

Perioperative Management during Cardiac Surgery for a Patient with Bombay Blood Group: A Case Report and Review of Literature

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Abstract

Bombay blood type, found in approximately 1 in 10,000 individuals in India and even less globally, complicates the process of obtaining compatible blood products. For patients undergoing cardiac surgery, preoperative planning and effective management strategies involve early identification of the blood type, coordination with blood banks for pre-surgical stockpiling, and establishing protocols for rapid access to compatible blood in emergencies. We present a case report of patient with Ruptured sinus of valsalva opening into right atrium with large ostium secundum atrial septal defect with Bombay blood group. Intraoperatively with the technique of acute normovolemic hemodilution, auto transfusion done to maintain hematocrit. RSOV closure with ASD closure done with minimal blood loss. Postoperatively patient hematological changes were monitored. Patient extubated on POD-1 with mild inotropic support and diuretics, discharged on POD-7 under stable condition.

Keywords: Bombay Blood Group; Healthcare Providers; Normovolemia; Antigens; Cardiac Surgery; Perioperative Management

Abbreviations

ADS: Atrial Septal Defect; TTE: Transthoracic Echocardiogram; RSOV: Ruptured Sinus of Valsalva; OS-ASD: Ostium Secundum-Atrial Septal Defect; AHN: Acute Intraoperative Normovolemic Hemodilution; IJV: Internal Jugular Vein; CPB: Cardio-Pulmonary Bypass; RA: Right Atrium; PAD: Preoperative Autologous Donation; CABG: Coronary Artery Bypass Graft.

Introduction

Bombay blood group rare blood type in which individuals lack the H antigen, which is the precursor to the A, B, and

AB blood group antigens [1]. People with the Bombay blood group can only receive blood from others with the same blood type, making transfusions challenging. In cardiac surgery, the Bombay blood group presents unique challenges due to its extreme rarity and the difficulty in finding compatible blood for transfusions. Meticulous planning and coordination between healthcare providers are crucial to managing cases involving the Bombay blood group in cardiac surgery. This paper discusses about patient with bombay blood group who had ruptured sinus of valsalva with Atrial Septal Defect (ASD). In this paper, perioperative management during surgery was discussed with reference to case report.

Case Report

A 30-year-old patient resident of Telangana came with c/o progressively increasing breathlessness of NYHA (New York Heart Association) grade III since 3 months. Clinically patient had continuous murmur over all areas, bounding pulse. On Transthoracic Echocardiogram (TTE) showed ruptured sinus of valsalva (RSOV) opening into right atrium with large Ostium Secundum-Atrial Septal Defect (OS-ASD) on hematological analysis showed BOMBAY blood group with no other abnormalities. Patient was preoperatively stabilized with iron folic acid and B complex tablets. Preoperatively after induction of anesthesia, Acute Intraoperative Normovolemic Hemodilution (ANH) was performed through left Internal Jugular Vein (IJV) vascular access, blood was collected through gravity into blood bag under strict aseptic conditions as shown in figure 1. Acute normovolemic hemodilution (ANH) is a blood conservation technique that entails the removal of whole blood from a patient shortly after induction of anesthesia, with maintenance of normovolemia using crystalloid and/or colloid replacement fluid.

Through Standard median sternotomy and Cardio-Pulmonary Bypass (CPB) Aortotomy and Right Atrium (RA) opening done. Rupture of NCC (Non Coronary Cusp) of Aortic valve was observed which is opening into RA of size 5mm*7mm. RA side opening closed with pledged prolene sutures. Aortic side opening closed with savauge patch with interrupted pledged prolene sutures. OS-ASD closed with pericardial patch. Aorta and RA closed in layers. Appropriate Hemostasis secured. Standard chest closure done with minimal blood loss. Intraoperatively auto transfusion done to maintain hematocrit. In view that surgery needed longer pump time we opted out minimally invasive approach to reduce risk of hemorrhage. Controlled hypotension and judicious use of suction devices do not necessitate the use of cell salvage techniques. Post operative Transthoracic Echocardiogram showed no shunt across RSOV and ASD, good biventricular function. Hematological changes before and after surgery is mentioned in Table 1. Patient extubated with minimal inotropic support on POD-1 and kept on diuretics. On POD-7, discharged under stable condition.

