CARPEDIEM (MINIATURIZED CRRT EQUIPMENT FOR INFANTS) THE FIRST APPLICATION

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Background -Aim

Acute kidney injury (AKI) is an independent risk factor for morbidity and mortality in critical ill children. Renal replacement therapy (RRT) is a cornerstone of therapy to correct uremia and fluid overload. Provision of maintenance dialysis to neonatal and infants implicate many challenges: blood flow rate, UF settings and accuracy, catheter size and length, extracorporeal circuit volume, circuit functional survival and the anticoagulation strategy.

Aim

We evaluated the technical aspects of the first world in-vivo treatment with the new cardio renal paediatric dialysis machine (CaRPeDiEM) specifically designed for infants.

Material and Methods

Patient weighting 3.2 Kg admitted at the PICU, was treated with the CaRPeDiEM settings on CVVH pre dilution. Fluid overload was the main reason for RRT initiation. The extracorporeal circuit included a D50 hemofilter (polysulfone, 0.075m²) totalizing 27ml of priming volume (10% of total circulating blood volume). No blood priming was done to prevent hypotension or hemodilution.

A 4.5 FR dual lumen catheter length 3.9 inch was placed in the femoral veins. Heparin was continuously infused of 10 U/kg/hr. Haemoglobin was 10 g/dL.

Table of prescription and parameters

Qb	12 ml/min	Treatment Duration	24h
Total Net UF	360 ml	Total UF flow	0.6 ml/min
Total Infusion	500 ml	Filtration Fraction	3.3% * (HCT 33)
Dialyzer	D50	Surface	0.075m²
Priming Volume	27 ml	Heparin	1.5

Arterial, Venous, Drop and Pre-filter pressure were recorded hourly. Blood Flow, infusion and UF rate were also observed.

A total number of 61 hours was done with 4 circuits.

The total UF prescribed was 360 ml/day, with 500ml/day of pre-infusion and a blood flow of 12ml/min, resulting in a Filtration Fraction of 3%. See table for details. The maximum UF allowed is limited by a FF of 20% and is furthermore conditioned by the filter used: UFmax is 2.5, 4.0 or 5.0 ml/min respectively with the D50, D 150 and D200 circuit.

Case Report

Patient 10 weeks-old was transferred from a community hospital and admitted to the PICU with sepsis and acute lung injury due to severe combined immunodeficiency syndrome.

Medications include 2 inotropes and almost one potential nephrotoxic agent (aminoglycosid). He was sedated and intubated 10 hours after admission.

Adequate diuresis was always maintained with continuous infusion of diuretics. The degree of FO was 24% of body weight on the Day 4 (fig.1).

Concomitant with bone marrow transplantation on Day 6, fluid intake rise to 709 ml/day (32% of FO) and patient had a further decline in renal function probably due to the amount and the total dose of drugs received.

The fluid balance was dramatically positive from the 12th day. Urine output of 200-300 ml/day did not compensate the total intake. To reduce the degree of FO, became 30%, 500 ml/day of fluid was removed with CRRT from day 17 to 21. The treatment initiation was delayed due to organizational problems. The clinical condition and the low weight of the patient required a multidisciplinary approach.

The pRIFLE (fig.1) was calculated to better describe the renal function. pRIFLE was R concomitant with bone marrow transplantation, reaching pRIFLE I on Day 9 anticipating the incoming diuresis contraction. As the primary conseguence of the reduction of fluid prescribed the pRIFLE got back to R class.

Results

Despite the negative data in literature (13.9±8.6 h with 6.5 FR catheter for patients weighting < 3Kg * or circuit life < 20 h with 5 FR catheter, ppCRRT**) our circuit life was quite long (17.5±6.24 h). In addition the reasons for downtime were clinical.

Arterial, Venous, Drop and PreFilter Pressures were stable during all treatments (see figure 2 for details of the first circuit during the first 16 hours) confirming the parameters observed during our previous in vitro test done with milk and bovine blood. There was no need of catheter relocation in any of the 4 treatments.

