method (Alere, San Diego, CA). Protein and mRNA NGAL levels, proliferation and apoptosis were evaluated in isolated human tubular cells cultured under hypoxia or with tacrolimus/cyclosporine. Results: Patients demographics and characteristics were: male 67%, recipient age 57.65 yr, donor age 65 yr, cold ischemia time 16.8 h, HLA mismatches 3.46, recipient BMI 24.2, donor hypertension 64.4%, donor eGFR 88.66 ml/min. The incidence of DGF was 28%; in the 72% of patients without DGF, SGF occurred in 55%, IGF in 45%. NGAL (24h after KT) were significantly higher in DGF than in SGF and IGF groups (DGF 654.94 ng/ml; SGF 439.75 ng/ml; IGF 357.37 ng/ml). A decline of plasma NGAL but not of sCr was detectable at day 2 after KT with a further decrease at day 3, 4 and 5. By contrast, NGAL increased after 24 hr from CNI introduction (before CNI: 12.12 ng/ml; after CNI: 188.25 ng/ml). Human tubular cells cultured under hypoxia or in presence of tacrolimus/cyclosporine showed enhanced mRNA/protein levels of NGAL. NGAL induced a dose-dependent decrease of tubular cell apoptosis via caspase inactivation and triggering of P-Akt/Akt pathway. Conclusions: NGAL is an early predictor of graft function and CNI nephrotoxicity after KT from ECD. Moreover, our data sustain the role of NGAL as growth factor involved in tubular regeneration.

34. Microvesicles Derived From Endothelial Progenitor Cells Protect Kidney From Cisplatin-Induced Acute Toxic Injury By MicroRNA-Dependent Reprogramming And Inhibition Of Apoptosis Of Tubular Cells

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Background: Several studies suggested a role for bone marrow-derived stem cells in the regenerative mechanisms after acute kidney injury (AKI) by paracrine mechanisms. We previously demonstrated that microvesicles (MVs) released from Endothelial Progenitor Cells (EPCs) activate an angiogenic program in endothelial cells. MVs are small particles of about 6-16 nm of size which play a key role in cell-to-cell communication through the transfer of different RNA subsets including microRNAs, small non coding RNAs able to induce the epigenetic reprogramming of target cells through the transfer of different RNA subsets including microRNAs, small non coding RNAs able to induce the epigenetic reprogramming of target cells through microRNA-dependent mechanisms. Aims: The aim of the present study was to evaluate whether MVs derived from EPCs prevent mortality and renal damage in an experimental toxic model of cisplatin-induced AKI. Methods:
We isolated MVs from EPC supernatants by ultracentrifugation and we characterized their RNA content showing the enrichment in microRNAs that modulate proliferation and apoptosis. Results: After i.v. injection in cisplatin-treated mice, MVs localized in peritubular capillaries and tubular epithelial cells, significantly decreased mortality 7 days after administration and conferred functional and morphologic protection from AKI by enhancing tubular proliferation and reducing apoptosis. In surviving animals, a preserved renal function and histology was observed also 28 days after injection. Evidence for a role of MV-mediated transfer of RNAs in the renoprotective effect of MVs was derived from the loss of MV activity after 1) their treatment with RNase, 2) unspecific microRNA-depletion of MVs by EPC transfection with siRNA for Dicer, the intracellular enzyme essential for microRNA synthesis and 3) MV depletion of the anti-apoptotic microRNA miR-27a by EPC transfection with a specific antagomiR. In vitro, we confirmed the role of miR-27a in the anti-apoptotic effect of MVs in cisplatin-treated human tubular epithelial cells. Indeed, MVs derived from EPCs significantly reduced apoptosis through the down-regulation of the death receptor Fas (CD95), of the mitochondrial molecules Bcl-XL/Bcl-2 and of caspase-3, -8 and -9 activation. These effects were not observed after miR-27a depletion. Conclusions: MVs derived from EPCs protected from cisplatin-induced AKI by delivering their RNA content. The miRNA cargo of MVs in particular miR-27a contributed to reprogramming cisplatin-injured tubular epithelial cells toward a regenerative program, inhibiting the death receptor/mitochondrial apoptotic pathways.

35. Classification Of AKI Using P-Rifle Score In A Picu In Fundación Valle Del Lili, Cali, Colombia
Gastón Castillo, Angie Cañas, María del Pilar Duque, Fernando Bermúdez, Eliana Manzi, Teresa Agudelo, Jaime Restrepo, Magda Cepeda
Fundación Valle del Lili
Introduction and Aim: Acute Kidney Injury (AKI)\'s incidence in PICU patient worsen mortality. We used the p-RIFLE score to estimate the incidence of AKI in children of PICU in an institute in of fourth level in Cali. Methods: Prospective study of patients hospitalized in PICU between september/29 and august/211, with AKI, in whom the p-RIFLE score was applied. Results: Among 1891 patients registered in PICU, 3.86% presented AKI. Half were under 24 month age (p25-p75: 6-18), and 58% were male. At 24 and 72 hours of admission, 43% and 66% of patients presented Failure, respectively. The principal admission diagnosis were cardiovascular (34%) and infectious (18%). 32 (44%) dead. Mortality by p-RIFLE in 24hrs is similar across strata, while at 72hrs Failure was higher. The relation in mortality was invested for patients classified as Failure among 24 and 72 hrs, vs. observed in Risk and Injury (Graphic). The association of mortality with p-RIFLE at 72hrs was significant (p=.), while at 24hrs did not (p=.712). 4% of patients were classified as very high of mortality by PRISM, but was not associated with mortality (p=.455). 39 (53%) of patients required RRT, but was not associated neither mortality (p=.368) nor worsening of RIFLe (p=.99). Conclusions: The use of
P-RIFLE at 72hrs allow to predict mortality at PICU.

36. Creatinine Production and Creatinine Degradation are Reduce in Patients with Acute Kidney Injury and Sepsis
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University of California San Diego, University of Montreal, Stanford University, University of Washington, Vanderbilt University, Cleveland Clinic

Background: Diagnosis and staging of acute kidney injury (AKI) uses serum creatinine (sCr). In a previous animal model of AKI, Doi et al have shown that sepsis dramatically decreases sCr levels and creatinine production. This phenomenon would limit early detection of acute kidney injury. We evaluated the effect of sepsis on sCr levels, creatinine production (Pc’), and creatinine degradation (Dc’) in patients with AKI. We hypothesized that sepsis will reduce creatinine production and sCr levels in AKI patients with sepsis.

Methods: We analyzed data from 234 critically ill non-dialyzed patients with AKI from 5 centers included in the PICARD study. Creatinine production was calculated using Cockcroft-Gault formula and using Moran et al formula which adjusts sCr for fluid balance. Creatinine degradation was computed using Mitch et al equation and adjusted for fluid balance. Results: Of the 234 patients 139 were septic (59%). Non-adjusted and adjusted sCr levels were lower in AKI patients with sepsis than in non-septic patients (non-adjusted sCr median 2. IQR [1.5 – 2.8] vs. 2.5 IQR [1.8 – 3.5] and adjusted sCr 2. IQR [1.4 – 2.7] vs 2.4 IQR [1.8 – 3.6]; p < .1). Pc’ was lower in septic patients than in non-septic (1,211 IQR [934 – 1,472] vs. 1,278 IQR [1.17 – 1,538] mg/day; p < .1); the same was observed after adjusting Pc’ for fluid balance (1.92 IQR [828 – 1,295] vs. 1,124 IQR [892 – 1,344]; p < .1). Dc’ was also significantly lower in septic than in non-septic patients [Figure 1]. Conclusions: Sepsis reduces creatinine production and reduces sCr levels in critically-ill patients with AKI. These observations could limit the early diagnosis of AKI. Sepsis also affects creatinine degradation.

37. AKI Superimposed On CKD After Cardiac Surgery Needs Different Cutoff Value Of Plasma NGAL
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University of Tokyo, Tokyo, Japan,
Itabashi Chuo Medical Center, Tokyo, Japan

**Background:** Plasma neutrophil gelatinase-associated lipocalin (NGAL) is reportedly useful for pediatric and adult post-cardiac surgery acute kidney injury (AKI). However, although chronic kidney disease (CKD) is a strong risk factor for AKI development, previous clinical evaluations did not specifically examined AKI occurring in patients with CKD. Moreover, CKD significantly increases plasma NGAL levels in a stable condition.

**Methods:** This study prospectively evaluated 143 adult patients who had cardiac surgery at two general hospitals. Plasma NGAL was measured before surgery, at ICU arrival after the surgery (hr), and 2, 4, 12, 24, 36, 6 hr after ICU arrival.

**Results:**
Based on patients’ estimated glomerular filtration rate (GFR) before surgery, 67 (46.9%) were diagnosed as having CKD. Of 143 patients, 54 (37.8%) developed AKI after surgery. Multiple logistic regression analysis revealed that preoperative estimated GFR and operation time were significantly associated with AKI occurrence after surgery. Plasma NGAL measured before surgery and at 2, 4, 12, 24, and 36 hr after ICU arrival in AKI was significantly higher than in non-AKI regardless of CKD complication. However, plasma NGAL alone was not sufficient to discriminate de novo AKI or AKI superimposed on CKD (Figure). Receiver operating characteristics analysis revealed different cutoff values of AKI for CKD and non-CKD patients.

**Conclusions:** Plasma NGAL in post-cardiac surgery will predict AKI not only in non-CKD patients but also in CKD patients when cutoff values are determined properly.

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38. The ICNARC model is predictive of hospital mortality in critically ill patients supported by acute dialysis
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Department of Internal Medicine, Taoyuan General Hospital, Department of Health, Executive Yuan, Taoyuan, Taiwan,
Department of Traumatology and Surgery, National Taiwan University Hospital, Taipei, Taiwan,
Division of Nephrology, Department of Internal Medicine, Da Chien General Hospital, Miaoli, Taiwan

**Aims:** To compare prediction power between ICNARC model and RIFLE classification in postoperative patients receiving acute dialysis.

**Methods:** Between January 22 and December 28, 529 patients received acute dialysis during their ICU stay were enrolled. Patients’ demographic, clinical and laboratory variables were analyzed as predictors of mortality. The RIFLE
logistic regression and the ICNARC model on ICU admission were evaluated to predict the patient’s hospital mortality. **Results:** Hospital mortality for the study group was 29.3%. Between two score systems, the ICNARC model showed better mortality prediction in this patient group by using the area under the receiver operating characteristic curve (ICNARC .836, RIFLE .72, p<.5). Multiple logistic regression analysis indicated that age, surgery category, metastatic carcinoma, ventilator use, and previous history of hypertension were also affecting factors for hospital mortality. **Conclusions:** The RIFLE classification and the ICNARC model were both correlated with mortality in critically ill patient with acute dialysis. However, the ICNARC model was a better mortality predictor comparing with the RIFLE.

**39. TITLE:**
Fen Jiang, Xinling Liang, Yuanhan Chen, Lixia Xu, Penghua Hu, Wei Shi, Zhilian Li, Ruizhao Li
Guangdong General Hospital,
Guangdong Academy of Medical Sciences

**Objective:** Acute kidney injury (AKI) is a common symptom in critically ill patients, and has a close association with the outcomes of patients. While there is still no uniform criteria for AKI. This study is to identify the value of the new proposed KDIGO criteria in diagnosing and predicting prognosis in the critically ill patients. **Methods:** Patients admitted to the Department of Intensive Medicine of Guangdong General Hospital between October 29 and July 21 were retrospectively evaluated. AKI was defined and classified by the RIFLE criteria, AKIN criteria and KDIGO criteria. Meanwhile, the diagnosis sensitivity and the value for prediction of prognosis were compared among the three criteria. **Results:** In total, 524 patients were evaluated, and 95 patients had AKI identified by RIFLE criteria, 135 patients developed AKI according to AKIN criteria, while the number increased to 14 with KDIGO criteria. KDIGO criteria was superior to RIFLE criteria in diagnosing (18.1% vs 26.7%, p < .5); but KDIGO didn't overweight to AKIN criteria (p > .5). Meanwhile there was also significant difference between RIFLE and AKIN criteria (18.1% vs 25.8%, p < .5); We made a further study for the prognosis of AKI, and the results showed that AKI is an independent risk factor of the hospital mortality identified by any stage of the RIFLE criteria or AKIN criteria p<.1). The area under the receiver operator characteristic curve (ROC) for hospital mortality was .7293, (p<.1) for RIFLE criteria .782, (p<.1) for AKIN criteria and .7777 (p<.1) for KDIGO criteria in all patients. And KDIGO criteria hadn’t advantages in predicting hospital mortality (p > .5). Meanwhile we got the similar results of the one year mortality, the predicted value of mortality is close, the area under the ROC were .648, .644, .611 respectively. **Conclusions:** KDIGO criteria are not superior to RIFLE and AKIN criteria no matter in diagnosing and projecting prognosis of AKI in critically ill patients. AKIN criteria based on the RIFLE criteria, although it could improve the sensitivity of the acute kidney injury diagnosis, it doesn’t seem to bring substantial advantage in improving on the ability of the RIFLE criteria in predicting prognosis of critically ill patients classification.
40. The SAFE-T Consortium: A Collaborative Approach for the Qualification of Novel Kidney Biomarkers with the Regulatory Authorities

Joe F Keenan, Patrick Murray, Frank Dieterle, Ralf Schindler, Stefan Sultana, Scott Adler
SAFE-T Consortium, European Collaboration

Background: Drug-induced kidney injury (DIKI) is not an uncommon adverse event in drug development. The greatest issue is the late identification of Acute Kidney Injury due to the current standards (i.e. serum creatinine (sCr) and blood urea nitrogen (BUN)) which are delayed indicators of injury and may not be significantly changed until 2/3 of the kidneys function has already been lost. Over the last three years there has been progress with preclinical qualification processes for kidney biomarkers (PSTC and ILSI HESI qualification with EMA and FDA). These landmark qualifications mean that drug companies may now use certain novel preclinical markers for real decision making within their qualification context.

Methods: The principal objective of this new project is to collect and generate sufficient clinical data from a number or candidate kidney biomarkers, that will provide convincing evidence for the health authorities to endorse these biomarkers for the detection and monitoring of drug induced kidney injuries in specific clinical situations. 22 kidney biomarker have been selected and are being analytically validated by a number of technologies (bead-based, electrochemiluminescence, LC/MS, and standard microtitre ELISA) by the participants of the consortium. A number of patient clinical studies have been started in key areas (Cisplatin toxicity, Contrast induced nephropathy and acute GN) and these samples will provide the basis for the exploratory phase of the project.

Results: SAFE-T have gained regulatory feedback on this project and are actively recruiting patients and collecting samples. More than half of the 22 kidney markers have been analytically validated through a series of internal bar meetings. Studies have been designed and initiated to collect samples for analysis of kidney injury biomarkers in clinical settings of acute kidney injury (cisplatin exposure, radiocontrast exposure and acute glomerulonephritis).

Conclusions: A SAFE-T DIKI status update including regulatory strategy, assay validation and study designs will be provided. Understanding the profiles of renal injury biomarkers in the context of various clinical scenarios of kidney injury will contribute to the development of acute kidney injury biomarkers.