Hematological Changes			
	HB(g/dl)	PCV	Platelets
PRE-OP	14.3	41.2	1,80,000
POD-0	11.5	32.4	1,40,000
POD-1	12.5	38	1,60,000
POD-3	13	40	1,80,000
POD-5	13.5	40.2	2,00,000

Table 1: Showing hematological changes.

Review of Literature

Bombay blood group is rare group lack A, B, and H antigens on their red blood cells due to mutations in the FUT 1 gene. Around 179 patients reported in India with 1 in 10000 [2], frequency. Para-Bombay blood group is another group may occasionally have A and B antigens on red cells due to passive adsorption of A and B blood group substances from plasma. Bombay blood group is red cell H deficient non-secretors, while Para-Bombay individuals are red cell.

H-deficient secretors

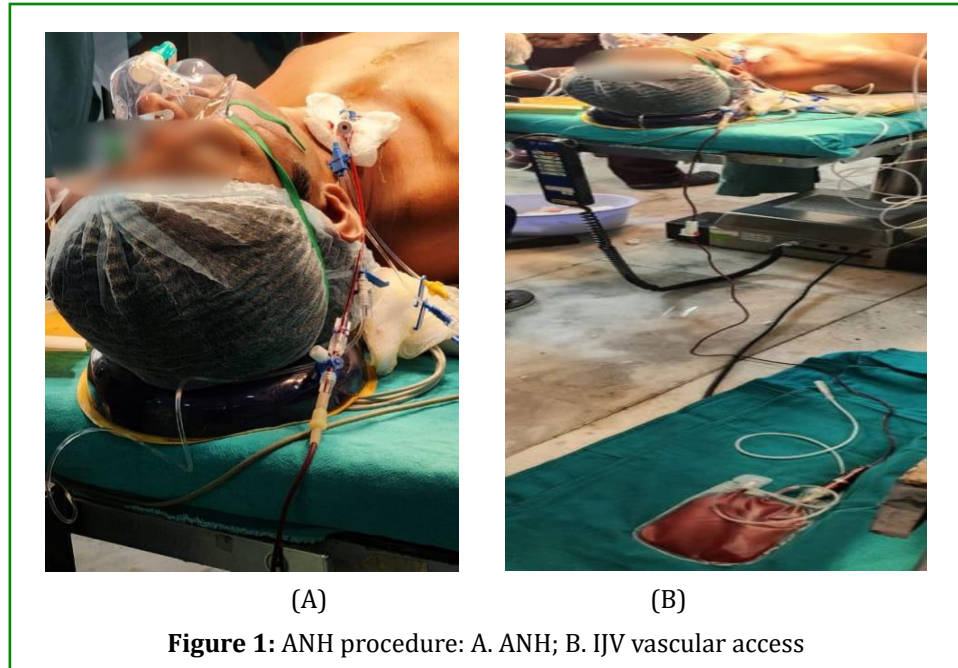
The perioperative management of patients with the Bombay blood group undergoing cardiac surgery presents unique challenges due to the rarity of this blood type and the limited availability of compatible blood products. Comprehensive preoperative evaluation is crucial to confirm the patient's Bombay blood group through laboratory testing. This information should be communicated to the entire surgical team, including anesthesiologists, surgeons, and blood bank personnel.

