CRRT Applications

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CRRT Applications

1

Continuous Renal Replacement Therapy (CRRT) for Non-Renal Indication: Hypernatremia in a patient with Congestive Heart Failure

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Background: In management of hypernatremia developed in a patient with congestive heart failure, fluid therapy may be insufficient because fluid replacement can induce hypervolemic state. In this regard, we report a case that was successfully treated by CRRT from hypernatremia with hypervolemic state that developed in a patient with congestive heart failure. Case: A 53 years old man visited Emergency Room because of oliguria and confusion. During the previous a few days, he had suffered from poor oral intake. Three years ago, he was diagnosed as congestive heart failure resulted from myocardial infarction. On echocardiography, global dyskinesia and decreased systolic function (ejection fraction was 20.9%) was detected. Initial laboratory finding was serum sodium level of 169 mEq/L, blood urea nitrogen of 42.3 mg/dL, and serum creatinine of 1.79 mg/dL. Calculated water deficit was 7.8 L and FeNA was 0.3, which indicated volume depletion. We started fluid supplement and promptly urine output was increased. Serum creatinine level was normalized, but serum sodium level was still 157 mEq/L. We could not treat hypernatremia with sufficient fluid supplement because of the risk of pulmonary edema. We performed fluid supplement and medical therapy of pulmonary edema including intravenous furosemide alternately. However, the patient still had hypernatremia with pulmonary edema. He was sent to Intensive Care Unit and we started CRRT. After 3 days' treatment of CRRT, pulmonary edema disappeared and serum sodium level decreased to 145 mEq/L. During patient was on CRRT, hemodynamically unstable event did not occur. He discharged with improved condition. **Conclusion:** This case suggests that CRRT is effective not only in patients with impaired renal function but also in non-renal indication such as hypervolemia or electrolyte disturbance combined in acute non-renal diseases in the intensive care setting.

2

SLEDDing in the ICU

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Background: Christiana Care Health System (CCHS) is known for being progressive and using state of the art technology to provide exceptional care to the local and surrounding communities. Because the equipment used by the Hemodialysis Department (HD) was rapidly becoming outdated, a need to explore new options arose. Staff satisfaction with the Continuous Renal Replacement Therapy (CRRT) was minimal. A focus group was formed to evaluate various options available which included continuing with the current modality or exploring a new modality such as Slow Low Efficiency Daily Dialysis (SLEDD). Literature showed that SLEDD was an alternative for CRRT in the Intensive Care (ICU) setting. Changing to SLEDD would allow CCHS to purchase HD machines capable of performing both intermittent HD (IHD) and SLEDD. The team determined that changing the modality would be beneficial to patient outcomes, be more cost effective, and improve stakeholder satisfaction. They then began to develop a plan for implementation. In Jan 2008, the group's goal was to change modalities within a nine month period. Team Members included nursing staff from HD, all 5 ICU's, and Nursing Resources; Physicians, and Pharmacists. Multiple meetings took place to design new physician order sets, nursing flowsheets, and Clinical Practice Guideline. CCHS purchased Fresenius 2008K HD machines staff began utilizing them for IHD in order to become familiar with them. Nephrologists were updated regarding the new modality and system changes. Education for ICU staff was developed and included handouts, classroom instruction, and hands on machine orientation. Resource nurses were identified and trained in each individual ICU. A resource phone was identified and answered by a HD nurse for immediate response to questions. The goal was met and go-live was accomplished on Oct 15, 2008 with conversion from CRRT to SLEDD throughout all CCHS. Pre and post implementation data was gathered and results have not shown any significant alterations in outcomes. Data from a staff satisfaction survey suggest marked improvement. Minor updates in the physician orders and the nursing flowsheet have taken place as a result of staff feedback. The team

continues to meet quarterly to review results and opportunities.

3

The Treatment of Intractable Adult Idiopathic Focal Segmental Glomeruloslerosis by Continuous Veno-Venous Hemofiltration

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Objective: To observe the effect of intractable adult idiopathic focal segmental glomeruloslerosis(FSGS) treated by continuous veno-venous hemofiltration(CVVH).

Methods: A retrospective study was performed to analyze the data of 33 patients receiving CVVH in Research Institute of Nephrology, Jinling Hospital, who were diagnosed as idiopathic FSGS by renal biopsy. The indications for CVVH included irresponsiveness to steroid or immunosuppressant, ultra-massive proteinuria, severe hypoalbuminemia, severe edema, pleural effusion, acute kidney injury, electrolytes abnormality, infection. The protocol for CVVH was as following: right jugular venous catheterization was used as blood access, hemofilter was AV600 filter, substitute fluid was infused by pre-dilution route at the rate of 2L/hr(in patients with serum creatinine<1.2mg/dl) or 4L/hr(in patients with serum creatinine≥1.2mg/dl or hypercatabolism).**Results:** Among 33 patients, 6 cases was previously untreated, 17 were irresponsive to either steroid or cytotoxic agents, 3 were steroid-dependent, 7 were resistant to steroid. Pre-existed complications were found: hypercoagulation status in 17 cases, hypotension in 15 cases, electrolytes abnormality in 7 cases, infection in 8 cases, severe edema or pleural effusion in 18 cases. Twelve patients received the fluid exchange rate of 2L/hr, the others received the rate 4L/hr. The mean treatment duration was 41.26±22.57hr, and mean cumulated net ultrafiltration volume was 8.23±5.34L（the largest value 37.65L). The mean weight loss was 6.05±4.57Kg(the largest value 17.3kg). After CVVH, all above-mentioned pre-existed complications were corrected, estimated glomerular filtration rate(eGFR) was reduced in 11 patients, and was stable in 20 patients. There was no difference between patients with reduced eGFR or stable eGFR on net ultrafiltration rate or weight loss, but difference existed on hypotension occurrence. Twenty-five patients were followed up for 1-2 months, and 8 dropped out. Among 25 patient finished follow-up, 20 cases were in stable eGFR, and 5 with reduced eGFR. In regarding proteinuria, 11 experienced partial remission, and 1 experienced completed remission, and 13 had no response.

Conclusions: CVVH is effective in correction of complications of patients with intractable idiopathic FSGS, and may improve their responsiveness to steroid or immunosuppressant. However, its potential impact on renal function is still needed further investigated.

4

Treatment Of Hyperlipidemia Due to Nephrotic Syndrome using Double Filtration Plasmapheresis Combined with Oral Statins

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Objective: To evaluate the effect on blood lipoprotein level of double filtration plasmaphersis(DFPP) combined with oral statins in patients with severe hyperlipidemia due to nephrotic syndrome(NS). **Methods:** Six patients with severe hyperlipidemia(total cholesterol >=10mmol/l) due to NS were treated with seven sessions of DFPP. DFPP was performed using a primary plasma separator MPS07(Bellco,Italy) and a secondary plasma component separator Cascadeflo EC-50W(KAWASUMI LABORATORIES,Japan), with 1.5-2 folds plasma volume being treated. The clinical symptoms, serum levels of blood lipids ,immunoglobin and fibrigen(FIB) were observed before and after DFPP. Prior to and after DFPP, 3 patients received oral statins therapy and the others not. **Results:** The average age of the six patients was 27.5±14.8 (14-52)years old. Total treated plasma volume was 4857±1160 (3700-7100) ml per session. After treatments there were significant reduction of total cholesterol (Tchol),triglyceride (TG),low density lipoprotein(LDL),high density lipoprotein (HDL), apolipoprotein A (apoA), apolipoprotein B (apoB), IgM, IgA and FIB. A rebound of blood lipids was found in all patients after DFPP, which was much slower in the three patients receiving statins therapy .No notable side effects were observed during and after DFPP.

Conclusion: Combination of DFPP and oral statins is effective in control of severe hyperlipidemia due to NS in short term.

	before DFPP	after DFPP	p	reduction ratio for single session(%)
Glo(g/l)	17.14(±2.09)	8.26(±2.79)	<0.001	51.71(±14.03)
Tchol(mmol/l)	13.62(±2.88)	1.87(±1.11)	<0.001	85.71(±8.85)
TG(mmol/l)	3.93(±1.29)	0.75(±0.33)	<0.001	80.33(±6.10)
LDL(mmol/l)	8.98(±2.62)	0.9(±0.81)	<0.001	89.84(±10.29)
HDL(mmol/l)	1.35(±0.44)	0.51(±0.2)	0.001	60.81(±12.65)
apoA(mmol/l)	1.73(±0.23)	0.79(±0.20)	<0.001	54.63(±8.06)
apoB(mmol/l)	1.89(±0.263)	0.25(±0.2)	<0.001	86.52(±11.15)
IgA(g/l)	1.42(±0.9)	0.81(±0.63)	0.017	40.64(±19.91)
IgM(g/l)	1.27(±0.87)	0.18(±0.14)	0.027	84.40(±10.31)
IgG(g/l)	1.42(±0.65)	1.86(±1.14)	0.242	
Fibrogen(g/L)	423.57(±52.97)	188.0(±70.37)	<0.001	56.09(±13.28)

5

A case of continuous renal replacement treatment in a renal failure patient with acute liver disease simultaneous with myocardial infarction.

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Background: The development of renal failure in the patient with hepatic disease is one of the few prognostic indicators of poor outcome. Its presence is associatied with prolonged intensive care unit (ICU) stay, prolonged hospitalization and death. CRRT is becoming the treatment of choice for critically ill patients with acute renal failure. In particular, CRRT is used for patients with combined liver disease and renal failure, because they are often hemodynamically unstable. A 56-year-old diabetes mellitus male patient with a history of chronic alcohol ingestion (3 oz/day for 30 years), was admitted to the hospital with the symptoms of nausea, vomting, and general weakness. On admission day, he was confused, icteric, afebrile and blood pressure was 170/100 mmHg. Laboratory tests disclosed hemoglobin 15.5g/dL, heamatocrit 42.4%, WBC count 8700/mm3, platelet count 63000/mm3, serum creatinine 8.4 mg/dL, BUN 76.6 mg/dL, AST 1307 UI/l, ALT 2097 UI/l, total bilirubin 13.5 mg/dl. An ultrasound showed normal-sized kidneys, with normal cortical area and no obstruction. The patient remained oliguric despite aggressive fluid resuscitation.
On day 3, emergent hemodialysis treatment was started due to exacerbation of pulmonary edema. During hemodialysis, the patient became hemodynamically unstabe.The immediate transthoracic echocardiography (TTE) and ECG confirmed STEMI (ST elevation myocardial infarction) of the anterior wall. Because urgent coronary intervention was refused by his family, we infused with tissue plasminogen activator to the patient and CVVHDF was commenced immediately through a internal jugular venous double lumen catheter. CVVHDF was switched to extended hemodialysis after 72 hours with recovery of cardiac performance. On day 18, after 5 session of extended hemodialysis, renal function gradually improved with no need for further renal replacement therapy. The question arises as to whether the use of CRRT should be extended to those patients with acute and chronic liver failure who do not have dialysis-dependent renal failure.

6

Single center CRRT experience after cardiac surgery

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Objective: To evaluate the outcome of patients who require continuous renal replacement therapy (CRRT) following cardiac surgery in a single center. **Methods:** All patients who received CRRT after cardiac surgery from January 2006 to August 2009 at the Intensive Care Unit of Cardiothoracic Surgery were reviewed. Among 60 consecutive patients, 14 underwent CRRT postoperatively. **Results:** The mean delay between surgery and CRRT initiation was 2±3.5 days, and the duration of CRRT was 9±3 days, without a difference between survivors and non-survivors. Mortality was 33.3% after a coronary artery bypass graft (CABG), 62.3% after CABG and valve surgery, 25.0% after valve surgery. 79% of survivors and 86% of non-survivors had received a cardiopulmonary bypass ($p = NS$). The requirement of an intra-aortic balloon pump were higher in non-survivors ($p<0.05$). The mean length of ICU and hospital stay was 27.4 and 34.2 days for survivors and 17.9 and 22.3 days for non-survivors, respectively ($p<0.05$). However, there was no difference in median serum creatinine levels during the CRRT. **Conclusions:** Renal impairment is relatively common after cardiac surgery. The mortality of patients who required CRRT after cardiac surgery was 50.0% and was particularly influenced by the type of surgery. Moreover, it is more important that the early start of CRRT is essential to maintain patient's renal function.

7

Fluid Overload and CRRT in Critically Ill Patients

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Objective: CRRT is used for renal replacement and fluid management in critically ill patients. Recent study suggested that fluid accumulation is associated with adverse outcome in these patients. We reviewed our experience of CRRT in ICU patients to evaluate factors associated outcome. **Methods:** From January 2007 to December 2008, patients who underwent CRRT in ICU were evaluated. Percent fluid overload(%FO) was defined as total fluid input minus output (3days before CRRT start(%FO1) and from CRRT initiation to ICU discharge(%FO2)) divided by body weight. 143 patients underwent CRRT in ICU, we included 74 patients who had complete data. Clinical variables between survivors and nonsurvivors were analyzed. **Results:** Median patients age was 59.5 yrs. Mean renal replacement time was 109.24 hrs. 38 patients survived(51.4%). Median %FO2 was significantly lower in survivors vs. nonsurvivors(1.4% vs 6.5%, p=0.035). Median %FO1 was higher in survivors, but statistically not significant(5.5% vs 4.7%, p=0.492). Number of organ failure, body temperature, total bilirubin were significantly higher in nonsurvivors. Mortality rate between lower %FO and higher %FO group was not different. Total bilirubin and AST was lower in higher %FO group vs. lower %FO group (2.66mg/dl vs. 4.81mg/dl, p=0.013 and 281.0IU vs 575.9IU, p=0.032 respectively) **Conclusion:** Our study shows fluid overload during CRRT was associated with mortality. But fluid status during 3 days before CRRT was not associated with mortality. Because mean %FO1 was 5.1 and only 10 patients(13.5%) %FO was more than 10, actual fluid overload patients was small and this was limitation of our study.

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Citrate Regional Anticoagulation (CRA) in CRRT: Single Centre Experience

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Background: Citrate regional anticoagulation (CRA) has the potential to maintain or extend circuit life during continuous renal replacement therapy (CRRT) without a systemic anticoagulant effect or the need for heparin exposure. It also has been shown to prevent blood filter membrane interactions maintaining fiber bundle function. The use of citrate has been limited previously by the requirement for pharmacy-produced designer solutions and extemporaneous mixing as well as the lack of standardized protocols. In this report we describe our experience with a new method for providing CRA for CRRT. **Objective:**To study the efficacy of citrate as anticoagulation in continuous renal replacement therapy on dialysis filter survival. **Methods:** Our study included 6 consecutive patients who were in shock state requiring continuous renal replacement therapy. All patients who were included in the study were started on citrate regional anticoagulation according to protocol. **Results:** Out of 6 patients who were included in the study 3 were males and 3 were females. Mean age is 54. Three patients had cardiogenic shock; remaining three patients had septic shock .In one patient CRA was stopped because of ischemic hepatitis. Mean duration of dialyser survival was 78 hours. This was accompanied by excellent control of the clinical and biochemical parameters. **Conclusion:** It is possible to provide safe and effective CRA with commercially available solutions. There was a dramatic improvement of dialysis filter survival in patients who received CRA. This was accompanied by excellent control of the clinical and biochemical parameters. By improving the dialysis filter survival and clearances we can cut the cost of renal replacement therapy.

9

Parameters for Quality Assessment in a CRRT Program

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Background: Assessing the quality of care provided in a CRRT program is essential to maximize patient outcomes. National benchmarks have yet to be established for the acute care setting. **Objective:** To share the process and performance standards developed by UCSD for CRRT programs. **Methods:** The UCSD acute program has established parameters for assessing CRRT therapy quality. The performance improvement committee meets monthly to review the data, identify problem areas and develop action plans. Data is tracked for established indicators. Indicators and target thresholds have been established for FUN/BUN ratios, intake and output compliance, daily weights and nursing documentation. Additionally, chart reviews have provided data

for extended filter life, time on filter and the reason for filter changes. **Results:** Improved compliance with 24 hour intake and output goal, significant improvement on recording daily weights, extension of filter life, increased time on therapy, and reduction in nursing costs. **Conclusions:** The development of performance improvement parameters for a CRRT program has provided information for identifying problem areas, improving patient outcomes, and realizing financial benefits as it relates to nursing expense.

10

The use of CRRT-CVVH in Hemato-Oncological Intensive Care Unit in patients treated with Defibrotide for Venooclusive Disease in patients after Allogeneic Hematopoetic Stem Cells Transplantation

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Background: The complex care in hematooncological ICU requires sometimes the use of CRRT. As the hematooncological patiens (pts) have some specifications we retrospectively followed up the results of our effort in pts with acute renal failure due to venooclusive disease (VOD) after allogeneic hematopoetic stem cells transplantation. Venooclusive disease is one of the most severe early complication in this type of patients and its mortality is high. **Methods:** From 1.1.2007 to 30.10.2009 we performed 94 procedures (1 procedure = 24hrs) in 15 pts with VOD and acute renal oligo-anuric failure. As a standard we perform in our ICU CVVH with post dilution on Fresenius Multifiltrate machine. The key drug for the treatment of VOD is defibrotide and the pts were severe trombocytopenic, we have not used any anticoagulation in CVVH set. The dose of defibrotide ranged from 10 to 20mg/kg/day according to the severity of trombocytopenia and eventualy hemorrhagic symptoms. Blood count, acid-base balance and biochemistry were monitored at least twice daily. The trombocytopenia was corrected with the donor platelets and the platelets level was sustained on the 20x109/L. **Results:** The introduction of CVVH in all of the 15 pts dramatically helped to overcome the severe part of the VOD until the defibrotide helped to restore the right function of vascular endothelium. No one of the 15pts died on VOD as a cause of death. Suprisingly the median patency of the CVVH tubing set was 46 hours despite of no anticoagulation in the tubing set. Defibrotide is efficient in preventing of coagulation in the tubing set. No serious hemorrhagic events were observed. The fluent maintenance of fluid balance, the removal of waste products of metabolism and the maintenance of acid-base balance was very important for the patient in the critical point of advanced VOD. **Conclusions:** CVVH is integral part in intensive care in hematooncology and the use of this therapeutic modality in pts with VOD with acute renal failure can significantly improve the results of our therapeutic effort.

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Successful treatment of Continuous Renal Replacement Therapy in a patient with Acute Kidney Injury after Anaphylactic Shock due to Ceftriaxone use.

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Background: Aanphylaxis is a potentially fatal disorder. Anaphylaxis is not always recognized as such because it can mimic many other conditions and is variable in its presentation. We report a 49-year-old male survived from acute kidney injury due to antibiotics induced anaphylactic shock by Continuous Renal Replacement Therapy. He was transfered to our hospital from local clinic because of hypotension, anuria, thrombocytopenia, elevated liver enzyme and unknown origin fever. He had been treated with Ceftriaxone for 3 day because of pharyngitis and fever. He had elevated serum BUN and creatinine levels, requiring hemodialysis treatment at the time of arrival. But conventional hemodialysis was not available because of hypotension. On admission day, we started continuous renal replacement therapy (Prisma®, gambro) and mechanical ventilation care at ICU. After 22 days of continuous venovenous hemodiafiltration (CVVHDF), his urine output recovered and his BUN, creatinine, liver enzyme levels returned to normal. And 7 days later he was weaned mechanical ventilation care and stopped ICU care. During the treatment of CVVHDF, we did not have any evidence of atypical infection. After 14 days later general ward care started, he was administered Ceftriaxone one time by mistake. He had hypotension, pancytopenia, elevated serum BUN, creatinine and liver enzyme levels again. He recovered his normal blood pressure, normal

liver and kidney function after 6 more days ICU care with dopamine, epinephrine and diuretics.

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Risk Factors of Acute Renal Failure in Critically Ill Children Treated With Continuous Renal Replacement Therapy

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Objective: Acute renal failure is a common problem among pediatric intensive care unit (PICU) patients, and is associated with high risk of mortality and substantial morbidity. Continuous renal replacement therapy (CRRT) has emerged as the preferred dialysis modality for critically ill patients. We reviewed our experience with pediatric CRRT patients admitted to PICU to evaluate risk factors associated with outcome. **Methods:**We retrospectively reviewed the medical records of critically ill patients admitted to our 14-bed pediatric ICU requiring CRRT for acute renal failure from November 2004 to October 2009. **Results:** A total of 68 patients received CRRT for acute renal failure during the study period. The median age was 6.8 (range, 0.1-24.0) years and 50% of the patients were males. The overall mortality rate was 51.5%. The most common cause leading to CRRT was sepsis or septic shock (n=29, 42.6%). Hemato-oncology disease (n=33;48.5%) and liver disease (n=12;20%) were the most common comorbid underlying conditions and only one patient presented with primary renal disease. The patients with underlying congenital heart disease showed the highest mortality(83.3%). The mean %fluid overload (%FO) at CRRT initiation was 12.7% in survivors vs 19.5% in nonsurvivors and was not significantly associated with mortality ($p=0.112$). Pediatric Risk of Mortality (PRISM II and PRISM III) score, Sequential Organ Failure Assessment (SOFA) score, number of organ failures, and use of vasopressors or mechanical ventilatory support at CRRT initiation were significantly lower in the survivors than in the nonsurvivors ($p<0.01$). Presence of multiple organ dysfunction syndrome (MODS) showed a significant relationship with mortality ($p<0.01$). And, the mortality increased with increasing number of failed organs (number of failed organs 1-2: 7.1%, 3-4: 48.6%, 5-6: 89.5%) and SOFA score (score 0-4: 25%, 5-9: 26.7%, 10-14: 54.1%, ≥15: 90.9%). **Conclusion:**The mortality in critically ill children treated with CRRT was correlated with the number of failed organs and SOFA score, but not with fluid overload and parameters of renal failure. CRRT survival may be associated with the severity of MODS, rather than that of renal failure.