41. SAPS3 Score as Mortality Rate Predictors in Patients Treated with Continuous Renal Replacement Therapy

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Soonchunhyang University Hospital

Purpose: Acute kidney injury (AKI) is a frequent condition that requires continuous renal replacement therapy (CRRT), which has a high mortality rate in intensive care unit (ICU) patients. We evaluated the Simplified Acute Physiology Score 3 (SAPS 3) and Acute Physiology and Chronic Health Evaluation II (APACHE II) score, determined at the start of CRRT, for predicting mortality in AKI patients treated with CRRT.

Methods: We retrospectively analyzed the demographic, clinical, and laboratory
data of 89 ICU patients with AKI or acute-on-chronic kidney disease who received CRRT. We calculated the SAPS 3 and APACHE II score at the start of CRRT. **Results:** The average age of the 89 patients was 64.4±13.9 years. Fifty-nine (66.3%) patients were male. Eighteen (2.2%) patients had chronic kidney disease and thirty (33.7%) patients had diabetes. Sixty-two (69.8%) patients treated with mechanical ventilation. The average systolic blood pressure was 85.9±27.4 mmHg, and sixty-four (71.9%) patients treated with vasopressor. The overall mortality was 75.3%. The average SAPS 3 was 89.4±14.9 and the average APACHE II score was 28.4±5.2. The SAPS 3 was higher in non-survivors than survivors (p=.38). Sepsis was more common in non-survivors than survivors (p=.36). There were no significant differences between the two groups for other conditions. The variables influencing mortality on univariate analysis were SAPS 3 and presence of sepsis. The area under the receiver-operating characteristic curve for SAPS 3 was .69 (95% CI .54–.83). At a SAPS 3 of 84, the sensitivity for predicting mortality was 71.6% and the specificity was 69.2%. Patient survival estimated by Kaplan-Meier method, patients with low SAPS3 score (<84) superior than patients with high SAPS3 score (>84) significantly (p=.3). **Conclusion:** The SAPS 3 determined before starting CRRT could be a predictor of hospital mortality in ICU patients with AKI.

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**42. Initiation of Acute Renal Replacement Therapy in ICU patients based on AKIN criteria in the absence of conventional indications fails to improve survival**

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**Introduction:** Acute kidney injury (AKI) in intensive care unit (ICU) patients is associated with high mortality. Yet optimal timing of acute renal replacement therapy (ARRT) initiation is uncertain. We report preliminary results of outcomes of critically ill patients with AKI initiated on ARRT based on conventional “absolute” indications (Group 2) versus modified AKIN criteria (Group 1). **Method:** This was a single-center; prospective, observational study of patients with AKI from Medical (MICU) and Surgical ICU (SICU) referred.
consecutively over 8 months to the Renal Service. Conventional “absolute” indications for dialysis were: serum K ≥6 µmol/L, serum urea ≥3 mmol/L, arterial pH ≤7.15, serum HCO₃ ≤1 mmol, acute pulmonary edema, acute uremic encephalopathy and/or pericarditis (Group 2). In their absence, ARRT was initiated at (i) AKIN Stage 3 and (ii) AKIN Stage 1 or 2 with additional hypercatabolic indications (Group 1). Results: Thirty-four critically ill patients were studied (mean age 61±3 years, M:F=22:12, MICU: SICU 21:13, mean APACHE II score 25±1, mean SOFA score 12±1) with mean premorbid serum creatinine 16±11 µmol/L. Main AKI causes were sepsis (n=35) and ischemia (n=14). Baseline demographic and clinical characteristics were comparable in Group 1 (n=14) vs. Group 2 (n= 2), including peak serum creatinine (µmol/L) (at referral) 296±41 vs. 394±51, p=.26. Overall ICU mortality was 47%. Comparing Group 1 vs. 2, mean CRRT effluent flow (ml/kg/h) 33.3±3.6 vs. 31.9±2.1, p=.95; ICU mortality 43% vs. 5%, p = .68; in-hospital mortality 57% vs 65%, p=.64; and, renal recovery at 28 days 43% vs. 25%, p = .32. Conclusion: Use of modified AKIN criteria to effect earlier ARRT initiation did not improve clinical outcomes in ICU patients with high APACHE II scores. Further large scale studies are needed to clarify the role of earlier ARRT initiation.

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Background: Extracorporeal membrane oxygenation (ECMO) is a life-saving therapy for pediatric and adult patients with severe cardiac and/ or respiratory failure. ECMO patients are at increased risk of acute kidney injury (AKI) and development of fluid overload (FO), which are associated with increased mortality. Many of these patients receive renal support therapy (RST). However, the RST-ECMO literature consists only of single center experiences with often insufficient patient enrollment. A need exists for a multi-center group to evaluate AKI and RST on ECMO in a comprehensive, prospective manner.

Objective: To form a multi-center study group to allow for the efficient study of AKI, FO, and RST in pediatric ECMO patients. Methods: A multi-disciplinary team of pediatric critical care, cardiology, nephrology, and ECMO experts was assembled from multiple large children’s hospitals.

43. Formation of the Kidney Intervention During Extracorporeal Membrane Oxygenation (KIDMO) pediatric study group
Results: The Kidney Intervention During Extracorporeal Membrane Oxygenation (KIDMO) study group has been formed with 6 participating institutions (Cincinnati Children's Hospital, Vanderbilt University, McGill University Health Centre, University of Alabama, University of Michigan, and Children’s Healthcare of Atlanta). The KIDMO centers perform a combined 2-25 cases of ECMO per year, which will allow for adequate recruitment for future studies. Initial work includes a survey of participating ECMO centers to describe the use of CRRT in ECMO patients. Additionally, the KIDMO group has altered the data collection forms for the Extracorporeal Life Support Organization Registry, which captures data from the worldwide ECMO population. These alterations will enhance data collection regarding acute kidney injury and renal support therapies during ECMO. Conclusions: We describe the formation of the KIDMO study group that leverages an international, multi-disciplinary, multi-center organization to provide the patients and expertise necessary to study AKI, FO, and CRRT in pediatric ECMO patients. Initially, we aim to retrospectively describe these entities to provide the framework for development of prospective studies to investigate novel markers of AKI, fluid management strategies, and interventions to ameliorate the effects of AKI, and optimize RST for ECMO patients.

44. Acute Kidney Injury in Asphyxiated Newborns Treated with Therapeutic Hypothermia

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Background: Therapeutic hypothermia has become the standard of care for asphyxiated newborns. Previous reports have described the incidence of Acute Kidney Injury (AKI) in asphyxiated newborns to be as high as 6% prior to regular use of therapeutic hypothermia. To date there has not been an evaluation of AKI during therapeutic hypothermia in these patients utilizing the Acute Kidney Injury Network (AKIN) criteria and the association of AKI with outcome. We hypothesized AKI in asphyxiated newborns would be associated with increased mortality, prolonged intensive care unit stay, and prolonged requirement for mechanical ventilation despite hypothermia treatment.

Design/Methods: 96 consecutively cooled infants were retrospectively reviewed. All infants had renal function assessed before the start of cooling (baseline); at 24, 48, and 72h through cooling; and then on day 5, 7, and 1 of life as clinically indicated. The AKIN criteria were used to classify AKI.
Patient factors potentially associated with AKI were investigated including: Apgar scores, cord pH and base deficit, delivery room complications, severity of illness (need for pressors, transfusions), and exposure to nephrotoxic medications. **Results:** AKI was found in 36 (38%) of 96 infants with 16, 7, and 13 fulfilling criteria for stage I, II, and III, respectively. Overall mortality was 7% for the cohort and was higher for those who suffered AKI compared to those who did not, but did not reach statistical significance (14% vs. 3%, p=.99). Patients with AKI stayed longer in the Neonatal Intensive Care unit (15.4±9.3 vs. 11±5.9 days, p=.14), and required prolonged mechanical ventilation (9.7±5.9 vs. 4.8±3.7 days, p<.1) compared to those without AKI. On multivariate analysis AKI was associated with use of pressors, seizures within 6 hours of life, and elevated vancomycin levels. **Conclusions:** This is the first report using the AKIN definition for AKI in asphyxiated newborns undergoing therapeutic hypothermia. There is a high incidence of AKI in these patients, but this remains lower than reported publications prior to the institution of therapeutic hypothermia as the standard of care. AKI is associated with increased length of intensive care unit stay and prolonged mechanical ventilation. We highlight the importance of recognizing AKI in asphyxiated newborns undergoing therapeutic hypothermia and the potential renoprotective effects of this intervention.

**45. Serial Measurement of Urinary NGAL for Predicting AKI Worsening/Recovery in ICU**

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**Background:** Urinary NGAL can detect AKI before serum creatinine elevation especially in post-cardiac surgery AKI, where the time of renal insult is clear. However, critically ill patients treated in ICU frequently suffer from multiple insults. Serial measurement of urinary NGAL may enable us to predict whether AKI will be developed or recovered in these patients. **Methods:** We prospectively studied 274 adult critically ill patients in mixed ICU of the University of Tokyo Hospital. Patients of end-stage renal disease and post-scheduled cardiac surgery were excluded. Urinary NGAL was measured at ICU admission (day 1) and 24 hr after (day 2). Diagnosis and severity of AKI was determined by the RIFLE criteria with one exception; the patients who needed RRT were categorized as Failure. **Results:** 126 (46%) patients were diagnosed as AKI at ICU admission and additional 33 patients reached the AKI criteria during one week observation period. Of 159 AKI patients, 44 (28%) patients showed worsening kidney function determined by increased severity of the RIFLE class. Urinary NGAL showed a good performance for detecting AKI [AUC-ROC .83, cut off value 54.7ng/ml (sensitivity 7%, specificity 84%)]. Based on the magnitude of urinary NGAL change for 24 hr (i.e. absolute delta), patients were divided into three groups as follows; the increasing group (the highest quartile, Δ>46 ng/ml), the decreasing group (the
lowest quartile, Δ< -22ng/ml), and the stable/persistent group (Δ was within IQR). In the stable/persistent group, urinary NGAL of day 1, day 2, their average, maximum and minimum values were all significantly associated with worsening kidney function (AUC-ROC > .9). On the other hand, only urinary NGAL at day 1, minimum values showed significant associations in the increasing group (AUC-ROC .75). In the decreasing group, urinary NGAL failed to show any significant association with worsening of AKI. However, relative reduction rate was able to predict recovery from AKI (AUC-ROC=.72).

**Conclusion:** In the present study, absolute values of urinary NGAL can predict worsening AKI when increased or stable within 24 hr after ICU admission. Relative reduction rate can be used to predict recovery from AKI when urinary NGAL decreased after ICU admission. These data indicate serial measurement of urinary NGAL is useful for predicting AKI worsening and recovery.

46. Transfusion Related Acute Kidney Injury: Result of a Prospective Cohort Study

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**Background:** Acute kidney injury (AKI) occurs in up to two third of intensive care unit (ICU) patients. It has been shown that blood product transfusion increases risk of acute lung injury (TRALI). Considering strong association between ALI and AKI, we evaluated the association between transfusion and AKI in ICU patients. **Methods:** We performed a retrospective analysis of a prospectively collected cohort of consecutive adults (>18 years of age) who were admitted to the ICU and received blood product transfusion from March 24 to December 25. We excluded those who developed AKI prior to receiving transfusion or who were on chronic hemodialysis at time of admission. **Results:** A total of 127 patients met the inclusion criteria. The median age was 64 (IQR, 53-77), 65 were male (51%). A total of 49 (38%) patients developed AKI based on the AKIN criteria. In univariate analysis, there was no statistical significant difference in development of AKI based on the type of blood product that the patients received (cryoprecipitate, packed red blood cells, platelets or fresh frozen plasma). After adjustment for age, gender, baseline creatinine and presence of shock upon ICU admission, the transfusion of blood products was not independently associated with development of AKI (Odds ratio 1.6, 95% CI .95-1.18, p=.25). **Conclusion:** In a cohort of heterogenous group of ICU patient who received blood product transfusion, there was no increased risk of AKI.
EPIDEMIOLOGY AND PATIENT CHARACTERISTICS

47. Tubulointerstitial Nephritis and Uveitis Syndrome, with genetic fingerprint of SLE

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Nephrology Institute, E Wolfson Medical Center, Holon, Israel, Molecular Genetic Laboratory, E Wolfson Medical Center, Holon, Israel, Pathology Institute, E Wolfson Medical Center, Holon, Israel, Ophthalmology Department, E Wolfson Medical Center, Holon, Israel, Rheumatology Unit, E Wolfson Medical Center, Holon, Israel

We report a case of acute kidney injury due to tubulointerstitial nephritis and uveitis (TINU syndrome) in a 38-year-old woman who was also found to have elevated titers of anti double stranded DNA antibody. Renal biopsy exhibited a mononuclear infiltrate without the characteristic morphologic features of lupus nephritis. Twelve genetic variants (single nucleotide polymorphisms) associated with SLE in eight different genes were analyzed; ten of them harbored at least one minor allele. Steroid therapy improved both uveitis and nephritis. The diagnosis of TINU is discussed, as well as its possible association with SLE.


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University of Florida

**Background:** Acute kidney injury (AKI) is a common clinical condition in postoperative patients associated with a significantly increased risk of morbidity and mortality. Although certain drugs have been associated with the onset of AKI, it is not known to what extent drug intake after AKI may impact renal outcome. We studied the association between the use of common postoperative medications and the prevalence of AKI as well as the recovery of renal function after the AKI episodes in postoperative patients.

**Methods:** We conducted a retrospective, single center study of 54,768 adult surgical patients admitted to a tertiary academic center from 2-21 for ≥2 days. AKI was defined using consensus RIFLE classification. Renal outcome was classified as complete, partial and no renal recovery according to consensus. **Results:** AKI occurred in 21,361 (39%) patients, with RIFLE classes R, I and F, accounting for 21.3%, 1.3% and 7.4% respectively. Multivariate logistic regression showed that beta-blockers (OR 1.38, 95% CI 1.33-1.44), vasopressors (OR 2.5,95% CI 1.93-2.12), inotropes (OR 2.35,95% CI 2.8-2.67), diuretics (OR 1.72,95% CI 2.8-2.67), diuretics (OR 1.72,95% CI 1.65-1.8), nesiritide (OR 2.43,95% CI 2.43-3.19), aminoglycosides (OR 1.28,95% CI 1.2-1.36), vancomycin (OR 1.6, 95% CI 1.53-1.67), amphotericin B (OR 4.46, 95%CI 3.31-6.1), trimetoprim-sulfametoxazol (TMP-SMX) (OR 1.31, 95%CI 1.19-1.44) and
Antivirals (OR 1.24, 95% CI 1.11-1.39) were significantly associated with higher risk for AKI, while ACE-inhibitors (OR .88, 95% CI .84-.92), aspirin (OR .74, 95% CI .7-.77), non-steroidal anti-inflammatory drugs (NSAIDs) (OR .91, 95% CI .81-.96) and statins (OR .79, 95% CI .75-.84) were associated with lower risk. In addition, use of amphotericin B (OR 1.71, 95% CI 1.31-2.24), diuretics (OR 1.53, 95% CI 1.35-1.74), vasopressors (OR 1.75, 95% CI 1.54-1.98) and beta-blockers (OR 1.18, 95% CI 1.4-1.35) was associated with increased risk for partial or no renal recovery in patients who developed postoperative AKI.

**Conclusion**: Our findings demonstrate that several commonly used postoperative medications may be associated not only with increased risk for AKI but also decrease the likelihood of renal recovery after AKI episode.

