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Case Series

Transfusion challenges and management strategies in Bombay blood group pregnancies: a case series

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ABSTRACT

The Bombay blood group (Oh phenotype) is a rare blood type characterized by the absence of the H antigen, rendering standard O group transfusions incompatible. Its rarity presents unique challenges in obstetric care, where transfusion preparedness is critical. We describe the clinical course, transfusion planning, and perinatal outcomes in three pregnant women with the Bombay blood group. Three antenatal patients with confirmed Bombay phenotype (O Rh[D] positive) were managed at our tertiary care center between 2023 and 2025. All were primigravidae or with precious pregnancies, and two had moderate anemia corrected with intravenous iron. Bombay-compatible blood units were arranged in advance through a rare donor registry. Case 1 had spontaneous vaginal delivery and required a single unit transfusion post-delivery, complicated by a mild allergic reaction. Case 2, with IVF conception and severe preeclampsia, underwent emergency caesarean section complicated by atonic postpartum hemorrhage (PPH) managed medically and with a Bakri balloon. One unit of Bombay blood was transfused postoperatively. Case 3 underwent elective caesarean delivery without transfusion. Key management strategies included early blood group identification, proactive donor coordination, and prioritization of non-transfusion approaches for anemia correction. Multidisciplinary collaboration with transfusion services ensured timely access to compatible blood and safe delivery. Pregnancy in Bombay blood group women requires individualized planning and a multidisciplinary approach. Early diagnosis, rare donor registry utilization, and non-transfusion anemia correction play pivotal roles in optimizing maternal and neonatal outcomes.

Keywords: Bombay blood group, Anemia in pregnancy, Perinatal outcomes, Multidisciplinary care

INTRODUCTION

The Bombay blood group is a rare blood type first identified in India characterized by the absence of H antigen on red blood cells.[1] Unlike the common ABO blood group system, individuals with the Bombay phenotype (hh) do not express A, B, or even the precursor H antigen, making standard O blood group transfusions incompatible.[2,4] The frequency of O_h phenotype varies globally, but is commonly found in India and Europe with prevalence of 0.01% and 0.0001%, respectively.[3] This rarity presents significant challenges in medical management, particularly in obstetric care, where the need for blood transfusion can arise due to complications such as anemia, hemorrhage, or operative delivery.

During pregnancy, the management of an antenatal mother with the Bombay blood group requires meticulous planning to prevent alloimmunization and ensure the availability of compatible blood if needed. Since Bombay phenotype individuals can only receive blood from another Bombay donor,[4] sourcing compatible units becomes a logistical challenge, especially in emergency situations. Proper prenatal screening, early identification of blood group status and collaboration with blood banks are essential to mitigate risks and optimize maternal and fetal outcomes.

This case series highlights the unique considerations in managing Bombay blood group antenatal mothers, detailing the approach to blood transfusion, immunohematological challenges, and perinatal outcomes. By documenting these cases, we aim to provide insights into best practices for obstetricians, transfusion medicine specialists and healthcare providers.

CASE SERIES

Case 1

A 26-year-old primigravida woman presented at 38 weeks+1 day of gestation on October 2023 with complaints of abdominal pain. She had no history of leaking or bleeding per vaginum and continued to perceive fetal movements well. Her pregnancy was spontaneous, confirmed at 45 days of amenorrhea, and antenatal visits were uneventful except for moderate anemia diagnosed at 27 weeks of gestation, requiring correction with injection ferric carboxymaltose (FCM) due to an allergy to iron sucrose.

Her blood group was Bombay O Rh(D) positive. Two Bombay phenotype-compatible blood units were collected and reserved in preparation for any obstetric emergency. Donor 1, a 46-year-old male, had a hemoglobin level of 12.5 g/dl and was deemed fit for donation. Donor 2, a 32-year-old male, had a hemoglobin level of 15.3 g/dl and was also fit to donate. The donation process was uneventful, with no adverse reactions observed in either donor.

She had no history of blood transfusions, co morbidities, or significant systemic illnesses. On admission, general and systemic examinations were unremarkable, with stable vital signs. Baseline blood investigations showed Hb 11.6 g/dL, total count 10,280 cells/cu.mm, and platelet count 2.71 lakhs/cu.mm. Non-Stress Test (NST) was reactive, and amniotic fluid index (AFI) was adequate.