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High-volume hemofiltration septic shock: Experience police hospital, Chile

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Background: The high volume hemofitracion (HVHF) represents an emerging therapy in the treatment of severe septic shock. His evidence is still evolving, given the small number of patients and heterogeneity of designs. In this treatment paradigm, we show our experience in the real world, outside the tight control and selection bias in a clinical trial. **Methods:** Retrospective analysis of cases treated from April 2008 to August 2009 in a general ICU of 6 beds, closed system. All therapies were given and guided by residents of the unit, with the existence of a coordinator with experience in continuous venovenous hemofiltration. It included all patients with severe septic shock, refractory to achieve the goals of resuscitation, with the usual measures of the Surviving Sepsis Campaign 2008, being a measure of HVHF bailout. The renal failure was not a necessary criterion for the start. Therapy success was defined as a fall in norepinephrine level> 50% with MAP> 65 mm Hg. Severity scores were recorded and SOFA admission the day of initiation. actual versus expected mortality, as well as indices of oxygenation, vascular access complications and therapy itself. Stata Statistical 8.1 **Results:** We treated 12 patients on mechanical ventilation all with mean APACHE II 28 and SOFA 17 the starting day of HFAV. The most common etiology corresponded to tertiary peritonitis. The average effective replacement dose of 50.4 ml / kg / hr. Only 2 patients did not meet criteria for success (16.6%). Mortality at 30 days was 50%. There is a clear and significant improvement in oxygenation index. Complications from central venous double lumen catheter, a non-surgical management hematoma and one case cellulite. **Conclusion:** Treatment feasible and safe to implement by intensivists in a closed system. Emphasizes the high response rate, with mortality by SOFA at the time of initiation of therapy greater than 90% actual versus 50%. Despite being retrospective, there is consistency

with international prospective work undertaken, which enhances its utility, perhaps not only as a salvage therapy.

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Management of severe tumor lysis syndrome with CVVH: A case report

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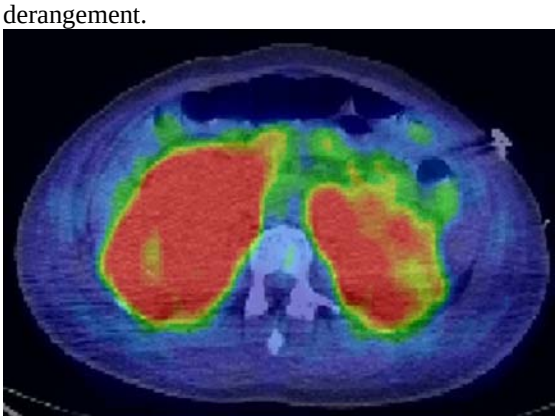
Background: A 26 year old G2P2 female presented to an outside institution with gynecomastia two weeks post-partum. Breast biopsy revealed high-grade Burkitt's lymphoma with fluorescent in situ hybridization (FISH) demonstrating a t(8;14)(q24;q32) leading to MYC/IGH fusion. Abdominal US revealed complex cystic hepatic lesions, multiple renal lesions, and a small pancreatic lesion. Laboratory abnormalities at the outside hospital included a serum creatinine of 2.5, LDH of 3364, and calcium of 12.1. Due to oliguric acute kidney injury with hypercalcemia and hyperuricemia, intermittent hemodialysis was initiated. At presentation to our institution, the patient was in spontaneous tumor lysis, with LDH of 2550, creatinine 2.0, phosphorus 1.7 after 8 hours of dialysis, and uric acid 6.4. CVVH was initiated at 50 ml/kg/hr. CT-PET imaging revealed extensive tumor burden including renal involvement (Figure 1). She also had CNS involvement documented on spinal fluid analysis. Vanderbilt chemotherapy was started with rituximab, cyclophosphamide, etoposide, bleomycin, methotrexate, and prednisone along with intrathecal administration of methotrexate. In spite of CVVH at a replacement rate of 50 cc/kg/hr, four hours after the start of chemotherapy, potassium rose to 7.7 mg/dl. Phosphorus rose to 12.9, and uric acid increased from 1.1 in the morning to 10.6. Intermittent hemodialysis was performed for 3 hours, after which all electrolytes improved and CVVH was restarted at 85 ml/kg/hour. There were no recurrent electrolyte abnormalities with higher doses of CRRT. About 12 hours after administration of cyclophosphamide, the patient began to make urine; 24 hours later CRRT was held. The creatinine fell rapidly to her baseline of 0.6. Physical examination revealed almost complete resolution of gynecomastia, and the patient was discharged 9 days after transfer to our institution.

The patient had a good response to chemotherapy and underwent consolidation with autologous stem cell transplantation approximately 3 months after diagnosis. She remained in a complete remission at last follow-up approximately 10 months after diagnosis.

Conclusion: we reported a case of spontaneous tumor lysis syndrome in a patient with Burkitt's lymphoma with kidney infiltration which recovered soon after initiation of chemotherapy. Very high dose CRRT (CVVH) was a safe and effective modality to control her metabolic derangement.



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Modality Transitions in Patients with Acute Kidney Injury on Renal Replacement Therapy

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Background: Intermittent and continuous modalities of renal replacement therapy (RRT) are commonly used for managing critically ill patients with acute kidney injury (AKI). Hemodynamically unstable patients are usually managed using CRRT and stable patients are generally treated with IHD. However, it is unclear how frequently modalities are utilized and how modality transitions influence outcomes from AKI. The aim of this study was to investigate the frequency of modality transitions in critically ill patients with AKI and its association with hospital mortality. **Methods:** We retrospectively analyzed medical records of patients who were diagnosed with AKI and treated with RRT in the intensive care units at an academic medical center from July 2008 to June 2009. We assessed the frequency of modality transitions and compared the hospital mortality in patients based on the initial modality of RRT and number of transitions between CRRT and IHD. **Results:** 106 patients were included in the study; 76 (71.7%) were treated with CRRT and 30 (28.3%) with IHD as initial therapy. 42 (39.6%) had at least one switch of RRT modality and 13 (12.3%) had more than one transition.

Hospital mortality rate was higher in patients who were initially treated with CRRT than those with IHD (59% vs 37%, p=0.036). 15 patients initially treated with CRRT had < 48 hrs of therapy, whereas 9 patients had < 2 treatments for IHD. However, hospital mortality rate in patients with CRRT for < 48 hrs was 86.7% vs 55.6 % in those who had < 2 sessions of IHD. Hospital mortality rate varied in patients based on the number of transitions; none 64.1%, 1 transition 31.0% and > 1 transition 46.2%, respectively (p=0.011). In patients who started CRRT initially, the mortality rate of patients transitioning to IHD was significantly different than those that did not transition or switched back to CRRT (Table). **Conclusion:** Modality switches are common in critically ill patients with AKI on RRT. The initial RRT modality and switches between CRRT and IHD are likely dependant on the patient's underlying severity of illness. Modality transitions offer an opportunity to tailor renal support and optimize outcomes.

Initial modality	Number of modality transitions	n (%)	Hospital mortality n (%)
CRRT (n=76)	0	51 (67.1)	38 (74.5)
	1	18 (23.7)	3 (16.7) *
	> 1	7 (9.2)	4 (57.1)
IHD (n=30)	0	13 (43.3)	3 (23.1)
	1	11 (36.7)	6 (54.5)
	> 1	6 (20.0)	2 (33.3)

Epidemiology And Patient Characteristics

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RIFLE Classification Outperforms Acute Kidney Injury Network Classification in Isolated Coronary Artery Bypass Surgery Patients.

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Objective: Since their introduction, RIFLE criteria and Acute Kidney Injury Network (AKIN) criteria for acute kidney injury (AKI) staging have been head to head compared in several studies, but no difference in predicting mortality was detected in different patient groups. Only one was performed in cardiac surgery patients and the patient number was limited. We compared the performance of mortality prediction of RIFLE and AKIN criteria in isolated coronary bypass surgery in our prospective NSARF Database. **Methods:** From 2002 to 2007, all patients undergoing isolated coronary bypass surgery (CABG) and without previous dialysis dependence were enrolled. The AKIN and max RIFLE criteria during their ICU stay post operation were recorded. Logistic EuroSCORE in each patient was also calculated as severity index. The primary end-point was in hospital mortality. Cox regression was done in each scoring system with adjustment with logistic EuroSCORE. Performance of these two scoring systems were evaluated with area under receiver operating characteristics curve for discrimination and Homer-Lemeshow's statistics for calibration. Comparison of these two scoring system was done with the DeLong algorithm. **Results:**Total 1353 patients were enrolled for final analysis. The mean age was 65.4±11.0 years old. 76.7% of them were male. The overall mortality rate was 6.1%. Mean length of stay was 17.1±24.6 days. AKIN-1, AKIN-2, and AKIN-3 developed in 26.4%, 6.1% and 13.8% patients while RIFLE-R, RIFLE-I and RIFLE-F developed in 26.9%, 11.7% and 4.9% patients respectively. Cox regression disclosed hazard ratios for mortality were 3.5 (p=0.02), 7.4 (p < 0.01), 22.4 (p <0.01) and 8.1 (p < 0.01) for AKIN-1, AKIN-2 and AKIN-3 respectively when adjusted with logistic EuroSCORE (HR = 8.1, p < 0.01), while RIFLE-R had a hazard ratio of 3.3 (p=0.02), RIFLE-I of 19.9 (p < 0.001), and RIFLE-F of 29.8 (p < 0.001), when adjusted with logistic EuroSCORE (HR = 4.2 (p = 0.05). The AUROC of RIFLE criteria outranked AKIN criteria significantly (0.89 vs. 0.87, p = 0.003). **Conclusion:** Both RIFLE and AKIN criteria performed well in isolated CABG patients, but the former (RIFLE) discriminates in-hospital mortality better than the latter (AKIN).

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Delayed Nephrology Consultation (NC) Influences the Outcome of Acute Kidney Injury (AKI) Patients in the Intensive Care Unit (ICU)

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Objective: Delayed NC may influence the outcome of AKI ICU patients. However, there is scanty data addressing the role of NC. The aims of this study were to analyse: 1) factors related with NC in critically ill AKI pts; 2) the impact of NC on outcome of these pts. **Methods:** A prospective study was done by a daily visit searching for AKI cases in 6 ICUs of University of São Paulo School of Medicine (Pneumology, Internal Medicine, Trauma, Surgery, Infectious Diseases and Emergency) by an independent nephrologist, from november 2003 to June 2005. AKI was defined as an increase 50% in the baseline serum creatinine (SCr). AKI was classified as surgical or clinical. Renal function recovery was defined as return to baseline SCr. **Results:** Total of 366 patients were included. AKI incidence was 18%. Mortality rate was 68%. NC was solicited in 196 pts (53%) and was associated with higher mortality (OR:2.96/CI: 1.87-4.67). The 3 variables retained in the propensity score model for NC were: SAPS II score (OR: 1.03/CI:1.01-1.05), diuresis (OR: 1,00/CI: 0.99-1.00) and SCr (OR: 2.68/CI: 2.04-3.51). After correction by the PS, NC was no longer associated with higher mortality (OR:1.21/CI: 0.66-2.19). NC occurred at 2.8 +/- 3.5 (mean SD) days after diagnosis day (DD) and 66% of the NC were done in the first 2 days after DD (early- NC group). The remaining were considered as delayed-NC group. This last group presented higher mortality: (OR:4.04/CI:1.60-10.17) and reduced renal function recovery (OR:0.22/0.08-0.60). The 6 variables retained in the PS for early-NC model were: clinical AKI (OR:2.62/CI:1,14-5.99), diuresis (OR:0.99/CI:0,99-1,00), SCr (OR:2,04/CI:1.38-3.02), pH (OR:0,008/CI:0,001-0,20), Pneumology (OR:3,58/CI:1,06-12,06) and Internal Medicine (OR:5,95/CI:1,80-19,59) ICU origin. After correction by the PS, delayed NC was associated with higher mortality (OR: 4,04/CI: 1,60 – 10,17) and reduced renal function recovery (OR: 3,61/CI: 1,14 – 11,40). In conclusion, factors influencing early NC were SCr, diuresis, pH, ICU origin and clinical AKI. **Conclusions:** A delay in NC was associated with higher mortality and worse renal function recovery even after correction by confounding factors.

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A Retrospective Review of Prescribed Versus Delivered CRRT Dose in Children: How Close Do we come to our Set Goals?

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Background: The CRRT prescription is formulated to maximize renal support in the critically ill child with renal insufficiency. Although the ideal dose of CRRT remains unclear, certainly there is a minimum required to optimize outcome. Adult data suggest that only two-thirds of the prescribed dose may actually be delivered. Pediatric data are lacking and factors specific to children might amplify this dosage shortfall. We set out to determine whether a shortfall in delivered dose occurs in our pediatric population and what factors might contribute to the discrepancy in prescribed versus delivered dose. **Methods:** A retrospective chart review was done of all patients requiring CRRT in our PCCU between 1/1/2008 and 10/30/2009. All patients with complete CRRT data were included; twenty patients were identified. Prescribed and delivered dose of CRRT were collected. Patient data (age, weight, catheter size), CRRT circuit data (blood flow, filter size, hemofiltrate and dialysate prescribed and delivered, total run time), and downtime data were recorded. Statistical analysis was done using Wilcoxon matched-pairs signed-ranks test for differences in delivered and prescribed dose of CRRT. Multiple regression analysis was employed to discern which factors influenced the discrepancy between prescribed and delivered dose of CRRT. **Results:** Mean prescribed hemofiltration rate was 60.6 + 66.3 ml/kg/hr and 57.3 + 62.6 ml/kg/hr for delivered ($p < 0.0001$). Mean prescribed dialysate rate was 37.0 + 41.3 ml/kg/hr and 34.7 + 39.6 ml/kg/hr for the delivered dialysate ($p < 0.0001$). The mean % difference between prescribed and delivered dose was 5.2 + 3.5 % for hemofiltration and 5.7 + 4.0 % for dialysis. Only % downtime (0.9% + 1.5 %) and run time were found to correlate with total CRRT dose shortfall ($p = 0.006$; R squared = 0.4503). **Conclusion:** Significant shortfall in delivered versus prescribed CRRT dose does occur in our PCCU. However, our delivered rate was at or above that commonly accepted as adequate. In calculating the prescribed dose it may be prudent to adjust the dose for a 5-10 % shortfall to assure an adequate delivered dose of CRRT. Dose shortfall was associated with greater % downtime or longer run times.

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Hypophosphatemia – major but relatively unrecognized complication during CRRT

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Background: Dialysates and supplementary fluids used for CRRT do not usually contain phosphates. Because of the nature of CRRT, a considerable amount of phosphate can be removed, causing profound hypophosphatemia. Several investigations have shown hypophosphatemia during CRRT. We investigate the incidence of hypophosphatemia during CRRT and the factors affecting the emergence of hypophosphatemia retrospectively.

Objectives: We investigated all patients who underwent CRRT in the ICU at our tertiary teaching hospital during 2007. We collected data from medical charts for CRRT therapy and laboratory data including serum phosphate concentration.

Results: During the study period, 95 CRRT courses were performed. Among them, the serum phosphate of only 63 patients was measured. Most who were measured experienced moderate to severe hypophosphatemia (median 1.9 mg/dl) during the course. The time up to the measurement was inversely related with the minimal value of phosphate; the creatinine level at the measurement was positively related. In general, the incidence of hypophosphatemia was high among this population. The findings accord with those described in existing reports. Particularly, because of the nature of observational retrospective study, the serum phosphate level was not determined in many cases, which indicates that the decreased levels of phosphate during the CRRT course are very common, but that fact is not so familiar to physicians working in the ICU. Appropriate supplementation of phosphate can avoid profound decreases in serum phosphate. Therefore, nephrologists should take efforts to make ICU physicians aware of the significance of hypophosphatemia during CRRT.

Conclusion: Results of this study reconfirmed the high incidence of hypophosphatemia. For physicians of other fields, nephrologists must raise awareness of hypophosphatemia during CRRT.

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Anatomical variation of internal jugular vein in Korean hemodialysis patients

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Objective: The internal jugular vein (IJV) is preferred site for central cannulation for hemodialysis (HD) because of its low incidence of central vein stenosis. Although IJV is commonly located on the anterior-lateral side of the carotid artery, some patients have anatomical variation of IJV, which can be cause for difficulty in cannulation. This study was performed to evaluate the incidence of anatomical variation of IJV in Korean HD patients. **Methods :** We enrolled 358 patients receiving IJV catheter for HD using doppler ultrasonography between January 2007 and February 2009. We examined the anatomical positions of IJV according to the CA and evaluated incidence of anatomical variation in both sides. And we investigated too small sized or obstructed IJV to cannulate. **Results:** The mean age of 358 patients was 57±15 years (14-88 years) (M : F = 203 : 155). Anatomical variations of the left and right IJV were found in 36.3% and 27.1%, respectively. Abnormal anatomical positions were consisted of the anterior side (23.7%, 21.2%), anterior-medial side (7%, 2.5%), and the lateral side (1.1%, 1.7%). Inadequate size of left and right IJVs for central cannulation were 6.4%, 2.8%, respectively. **Conclusion:** This study suggests that about one third of Korean HD patients had anatomical variations of IJV. Therefore, Doppler ultrasound survey on the IJV anatomy is recommended for insertion of central cannulation in HD patients to minimize cannulation-induced complication.

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Clinical study of Pediatric RIFLE in Severe Pediatric patients who received CRRT

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Background: There are no clear indications in CRRT. In 2004 Acute Dialysis Quality Initiative(ADQI) Group proposed RIFLE (aRIFLE) classification. In 2007 pediatric RIFLE was published. We studied pediatric RIFLE (pRIFLE) in Japanese pediatric severe pediatric patients who were performed CRRT. **Methods:**

We retrospectively reviewed the medical records of patients who were performed CRRT at Shizuoka children's hospital from January 2002 to July 2005. We excluded the patients who had severe neurological problems or were performed ECMO because we cannot calculate PELOD score. Finally there were 24 patients.
24 patients were investigated by aRIFLE, pRIFLE and corrected pRIFLE for Japanese children(jpRIFLE). e-GFR was calculated using the Schwartz formula from a serum creatinine. What jpRIFLE is different from aRIFLE and pRIFLE is using Japanese children's average height and children's average serum creatinine as baseline e-GFR. We checked serum creatinine, urine output, age, body weight, diagnosis, PELOD score, CRRT and so on. **Results:** Average age was 3 years and 1 month. Average body weight was 12.8 kg. Diagnosis was sepsis(5 cases), congenital heart disease(3 cases), pediatric surgery disease(4 cases), kidney disease(2 cases), oncology disease(6cases), acute encephalopathy(2 cases), brain surgery disease(1 case), congenital metabolic disease(1 case), and others(2 cases).Type of dialysis was CHDF(18 cases) and CHF(6 cases). Concomitant therapy was PMX-DHP(4 cases). Average PELOD score was 24.9. Evaluated by aRIFLE(Cr) there were 3 cases of normal(N), 1 case of risk(R), 1 case of injury(I) and 19 cases of Failure(F). In pRIFLE(base line e-GFR=100) there were 3 cases of N, 1 case of R, 3 cases of I, 17 cases of F. In jpRIFLE(base line e-GFR is from Japanese average height and creatinine) there were 3 (cases of)N, 2 R, 10 I and 9 F.
In both aRIFLE(urine output;u/o) and pRIFLE(u/o) there were 16(cases of) N, 0 R, 0 I and 8 F. **Conclusions:** It is easy to evaluate acute kidney failure, when we use RIFLE scoring system. RIFLE is important for indication of CRRT. In neonate or small body patients it is necessary to correct RIFLE, because e-GFR is not 100.

