Successful Parallel use of CArdio-Renal PEdiatric DIalysis Emergency Machine (Carpediem™) and Extracorporeal Membrane Oxygenation (ECMO) for Infant Kidney Support Therapy (KST)

J. Morgan, DNP, APRN; A. Snyder, MSN, APRN; F. Flores, MD; R. Smith, RN; A. Benscoter, MD; C. Slagle, MD; S. Goldstein, MD
Center for Acute Care Nephrology, Cincinnati Children's Hospital Medical Center

Purpose

- The sensitive access and return pressures registered by Carpediem™ (CD) causes concern that CD could be incompatible with the pressures generated by ECMO
- We describe an *in vitro* simulation trial connecting Carpediem™ to an ECMO circuit using expired red blood cells and translation to a bedside experience

Methods: *In vitro* Simulation

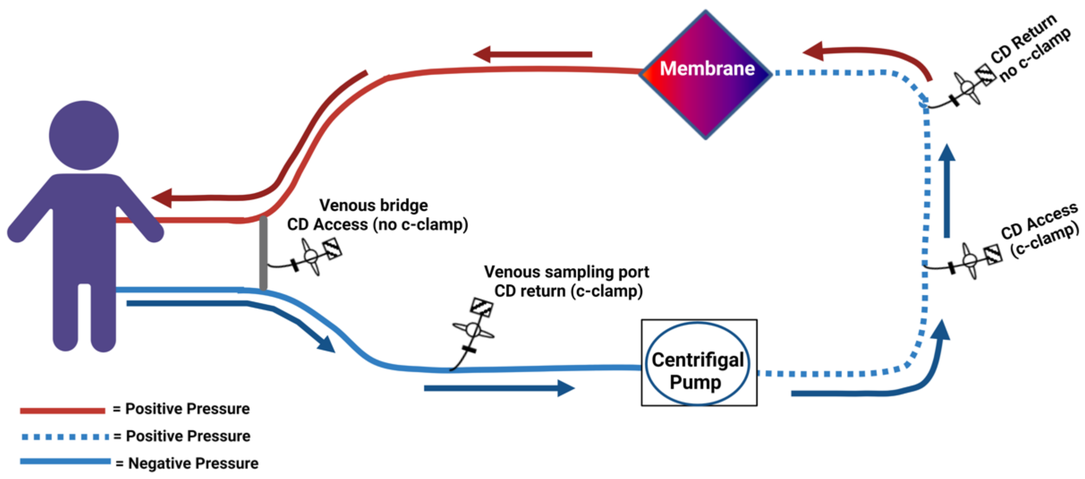
First Approach

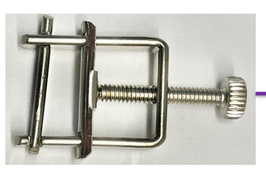
- CD bloodlines were connected to the positive pressure portion of the ECMO circuit
- CD access line was attached to the first ECMO port post pump head with a c-clamp applied to generate a negative access pressure
- CD return line was attached to the second ECMO port post pump head
- As ECMO blood pump flow increased, high pre-membrane pressure (PMP) >200 mmHg triggered CD return pressure alarms (the microclave was removed from the return port, but alarms persisted)
- The CD return line was then moved to the venous sampling port (ECMO negative flow), with c-clamp application to generate a positive return pressure

Second Approach

- CD bloodlines were connected to the negative pressure portion of the ECMO circuit
- The CD access was attached to the ECMO venous bridge port, and the CD return line was connected to the venous sampling port with a c-clamp to generate a positive return pressure

CD & ECMO circuit connection sites





c-clamp

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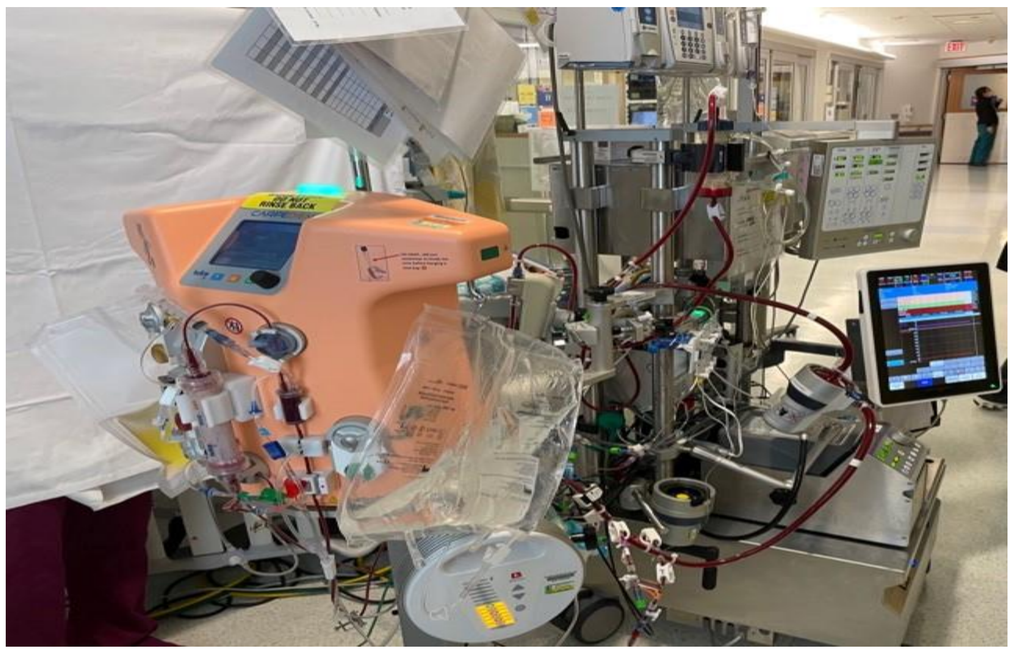
Results: Translation to the Bedside



- We translated lessons learned from *in vitro* testing to the bedside: A 3.5 kg 6-week infant with congenital diaphragmatic hernia required ECMO and KST for acute kidney injury and fluid overload (31%)
- KST was initially performed via an in-line ECMO hemofilter but inconsistencies between the infusion pump and ultrafiltration led to CD transition
- The ECMO blood flow rate (Qb) was 0.52 L/min, venous and PMP were 21 and 216 mmHg, respectively
- CVVHD via the CD used a HCD 025 filter, Qb 25 mL/min and Qd of 4 mL/min (240 mL/hr)
- CD bloodlines were connected post pump head but moved pre pump due to high RP (220 mmHg) and PMP (230 mmHg), which recapitulated what we observed with *in vitro* testing
- The CD circuit was changed daily as required by the manufacturer and pressures remained acceptable (mean AP-50; VP 70) for 4 consecutive days
- Urea reduction was 64% within 24 hours
- Fluid removal and anticoagulation were managed via ECMO

Conclusion

- We report the first case of CD provision in parallel with ECMO
- Successful management of CD pressures were achieved connecting bloodlines pre pump head without altering ECMO blood flow
- Mitigation of CD alarms allowed uninterrupted therapy and KST dose delivery
- Although concomitant use of CD and ECMO does work with our standard connection, we were able to test multiple configurations to bypass high ECMO pre-membrane pressure