The Use of Cardiopulmonary Bypass and Extracorporeal Membrane Oxygenation for Support During Removal of Two Teratomas and Hydrops Fetalis

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Abstract: The removal of massive tissue tumors often leads to rapid blood loss and decreased lung compliance because of large volume shifts. Cardiopulmonary bypass (CPB) and extracorporeal membrane oxygenation (ECMO) have both been used as a means of support during resection of saccrococcygeal teratomas (1). Hydrops fetalis is the accumulation of fluid in extravascular spaces and body cavities. This leads to edema and sometimes hypoxia. ECMO has been used for support during treatment of hydrops fetalis (2). This patient was diagnosed, via sonogram, at 30 weeks gestation to have two teratomas and hydrops fetalis. Because of the risk of hemorrhage and poor lung compliance during removal of these types of tumors, CPB and ECMO were used. This support allowed for successful removal of the tumors. Following removal of the tumors, the patient failed to wean from CPB because of the severity of hydrops. The patient remained on extracorporeal support for treatment of hydrops fetalis. This report describes the perfusion techniques used for support during the removal of teratomas and the treatment of hydrops fetalis.

Keywords: saccrococcygeal teratoma, hydrops fetalis, cardiopulmonary bypass, extracorporeal membrane oxygenation, high-output cardiac failure.

CASE DESCRIPTION

The patient was diagnosed, via sonogram, at 30 weeks gestation to have two saccrococcygeal teratomas and hydrops fetalis. The weight of the baby and the teratomas was estimated to be 4.0 kg. The actual weight of the baby was estimated to be 2.0 kg. Because of the high blood flow through the tumors, the fetus was not thriving in the womb. At 31 weeks gestation, a C-section was performed. A large mass about the size of a softball protruded from...
the abdomen, and a second mass of the same size protruded from the coccyx region. Immediately after the C-section, the baby was intubated for mechanical ventilation and cannulated for CPB. The patient was fully heparinized at 3 mg/kg. An 8 fr Biomedicus (Medtronic Inc., Minneapolis, MN), arterial cannula was used to cannulate the right common carotid artery and 10 fr Biomedicus (Medtronic Inc., Minneapolis, MN) venous cannula was used to cannulate the right internal jugular vein. The baby was then placed on CPB for circulatory support. After initiating bypass, the umbilical cord was cut. The baby was transported, while being supported with CPB, to another OR for removal of the teratomas. The CPB circuit consisted of a Dideco Lilliput I oxygenator (Sorin Biomedical, Arvada, CO), a Capiox 100 cc venous reservoir bag (Terumo, Somerset, NJ), a 40 μm Dideco arterial filter (Terumo, Somerset, NJ), a 40 μm Dideco cardiotomy reservoir (Sorin Biomedical, Arvada, CO), and a ¼ in Cobe custom tubing pack (Sorin Biomedical, Arvada, CO). The circuit was primed with 300 cc Plasma-lyte-A (Baxter-Healthcare Corp., Deerfield, IL), 100 cc packed rbc’s, 0.5 cc beef lung heparin (500 units), 20 mL (20 meq) NaHCO3, and 30 mL (30 meq) THAM. During the first 24 hours of ECMO, the patient required 1043 cc of packed rbc’s, 132 cc of FFP, and 638 cc of platelets. Blood loss during this procedure was estimated to be 850 cc. After removal of the dorsal teratoma, the patient failed to wean from ECMO and remained on ECMO for pulmonary and cardiac support for approximately 9 more days. During the first 24 hours after removal of the dorsal teratoma, the patient required 601 cc of packed rbc’s, 257 cc of FFP, 407 cc of platelets, and 180 mL of 5% albumin. The bleeding subsided approximately 48 hours after the second procedure, and blood product usage decreased. Once the bleeding slowed down, the patient was trialed to wean off ECMO. ECMO trials consistently failed. After a total of 12 days of ECMO, the patient had no improvement in pulmonary or cardiac function. Support was withdrawn, and the patient died.

DISCUSSION

CPB and ECMO have both previously been used for support during removal of a saccrococcygeal teratoma (1). Both of these methods were chosen for support because of the risk of hemorrhage and the decrease in lung compliance caused by massive volume shifts during removal of a tumor. CPB was chosen because it allows for better volume control, lower priming volume, better air handling from the venous line, and the ability to use pump suction. Blood loss from the field can be suctioned into the CPB circuit and given back to the patient, which would result in less blood product usage. Because of the small size of the baby (2.0 kg), hemodilution was a concern. CPB offers a significant decrease in priming volume. The priming volume of the neonatal CPB circuit is about 500 cc, and the priming volume of the neonatal ECMO circuit is about 800 cc. To reduce blood loss, hypothermia was used. This allowed for lower pump flows and lower mean arterial blood pressures. When the baby could not be weaned from CPB, ECMO was used for long-term support.

CPB and ECMO were successful as support during the removal of these tumors. Blood gases, pump flows, and volumes were maintained during both procedures. Postoperative bleeding, however, was excessive, and the baby required large amounts of blood products to maintain pump flows. Blood tests revealed that the baby had nonimmune hydrops fetalis. Nonimmune hydrops fetalis, as previously discussed, has a poor prognosis. This is especially true in cases of unknown etiology.

This report shows that both CPB and ECMO may be used for support during removal of saccrococcygeal teratomas. Blood loss can be minimized through the use of pump suction, hypothermia, and careful surgical technique. The use of ECMO for support of nonimmune hydrops fetalis was unsuccessful in this case. Nonimmune hydrops fetalis is a poorly understood disease; therefore, it is difficult to treat and cure. ECMO support should not be excluded for the treatment of nonimmune hydrops fetalis; however, it must be understood that prognosis of nonimm-

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mune hydrops fetalis is poor. ECMO, when begun early, may help to improve the chances of survival of those babies with nonimmune hydrops fetalis who, otherwise, may have no chance of survival.

If presented with a similar case, there are a few changes that could be made to serve the patient better. The initial mode of support will be ECMO. This will decrease the use of blood products and foreign surface exposure. It was not anticipated, in this case, that the patient would require cardiopulmonary support after surgery, and CPB was chosen because of the benefits previously stated in this report. The addition of a hemofilter to the circuit would allow for removal of intravascular water, bradykinins, and catecholamines during the operative procedure. At the Children’s Hospital of Pittsburgh, a 1500 ECMO oxygenator is currently used for neonatal ECMO procedures. This is done to allow for longer bypass runs and less frequent change out of the oxygenator. A 0800 ECMO oxygenator would allow for a lower priming volume and less foreign surface exposure.

REFERENCES