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Impact of Acute Kidney Injury (AKI) on survival in very low birth weight infants

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Background: AKI is an independent predictor of poor outcomes in many patient populations. **Objective:** Determine the association of AKI with survival in premature infants. **Methods:** Infants with birth weight between 500-1500gm and gestational age >25 weeks were enrolled over 18 consecutive months in a regional quaternary care NICU. AKI was defined as: SCr ≥ 1.5 mg/dl in 1st week of life (or)↑ SCr ≥ 0.3 mg/dl from previous value (or) ↑ SCr ≥ 150-200% from previous value. A matched cohort study was done, matching each subject with AKI to one control infant without AKI by birth weight (+/- 100gm) and gestational age (+/- 5 days). Survival was defined as survival to 36 weeks' post-menstrual age. **Results:** 41/229 (18%) of studied infants had AKI. From this study population, 38 infants with AKI and 38 infants without AKI were selected (3 subjects with AKI could not be matched). Blood pressure support medication was directly associated with AKI, while preeclampsia and maternal high blood pressure inversely correlated with AKI. Mortality was more frequent in those with AKI (15/38; 40%) vs. No AKI (5/38; 13%);p<0.02. Infants with AKI had 2.4 (95%CI- 0.856,6.756)-fold higher mortality after adjustment for blood pressure support medication and maternal high blood pressure. **Conclusions:** AKI is an independent predictor of survival in very low birth weight premature infants suggesting that AKI is an indicator of illness severity in this population, and it needs to be determined if therapies to prevent AKI impact mortality.

Infant Characteristics	No AKI N=38 (50%)	AKI N=38(50%)	P value
Cord pH	7.3±0.06	7.3 ±0.07	0.47
Apgar 1 minute	3.39 ±0.4	3.47 ±0.33	0.12
Apgar 5 minute	6 ±0.3	6.11 ±0.27	1.0
Standard Ventilator	28(78%)	31(86%)	0.35
Umbilical Artery Catheter (UAC)	24(67%)	24 (67%)	1.0
Blood pressure support medication	11(30.6%)	20(55.6%)	0.03
Maternal Characteristic : Age	24.4± 5	26± 5.7	0.19
Prenatal care	25(69.4%)	27(75%)	0.6
Diabetes	2 (5.6%)	2 (5.6%)	1.0
High Blood pressure	16 (44.2%)	8(22.2%)	0.046
Steroids	29 (81%)	28(78%)	0.1
Indomethacin	1 (2.8%)	2(5.6%)	0.1
Preeclampsia	13 (36%)	5(14%)	0.02
Multiple birth	9(25%)	8(22%)	0.78
Drug abuse	5 (2.7%)	3(7.3%)	0.15
Chorioamnionitis	2 (5.6%)	1 (2.8%)	0.55

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Prevalence of sub-clinical infection with 2009 pandemic influenza virus in ESRD patients – a preliminary observation from Asia

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Background: The spectrum of clinical illness due to 2009 pandemic influenza ranges from mild illness to severe pneumonia which may be complicated by multi-organ dysfunction and death. The possible transmission of infection from asymptomatic individuals is a cause for concern. Meta-analysis of experimental studies on course of influenza virus infection in healthy human volunteers challenged with wild type influenza viruses indicates that 33% may have asymptomatic infection. Reports on the prevalence of asymptomatic infection due to 2009 pandemic influenza are emerging. This study was initiated to observe the prevalence of asymptomatic infection due to 2009 pandemic influenza in a cohort of apparently asymptomatic ESRD patients who are receiving maintenance hemodialysis from July 2009 to October 2009 at a tertiary care hospital in Colombo, Srilanka.
Methods: Consecutive apparently asymptomatic adult End Stage Renal Disease (ESRD) patients aged >18 years visiting our dialysis center three times weekly maintenance hemodialysis were interviewed for basic medical complaints followed by clinical examination and routine screening medical tests along with throat swab for RT-PCR (real-time polymerase chain reaction) to detect swine influenza A (H1N1). Informed consent was obtained from all participants. The study was approved by our institutional ethics committee. Patients who had fever or respiratory illness during the previous 30 days and those who refused consent for testing were excluded. Throat swab was obtained and tested by RT-PCR for swine influenza A (HINI) as per WHO (World Health Organization) protocol. Differences in baseline characteristics between patients with asymptomatic infection and no infection were compared using student's' test or chi-square test. A p value less than 0.05 was considered statistically significant. **Results:** 212 patients were initially enrolled of which 40 were excluded due to the presence of one or more criteria for exclusion leaving a sample of 172 as the study cohort. The prevalence of asymptomatic H1N1 infection was 23.8% (41 of 172). There were no statistically significant differences in the baseline characteristics between the infected and uninfected group in all variables except that patients with asymptomatic infection had a lower serum albumin (P = 0.011)
Conclusion: 23.8% prevalence of asymptomatic infection due to 2009 pandemic influenza was observed in our study. Patients with asymptomatic infection have significantly lower level of serum albumin.

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Outcomes of Cancer and Non-Cancer Patients with Acute Kidney Injury and Need of Renal Replacement Therapy Admitted to General Intensive Care Units

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Background: to evaluate and to compare the characteristics and outcomes of cancer and non-cancer patients requiring renal replacement therapy (RRT) for acute kidney injury in general intensive units (ICU).
Methods: Prospective cohort study conducted in 11 medical surgical ICUs. From December 2004 to July 2008, 779 consecutive patients who required RRT for AKI during the ICU admission were studied. Data were collected at admission and during ICU stay. Uni- and multivariate logistic regression analyses were used to identify independent predictors of hospital death.
Results: There were 655 (84%) non-cancer and 124 (16%; Solid tumors=100 and hematological malignancies=34) cancer patients. Continuous RRT was used in 78% patients. Sepsis (72%) and shock (66%) were the most frequent reasons for AKI in both groups but nephrotoxins and urinary tract obstruction and major surgeries were more frequent in cancer patients. Patients were classified accordingly to RIFLE criteria as Failure (56%), Injury (20%) and Risk (24%) and there were no differences between the groups. ICU (85%, 67% and 64%; p=0.032) and hospital (91%, 74% and 68%; p=0.010) mortality rates were higher in patients with hematological malignancies than in patients with solid tumor and non-cancer patients, respectively. In multivariate analysis, older age [odds ratio (OR)=1.03 (95% confidence interval, 1.02-1.05)], poor chronic health status[OR=1.62(1.01-2.58)], comorbidities [OR=1.90(1.21-2.60)], the number of associated organ failures [OR=2.14(1.76-2.60)], the number of ICU days

until the start of RRT [OR=1.61(1.39-1.86)], and lactate levels [OR=1.16(1.08-126)] were associated with increased mortality. Adjusting for other covariates, the type of cancer was not associated with a worse outcome. Independent predictors of death in cancer patients were medical admission and the number of organ failures. **Conclusions:** Despite high mortality rates, the diagnosis of cancer was not independently associated with a worse outcome. Mortality in these patients is mostly dependent of the number of associated organ dysfunctions. ICU admission and provision of RRT should be considered in selected critically ill cancer patients with AKI.

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Oliguria Predicts Acute Kidney Injury and Clinical Outcomes in Critically ill Patients

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Background: Urine output (UO) is a criterion for AKI diagnosis and staging in the RIFLE and AKIN classification systems. Most of the studies have validated serum creatinine (sCr) criterion but few have systematically assessed the urine output (UO). We hypothesized that in comparison to the sCr criterion, UO criterion would be a more sensitive and earlier marker of AKI. Oliguria would be associated with increased mortality, dialysis requirement, and longer length of stay. **Method:** We analyzed data from a cohort of 326 surgical ICU patients screened in a prospective observational study on incidence of AKI from June 2006 to December 2008. sCr was measured at least once per 24 hr and hourly urine flow was recorded in an electronic medical record. We used the AKIN sCr criterion (>= 0.3mg/dl absolute or 1.5x relative change from reference within 48 hours) and the AKIN UO criterion (<0.5ml/kg over 6hr) to diagnose and stage AKI. We compared the incidence of AKI and time to reach these criteria from ICU admission. **Results:** The incidence of AKI increased from 21%, based solely on sCr criteria, to 39% when both sCr and UO criteria were applied. Of 101 patients with AKI identified by the UO criterion, 36 (35%) also developed AKI by sCr criteria. AKI was diagnosed earlier based on UO than by creatinine criteria in those who met both criteria (16 hrs (IQR 8-36 hrs) vs. 24 hrs (12-36 hrs); p=.001. Patients with UO criterion alone had a significantly higher need for dialysis and trend to increased ICU mortality than non-AKI patients (no AKI 1.3%; UO only 8.8%; sCr only 4.9%; both UO and sCr 16.7%; p=0.002). **Conclusion:** The UO criterion identifies additional patients with AKI compared to the sCr criterion. The diagnosis of AKI by UO alone is associated with an increased mortality, increased dialysis requirement and longer length of ICU and hospital stay. Oliguria is a diagnostic marker of altered renal function in ICU patients and should be included in future studies in AKI.

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Comparing Definitions of Urine Output Criterion for Acute Kidney Injury in Critically ill Patients

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Background: The RIFLE/AKIN classification systems have recognized the need to include urine output (UO) as a criterion for diagnosing and staging acute kidney injury (AKI). Although sCr has been validated, few studies have applied and validated urinary output criterion prospectively. We assessed hourly UO in ICU patients to determine whether the current standard for AKI diagnosis is optimal in comparison to other proposed criteria. **Methods:** Hourly UO was recorded continuously in patients in a medical ICU using a digital monitor. Serum creatinine (sCr) measurements were done at least once per 24hrs and compared to changes in UO assessed by four different definitions of oliguria. Patients were diagnosed as AKI if they met either the AKIN sCr or UO criteria. **Results:** Fifty five percent of patients had an episode of oliguria during the ICU stay. There was no significant difference applying UO measurements every hour or urine volume in a six hour period for the detection of episodes of oliguria. Twenty one (28%) of patients were diagnosed as AKI using the sCr criteria, whereas additional 24 (32%) were identified using the UO criteria. The overall mortality rate was 15%, decreases in UO for 6 hours were associated with a trend for higher mortality (no AKI 7% vs. 17% AKI by UO1 only; p=0.50) whereas patients with prolonged oliguria had a significantly higher mortality rate than non oliguric patients (no AKI 7% vs. 33% AKI by UO4; p=0.004). Additionally, patients with more than 3 episodes of oliguria had a significantly higher mortality rate; 30% versus 6% less than 3 episodes of oliguria (p=0.010). **Conclusion:** Episodes of

oliguria occur frequently in ICU patients and identifies a higher percentage of AKI patients compared to sCr criterion. Alterations in urine flow may be a diagnostic marker of renal dysfunction and need to be validated in larger cohorts.

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Clinical Risk Scores for Acute Kidney Injury

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Background: Acute kidney injury (AKI) is associated with a high morbidity and mortality rate in critically ill patients. Accurate identification of individuals at risk of AKI is essential to improve the outcomes associated with this syndrome. The aim of this study was to develop and validate a clinical risk score for predicting AKI in an intensive care unit (ICU) setting. **Methods:** Our cohort included 717 patients admitted to a surgical intensive care unit (SICU) and medical intensive care unit (MICU) at UCSD from June 2006 to December 2008. Baseline risk factors were ascertained at ICU admission and additional acute factors within the first 48 hrs of ICU stay. Three separate risk scores were developed using multivariable regression coefficients based on baseline (model A), acute (model B) and combined baseline and acute risk factors (model C). Risk Scores were further evaluated in a validation cohort. **Results:** The overall incidence of AKI was 22.9% (164 cases) and 5.6% (n=40) of patients required dialysis. Independent predictors of AKI in Baseline risk score (Model A) included six chronic risk variables (hypertension (HT), morbid obesity, chronic liver disease, congestive heart failure (CHF), chronic lung disease and chronic kidney disease (CKD). The Acute risk score (Model B) included 4 acute risk variables (hypotension, sepsis, nephrotoxic drugs and mechanical ventilation) and the Enhanced risk score (Model C) included 4 chronic factors (HT, chronic liver disease, CHF and CKD) and 5 acute factors (sepsis, ph value ≤ 7.30, hypotension, nephrotoxic drugs and mechanical ventilation). The risk score models showed good discrimination in both the study and validation subsets (Model A: c statistic = 0.72 (0.74 in validation subset); Model B: c statistic = 0.73 (0.77 in validation subset); Model C: c statistic= 0.78 (0.83 in validation subset)). **Conclusion:** Simple risk scores based upon readily available clinical variables can accurately predict AKI. These risk assessment tools could help clinicians to stratify patients for surveillance, prevention and early therapeutic intervention.

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Combination of Risk Factors Improves Prediction of Acute Kidney Injury

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Background: Several individual risk factors have been reported to be associated with Acute Kidney Injury (AKI). A previous study by Chawla et al has proposed combining individual risk factors to improve predictive value for AKI. We evaluated the performance of a modified AKI risk sampling tool in a prospective cohort of critically ill patients. **Method:** Our cohort included 717 patients admitted to a surgical intensive care unit (SICU) and medical intensive care unit (MICU) at UCSD from June 2006 to December 2008. Risk factors were classified as chronic major comorbidities (e.g., advanced age, diabetes mellitus, chronic kidney disease, or cardiovascular disease), chronic minor (e.g., hypertension, morbid obesity, cancer, chronic lung disease) and acute factors (e.g., hypotension, sepsis, high-risk surgery, mechanical ventilation or nephrotoxin exposure). Within 48 hours of ICU admission we stratified patients as high risk (HRG), low risk (LRG), and no risk (NRG) based on their risk factor profile. AKI was defined by an absolute increase of 0.3mg/dL from reference sCR within 48 hours. The incidence of AKI, need for renal replacement therapy (RRT) and mortality were assessed among risk groups. **Results:** The overall incidence of AKI was 22.9% (164 cases) and 5.6% (n=40) of patients required dialysis. Patients classified as HRG had a higher incidence of AKI (28.9% vs. 7.1%; $p < 0.001$), higher mortality (9.6% vs. 0.7%; $p < 0.001$) and need for RRT (7.5% vs. .0%; $p< 0.001$) in comparison to LRG. HRG patients had extended ICU and hospital stay (5.5±5.0 and 12.5±14.6 days, respectively) as compared to LRG (3.1±1.7, 6.8±8.7 days) and NRG (2.6±1.6, 3.8±2.5 days; p<.0001). **Conclusion:** The use of simple risk classification system based on chronic comorbidities and acute events can identify patients at high risk to develop AKI and adverse outcomes. Future studies should incorporate these factors to stratify patients for prevention and early therapeutic intervention.

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Absolute vs. Relative change in Serum Creatinine: Influence of Baseline Renal Function on diagnosis and staging of AKI

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Background: Several diagnostic criteria including the AKIN, RIFLE and Waikar classification systems have been proposed for diagnosing and staging acute kidney injury (AKI) based on absolute and relative changes in serum creatinine (sCr). The aim of the study was to evaluate the performance of different classification systems to diagnose and stage AKI and to evaluate whether the time to diagnose AKI based on absolute and relative changes in sCr is influenced by the level of underlying renal function. **Methods:** We assessed the incidence, time to diagnosis and severity of AKI in 717 patients admitted to surgical intensive care unit (SICU) and medical intensive care unit (MICU) at UCSD between June 2006 and Dec 2008. We compared the AKI incidence and staging based on: AKIN (Crit Care; 2007), RIFLE (Crit Care; 2004) and Waikar (JASN; 2009) classification systems. **Results:** The incidence of AKI ranged from 22.5% (Waikar), 28.3 % (AKIN), to 34.7 % (RIFLE). The median time to reach AKI diagnosis in the above three criteria were 19.0 hrs (12.0-35.0), 24.3 hrs (13.4-39.8) and 32.1 hrs (17.1-61.5), respectively; p=0.20. Forty-two and 23 patients diagnosed by AKIN classification were misclassified as not having AKI by Waikar and RIFLE criteria, respectively. The Waikar misclassification was due to the shortened time interval available (24 hrs) whereas the RIFLE misclassified patients that did not reached 50% relative criterion. The overall mortality rate was 15.3% in AKI versus 4.7% in non AKI patients. Patients misclassified by Waikar and RIFLE had mortality rate of 11.9% and 13%, respectively. **Conclusion:** Diagnostic and staging criteria vary in sensitivity for identifying AKI. RIFLE classification identifies more patients with AKI as it includes GFR as a criterion and computes the changes over the 7 day period; however it is less sensitive to detect small changes in kidney function. Waikar misclassifies patients with slow development of AKI. Absolute changes in sCr are not influenced by baseline kidney function and occur earlier than relative change in sCr. Further studies are required to define the influence of the underlying renal function on time to diagnosis and progression in severity of AKI.

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Importance of Phenytoin Monitoring and Dose Adjustment during Continuous Veno-Venous Hemofiltration (CVVH)

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Objective: Phenytoin binds to serum albumin. Factors including acute kidney injury (AKI) and hypoalbuminemia may result in higher levels of unbound phenytoin. Unbound phenytoin may be cleared during CVVH and this may impact the efficacy of phenytoin in the treatment of seizures. **Methods:** Two patients at our institution received phenytoin while undergoing CVVH using the NxStage System One. Serum free phynetoin (SFP) levels and CVVH effluent concentrations (EC) of phenytoin were measured and compared. Patient 1: 64 year-old female was admitted with a subdural hematoma, seizures, and AKI. Her serum albumin was 2.5 g/dl. CVVH was initiated with a blood flow rate (BFR) of 250 ml/min and a replacement fluid rate (RFR) of 2L/hour. Sixteen hours after a phenytoin load, a SFP level was supratherapeutic at 2.4 mg/L. She was started on phenytoin 100 mg IV q12hrs. One day later, trough SFP was 1.9 mg/L, with EC of 1.6 mg/L. On day 3, trough SFP=1.2 mg/L with EC=1.3 mg/L and a serum total phenytoin concentration (TPC) of 3.2 mg/L. Serum phenytoin unbound fraction was elevated at 0.38 and was nearly equal to the sieving coefficient. Patient 2: 63 year-old male with AKI following mitral valve surgery. His serum albumin was 2.3 g/dl. CVVH was initiated with a BFR of 250 ml/min and RFR of 3 L/hour. Phenytoin was initiated for treatment of seizures. Four hours after a phenytoin loading dose of 2700 mg the SFP was 2.4 mg/L. He was then started on a maintenance dose of 150 mg IV q8hrs. One day later, SFP was 2.3 mg/L with an EC of 2.1 mg/L. Day 3, SFP=2.1 mg/L, EC=1.9 mg/L. Day 4, SFP=1.1 mg/L, TPC=4.7 mg/L, phenytoin unbound fraction=0.23. **Conclusions:** Hypoalbuminemia and AKI can lead to higher unbound fractions of phenytoin. Unbound phenytoin is removed by CVVH as indicated by our comparison of serum free phenytoin levels and CVVH effluent concentrations. Dose increase and close monitoring of serum free phenytoin levels is recommended in hypoalbuminemic patients undergoing CVVH.

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Plasma NGAL level in patients immediately after Cardiopulmonary Bypass Surgery predicts AKI

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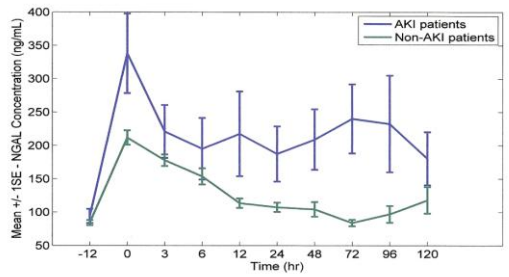
Background: Neutrophil gelatinase-associated lipocalin (NGAL) has previously been shown to be a marker of acute kidney injury (AKI) in populations including cardiopulmonary bypass (CPB) surgery. The EVOLVE study was designed to test the predictive ability of NGAL to determine AKI following CPB. High-Risk, Cohort 1 results have been previously reported. Cohort 2 studied intermediate to high risk patients (results reported herein). The study hypothesis was that plasma NGAL levels in the immediate post-operative period would aid in the early-risk assessment of AKI. **Methods:** Inclusion criteria for Cohort 2 required at least one of the following: age > 70; pre-operative creatinine > 1.4 mg/dL; heart failure; insulin-dependent diabetes; undergoing cardiac valve surgery; or history of previous cardiac surgery. EDTA-anticoagulated plasma samples were collected and measured at the following time points: pre-operative, 0 hr, 3 hr, 6 hr, 12 hr, 24 hr, off of CPB and daily through Day 5 post-operative. Creatinine measures were assessed for 5 days post operatively and patients were assigned to AKI endpoints as defined by the creatinine thresholds described in the RIFLE criteria1,2. RIFLE-Risk (R) criteria were required to be sustained for a minimum of 24 hrs. Receiver Operating Curves (ROCs) were generated for NGAL and Cr at time zero immediately off of CPB bypass for the thresholds of ≥R and for ≥ Injury (I). **Results:** Cohort 2 enrolled 156 moderate to high risk AKI adult CPB patients. 150 patients are described in this analysis after exclusion of 6 patients due to missing baseline (n=5) or post operative creatinine (n=1) measurements. 19 patients, 12.7% of the study population, developed post-operative AKI ≥R. Using maximum RIFLE criteria there were 5 Risk (R), 6 Injury (I), and 8 Failure (F) events. Median NGAL concentrations at time zero (immediately off of CPB) in AKI patients were significantly higher than those of non-AKI patients 285.0 ng/mL (IQR 181.8–392.3 ng/mL) vs. 177.4 ng/mL (IQR 131.2–276.9 ng/mL), respectively, (p=0.0062). NGAL concentrations immediately off of CPB were statistically significant in predicting post-operative AKI ≥R, ≥I and F with AUCs of 0.71 (p<0.0001), 0.69 (p=0.0174) and 0.73 (p=0.0264) respectively. Creatinine measurements (AUC) at time zero were not significant in predicting any AKI events: AUCs of 0.50 (p=0.9680); 0.58 (p=0.2758); and 0.55 (p=0.6100) for ≥R, ≥I and F respectively. Figure 1 displays the mean plasma NGAL levels from pre-operative status to 120 hours post surgery for AKI ≥R and non-AKI patients. **Conclusion:** Plasma NGAL levels measured immediately off of CPB were predictive of the development of AKI in this cohort of intermediate to high risk patients.