Due to a poor Bishop's score, labor was induced. Labor was further augmented with one dose of PGE2 gel, and artificial rupture of membranes (ARM) revealed clear liquor. Under continuous cardiotocography monitoring, she progressed well and had a spontaneous vaginal delivery, delivering a healthy male neonate weighing 2.92 kg with Apgar scores of 8/10 and 9/10. Estimated blood loss was less than 150ml.

The postnatal period was uneventful. The patient tolerated a soft solid diet, resumed normal bowel and bladder habits, and had good bilateral breast secretions. Repeat hemoglobin was 10.9 g/dl. She was transfused 1 unit of packed red blood cells but developed an allergic reaction, which resolved with Injection Hydrocortisone 100 mg. At discharge, her vitals were stable, and episiotomy was intact with bleeding within normal limits. Both mother and baby were healthy and discharged with appropriate medications and advice.

Case 2

A 38-year-old G3A2 woman presented at 33 weeks + 2 days of gestation on September 2024 with a history of IVF conception and newly diagnosed severe preeclampsia without imminent symptoms. She was on Tab. Ecosprin. She had no complaints of abdominal pain, bleeding per vaginum, or reduced fetal movements.

Her antenatal course was uneventful until 32 weeks, when she developed elevated blood pressure and was admitted for further management. She had a history of hypothyroidism on Tab. Thyronorm 25 mcg daily but no other comorbidities or prior blood transfusions. On admission, BP was 170/110 mmHg, and bilateral grade II pedal edema was present. Baseline investigations showed Hb 11.7 g/dl, total count 14,340 cells/cu.mm, and platelet count 1.2 lakhs/cu.mm.

Her blood group was reported as Bombay O Rh(D) positive blood group by conventional tube technique. One Bombay phenotype-compatible blood unit was reserved in preparation for any obstetric emergency. The donor was identified through our hospital's rare blood group donor registry and was assessed for eligibility before donation. The 49-year-old male donor had a hemoglobin level of 12.8 g/dL and was also fit to donate. The donation process was uneventful without any adverse reactions.

She received two doses of Inj. Betamethasone for fetal lung maturity and magnesium sulfate prophylaxis. Strict BP monitoring, urine albumin dipstick tests and NSTs were done daily. She was started on Tab. Lobet 100 mg TDS and Tab. Depin 10 mg BD for blood pressure control.

Due to her precious IVF pregnancy in preterm labor, she underwent an emergency lower segment cesarean section (LSCS) under spinal anesthesia. A female neonate weighing 1.93 kg was delivered with Apgar scores of 8/10 and 9/10. Intraoperatively, atonic PPH was noted and managed medically, and a Bakri balloon was placed intra-cavity. A BP spike of 170/90 mmHg was recorded, and Inj. Lobet 40 mg IV was administered. Estimated blood loss was 300 ml. On POD 0, she was kept NPO, catheterized, and monitored strictly for excessive bleeding, which was not observed. On POD 1, the Bakri balloon was removed, and she was started on sips of water followed by clear liquids. Strict BP monitoring and urine albumin dipstick testing continued. Postoperative PIH profile was within normal limits. By POD 2, she tolerated a soft solid diet, and her catheter was removed, with free voiding noted. Repeat hemoglobin was 8.8 g/dl, which dropped to 7.9 g/dL on POD 3 necessitating one unit of packed red blood cell transfusion. Transfusion was uneventful.

On POD 3, dressing was removed, and the wound was healthy. On POD 8, sutures were removed, and wound approximation was good. With stable BP readings and both mother and baby in good health, they were discharged with appropriate medications and advice.

Case 3

A 29-year-old primigravida woman with a history of late booking presented at 38 weeks + 6 days of gestation with decreased AFI-7.9 cm) and a history of moderate anemia, which had been corrected with six doses of intravenous iron sucrose at an outside hospital. She was admitted for safe confinement on January 2025.

Her pregnancy was conceived through ovulation induction, and the pregnancy test was confirmed at 50 days of amenorrhea. The first and second trimesters were uneventful, with routine iron, calcium, and folic acid supplementation. Anomaly scan ruled out fetal anomalies. She had no history of diabetes, hypertension, thyroid disorders, or other systemic illnesses. On admission, she was clinically stable with a BP of 100/70 mmHg, HR 84 bpm, and RR 14/min. Systemic examination findings were normal. Baseline investigations showed Hb 11.4 g/dL, total count 14,740 cells/cu.mm, and platelet count 2.05 lakhs/cu.mm.