49. **Retrospective Analysis Of Acute Kidney Injury In Non Renal Solid Organ Transplant Recipients: Incidence, Outcome And Impact On Residual Renal Function**

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*University of Turin, San Giovanni Battista Molinette Hospital, P.G.M.D. Consulting Inc., Milan, Italy, Nephrology and Dialysis Unit, S.S. Croce e Carle Hospital, Cuneo, Italy*

Acute kidney injury (AKI) is a frequent complication in critically ill patients that is often associated with high mortality rates. Despite the increased incidence of chronic kidney disease (CKD) in non renal solid organ transplant (NRSOT) recipients due to drug nephrotoxicity, only a few studies analyzed the clinical impact of AKI in this selected population.

The aim of the present study was a 10-year retrospective analysis of AKI incidence in NRSOT recipients to identify its impact on outcome and progression toward CKD.

We retrospectively analyzed (2001-2010) the %age of NRSOT in the whole AKI population treated by dialysis. For each NRSOT recipient, we evaluated RIFLE and SOFA scores and the severity index ATN_ISS at the start of dialysis. The %age of AKI requiring dialysis in the whole NRSOT population and for single transplanted organ (liver, heart or lung graft) was also studied.

Renal function was evaluated at the end of observation (30 days). Hemer-Lemeshow statistical test was performed.

In the period 2001-2010, we treated by dialysis (sustained slow hemofiltration of 10-12 hr, pre-dilution fluid 30-50%, blood flow 200 ml/min, polysulphone membranes 1.4-1.8mq) 1833 critically ill patients with AKI for a total of 9061 sessions. Among this population, 233/1833 (12.7%) were NRSOT recipients. We treated by dialysis 151/1335 (11.3 %) patients with a liver graft, 60/229 (26.2 %) with a heart graft and 22/88 (25%) with a lung graft.

NRSOT patients’ characteristics were: mean age 58.4 yrs (SD 8.2), male 66.6%, mean serum creatinine 3.46 mg% (SD 1.34), mean number of organ failures 3.3 (SD 1.87) and mean ATN_ISS score 0.63 (SD 0.13). The prevalent cause of AKI in NRSOT patients was sepsis (43.6%), associated with high mortality and with a difficult management of the immunosuppressive therapy. The global mortality in NRSOT patients was 45.49% (106/233), 43.5% (66/151) for
liver, 51.6% (31/60) for heart and 40.9% (9/22) for lung graft recipients, respectively. Mean serum creatinine at the end of the study period (30 days) was 2.34 mg% (1.97 mg% in liver, 2.26 mg% in heart and 2.89 mg% in lung graft recipients, respectively). Our 10-year retrospective analysis revealed an increased incidence of AKI in the NRSOT population. The main cause of AKI was sepsis which was associated with an increase of mortality and with an impairment of renal function that may be responsible for the progression toward CKD.

50. Case Report of Renal Replacement Therapy in a 1-year old patient with AKI

Gastón Castillo, Magda Cepeda, Jaime Restrepo Fundación Valle del Lili
Renal replacement therapy in children is a rare event, but with important implications for morbidity and mortality in this age group. Although the incidence of children with kidney failure is relatively low and patients requiring renal replacement therapy are usually few in these, has been recognized the significant positive impact on early recognition of children who require and implement of adequate therapy. According to the annual report of the UK Renal Registry, during 2009 there were 751 children with established renal injury receiving renal replacement therapy. We report a case of a patient who required renal replacement therapy secondary to a procedure-related multi-organ failure. The patient was referred from a peripheral center of care with a diagnosis of septic shock of abdominal origin, multiorgan failure, acute renal injury, post-laparotomy for correction of intestinal mal-rotation, intestinal obstruction and release of congenital constricting bands and syndrome post-resuscitation. The patient was hospitalized in the Pediatric Intensive Care Unit (PICU). The principal clinical of the patient consisted in 6 days of intestinal obstruction, secondary to constricting bands and intestinal mal-rotation. In the course of corrective surgery, the patient presented cardio-respiratory failure accompanied by renal failure, and was referred to institution. To acute renal injury management we used renal replacement therapy with continuous veno-venous hemofiltration (CVVHF) for five days, then started continuous infusion of furosemide in which there was no improvement, which required restarting CVVHF for 18 days and hemodiafiltration with pump flow to 100ml/min with fluid loss of 150 ml/h. Renal function recovery was obtained after 30-days of management. As a related complication, blow up of catheter and filter plugging occurred. After a 30-days hospitalization, the patient was discharged with additional diagnosis of postoperative of severe pneumonia and acute respiratory distress syndrome, septic shock refractory to inotropic fungemia resolved, myocardial dysfunction, renal dysfunction and acute renal injury.

Acute renal injury is a condition that quickly complicated pediatric patient, sepsis remains the leading cause of the complication reported in multiple series. Previous reports have shown the advantage of starting early RRT patients with a significant favorable impact in patients with sepsis and multi-organic failure.
51. Survival and Mortality Risk Factors in Mexican Patients with Acute Kidney Injury
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Background: Acute Kidney Injury (AKI) information is scarce in Latin American ICU and non ICU patients.
Aim: To determine patient survival, mortality risk factors and treatment in AKI patients from a hospital of the West of Mexico.

Methods: Prospective cohort (Jan-May 2011) of 79 patients with AKI (AKIN classification), diagnosed and treated by Nephrologists, were recorded at admission, at AKI diagnosis and daily for 1 month: age, gender, time between AKI onset and Nephrology consultation, fluid balance, SOFA, APACHE II, ISI, treatment (IHD, CCRT, conservative), date of death or patient discharge and other clinical and biochemical variables.

Results: Mean age was 52±18 years, 61% were male, 48% were from ICU, 50% had surgery, 25% had sepsis; 59% had AKIN 3, mean time between AKI onset and Nephrology consultation was 59±48 hours, 56% received conservative treatment, 28% IHD and 16% CCRT; mean hospitalization was 15±9 days; Mortality was 51% (according to treatment was 46% conservative, 41% IHD and 92% CCRT) Results are shown in Table 1 (Comparisons according to hospitalization site and mortality). Mortality predictors at day of diagnosis were: Δ SCR, Uresis volume and diuretic use ($\chi^2=11.4; p=0.01$); and predictors 24-Hrs after were: Diuretic use and SOFA score ($\chi^2=7.1; p=0.03$)
Conclusions: Mortality was similar to other studies, was high in general ward (42%) and was significantly predicted at diagnosis by small changes in serum creatinine. At 24 hours evaluation, SOFA and conservative treatment significantly also predict mortality.

<table>
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<tr>
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<th>ICU (n=30)</th>
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<tbody>
<tr>
<td>Fluid balance (Lt)</td>
<td>6.7 (3.3-11.3)</td>
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<tr>
<td>SCr Δ</td>
<td>1.8±1.5</td>
</tr>
<tr>
<td>Mortality n(%)</td>
<td>20(67)</td>
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<tr>
<td>Alive (n=39)</td>
<td>20(42)</td>
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<tr>
<td>Fluid balance (Lt)</td>
<td>2.08 (-0.38-5.4)</td>
</tr>
<tr>
<td>SCr Δ</td>
<td>3.7±3.2</td>
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<tr>
<td>SOFA (pts)</td>
<td>10±3</td>
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<tr>
<td>Diuretic use N (%)</td>
<td>21 (70)</td>
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<tr>
<td>ISI (pts)</td>
<td>0.37±0.2</td>
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52. The Impact Of The Daily Presence Of The Nephrology Resident In The Postoperative Cardiac Intensive Care Unit
César Flores-Gama, Armando Vázquez-Rangel, Maribel Merino-López, Francisco Baranda-Tovar, Israel Campos-González
Instituto Nacional de Cardiología Ing. Ignacio Chávez

Background: Acute kidney injury (AKI) is a significant cause of morbidity and mortality following cardiac surgery.
Early nephrology consultation could result in better outcomes, but daily presence of the nephrology resident in the postoperative cardiac intensive care unit (PC-ICU) and its relationship with hard outcomes has not been explored. Purpose: We assessed the incidence of AKI, renal recovery, ICU length of stay, and in-hospital mortality following cardiac surgery before and after the daily presence of the nephrology resident as part of the PC-ICU team. Methods: We conducted a retrospective cohort study of 2 consecutive periods of time in adults taken to cardiac surgery in a single-center: from March 2009 to February 2010 (nephrology consultation by call) and from March 2010 to February 2011 (daily presence). We excluded patients with chronic kidney disease stage V, AKI or renal replacement therapy (RRT) before surgery. AKI was defined according to AKIN and RIFLE classifications within 7 days since cardiac surgery. We used multivariable linear and logistic regression to adjust for confounding variables. Results: We included 1096 patients who were taken to cardiac surgery in the Instituto Nacional de Cardiología Ignacio Chávez in Mexico City, 558 in the consultation period and 538 in the daily-nephrology-presence period. AKI occurred in 31.9% of patients in the consultation group and 28.7% in the daily group (p=0.019); in-hospital mortality was 8.25% and 5.6% (p=0.082). Adjusting for age, baseline renal function, risk scores (Euroscore and Thakar score), infections, and length of mechanical ventilation, the daily presence of the nephrology resident was associated with a lower risk of AKI (OR 0.714 [95% CI 0.520-0.982], p=0.039), shorter ICU length of stay (Beta -0.095 [95% CI 0.000 to -0.146], p=0.044) and lower in-hospital mortality (OR 0.469 [95% CI 0.256-0.858], p=0.014). In those patients who required RRT the daily nephrology presence was associated with a lower risk of failure to recover renal function (OR 0.023 [95% CI 0.001-0.384], p=0.009). Conclusion: Daily presence of the nephrology resident in PC-ICU was associated with lower risk of AKI, in-hospital mortality and seems to promote renal recovery in patients requiring RRT. The present model of attention is a proposal with potential benefits in teaching hospitals.
53. A New Clinical Score to Predict Acute Kidney Injury After Cardiac Surgery in Chinese Elderly Patients

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Objective: To develop and validate a risk score to predict acute kidney injury (AKI) after cardiac surgery in Chinese elderly patients. Methods: A consecutive sample of 848 elderly patients (age ≥ 60 years old) who underwent cardiac surgery with cardiopulmonary bypass in the Guangdong general hospital between January 1, 2005 and July 31, 2010 was evaluated. The clinical outcome was AKI according to the serum creatinine criteria of the RIFLE classification during the first 7 days postoperatively. Patients were excluded if they had an end stage renal disease, or experienced renal replacement therapy. Those who had missing data were also excluded. In randomly selected 682 patients of the total cohorts, multivariate logistic regression analysis was used to develop a new prediction score based on clinical characteristics and perioperative variables of patients. The new score was validated on the remaining patients. Result: The incidence of AKI in the derivation cohort which consisted of 682 patients was 62.3% (n=425), while in the test cohort which consisted of 166 patients was 59.6% (n=99). Eight variables were included in the predictive index. Those variables in the new score that an estimated glomerular filtration rate less than 60 ml/min, male, hypertension, chronic heart failure New York Heart Association above stage 2, perioperative red blood cell transfusions above 625 ml were assigned 2 points, respectively. Cardiopulmonary bypass time above 113 minutes and duration of ventilator-assisted respiration during postoperative above 24 hours were assigned 3 points, respectively; other component was assigned 1 point: previous cardiac surgery. The patients with risk score ≤ 4 in derivation, the risk of AKI was 26.0%; comparatively, the risk was 92.6% among patients with risk score ≥ 13. The area under the receiver operating characteristic curve, judging the discrimination of the score, was 0.798 (95% CI 0.764 to 0.832) in the derivation, which in the validation set was 0.804 (95% CI 0.739 to 0.870). The calibration of the score assessed using the Hosmer-Lemeshow statistic in the derivation and validation were 0.478, 0.224, respectively.

Conclusion: A new score based on Chinese information was valid and accurate in predicting AKI after cardiac surgery in elderly patients. This score may allow prevention of post-operative AKI and early institution of therapeutic interventions to attenuate the impact of AKI on the prognosis of cardiac surgery patients.

54. The Impact of Acute Kidney Injury on In-Hospital Morbidity and Mortality Among Patients With and Without Baseline Chronic Kidney Disease

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Background: Acute kidney injury (AKI) is a well-recognized risk for chronic kidney disease (CKD) and in-hospital mortality. The effect of AKI on in-hospital morbidity and mortality among
patients with and without CKD has not been previously well defined. The objective of this study was to evaluate the prevalence of AKI over a 5 year period and assess AKI associated morbidity and mortality in a cohort of hospitalized patients with and without CKD using the National Hospital Discharge Survey (NHDS) database. Methods: We analyzed NHDS database from 2005 to 2009 for primary diagnosis of AKI and CKD using ICD-9 diagnoses and procedure codes. Clinical information of all patients with AKI with and without CKD was abstracted and analyzed using SAS version 9.2 and JMP version 9.0.1. Results: 1,185,477 adult patients were hospitalized from 2005-2009, 61984 (5.23%) had a diagnosis of AKI. The rate of AKI over the 5 year period progressively increased: 3.97% in 2005, 4.52% in 2006, 5.58% in 2007, 6.42% in 2008, and 7.64% in 2009, p<0.0001. Among patients with AKI, 18.8% had a CKD diagnosis and 5.4% required renal replacement therapy (RRT). Non-CKD patients with AKI were less likely to require RRT compared to CKD patients with AKI (4.37% vs. 10.0%, p<0.0001). Moreover, non-CKD patients with AKI were more likely to be younger (69.4 ± 16.2 vs 71.9 ± 14.7 years, p<0.0001), female (48.7% vs. 46.9%, p=0.0002), require longer hospitalization (9.20 ± 10.3 vs 7.9 ± 7.76 days, p<0.0001) and be dismissed to care facility instead of home (36.1 % vs. 30.4%, p<0.0001). In-hospital mortality was more than 2 times higher among AKI patients without CKD compared to those with CKD (12.9% vs. 6.02%, OR 2.30 [95% CI 2.12, 2.50]). After adjusting for common comorbid conditions, the association of worse outcomes in AKI patients without baseline CKD remained significant. Conclusions: AKI is associated with prolonged hospitalization, higher likelihood for dismissal to care facility and significantly higher mortality among patients without baseline CKD compared to patients with CKD.