Figure:



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SAPS 3 scores for Predict Mortality in patients who treated with Continuous Renal Replacement Therapy

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Background: Acute kidney injury(AKI) is a frequent complication in patients who admitted to hospital. And AKI which is required continuous renal replacement therapy(CRRT) associated with high mortality rate. we evaluated the SAPS 3 scores, determined at the start of CRRT, for prediction of mortality in AKI. **Methods:** We analyzed the clinical setting of 89 patients who received CRRT between September 2006 and September 2009. Patients with AKI or acute on chronic kidney injury were included. Patients with end stage renal disease requiring chronic dialysis were not considered. We identified the demographic, clinical and laboratory data, retrospectively. We calculated SAP 3 score at the time to start of CRRT. **Result:** The average age of the 89 patients was 64.4±13.9 years. Fifty nine(66.3%) were males

and thirty(33.7%) were females. Eighteen(20.2%) patients had chronic kidney injury and Thirty(33.7%) had diabetes. Overall mortality was 75.3%(67 of 89 patients). The average SAPS 3 score was 89.4±14.9. SAPS 3 score was higher in nonsurvivors than survivors(91.3±14.1 vs. 83.7±16.3, p=0.038). There were no significant difference between the two groups for age, mean arterial pressure, serum creatinine and serum bicarbonate, bilirubin, albumin, CRP level. The frequency of female, diabetes, chronic kidney injury ware not significantly different. Oliguria was not related with mortality. The variables influencing mortality on multivariate analysis was only SAPS 3 score. Area under receiver-operating characteristic curve for SAPS 3 was 0.69 (95% CI. 0.54-0.83). At the SAPS 3 score of 84, sensitivity to predict the mortality was 71.6% and specificity was 69.2%. **Conclusion:** Discriminative ability of SAPS 3 score, determined at the time to start CRRT, is not accurate, but useful predictor for mortality of CRRT patients.

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Acute Kidney Injury (AKI) in Intensive Care Unit (ICU) - a Prospective Study on Incidence, Risk Factors and Mortality

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Background: AKI in the ICU is a serious complication can affect the patient outcome. **Objective:** of this study were to identify incidence, risk factors and mortality in AKI patients admitted to ICU from a Brazilian university hospital. **Methods:** It was a cohort study of 564 patients followed up prospectively and daily from admission until discharge or death from July 2007 to may 2009 divided into 2 groups: acquired AKI (G1) and without acquired AKI (G2). Statistics: univariate and multivariate analysis, p <0.05. **Results:** AKI incidence was 29.7%. The groups were different in etiology of admission to ICU (sepsis G1: 29.7% vs. G2: 23.2%, p<0.0001 and postoperative neurological 14.8% vs. 38.7%, p<0.0001), age (56.4±15.7 vs 49.6±17.6 years, p<0.0001), APACHE II (21.3±5.6 vs 13.4±4.7, p<0.0001), mechanical ventilation (89.9 vs 69.7%, p<0.0001) and vasoactive drugs (76.3 vs 55.1%, p <0.0001). With regard to risk factors and comorbidities, the groups were different in the presence of diabetes mellitus, cardiac heart failure, chronic kidney disease and NSAIDs use (28.9 vs 19. 6%, p = 0.03, 22.6 vs 11.1%, p = 0.0002, 21.4 vs 11.5%, p <0.0001 and 23.1 vs 7.4%, p <0.0001, respectively). The length of stay and mortality were higher in patients with acquired AKI (6.8 ± 2.6 vs 12.7 ± 5.4 days p <0.0001 and 62.1 vs 16.5%, p <0.0001). At multivariate analysis were identified as risk factors for AKI, age> 55 years, APACHE II> 16, creatinine > 1.2 and NSAIDs use (OR=1.37 IC :1,23-1, 87 , OR=1.2 IC :1,11-1, 30, OR=5.3 CI :2,3-12, 3, and OR=27.5 CI :1,1-74, 3, respectively) and AKI was independently associated with longer hospital stay and mortality (OR=1.16 IC :1.5-1.29 and OR=1.22 CI :1.09-1.98 respectively). The analysis of the survival curve after 30 days in the ICU, mortality rate was 84% in G1 and 45% in G2 (p <0.0001). **Conclsion:** the incidence of AKI was high in ICU, the independent risk factors for acquiring AKI were age> 55 years, APACHE II> 16, baseline Creatinine> 1.2 and NSAID use and the AKI was an independent risk factor for longer ICU stay and mortality.

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AKI in ICU: Prospective Study on the Clinical Characteristics And Patients Outcome with or without Nephrology Consultation

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Background: Acute Kidney Injury (AKI) in intensive care unit (ICU) represents a serious complication and nephrology consultation can influence the patient outcome. **Objective:** of this study was to compare clinical characteristics and AKI patients outcome in the ICU from a Brazilian university hospital with or without the nephrologists consultation and to explore the relationship between the time nephrology consultation and patients outcome. **Methods:** A prospective study with 148 patients who acquired AKI during the ICU stay from July 2007 until may 2009. Patients were divided into 2 groups according to presence or absence of nephrologist consultation: G1 – consultation and G2 – no consultation. After, patients from G1 were again divided into 2 groups according the time of nephrologist consultation: EC - Early Consultation (< 48 h) and LC – later consultation (>48 h). Statistics analysis: univariate and multivariate analysis, p <0.05. **Results:** AKI incidence was 29.7% and 52% of these were assessed by the nephrologist. Multivariate analysis showed that the groups were similar in the etiology of ICU admission (sepsis: 40.2±13.7 x 43.5±12.9, AKI cause (ischemic ATN

65.2±16.9 x 62.8±14.8), age (60.4±15.7 x 58.4±15.6), APACHE II (23.3±5.9x 21.9±5.4) and mortality rate (66,2% x 66,3%) and they were different in the prognostic index specific for AKI - ATN-ISS (0.66 ± 0.14 X 0.55 ± 0.18, p <0.0001), maximum Cr (3.6 ± 1.8 mg / dl X 2.9 ± 1.4 mg / dl, p = 0.009), dialysis indication (74 X 0%, p <0.0001) and length of stay in ICU (14.0 ± 6.4 X 10.3 ± 5.8 p = 0.002). Among the patients evaluated by nephrology, early assessment occurred in 37.7% and it was associated with decreased mortality rate (OR =0.23,95%CI:0.07to0.77). **Conclusion:** The AKI was frequent in the ICU and half of cases were evaluated by nephrologist. AKI patients in ICU assessed by the nephrologist although were more serious, presented similar mortality rate when compared to AKI patients without nephrologist consultation and the early consultation was associated with lower mortality rate.

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CRRT Experiences in NICU; A Single Center Experience in Japan

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Background: It is technically difficult to perform CRRT in neonates. And there are few reports of CRRT in low birth weight infants. We report experiences of CRRT in one Neonatal Care Unit (NICU) in Japan. **Methods:** We retrospectively reviewed the medical records of all NICU patients who performed CRRT at Kurashiki Central Hospital from January 2002 to June 2009. We identified characteristics of patients, underlying diagnosis, methods of CRRT and prognosis. **Results:** We performed CRRT in 15 neonats. This was about 0.54% of the total NICU administrations (15/2,790). Their body weight was 1.2-3.5kg. Underlying diagnosis was diaphragmatic hermia (7 cases), septic shock (4 cases), persistent pulmonary hypertension of the newborn (2 cases), congenital metabolic disorder (1 case) and neonatal asphyxia (1 case). We used concomitant therapy with extracorporeal membrane oxygenation (ECMO, 9cases) and PMX-DHP (4 cases). We used two dialysis machines; KM-8700 and TR525 (Qb 1mL/min ~). Dialysis membrane was APS-03S (Polyacrylonitrile membrane, 0.3m2). Their priming volume was 67-100mL. The priming of hemodialysis circuit was mixed blood (packed red blood cells and fresh frozen plasma). Blood access was inner-ECMO-circulation (9 cases), veno-venous (4 cased) and arterio-venous (2 cases). Type of dialysis was continuous hemodialysis (CHD, 9 caces) and continuous hemodiafiltration(CHDF, 6 cases). Dialysate was commercially available one (HCO3-, Na 140mEq/L, K 2.0mEq/L, Glu 100mg/dL), sometimes we added potassium chloride or potassium phosphate into dialysate. We used nafamostat mesilate and heparin for anticoaglant. Average PELODs score was 30.9, when was started CRRT. Estimate mortality rate was 84.0% due to PELOD. Practical mortality rate was 60.0% (9/15). There were no CRRT-related deaths. **Conclusion:** We are able to perform CRRT safely and steadily to neonates. CRRT might provide an effective treatment to the critically ill neonates. CRRT might be of help to increase the survival rate of the patients in NICU.

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Modifiable Risk Factors of Acute Kidney Injury Post Isolated Coronary Artery Bypass Surgery.

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Acute kidney injury (AKI) is a major cause of morbidity and mortality after coronary bypass surgery (CABG). The current study is to identify potentially modifiable risk factors for AKI post isolated CABG. From 2002 to 2007, all patients undergoing isolated CABG for the first time were enrolled for retrospective analysis. Patients who were dialysis dependent pre-operatively were excluded. The primary end point is AKI defined by Acute Kidney Injury Network criteria within 48 hours after surgery. Logistic regression with stepwise selection was used for multivariate analysis. A total 1480 patients were enrolled for final analysis; AKI developed in 19.1% of them. 1308 of them underwent logistic regression and the analysis identified risk factors for post-operative AKI being older age (Odds Ratio, OR = 1.02, p= 0.0026), congestive heart failure (OR = 1.94, p = 0.0017), usage of intra-aortic balloon pumping (OR = 4.27, p < 0.001), usage of extra-corporeal membrane oxygenation (OR = 10.23, p < 0.001), higher creatinine (OR=1.43, p < 0.001), low albumin (OR=2.14, p < 0.001), high

WBC (OR=1.751, p = 0.0262), usage of cardiopulmonary bypass (OR=4.66, p < 0.001) and low hemoglobin (OR=1.84, p = 0.0105). The full model showed a good c-index (0.864) and p-value for goodness-of-fitness of 0.1154 (>0.05). Pre-operative low hemoglobin, low albumin and CPB are potentially modifiable risk factors for acute kidney injury post isolated coronary artery bypass surgery.

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Multi-center evaluation of CRRT to severely ill children of 20kg or less in Japan

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Objective: The CRRT multi-center study in small children is still few. We show the current state of CRRT in multi-center in Japan to the low body weight cases in which PELOD is high. **Methods:**140 children are enrolled in 13 pediatric centers. The average weight and age was 6.9 kg (median 5.0), and 1.3 years old (median 0.33) respectively. The average of PELOD was 20.6 and cases of no urine were 59. **Results:** All cases were CHDF and the average duration was 6.1 days. The machines were enforced by the one to begin from Qb 1ml/min. Only 7 cases discontinued less than 6 hours after initiation. Filters were used of 0.1m2 in 11 cases, 0.3m2 in 113, and 0.6m2 and more in 13. Blood and/or albumin use occupied 124 cases to the priming in the circuit. In the blood access, all cases were inserted of double lumen catheter. The size was 15G in 6 cases, 6Fr in 37, 6.5Fr in 19, 7Fr in 12, and 8Fr in 30, and the insertion sites (excluding ECMO cases) were 83 cases to jugular and 25 to femoral vein. An anti-coagulant is nafamostat mesilate in 116 cases, and heparin in 24 cases. The average initial conditions of CHDF were Qb:5.6ml/kg/min, QF/GB: 5.5%, QD/QB: 87.3%. The entire mortality rate was 20% after seven days and 29% after 28 days. A significant difference was seen in age, no urine, PELOD, the ECMO use and QB. In a logistic multi regression analysis, PELOD and no urine were significant. The mortality rate of 33 cases in PELOD 30 or more (probability of death 80%) was 39% and 13 cases in PELOD 40 or more (probability of death 99%) was 62%. **Conclusion:** The ratio of QD versus QF was high and it tends to be chosen of high flow CHDF in Japan. Anti-coagulant and machine were also different from those in previous reports. More analysis is necessary for low mortality rate, especially high PELOD cases.

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The Effect of Maintaining a Continuous Renal Replacement Therapy Expert Team in The Intensive Care Unit : A Single Center Experience

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Objective: In Korea, there are 102 centers practicing continuous renal replacement therapy (CRRT), using around 300 CRRT machines. However, only 3 hospitals maintain a CRRT expert team which consists of CRRT specialists (nephrologists) and CRRT expert nurses. We investigated the effect of maintaining a CRRT expert team on outcome in patients with acute kidney injury treated in the intensive care unit (ICU). **Methods:** Study subjects were 577 patients who underwent CRRT from August, 2007 to August, 2009. Demographic variables, clinical features, characteristics and duration of CRRT, and patient outcome were reviewed. Since a CRRT expert team had been set up in August, 2008, outcome before and after CRRT team establishment was compared. **Results:** The number of patients treated on CRRT was increased from 244 patients/year to 353 patients/year after CRRT team maintenance. Most of the patients were referred for CRRT from the Cardiology department (15.6%) following Gastroenterology (13.9%), Pulmonology (11.4%), Hematology (10.4%), Chest surgery (9.5%), General surgery (7.6%), and Nephrology (6.9%). The most common causes for CRRT initiation was azotemia followed by volume overload and metabolic abnormalities. There were no significant differences in the level of BUN, Cr and mean blood pressure at the time of CRRT commencement between the period before CRRT expert team establishment and after. However, although there was no significant difference in ICU mortality the duration of CRRT (6.64 versus 5.58 days, p = 0.003), the number of filters used (5.35 versus 4.46, p = 0.015), and ICU stay (20.58 versus 16.86 days, p = 0.009) were significantly decreased after CRRT expert team maintenance. **Conclusion:** Maintaining a CRRT expert team may be beneficial for the management of patients undertaking CRRT in the ICU. Moreover,

additional economic benefits may be present as well.

Research in AKI

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Circulating Plasma Exosomes induce Tubular and Glomerular alterations in Sepsis-Associated Acute Kidney Injury

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The mechanisms of sepsis-induced acute kidney injury (AKI) are not only related to the ischemic response to hypoperfusion, but also to a direct detrimental activity of circulating mediators on kidney cells. We have previously demonstrated that plasma from septic patients induced functional alterations in tubular and glomerular epithelial cells. Exosomes, small particles involved in cell-to-cell communication through the transfer of proteins and RNAs, have been found in plasma of normal subjects. Plasma exosomes are mainly derived from platelets and monocytes and are enriched of microRNAs, small non-coding RNAs regulating gene transcription. **Objective:** was to isolate exosomes from plasma of patients with sepsis-related AKI and to evaluate their role in tubular and glomerular epithelial cell injury. We selected 10 patients with sepsis-associated AKI (RIFLE/AKIN criteria). By ultracentrifugation, we collected exosomes from patients' plasma and by supernatants of platelets or monocytes activated by LPS. We evaluated the mechanisms of exosome internalization and their effects on tubular cells and podocytes. The concentration of plasma exosomes was significantly higher in septic-AKI patients (19.25 mg/ml) than in healthy subjects (4.76 mg/ml). Plasma exosomes contained defined patterns of microRNAs and expressed on their surface integrins (alpha4, alpha6, beta-1, alphaVbeta3), CD44, HLA class I and II, L-selectin, Fas-Ligand and CD40-Ligand, molecules involved in inflammation and apoptosis. A similar pattern of expression was found in exosomes derived from LPS-stimulated platelets and monocytes. Exosomes were internalized into tubular cells and podocytes inducing different biological activities such as cytoxicity, apoptosis (via caspase, Fas and CD40 pathway activation), alteration of cell polarity and permeability. These effects were not observed with exosomes derived from healthy subjects or produced by fibroblasts. In addition, during continuous hemofiltration (HF for 10-12 h, 35 ml/Kg/h, 50% predilution), we found only a small amount of exosomes in the effluent fluid, without a significant variation of their plasma concentration. These results suggest an inefficient exosome removal by a convective modality. **Conclusion:** plasma of septic patients contains exosomes released by activated leukocytes and platelets and potentially involved in AKI. The selective removal of exosomes by specific extracorporeal therapies may limit sepsis-related AKI.

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Piperacillin/Tazobactam has a large volume of distribution and long half-life in patients receiving CVVHD

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Background: Mortality rates of patients with acute kidney injury (AKI) requiring dialysis remains unacceptably high. Data guiding antibiotic dosing in patients on CRRT generally comes from small numbers of patients treated with heterogeneous renal replacement prescriptions. As infection is a leading cause of death in AKI, we hypothesized that altered antimicrobial pharmacokinetics (PK) might adversely affect plasma drug levels in patients receiving RRT and antibiotics. **Methods:** Patients treated with CVVHD and piperacillin/tazobactam had blood and dialysate effluent collected to determine PK parameters. After the patient had received CVVHD for 24 hours and at least 4 doses of piperacillin/tazobactam, paired blood & dialysate effluent samples were collected before a dose, 30 mins after the dose, and immediately before the next dose. Samples were stored and piperacillin and tazobactam levels measured by reverse-phase HPLC. PK parameters were calculated by standard methods. **Results:** 15 sample pairs collected (10 complete sets and 5 incomplete sets with trough & peak only secondary to interrupted CVVHD). Mean peak total drug levels were 166.2mcg/mL (range 98-371 mcg/mL) for piperacillin and 29.9mcg/mL (range 16-56 mcg/mL) for tazobactam. Mean piperacillin steady state volume of distribution (Vdss) was 34.6L and tazobactam Vdss was 30.8L both of which are significantly higher than healthy controls (approx 14-16L). Mean trough

level for piperacillin was 76.8 µg/mL (range 33.8-187 µg/mL). Elimination half-life (t1/2) for piperacillin & tazobactam was 7.4 hours and 10.9 hours respectively (piperacillin t1/2 in healthy controls is approximately 1 hour). **Conclusions:** Findings reveal that patients on CVVHD have very high volumes of distribution and a prolonged half-life for piperacillin and tazobactam compared to healthy controls. Commensurate with elevated Vdss our subjects had low peak piperacillin levels compared to healthy volunteers (peak approximately 240mcg/ml). This may arise from either volume overload or high first pass clearance by CVVHD. The trough values of piperacillin exceed the MIC of the majority of susceptible Enterobacteriacae (<16mcg/mL). Pseudomonas species may have significantly higher MICs (up to 64mcg/mL) suggesting that dosing adequacy of piperacillin during CRRT in patients with Pseudomonas may be inadequate and deserves further study.

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Effluent Piperacillin Levels Predict Serum Piperacillin Levels in Critically Ill Patients on CRRT

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Background: Mortality in dialysed acute kidney injury (AKI) remains unacceptably high, and infections are a leading cause of death in AKI. Therapeutic drug monitoring (TDM) of antibiotics can require expensive sample preparation and multiple phlebotomies. We hypothesized that CRRT effluent might provide an economic vehicle for TDM in the ICU. Effluent is cell- and protein free, and simple to prepare for HPLC. **Methods:** In an IRB-approved protocol, paired plasma and effluent samples were obtained before antibiotic dose, after antibiotic dose, and before the next antibiotic dose for patients receiving any of six antimicrobial agents. Fifteen patients receiving piperacillin/tazobactam were enrolled and samples obtained. Plasma free and total drug levels, as well as drug levels in CRRT effluent were measured by HPLC. Effluent levels were compared to plasma free and total drug levels. **Results:** Effluent levels generally predicted free and total drug levels well. This suggests that CRRT effluent provides a fast and inexpensive substrate for TDM in the ICU.

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Neutrophil Gelatinase-Associated Lipocalin an Emerging Biomarker for Acute Kidney Injury in adult ICU.