Blood pressure was stable, particularly around the time of CRRT initiation (fig3), without any hypotension episode for all the entire duration of CRRT.

The only limitation was on the infusion flux due to the presence of lactate on the bags. Problem will be solved with the next generation of lactate free bags.

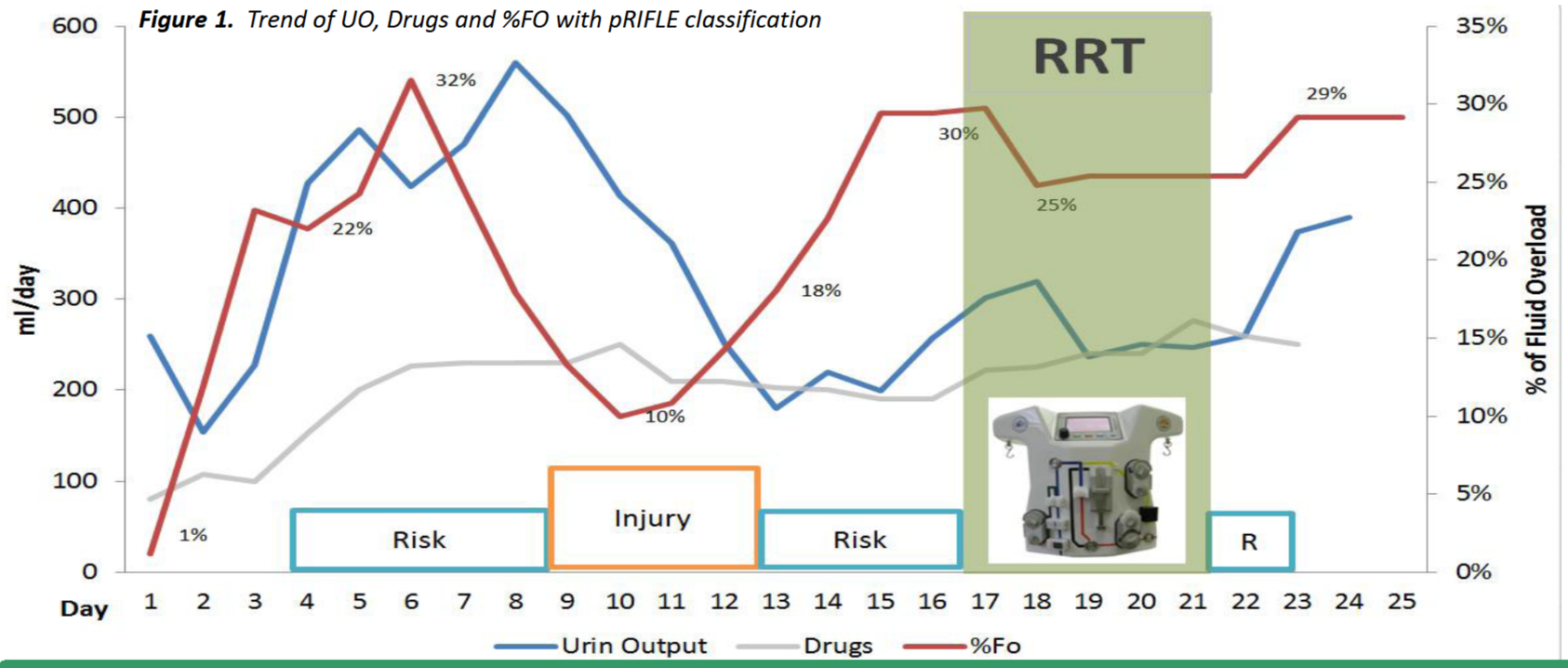

Figure 1. *Trend of UO, Drugs and %FO with pRIFLE classification*

Discussion

Pediatric CRRT performance is strongly associated with many factors such us: catheter (size, length, position), patients characteristics (body weight, hematocrit), machine and circuit design.