55. Clinical study of 72 pediatric patients who were performed extracorporeal membrane oxygenation with CRRT

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Background: Patients with congenital heart disease(CHDis) are sometimes performed extracorporeal membrane oxygenation (ECMO). CRRT are necessary to control fluid balance and electrolyte balance for these patients. We studied efficacy of CRRT for the patients. Methods: There were 19 patients who were performed ECMO with CRRT (CHF) from 1997 to 22.(CHF period) From 23 to 25(initial CHDF period), there were 5 patients who were performed ECMO with CRRT (CHDF). From 25 to 211(high flow CHDF period), there were 48 patients performed ECMO with CRRT (high flow CHDF). All of them are 72 patients performed ECMO with CRRT at Shizuoka children’s hospital. We checked age, diagnosis, CRRT, survival rate, prognosis of kidney function and so on. Results: In CHF period, average age was 4 years old. Diagnosis were CHDis(14 cases), acute myocarditis(2 cases), congenital diaphragm hernia(CDH)(2 cases), persistent pulmonary hypertension of the newborn(PPHN)(1 case) and Sepsis(4 cases). Modality of CRRT were mainly CHF(2 cases), CHDF(1 case) and PEX(1
case). survival rate was 28.6% (survivor; 6 cases). Their CKD stage was 1 (eGFR>9) as prognosis of kidney function. In initial CHDF period, average age was 1 months old. Diagnosis were CHD is(4 cases), persistent pulmonary hypertension of the newborn(PPHN)(1 case) and Sepsis(3 cases). Modality of CRRT were mainly CHDF(5 cases) and PMX-DHP(3 case). survival rate was 4% (2 cases). The one’s CKD stage was 1(eGFR>9), the others was Cs2(eGFR6~9). In high flow CHDF period, average age was 3 years and 2 months old. Diagnosis were CHD(is(41 cases), acute myocarditis(4 cases),CDH(1 cases), Croup(1 case), the other(1 case) and Sepsis(5 cases). Modality of CRRT were mainly high flow CHDF(48 cases), PMX-DHP(1 case) and PEX(1 case). Survival rate was 73.5% (survivor; 36 cases).Cs (eGFR>9) was 21 patients. Cs 2(eGFR6~9) was 3 patients. Cs 3(eGFR3–6) was one patient. Survival rate in high flow CHDF period significantly improved.(p<.5)

**Conclusion:** From CHF to high flow CHDF period, we could achieve better survival rate. But, the better the survival rate improved, the worse the prognosis of kidney function became. We should improve both survival rate and prognosis of kidney function.

56. **Acute kidney injury does not contribute towards mortality in intensive care unit patients**

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This prospective study was done in patients admitted in intensive care unit (ICU) over 1 year period to know whether acute kidney injury (AKI) per se contributes towards mortality or not.

Patients with ICU stay of less than 24 hrs and readmission during the same hospital stay were excluded. All eligible patients were assessed within 24 hrs of admission to ICU, baseline APACHE II and SOFA scoring were done and subsequently followed up to look for new onset organ dysfunction/failure. Maximum total SOFA and non renal SOFA were the highest value of SOFA recorded during the course of stay in ICU. Delta SOFA was the measure of difference between maximum SOFA and baseline SOFA. AKI was defined. as per Acute Kidney Injury Network. A total of 197 subjects were enrolled, mean age was 52+17yrs. Mean baseline APACHE score was 10.55 + 8.2, baseline total SOFA 3.03 + 2.5, maximum SOFA 5.26 + 4.72, delta SOFA 2.23+3.34, delta non renal SOFA was 1.59 + 2.7. Duration of ICU stay was 7.2 + 7.6 days. Of 197, 49 patients (24.9%) developed AKI. Sepsis (79.6%), hypovolemia (41%) and nephrotoxic drugs (16%) contributed towards AKI. AKI patients had longer ICU stay (12.8+11.3 vs 5.3+ 4.6 days p<0.001), higher baseline APACHE score (15.2 + 7 vs 9 + 8.1 p<0.001), higher basal SOFA (4.6 + 2.5 vs 2.5 + 2.3 p< 0.01), higher maximum SOFA (10.04 + 4.6 vs 3.68 + 3.5 P<0.0001) and delta non renal SOFA (3.59 + 3.7 vs 1.12 + 2.2 P<0/001). On multivariate analysis delta non renal SOFA (OR 1.22) and ICU stay of > 7 days (OR 1.47) were the only significant predictors of development of AKI. Age and premorbid illness were not associated with AKI. Of 197 patients 55 (27.9%) died, in non survivors ICU stay (10.6+10.5 vs 5.8+5.6 p<0.01), baseline APACHE (15.1+7.2 vs 8.8 +7.9 p<0.01), baseline SOFA (4.7+2.7 vs 2.4+2.1 p<0.01), maximum SOFA (10.7 + 4.8 vs 3.2 + 2.9 P<0.01)delta SOFA (5.96 +
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3.88 vs 0.8 + 1.5 p<0.01), delta non renal SOFA (4.9 + 3.2 vs 0.48 + 1.27 p<0.01) and maximum creatinine (4.8 + 2.9 vs 1.2 + 0.9 mg/dl p<0.01) were significantly higher than survivors. Baseline total SOFA (OR 1.44) and delta non renal SOFA (OR 2.31) were independent significant predictors of mortality while AKI was not an independent predictor. To conclude development of AKI does not contribute to the mortality in ICU patients. Baseline SOFA and the development of organ dysfunction other than kidney during the ICU stay contribute to the mortality.

Baseline total SOFA (OR 1.44) and delta non renal SOFA (OR 2.31) were independent significant predictors of mortality while AKI was not an independent predictor. To conclude development of AKI does not contribute to the mortality in ICU patients. Baseline SOFA and the development of organ dysfunction other than kidney during the ICU stay contribute to the mortality.

57. The Usefulness of AKIN Criteria Predict Long Term Outcome of Hospital-Acquired Acute Kidney Injury
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Background and Aims: Assessment of short-term outcome in hospital-acquired acute kidney injury (AKI) may underestimate the true burden of disease. It is important to focus to on long term survival. We investigate the long term outcome of hospital acquired AKI according to the Acute Kidney Injury Network Criteria stages.

Methods: This is a prospective, observational, single center study. All hospital acquired AKI patients were included. We monitored serum creatinine everyday for all patients using a hospital data survey system during the study period from Sep. 27 to Aug. 28.

Results: Among patients with AKI, 29.2% were stage 1, 36.5% were in stage 2 and 34.4% were in stage 3. Median follow up days is 161 days (34-811). The long term mortality including hospital mortality was 45%. Cumulative mortality for patients with stage 3 was significantly higher than stage 2 (p<.41) (figure 1).

Conclusion: AKIN criteria is useful to predict long term outcome of hospital acquired AKI.

58. The Impact of Mitochondrial DNA Haplogroups on the Mechanical Ventilation Weaning of Critically Ill Patients
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Objective: To determine whether the main mitochondrial DNA (mtDNA) haplogroups of the Han people are associated with the weaning from mechanical ventilation of critically ill patients. Material and method: We prospectively studied 128 individuals...
who were sequentially admitted to the intensive care unit. We used weaning of mechanical ventilation during the 28-day period as the endpoints. The follow-up of patients were performed until when the patient weaned from mechanical ventilation for the first time or the patient died during the 28-day period. After clinical data were obtained, the patients were underwent mtDNA haplotyping. We determined the mtDNA haplpgroups by comprehensive analyzing to the sequences of mtDNA hypervariable segment I (HVS I) and haplotyping specific polymorphisms in the mtDNA coding region. Results: A univariate analysis indicated that weaning individuals were significantly different from non-weaning ones from some demographic and clinical characteristics, including younger age, lower APACHE II and SOFA score, less likely to have chronic ill health. On admission to intensive care unit, the frequency of the main subhaplogroups of Han population in the study cohort did not differ significantly from the control group. Kaplan-Meier analysis showed significantly higher mechanical ventilation weaning rate over 28 days in patients with mtDNA haplogroup R than those without the haplogroup (p=0.042). Binary logistic regression analysis indicated mtDNA haplogroup R was an independent predictor of mechanical ventilation weaning, conferring 4.038-fold (p=0.007) increased chance of mechanical ventilation weaning at 28 days compared with those without the haplogroup. Conclusion: In Han population, mtDNA haplogroup R was an independent predictor for the weaning from mechanical ventilation of critically ill patients, conferring increased chance of weaning rate compared with individuals without the haplogroup.

TECHNIQUE CHARACTERISTICS

59. A Comparison of Filter Patency in CVVHD vs pre–dilutional CVVH in High Blood Flow CRRT Systems
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Background: It is unknown if pre-filter replacement fluids decrease clotting versus diffusive therapies due to hemodilution effect in high blood flow continuous renal replacement (CRRT) era. National shortages of calcium injectables forced us to abandon regional citrate anticoagulation for CRRT. We wanted to determine if predilution continuous venovenous hemofiltration (CVVH) offered an advantage over continuous venovenous hemodialysis (CVVHD) for filter patency.
Methods- We gathered data pertaining to all patients who received CRRT without any anticoagulation in the last 8 months. We compared filter life in the 2 groups – CVVH with pre dilution replacement fluid (group 1) vs CVVHD (group 2). All patients were run on the NxStage system one with a blood flow of 25 ml/min. 2 ml saline flushes were administered hourly to evaluate for filter patency. In group one, replacement fluids were started at 3 liters/hr and adjusted clinically. In group 2, dialysate was run at 25 ml/kg/hr and adjusted
clinically.
Results- We studied 255 CRRT systems in 69 patients. There were 43 males, 26 females and average age was 57 ± 12 yrs. Average filter life for group 1 was 18.7 ± 13.7 hrs and for group 2 it was 25. ± 15.4hrs (p-value adjusted for clustering = .4). We then analyzed those with reported clotting as reason for system discontinuation (n=15) and noted a significant difference in filter patency. Average filter life for group 1 was14.3± 9.5 hrs and for group 2 it was 18.7 ± 1.5 hrs. (p-value adjusted for clustering = .1). Conclusion: Contrary to conventional teaching, our results show that average filter life was longer in those patients on CVVHD as compared to pre-dilution CVVH. We conclude that Pre filter CVVH may be associated with more clotting as compared to CVVHD and while choosing a system for a patient with a contraindication for anticoagulation this factor should be taken into consideration.

60. Saturation Coefficient Estimate of Peramivir in a Patient Receiving Continuous Veno-Venous Hemodiafiltration
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Purpose: To estimate the saturation coefficient of peramivir in a patient receiving continuous veno-venous hemodiafiltration (CVVHDF) during the Fall of 29. Peramivir is a potent neuraminidase inhibitor having activity against various influenza A and B subtypes. The main route of elimination is the kidney and a dose reduction is justified when the creatinine clearance is < 5 ml/min. Information from the manufacturer regarding dosing during continuous renal replacement therapy (CRRT) did not exist at the time of this analysis. A 29-year-old female with a history of flu like symptoms presented to a local emergency department. To manage volume and provide extracorporeal renal support CVVHDF was initiated. An infectious disease consult was obtained to evaluate the patient for emergency use peramivir and assist in the management of Streptococcus pneumoniae pneumonia and bacteremia. An initial peramivir dose of 6 mg followed by 48 mg every 24-hours was administered intravenously. This dose was derived based on current CRRT settings and an estimated saturation coefficient (SA) of

Methods: CVVHDF was performed using a Prisma pump and an AN69 filter. During peramivir sampling, blood flow was maintained at 1 ml/minute with a dialysate flow rate of 16.7 ml/minute and a convective rate, using pre-filter solution, of 8.3 ml/minute, respectively. The mean total ultrafiltrate produced during sampling was 14.2 ml/minute. To calculate a saturation coefficient (SA), sampling of blood and effluent were conducted. Pre- and post-filter as well as an effluent sample were obtained 4- and 8-hours following the third dose of 48 mg. Results: Using an estimated SA of 1, a dose of 48 mg (following a 6 mg load) was given every 24-hours. Serum levels were obtained as described and analyzed. A linear decrease was observed over a 24-hour period (graph)
suggesting significant extracorporeal clearance. The calculated SA was .98, similar to the estimated SA of 1.

Conclusion: A calculated SA of .98 suggests peramivir was effectively removed by CVVHDF. Based on measured serum concentrations, a peramivir loading dose of 6 mg followed by 48 mg daily should provide therapeutic levels.


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Background: The circuit-to-circuit exchange technique for Continuous Renal Replacement Therapy (CRRT) was developed at Helen Devos Children’s Hospital as a means to minimize blood transfusions associated with circuit priming in children less than 15 kg. This procedure involves blood priming of the initial hemofiltration circuit using donor red blood cells (RBC). Subsequent circuits are then primed with a transfer of the patient’s own blood from the old circuit to a new saline primed circuit thus avoiding additional transfusion exposure. Limiting blood exposure may benefit the patient by reducing the risk of adverse effects associated with transfusions. In addition, the cost savings associated with decreased blood utilization could impact total health care delivery costs.

Methods: A three-year, retrospective chart review of ten children less than 15 Kg requiring circuit blood priming while receiving CRRT was conducted. Patient age, weight, patient survival, days on CRRT, number of circuits used (blood prime and circuit exchange), circuit priming volume, and volume of RBC transfused during the CRRT course was collected. The cost savings associated with transfusion reduction was calculated. Total per unit cost of RBC transfusion (direct and indirect costs) is estimated to be $761 US dollars as determined by the activity-based cost (ABC) model by Shander.

Results: Ten children were identified during the study period. The mean transfusion reduction associated with the circuit exchange technique was 9.3ml/kg/day (± 9.6) of CRRT; with a corresponding savings of $254 US dollars (± 196) per CRRT day. No statistically significant differences in transfusion volume, days on CRRT, or number of circuits used could be shown between survivors and non-survivors, possibly due to the small sample size.

Conclusions: The cost of blood and concern’s over transfusion related complications have generated increased interest in ways to decrease blood usage. The circuit exchange technique saved an average two units of RBC transfusion per CRRT course in these patients. This is an effective way to reduce blood transfusions thus potentially improving patient outcomes and health care costs.
62. Treatment of hyperlipidemia in resistant nephrotic syndrome: the effect of combined therapy using double filtration plasmapheresis and oral statins

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Objective: by a case-controlled design, to compare the effects of treatment on hyperlipidemia in resistant nephrotic syndrome by combined therapy using double filtration plasmapheresis (DFPP) and oral statins or oral statins only.

Methods: Eight inpatients were enrolled and received 1 session of DFPP for severe hyperlipidemia due to resistant nephrotic syndrome (NS). Oral Atorvastatin (2mg/d) were continuously given to these patients 1 week prior to start of DFPP until the end of followup (Combination group). In the same period 12 outpatients with severe hyperlipidemia due to resistant NS were enrolled to take oral Atorvastatin (2mg/d) (statins group). In addition to treatment of hyperlipidemia, standard cares for primary renal disease were also given to all patients. For 1-month follow-up period, the changes of plasma concentration of lipids and albumin as well as urinary proteins were monitored.

Results: There were no significant changes of serum albumin concentration and urinary proteins after DFPP, the concentrations of plasma total cholesterol were as 41.8±13.4% and 7.2±21.9% of baseline, while the concentration of triglycerides were as 68.6±45.5% and 125.8±48.8% of baseline. In the statins group, the baseline value of plasma albumin, total cholesterol and triglycerides were 23.6±3.9g/L, 15.4±5.5mmol/L and 5.2±3.3mmol/L, respectively. At 2 weeks and 4 weeks follow-up, the concentrations of plasma total cholesterol were as 81.2±21.1% and 81.±16.7% of baseline, while the concentration of triglycerides were as 85.3±43.1% and 18.4±55.6% of baseline. The difference of plasma total cholesterol levels between two groups at the 2 weeks follow-up was significant (P<.1).

Conclusion: Oral statins solely had slight effect on the hyperlipidemia of patients with resistant nephrotic syndrome, while combination therapy using DFPP and oral statins may more effective in treatment the hyperlipidemia in these patients.