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Background: This study was designed to assess the ability of Neutrophil Gelatinase-Associated Lipocalin (NGAL) to predict for Acute Kidney Injury (AKI) in an adult critically ill patient population. **Methods:** This prospective cohort study was conducted in a single center university hospital where during a period of 6 months all consecutive admitted patients where included. On admission plasma and urine samples were collected, processed and stored at -80°C. NGAL measurements were performed in the Biosite central laboratory, San Diego, using the Triage® Test point-of-care fluorescence immunoassay blinded for all patient related data. After exclusions, 632 patients were eligible for analysis. Test performance was calculated using Receiver Operating Characteristic Curve analysis (ROC). AKI was defined according to RIFLE classification criteria for rise in serum creatinine (SCr) within 7 days after admission. **Results:** A total of 171 (27%) patients developed AKI of which 28 patients were initiated on continuous renal replacement therapy (CRRT). Admission plasma and urine NGAL values significantly increased with the severity of AKI. The area under the ROC curves for plasma and urine NGAL were calculated for RIFLE R (0.77±0.05 and 0.80±0.04 respectively), RIFLE I (0.80±0.06 and 0.85±0.04 respectively) and RIFLE F (0.86±0.06 and 0.88±0.04 respectively). Furthermore, admission plasma and urine NGAL had equal predictive power for the initiation of renal replacement therapy (AUC: 0.88±0.06 and 0.89±0.04 respectively). Test cutoffs were defined for prediction of RIFLE F, as were the corresponding positive (PPV) and negative (NPV) predictive values (table 1). **Conclusions:** Plasma and urine NGAL values measured at ICU admission are very good predictors for the occurrence of AKI within 7 days and the initiation of CRRT in adult critically ill patients. Plasma and urine NGAL values perform equally well and their predictive power increases when using stronger endpoints of AKI.

CUT-OFFS	SENSITIVITY	SPECIFICITY	PPV	NPV	AUC
PLASMA NGAL					
168 ng/ml	0.91	0.50	0.15	0.98	0.86
245 ng/ml	0.82	0.70	0.21	0.98	
417 ng/ml	0.70	0.90	0.40	0.97	
URINE NGAL					
94 ng/ml	0.98	0.50	0.16	1.00	0.88
247 ng/ml	0.89	0.70	0.22	0.98	
1310 ng/ml	0.55	0.90	0.35	0.95	

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Role of urinary L-FABP as an AKI Biomarker in a Mixed ICU

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Background: Acute kidney injury (AKI) remarkably worsens the outcomes of critically ill patients and early detection and accurate prediction of AKI are indispensable to improve AKI therapeutic strategy. The present study is aimed to evaluate whether urinary L-type fatty acid binding protein (L-FABP) can detect and/or predict AKI in a cohort of heterogeneous patients in intensive care unit (ICU). Adult patients who admitted to the ICU of Tokyo University Hospital from Dec 2008 to May 2009 were eligible. Patients with end-stage renal disease were excluded. Three hundred thirty five patients (medical 162, elective surgery 125, and emergency surgery 48) were enrolled. Urine samples collected within 12 hr of admission were analyzed for urinary L-FABP, N-acetyl-β-D-glucosaminidase (NAG), and albumin. AKI was defined with the modified RIFLE serum creatinine criteria at the admission of ICU [AKI 129 (38.5%): R 53, I 32, F 44]. Urinary L-FABP levels were significantly higher in AKI patients compared with non-AKI patients [non-AKI 7.3 (1.9-22.0) ng/ml, R 18.8 (5.6-72.8) ng/ml, I 37.0 (7.3-193.3) ng/ml, F 162.8 (36.0-716.8) ng/ml, median (IQR), $p<0.05$]. Urinary L-FABP had the highest area under the receiver operating characteristic curve (ROC-AUC) for AKI diagnosis among the three urinary markers (L-FABP 0.75, NAG 0.62, Alb 0.68). Sixty three patients were newly diagnosed as AKI during one week time frame after ICU admission. These patients showed significantly higher urinary L-FABP levels at ICU admission than non-AKI patients. The ROC-AUC of L-FABP for prediction of newly diagnosed AKI was 0.70. The 14-day mortality of this cohort was 4.2% and non-survivors showed higher urinary L-FABP levels [non-survivor 264.0 (126.5-904.5) ng/ml, survivor 10.0 (3.0-40.7) ng/ml, median (IQR), $p<0.05$]. Urinary L-FABP had the highest ROC-AUC for the 14-day mortality among the three urinary markers (L-FABP 0.90, NAG 0.66, Alb 0.63). In conclusion, our data indicated that urinary L-FABP could detect AKI at the ICU admission, predict AKI development and mortality in mixed ICU that has heterogeneous patients.

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Middle-Molecule Clearance at 20 ml/kg/hr and 35 ml/kg/hr CVVHDF: Pre vs Post Dilution

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Background: Of five clinical trials testing dose-response of CRRT in AKI, two showed a benefit, two showed none, and one appears equivocal. However, blood-membrane interactions may dominate macromolecule transport in CVVHDF, reducing the impact of dose adjustment. We explored the role of pre- and post- dilution modes on middle molecule clearance using a popular CRRT system. **Methods:** Bovine blood with an added fluorescent tracer was treated with 1:1 balanced CVVHDF at 20 and 35 ml/kg/hour in pre-dilution mode and post-dilution mode. Clearance of tracers between 10-100 kilodalton (kD) molecular weight was measured during six hours of therapy. **Results:** Dialysate-side middle molecule clearance differed by less than 2 ml/min between the two dosing arms in pre-dilution CVVHDF, but varied by almost a factor of 2 in post-dilution CVVHDF. **Conclusion:** The prescribed mode of CVVHDF (pre- dilution or post-dilution) has a significant impact on middle molecule clearance. This may suggest subsequent trial designs.

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Modifiable Risk Factors of Acute Kidney Injury Post Isolated Coronary Artery Bypass Surgery

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Objective: Acute kidney injury (AKI) is one of the major cause of morbidity and mortality after coronary bypass surgery (CABG). The current study is to identify potentially modifiable risk factors for AKI post isolated CABG.

Methods: From 2002 to 2007, all patients more than 18 years old undergoing isolated CABG for the first time were enrolled for retrospective analysis. Patients with dialysis dependent pre-operatively were excluded. Primary end point is AKI defined by Acute Kidney Injury Network criteria within 48 hours after surgery. Spline function curves were plotted in all continuous variables to define cut-off value for AKI. Logistic regression with stepwise selection was used for multivariate analysis. Final model was diagnosed with good-of-fitness assessment. **Results:** Total 1480 patients were enrolled for final analysis. AKI developed in 19.1% of them. Albumin less than 4g/dL, hemoglobin less than 14g/dL, white blood cell count (WBC) more than 10000/uL and left ventricular ejectin fraction (LVEF) less than 60% were identified as cut off values in spline function curves. 1308 of them underwent logistic regression and the analysis identified risk factors for post-operative AKI being older age (HR = 1.02, with 95% CI = 1.00-1.04, p= 0.0026), congestive heart failure (HR = 1.94, with 95% CI = 1.28-2.92, p = 0.0017), usage of intra-aortic balloon pumping (HR = 4.27, with 95% CI = 2.37-7.69, p < 0.001), usage of extra-corporeal membrane oxygenation (HR = 10.23, with 95% CI = 3.39-30.94, p < 0.001), higher creatinine (HR=1.43, with 95% CI = 1.23-1.66, p < 0.001), low albumin (HR=2.14, with 95% CI = 1.47-3.10, p < 0.001), high WBC (HR=1.751, with 95% CI = 1.67-2.87, p = 0.0262, usage of cardiopulmonary bypass (HR=4.66, with 95% CI = 3.08-7.05, p < 0.001) and low hemoglobin (HR=1.84, with 95% CI = 1.15-2.95, p = 0.0105). Full model showed a good c-index (0.864) and p-value for goodness-of-fitness was 0.1154 (>0.05). **Conclusion:** low hemoglobin, low albumin and CPB are potentially modifiable risk factors for acute kidney injury post isolated coronary artery bypass surgery.

Covariate	Estimate	Standard Error	Wald	p-value	Odds Ratio	95% Confidence Interval
Intercept	-4.9354	0.6016	67.3044	<.0001	-	-
Age (years)	0.0197	0.00883	4.9541	0.026	1.02	1.002-1.038
CHF	0.6599	0.2103	9.8417	0.0017	1.935	1.281-2.922
IABP	1.451	0.3004	23.3388	<.0001	4.268	2.369-7.688
ECMO	2.326	0.5642	16.9939	<.0001	10.237	3.388-30.937
Cr (mg/dl)	0.3565	0.0762	21.896	<.0001	1.428	1.23-1.658
Low Albumin	0.7593	0.1904	15.9099	<.0001	2.137	1.471-3.103
High WBC	0.5605	0.2521	4.9443	0.0262	1.751	1.069-2.871
CPB	1.5383	0.2117	52.7915	<.0001	4.657	3.075-7.051
Low HB	0.6115	0.2391	5.5405	0.0105	1.843	1.154-2.945

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The incidence of Acute Kidney Injury(AKI) and Multivariate Analysis of its influencing factors in the patients in Cardiac Care Unit

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Background: Acute kidney injury (AKI) is an important clinical issue, especially in the critical care setting with incidence ranging 1-31% and mortality 28-82%.The reason of incidence and mortality rates vary widely was over 30 definitions of acute renal failure/AKI have been used in the literature. objective • Validating the property of AKIN criteria for diagnosis and staging of AKI • Seeking the relationship of AKI with mortality **Methods:** • We investigate whole patients admitted to our CCU during 2002-2005. Patients with at least one ΔScr/48hrs were recruited. According to AKIN criteria, patients were classified into the following 4 groups by their maximal ΔScr/48hr : Non AKI: ΔScr <0.3mg/dl AKI stage 1: ΔScr ≥ 0.3 mg/dl or increase to ≥150% - 200% from baseline AKI stage 2: ΔScr > 200%-300% from baseline AKI stage 3: ΔScr >300% from baseline (or Scr≥4.0mg/dl with an acute rise of at least 0.5 mg/dl) **Results:** Total selected patients were 1085, include 786 males, 299 females (the ratio is 2.6:1).The average ages were 63.6±12.9. The incidence of AKI was 44.3% (n=481)and the mortality of all of the 1085 patients was 12.4% (135/1085). The mortality of AKI patients was higher than non AKI patients (n=604) significantly 1.2% vs. 26.6%, P<0.001) and the mortality raise gradually combine with the

raising stage of AKI. **Conclusions:** The incidence of AKI in CCU was high according AKIN criteria. The mortality of AKI patients was higher than non-AKI patients, even in AKI stage 1 and even adjusted with other risk factors, AKI stage were independent risk factors of mortality in CCU patients. So we think the AKIN Scr criteria seems good in prediction of patients outcome. But there are some defects of AKIN criteria: 1. The exact urine volume is hard to get especially 6hrs output. 2. Diureses disturb the correct evaluation of real renal function by using output

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Influence of Gender on the Baseline Urinary NGAL Excretion

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Background: NGAL is one of the potential biomarkers of acute kidney injury (AKI) which has recently been under intense investigation in several different clinical scenarios. It has been reported that urinary NGAL excretion is a very sensitive and specific marker of AKI after cardiopulmonary bypass surgery in a pediatric population, but perhaps less sensitive in adult populations at risk for AKI. Gender differences in urinary NGAL levels have never been reported. **Methods:** As part of a clinical validation of urinary NGAL a reference range study was completed among 67 females and 58 males ranging in age from 22 to 77 years (mean 45.7). Individuals with diabetes or chronic kidney disease were excluded. Both random and 24 hr urine samples were collected. Data from the 24 hour collections are reported here. Urinary NGAL was measured by ELISA using reagents form Bioporto. Retinol binding protein (RBP) and alpha1microglobulin were measured on a nephelometer using Deadheaded Behring reagents. **Results:** Mean urinary NGAL excretion was greater in females than males whether normalized for creatinine (F: 41.5 ng/g (31.7, 51.4); M: 12.8 ng/g (10.2, 15.3)) or not (F: 33.4 ng/ml (26.0, 40.8); M: 14.0 ng/ml (11.6, 16.5); P<0.001 for each. Urinary NGAL excretion did not vary by age in either gender. Urinary excretion NGAL also did not correlate with the low molecular weight proteins RBP and a1m, nor with albumin. Furthermore, urinary levels of these 3 proteins did not differ by gender. **Conclusion**: we have established a reference range for urinary NGAL that differs between men and women. This observation has not yet been reported and may affect the level of NGAL expression following AKI. Further studies are needed to address whether gender needs to be accounted for during studies to identify urinary biomarkers of injury such as NGAL.

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Baseline values of Acute Kidney Injury (AKI) Urine Biomarkers differ by Gestational Age (GA) in Premature Infants

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Background*:* Recently identified urinary biomarkers of AKI may improve detection of AKI earlier in the disease process in critically ill pediatric and adult populations. Premature infants are at high risk of AKI during the process of renal development and maturation, and normative data of AKI biomarkers for these vulnerable infants are lacking. **Objective:** To determine how gestational age affects baseline values of 3 known urine AKI biomarkers: neutrophil gelatinase-associated lipocalin (NGAL), interleukin-18 (IL-18), and Kidney Injury Molecule -1(KIM-1). **Methods:** Infants with birth weight between 500-1500g and GA >25 weeks were enrolled from a regional quaternary care NICU. Infants with known AKI were excluded from the analysis. Participants were divided into 4 groups according to GA. Urine samples were collected on postnatal days 1 through 6. Analysis of variance (ANOVA) was used to determine differences between groups. **Results:** We analyzed 249 samples from 73 infants .We found NGAL and KIM1 urinary concentrations were increased in more premature infants, whereas IL18 did not vary by GA. (Table 1). Similar findings were seen if birthweight categories were used, and if values were corrected for urine creatinine (data not shown) **Conclusion:** Normative data for the 3 urinary AKI biomarkers have been determined in premature infants, which will be helpful as we test their ability to predict AKI and survival in premature infants. The elevated urine NGAL and KIM -1 in premature infants may possibly be detection of a normal maturational process as renal function is immature in this population.

Biomarker (Mean ± S.D)	< = 26 weeks	26 - <=28 wks	28 - <= 30 wks	30 - <=36 wks	p value
IL18 pg/ml	63 ± 100	97 ± 128	56 ± 59	91 ± 136	0.12
KIM1 pg/ml	308 ± 368	223 ± 172	182± 144	171± 115	0.01
NGAL ng/ml	301± 198	306± 281	172± 185	137 ± 165	<0.001

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Rhabdomyolysis in H1N1 Influenza Virus Infection, a Retrospective Cohort Study

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Background and Objectives: Creatinine phosphokinase (CPK) elevation is common in H1N1 influenza virus infection. However, till date no study has evaluated the factors associated with rhabdomyolysis in H1N1 Influenza virus infection. Our study is an effort to analyze the prevalence of rhabdomyolysis in H1N1 Influenza virus infection and the factors associated with it. **Methods:** Retrospective cohort study of adult patients with H1N1 Influenza virus infection complicated by rhabdomyolysis from August 2009 - November 2009. Rhabdomyolysis was defined as serum creatine kinase > 2000 IU/L. H1N1 infection was confirmed by Real Time – Polymerase Chain Reaction (RT-PCR) from a throat swab according to WHO protocol. The study population was divided into group-A (Mild symptoms), group–B1 (severe symptoms), group-B2 (severe symptoms with co-morbid illness) and group-C (presence of respiratory failure). **Results:** From a total of 620 consecutive patients with H1N1 influenza Infection (Group A -220, group B1- 212, group B2- 151 and group C: 37) who were admitted in our tertiary care center. 180 patients (29 %) (Group A -74, group B1- 45, group B2- 40 and group C: 21) had rhabdomyolysis. Mean age was 49 years. Mean creatine kinase was 11531 IU/L and mean serum creatinine on admission was 2.1 mg/dl. 63 % of patients with rhabdomyolysis had one or more additional causal factor for rhabdomyolysis like statin intake, chronic alcoholism, hypokalemia, hypernatremia and hypophosphatemia. Mortality was 41%. A higher APACHE score (P=0.021), higher HbA1C (P=0.033), anemia (0.012) and higher serum lactate (0.041) were significantly associated with rhabdomyolysis. **Conclusion:** Rhabdomyolysis was common in patients with H1N1 influenza infection with higher prevalence noted with more severe infection. Poor glycemic control, anemia, higher APACHE score, higher serum lactate levels are commonly associated factors.

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Acute Kidney Injury in Dengue Fever using AKIN criteria – incidence and risk factors

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Background: This study was designed to find out the incidence and risk factors for acute kidney injury(AKI) in patients with Dengue fever (DF). 223 patients treated in a tertiary care centre in South India were retrospectively analyzed. Only Dengue IgM positive patients (confirmed by ELISA) were included. **Methods:** Our study group comprised 223 patients (M-130,F-93) with mean age of 26.2+18.2 years. Based on the AKIN criteria, the patients were divided into 2 Groups, Group A with AKI and Group B without AKI. In addition, Group A patients with AKI were subdivided into 3 categories: Mild (Group A1), Moderate (Group A2) and Severe (Group A3) based on AKIN criteria. Statistical analysis of the clinical data for all these patients was done using t-test(s), chisquare, ANOVA and tukey tests to examine the effects between the Group / Subgroup and the clinical parameters (vital signs, Haemogram analysis, Liver Function tests, Renal Function tests, Electrolytes, Co-morbidities). **Results:** ARF developed in 24(10.8%) and as per AKIN criteria 12(5.4%) had mild AKI, 7(3.1%) had moderate AKI and 5(2.2%) had severe AKI. 54(24%) were diagnosed with Dengue hemorrhagic fever (DHF). 11(5%) were co-infected with Leptospirosis. Thrombocytopenia was present in 157 (70%). 64(29%) were hypotensive. Overall 22 patients died(9% all cause mortality). Results of the risk factor analysis between Group A and Group B showed that the following clinical parameters were statistically significant: Total count (A= 9824;B= 6706;p= 0.01); BUN on discharge(A= 26;B=13;p< 0.001); Cr on discharge(A= 1.78;B= 0.79;p< 0.001); GFR on discharge(A= 51.76;B= 101.75;p<0.001); SGPT(A= 450;B= 144;p= 0.001); ALP(A= 207;B= 142;p= 0.001); Albumin(A= 2.65;B= 3.09;p<0.001); HCO3(A= 20.57;B= 23.21;p= 0.009);hypotension(p= 0.01); viral hepatitis(p< 0.001); sepsis(p< 0.001); MODS(p< 0.001); inotrope use(p< 0.001);mortality(p< 0.01). Results of the risk factor analysis between Group A1, A2 & A3 showed the following clinical parameters to be

statistically significant: Total Count (p = 0.038); GFR on discharge (p=0.034); specific gravity of urine (p=0.006); ALP (p=0.013) ; SGPT(p=0.042), MODS(p=0.05), Platelet FFP(p=0.007), mortality(p=0.005). **Conclusions:** AKI develops in 10.8% of patients with dengue fever. The all cause mortality from dengue fever is 9%. Higher total white count, higher SGPT and ALP levels; and lower albumin and serum bicarbonate are risk factors for ARF in dengue fever. Hypotension, coexisting viral hepatitis, sepsis, MODS and need for inotropes were also risk factors for AKI. Total white count, GFR on discharge, specific gravity of urine, ALP, SGPT, MODS and use of platelet FFP transfusion were significantly different between mild, moderate and severe AKI. AKI is associated with increased mortality in dengue fever.

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Effect of Peritoneal Dialysis on Kidney Function Recovery and Urinary Acute Kidney Injury Biomarkers in Infants After Congenital Heart Surgery

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Objective: Acute kidney injury (AKI) after cardiopulmonary bypass (CPB) to correct congenital heart disease (CHD) is common. Post-CPB patients have hemodynamic instability from poor cardiac function, further compromised by oliguria and fluid overload. We use continuous peritoneal dialysis (CPD) to prevent fluid overload and remove fluid in oliguric patients. The effect of CPD on kidney recovery is unknown, thus indications for discontinuing CPD remain unclear. Change in urine output (UOP) may suggest recovery. Urinary biomarkers are earlier, more sensitive indicators of AKI than serum creatinine, and may not be affected by CPD. However, urinary biomarkers have not been evaluated to predict kidney recovery. We aim to determine how CPD affects kidney recovery, if change in UOP can predict kidney recovery, and if urinary biomarker levels can predict kidney recovery. **Methods:** Patients <30 days old undergoing CPB for CHD treated with CPD are randomized to two groups matched for CHD physiology. At CPD discontinuation, patients either 1) stop CPD or 2) continue CPD for an additional 24 hr. UOP (ml/kg/hr) is measured throughout the study period. Urine samples for biomarkers (NGAL, IL-18, KIM-1, and L-FABP) are collected 6 hr post-CPB, then at 12 hr intervals until CPD catheter removal. **Results:** 40 pts are needed to detect a 30% difference in UOP (ml/kg/hr) between study groups, with 20 patients in each group. Four patients have been randomized to date, 2 stopping CPD and 2 continuing CPD for 24 hr. Eight hr following randomization, after stopping CPD, UOP averaged 5.0 ml/kg/hr and when continuing CPD, UOP averaged 1.2 ml/kg/hr. UOP and %change UOP will be compared between both groups to assess for potential differences in kidney recovery. Urine NGAL levels did not change in patients who continued versus stopped PD. Urinary biomarker concentrations will be compared between both groups to assess potential correlation with CPD duration and/or if urinary biomarkers can predict the time course of kidney recovery. **Conclusions:** Our preliminary data provide insight into the effect of CPD on UOP recovery after CPB.

