A Novel Approach using Hydroxyethyl Starch 130/0.4 (Voluven) for a 2-year-old Jehovah's Witness for VSD Repair


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Introduction

The anesthetic management of pediatric cardiac surgical procedures can be a complex series of events. Maintaining a patient of the Jehovah’s Witness faith, where blood product usage is not desired, can complicate many steps in this process. There have been numerous case series and case reports, in adult and pediatric literature, of various strategies employed to provide a bloodless cardiac surgical procedure. Previously, surgical teams, in their efforts to accomplish this, have used low priming volume cardiopulmonary bypass circuits, deep hypothermic circulatory arrest, autologous normovolemic hemodilution (ANH), and antifibrinolytics, among other techniques. The use of hydroxyethyl starch 130/0.4 (Voluven®, Fresenius/Hospira, Germany) was not included in the literature as a volume expander, specifically in conjunction with ANH, in use in pediatric cardiopulmonary bypass in Jehovah’s Witness patients. We report a case of transfusion-free ventricular septal defect repair in a 2-year-old Jehovah’s Witness patient with the use of Voluven.

Case Report

A 31-month-old child of a Jehovah’s Witness mother presented to the Cardiac Surgeon with a restrictive, membranous VSD and progression of heart failure. Plans were made for patch repair. She was followed by a Hematologist early in planning, with a starting hemoglobin of 12.9 g/dL and a hematocrit of 35.9%. The patient was started on vitamin K, iron supplementation and erythropoietin (0.2 mL/m kg) approximately 6–7 weeks prior to surgery.

The patient was followed by a Hematologist early in planning, with a starting hemoglobin of 12.9 g/dL and a hematocrit of 35.9%. As was previously discussed in multiple family meetings with her parents, we discussed that we would do everything by abiding by their request to avoid blood product administration. However, knowing that we would do what was safest for the patient. The patient was sedated preoperatively with midazolam, progressing to a smooth inhalation induction with Sevoflurane. Standard monitors were applied along with a radial arterial line, and a central venous line. Anesthesia was maintained with hi-dose fentanyl, rocuronium, and sevoflurane titrated to maintain stable hemodynamics. The patient’s tissue oxygenation was further monitored via a near-infrared spectrophotometric device.

The anesthetic plan to avoid transfusion of the patient was approached from several directions. First, e-isocaproic acid was transfused pre-bypass, on-bypass and post-bypass at 100 mg/kg. Next, Voluven® was used as a normovolemic hemodilution agent to replace the patient's blood to a CPD-bag, 50 mL at a time to one-to-one replacement with Voluven colloid solution. This dropped the patient’s hemoglobin to 7.5 g/dL, and hematocrit to 25%. This bag of blood was kept in constant connection with the patient so as to abides by the wishes of the mother.

The blood was removed via the central line and reconnected to one of the peripheral intravenous catheters. Further monitoring was accomplished with thromboelastography, which was sent off at five different times during the procedure, with reports received by telephone into the operating room as the study was completed.

The perfusion team utilized the cardiopulmonary bypass (CPB) circuit to minimize the priming volume. The smallest possible circuit tubing, a combined oxygenator with arterial filter, and one pump sucker line were used. Additionally, the cell saver was available with permission of the patient, although it was not utilized. The total priming volume of the circuit was 350 mL, and consisted of 100 mL of Voluven and 250 mL of Plasmalyte-A. Following systemic heparinization, the surgery proceeded without complication with an arterial cannula and two caval cannulae. Additionally, autologous priming was accomplished prior to initiation of bypass, in order to minimize added volume. A large perivascular Voluven was visualized and closed with a Dacron patch using interrupted pledged suture. Throughout the procedure, conventional ultraration was utilized, resulting in a fluid removal of 300 mL. Following rewarming, the patient was weaned off bypass in sinus rhythm and low dopamine infusion, which was weaned off within 15–20 minutes based on hemodynamics. Modified ultrafiltration was performed next for 10 minutes, with an additional 300 mL removed. Protamine was administered and the cannulae were removed in sequential fashion. Following protamine reversal, the ANH blood was administered back to the patient during rewarming.

The patient’s postoperative course was uneventful. She was transferred to the cardiac intensive care unit in stable condition. Initial postoperative labs on the patient were pH of 7.4, base excess of 2, a hemoglobin of 11 g/dL, and hematocrit of 32%. Exsufflation occurred within four hours of arrival in the unit. She was discharged home on postoperative day four. "One month in the hospital was the one-month in the hospital we have ever done," Anderson said. "We only have to do for a patient to get their units off them. We've done it all with in-water balance."

References


Discussion

The difficulty in providing a transfusion-free cardiopulmonary bypass procedure was evident in this case. This case highlights three important topics to include autologous normovolemic hemodilution and antifibrinolytics. It was shown here that using Voluven® as an intravenous volume expander after autologous normovolemic hemodilution was successful with minimal hemodynamic compromise. Additionally, ANH was used effectively within the literature of blood conservation within the pediatric and congenital cardiac surgical populations. This technique has been used more as an over-growth concern over the risks of blood transfusion and the effects on morbidity and mortality.

The use of Voluven was as an evaluation of this patient’s coagulation and platelet function. In addition to clinical indices, Voluven® ANH coagulation index (figure 2) was used. However, limitations of this study are that drawbacks to most hetastarch colloid products is that their effects on coagulation and platelet function make them less useful in prolonged surgical procedures. Moreover, plasma accumulation of many other heterostarches can lead to the negative consequences of renal impairment. A more thorough evaluation of available literature on Voluven, approved by the FDA since 2007, showed comparable results to other hydroxyethyl starches. Further randomized, controlled trials are needed to determine the impact of Voluven®."