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Case of the week 49/2021

Use of hemoadsorption therapy in neonatal surgery – A case of extreme tetralogy of Fallot and severe pulmonary stenosis undergoing corrective surgery with a special emphasis on technical aspects

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This case reports on a 20-day old newborn (weight 3.1 kg, body surface area 0.20 m^2), who was diagnosed with an extreme tetralogy of Fallot presenting in a severe cyanotic crisis.

Case Presentation

- The echocardiogram showed a large subaortic ventricular septal defect (VSD) with overriding of the aorta and severe pulmonary stenosis with a gradient of 100 mmHg and a large component of infundibular stenosis resulting in the decision for urgent corrective cardiac surgery
- Surgery was performed with cannulation of the right atrium and aorta, at 32°C rectal temperature and histidine-tryptophane-ketoglutarate crystalline cardioplegia. By means of right infundibular ventriculotomy, type II ventricular septal defect closure was performed with the use of a polytetrafluoroethylene patch, infundibular resection and pulmonary commissurotomy
- Aortic clamp time was 35 minutes and time on cardiopulmonary bypass (CPB) was 75 minutes
- In order to hemodynamically stabilize the patient during this highly demanding and invasive procedure, a CytoSorb hemoadsorption device was integrated into the CPB circuit
- Following extracorporeal circulation, modified ultrafiltration (MUF) was performed with the adsorber and the hemofilter in series for 15 minutes. Subsequently, decannulation and chest closure was performed
- During the procedure, 1 unit of platelets, 1 unit of red blood cells and 1 unit of cryoprecipitate were transfused
- The patient was given anesthetic care with monitoring according to FAAAR/IRAM (Argentine anesthesia legislation) standards with serial laboratory tests throughout the procedure, for which a 22 gauge arterial catheter was placed in the right upper limb from which arterial blood samples were extracted
- Postoperatively, the patient was transferred to the pediatric intensive care (PICU) unit with an ongoing infusion of epinephrine (0.16 µg/kg/min), milrinone (0.75 µg/kg/min) and dexmedetomidine (0.4 µg/kg/min)

Treatment

- One CytoSorb adsorber was used for the entire CPB time as well as for a short post CPB interval
- A Stockert Compact SC, heart pump machine was used and for the integration and priming of the extracorporeal hemoadsorption circuit, a straight ¼ x ¼ connector with luer lock was added to the arterial outlet (Eurosets, Trilly Infant) of the oxygenator (usual connection to perform MUF) (see Figure 1)

- In order to have precise control of the flow rate and to guarantee the minimum value recommended in the IFU that the device needs (100 ml/min), the adsorber was integrated into a roller pump with ¼ silastic track, and from the outlet of that roller the adsorber and the hemofilter were connected in series. The above set up with MUF is required in low weight patients, regardless of whether it was at the end of the procedure in order to have flow control to avoid hypoperfusion phenomena, hemodilution and hypotension caused by leaving the shunt open, without control of a roller
- Once the circuit had been primed according to the manufacturer's protocols, the adsorber outlet was connected to the hemofilter inlet (Maquet, neonatal), using conventional female DIN-lock type adapters between the adsorption column and the hemofilter, from there, the return of the same to a luer-lock connector was located in the venous line
- For this patient a flow sensor (Transonic Systems HT110) was located on the arterial line to ensure accurate monitoring of the shunt created on the arterial circuit and thus measure the real flow located at the end of the arterial line
- This is part of an active integration, i.e. with the help of an additional roller pump to control for the flow through the adsorption column. It should be also clarified that it is imperative to use a roller pump to perform the Modified Ultra Filtration technique

Measurements

- Hemodynamics
- Lactate levels

Results

- There was a gradual decrease in inotropic drugs until discontinuation of the epinephrine infusion was possible 8 hours after completion of surgery. At no time did the patient present signs of vasoplegia and/or sustained hypotension, and the patient showed good perfusion parameters. During therapy, he only required volume expansion with 5% albumin 10 ml/kg three hours after leaving the operating room
- Under CPB with adsorption, there was a rapid decrease in lactate levels. The patient started with a lactate level of 4.4 mmol/l and left the operating theatre following CPB/adsorption/MUF with a value of 1.9 mmol/l. In the immediate postoperative phase in the PICU, his lactate level was 4.3 mmol/l decreasing to 2.7 mmol/l over the next 8 hours