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RenalGuard System (RGS) for Prevention of Contrast Induced Nephropathy

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Objective: Contrast media directly damages renal epithelial cells independent of any hemodynamic effects. We hypothesized that increasing urine output to very high levels would dilute the luminal concentration of contrast media and diminish contact time with epithelial cells thus reducing nephrotoxicity. **Methods:** The RGS replaces urine losses with intravenous fluid in real time. An initial 250 mL of normal saline (NS) is given intravenously over 30 minutes and followed by intravenous furosemide (0.25-0.50 mg/kg). The RGS is then activated with NS as replacement fluid. Cardiac angiography (CA) is delayed until urine output exceeds 300 mL/hr. RGS is deactivated 4 hours after angiography. **Results:** MYTHOS trial randomized 105 patients with CKD III-IV (mean eGFR 37 ml/min) undergoing CA ± PCI. RGS patients received 0.5 mg/kg of furosemide at initiation. Control patients received 1 mL/kg/h of NS starting 12 h before and for 12 post CA. CA was performed 48 ± 16 minutes after initiation of RGS. Peak urine output was 827 ± 324 ml/hr. CIN (>0.5 mg/dL or >25% increase over 72 hr) occurred in 4% of RGS vs 14% of control. Post CA complications were 6% in the RGS vs. 18%

in control patients. REMEDIAL II randomized 112 patients (mean eGFR 32 ml/min) undergoing CA or peripheral angiography ± PCI. The RGS group received 0.5 mg furosemide and 1500 mg NAC intravenously. Control patients received 1500 mg IV NAC plus IV bicarbonate (7 hours) and high dose oral NAC (48 hour). Angiography was performed 45 minutes after initiation of RGS. Peak urine output was 600 ml/min. CIN (>0.3 mg/dL rise within 48h) occurred in 8 % of RGS vs 16% of control. **Conclusion:**The RGS results in significant increases in urine output not typical of intravenous fluid alone. Polyuria occurs without altering extracellular volume. The polyuria appears to reduce the incidence of CIN in these high risk patients supporting the hypothesis regarding direct cell toxicity. There was also a reduction in hospital events in the RGS treated patients.

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Impact of Statins on Renal Outcome of Isolated Coronary Artery Bypass Surgery Patients.

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Objective: Statins possess renoprotective properties, which benefit patients with chronic kidney disease beyond their lipid lowering effect. Previous study did not consistently demonstrate its benefit of protection of statins from cardiac surgery associated acute kidney injury (CSA-AKI). We conducted a retrospective study to clarify the role of statins in CSA-AKI, with the modern definition of acute kidney injury (AKI): Acute Kidney Injury Network (AKIN) Classification. **Methods:** All patients undergoing elective isolated coronary bypass surgery (CABG) in our hospital from 2002 to 2007 were enrolled for analysis. Patients with previous dialysis were excluded. Detailed demography was recorded. Propensity score matching method for statin prescription was applied with logistic regression. Selective logistic regression for outcomes, including any stage of AKIN classification, renal replacement therapy (RRT) and death were done and goodness of fit tests were also performed with adjusted R square and Homer-Lemeshow's test. **Results:** 1251 patients were enrolled for analysis. 320 (25.6%) of them took statins prior to surgery. 75.9% of them are male. The mean age was 65.3±10.9 years old. Stepwise logistic regression identified that patients with younger age (Odds ratio, OR = 0.98), higher total cholesterol (OR = 1.00), recent myocardial infarction (OR = 1.92) and hypertension (OR = 5.81) are more likely to take statins. Propensity score matching method finally identified 297 pairs of patients. There was no significant difference of any stages of AKIN classification (p = 0.61), RRT (p = 0.3) or death (p = 0.80) between these two treatment groups. Selective logistic regression for each stage and RRT did not disclose pre-operative statin to be a association factors. **Conclusion:** Pre-operative statin prescription did not protect from acute kidney injury, post operative renal replacement therapy or death in our cohort.

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High Volume Peritoneal Dialysis versus Sustained Low Efficiency Dialysis: a randomized, controlled trial in patients with acute kidney injury – initial results

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Background: Sustained low efficiency dialysis (SLED) is much utilized in acute kidney injury (AKI) and peritoneal dialysis (PD) is used in the developed world. Recently we demonstrated that high volume PD (HVPD) and daily hemodialysis are comparable methods. **Objective:**this is a double-center prospective, randomized, controlled trial to compare the effect of HVPD versus SLED on AKI patient survival, beginning in 2008 in Clinical Hospital of Botucatu and General Hospital of Bauru, Sao Paulo, Brazil. **Methods:** we calculated that with at least 180 patients, study statistical power will be 80% to detect an absolute difference in mortality of 20% between the groups. The primary endpoint will be patients' mortality in 60 days. Eligible subjects are critically ill adults with AKI (defined according to AKIN) due to acute tubular necrosis who require use of vasoatives drugs in Intensive Care Unit (ICU). Patients with severe hypercatabolism are excluded. After enrollment, patients are randomly assigned to either the HVPD or SLED group. A HVPD session is defined as 24 h of dialysis 7 days/week using an automated cycler and a SLED session is defined as 6-8 h performed 6 days/week with hemodialysis machine. **Results:** after 15 months, 179 patients were eligible for enrollment. Fifty-six patients were withdrawn (18 HVPD and 38SLED) because they had died during first dialysis session or the method was modified. Of

the remaining 123 patients (68.3% of the calculated), 52 received HVPD and 71 SLED. The patients' characteristics are similar: male (HVPD= 70.8% and SLED= 70.1%), age (60.9±18 and 67.8±10 years), internal medicine (70% and 65%), ATN-ISS score (0.74 and 0.61), BUN (94±20 and 90±30 mg/dL), serum creatinine (5.8±3.3 and 4.5±1.7 mg/dL) and ischemic AKI (85% and 87%). Delivered dialysis dose, ultrafiltration per session and metabolic control had been not yet analyzed. Infections complications occurred in 15.3% HVPD (peritonitis) and 0% in SLED (p= 0,002). Overall mortality rates were similar for both groups (65.4% and 77.4%). Of the patients who survived 47% HVPD and 50% SLED recovered renal function after 60 days. **Conclusion:** the initial results show that HVPD and SLED can be effective methods for treating AKI patients.

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Impact of timing of renal replacement therapy initiation on outcome of septic acute kidney injury patients

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Background: Sepsis is the leading cause of acute kidney injury (AKI) in critical patients. The optimal timing of initiating RRT remained controversial in septic AKI patients. The objective of this study is to determine the impact of early or late initiation of RRT, defined with RIFLE classification, on hospital mortality of septic AKI patients. **Methods:** Patients underwent RRT due to septic AKI in surgical intensive care units were enrolled between January 2002 and October 2009 from our prospective database, the NSARF (National Taiwan University Hospital Study Group on Acute Renal Failure) database. The patients were divided into early (RIFLE-0 or Risk) or late (RIFLE-Injury or Failure) initiation of RRT by RIFLE criteria. The primary endpoint was in-hospital mortality. Propensity score matching method with stepwise logistic regression was employed to eliminate selection bias of these two treatment options. **Results:** Among the 370 patients, 192 (51.9%) underwent early RRT and the rest (178, 48.1%) received late RRT. In-hospital mortality was recorded in 259 patients (70.0%). The in hospital mortality of these two groups were 135 (70.8%) and 124 (69.7%) respectively. Logistic regression showed that male gender ($p = 0.04$), post-operative condition ($p = 0.03$), higher pre-dialysis creatinine level ($p < 0.01$) and without congestive heart failure ($p = 0.02$) were more in late RRT group. After matching, there were 178 patients in each cohort. The mortality rate in early and late RRT groups were 70.8% and 69.3% respectively ($p > 0.05$). Cox regression disclosed that higher predialysis creatinine (Hazard ratio = 0.90, $p = 0.02$), predialysis diastolic blood pressure (HR = 0.98, $p < 0.01$) and better consciousness level (HR = 0.92, $p < 0.01$) got less in-hospital mortality, while higher predialysis central venous pressure (HR = 1.02, $p = 0.04$) and higher predialysis lactate (HR = 1.09, $p < 0.01$) were associated with poor outcome. Log Rank test of Kaplan-Meyer curves was insignificant between these two treatment options (HR = 1.13, $p = 0.33$). **Conclusions:** Early dialysis classified by RIFLE criteria showed no survival benefit than late dialysis in septic acute dialysis patients. Further prospective controlled trials are needed for further clarification.

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Effluent Volume in Continuous Renal Replacement Therapies Overestimates the Delivered Dose of Dialysis

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Background: CRRT dose and outcome studies have shown conflicting results. Most studies used prescribe ml/kg/hr effluent rate and report measured effluent volume as a surrogate of solute removal. Since filter fouling and clotting can reduce its efficacy, the actual delivered dose maybe substantially lower. We hypothesized that prescribed and measured effluent volume overestimate CRRT delivered dialysis dose. **Methods:** We analyzed data from 426 treatments in 52 critically ill patients from one center included (UCSD) in the PICARD study that were treated with pre-dilution CVVHDF. All patients were treated with regional citrate anticoagulation with pre-filter dilution fluid to keep the circuit patent. Filter performance was monitored during the entire therapy course by measuring blood urea nitrogen (BUN) and

effluent urea nitrogen (FUN) samples at initiation and q/12 hours. Filter efficacy was assessed by calculating FUN/BUN ratios and the ΔFUN/BUN was calculated for each 12 hr period of filter use. Prescribed dose (K, ml/min) was determined from the effluent rate. Estimated urea clearance (K estimated) was calculated from the measured effluent volume normalized for actual treatment time. Prescribed (Kc prescribed) and estimated (Kc estimated) clearance were corrected for pre-dilution effect. Actual delivered urea clearance (K delivered) was determined with the formula (effluent urea nitrogen * effluent volume)/plasma urea nitrogen. **Results:** Mean daily treatment time was 1,388+/-202 min with a total effluent volume of 46,416+/-17,414 ml and urea mass removal of 13.0+/-7.6 mg/min. K prescribed and K estimated were similar (p=0.625), whereas K prescribed and K estimated overestimated the actual K delivered by 23.8% (p<0.0001); also Kc prescribed and Kc estimated overestimated the actual K delivered. **Conclusions:** Measured effluent volume significantly overestimates delivered dose of small solutes in CRRT and may contribute to inconsistencies in the results of clinical trials of dialysis dose in AKI. Future trials should consider the use of direct dialysate effluent solute quantification as an index of delivered dose. Effluent rate based prescriptions for CRRT should incorporate an increment between 20-25% in the prescribed dose to account for the decrease in treatment time and lack of filter efficacy in CRRT.

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Continuous Renal Replacement Therapy in the Management of Metabolic Acid-base Disorders

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Background: In addition to small solute control, correction of metabolic acid-base disorders is an important component of RRT adequacy. CRRT can be maintained for 24 hours providing optimal time for acid-base management and control. Different types of mixed metabolic acid-base disorders are not well characterized during CRRT treatment. We hypothesized that the time frame to control these metabolic acid-base disorders would differ during CRRT treatment. **Methods:** We analyzed data from 420 treatments in 56 critically ill patients from one center included in the PICARD study. All patients were treated with pre-dilution CVVHDF, and anticoagulation was performed with regional citrate. We assessed acid-base disorders using the physiological and the physicochemical approaches. Mixed acid-base disorders were further classified using ΔAG/ΔHCO3 in 3 groups: G1) pure AG acidosis [Δ/Δ1-2]; G2) AG metabolic acidosis + metabolic alkalosis [Δ/Δ >2]; G3) non-AG acidosis + AG acidosis [Δ/Δ <1]. We assessed improvement of pH, HCO3, albumin corrected AG (AGcorr), effective strong ion difference (SIDeff) and strong ion gap (SIG) during the first 7 days of CRRT therapy. **Results:** Mean daily treatment time was 1,388 202 min. The steady state was achieved at 40.8±17.5 h. pH and HCO3 levels normalized at 48 and 72 hours respectively; while AGcorr, SIDeff and SIG showed improvement after 24 hours, but did not reach normal values after 7 days of treatment. As shown in figure 1, the number of patients with pure AG metabolic acidosis improved, although part of these patients developed metabolic alkalosis during treatment. The percentage of patients with mixed metabolic acidosis (G3) increased over time. **Conclusions:** CRRT is an effective tool in the management of metabolic acid-base disorders. Although normal levels of pH and HCO3 could be achieved in the first two days of therapy, the physiological and physiochemical approaches to assess acid-based disorders showed persistence in mixed acid-base disorders. Use of saline solution and consequent hyperchloremia, citrate and other factors that are present during CRRT treatment could contribute to the persistence in mixed metabolic acid-base disorders like mixed metabolic acidosis.

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Study of the effect of CVVHDF on the Microcirculation of Critically ill Patients

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Background: Recently, there has been an arising interest on the use of continuous renal replacement therapies(CRRT) beyond their classical indications (acute renal failure, fluid overload unresponsive to diuretics, electrolyte disturbances , resisting to conventional treatment and severe metabolic acidosis. We hypothesized

that CVVHDF could have a beneficial influence on peripheral microcirculation **Objective:** To investigate the possible effect of CVVHDF on microcirculation using NIRS (near-infraded red spectroscopy). **Methods:** Tissue oxygen saturation (StO2%) was continuously monitored before, during and following 3-min occlusion of the brachial artery via a pneumatic cuff , before and after 5 hours of CVVDF in 19 patients. The same evaluation has been performed in 6 ICU patients who were not on CVVHDF **Results:** Oxygen consumption rate (StO2%/min) significantly improved after 5 hours of CVVHDF (16.9±10.4 vs. 26.5±17.3, p=0.039). There was also a significant improvement in % oxygen consumption rate in the group of CVVHDF when compared with the 6 patients who were not on CVVHDF (56%±13% vs. -15%±34%, p=0.005).**Conclusions:** Our study showed that CVVHDF can have a beneficial effect on peripheral microcirculation of critically ill patients.

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Pharmacokinetic studies in Critically ill Patients receiving Continuous Renal Replacement Therapy (CRRT) – a Systematic Review

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Objective: We aimed to review available literature on the pharmacokinetic studies in critically ill patients receiving CRRT and to evaluate the actual delivered dialysis dose and the quality of these studies. **Methods:** We searched Medline, PubMed, EMBASE and Cochrane databases from 1966 to October 2008 to identify clinical studies examining critically ill adult patients receiving CRRT and drug pharmacokinetics with following search terms: 1) “acute kidney failure” OR “acute renal failure” AND 2) “renal replacement therapy” AND 3) “pharmacokinetics” AND 4) “critical illness” OR “intensive care” OR “critical care”. Two independent reviewers assessed all abstracts for relevance. We included studies reporting adequate data to calculate dialysis dose normalised to body weight. We extracted data on dialysis and pharmacokinetics. We evaluated study quality using both ADQI minimal reporting criteria for CRRT studies and Downs and Black checklist. **Results:** We identified 155 potentially relevant studies. None of those studies reported dialysis dose. Only 46 articles reported adequate data to calculate the dialysis dose with minimal assumptions and were included in the systematic review. These articles reported 58 separate interventions. Of these 58, 22 studies had used a dialysis dose exceeding 25ml/kg/h and three exceeding 35ml/kg/h. The median (IQR) dialysis dose was 24.2 (18.8-27.9) ml/kg/h in all studies combined. Of 46 articles, 45 (97.8%) reported drug total clearance, 41 (89.1%) CRRT clearance, 22 (47.8%) renal clearance, 34 (73.9%) area under the curve, 45 (97.8%) volume of distribution at steady state, and 34 (73.9%) the sieving/saturation coefficient, respectively. Of the minimal reporting criteria by ADQI, only one study reported all variables (maximum 11 or 12 depending on the dialysis modality). The median (IQR) of reported values was 7 (4-8). There was no statistically significant difference between AQDI points before and after year 2002. The median (IQR) of overall quality score of 40 articles (6 case series excluded), as estimated by Downs and Black, was 15/32 (14-16). **Conclusion:**Pharmacokinetic studies in critically ill patients receiving CRRT are limited. Dialysis dose is poorly reported. The minimal reporting criteria by ADQI for dialysis treatment are poorly fulfilled even in the most recent studies.

Targeted Intervention

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Continous Renal Replacement Therapy (CRRT): The lifesaving therapy after lightning injuries and the following severe complications

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Background: Continuous Renal Replacement Therapy (CRRT): The lifesaving therapy of lightning injuries and the following severe complications **Objective:**We present a case report of a 24 year old male football player who survived a prolonged cardiac arrest after a lightning strike. High flow CRRT at the intensive care unit (ICU) was essential in the treatment of severe rhabdomyolysis and hyperkalemia. Cardiopulmonary resuscitation was immediately started after the lightning strike at a football match and the resuscitation continued for 10 minutes until the doctor ambulance arrived. There was spontaneous circulation after an additional 45 min. of resuscitation. The blood pressure was 80/40 mmHg and the arterieal blood sample indicated

metabolic acidosis (pH: 6,68, standard HCO3: 10,2 mmol/l, serum lactate: 24 mmol/l and serum-potassium: 6,9 mmol/l) after the arrival at the hospital. The patient was immediately transferred to the ICU, connected to a respirator while systematic cooling to 33 0C with the continuous venovenous haemofiltration (CVVH) (Aquarius, Baxter) modality was used to reduce the neurologic impact of prolonged cardiac arrest. The replacement fluid rate was 9.000 ml/h (equal to 112 ml/kg/h). Despite the applied high flow CVVH creatinine phosphor kinase (CPK) increased from 28.500 U/L on the first day to 706.000U/L on the 4. day of treatment. The replacement fluid rate was increased to 10.000 ml /h (equal to 125 ml /kg /h). This increase was also effective to remove the spontaneously increased serum-potassium (6,5mmol/l) at the 3. day of treatment. The serum levels of myoglobine were above 3000 µg/l until the 15.day. Significant changes in serum concentrations of zink, phosphate, magnesium, calcium were not observed despite the higher replacement fluid rate. Dialysis was performed without anticoagulation because of severe coagulation problems. Instead Prostacyklin af 5-6ng/kg/min was initiated to inhibit aggregation of the platelets. Reduction in replacement fluid rate was possible on the 9.day to 50 ml/kg/h and intermittent dialysis was necessary for additional a few weeks until the kidneys regained their function. This young man survived and fully recovered the lightning strike. Very high flow CRRT was the key of successful treatment in ICU and essential for this case.

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The evaluation of a fluid overload assessment tool in a Level III community hospital ICU

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Objective: Will a fluid overload assessment tool improve the quality of care, reduce length of stay and reduce readmissions to ICU. The population targeted in this Level III community hospital ICU is the critically ill patient with sepsis, the critically ill patient with AKI and the critically ill patient with ARDS. The goal of implementing this tool is to improve care by initiating early goal directed therapy for the septic patient in a timely fashion, early CRRT for the AKI patient and fluid reduction to facilitate extubation and improve respiratory function in the critically ill patient with ARDS. **Methods:** In this study of 20 patients, a fluid overload assessment tool was utilized to monitor patient weight, cumulative fluid balance, Hgb, BUN and creatinine. Retrospective chart audits were performed on 10 critical care patients and an ongoing study of 10 current critical care patients is being conducted. **Conclusions:** As a result of this study, the Critical Care team has become more aware of the negative implications of a positive fluid balance and the improved outcomes related to early intervention for patients with fluid overload.

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On line blood volume monitoring with the Critline monitor in conjunction with continuous renal replacement therapy in intensive care unit patients.

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Objective: Intensive care unit patients with acute kidney injury frequently suffer volume derangements and have a mortality rate exceeding 50 percent. Evidence suggests that a volume overloaded state may be an important contributing factor. The utility of non-invasive devices to assess blood volume change has not been studied in critically ill patients with acute kidney injury requiring renal replacement therapy. **Methods:** We conducted an observational quality improvement project including 10 intensive care unit patients with acute kidney injury receiving continuous renal replacement therapy. Measurements included prescribed volume change, actual volume change, and blood volume change as indicated by the blood volume monitor (BVM). The primary outcome was correlation between prescribed volume change, actual volume change, and percent change as determined by the BVM. The prescribed volume change was determined retrospectively and was defined as volume reduction, expansion, or even. A change in volume of greater than 500 milliliters was considered significant. **Results:** The prescribed volume change correlated with actual volume change in 60 percent of patients and with the data from the BVM in 70% of patients. The mean duration of monitoring was 16 hours (plus/minus 5.5 hours). **Conclusion:** The use of BVM data could have changed clinical management in at least 30 percent of patients. This small, observational study suggests that non-invasive blood volume monitoring may be of benefit in optimizing volume management in

critically ill patients receiving continuous renal replacement therapy.