Blood grouping and typing was done using conventional tube technique. Routine forward blood grouping showed no agglutination with anti-A, anti-B, or anti-H antisera. Reverse grouping confirmed that she had the rare Bombay O blood group. Rh(D) status was positive. Given the transfusion challenges associated with her rare blood group, a multidisciplinary team of obstetricians and transfusion specialists were involved in her care. Two Bombay phenotype-compatible blood units were collected and reserved in preparation for any obstetric emergency. Both donors were identified through our hospital's rare blood group donor registry and were assessed for eligibility before donation. Donor 1, a 22-year-old male had a hemoglobin level of 15.6 g/dl and was deemed fit for donation. Donor 2, a 49-year-old male, had a hemoglobin level of 13.2 g/dl and was also fit to donate. The donation process was uneventful, with no adverse reactions observed in either donor.

She was induced with Mifepristone 200 mg, followed by Foley's catheter induction. Labor was further augmented with PGE2 gel. Due to maternal request, she underwent an emergency LSCS under spinal anesthesia. A female neonate weighing 2.81 kg was delivered with Apgar scores of 8/10 and 9/10. Intraoperatively, minimal clear liquor was drained, and the placenta and membranes were delivered in toto. Estimated blood loss was less than 150 ml.

There was no PPH and bilateral tubes and ovaries were normal. The postoperative course was uneventful. On POD 0, her vitals remained stable. On POD 1, she was started on sips of water, followed by a clear liquid diet, and her urinary catheter was removed. She voided freely, and her repeat hemoglobin was 11.3 g/dL. By POD 2, she tolerated a soft solid diet, and by POD 3, her dressing was removed, and the wound appeared healthy. Suture removal was done on POD 7.

Both mother and baby remained stable throughout the hospital stay and were discharged in good condition with appropriate postnatal care advice.

Since mother was hemodynamically stable, no blood transfusion was required.

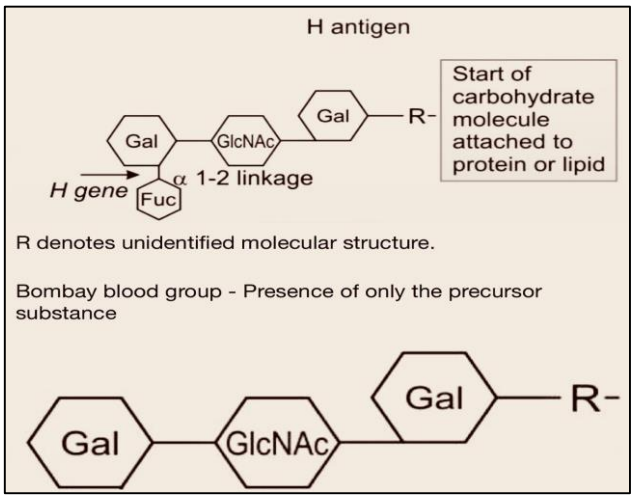

Figure 1: Comparison of molecular structure of H antigen in group O individuals versus Bombay blood group individuals.

Schematic representation comparing the molecular structure of the H antigen in group O individuals and Bombay blood group individuals. In group O, the H antigen is intact and serves as a substrate for A and B antigens. In contrast, individuals with the Bombay blood group lack functional fucosyltransferase (FUT1) enzyme, resulting in the absence of H antigen on red blood cells.

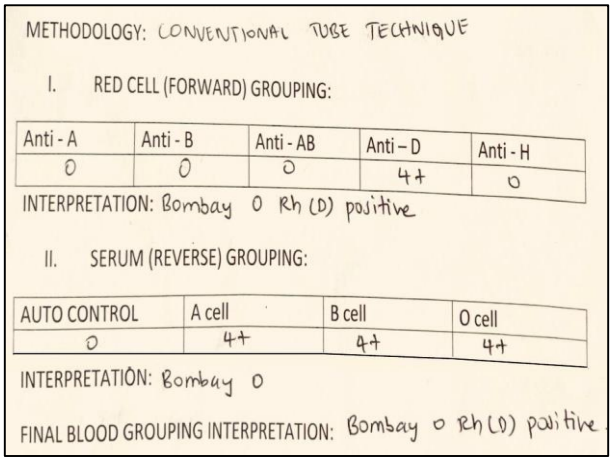

Figure 2: Interpretation of Bombay blood group (O Rh[D] positive) using conventional tube technique.