Due to the limited availability of Bombay blood group-compatible blood products, blood conservation strategies are essential. Blood conservation strategies aim to minimize the need for blood transfusions and preserve the body's own blood during medical procedures. Most common strategies are

- Preoperative Optimization of patient condition by correcting anemia, optimizing nutrition, and managing underlying medical conditions.
- By using Minimally Invasive Surgery techniques such as laparoscopic or robotic surgery typically result in less blood loss compared to traditional open surgery.
- Autologous blood transfusion [3,4] through cell salvage equipment that involves patients donating their own blood for use during a planned medical procedure, typically a surgery. This can be Preoperative, Intraoperative or Postoperative transfusion. Preoperative Autologous Donation (PAD) patients donate blood in advance of their scheduled surgery. This blood is typically stored and reserved for their use during or after the procedure. Intraoperative blood salvage involves the collection, processing by cell saver and reinfusion of blood lost during surgery typically through techniques such as suction or drainage. Postoperative blood salvage involves blood lost into drains or collected from wound dressings can be salvaged, processed, and returned to the patient if necessary after surgery.
- Intraoperative Acute normovolemic hemodilution (ANH) [5] is a blood conservation technique used during surgery considered to minimize blood loss and the need for transfusions during surgery.

ANH is a simple and low-cost procedure, with no evidence of clotting, hemolysis, fibrinolysis or immunological activity in the collected blood. It is the only technique capable of collecting 'fresh whole blood'.

ANH is a technique that involves, with due monitoring, the removal of blood from the patient in the operating room immediately after anesthetic induction and replacing it with crystalloids and/or colloids to maintain normovolemia.



Discussion

Bombay blood group is very rare and has high risk of perioperative hemorrhagic diathesis especially in cardiac surgery. Therefore, conventional blood typing and cross-matching may not accurately identify compatible blood products. Instead, specialized serologic testing and extended phenotype matching are necessary to ensure safe transfusions and prevent all immunization. Patients with the Bombay blood group are at risk of developing antibodies against common blood antigens if they receive mismatched blood transfusions. To mitigate this risk, it's crucial to use blood products that closely match the patient's phenotype or, ideally, transfuse blood from donors with the Bombay blood group. Continuous hemodynamic monitoring is essential during cardiac surgery to optimize tissue perfusion and oxygen delivery. This may involve invasive monitoring techniques such as arterial and central venous pressure monitoring, as well as advanced hemodynamic monitoring tools to assess cardiac function and volume status.

Due to potential challenges associated with blood transfusions, strategies to minimize blood loss and conserve the patient's own blood are paramount. This may include intraoperative blood salvage techniques, meticulous surgical hemostasis, and the use of antifibrinolytic agents to reduce bleeding. In a study by Md. Rahman, et al. [5], Coronary Artery

Bypass Graft (CABG) was performed through perioperative auto transfusion. Two units of self-blood donation in 4 days interval were performed in the blood bank of the same institute with supplementation of oral iron (350 mg/day Fe+) in addition to recombinant human erythropoietin (rh-EPO 10,000 units subcutaneously) during each donation under optimal monitoring before the operation. In another study by Shio Priye, et al. [6], reported a case of stenotic mitral valve with Bombay phenotype that underwent minimally invasive right lateral thoracotomy for the replacement of the mitral valve. Preoperatively patient received erythropoietin, intravenous iron succinate and folic acid tablets. Autologous blood transfusion was carried out postoperatively. In our study, we used Acute Normovolemic Hemodilution technique preoperatively allowing for real-time adjustment of blood volume and hematocrit based on the patient's hemodynamic status and surgical requirements. In contrast, autologous blood transfusion requires preoperative blood donation, which may not always align with the timing of surgery or the patient's hemodynamic needs.

Conclusion

Perioperative management during cardiac surgery for patients with the Bombay blood group poses unique challenges related to blood transfusion, coagulation, and hemodynamic optimization. ANH offers several advantages,

including the minimization of blood storage, preservation of blood components, reduced risk of infection, flexibility in timing, cost-effectiveness, and reduced transfusion-related complications. These factors make ANH an attractive option for reducing the need for allogeneic blood transfusions and optimizing patient outcomes during surgery. By employing specialized testing, blood conservation strategies, and multidisciplinary collaboration, healthcare providers can effectively navigate these challenges and provide safe and successful surgical care for these patients.

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