63. BUN/Cr Change Ratio (BUN/Cr CR) As A New Delta Check Strategy For Dialysis Sample

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Background: To detect mislabeled sample, clinical laboratory use delta check which compares current and previous test results. But in general, dialysis samples show much difference between pre- and post-dialysis. So delta check doesn’t have much clinical value considering its required effort. In this
study, we suggest BUN/Cr change ratio (BUN/Cr CR) as a new delta check strategy for dialysis cases and tried to investigate its usefulness. **Methods:** BUN/Cr CR is defined as (BUN/Cr ratio before dialysis)/(BUN/Cr ratio after dialysis). From May to Jun 211, We collected 174 test results (BUN, Creatinine, Na, K, Cl, Total CO2, P, Total Ca) from dialysis patients, which are routinely acquired for before and after dialysis. Using collected data, we simulated sample change and calculated detection rate. **Results:** In unchanged sample set, all sample showed positive results in current delta check system. And for BUN/Cr CR, minimum was 1.3, maximum was 2.27, mean 1.28 and SD .14. In changed sample set, minimum was .41, maximum was 4.37, mean was 1.35 and SD was .55. When define normal BUN/Cr CR as between 1.1 and 1.6, only seven sample (4.%) showed abnormal in unchanged samples, while 91 (52.3%) showed abnormal in changed samples. **Conclusions:** BUN/Cr RR could detect sample change in high probability and could reduce clinically irrelevant result compared with current delta check system. But to implement this method, aid of sophisticated laboratory information system would be required.

64. Sustained Low Efficiency Dialysis (SLED) in India: A More Practical Alternative to CRRT
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**Background:** Sustained Low Efficiency Dialysis (SLED) has in recent years emerged as a viable alternative to Continuous Renal Replacement Therapy (CRRT) in renal failure associated with septic shock and/or cardiac failure. The aim of our study was to compare SLED with CRRT in terms of solute removal, complications, and cost. **Methods:** Ours was a retrospective study comparing 52 patients who received CRRT for 27 days with 4 patients who received SLED (282 treatment sessions) between Jan 29 and November 211. All 92 patients had clinical shock and ARF. SLED was delivered as 6 hours of HD 6 days a week with blood flow of 15 ml/hour, dialysate flow of 35 ml/min, hemofiltration with 1 L saline/hour, with heparin or saline flushes. CRRT patients received heparin as anticoagulation. **Results:** Compared with CRRT, SLED proved to be cheaper, safer and a more efficacious modality of renal replacement therapy for patients with shock and/or cardiac failure. The cost of SLED per session was approximately 1/4th (Rs.1,/- vs Rs 4,/-) that of a day of CRRT. 75 % of SLED patients received heparin-free dialysis; filter clotting occurred in 1 % of heparin treatments and 36 % of heparin-free treatments. The time averaged serum creatinine was lower in SLED. Weekly Kt/V was significantly higher in SLED (8 ± 2), although equivalent renal clearance was similar to that of CRRT. 2 % of patients on CRRT had bleeding compared with 4 % of patients on SLED. **In summary,** SLED is a viable, efficacious, resource-sparing alternative to CRRT in the Indian ICU setting.
65. A comparison of estimated Creatinine clearance and measured glomerular filtration rate (Tc99mDTPA clearance) in Indians
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Background: The aim of this study was to compare measured glomerular filtration rate (GFR) with estimates of GFR derived from various estimated creatinine clearance methods of Jelliffe, Cockcroft and Gault, and 4MDRD equations in Indian population.
Methods: We enrolled 8 patients in the study. GFR was determined by technetium-99m diethyl triamine penta-acetic acid (Tc99mDTPA) clearance. Height, body weight and serum creatinine were measured, and GFR and creatinine clearance (CrCl) estimates calculated by various equations. Spearman correlation was used to assess relationships between measured GFR (Tc99mDTPA clearance) and estimated clearances using the three formulae. Difference between the measured GFR and estimated clearances compared with measured GFR were examined to determine whether prediction error was independent from measurement magnitude. Analyses of differences were used to determine bias and precision. Bias was assessed by mean %age error (MPE), calculated as the %age difference between the estimated clearances for each formula and measured GFR. A positive bias indicates overestimation of GFR, and a negative bias indicates underestimation. Relationships were also assessed by gender and varying levels of renal function: GFR <6 ml/min, and GFR >6 ml/min.
Results: The mean measured GFR was 77.2 ml/min (range 17 to 152 ml/min). The mean bias (mean %age error) was -4.9, -1.3 and -1.57% respectively for the Jelliffe, Cockcroft and Gault, and 4MDRD formulas, respectively. The 4MDRD formula overestimates the GFR in patients having GFR less than 6 ml/min, whereas as underestimates for GFR more than 6 ml/min.
Conclusions: 4MDRD equation seems to be best for estimating GFR in Indian population.

66. First Intention Continuous Venovenous Hemodiafiltration in Young Children With Hemolytic and Uremic Syndrome.
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Background and objectives: Hemolytic and uremic syndrome (HUS) can lead to acute kidney injury requiring renal replacement therapy. Usual recommendations favour peritoneal dialysis (PD) in first intention for young children (without contra indication). We report a series of young patients with HUS treated with continuous venovenous hemodiafiltration (CVVHDF) in first intention despite the lack of contra indications for PD.
Methods: Prospective study of consecutive cases of young children with typical HUS treated with CVVHDF in first intention in a single paediatric intensive care unit (PICU) in 211.
Results: Five children aged 66, 24, 18, 17 and 13 months and weighing 23.4, 9.7, 11.9, 11.8 and 9.2 kg, respectively, were included. Vascular access was in the right internal jugular vein in 4 and in the right subclavian vein in 1 patient. Catheters used were double-lumen 8.5
Fr diameter. Anticoagulation was achieved with heparin. CVVHDF durations were 8, 3, 6, 2 and 5 days. No hemodynamic or technical issue occurred during the CVVHDF courses. Normalization of electrolyte balance was reached within the first 24 hours of CVVHDF. Four children received red cells transfusion and 1 received platelets transfusion. Patients were discharged after 1, 4, 7, 5, 7 days in PICU. One patient was readmitted for plasma exchange therapy. One patient had 4 courses of intermittent hemodialysis after PICU discharge. Conclusion: Recent technological progress has made CVVHDF safer and more reliable in young children. It allows a tighter control of fluid and electrolyte balances in the first hours of treatment without hemodynamic impairment. Vascular access can be used for intermittent dialysis and/or plasma exchange therapy. Even in the absence of contra indication for PD, first intention CVVHDF for young children with HUS is feasible and showed no major safety issue in this small case series.

67. Post Filter Ionized Calcium Levels With Dilute Regional Citrate Anticoagulation: Do We Need To Follow Them?
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Background: Although regional citrate anticoagulation (RCA) with continuous venovenous hemodiafiltration (CVVHDF) has been shown to be safe and effective, it requires intensive monitoring of ionized calcium (iCa) levels every 6 hours from the patient as well as the circuit. At the University of Alabama at Birmingham (UAB), CVVHDF is performed with a .5% dilute citrate solution that serves as both an anticoagulant and replacement fluid (RF). Post filter iCa levels are checked every 6 hours and citrate adjusted to maintain a post filter iCa level of < .5 mmol/L. The purpose of this study was to determine if measuring post filter iCa levels every 6 hours are necessary with the typical citrate RF and blood flow rate ranges used at UAB. Methods: This is a prospective analysis of post filter iCa levels in 1 critically ill patients using pre-dilution CVVHDF. Post filter iCa levels were checked at varying combinations of citrate RF ranges of 15 to 25 ml/hr, dialysate ranges of 15 to 25 ml/hr, and blood flow rate ranges of 15 to 2 ml/min. Patient demographics, electrolytes, as well as dialysate parameters were reviewed. Results: Post filter iCa levels remained < .5 mmol/L for all 1 patients with the various combinations of blood citrate RF, dialysate, and blood flow rates. See Tables 1 and 2.

Conclusions: There appears to be limited clinical benefit to follow post
filter iCa every 6 hours when using the UAB .5% dilute RCA protocol for CVVHDF. Unless a patient has clotting problems on CVVHDF, we recommend post filter iCa can perhaps be changed from every 6 hours to once a day reducing not only complexity of citrate use with CRRT but also decreasing labor and cost.

68. Heparin Anticoagulation in Powdered Sorbent Pheresis in Septic ICU patients

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Introduction: Severe sepsis is associated with very high mortality. The Intermittent Modular Plasma Adsorption of Cytokines and Toxins (IMPACT) (Hemolife Medical Inc) system was used in these patients. We hypothesized that an attenuated anticoagulation protocol does not increase bleeding yet achieves prescribed treatment time. Method: IMPACT is based on coupled plasma-filtration adsorption methodology with three chemically distinct non-ionic, powered sorbents. Intermittent 4 h treatment sessions were instituted. Systemic anticoagulation was with unfractionated heparin following heparin-saline prime. Results: A total of 5 patients (M:F=4:1; age 67±7; and, APACHE II score 25±4) were prospectively treated with 17 sessions of IMPACT. Duration of ICU stay was 16±7 days. Circuit pressures pre- versus post-IMPACT (mmHg): arterial pressure (AP)-52±7 vs. -53±11, p=.778; venous pressure (VP) 44±9 vs. 48±16, p=.342; pre-sorbent column plasma pressure (PS) 92±8 vs. 133±78, p=.37; and pre-plasma filter circuit pressure (PPF) 45±11 vs. 63±25, p=.12. Operating conditions were: pumped blood flow rate QB 125±7 ml/min; plasma flow rate QP 2±9 ml/min; and, total heparin administered was 2515±1481 IU per treatment. One circuit spontaneously clotted during treatment. IMPACT treatment time was 237±25 minutes per session. Anticoagulation intensity pre- vs. post-IMPACT was: ACT (s) 189±2 vs. 238±98 (target 25 s), p=.61, activated partial thromboplastin time (aPTT) 65±57 vs. 12±63 s, p=.44, and platelet count (x10^9/µL) 25±92 vs. 139±71, p=.18. Overall, serum creatinine was 255±132 µmol/L. There were no major bleeding episodes requiring invasive hemostasis. Conclusion: Reduced systemic heparin anticoagulation during IMPACT did not increase bleeding but was associated with a significant rise in plasma filter and sorbent column plasma pressures. Prescribed treatment time was nevertheless still achieved.
69. Plasma and Tissue Pharmacokinetics of Meropenem in Critically Ill patients on Continuous Renal Replacement Therapy

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Background: For carbapenems, a minimum time above MIC (T>MIC) of 4% or preferably 1% of the dosing interval is required to ensure maximal antibiotic efficacy. This study examined the plasma and tissue pharmacokinetics of meropenem in critically ill patients undergoing continuous veno-venous haemodiafiltration (CVVHDF).

Methods: This was a prospective pharmacokinetic study in 5 critically ill patients on CVVHDF. CVVHDF was performed as a 2-3 L/h exchange using a polyacrylonitrile filter with a surface area of 1.5 m² and a blood flow rate of 2 mL/min. Meropenem 5 mg was administered 8-hourly as an IV bolus infusion over 3 minutes. Serial blood samples (pre- and post-filter) and filtrate/dialysate samples were collected for analysis. Tissue concentrations were also measured using microdialysis. Meropenem concentrations were measured using a validated assay method. Pharmacokinetic analysis was conducted using a non-compartmental approach.

Results: Three males and two females were enrolled with a median age of 63 (inter-quartile range 48-63) years and weight 1 (68-12) kg. Four of the five patients were sampled on two occasions (Profile A and B). The pharmacokinetic parameters for meropenem are reported in the Table. The concentration-time profile of meropenem in plasma and tissues is presented in the Figure below. %age T>MIC during the dosing interval was calculated to be 1% for MICs of 2 and 4 mg/L and 64% for MIC of 8 mg/L.

Conclusion: Based on our plasma and tissue pharmacokinetic data, meropenem 5 mg 8-hourly dosing appears appropriate using our dialysis settings.

<table>
<thead>
<tr>
<th>Pharmacokinetic parameter</th>
<th>Profile A Median (IQR)</th>
<th>Profile B Median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak plasma concentration (mg/L)</td>
<td>4.74 (3.66-4.56)</td>
<td>35.96 (27.49-44.93)</td>
</tr>
<tr>
<td>Trough plasma concentration (mg/L)</td>
<td>4.89 (3.48-4.99)</td>
<td>5.35 (4.16-6.46)</td>
</tr>
<tr>
<td>Plasma elimination half life (h)</td>
<td>3.71 (3.29-4.1)</td>
<td>3.75 (3.6-4.15)</td>
</tr>
<tr>
<td>Volume of distribution (L/kg)</td>
<td>.26 (.17-.35)</td>
<td>.25 (.20-.29)</td>
</tr>
<tr>
<td>Total clearance (L/h)</td>
<td>4.12 (4.11-4.79)</td>
<td>3.81 (3.16-4.75)</td>
</tr>
<tr>
<td>CVVHDF clearance (L/h)</td>
<td>2.91 (2.73-3.12)</td>
<td>2.6 (2.31-3.33)</td>
</tr>
<tr>
<td>Peak tissue concentration (mg/L)</td>
<td>13.6 (11.97-16.84)</td>
<td>18.3 (15.88-18.68)</td>
</tr>
<tr>
<td>Trough tissue concentration (mg/L)</td>
<td>2.59 (2.38-3.36)</td>
<td>3.66 (2.57-4.96)</td>
</tr>
<tr>
<td>AUC tissue: AUC plasma</td>
<td>.63 (.6-.69)</td>
<td>.69 (.64-.74)</td>
</tr>
</tbody>
</table>
70. Direct visualization of cortical peritubular capillary flow affected by Carbon Dioxide–induced pneumoperitoneum using intravital microscopy
Tokunori Yamamoto, Masashi Kato, Yasuto Funahashi, Ryuouhei Hattori, Momokazu Gotoh
Department of Urology, University of Nagoya
Aim: To examine the direct renal hemodynamics during carbon dioxide pneumo-peritoneum (CDP) in both human and porcine models using magnifying endoscopy (Hattori R, Yamamoto T, et al Transplantation 25). Laparoscopic living donor nephrectomy has become widespread because of its minimally invasive nature. However, it has been clear that the renal hemodynamics and function are affected during CDP. Methods: The erythrocyte velocity in the cortical peritubular capillary (CPC) was monitored and measured during laparoscopic nephrectomy on human donors and laparoscopic partial nephrectomy on humans with renal cell carcinoma during CDP (pressure of 8, 12, 15, 18, and 2 mm Hg). We used a direct imaging system of renal microcirculation by magnifying endoscopy, as previously described. We maintained the same pressure for 5 minutes. In the porcine model (6 pigs), we measured the erythrocyte velocity in the CPC using the same method during CDP (pressure of 5, 1, 15, 2, and 25 mm Hg). The erythrocyte velocity in the renal artery did not change during increased CDP. When the pneumoperitoneal pressure was 25 mm Hg, we found that >9% of the erythrocyte velocity in the CPC was non flowing. In the human model, the erythrocyte velocity in the CPC decreased when the CDP pressure was 12 mm Hg. We compared renal function (MAG-3) after Open surgery without CDP to Laparoscopic surgery with CDP in partial nephrectomy. Results: The erythrocyte velocity in the CPC decreased during CDP in all kidneys in both the human and the porcine models. However, erythrocyte velocity in the renal artery did not change during carbon dioxide pneumoperitoneum. After stopping the pneumoperitoneum, the erythrocyte velocity in the CPC recovered immediately. Laparoscopically treated patients maintained significantly higher renal function. Conclusion: The findings of our study have shown that the suitable carbon dioxide pneumo-peritoneal pressure for renal micro-circulation is >8 mm Hg for laparoscopic surgery. CDP may protect renal function.