Results of conventional tube technique showing blood grouping in a patient with the Bombay phenotype (O Rh[D] positive). The forward grouping demonstrates no agglutination with anti-A, anti-B, and anti-H reagents, indicating the absence of A, B, and H antigens. Reverse

grouping shows strong agglutination with A cells, B cells, and O cells (containing H antigen), confirming the presence of anti-A, anti-B, and strong anti-H antibodies in patient's serum.

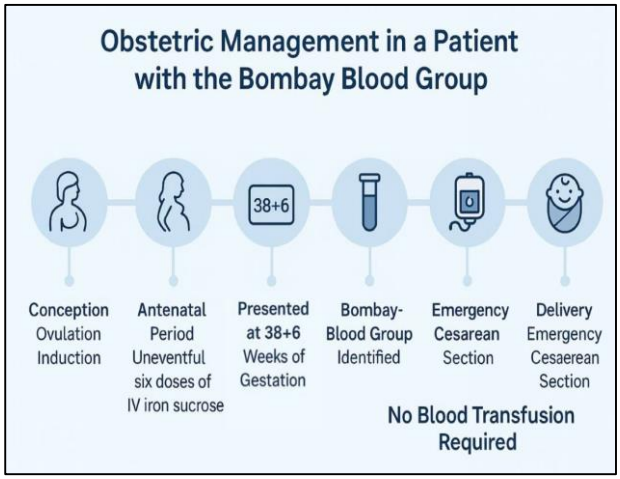

Figure 3: Graphic timeline depicting clinical course and management of case 3.

DISCUSSION

The Bombay blood group, first identified in India, is an exceptionally rare phenotype resulting from the absence of the H antigen on red blood cells. Unlike individuals with the O blood group, who retain the precursor H antigen, Bombay phenotype individuals completely lack it due to homozygous mutations in the FUT1 and FUT2 genes.[5] This makes them incompatible with standard O group blood transfusions, requiring blood exclusively from another Bombay phenotype donor. This scarcity presents significant challenges in obstetric care, where blood transfusions may be needed for anemia, PPH, or operative deliveries.

All three cases in our series required careful transfusion planning. In case 1, the patient had a mild transfusion reaction despite meticulous blood compatibility testing. This highlights the immunohematological complexity of Bombay phenotype transfusions. Even when Bombay-matched blood is available, other transfusion reactions can still occur underscoring the need for early identification and multidisciplinary collaboration with transfusion services.

Two of our patients (cases 1 and 3) had moderate anemia during pregnancy, which was managed with parenteral iron therapy instead of blood transfusion due to their rare phenotype. Case 3 demonstrated successful correction with iron sucrose, whereas Case 1 had an iron sucrose allergy, requiring alternative management with FCM. Similar to the findings of Fein et al we observed that IV iron therapy provided a safe and effective alternative to blood transfusion for treating moderate anemia in pregnancy.[6] This reinforces the importance of non-transfusion strategies for anemia correction in Bombay blood group pregnancies.

The mode and timing of delivery in Bombay blood group pregnancies depend on maternal and fetal conditions. Case 3 underwent caesarean section as per maternal request, while case 1 had a spontaneous vaginal delivery after induction. Case 2, however, presented with severe preeclampsia and was delivered preterm at 33 weeks due to worsening maternal hypertension. Hypertensive disorders in pregnancy increase the risk of PPH, requiring additional uterotonic measures and Bakri balloon placement in this case.

While PPH is a common obstetric emergency, managing PPH in a Bombay blood group patient is uniquely challenging due to the unavailability of emergency-compatible blood. In case 2, atonic PPH was managed successfully with medical therapy and a Bakri balloon, preventing the immediate need for massive transfusion. However, due to postoperative anemia (Hb drop to 7.9 g/dL), a single unit of Bombay-matched blood was transfused on POD 3, demonstrating the importance of having a contingency plan in place for postpartum patients.

