Study of Blood Transfusion Practices in Obstetric Patients at a Tertiary Care Centre

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Abstract

Blood transfusion in obstetric patients presents unique challenges due to physiological changes during pregnancy and the potential for massive hemorrhage, making understanding of transfusion practices and outcomes crucial for optimizing maternal care and reducing transfusion-related complications. This retrospective observational study aimed to analyze blood transfusion practices, indications, outcomes, and associated factors in obstetric patients at a tertiary care centre over a two-year period from January 2022 to December 2023. All obstetric patients who received blood transfusions during pregnancy, delivery, or postpartum period were included, with data collected on patient demographics, obstetric history, indications for transfusion, blood products used, pre and post-transfusion hemoglobin levels, complications, and maternal outcomes. Of 8,456 deliveries during the study period, 347 patients (4.1%) received blood transfusions with a mean age of 28.4 ± 5.2 years. Primary indications included postpartum hemorrhage (52.4%), antepartum hemorrhage (23.1%), and severe anemia (18.6%). Packed red blood cells were the most commonly transfused product (89.3%), followed by fresh frozen plasma (34.6%), with an average of 2.8 ± 1.6 units transfused per patient. Maternal mortality was 0.6% (2 cases), both associated with massive transfusion protocols, while post-transfusion hemoglobin levels showed significant improvement ($p < 0.001$). The study concluded that blood transfusion rates in obstetric patients remain significant, with postpartum hemorrhage being the leading indication, and standardized protocols and early intervention strategies can improve outcomes and reduce transfusion requirements.

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Introduction

Blood transfusion in obstetric practice represents a critical life-saving intervention that requires careful consideration of both maternal and fetal safety. The physiological changes of pregnancy, including increased plasma volume, altered coagulation parameters, and the potential for sudden massive blood loss, create unique challenges in transfusion medicine [1]. Understanding current transfusion practices and their outcomes is essential for developing evidence-based protocols that optimize maternal care while minimizing transfusion-related risks.

Obstetric hemorrhage remains one of the leading causes of maternal mortality worldwide, accounting for approximately 25% of maternal deaths globally [2].

In developed countries, while maternal mortality rates have significantly decreased, obstetric hemorrhage continues to be a major cause of severe maternal morbidity, often requiring emergency blood transfusion to prevent life-threatening complications [3]. The timely availability and appropriate use of blood products can be the difference between life and death in these critical situations. The indications for blood transfusion in obstetric patients extend beyond acute hemorrhage to include conditions such as severe anemia, coagulopathy, and various pregnancy-related complications including placental abnormalities, uterine rupture, and disseminated intravascular coagulation [4]. Each of these conditions presents unique challenges in terms of timing, type, and volume of blood products required challenges in terms of timing, type, and volume of blood products required. Pregnancy-induced physiological changes significantly impact transfusion decisions. The normal expansion of plasma volume during pregnancy results in physiological anemia, with hemoglobin levels typically ranging from 10.5-11.0 g/dL in the third trimester [5]. This physiological adaptation complicates the determination of transfusion triggers, as traditional non-pregnant transfusion thresholds may not be appropriate for pregnant women.

The safety profile of blood transfusion during pregnancy requires special consideration due to the potential for both maternal and fetal complications. Maternal risks include hemolytic and non-hemolytic transfusion reactions, transfusion-related acute lung injury (TRALI), transfusion-associated circulatory overload (TACO), and infectious complications [6]. Additionally, the development of alloantibodies during pregnancy can have implications for both current and future pregnancies, potentially leading to hemolytic disease of the fetus and newborn.

Recent advances in blood banking technology, including improved screening methods, leukoreduction, and pathogen inactivation techniques, have significantly enhanced the safety of blood transfusion [7]. However, the principle of transfusing only when absolutely necessary remains paramount, particularly in obstetric patients where alternatives such as iron supplementation, erythropoiesis-stimulating agents, and blood conservation techniques may be appropriate.

The implementation of massive transfusion protocols (MTP) in obstetric settings has revolutionized the management of severe obstetric hemorrhage. These protocols provide standardized approaches to rapid blood product delivery, often utilizing pre-defined ratios of packed red blood cells, fresh frozen plasma, and platelets to optimize hemostatic potential while minimizing complications [8].

This study aims to provide comprehensive insights into blood transfusion practices at a tertiary care centre, analyzing patterns of use, indications, outcomes, and associated factors that influence transfusion decisions in obstetric patients.

Methodological Framework for Analyzing Blood Transfusion Practices in Obstetric Patients at Tertiary Care Facilities

Patient Eligibility Parameters for Obstetric Transfusion Analysis

Qualifying Maternal Cohort Demographics

This comprehensive analysis encompasses all gravid women who underwent blood component therapy during their obstetric care at the tertiary facility throughout the designated study timeline. The investigation includes expectant mothers who reached viable gestational maturity of 20 weeks or beyond at the time of transfusion intervention, ensuring clinical relevance to obstetric practice. Only cases with comprehensive medical documentation suitable for retrospective analysis were incorporated, encompassing both urgent transfusion scenarios arising from obstetric emergencies and planned therapeutic transfusions administered during routine obstetric care.