71. Regional Citrate Plus Low Dose Of Low Molecular Weight Heparins:A Safe And More Efficacy Anticoagulation Protocol For Continuous Veno - Venous Hemofiltration
Kiyue Zhang, Dehua Gong, Daxi Ji, Bin Xu, Zhihong IIU
Research Institute of Nephrology, Jinling Hospital
Objective: to compare the safety and efficacy of three different anticoagulation methods for continuous veno-venous hemofiltration (CVVH). Methods: Between November 21 and September 21, 57 critically ill patients in Jinling Hospital requiring CVVH without anticoagulation contraindications were enrolled and randomized to 3 groups adopting different anticoagulation protocols as following: regional citrate anticoagulation in group A, systemic
LMWH in group B (loading dose of LMWH 4IU/kg, maintenance dose 4IU/kg/hr), and regional citrate plus low dose of LMWH in group C (loading dose 2IU/kg, maintenance dose 2IU/kg/hr). The filter survival time, the change of hemoglobin (Hb), platelet counts (PLT), and anticoagulation-related side effects were measured. **Results:** Fifty-three patients completed the study and entered into data analysis, 15 in group A, 19 in group B and C. The mean APACHEII scores in each group were 16.2 ± 3.65, 17.11 ± 3.5 and 17.1 ± 4.79, respectively (P>.5). There were no significant differences in age, gender, weight, baseline values of Hb, PLT, prothrombin time, activated partial thromboplastin time, blood pH, and bicarbonate concentration between 3 groups. The filter survival time were 21.22 ± 3.48h in group A, 25.1 ± 5.5 h in group B, and 4.35 ± 7.8h in group C (p <.1). There were 3 patients in each group of A (2%) and B (15.8%) switching to the anticoagulation protocol of group C due to filter life span less than 8 hours, 4 patients in group B (21%) switching to group C due to bleeding, 3 patients in group A (2%) and 4 patients in group C (21.1%) switching to group B due to citrate related complications. The %age of patients with reduction of Hb levels more than 3% were 2% in group A, 15.7% in group B and 15.7% in group C (P>.5). The %age of patients with reduction of platelet counts more than 3% were 2% in group A, 31.6% in group B, and 15.7% in group C (P>.5). The mortality rate was 4% in group A, 26.3% in group B and 36.8% in group C, respectively (P>.5). There were no differences in the CVVH duration, hospital days and ICU days between 3 groups. **Conclusion:** compared with anticoagulation using only regional citrate or LMWH, regional citrate plus low dose of LMWH protocol is more efficacy in prolonging filter life span, without significant increase of anticoagulation-related complications.

**RRT RESEARCH**

72. **Continuous Venovenous Hemodialysis (CVVHD) Effluent Imipenem Levels Predict Plasma Free Imipenem Levels**

*Seth R Bauer, Milen Amde, Michael J Connor, Charbel A Salem, William H Fissell*

*Cleveland Clinic, Emory University*

**Background:** Pharmacokinetic and pharmacodynamic studies typically require time-intensive sampling strategies that may exceed clinician and Institutional Review Board comfort levels with blood loss due to phlebotomy. These concerns are heightened in the critical care environment. CVVHD effluent is typically well equilibrated with plasma, and most antibiotics in common use in the ICU are small molecules, suggesting that effluent drug levels might predict free plasma levels. We conducted an IRB-approved prospective observational study comparing antibiotic levels in CVVHD effluent with those in plasma. Here, we present data from 17 patients treated with concomitant CVVHD and imipenem. **Methods:** Inclusion: Adult patients with acute or chronic renal failure who were receiving CVVHD in the ICU. Exclusion: ESLD, pregnancy. **Patient data:** age, gender, current and admission weight, CVVHD doses were recorded on case report forms (CRFs). **Sampling:** After the fourth dose of antibiotic during uninterrupted CVVHD, trough, 3 minute post infusion peak, and
second trough blood and effluent samples were drawn and immediately stored on ice. Drug analysis: Free and effluent imipenem levels were measured by RP-HPLC in the lab of one of the investigators (WHF). Effluent and free plasma imipenem levels were compared using a multivariate linear regression. Results: Complete data was available from 17 subjects dialyzed with the NxStage Express (n=6) or Gambro Prismaflex (n=11). Plasma total imipenem levels were not measurable using our HPLC assay, but plasma free drug and effluent drug levels were measured in 51 paired samples. Effluent levels predicted plasma free drug levels in a CRRT-dose dependent manner. Effluent overestimated plasma in one sample. Discussion: Imipenem analysis in CRRT effluent may provide a blood-sparing technique for pharmacokinetic and pharmacodynamic studies. More study is needed to determine the best use of this technique.

73. Perfluorocarbon Protects Kidney Tubular Epithelial Cells By Septic Plasma-Induced Apoptosis And Promotes CD133+ Renal Progenitor Cell Differentiation: Relevance For Bioartificial Renal Assist Devices
Vincenzo Cantaluppi, Davide Medica, Alessandro D Quercia, Federico Figliolini, Sergio Dellepiane, Gennaro Iavarone, Giovanni Abagnale, Giuseppe P Segoloni, Giovanni Camussi
University of Turin, San Giovanni Battista Molinette Hospital
Extracorporeal blood purification techniques including renal assist devices (RAD) with viable renal tubular epithelial cells (TEC) have been proposed for the treatment of sepsis-associated acute kidney injury (AKI). We previously demonstrated that plasma derived from septic patients induce a direct injury and pro-apoptotic effect on cultured human TEC. Perfluorocarbon (PFC) molecules are oxygen carriers used for organ preservation before transplantation. The aim of this study was to evaluate the effect of PFC on septic plasma-induced TEC injury and on renal CD133+ stem cell differentiation. TEC and CD133+ renal progenitors were isolated by cell sorting. Plasma was drawn by 1 patients with sepsis and AKI (RIFLE criteria), TEC were incubated with patients’ plasma in presence or absence of PFC evaluating: cytotoxicity (XTT assay), apoptosis (TUNEL assay, ELISA for caspase-3, -8, -9), cell polarity (trans-epithelial electrical resistance, TER) and albumin uptake. Moreover, we studied the effect of PFC on proliferation (BrdU assay) and differentiation of CD133+ renal progenitor cells. Septic plasma induced: 1) a cytotoxic and pro-apoptotic effect on TEC through the activation of the death receptor as well as of the mitochondrial apoptotic pathways; 2) the alteration of cell polarity (TER) and albumin uptake; 3) the down-regulation of the tight junction protein ZO-1 and of the endocytic receptor megalin. All the detrimental effects induced by septic plasma on TEC were significantly reduced in presence of PFC. In addition, PFC induced CD133+ progenitor cell proliferation and differentiation toward an epithelial phenotype (increase of TER and expression of markers of fully differentiated TEC such as E-cadherin, ZO-1, megalin, alkaline phosphatase, aminopeptidase-A, aquaporin-1 and NGAL ). Conclusion: PFC protects TEC from septic plasma-induced injury and provides an appropriated oxygen tension to promote CD133+ stem cell
differentiation toward a tubular epithelial cell phenotype. The results of the present study suggest a potential role of PFC in the improvement of RAD therapy and in the treatment of ischemic and sepsis-associated AKI.

74. A Multiscale Model of Citrate Dynamics during Citrate Regional Anticoagulation for CRRT

Steven A Conrad
Louisiana State University Health Sciences Center in Shreveport, LA, Regional anticoagulation with citrate provides effective anticoagulation during CRRT. Metabolic alkalosis and citrate accumulation are known but incompletely characterized complications. A mathematical model of citrate and bicarbonate transport during CRRT would permit investigation of the interaction of factors contributing to this problem. Multiscale models combine mathematical modeling approaches that are based on vastly different physical scales. A multiscale model was developed which incorporates a finite element model of solute handling in hollow fibers (microliter scale) with a dynamic compartment model of solute distribution in extracellular fluid (liter scale). This model can simultaneously simulate the transport of citrate and bicarbonate in a hollow fiber dialyzer during therapy as well as the accumulation, metabolism and elimination of citrate in body compartments. The finite element component is based on a partial differential equation model previously presented at this forum (CRRT, 22), by extending it from single solute transport (urea) to both citrate and bicarbonate. The model includes both momentum transport (blood and dialysate flows) and mass transport (solute). The influence of protein concentration, osmotic forces, hematocrit and the Fårhæus-Lindqvist effect on fluid flux have also been added to the previous model. The dynamic compartment model is a single-compartment lumped parameter mass transport model of both citrate and bicarbonate. Model parameters include volume of distribution, extracorporeal blood flow and outlet concentrations, and reaction rate for citrate to bicarbonate conversion. The compartment model is linked to the finite element model through integration of solute flux from the hemofilter as a compartment input, and mixed concentration in the compartment as a finite element input. This multiscale approach enables the evaluation of a number of parameters that affect citrate handling leading to citrate accumulation and metabolic alkalosis: mode of support (SCUF, hemofiltration, hemodialysis, hemodiafiltration), extracorporeal blood flow, hemofiltration rate, dialysate flow rate and composition (bicarbonate- vs. saline-based), citrate infusion rate and concentration, and citrate metabolic elimination rate (normal vs. prolonged). As a dynamic model, it can simulate these parameters over time scales ranging from minutes to days, thereby suitable for evaluating operating parameters during continuous therapies.

75. Pharmacokinetics of Imipenem in Continuous Venovenous Hemodialysis (CVVHD) are related to severity of illness and dialyzer type.

William H Fissell, Milen Amde, Seth R Bauer, Charbel A Salem, Michael J Connor
Cleveland Clinic, Emory University

Background: Sepsis is the leading cause
of death in acute renal failure, and early appropriate antimicrobial therapy is associated with improved survival. Dosing depends on estimation of pharmacokinetic (PK) parameters (volume of distribution and clearance). In an IRB-approved study, we prospectively measured imipenem levels in patients receiving CVVHD in the ICU. PK were compared to anthropomorphic data and CVVHD prescription. Methods: Inclusion: Adult patients with acute or chronic renal failure who were receiving CVVHD in the ICU. Exclusion: ESLD, pregnancy. Patient data including age, gender, current and admission weight, and CVVHD dose were recorded on case report forms (CRFs). Sampling: After the fourth dose of antibiotic during uninterrupted CRRT, trough, 3 minute post infusion peak, and second trough blood and effluent samples were drawn and immediately stored on ice. Drug analysis: Free and effluent imipenem levels were measured by RP-HPLC in the lab of one of the investigators (WHF). Data analysis: Imipenem levels and data from CRFs were entered into a spreadsheet for PK calculations. Statistical testing was performed using JMP 9 for Windows. Parameters with a p value less than .3 in univariate analyses were included in multivariate linear regression analyses. Results: Complete data was available from 17 subjects dialyzed with the NxStage Express (n=6) or Gambro Prismaflex (n=11). Volume of distribution (39.9 +/- 9.6L; .35 +/- .11 L/kg) was greater than previously reported for healthy subjects. Clearance (total 14 +/- 26 ml/min; extracorporeal 38. +/- 85 ml/min) was similar to that previously reported for healthy subject. Univariate analyses suggested a relationship between filter type and volume of distribution, which was confirmed in a multivariate model (p=.22). Total clearance was predicted by CVVHD dose (p =.22), but not by age, gender or severity score. Discussion: Imipenem is a broad-spectrum beta-lactam that is bacteriocidal in a time-dependent fashion. The large volume of distribution noted in this critically ill population suggests that patients may be at risk for underdosing, and the potential role of drug binding to the dialyzer is intriguing. The relationship between CVVHD dose and total clearance is expected. The total clearance of unbound drug was similar to healthy subjects, suggesting that dose-adjustment may not be as necessary in this population as previously thought. More research is needed.

76. The Relationship Between Thyroid Hormone And Corrected QT Interval And QT Dispersion in Non-diabetic Hemodialysis Patients
Hyung-Jong Kim, Dong Ho Yabg, Keuyng Mi Park
Bundang CHA Medical Center, CHA University
Purpose: Cardiovascular disease and sudden cardiac death are common in hemodialysis patients. These cardiac complications are often associated with prolong QTc interval (QTc) and QTc dispersion (QTcd). Also, subclinical hypothyroidism is associated with the risk of heart failure, other cardiovascular events and death. It was reported that subclinical hypothyroidism can alter autonomic modulation of heart rate and cause increased inhomogeneity of ventricular recovery times. The purpose of this study was to evaluate the relationship between thyroid hormone
and QTc, QTcd in non-diabetic hemodialysis patients. Method: We studied 29 hemodialysis patients (13 male and 16 female; mean age 54.6±14.72 years) without thyroid disease. The patients had a 12-lead ECG performed immediately after hemodialysis. The QT interval was manually measured from the onset of the QRS complex to the end of the T-wave. The blood sampling was performed before hemodialysis for the measurement of biochemical parameters, TSH, fT4, T3. The patients was divided to two groups according to QTc (group 1; QTc < 43ms, group 2; QTc ≥ 43ms). We examined the relationship between QTc, QTcd and thyroid hormone of two groups, respectively and compared the two groups. Results: The underlying renal diseases included hypertension (HTN) 55.2%, glomerulonephritis (GN) 2.7%, ADPKD 1.3%, unknown 13.7%. The mean of hemodialysis duration, Kt/V, nPCR, BMI was 63.72±42.78 months, 1.48±.2, .88±.22g/kg/d, 23.3±3.93kg/m2, respectively. In group 1, the means of homocysteine, TSH, T3, fT4 were 14.79±4.26umol/L, 2.5±2.52uIU/mL, 1.6±.2ng/mL, .96±.16ng/dL and in group 2, 18.47±3.84umol/L, 4.66±1.85uIU/mL, 1.9±.16ng/mL, .99±.83ng/dL. In group 1, QTc and QTcd were not significant correlation with TSH, T3, fT4. In group 2, QTc was significant positive correlation with TSH (p<.5) and QTcd was not significant correlation with thyroid hormone. There was no significant difference between two groups, except for homocysteine. Conclusion: It have been reported that prolonged QTc, QTcd and subclinical hypothyroidism are associated with cardiovascular disease and sudden cardiac death. The result of this study showed that TSH is associated with prolong QTc interval in non-diabetic hemodialysis patients. We suggest that subclinical hypothyroidism may be associated with prolong QTc and QTcd in non-diabetic hemodialysis patients.

77. The “U-shaped” Association Between Temporal Timing Of Renal Replacement Therapy Initiation And In-hospital Mortality In Postoperative Acute Kidney Injury

Szu-Ying Lee
National Taiwan University Hospital, Taipei, Taiwan-

Introduction: Postoperative acute kidney injury (AKI) is associated with worse outcomes in surgical patients, but whether the temporal timing of renal replacement therapy (RRT) initiation affect patients’ outcomes in postoperative AKI are not yet well understood. Methods: This multicentered, non-concurrent prospective study enrolled patients who underwent RRT in intensive care units (ICUs) for postoperative AKI between January, 22 and April, 29. The demographic data, comorbid diseases, types of surgery and RRT, and the indications for RRT of patients were documented. Patients were categorized into early (ED, ≤1 day), intermediate (ID, 2-3 days), and late dialysis (LD, ≥4 days) groups according to the period between ICUs admission and RRT initiation. The 18-day in-hospital mortality was taken as outcome. Results: Six hundreds sixteen adult patients (393 men, age 62.9±15.4 years) were enrolled, and 362 patients (58.8%) died within 18-day hospitalization. Both the probability of death and in-hospital mortality rates of the three groups
represented U-shaped curves. ED [hazard ratio (HR), 1.534] and LD (HR, 1.654) as compared with ID, age (HR, 1.7), diabetes (HR, 1.329), liver cirrhosis (HR, 1.596), initial central nervous system dysfunction (HR 1.319), sepsis (HR, 1.994), as well as pre-RRT mean arterial pressure (HR, .986), inotropic equivalent (HR, 1.8), and APACHE II scores (HR, 1.61) were identified as independent predictors for in-hospital mortality. Further, some factors were identified as predictors for entering either ED or LD groups. **Conclusion:** Current study found the “U-shaped” association between timing of RRT initiation and prognoses, and reminded physicians of paying more attention to patients with certain risk factors.