Similar to our study, Shaik et al described surgical intervention and coordination with regional blood banks to secure compatible blood highlighting the need for a multidisciplinary approach in managing PPH in Bombay blood group mothers. [7]

Clinical implications and recommendations

Early identification of Bombay blood group

All pregnant women should undergo detailed blood grouping with reverse typing to avoid misclassification as group O.[8] If Bombay phenotype is suspected, confirmatory testing with anti-H lectin reagent should be done. [8]

Multidisciplinary delivery planning

Obstetricians, transfusion medicine specialists, and neonatologists should be involved early in the pregnancy to ensure a delivery plan is in place. Blood banks should be informed well in advance to secure Bombay-compatible units, if possible. Similar to our study, Bottle et al advocate for an interdisciplinary approach involving obstetricians, transfusion medicine specialists, neonatologists, and blood bank teams to optimize the management of Bombay blood group pregnancies[9]

Optimizing anemia management

Optimizing iron, folic acid, and vitamin B12 levels can help prevent anemia-related complications and reduce the need for transfusion.

Oral iron (Ferrous sulfate, fumarate, or gluconate): 60-120 mg elemental iron daily for prevention of anemia.

Intravenous (IV) iron therapy: For those who cannot tolerate oral iron or have moderate-to-severe anemia (Hb <10 g/dl). Parenteral iron therapy should be prioritized over blood transfusion whenever possible. Alternative therapies like erythropoietin-stimulating agents (ESAs) may be considered in select cases to improve erythropoiesis.

Vegetarian Bombay blood group mothers are at higher risk of B12 deficiency due to limited dietary sources. Serum B12 levels should be checked in cases of unexplained anemia.

Hemorrhage preparedness

Active management of the third stage of labor (AMTSL) is critical to minimize PPH risk. Uterotonic agents like carboprost and misoprostol should be readily available. In high-risk cases, pre-emptive measures such as Bakri balloon placement may be lifesaving.

Autologous donations

Autologous blood donation can be a lifesaving strategy, particularly for surgeries or other interventions where blood loss is anticipated. But it is it is not routinely recommended for pregnant women due to risk of hemodynamic instability in anemic or high-risk antenatal mothers. Also, the unpredictability of obstetric hemorrhage makes it difficult to ensure timely reinfusion of stored blood. Unlike our study, Paudyal et al described a case where an elderly gravida with Bombay blood group and placenta previa underwent autologous blood donation as a precautionary measure prior to delivery. In their study, the patient successfully donated blood, ensuring that compatible blood would be available during delivery.[10] However, in our case, the patient did not undergo autologous blood donation.

Directed donations

Bombay blood group individuals undergoing planned surgeries can arrange directed donations in advance to ensure availability. Unlike surgical patients, pregnancy-related bleeding is unpredictable, making it crucial to secure Bombay-matched blood units well in advance. If a compatible donor is identified, blood should ideally be collected and stored in the last trimester, considering blood shelf-life limitations (typically 35-42 days for red cell units).

Rare donor programs

National and regional initiatives like ICMR-rare donor registry of India (RDRI), Kerala's rare blood donor registry and certain NGOs are formulated to address the challenges in transfusion services by identifying eligible donors with rare blood types. Despite these efforts, challenges persist in establishing a comprehensive rare blood group donor program in India. These challenges include technical, logistical, and administrative limitations, such as a lack of trained resources, limited awareness, absence of routine antibody screening, insufficient laboratories with blood group genotyping facilities, and a decentralized blood transfusion service structure.

Intraoperative cell salvage

Intraoperative cell salvage works by collecting shed blood from the surgical field using a suction device. The collected blood is filtered and washed to remove contaminants (e. g., clotting factors, fat, and debris). The cleaned red blood cells are returned to the patient intravenously, reducing the need for donor blood. However, ICS cannot be used in contaminated surgical fields (e. g., infections), high technical expertise required, ICS machines are not widely available in all centers, especially in low-resource settings. Also, in cesarean deliveries, fetal cells and amniotic fluid must be adequately removed to prevent amniotic fluid embolism. Unlike our study, Van Denakker et al utilized intraoperative cell salvage in their management of a high-risk pregnancy involving placenta previa in a patient with the newly diagnosed Bombay blood group. In their case, ICS was employed to mitigate blood loss during surgery, thereby avoiding the need for allogeneic blood transfusions.

CONCLUSION

This case series highlights the unique transfusion challenges and obstetric management strategies required for Bombay blood group pregnancies. Early blood group identification, preemptive transfusion planning, and alternative anemia management strategies are essential to ensuring safe maternal and fetal outcomes. Through multidisciplinary care and personalized obstetric planning, complications associated with this rare phenotype can be effectively managed.

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