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Prophylactic Continuous Venovenous Hemofiltration can prevent worsening of the Kidney Functions after Percutaneous Coronary Intervention in Patients with Advanced Chronic Kidney Disease

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Objective: Chronic kidney disease (CKD) patients are at higher risk of contrast nephropathy (CIN). The purpose of this study was to find whether post procedure continuous venovenous hemofiltration (CVVH) can prevent CIN in CKD patients after coronary angiography. **Methods:** All patients with stage III and IV CKD scheduled for coronary angiography in chest disease hospital of Kuwait from January 2004 to December 2006 were enrolled in the study. Patients with cardiogenic shock, pregnancy, exposure to contrast or nephrotoxic drugs during the previous two weeks, renal transplantation and, patients requiring regular dialysis were excluded. Acetylcysteine, mannitol, dopamine, were not used during the procedure. Patients were started on CVVH using Prisma continuous fluid management system and bicarbonate buffered solution for CRRT from Hospal for 18-24 hours as soon as possible after the procedure, and the time interval from contrast exposure to initiation of dialysis was recorded. Blood urea nitrogen (BUN) and serum creatinine were measured before the procedure, at the end of the CVVH session, daily for the following three days, at hospital discharge, and 15 days after the procedure. Glomerular filtration rate (GFR) was calculated at the same times using Cockcroft and Gault equation. The incidence of CIN defined as > 25% increase from baseline serum creatinine, in hospital mortality, and the need for long term dialysis were calculated. **Results:** 98 patients were included. Mean age was 60.7 ±10.99 years. All patients underwent post procedure CVVH for 21.34 ± 2.12 hrs. The mean time interval between the procedure and the start of CVVH was 44.34 ± 18.77 min. Serum creatinine was 411.29 ± 79.94, 403.58 ± 8 8.39 , and 422.54 ± 88.86 µmol/l, and GFR was18.04 ± 4.26, 18.52 ± 4.61, and 17.62 ± 4.27 ml/min before the procedure, at discharge and 15 days after the procedure respectively (P> 0.05)
One patient (1.02%) developed CIN that required repeated CVVH during hospitalization and ended up on regular hemodialysis. The in-hospital mortality was 0%. **Conclusion:** CVVH is effective in preventing permanent loss of the kidney functions after exposure to contrast in patients with advanced CKD.

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Continuous VenoVenous Hemofiltration In cancer patients with acute renal failure *Amal H A Hassan, Naser H A Hussain, Mubarak Al Kabeer hospital - nephrology Unit- Ministry of health -Kuwait*

Background: Acute renal failure (ARF) is a common complication in patients with cancer and may occur as a consequence of the cancer itself, its treatment, and associated severe complications like sepsis. In critically ill cancer patients ARF is associated with high mortality rates ranging from 53% to 93%. Continuous venovenous hemofiltration (CVVH) for treatment of ARF in such patients has a potential advantages of being applicable at bedside and associated with a good hemodynamic tolerance. The aim of the present study was to demonstrate the effectiveness of CVVH in treatment of ARF in cancer patients and to determine the factors associated with hospital mortality. **Methods** :
A retrospective single center study conducted in Kuwait. All patients with cancer and ARF requiring dialysis and treated with CVVH between January 2006 and December 2007 were included in the study. **Results:** Eighteen cancer patients were included in the study. Fourteen were males and 4 were females. Their median age was 45.5 years. Two patients had solid organ malignancy while 16 had hematological malignancy. The number of organ failure (MOF) was 1/2/3/4 in respectively 6/2/3/4 patients. The median duration of CVVH therapy was 52 hours. Ten (55.5%) patients were discharged alive from the hospital, whereas, 8 (44.5%) died. Renal recovery was noted in 14 (77.8%) four of them died from other causes. Univariate analysis showed that older age, more than two MOF, hemodynamic instability, use of vasopressors and mechanical ventilation were significantly associated with hospital mortality. Multivariate analysis showed that the presence of MOF and the use of vasopressor drugs were the only independent factors determining hospital mortality. (p= 0.001, 0.01 respectively)
Conclusion: CVVH is an effective treatment for ARF in cancer patients. The presence of more than 2 MOF and the use of vasopressors were the only variables associated with hospital mortality.

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Effect of Daytime High Volume Hemofiltration Therapy in Sepsis Patients with Acute Kidney Injury

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Objective: To study the effect of daytime high volume hemofiltration(HVHF) in sepsis patients with acute kidney injury. **Methods:** 30 patients were divided randomly into two groups, who had been treated with daytime HVHF or with continous vein-vein hemofiltration(CVVH) for 7 days. Temporary vascular access were set up by cathetering in the right internal jugular vein or femoral vein. Fluid replacement were input by both pre-filtration and post-filtration(the rato is 2:1). In HVHF group, Blood flow is 220-250ml per minute. Replacement fluid is 6L/h, total replacement fluid is 48-60L each day. While in CVVH group, Blood flow is 180-220ml per minute. Replacement fluid is 2-4L/h total replacement fluid is 48-60L each day. Serum creatinine, BUN, electrolyte and CO2CP was measured before and after treatment. Serum TNFα, IL-1β, IL-6 were measured before and 4h, 8h, 12h after treatment. The Severity of illness were evaluated by APACHE II, organ dysfunction/failure described by the SOFA score. **Results:** In HVHF group, 12 cases survived and mortality rate was 20% in CVVH group, only 6 cases survived and mortality rate was 60%. Difference of mortality between two group was statistically significant ($p<0.05$). Patients in two groups showed stabled dynamics and favorable change of creatinine, BUN, electrolyte and acid-base balance. However, serum TNFα, IL-1β and IL-6 decreased significantly in HVHF group than in CVVH group ($p<0.05$). **Conclusion:** Daytime HVHF, containing the benefits of HVHF and CVVH, can effectively remove extra solute and adjust ionic and acid-base balance with little influence on blood flow dynamics. Daytime HVHF can better eliminate inflammatory cytokines to improve the prognosis of sepsis patients.

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The Dawning of the Aquarius - Audit on outcome after continuous replacement therapy for acute renal failure following cardiac surgery February 2008-September 2009

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Background: Acute kidney injury during cardiac surgery is related to a variety of factors, has an incidence of 5% to 20% and causes significant morbidity and mortality. The need for renal replacement therapy, whether intermittent (IHD) or continuous(CRRT), is associated with poorer outcomes. **Methods:**We conducted a prospective audit in the Cardiac Surgical Intensive Care Unit, Royal Victoria Hospital, Belfast. We recorded patient and perioperative demographics, reasons for development of renal failure and commencement of CRRT, total duration of CRRT, recovery of renal function, need for continuing IHD and 30 day mortality. Those continuing on IHD were followed up for 90 days. **Results:** From February 2008 to September 2009, 66 patients required CRRT post cardiac surgery. The reasons recorded singly or in combination were bleeding 23/66 (34.8%), acidosis 13/66(19.7%), preoperative renal impairment 15/66(22.7%), overload 8/66(12.1%), rising lactates 4/66(6%) and deteriorating renal profile 17/66(25.7%). 37 out of the 66 patients made complete renal recovery, while 14 died within 30 days. The remaining 15 patients transitioned to IHD of which 5 showed complete renal recovery, 6 patients required permanent intermittent dialysis while 4 patients died within 90 days. The following table shows perioperative details of these 66 patients.
Conclusion: This audit of renal support in our unit highlighted the following. Firstly, the reasons for commencing CRRT were diverse. Secondly, the majority of patients 37 made a complete renal recovery within 30 days. Finally, as care progresses, CRRT transitioned to IHD. In these 15 patients 6 recovered normal renal function and 9 patients required long term IHD, while 4 patients died within 90 days (albeit with complete recovery of renal function).
This is in keeping with current literature showing equivalence of renal support modes with choice depending on patient condition. The poorer outcomes with prolonged renal support suggests further work is required to identify which patients are particularly at risk of requiring longer term renal support.

Total Patients (n=66)	CRRT only (n=51)	CRRT followed by IHD (n=15)
Renal Recovery (%)	72.5	33
30 day mortality	27.5	0
90 day mortality (%)	27.5	27
Age (years)	68.0 +/- 9.9	69.7+/- 8.9

Sex Male (%)	62.7	80
CABG (%)	37.1	40
Valve (%)	33.3	40
Complex (%)	29.6	20
CPB (minutes)	185.0+/- 109.3	179.3+/- 139.3
X-Clamp (minutes)	105.7+/-55.7	109.1+/- 79.4
Time CRRT (hours)	145.2+/-150.5	274.5+/- 192.7

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Diabetes Insipidus Induced Hypernatremia Causing Rhabdomyolysis and Acute Renal Failure Treated with Continuous Hemodiafiltration: A Case Report.

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Background: A dramatic alteration in body water homeostasis can occur in individuals with Diabetes Insipidus (DI) leading to severe hypernatremia. Although rare, hypernatremia has been shown in several case reports to cause rhabdomyolysis which often leads to renal failure. A large amount of fluid is required to replace the high volume of water that is lost through the kidneys and to overcome the water deficit. On the other hand, extreme care must be taken to avoid volume overload and extreme changes in sodium levels which could lead to brain edema, herniation and death. We demonstrate the use of continuous renal replacement therapy (CRRT) for controlled correction of DI induced severe hypernatremia, rhabdomyolysis and acute renal failure. **Methods:** A 20 yr old patient presented with severe hypernatremia (sodium 202 mEq/L), rhabdomyolysis (CPK 588,620 U/L) and acute renal failure (Cr 3.5mg/dL). After three days of fluid administration, due to the continued need to replace volume and worsening renal function the decision was made to initiate continuous veno-venous hemodiafiltration (CVVHDF) with a Gambro Prisma machine and a polyacrylonitrile hollow fiber hemofilter (Prisma M100 AN 69 filter, Gambro Inc.). All replacement was post-filter. Dialysate and replacement solutions were constituted to achieve a gradual correction of serum sodium. After three days of therapy his renal function improved, CPK level trended down and sodium stabilized in the range of 151 to 156 mEq/L. **Discussion:** In the setting of DI, severe hypernatremia can cause rhabdomyolysis and acute renal failure. Intermittent hemodialysis results in significant fluid shifts and changes in osmolality during treatment which may in fact be detrimental and not well tolerated. Hemodialysis may also lead to extremely rapid correction of serum sodium. **Conclusions:** CRRT, due to its favorable hemodynamic profile and ability to control volume status and support renal function can play an important role in the safe management of these patients. Furthermore, replacement and dialysate solutions can be individualized for each patient to correct hypernatremia gradually.

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Use of Total Plasma Exchange (TPE) in Patients with Acute Respiratory Distress Syndrome (ARDS) Secondary to H1N1: A Case Series.

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Objective: Subset of patients with 2009 H1N1 are developing ARDS with or without superimposed bacterial infection. An apparent cytokine storm leads to diffuse alveolar damage associated with necrotizing bronchiolitis and extensive hemorrhage. Many also have profound hemodynamic compromise. Mitigating the cytokine storm may offer clinical benefit. Besides the early use of neuroaminidase inhibitors, no other therapies have demonstrated efficacy. We report a case series of three pediatric patients with H1N1 associated ARDS and hemodynamic compromise treated with TPE as a blood purification system to mitigate the cytokine storm. **Methods:** TPE was performed using membrane filtration. Each patient received a plasma exchange per session calculated at 35 ml/kg. Fresh frozen plasma alone or FFP with albumin were used as the replacement solution. Critical care nurses under the supervision of the intensivist, performed the procedure. Plasma exchange was tolerated well and no complications reported. Admission pediatric risk of mortality (PRISM) and daily pediatrics logistic organ dysfunction (PELOD) scores were calculated. See table for details. **Results:** Three patients, ages 11, 13, 18 were treated with TPE. All were on mechanical ventilation and inhaled nitric oxide with one patient receiving extracorporeal membrane oxygenation and continuous renal replacement therapy. In addition, all three patients required significant vasopressor support. One patient received two exchanges, the other two received four on consecutive days. All three patients survived, two without sequella and one with myopathy of

critical illness requiring long term rehabilitation referral. **Summary:** In this small series of patients with H1N1/ARDS and hemodynamic compromise, TPE appeared to benefit as a method of mitigating the associate cytokine storm. The procedure was well tolerated, quickly performed and no reported side effects. All three patients survived defying the predicted mortality. Because these procedures used filtration TPE, it was performed in a timely fashion by ICU personnel and on equipment already available in the ICU for renal support.

Patient	PRISM	PELOD Pre	PELOD Post	Predicted Mortality
1	20	23	2	32%
2	31	32	3	85%
3	14	20	0	16%

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Successful Continuous Veno-Venous Hemofiltration in a small infant using NxStage.

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Objective: CRRT is routinely used in pediatric acute kidney injury [AKI]. Delivering safe and effective therapy to small infants is a challenging problem due to lack of suitable dialysis circuits and accuracy of ultrafiltration [UF] control. Limited experience with CRRT using NxStage system exists in children smaller than 10 kg. We provided compassionate CVVHF using NxStage to a 3 kg critically-ill infant with anuric AKI (BUN 99 mg/dL, Creatinine 2.2 mg/dL) following failure of peritoneal dialysis. The infant was status post complex cardiac surgery with subsequent development of multi-organ failure requiring high inotropic and vasopressor support. At initiation there was uremia, acidosis, moderate hepatic dysfunction and significant volume overload. **Methods**: Access achieved with Mahurkar 8 French 12 cm double lumen catheter in internal jugular. Nxstage Low Volume (83 mL) circuit was primed with PRBC's (~34% of total blood volume). Calcium chloride 10% was used to maintain ionized calcium from 1.3 to 1.4 mMol/L. Blood flow set at 50 mL/min (~16 mL/kg/min) and pre-filter fluid with bicarbonate buffer used as therapy for CVVHF at 200 mL/hr (~63 mL/kg/hr) for 5 days followed by decrease to 100 mL/hr (~32 mL/kg/hr). Further lowering of rates was software limited. Anticoagulation achieved with titrated heparin 1.2 to 1.5 fold normal aPTT as required. On majority of days a nurse was dedicated to CRRT circuit. **Results.** During each circuit initiation, patient experienced hypotension requiring short term vasopressor and calcium chloride adjustment; vasopressor doses returned to pre-circuit rates within 30 minutes. Despite wrapping CRRT membrane and tubing with foil and use of warming devices for infant and CRRT-therapy fluids; frequent medications, blood products, and fluid boluses detracted from patient warming. Core body temperature dropped below normal ~45% of the time on CRRT (Figure). Conversely, electrolytes stabilized within 24 hrs of initiation with 66% reduction in BUN, normalized sodium, and cessation of intermittent bicarbonate and calcium infusions. Phosphorus was efficiently cleared and required supplementation during therapy (Table). Over 14 therapy days, only 6 total circuits were used; average life span of circuit was 2.4 days ± 0.9 days (elective maximum of 3 days). In weeks preceding CRRT, patient accumulated average of 48 ml/day. CRRT maintained neutral fluid balance, though further UF was limited by high filtration fraction. Serial cranial ultrasounds revealed no gross hematologic/neurologic complication. **Conclusions:** There were some initial concerns in recommending CVVHF-CRRT modality with NxStage due to size and safety. Although, temperature control was challenging, our experience with this case has shown that therapy tolerance and duration was very similar to older and larger infants/children. On NxStage-CVVHF, patient had good control of electrolytes and acceptable tolerance of ultrafiltration. Additional experience may help to refine technique for more efficacious administration.

Table	2 weeks preceding CRRT (Mean ± Standard Deviation)	CRRT (Mean ± Standard Deviation)
Sodium (mg/dL)	133.2 ± 6.0	137.7 ± 3.5
Bicarbonate (mg/dL)	20.6 ± 2.3	24.2 ± 4.2
Phosphorus (mg/dL)	6.3 ± 0.8	4.5 ± 0.9
BUN (mg/dL)	81.6 ± 16.5	22.8 ± 10.1

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Adequacy of Continuous Veno-Venous Hemofiltration in a small infant using NxStage.

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Guidelines for prescription adjustment based on adequacy for are limited for children receiving CRRT. Therefore, we chose to measure urea clearances, mass-balance creatinine clearance [CrCl], and accuracy of ultrafiltration [UF] control in a CRRT-CVVHF model using NxStage over one week period. We provided CVVHF to a 3kg critically ill infant with cardiac/hepatic dysfunction and anuric acute kidney injury (BUN 99 mg/dL, Creatinine 2.2 mg/dL) following failure of peritoneal dialysis. CVVHF was initiated using NxStage when patient failed medical management of uremia, acidosis, and significant volume overload. **Methods.** Using NxStage Low Volume circuit (Minntech Renaflow II hemofilter: HF400, 0.3m2), blood flow set at 50 mL/min (~16 mL/kg/min), and pre-filter fluid with bicarbonate buffer was used for CVVHF at 200 mL/hr (~63 mL/kg/hr) for 5 days followed by decrease to 100 mL/hr (~32 mL/kg/hr). At steady state, adequacy and CrCl were tested at various times over period of one week. NxStage machine's effluent emptied into tegaderm-sealed collection jar for 4 hours. Pre-filter BUN (from patient) drawn at beginning of collection. Urea, creatinine, volume, and protein levels were measured in effluent. Collection jar weighed pre and post collection for volume ascertainment. Data was obtained from machine for liters processed and UF. Accuracy of UF control was assessed by comparing the measured effluent volume to volume processed plus UF recorded by machine during that interval. **Results.** Kt/V ranged from 0.34 to 0.47 per 4 hrs with an average of 0.4 ± 0.05. Extrapolated Kt/V ranged from 2.04 to 2.82 with an average of 2.4 ± 0.3 daily (Table). CrCl varied from 4.23 to 6.88 ml/min/1.73m2 per 4 hours with an average of 5.8 ± 1.15 ml/min/1.73m2. Estimated CrCl ranged from 25.38 to 41.28 ml/min/1.73m2/day with an average of 34.8 ± 6.92 ml/min/1.73m2/day. Protein loss during CRRT ranged from 0.75 to 1.8 grams per 4 hours with an average of 1.08 ± 0.48 grams per 4 hours (Figure). Extrapolated protein loss ranged from 1.65 to 3.8 gm/kg/day with an average of 2.03 ± 0.91 gm/kg/day. Decreasing hemofiltration from 66 ml/kg/hr to 33 mL/kg/hr had no discernable effect on CrCl (Table). UF accuracy ranged from -9.1% to 7.9% (-44 mL to 70 mL) with an average of 6.08 ± 2.78%. **Conclusions:** To our knowledge, no reports have provided detailed clinical experience of NxStage in infants and certainly none have examined the adequacy, clearance, or UF accuracy. CRRT-CVVHF allowed us to achieve Kt/V and CrCls that are comparable to those achieved in older children. However, normative data is not available for evidence-based changes in prescription. Daily protein loss was similar to that reported in peritoneal dialysis and might respond to dietary adjustment through parenteral nutrition. UF accuracy was noted to be 6.08%, which is more than the 1% (in-vitro) reported by manufacturer; discrepancy may be related to our in-vivo collection methods. This analysis shows that NxStage system can provide CRRT with excellent metabolic clearances in an infant who was hemodynamically unstable and had high obligatory fluid intake.

