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Case Report

Different Approaches to Reduce Bleeding of a Hemophilia-A Patient during Cardiac Surgery

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ABSTRACT

A 16-year-old hemophilia-A patient presented with symptomatic atrial septal defect (ASD). Managing bleeding during cardiovascular surgeries is a significant challenge, even for none-hemophilic patients, due to heparin administration, cardiopulmonary bypass (CPB) coagulopathy and surgical complications. This essay is an effort to discuss ASD, CPB effects on the coagulation system, and highlight some approaches to lower bleeding in hemophilic patients with congenital heart disease.

Introduction

Hemophilia A (HA), also called factor VIII deficiency or classic hemophilia, is often a hereditary disorder caused by missed or defected factor VIII [1]. Affected patients are typically male, and different kinds of the disease may provoke a lack of production, reduced production, or production of a defective FVIII. Based on the measured activity of FVIII, HA may be classified as mild (the activity of 5%-50%), moderate (1%-5%), or severe (less than 1%). Though it is known as a genetic disorder, about 33% of cases are caused by a spontaneous mutation [2].

Both Hemophilia A and B are the results of mutations in factor VIII and IX genes, which happens 1 in 5000 and 1 in 30 000 males, respectively [3]. Children born with hemophilia today can rationally presume an average or near-average lifespan, although this differs significantly across the developing world [4, 5]. HA cases are at high risk of persistent and prolonged bleeding and related sequelae, which may lead to reduced quality of life and can influence mental, social, and physical components of patients' well-being and function [5].

Atrial septal defects (ASD) are among the third most common types of congenital heart disease [6]. It may influence survival, training capacity, and induce heart failure, pulmonary hypertension, and arrhythmias [7, 8]. Cardiac surgery in patients with HA presents a unique challenge to medical teams in ensuring hemostasis as it provokes significant changes in the hemostatic system through the use of sternotomy, heparinization, cardiopulmonary bypass(CPB), and postoperative thromboprophylaxis [9, 10]. The dilemma in the clinical management of HA patients is maintaining a balance between hemostasis and anticoagulation under dynamic conditions associated with blood loss, hemodilution, and factor replacement therapy. This article aims to present a case report on the management of atrial septal defect (ASD) in a patient with severe HA and define different approaches to reduce bleeding of HA patients during cardiac surgery.

Case Report

A 16-year-old, 72-kg male with severe HA and A-positive blood type, presented with symptomatic ASD with sporadic dyspnea and palpitation and was scheduled for minimally invasive ASD closure surgery under CPB. The patient had a maternal history of hemophilia, and he was diagnosed with hemophilia-A at age 2 and since then was followed with a hematologist; not any other diseases were documented during the admitting and visit process. On admission, FVIII activity was 14%, which was within the normal range of 4 to 14% because in the prior week patient had a recombinant factor VIII administration. Other laboratory findings were normal. Transesophageal echocardiography indicated a

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mild tricuspid regurgitation, moderate pulmonary insufficiency, mild Mitral regurgitation, and moderate sized ASD of Secundum type (14*16 mm) with left-to-right shunt.

The perioperative coagulation plan for the current case was based on consultation with the patient's hematologist, along with the anaesthesia, surgery, and perfusion team. On that basis, 3500 IU of Moractocog alpha-recombinant human coagulation factor FVIII [Safacto AF] was administered before transferring to the operating room. FVIII administration aimed to continue after surgery 2500 IU TDS for 24 hours and 2500 IU BD for another three days. We aimed to achieve a minimum FVIII activity level of 100% and then gradually taper it.

After an uneventful anaesthesia 150 mg propofol, 500 microgram fentanyl, and 50 mg atracurium, one gram of tranexamic acid was administered, and then a central venous line was placed in the right internal jugular vein under the guide of ultrasonography. An arterial line was also placed in the left radial artery, and 400 mL of autologous blood was stored. The patient's position for a right lateral thoracotomy was established in a stable hemodynamic status. A regular dosage of 300 IU per kilogram of patient's weight heparin did not result in an ACT of more than 480 seconds, so another 150 IU per kilogram was administered and an ACT of 680 seconds approved the safety for initiating CPB. CPB was primed with 1200 cc standard liquid; Because we aimed not to dilute coagulation factors of the patient, we used the RAP technique to extract 400 ccs out of the system in a stable hemodynamic status. CPB's time was 35 minutes, with a cross-clamp time of 19 minutes. After completion of ASD repair, the patient was weaned from CPB, and heparin was neutralized with protamine 450 IU/kg of patient weight; also, one gram of tranexamic acid was administered. When an ACT of 123 seconds was achieved, 400 ccs of autologous blood of the patient was transfused.

At the end of the surgery, the patient was transferred to the intensive care unit (ICU). He was hemodynamically stable and was extubated within 7 hours of arrival. FVIII administration was continued, as mentioned. The overall drainage of mediastinal tubes was 150 cc; chest tubes were removed on day-two after surgery, and the patient was transferred to the ward on the same day. He was discharged home on day-seven after surgery.