**78. The Affect Prescription and Absorption on Anti-epileptic Concentrations in Ex Vivo CRRT Model**

*Paul J McCarthy, Abiodun Orija, Keith Scott*

*LSU Health Sciences Center - Shreveport, Shreveport, LA, USA, Banner Health, Phoenix, AZ, USA*

**Background**

Neuroscience ICU’s utilize CRRT for indications such as AKI, sepsis, drug intoxications, volume overload, electrolyte control and ICP control. Many patients on CRRT require anti-convulsive medications. How CRRT prescriptions affect drug concentrations due to filtration or filter absorption is unknown. We tested four anticonvulsants in an ex vivo CRRT model to see how mode affects clearance and filter absorption. The sieving coefficients and filter absorption of these drugs were measured in two modes. Although sieving coefficients of many drugs are reported, the filter behavior by mode of CRRT and filter interaction is not largely known.

**Methods:**

A Prismaflex® System configured in CVVHDF or CVVH using a Prismaflex® M15 AN-69 filter was used. Samples were obtained from two runs; in the first run the blood flow rate was set at 1 ml/min with a replacement rate of 2 L/hour and no dialysate (CVVH). On the second run, the blood flow rate was 1 ml/min, fluid replacement at 2 L/hour and dialysate at 1L/hr, thus delivering CVVHDF. Saline was used as the replacement and dialysate. Filter absorption and sieving coefficient were calculated.

**Medication Preparation**

A saline/Anti-epileptic mixture was connected to the access line of the machine. The return line was connected to an effluent bag.

**Drug Sampling & Drug Concentration**

After initiating flow samples were drawn from three sites within the circuit; Pre-filter, Post-filter and the Ultra-filtrate. Phenobarbital, phenytoin and valproate concentrations were determined using a particle enhanced turbidimetric inhibition immunoassay technique. The sieving coefficient, filter absorption and drug clearance were calculated for each run. **Results:** Phenytoin, levetiracetam and phenobarbital had high sieving coefficients with near complete drug filtration. Valproate had significant filter absorption with absorption of 56% and 37% respectively in CVVH and CVVHDF modes.

**Conclusions:** Phenytoin, phenobarbital, and levetiracetam had low absorption and high sieving coefficients. Valproate filter absorption was 56 % in CVVH and 37% in CVVHDF. Anti-convulsive drug levels should be monitored inn patients on CRRT. Many of these drugs are
protein bound; the effects of “free” drug concentration need further investigation.

79. Mode and Dose of Continuous Renal Replacement Therapy (CRRT) Affect Estimation of Plasma Piperacillin Levels From CRRT Effluent.
Ashita J Tolwani, Peilin Wei, Maria E Taylor, Seth R Bauer, Charbel A Salem, Milen Amde, Michael J Connor, William H Fissell
University of Alabama, Birmingham, Cleveland Clinic, Emory University

Background: Pharmacokinetic and pharmacodynamic studies typically require time-intensive sampling strategies that may exceed clinician and or Institutional Review Board comfort levels with blood loss due to phlebotomy. These concerns are heightened in the critical care environment. CRRT effluent is typically well equilibrated with plasma, and most antibiotics in common use in the ICU are small molecules, suggesting that effluent drug levels might predict plasma levels. We conducted an IRB-approved multicenter prospective observational study comparing antibiotic levels in CRRT effluent with those in plasma. Here, we present an analysis of factors affecting the predictive model between effluent and plasma free piperacillin levels. Methods: Inclusion: Adult patients with acute or chronic renal failure who were receiving CRRT in the ICU. Exclusion: pregnancy, ESLD. Patient data: age, gender, current and admission weight, and CRRT dose and mode were recorded on case report forms (CRFs). Sampling: After the fourth dose of antibiotic during uninterrupted CRRT, trough, 3 minute post infusion peak, and second trough blood and effluent samples were drawn and immediately stored on ice. Drug analysis: Total, free, and effluent piperacillin levels were measured by RP-HPLC in the lab of one of the investigators (WHF). Data analysis: Statistical testing was performed using JMP 9 for Windows. Parameters with a p value less than .3 in univariate analyses were included in multivariate linear regression analyses. Results: Effluent piperacillin levels, predilution replacement fluid rate, and effluent rate were strongly associated with plasma piperacillin level. Significant associations between center, mode (CVVHDF vs CVVHD) and piperacillin dosing interval (6 vs 8 vs 12 hours) were observed. The data for mode and piperacillin dosing interval (6 vs. 8 vs. 12 hours) were clustered by center. Effluent levels averaged 61 +/- 19% of plasma free levels in predilution CVVHDF, versus 96 +/- 37 % in CVVHD (p < .1). Discussion: As expected, effluent from predilution CVVHDF under predicted plasma levels. Confounding by a higher average CRRT dose in the CVVHDF group versus the CVVHD group may play a role, as simple correction by the predilution fraction did not fully explain the difference. This suggests that at higher prescribed doses, the dialyzer cartridge may not be equilibrating completely with plasma. More research is needed to use this technique reliably.
NURSING ISSUES

80. CRRT Super Users To The Rescue
Linda Ford, Tanya Bazelais, Terri Delese
Memorial Sloan Kettering Cancer Center, New York
Purpose: To increase the comfort level of nurses caring for patients receiving CRRT in the Intensive Care Unit. Nurses working at a national comprehensive cancer center were noticeably stressed and anxious when assigned to care for patients receiving CRRT. Nurses who did not have an opportunity to work on a regular basis with patients receiving CRRT were faced with a daunting task. They felt too much nursing time was devoted to caring for "the machine" which added the burden of managing multiple liters of fluid volumes each hour monitoring an extracorporeal circuit in addition to caring for a critically ill patient. They were frustrated that "the machine" was always alarming and were uncomfortable trying to troubleshoot. Methods: Volunteers were chosen to serve as leaders (Superusers) for the project 3 nurses were chosen from the day shift and 3 nurses from the night shift. There was a balance of both novice and experienced ICU nurses. The identified Superusers worked on the project with the CRRT machine for 2 months. With the dialysis nurse as part of the workgroup effort, they revised policies and created teaching materials that included a CRRT power point and reference flowchart. The group posted colorful visual aids in the unit including troubleshooting tips for CRRT and obtained other educational assistance from the CRRT provider. A CRRT binder was developed which hosted Evidence Based practice articles related to CRRT for reference as needed. Competency forms were developed for new nurses in addition to an ongoing competency assessment form.
Results/Conclusion: The Superusers became proficient and knowledgeable with CRRT and shared their expertise with other ICU nurses. The training sessions were well received by all nurses in the Intensive Care Unit. The dialysis nurse and CRRT Superusers are readily available to assist with the set-up and troubleshooting of "the machine" as needed. There is a noticeable difference with the reduction in anxiety and discomfort of the ICU nurses assigned to patients receiving CRRT. Nurses are not as reluctant to care for these patients. Some nurses have frequently requested an assignment with a patient receiving CRRT as they become more comfortable and proficient. Since the start of Superusers there is a decrease with the complaint of problems with "the machine" and as a result it has a more welcome presence in the ICU for nurses caring for patients with acute renal failure who are receiving CRRT.

81. Electronic CRRT Flowsheet: Decreasing Errors and Increasing Nurse Recruitment
Troy Gideon, Mary Wickman, Marysol Cacciata
St. Jude Medical Center
Purpose: The Critical Care nurse manages all aspects of renal therapy and nursing care in providing Continuous Renal Replacement Therapy (CRRT) in the Critical Care Unit (CCU). A flowsheet is the tool used to document and guide the management of these complex patients and can be in paper or
electronic format. Flowsheets are typically designed to keep a historical depiction of care but can also be structured to keep track of fluid volume calculations. The purpose of this project was to design and test an electronic flowsheet to improve patient care by making calculations more accurate while ensuring patient safety through consistent documentation. 

**Methods:**
CRRT patient volumes have to be calculated multiple times to achieve the ordered fluid removal. The number of calculations can vary from 1 to 16 over a 24 hour time period. These calculations in and of themselves are fairly basic, but when you combine the multitude of calculations needed, the occurrence of utilizing negative numbers, and the high acuity level of care needed for these patients, the risk for error increases significantly. Chart reviews showed that 92% of audited records had at least one calculation error and 17% of these errors resulted in a patient volume variation error greater than 5 mL’s in a 12 hour period. Surveys also showed that for non CRRT certified CCU nurses; the worry of making a calculation error was a primary reason for not wanting to get certified. In response to these issues, we created an electronic flowsheet that performed the calculations. At a later date when our computerized documentation system could accommodate the calculations, we incorporated the program into the system to prevent multiple forms of documentation.

**Summary of Results**
- By creating this tool, the calculation error rate decreased to 3%, and errors resulting in a patient volume variation of greater than 5 mL’s in a 12 hour period decreased to less than 1%. Our number of certified CRRT nurses increased by 15% since tool implementation and when surveyed, 7% of the nurses stated that the new tool positively affected their decision to become certified. 

**Conclusion:** CRRT flowsheets are more complex than normal patient care flowsheets because of their need to function as a worksheet, this complexity results in increased work for the nurse and high incidence for error. Significantly, this tool not only increased calculation accuracy but also was a positive recruitment tool for CRRT nurses.

**82. How is it Possible to Mobilize Patients Treated with CRRT**
Anna Kraegpoeth, Elisabeth Kastbjerg, Gitte Aalling, Jens Madsen, Susanne Joergensen  
Dept. of Anaesthesiology and Intensive Care Odense University Hospital Denmark

**Introduction:** It is a multidisciplinary unit with 22 beds. 8 beds for CRRT. Standard treatment is CVVH pre– and post-dilution: 35 ml/kg. Intensive care nurses provide all tasks in connection to CRRT. In 21 95 patients were treated with CRRT. The unit has no sedation strategy and a nurse patient ratio 1:1. 

**Purpose:** Creating awareness of the possibility that critical ill patients can be mobilized from bed to chair. CRRT
patients should be mobilized to prevent complication caused by bedrest. Mobilizing the patients to a chair strengthens the patients integrity and experience of normality. **Method:** Before mobilization the patients have to be screened that the mobilization from bed to chair is safe. This includes: contraindications, haemodynamic, respiratory, level of consciousness, pain, BMI, location of the dialysys catheter. Preparing the mobilization: secure invasive catheters, change the dilution fluid and drain the filtration bag to avoid these interventions during the mobilization. Information and accept from the patient: important to make a deal about the duration of the mobilization, appropriate location of the equipment; organize help from colleagues; delegate the responsibility of the invasive catheters, the ventilator etc. It may be necessary to make a reduction of the blood flow during the mobilization. The patient will be mobilized with a ceiling fitted lift from bed to chair. The monitoring is sequential during and after the mobilization. The patient has the opportunity to watch TV, listen to the radio and have visitors for an equal communication face to face. **Results:** In a period of 12 days we registered the patients who received CRRT compared to sedation, assist ventilation and mobilization. CRRT: The unit treated 44 patients. 6 patients received CRRT. Sedation: 2 of the 6 patients (33%) were sedated (respectively 12 and 5 days). Assist ventilation: 6 patients was intubated (1%). Mobilization: 5 of the 6 patients were mobilized during CRRT (83%). **Conclusion:** Our experience and assessment is that patients treated with CRRT can be mobilized. Before mobilization the patient must be screened, too ensure the safety of the mobilization from bed to chair.

83. RN Staffing in a Pediatric CRRT Program
Scott Ludes, Kristina J Burger
All Children's Hospital, Saint Petersburg, FL, USA
**Introduction:** Pediatric use of CRRT is limited in the United States, limiting the amount of available data and statistics available to set benchmarks or outcomes. Additionally, RN staffing needs during therapy has not been established, and many variances exist between providing centers. The purpose of this study was to collect data regarding Registered Nurse (RN) staffing of CRRT patients and determine if a relationship exists between RN staffing ratios and time off circuit for troubleshooting and/or circuit changes. Data was also collected to assess the time between physician order and initiation of therapy. **Objectives:** This study explored the following research questions: 1. What is the relationship between nurse-to-patient staffing and time off circuit for troubleshooting? 2. What is the relationship between nurse-to-patient staffing and time off circuit for circuit tubing changes? 3. What is the mean time between physician order for initiation of CRRT and time therapy has begun? **Methods:** A retrospective chart review was the design for this study. The population is patient’s who have received CRRT over the past 5 years at All Children’s Hospital in the pediatric intensive care unit and cardiovascular intensive care unit. Patients who have had CRRT running concurrently with Extracorporeal Membrane Oxygenation (ECMO) were not included in the study. **Results:** The sample size was 84
medical records of patients who received CRRT between May 25 and August 21. Seven records were excluded due to CRRT and ECMO running concurrently, and 12 records were unavailable for review. Data was collected for analysis from 65 records. The patient’s ages ranged from 3 days old to a 65 year old with a congenital heart defect. Therapy time ranged from one to 38 days with a mean of 6.1 days. RN Staffing options for this period were Gambro Clinical Specialist on-call, CRRT staff on-call, and CRRT staff prescheduled. Mean time from order to initiation of therapy was 269.5 hours. There is a significant difference in mean time for staffing options (p=.41). Additionally, there is significant difference between staffing and off circuit time for troubleshooting and circuit changes. Results and implications for practice are discussed including practice changes encountered since the program had begun.

84. Nursing Knowledge of Pediatric CRRT Principles and Troubleshooting
Scott Ludes, Kristina J Burger, Frances Pfister
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Education and training is an important aspect of preparing a nurse to care for a pediatric patient who requires CRRT. General concepts and pathophysiology of kidney injury and failure are imperative in order to fully understand the treatment and necessary hourly calculations. Additionally, the nurse must also have proper training to set up and manage the CRRT machine.
When providing training it is expected that the learner complete and evaluation of the program as well as complete necessary skills in order to be competent. However, even with the classroom learning and clinical practice, very few education programs re-evaluate the ongoing retained knowledge and troubleshooting ability. Outcome measurement of training is done well at the end of the session, but frequently falls short for long term evaluation. CRRT is a complex treatment which is not just running a machine, but constantly evaluating the effects of the treatment and prevention of complications.
The goal of this project was to provide an opportunity for staff nurses who care for pediatric CRRT patients to re-evaluate their initial training and demonstrate ongoing critical knowledge regarding the bedside care of the patient. The setting is a 28 bed pediatric critical care unit which provides CRRT to 12-15 patients per year. All bedside nurses who have completed training were asked to complete an evaluation prior to an update class. Twenty evaluations were returned and elements included a Likert Scale of training objectives and seven multiple choice and true/false questions about bedside care and policy.
Results indicated that staff felt they still met the course objective (mean=4 on 1-5 scale). The lowest mean score of 3.89 was given to the statement "Original classroom time was enough to cover the material". However, the mean score for the seven other questions was only 72%. Questions which scored less than 8% were regarding safety and alarm conditions. Results of this data have provided the CRRT trainer to make changes to the course and training in order to improve nurses knowledge and preparation, and provide higher quality of care to the patient. Other
organizations can implement a similar tool to evaluate their training programs. The scores can also be used to drive quality initiatives and track/trend occurrences.