Patient Follow-Up

- The patient was extubated 18 hours after leaving the operating room and milrinone was continued at a dose of 0.3 µg/kg/min
- Surgical drains were removed 28 hours after the procedure and the patient was gradually weaned from organ support, so that 48 hours after surgery he was back in the normal pediatric ward
- Post-surgical laboratory values were very favorable, with no alteration of renal function or hepatogram. Pre and post creatinine was 0.35 mg/dl and 0.32 mg/dl respectively and liver enzyme values were not significantly altered
- The patient could be discharged from the hospital 10 days after surgery
- At follow-up, the patient was in a good general condition, asymptomatic and gaining weight

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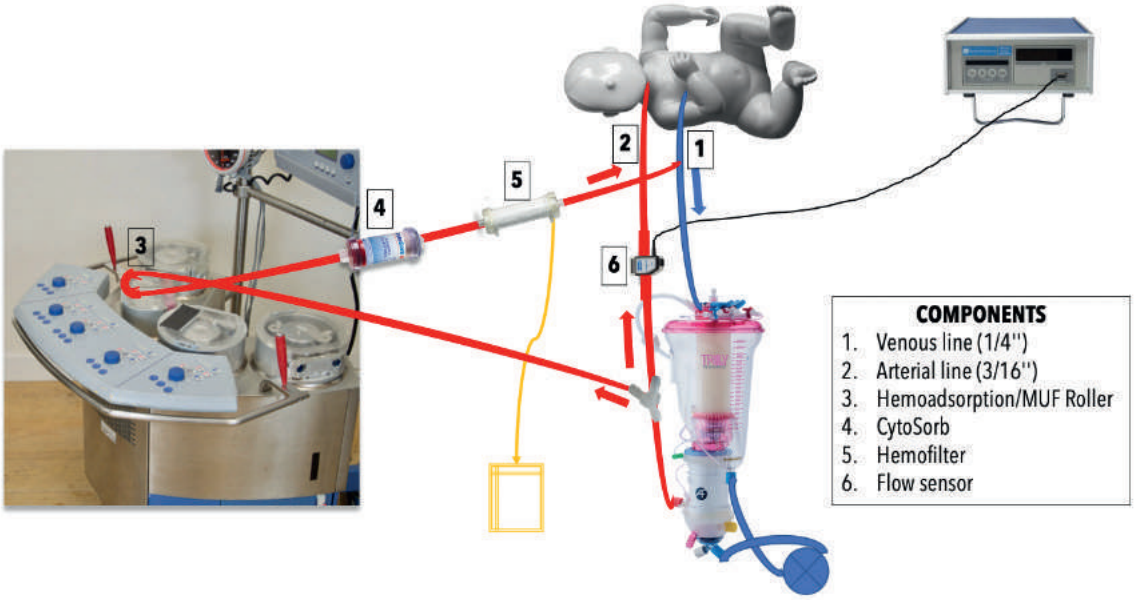

Conclusions

- In this case of a neonatal patient with extreme tetralogy of Fallot and severe pulmonary stenosis undergoing corrective cardiac surgery, the use of CytoSorb hemoadsorption therapy integrated into the CPB circuit resulted in rapid and sustained hemodynamic stabilization and resolution of metabolic acidosis
- Although it is necessary to expand the evidence on the use of hemoadsorption therapy in neonatal cardiac surgery, the results of the present case suggest a new horizon for the use of this therapy, reducing the surgical impact in this population
- At the same time, knowing the disadvantages of implementing an extracorporeal circuit that is somewhat larger than normal due to the integration of the adsorption column (including additional tubes for integration in the roller) in terms of hemodilution, this increase in volume was more than satisfactorily compensated for by the benefits provided by this device, which translated into hemodynamic stability and lactate clearance in the intra and immediate postoperative period, and in an extremely favorable recovery in the immediate postoperative period, which allowed the authors to have an extubated patient 24 hours after surgery, free from inotropic support and with good hemodynamic and perfusion parameters