Discussion

Atrial septal defect (ASD) is a common congenital heart defect (CHD) [11, 12]. ASDs constitute 10% of all CHDs [13]. Surgical repair of an ASD is a safe and effective operation with little to no morbidity and mortality. Our case was symptomatic, but even in the lack of symptoms, moderate to large ASD closure is recommended. Because it may limit pulmonary vascular obstructive disease, minimizes the risks of supra-ventricular arrhythmias, and restrain the symptoms later in the patient's life [14].

There are five types of ASDs: ostium secundum, ostium primum, sinus venosus, and coronary sinus, and common atrium defects [15]. The presented patient had anomalies in septum secondum tissue within the fossa ovalis, which is known as Secundum ASDs. Most secundum defects are separate from the atrioventricular valves, vena cava, pulmonary veins, and the coronary sinus [16]. It is the most common ASD after patent foramen ovale and can range in size from only millimeters to 2-3 cm; Our patient presented with a 16 mm lesion [17]. Larger lesions are due to the complete absence of the septum primum. ASD closure indicates in all hemodynamic shunt irrespective of the symptoms because it provokes enlargement of right heart structures. For an uncomplicated secundum defect, the intracardiac repair is relatively straightforward. More substantial defects usually require a patch repair [18].

ASDs can be closed using cardiopulmonary bypass (CPB) with a direct vision of the lesion. The classic approach was median sternotomy; however, other methods are accepted as well to diminish morbidity [19]. We utilized the right anterolateral thoracotomy, which has become more popular because of excellent cosmetic and functional outcomes [20, 21]. The patient was placed on the operation table with their right side raised by a roll supporting the shoulder, which is the typical method for positioning [22]. The right femoral vessels should constantly be left free in case peripheral cannulation is needed for bypass [23]. The incision is short: medially, it stops about 2-3 cm from the lateral edge of the sternum, and laterally it continues to the anterior axillary line. The fourth intercostal space is opened. If the aorta is profound and not easily accessible, the femoral artery is cannulated. The fifth intercostal space can be preferentially used if peripheral arterial and venous cannulation is pre-planned.

The use of CPB influences coagulation and inflammation [24]. Most coagulation factors and inhibitors are reduced by approximately 30% to 40% after an average CPB of 138 minutes [25]. The observed fall in FVIII (83% to 43%) thus followed the same pattern in this HA patient [26]. In none-hemophiliac patients, FVIII and von Willebrand factor (vWF) levels are maintained due to the endothelial release of stored FVIII/vWF. Nevertheless, because of beforehand actions of administrating FVIII, no major bleeding was observed in our HA patient. The perioperative coagulation plan for HA patients should be based on a teamwork of hematologists, anaesthesiologists, surgeons, and perfusionists [27].

The volume of solution (crystalloids) expected to prime tubes and reservoir in the CPB circuit regularly are up to one-third of the adult blood volume. The magnitude of hemodilution caused by this priming solution can be diminished by several maneuvers [28]. Retrograde autologous priming (RAP) was applied to our case to minimize the initial prime (1200 ml) to 800 mL. Patients with low haemoglobin tend to endure the dilutional consequences of CPB to a more notable degree. Fortunately, Hematocrit of our 16-year-old patient was 42%, which was decreased to 35% after CPB, a reduction which is less than usual [29].

Activated partial thromboplastin time (aPTT) is commonly used as a screening test and for confirmation of FVIII replacement in the perioperative management of HA [30-32]. In none-hemophilic patients who underwent CPB, the mean aPTT is lengthened from 31 to 36 seconds after CPB (a 17% increase from baseline), while mean international normalized ratio (INR) is prolonged from 1.1 to 1.8 (65% increase) [33, 34]. The observed changes in PT/aPTT in our patient were similar to none-hemophilic patients before and after CPB, and this confirms that aPTT is relatively insensitive to coagulation factor losses.

The ACT is the backbone system for heparin titration during cardiovascular procedures, but this contact-activated test is strongly

affected by FVIII levels [35]. The prolongation of ACTs by very low FVIII may theoretically result in underdosing of heparin. Inadequacy in monitoring heparin with ACT may result in overdosing of Protamine, which itself inhibits thrombin generation, and may increase hemorrhaging [36]. Because we had constituted FVIII up to 100%, ACT was even lower of 480 seconds in the first attempt of heparin administration, and we should have used another half-dose.

Conclusion

Devising a clear plan and interaction of anaesthesia, surgery, and CPB team can result in a less-morbid cardiovascular surgery in HA patients. The current essay indicated some approaches to be safe for avoiding complications perioperatively. A multidisciplinary decision on factor VIII compensation, autologous blood salvage, right lateral incision, RAP on CPB were some examples of communication among teams to achieve the best result in an HA patient who has congenital heart disease.

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