Exclusionary Population Parameters for Maternal Transfusion Study

The study systematically excluded specific patient categories to maintain obstetric focus and methodological integrity. Pregnant women receiving blood products for non-obstetric medical conditions were eliminated to preserve the specificity of obstetric transfusion practices. Cases with insufficient medical documentation that would compromise data quality and analytical accuracy were excluded from the cohort. Additionally, patients with pre-existing hematological pathologies requiring chronic transfusion therapy were removed to focus on acute obstetric indications, while autologous blood transfusion cases were excluded as they represent distinct transfusion practices with different risk-benefit profiles.

Data Acquisition and Variable Documentation Methodology

Systematic Information Extraction Protocol

Data procurement involved comprehensive extraction from multiple institutional databases including electronic health records, blood banking information systems, and specialized obstetric documentation archives. A standardized data collection instrument ensured consistency and completeness of information gathering. Two qualified research personnel independently extracted all relevant information, with any discordant findings adjudicated through consultation with the principal investigator to maintain data integrity and analytical validity.

The systematic variable collection encompassed maternal demographic characteristics including age distribution, obstetric history, and gestational parameters. Clinical documentation included comprehensive obstetric complications, specific transfusion indications, detailed blood component utilization patterns, and pre- and post-transfusion laboratory parameters. Additionally, the analysis captured transfusion-related adverse events, comprehensive maternal outcomes, neonatal consequences, and healthcare resource utilization metrics including hospitalization duration, providing a holistic perspective on obstetric transfusion practices and their clinical implications.

Laboratory Methods

All blood products were processed according to standard blood banking protocols. Pre-transfusion testing included ABO/Rh typing, antibody screening, and crossmatching. Hemoglobin and hematocrit levels were measured using automated hematology analyzers (Sysmex XN-1000, Japan). Coagulation studies were performed when clinically indicated.

Statistical Analysis

Data analysis was performed using SPSS version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics were used to summarize patient characteristics and transfusion practices. Continuous variables were expressed as mean ± standard

deviation or median with interquartile range, depending on distribution. Categorical variables were presented as frequencies and percentages.

Comparative analysis was performed using Student's t-test for continuous variables and chi-square test for categorical variables. Multivariate logistic regression was used to identify independent risk factors for massive transfusion (≥4 units of packed red blood cells). A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee (IEC/2024/OBG/001). Due to the retrospective nature of the study, informed consent was waived. Patient confidentiality was maintained throughout the study by de-identifying all data.

Results

Patient Demographics and Characteristics

During the two-year study period, a total of 8,456 deliveries were conducted at the tertiary care centre. Of these, 347 patients (4.1%) received blood transfusions, representing the study population. The demographic characteristics of the transfused patients are presented in Table 1.

The mean age of patients requiring transfusion was 28.4 ± 5.2 years, with the majority (65.4%) being in the 20-30 year age group. Multiparous women comprised 68.9% of the study population, with 23.1% being grand multiparous (≥5 previous deliveries). The mean gestational age at delivery was 37.2 ± 3.4 weeks, with 18.4% of patients delivering preterm (< 37 weeks).