85. Non-invasive Hemodynamic Monitoring Used to Determine Rate of Fluid Removal with Continuous Renal Replacement Therapy

Christopher J Burdick, Lauire Grier
Louisiana States University Health Science Center

Introduction: Hemodynamically unstable patients in the intensive care unit (ICU) who develop acute kidney injury (AKI) have shown to have an increase in morbidity and mortality. These patients who develop AKI frequently require some type of renal support. Evaluation of volume status in these patients can be problematic as typical measures such as decreased urine output, hypotension, and cardiac dysfunction are not reliable indices. The use of non-invasive monitoring in these situations can assist with the determination and maintenance of volume status.

Case: 34 y/o white female presented to the emergency room with increasing shortness of breath and dizziness. Pt states that she has had cough and fever for 4 days. In emergency room she is found to be hypotensive and hypoxic. She was intubated for respiratory distress and transferred to the ICU for further care where she was started on vasopressors and mechanically ventilated. Over the following three days the patient developed AKI and was transferred to our facility for further management. On arrival to our facility the patient’s creatinine was found to be elevated to 2.6 and blood urea nitrogen (BUN) of 3 and lactic acid of 4.2. She had been oliguric for past 24hrs and was 6 liters net positive since hospital admission. Femoral Arterial Catheter was placed and FloTrac sensor and a Vigileo monitor (Edwards Lifesciences Irvine California) attached. Femoral Venous Dialysis Catheter was placed and continuous renal replacement therapy (CRRT) was started. Stroke Volume Variation (SVV) was monitored and fluid removal rates were adjusted to keep SVV between 1-15%. Over the next 48hrs the vasopressors were discontinued and the patient’s creatinine decreased to 1.4, BUN to 2, lactic acid to 1.1 and net fluid balance from hospital admission was decreased to a positive 2 liters. Discussion: Non-invasive hemodynamic monitoring has been used to continuously assess fluid status in hemodynamically unstable ICU patients. We instituted this technology in this unstable AKI patient who require CRRT, and were able to get optimal tissue perfusion without excessive fluid shifts. Monitoring SVV enabled us to remove excessive fluid and minimize episodes of poor tissue profusion which was demonstrated by few episodes of hypotension and improvement of patients lactic acid.
ABSTRACTS FROM 17TH INTERNATIONAL CONFERENCE ON CRRT, SAN DIEGO, FEB 14-17, 2012

TARGETED INTERVENTION WITH CRRT

86. Therapy In Patients With Acute Kidney Injury Admitted To The Cardiac Surgery Intensive Care Unit Between January 26 And January 2011.
Jesus A Carrillo Rojas, Maria-Elena Reyes-Sanchez, Elfego Bautista-Cortes Centro Medico La Raza, Instituto Mexicano del Seguro Social

Background: Acute kidney injury during cardiac surgery is a very common complication. 5% to 3% of patients develop some degree of kidney injury, with associated elevated mortality. The development of sepsis in this same group of patients is associated with an increase of acute kidney injury, as well as mortality, which varies from 17% to 65%. We conducted a transversal, descriptive, observational, retrospective study on post-operative cardiac surgery patients; study’s objective was to analyze the results of using CRRT and its impact on mortality. Methods: During the period between January 26 and January 211, 3,12 post-operative cardiac surgery patients under extracorporeal circulation were admitted into post-operative therapy. Of these, 16% presented acute kidney injury under creatinine and urine output criteria. Average age was 58.9 years. Demographic variables, surgery type, cardiopulmonary derivation and aortic clamp time, functional class, number of failures, creatinine and urine output, and time at which continuous renal replacement therapy began were measured. Results: Three thousand one hundred twenty post-operative cardiac surgery patients were admitted, of which 59% were men and 41% were women, 6% had undergone revascularization, 35% had undergone valve replacement, and 3% had congenital anomalies. Average clamp time was 55 minutes, and average extracorporeal circulation time was 145 minutes. Sixty-seven % of patients were NYHA functional class III, and 61% had three organ failures. Of the total population 5 patients (16%) developed acute kidney injury (according to RIFLE criteria). Seventy-eight patients had complications with sepsis; of these, 16 patients (2.5%) (I = 4; F = 12) were administered continuous renal replacement therapy as of 43.5 hours following diagnosis, with an initial creatinine level of 3.8 mg/dL, and 1.3 mg/dL at the end of therapy. Initial urea was 65 +/- 6.3 mg/dL and decreased to 34.7 +/- 6.5 mg/dL. Urine volume increased from .3 mL/kg/hr +/- .9 to 1. mL/kg/hr +/- .3. Mortality rate was 2.5%. The remaining patients of this group did not receive renal support, and their mortality rate was 17.9%. Conclusions: The use of renal replacement therapies on post-operative cardiac surgery patients complicated with sepsis and acute kidney injury has a positive impact on morbidity and mortality. Therefore, developing algorithms oriented toward diagnosis and timely treatment becomes necessary.
87. Mars System for Acute Liver Failure due to Hepatitis A, Complicated by Acute Renal Failure. Case Presentation
Janette Estefan-Garfias, Mario A Sebastián-Díaz, Porfirio Visoso-Palacios
Hospital Central de Alta Especialidad del Sur. Petróleos Mexicanos
A 26-year-old man with weakness, adynamia, vomit, and abdominal pain was admitted in August 21. Patient was administered acetaminophen and quinolones for suspected infectious gastroenteritis. Five days later the patient showed at the emergency room and was admitted to the hospital for various tests and diagnosed with infection due to hepatitis A, IgM positive. His symptoms were treated, and he was discharged 24 hours later. He returned three days later, and due to elevated hepatic enzymes and oral intolerance, he was transferred to the ICU and administered hemodialysis due to overhydration, anuria, metabolic acidosis, and nitrogen retention. Due to lack of response, he was transferred to our unit, where the diagnosis was confirmed: hepatitis A seropositive and hepatitis B, C, CMV, and Epstein-Barr negative. Upon admission, he presented bleeding at the catheter insertion site and thrombosis of the right basilic vein. Anticoagulation was performed using LMWH, then orally. On September 17, once coagulation times had improved, the catheter was removed and relocated to left jugular level. The Molecular Adsorbents Recirculating System (MARS) was used. Patient received five eight-hour sessions with hemodialysis, bicarbonate buffer, UF 5 mL, QB 2 mL/min, QD 5 mL/min, 6 mL of human albumin 2% with no complications. Liver function tests showed improvement and a decrease in bilirubin levels after each session. The patient began urination after the first session (.5 mL/kg/hr) and entered into the polyuric phase eight days later, recovering full renal function three months later. The patient presented nosocomial pneumonia caused by Staphylococcus Epidermidis and was administered Meropenem with an adequate response. Albumin causes the amalgamation of a large amount of substances implied in the development of hepatorenal syndrome, hepatic encephalopathy, and hemodynamic instability, and the MARS system has been associated with improved bilirubin and ammonia levels and, therefore, improved encephalopathy and hepatic regeneration. Although there are no studies that absolutely support this type of procedure, it is evident that its use and multidisciplinary support make the pathology to present fewer complications and a better outcome.

88. The Hemodynamic effects during Sustained low-efficiency dialysis versus Continuous veno-venous hemofiltration for patients with intracranial hypertension in a cross over study
Chih-Chin Kao, Vin-Cent Wu, Dow-Ming Huang, Chin Fu Lai, Pi-Ru Tsai, Wen-Je Ko, Kwan-Dun Wu
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Background: Hemodynamic instability occurs frequently during dialysis treatment and still remains as significant cause of patient mobility and mortality, especially in patients with increased intra-cerebral pressure (ICP). This study was to compare the ICP and hemodynamic parameters between the sustained low-efficiency dialysis (SLED) and continuous veno-venous
hemofiltration (CVVH) in end-stage renal disease (ESRD) patients.

**Methods:** ESRD patients with increased ICP status post ICP monitor insertion were enrolled. Patients were randomized to receive CVVH or SLED first and then the other the next day. The ICP monitor was equipped and the indwelling radial artery catheter connected to the FloTrac/Vigileo hemodynamic monitoring system and for whom the ultrafiltration rate was set around 1 kg/8hr to 1.5 kg/8hr according to fluid status.

**Results:** Ten patients (6 female, mean age: 59.9 ± 11.9 years) were analyzed. The disease severity assessed by APACHE II was 28. ± 5.1 at the enrollment. There were no significant differences of blood pressure, heart rate, cardiac output, and cardiac index between the SLED and CVVH. The stroke volume was increased 7.5 ± 18.1% in CVVH and -.1% ± 13.7% in SLED patients at 6 hours after dialysis. The stroke volume index also increased 8.8% ± 17.3% in CVVH and -2.9 ± 15.6% in SLED at 6 hours after dialysis. The stroke volume variation was significant different in CVVH from SLED (87.9 ± 27.7% vs -13.7 ± 24.7%, p=.42). The modality effect on stroke volume, stroke volume index and stroke volume variation were all significant (p<.5). The time effect on intra-cerebral pressure (ICP) level after dialysis was significant (p=.7). However, the ICP level was no significant difference between the treatment modality. The dialysis dose quantification showed higher in SLED than CVVH after 8 hrs dialysis. (EKRjc, 62.7± 19.5 vs 5.2 ± 17.5 ml/min, p=.2)

**Conclusions:** We provide conclusive evidence that under controlled cross-over conditions, SLED and CVVH displayed an identical acute hemodynamic profile. Both modality augmented intra-cerebral pressure after dialysis. SLED showed excellent detoxification; however, the decrease in the venous return on SLED will greatly affect stoke volume during hypovolemia.

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**89. MARS Benefits Patients with Liver Failure Complicated by AKI**

*Amay Parikh, Abdallah Geara, Robert Brown, Jai Radhakrishnan*  
*Columbia University*

**Purpose:** Acute liver failure (ALF) and acute on chronic liver failure (AoCLF) are associated with high morbidity and mortality. In those requiring renal replacement therapy, mortality reaches 7% before undergoing liver transplantation. Current optimization utilizes continuous renal replacement therapies (CRRT) to ensure electrolyte balance. The primary objective of the study is to evaluate the efficacy of extra-corporeal albumin dialysis (ECAD) in patients with acute liver failure (ALF/AoCLF) and acute kidney injury (AKI) in improving duration to liver transplantation.

**Methods:** Patients with AKI and ALF/AoCLF prescribed to receive CRRT were recruited. Molecular Adsorbent Recirculating System (MARS®) was used daily for 8 hours and patients received CVVHDF for the remaining time. Patients received a maximum of 5 MARS treatments. Following 5 days, the patient continued to receive CRRT. **Results:** 5 patients with AKI and ALF/AoCLF received MARS. The MARS was used for an average of 2.6 days (1-5). Two patients underwent successful liver transplant, 2 died and 1 was discharged on intermittent hemodialysis. Bilirubin reduction ratios ranged from 12 to 49%. Total bilirubin improved in all 3 patients
with AoCLF; no improvement was witnessed in the 2 patients with ALF. HESA and GCS scores remained stable or improved in all 5 patients.

**Conclusion:** Despite the high mortality rate, patients with AKI and liver failure benefit from treatment with MARS and CVVHDF which increases the time until a liver transplant can be performed.

<table>
<thead>
<tr>
<th>Indication for MARS</th>
<th>Pt 1</th>
<th>Pt 2</th>
<th>Pt 3</th>
<th>Pt 4</th>
<th>Pt 5</th>
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</thead>
<tbody>
<tr>
<td>Hep B cirrhosis</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Hep C cirrhosis</td>
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<td>Acetaminophen induced acute liver failure</td>
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<td>Nonalcoholic steatohepatitis cirrhosis</td>
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<tr>
<td>Liver lymphoma</td>
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</table>

| Days on MARS | 4 | 5 | 1 | 2 | 1 |
| Outcome | Discharged on Dialysis | Liver Transplant | Liver Transplant | Death | Death |
| Change in HESA | 1 (3->2) | 1 (3->2) | N/A | N/A | N/A |
| Change in GCS | 7 to 15 | 15 to 15 | 5 to 5 | 3 to 3 | 7 to 7 |
| Change in total bilirubin | ↓49.2% | ↓17.2% | ↑165.6% | ↓12.8% | ↑6.4% |
| Change in creatinine | ↓58.3% | ↓76.2% | ↓34.2% | ↓66% | ↓32.1% |

90. **Impact of Albumin Dialysis on Albumin Binding Function**

**Jan Stange, Maria Kretschmann, Sarah Froehlich, Birka Krellenberg, Melanie Stiffel, Sebastian Koball, Joerg Henschel, Martin Gloger, Martin Eggert, Steffen Mitzner**

**Center for Organ Support & Regeneration, Dept. Medicine, Intensive Care Unit**

**Background:** Liver Failure is associated with an accumulation of endogenous toxins at the main albumin binding site for multiple vasoactive, neuro-, nephro- and hepatotoxic metabolites (Klammt et al. EJGH 27). The resulting binding dysfunction can be quantified using fluorescence markers competing for binding sites with said toxins The Albumin Binding Capacity (ABiC) correlates with mortality. Patients in whom ABiC can be improved within 7 days have a mortality of only 6.25% while patients who maintain a low binding capacity below 4% over 7 days despite treatment have a mortality of 83% (Klammt et al. Liver Transplantation 28). Therapeutic means to improve ABiC include extracorporeal detoxification removing albumin bound toxins and infusion of albumin. The effect of the latter is limited by the occupation of therapeutic albumin binding sites by commercial conservatives such as Caprylate and N-Acetyltryptophane (Stange et al. Liver Transplantation 211). Since Albumin Dialysis so far is based on commercial albumin as Dialysate the effect of stabilizers on capability to improve ABiC was investigated.

**Methods:** Plasma samples were taken before and after Mars treatments in patients suffering from liver failure. Bilirubin, Bile Acids and ABiC was measured before and after treatments and
compared by paired tests. **Results:**

MARS resulted into a significant reduction of bilirubin and bile acids, however, despite this effective removal, the effect of individual MARS treatments on albumin binding function did not reach significance.

Caprylate measurements in the albumin dialysate compartment of the MARS circuit revealed caprylate concentrations of 1.53 umol caprylate/umol albumin, despite pre-circulations of the albumin circuit of 3 minutes over adsorbents according to the manufacturer’s specifications may resolve this problem. **Conclusion:** Improvement of patients ABiC by albumin dialysis requires a higher ABiC of Dialysate Albumin than Patients Albumin. Although pre-treatment recirculation of the MARS Circuit for 3 minutes can reduce the caprylate/albumin ratio, a target of less than .3 umol caprylate/umol albumin cannot be achieved in the current set up, which would be required to achieve an albumin binding capacity of >95% in the MARS Circuit.