Limitation on flow through a tube described by Poiseuille law and the need of laminar flow dictated by Raynolds, suggest the right blood flow need to optimize the circuit survival, in particular with small catheter.

The Carpediem blood pump, in fact, allows a wide and appropriate range (2-50ml/min) of blood flow having, in addition, 1 ml/min of increments.

Fluid balance safety is moreover assured by a very high sensitivity, 1g, scale. Furthermore a 2g error detected on the infusion and/or in the effluent scale is highlighted by an alarm while 20g of fluid balance error cause the end of the treatment.

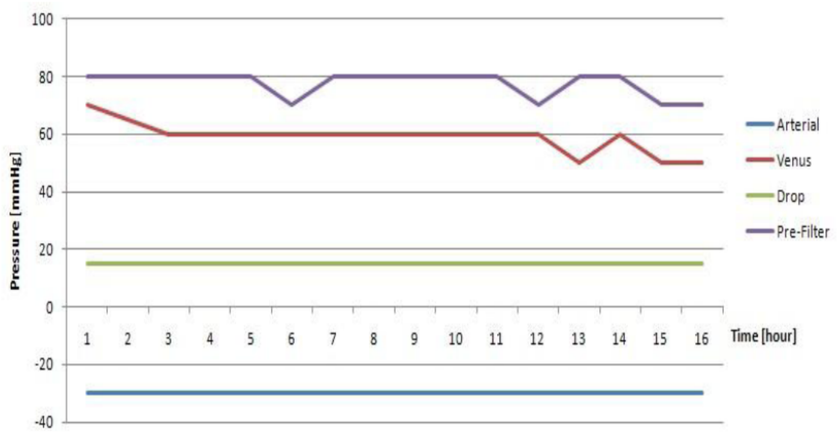

Figure. 2 *Trend of extracorporeal circuit parameters. Arterial, Venus, Drop and Pre-Filter pressures.*

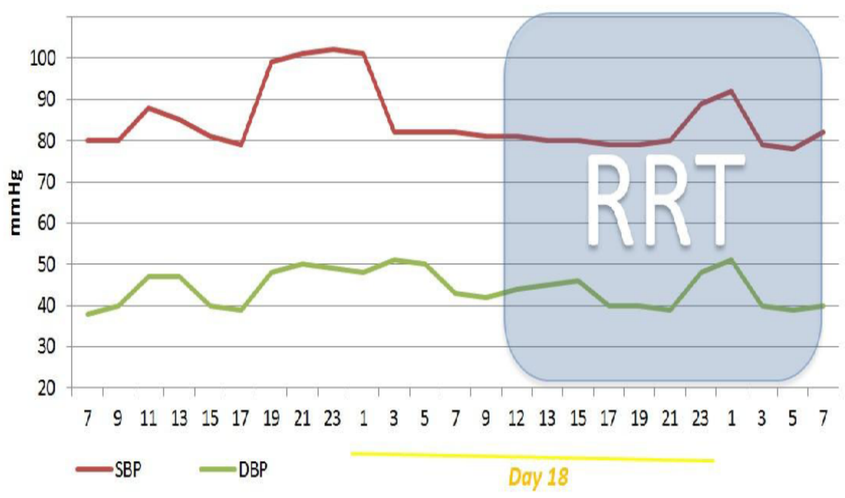

Figure 3 *Systolic and Diastolic Pressures before and during RRT*

Conclusions

The data of the first in vivo treatment, suggest that CRRT with Carpediem is safe and effective in neonates and infants weighting less than 10 Kg.

Prolonged circuit survival with small catheter due to equipped features, allows to explore all potential benefits of CRRT in infants without technical and clinical complications.

References

(*) Continuous renal replacement therapy in neonates weighing less than 3 kg. Y.B. Sohn, Korean J Pediatr. 2012 August.

(**) The effect of vascular access location and size on circuit survival in pediatric continuous renal replacement therapy: A report from the PPCRRT registry. R. Hackbarth et Al. Int J Artif Organs. 2007 Dec

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