Use of CytoSorb in a pediatric patient with severe SIRS, ARDS and vasoplegia post-cardiac surgery

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This case study reports on a 7-month old 5 kg female infant, who was admitted for emergency cardiac surgery for suspected acute myocardial infarction and subendocardial ischemia due to an underlying congenital heart disorder (FC III by Ross classification).

Case presentation
- The child exhibited a pre-known anomalous left coronary artery from the pulmonary artery (ALCAPA), mitral valve insufficiency and post-ischemic cardiofibrosis
- After successful cardiac surgery, the child was transferred to the ICU with low cardiac output syndrome and massive hemolysis following cardiopulmonary bypass
- She then went on to develop septic shock accompanied by multiple organ failure including respiratory, cardiovascular and renal failure
- ECMO (flow 125 ml/kg) and CRRT (3 days after ECMO start) were initiated for extracorporeal organ support
- On day 10 of anuria (day 7 of CRRT and day 10 of ECMO) the patient's condition was the following:
  - Vital parameters: heart rate 97/min, arterial pressure 85/60 mmHg, left atrial pressure 22 mmHg (measured directly in the left atrium by a 3 Fr intra-atrial catheter)
  - Respiration parameters: mechanical ventilation FiO2 40%, tidal volume 8 ml/kg, respiratory rate 15/min, PEEP 6 cm H2O; PIP 26 cm H2O; minute volume (MV) 0.48 l/min
  - Inflammatory parameters: CRP 118.85 mg/l, PCT 17.31 ng/ml
  - Vasopressor and inotrope requirements: dopamine 10 µg/kg/min, epinephrine 0.16 µg/kg/min
- With the rationale to control SIRS and to reduce free plasma hemoglobin associated with the ECMO procedure, to lower vasopressors and for the sake of extracorporeal detoxification the decision was made to install CytoSorb into the CRRT circuit

Treatment
- Two consecutive treatments with CytoSorb for a total treatment time of 40 hours (1st treatment 22 hours, 2nd treatment for 18 hours)
- CytoSorb was used in conjunction with CRRT (Multifiltrate, Fresenius Medical Care) performed in pediatric CVVH mode
- Blood flow rate: 100 ml/min
- Column was pre-filled with red cell concentrate 80 ml, FFP 60 ml
- Substitution fluid: 35 ml/kg; ultrafiltration 5 ml/kg/hr
- Anticoagulation: heparin, 10 U/kg/hr under ACT control
- CytoSorb adsorber position: pre-hemofilter

Measurements
- Hemodynamics and need for catecholamines
- Respiratory status
- Renal function (excretion)
- Inflammatory parameters
Results

- Immediately after start of the 1st CytoSorb session the hemodynamic situation improved and catecholamines could be reduced (dopamine 9 µg/kg/min, epinephrine 0.06 µg/kg/min)
- Striking decrease in inflammatory markers after two CytoSorb treatments (CRP dropped from 118.85 to 29 mg/l; PCT decreased from 17.31 to 0.39 ng/ml)
- Recovery of renal function:
  - After the 1st CytoSorb therapy session: progress from anuria to oliguria (0.15 ml/kg/hour)
  - After the 2nd CytoSorb treatment: diuresis 5 ml/kg/h with furosemide stimulation (6 mg/kg/day)
- Consciousness level improved, the infant started to open her eyes, extremities showed minimal motion activity on examination
- Extracorporeal circuit volume was rather large (260 ml for ECMO, 79 ml for CVVH, 120 ml for CytoSorb), equaling 480 ml (the baby's circulating blood volume), which exacerbated coagulation disorders: Activated Clotting Time rose from 180 sec to 270 sec without anticoagulant dose change, although no clinical evidence of bleeding was found. As blood flow rate (100ml/min) was only half of the recommended rate for CytoSorb (200ml/min), D-dimer concentration went up 40 times, however this hindered neither the oxygenator, or the ECMO function
- ECMO flow reduction to 85 ml/kg after the 1st CytoSorb treatment and to 40 ml/kg after the 2nd CytoSorb session
- After the 2nd CytoSorb session, ECMO as well as hemofiltration could be completely withdrawn

Patient Follow-Up

- Total ECMO duration was 13 days
- Patient was extubated on day 26 post op
- Delayed sternal closure on day 15 following initial surgery
- Discharge from ICU 47 days and from the hospital on day 54 after the surgical procedure

CONCLUSIONS

- ECMO combined with CVVH in pediatric patients has its specific features due to large pre-fill volumes, donor blood usage and high bleeding and thrombosis risks
- The use of CytoSorb in this case resulted in a clear and steady improvement in the patients critical situation predominantly through a stabilization in hemodynamics and an attenuation of the inflammatory response
- According to the medical team the use of CytoSorb defined the child's fate fundamentally.
- CytoSorb was easy to use in this setting and gave an overall positive adsorber experience