Table (4 hrs)	Day 1	Day 2	Day 3	Day 4	Day 7	Average
Total UF (Effluent, mL)	883	826	899	895	485	796.6 ± 177.19
Total UF (Machine, mL)	813	845	837	857	529	776.2 ± 139.12
Kt/V	0.43	0.38	0.47	0.38	0.34	0.4 ± 0.05
CrCl (ml/min/1.73 m2)	5.09	4.23	5.92	6.88	6.88	5.8 ± 1.15
Protein Loss (gm)	0.88	N/A	1.8	0.75	0.9	1.08 ± 0.48

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Potential For Hemodynamic Improvement by Charcoal Filtered Albumin Enhanced Dialysis

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Background: Albumin Dialysis has been introduced to remove albumin bound toxins. While MARS allows for regeneration of dialysate albumin, in Single Pass Albumin Dialysis (SPAD) commercial albumin is used once and discarded. Former research has shown that in SPAD and MARS high contents of industrial stabilizer (Caprylate at >5mol/mol albumin) cross the dialyzer membrane into the patients blood, reducing the improvement of patients albumin binding capacity for endogenous vasodilators and bearing the risk of additional vasodilation by caprylate itself. **Objective:** To test the safety of use of dialysate albumin which was cleaned from free fatty acids (including caprylate) by charcoal filtration prior to use versus use of standard commercial albumin. **Methods:** Retrospective analysis of patients with liver failure complicated by renal failure and need for pressure support who were treated with SPAD (n=6) or albumin dialysis using charcoal filtered albumin (n=9). Reduction

of norepinephrine (NA) dose by more than 20% while maintaining a mean arterial pressure above 65 mmHg within the following 24 hours was considered a safety feature while increase by 20% an unwanted event. **Results:** Albumin concentration in dialysis bags ranged from 1,6-4%. Norepinephrine use ranged from 0,03 to 0,8 ug/kg/min. Using SPAD with commercial albumin was followed by NA reduction in 1 out of 6, with no changes in 3 out of 6 and with increased pressure support in 2 out of six. Albumin dialysis with charcoal filtered albumin was associated with reduction of NA in 7 out of 9 and no change in 2 out of nine. Removal of Bilirubin was comparable without significant differences. **Conclusion:** Although SPAD has been demonstrated to remove albumin bound toxins like bilirubin, the hemodynamic improvements described for MARS in the literature could not be observed with SPAD when commercial albumin is used which leaks caprylate into patients blood. Since caprylate can induce mitochondrial dysfunction and vasodilation, reducing the potential benefit of albumin dialysis on hemodynamics, a prospective, double blinded, randomized controlled cross-over study is planned to confirm that charcoal filtered albumin enhanced dialysis is associated with reduced need for pressors to maintain renal perfusion.

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Infusion Fluids Contain Harmful Glucose Degradation Products

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Objective: Glucose degradation products (GDPs) are precursors of advanced glycation end products (AGEs) that cause cellular damage and inflammation. We examined the content of GDPs in commercially available glucose-containing infusion fluids and investigated whether GDPs are found in patients' blood. **Methods:** The content of GDPs was examined in infusion fluids by HPLC analysis. To investigate whether GDPs also are found in patients, we included 11 patients who received glucose fluids (standard group) during and after their surgery and 11 control patients receiving buffered saline (control group). Blood samples were analyzed for GDP content and carboxymethyllysine (CML), as a measure of AGE formation. The influence of heat-sterilized fluids on cell viability and cell function upon infection was investigated. **Results:** All investigated fluids contained high concentrations of GDPs, such as 3-deoxyglucosone (3-DG). Serum concentration of 3-DG increased rapidly by a factor of eight in the patients receiving standard therapy. Serum CML levels increased significantly and showed linear correlation to the amount of infused 3-DG. There was no increase in serum 3-DG or CML concentrations in the control group. The concentration of GDPs in most of the tested fluids damaged the neutrophils, reducing their cytokine secretion and inhibited the microbial killing. **Conclusions:** These findings indicate that normal standard fluid therapy involves an unwanted infusion of GDPs. A reduction of the content of GDPs in commonly used infusion fluids may improve cell function, and possibly also organ function, in intensive-care patients.

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Blood levels of d-Dimer Correlate with Clotting of Hemofilter in Patients Submitted to Continuous Renal Replacement Therapy

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Background: CRRTs are frequently used in critically ill patients. Hemofilter clotting is a major problem of CRRT, reducing efficiency and increasing blood losses. Different protocols of anticoagulation are used to reduce clotting, although many times its use is not safe due to hemostasis problems. Therefore, it could be useful to have the ability of predicting hemofilter clotting, to rationalize the use of anticoagulation. **Objective:** to determine laboratory tests that better predict the duration of the hemofilter in patients submitted to CRRT. **Methods:** we studied all patients needing CRRT for Acute Kidney Injury admitted between November 2007 and March 2009. Before CRRT we measured: aTTP, Prothrombin time (PT), Platelet count and D-Dimer. As indicators of inflammation we determined C-Reactive Protein and White Blood Cell (WBC) count. We also measured BUN, creatinine and hemoglobin. We recorded the duration of the hemofilter connected without anticoagulation. We excluded patients receiving drugs that alter coagulation, such as heparin or Drotrecogin alpha, and patients with catheter problems as the cause of clotting. Linear regression analysis was performed for every variable studied versus time of duration of hemofilter. **Results:** 33 patients (age 66.4 ± 19.6 years, 18 males). Mean filter duration was 11.7 ± 9.5 h (Range 1 to 38 h).

Mean coagulation tests were: aPTT 51 ± 37 s, PT 54 ± 19%, Platelet count 98770 ± 81805 /mm3, D-Dimer 6094 ± 2781 ng/mL. Inflammation tests were CRP 20 ± 22 mg/dL, WBC count 11706 ± 7553 /mm3. D-Dimer inversely correlated with duration of filter (r -0.733, p<0.001). In contrast, usual coagulation and inflammation tests did not correlate with hemofilter duration. When we compared hemofilters lasting more or less than 12 h, only D-Dimer showed a significant difference (7516 ± 2450 versus 4165 ± 1943 ng/ml, p<0.001) There was a tendency of higher CRP in patients whose filters lasted less (23.7 ± 27.4 versus 14.9 ± 11.7 mg/dL, p=0.09) **Conclusion:** high basal levels of D-Dimer predict hemofilter clotting better than other coagulation tests. It is possible that duration of filter could be also related with the degree of inflammatory state of patients.

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Optimizing Technology to Improve Care in the Delivery of CRRT

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Objective: Optimizing technology to improve care in the delivery of CRRT. The presentation will address the issues leading to the development of a standard methodology utilizing computer technology for order entry, automated hourly calculation and documentation of treatment for 7 ICUs. The Citrate orders are entered via Computer Assisted Physician Order Entry (CAPOE). All other orders for CRRT are hand written. With the hand written orders the pharmacist transcribes the orders into CAPOE. Based on the medication order chosen by the pharmacist, the medication would or would not appear on the continuous IV Gantt and the critical care electronic documentation affecting its calculation into automated Intake and Output documentation. Adding to the confusion, the nephrologists provided conflicting instructions on calculating the I & O. Based on these issues each ICU had developed methodology for calculating and documenting I & O and designated parameters.

Methods:1. Standardization of orders : The nephrologist enters all CRRT orders via CAPOE, the orders are legible and the pharmacist no longer performs transcription as these orders are directly linked to electronic medication administration record. The medication orders are programmed for inclusion or exclusion on IV Gantt therefore providing the clinician with accurate I & O calculations. 2. Standardization of documentation : An electronic documentation form with automated downloads was developed with the assistance of the end users. It decreases the amount of paper documentation and calculation for the nurse, increases consistency across the ICUs and provides the treatment team with real time access to the information.
3. Accessibility to the documentation: The orders and hourly documentation can be viewed via the physician's notebooks anywhere providing for efficient evaluation and treatment independent of nursing assessment and time to contact the physician or the need for the physician to be present on the unit or in the hospital to view the patient record. 4. Educational Process: An educational program was designed to standardize the documentation of the CRRT treatment and increase the knowledge of the ICU nurse.
5. Improve Patient Safety: All clinicians have agreed to a standardized approach to treatment orders and documentation promoting continuity of patient care for a very complex group of patients. **Conclusion:** The application of information technology improves accuracy and decreases errors in the delivery of CRRT, standardizes practice and documentation, improves communication, improves monitoring and promotes patient safety.

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Predictors of Serum Bicarbonate after 72 Hours of CRRT using Regional Citrate Anticoagulation.

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Background: Regional citrate anticoagulation (RCA) is commonly used to prevent clotting during continuous renal replacement therapy (CRRT). One recognized complication of RCA is the development of metabolic alkalosis due to metabolism of citrate. However, patients that are not able to metabolize citrate can have worsening of metabolic acidosis. **Objective:** To examine predictors of serum bicarbonate level, 72 hours post initiation of CRRT with RCA. We retrospectively reviewed charts of 25 adult patients with acute kidney injury (AKI) who had received continuous veno-venous hemodiafiltration (CVVHDF) with RCA for at least 72 hours at our institution between January 1, 2008 and September 30, 2008. All patients underwent CVVHDF using PRISMA with M100 hemofilters (Gambro, USA), PrismaSate BGK 2/0 (500 ml/hour), PrismaSol BGK 2/0 (1500

ml/hour), ACD-A and a blood flow rate of 100 ml/minute. We collected data on variables including demographics, etiology of AKI, laboratory data at start of CRRT including serum bicarbonate, liver function test, arterial pH, serum creatinine, serum potassium and anion gap. We also collected data on administration of blood products, parenteral nutrition and mean rate of ACD-A infusion during first 72 hours of CVVHDF. Linear regression was performed between above variables and serum bicarbonate level at 72 hours, using SigmaStat 3.5.
Mean age was 59.8 + 15 years; 9 males and 16 females; 20 had ischemic acute tubular necrosis, 4 had hepatorenal syndrome. 5 patients had cirrhosis. Incidence of metabolic alkalosis (serum bicarbonate >32 meQ/L) was 12%. On Univariate analysis elevated AST (p= 0.035), ALT (p= 0.038) and Anion Gap (p=0.017) at start of CVVHDF predicted lower serum bicarbonate level at 72 hours. On multivariable linear regression, there was a trend towards statistical significance between ALT (p=0.055) at start of CRRT and serum bicarbonate level at 72 hours. **Conclusion:** liver function specifically AST at start of CRRT predicts serum bicarbonate level after 72 hours of CRRT with RCA.

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Treatment of acute hepatic failure by combination of fraction plasma bilirubin adsorption and continuous veno-venous hemofiltration

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Objective: To observe the effect of acute hepatic failure treated by combination of fraction plasma bilirubin adsorption and continuous veno-venous hemofiltration. **Methods:** Six patients received total 18 sessions of treatment by combination of fraction plasma bilirubin adsorption and continuous veno-venous hemofiltration(FPBA-CVVH) due to acute hepatic failure(AHF)in Jinling Hospital. FPBA-CVVH was performed with duration of 8 hours per session as following: first, fraction plasma(mainly albumin and protein with small molecular weight) was separated from blood using a fraction plasma separator EC40W(),then passed through a filter(AV600) for ultrafiltration with rate of 4000ml/hr, then passed through a bilirubin adsorption column(BR350), finally joined blood to return to body. Equal amount of replacement fluid was infused in pre-dilution route. Blood total bilirubin(TB), direct bilirubin(DB), indirect bilirubin(IDB) was dynamically monitored during each session. **Results:** Therapies were withdrawn in two patients due to disease severity. Among the other patients, one died and 3 survived. In 30min, 2h, 4h, 6h, 8h of session, the clearance(ml/min) for TB was 29.12± 20.94, 11.87±12.75, 9.85±6.73, 8.24±9.48 , 7.94±6.29, respectively; the clearance for DB was 24.48±16.55, 11.40±12.56, 10.42±6.55, 8.36±9.10, 7.13±5.78, respectively, the clearance for IDB was 44.65±44.72, 16.03±18.12, 9.98±8.97, 7.37±11.24, 76±10.84, respectively. The reduction ratio (RR) of blood TB, DB, IDB after a single session was 53.73±15.93%, 55.55±16.52% , 30.59±33.97%, respectively. The treatment had indifferent effect on blood albumin, No severe side effects were found during treatment. **Conclusion:** Combination of fraction plasma bilirubin adsorption and continuous veno-venous hemofiltration is effective in removal of bilirubin and may have a beneficial effect on patients with acute hepatic failure.

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Direct hemoperfusion with Polymyxin-B Coated Textile Ameliorates Systemic Circulatory Disturbance in Patients with Septic Shock

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Objective: Septic shock defined as severe sepsis accompanied by hypotension, is a life-threatening complication of serious infections. Direct hemoperfusion (DHP) with polymyxin-B coated textile (PMX) has been shown to improve the state of shock patients with septic shock. However, no evidence has been presented for a direct link between endotoxin removal by DHP with PMX and improvement in septic shock. **Methods:**We retrospectively analyzed clinical profiles of 24 patients with septic shock (15 patients, gram-negative; 9 patients, non-gram-negative septic shock) who underwent DHP with PMX. **Results:**Patients with gram-negative septic shock were characterized by hyperdynamic circulation. DHP with PMX reduced blood endotoxin concentrations and ameliorated shock, with an improvement in hyperdynamic circulation in patients with gram-negative septic shock. Mean arterial pressure also elevated after therapy in patients with non-

gram-negative septic shock, but systemic hemodynamic were unaffected. Regardless of the causative microcirculation, patients with endotoxemia showed hyperdynamic shock. DHP with PMX reduced blood endotoxin levels and ameliorate hyperdynamic circulation, whereas patients without endotoxemia showed features of shock without hyperdynamic circulation. DHP with PMX ameliorated shock without affecting cardiac performance. In patients with gram-negative septic shock , blood endotoxin concentration correlated positively with cardiac output and negatively with systemic vasucular resistance before DHP therapy. Reduction in blood endotoxin concentration by DHP therapy positively correlated with the reduction in cardiac output. **Conclusion:**The improvement in hyperdynamic circulation was related directly to endotoxin removal by PMX-F column, and endotoxin has an important role in the development of hyperdynamic circulation in patients with gram-negative septic shock.

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Nurse Competency Assessment for a CRRT Program

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Background: Evaluating nurse competencies is critical to providing quality care in any patient situation. The acuity level and specialized care required for the patient receiving CRRT demands that the professional nurse have an additional skill set and an expanded body of knowledge. Nurse turnover necessitates an ongoing educational process for new nurses to learn and become proficient in this therapy. Lack of a national standard for CRRT nursing competencies forces each hospital to set and develop their own standards and competencies. **Objective:** To share the UCSD process for competency assessment and skill development. The program is a comprehensive, collaborative competency program that addresses basic knowledge and critical thinking skills coupled with a mentorship program to develop our ICU nurse's skills performance. **Methods:** UCSD Nephrology programs collaborated with the ICU Clinical Nurse specialists to design and implement a Core CRRT course.
A process was developed for participant selection. The class was designed to teach didactic and critical thinking skills as well as hands on experience. After the course, a mentorship program was created to facilitate the development of the novice nurse. **Results:** Annually approximately 50 new ICU nurses are selected and complete the didactic course. Outcomes have been tracked through the monthly Performance Improvement meetings. A multidisciplinary CRRT committee has been established to address identified issues. **Conclusion:** Nurse Competencies have been addressed by a systematic and comprehensive program that includes candidate selection, didactic course work, mentorship and skills assessment. A process for continuing program improvement has been implemented.

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Postfilter Normal Saline Infusion to Prevent Circuit Clotting With Prismaflex Continuous Renal Replacement Therapy.

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Objective: Continuous renal replacement therapy (CRRT) is the preferred dialysis modality for critically ill patients. Despite adequate anticoagulation, clotting of the extracorporeal circuit remains a significant challenge. Our center uses continuous venovenous hemodiafiltration (CVVHDF) and regional citrate anticoagulation (RCA) with 0.5% citrate delivered as prefilter replacement fluid. The bicarbonate based dialysiate has physiologic levels of electrolytes except calcium, which is given as a systemic infusion. Compared to the older Prisma machines, the new PrismaFlex CRRT system requires an additional postfilter normal saline infusion, which is intended to prevent clotting in the de-aeration chamber. This study investigated whether or not this postfilter saline infusion actually prevents circuit clotting. **Methods:** A retrospective review was performed over a five month period from April 2009 to August 2009, and patients receiving CRRT by the PrismaFlex system at a tertiary academic center were identified. All patients received regional citrate anticoagulation per a standardized protocol. Circuit failures due to clotting were noted. Normally and non-normally distributed variables were compared using Student's t-test and the Mann Whitney U test, respectively. Categorical data were compared using Fisher's exact test. Filter patency rates were compared using Kaplan-Meier survival estimates. $p<0.05$ was considered statistically significant. **Results:** Of 45 patients identified, 24 (119 filters) received a postfilter infusion of normal saline at 200 mL/hr. The remaining 21 patients (65 filters) had no postfilter fluid

infusion and comprised the control group. There were no significant differences between the two groups in terms of age, gender, race, weight, initial blood flow rate, citrate rate, dialysate rate, fluid removal rate, postfilter ionized calcium, hematocrit, platelet count, and INR. Clotting was observed in 21 of 119 (18%) filters in the postfilter infusion group and in 15 of 65 (23%) filters in the no-infusion group. Filter survival rates by Kaplan-Meier analysis between the two groups were not significantly different (p = 0.71). **Conclusion:** Within the limits of this study design, postfilter normal saline replacement fluid infusion to prevent blood-air interface in the de-aeration chamber, combined with the PrismaFlex CRRT system and RCA, is not associated with improved filter patency or decreased rates of clotting.

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Use Of Prismocitrate-Prismocal Anticoagulation for CRRT in Critically ill patients with severe Renal Failure

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Background: Citrate anticoagulation is a useful alternative in patients in whom heparin anticoagulation is contraindicated. Existing protocols are not user-friendly. We studied the use of a commercially available solutions PrismOcal and Prismocitrate (Gambro, Lund, Sweden) in our centre. CRRT was performed in 6 post-operative patients (M:F=5:1) with acute renal failure (ARF) in 4 and end-stage renal disease (ESRD) in 2 patients. While 2 patients were enrolled a priori, the others were recruited only after recurrent circuit thromboses during heparin-free CRRT. **Methods:** CVVHDF using the Prismaflex machine was performed in 5 patients while 1 patient had it delivered with the older Prisma platform. Operational settings using Prismaflex were as follows: QB 150mls/min, QD 1,000 mls/h, QCIT 1,500 mls/h and QPOST-DIL 50 mls/h. Similar settings were used with Prisma except for QPRE-DIL 1,500mls/h. All patients were initiated with intravenous 10% calcium gluconate at 10 mL/h (2.3 mmoL/h) to achieve systemic ionized calcium 1.0 – 1.2 mmoL/L. Biochemical test results were recorded at regular intervals **Results:** A total of 10 citrate circuits were studied (305 patient hours) with filter life of 30.5±16.7 h. Biochemical results achieved as follows: systemic ionized calcium 1.08±0.09 mmoL/L, pH 7.33±0.06, sodium 133±2 mmoL/L, bicarbonate 20±2.8 mmoL/L, urea 9.0 +/- 3.9 mmoL/L, creatinine 216 +/- 94 umoL/L. The subgroup of patients who underwent heparin-free CVVH prior to recruitment achieved 24 h circuit lifespan in only 5% of circuits compared to 43% of circuits when they were treated with citrate CVVH. ICU survival was 100% in all 6 patients. **Conclusion:** This preliminary single centre study suggests that protocol-driven citrate anticoagulation during CRRT using paired commercially available solution achieves reasonable circuit lifespan with minimal biochemical complications, especially in patients who demonstrated frequent clotting on heparin free CVVHDF. More work is however needed to further understand their use under more diverse and demanding clinical situations.

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First Clinical Experience of Adipose Derived Stem and Regenerative Cells therapy for Ischemic Renal Damage after Nephron-Sparing Surgery in small Renal Tumors.

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Objective: We are undergoing adipose derived stem and regenerative cells(ADRCs) therapy for intractable urinary disease(Yamamoto T et al. Int J Urol 2010 in press). During renal hilar clamping for nephron-sparing surgery (NSS), the kidney remains without blood flow for a period of time. The following reperfusion of this ischemic kidney causes functional and structural injury. We underwent ADRCs therapy for ischemic renal damage after NSS (N-5) in small renal tumors (diameter: mean 2.7cm, warm ischemic time: mean 28 min) without metastasis from 2009. We compared ADRC-injected group(n=5) with non-ADRC-injected group(n=5) in microcircution by contrast echo ultrasound(CEUS) examination with high-resolution US units (LOGIQ 7; GE Medical Systems) equipped with hybrid contrast imaging (perflubutane) at 7 and 28 post operative days(POD), respectively. Contrast enhancement as a function of time was measured in regions of interest and time-intensity curves were obtained. It is unique in that the patients' own cells were extracted from adipose tissue from subcutaneous liposuction and processed for delivery at the point of care using Cytori's Celution(R) System. The cells were then injected renal subcapular space into the patients , immediately before renal hilar re-clamping. The cells were evaluated by culture method. ADRCs secreted higher levels of vascular endothelial growth factor (VEGF) and

hepatocyte growth factor (HGF). Moreover, the conditioned media significantly increased endothelial cell (EC) compared to that obtained from control media only. There no difference between the injected group and the non injected group in blood creatinine and blood urea nitrogen at 7POD and 28POD. The new signals were detected in area around ADRC-injected by CEUS at 28POD. No significant adverse event was noted throughout the procedure of liposuction and injection of the ADSCs. Although mild subcutaneous hemorrhage spots were postoperatively noted in both cases, otherwise no severe side effects such as pelvic pain, inflammations or embolism occurred during the post-operative follow-up periods. ADRCs may promote angiogenesis via a paracrine mechanism as evidenced by the expression of pro-angiogenic factors, including VEGF and HGF. The present preliminary clinical study demonstrated that renal subscapular injection of the autologous ADRCs are safe and feasible treatment modality for ischemic renal damage.