CASE REPORT

Left Ventricular Assist with the Bio-Medicus Pump on a 4-Month Old Infant with Anamalous Left Coronary Artery

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History

This 5.4 kg. (.38 BSA) 4 month old boy was born full term with no significant immediate problems, although the mother had noticed occasional rapid breathing since birth. The child's growth, development and appetite were normal. Eventually, because of the apparent difficulty breathing, the mother took the child to a physician who referred the infant to a cardiologist. A chest x-ray revealed gross cardiomegaly and an echocardiogram reveald an akinetic left ventricular posterior wall with evidence of previous myocardial infarction. The septum displayed normal motion as did the lateral wall. The left ventricular ejection fraction was approximately 20% and evidence of anomalous take-off of the left coronary artery (LCA) off the main pulmonary artery (PA) was noted. The child was referred to Stanford University Hospital for surgical repair to redirect the LCA to the aorta (A^O) (J Extra-Corporeal Technol. 21(2): 73-74, 1989).

Technique

In the operating room a Cobe computerized pulsatile heart-lung machine with both level and bubble detectors was utilzed. A Cincinnati Sub-Zero Hemotherm heater-cooler was used as a water source for patient warming and cooling. The patient was cannulated with 12 Fr. and 20 Fr. DLP venous cannulae in the superior and inferior vena cava respectively, a 10 Fr. Bardic arterial cannula in the ascending aorta and a 10 Fr. vent line in the right superior pulmonary vein of the left atrium (LA). The single large chamber of a Cobe VPCML was used for oxygenation and heat exchange. A cardiopulmonary bypass (CPB) circuit was used with 1/4" tubing throughout and no arterial filter. The prime consisted of 250cc freshly packed cells and 400cc of fresh frozen plasma, 150cc of lactated ringers, 25 meq of sodium bicarbonate, 1000u sodium heparin, 1.5 gm mannitol and 25 mg of dilantin. Bypass was intiated at flow rates of 2.4-3.2 l/m^2/minute to maintain a venous O_2 saturation of 70%. After the patient was cooled to 20°C rectal temperature, the cross clamp was applied to the A0. The PA was short with small branch pulmonary arteries so both right and left PA were snared and 50cc of Stanford cardioplegic solution was administered in both A0 and PA to achieve cardioplegia. Surgical repair consisted of an intrapulmonary baffle created between PA and A0 to redirect flow from the A0 into the LCA. The aortic cross clamp time was 44 minutes. The patient was warmed and after multiple attempts, failed to be weaned from CPB.

Failing all attempts to be weaned from CPB with maximal phamacological support, a 2.5 cc Datascope intra-aortic balloon connected to a Datascope Model 90 Intra-aortic Balloon Pump (IABP) was inserted into the descending thoracic aorta through the chest wall with augmentation set at 1:1. Further attempts to wean from CPB with the IABP were unsuccessful. The decision was made to initiate left ventricular assist (LVAD) with the Bio-Medicus Pump. Venous cannulation was accomplished using a 20 Fr. DLP cannula placed into the right superior pulmonary vein of the LA and a 10 Fr. Bardic arterial cannula placed into the ascending aorta for arterial reinfusion. The LVAD circuit consisted of the BP 50 Bio-Pump head with 1/4" tubing of the shortest possible length and an electromagnetic flow probe. The circuit was primed while on CPB by cannulating the aorta and allowing aortic pressure and CPB volume to fill the LVAD circuit retrograde. The venous cannula was connected to the circuit and left heart bypass was initiated. A flow rate of 500cc/min at 1900 RPM was established with a mean arterial pressure (MAP) of 55 mmHg. At this time, CPB flows were reduced and the patient was weaned from CPB. Total CPB time was 2 hours, 51 minutes. Protamine sulfate was administered and hemostasis was accomplished with a resulting activated clotting time (ACT) of 132 seconds. The patient was transported to the surgical intensive care unit on the IABP and LVAD, and was maintained on both devices. No heparin was administered during the post-operative period. The IABP augmentation remained at 1:1 and the LVAD flow was 450-600cc/minute at 1900-2150

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was 7-10 mmHg and LA pressure was 8-11 mmHg. Shortly thereafter, it was determined the child should be a candidate for cardiac transplantation and was placed on the donor list. A donor heart became immediately available and the patient was successfully transplanted in an uncomplicated procedure after 13 hours of IABP and LVAD support. The patient was discharged on the 15th post-operative day following a normal recovery.

Comments

As a group, we were pleased with the relative ease with which this maximal mechanical circulatory support was initiated and maintained. Upon removal of the LVAD circuit, the tubing was drained and the BP 50 pump head was found to be completely free of visible fibrin strands or thrombus, but a small circumferential thrombus was noted at the arterial cannula connector. For this reason, a search for better aortic cannulae for LVAD in children is in progress. In addition, after surgical hemostasis is established, sodium heparin will be administered to maintain an ACT of 150-175 seconds (estimated dosage for a patient this size is 10-20 units/hour).