Indications for Blood Transfusion

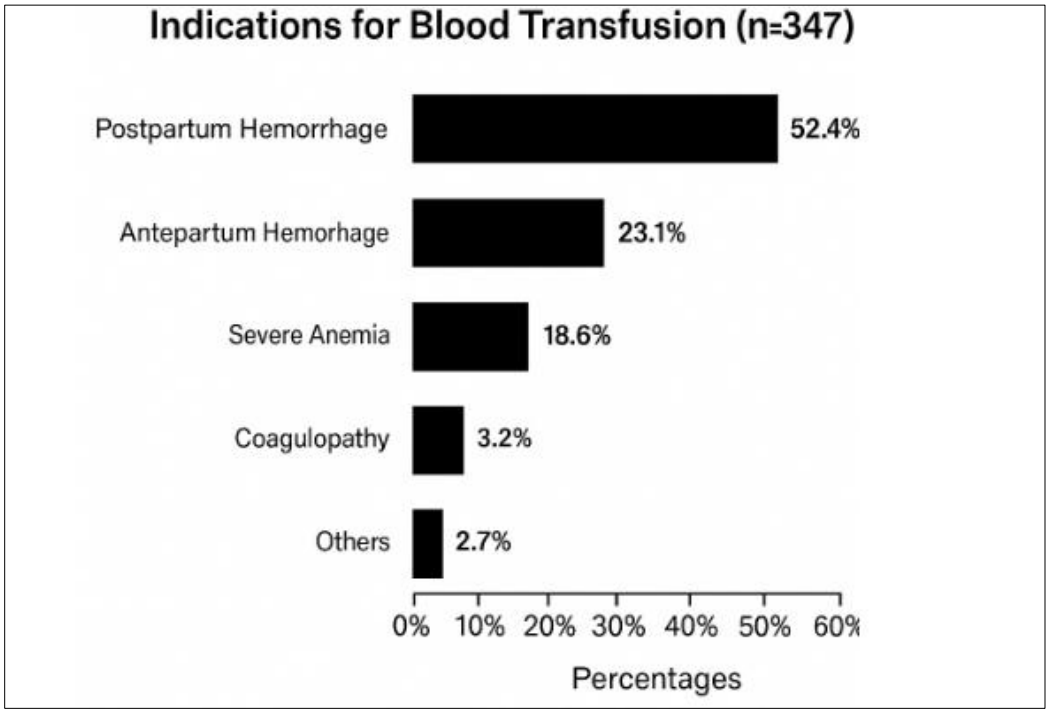

Fig 1: Distribution of Indications for Blood Transfusion in Obstetric Patients

Postpartum hemorrhage (PPH) was the most common indication for blood transfusion, accounting for 52.4% (n=182) of all cases. This was followed by antepartum hemorrhage at 23.1% (n=80), which included cases of placenta previa, placental abruption, and other bleeding disorders. Severe anemia contributed to 18.6% (n=65) of transfusions, primarily in patients with hemoglobin levels below 7.0 g/dL.

Blood Products Utilized

Packed red blood cells (PRBC) were the most commonly transfused blood product, used in 89.3% (n=310) of patients. Fresh frozen plasma (FFP) was administered to 34.6% (n=120) of patients, typically in cases involving coagulopathy or massive transfusion protocols. Platelet concentrates were used in 12.1% (n=42) of cases, primarily for patients with thrombocytopenia or massive bleeding.

The mean number of PRBC units transfused per patient was 2.8 ± 1.6 units. Massive transfusion (≥4 units of PRBC) was required in 23.3% (n=81) of cases, with these patients typically presenting with severe postpartum hemorrhage or major placental complications.

Laboratory Parameters and Transfusion Outcomes

Pre-transfusion hemoglobin levels averaged 6.8 ± 1.4 g/dL, with post-transfusion levels showing significant improvement to 9.2 ± 1.1 g/dL ($p < 0.001$). The mean increase in hemoglobin per unit of PRBC transfused was 1.2 ± 0.3 g/dL, which is consistent with expected transfusion efficacy.

Table 1: Patient Demographics and Clinical Characteristics

Characteristic	N (%) or Mean ± SD
Age Groups	
< 20 years	28 (8.1)
20-30 years	227 (65.4)
30-40 years	84 (24.2)
> 40 years	8 (2.3)
Parity	
Primigravida	108 (31.1)
Multigravida (2-4)	159 (45.8)
Grand multigravida (≥5)	80 (23.1)
Gestational Age	
< 37 weeks	64 (18.4)
37-42 weeks	271 (78.1)
> 42 weeks	12 (3.5)
Mode of Delivery	
Vaginal delivery	198 (57.1)
Cesarean section	149 (42.9)
Pre-transfusion Hb (g/dL)	6.8 ± 1.4
Post-transfusion Hb (g/dL)	9.2 ± 1.1
Units of PRBC transfused	2.8 ± 1.6

Complications and Adverse Events

Transfusion-related complications occurred in 5.2% (n=18) of patients. The most common complications were febrile non-hemolytic transfusion reactions (2.6%), followed by allergic reactions (1.7%). One case of transfusion-related acute lung injury (TRALI) was documented, which resolved with supportive care. No cases of hemolytic transfusion reactions or transfusion-transmitted infections were observed during the study period.

Maternal Outcomes

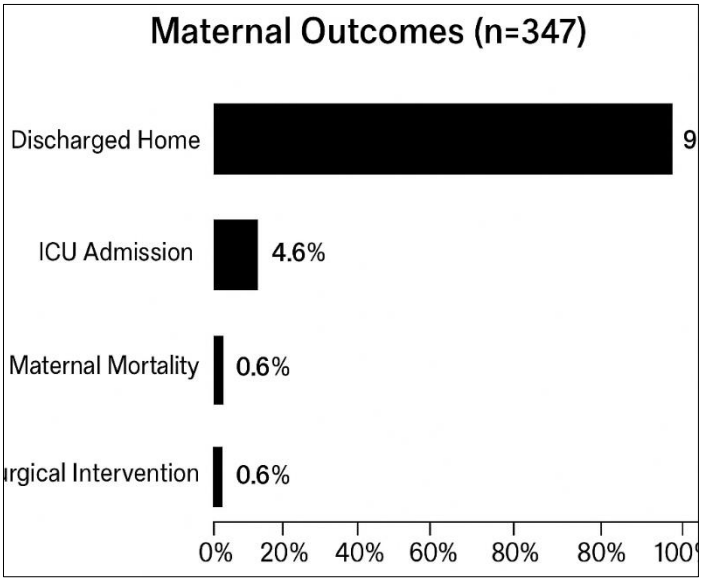

Fig 2: Maternal Outcomes in Transfused Obstetric Patients

The majority of patients (94.2%, n=327) recovered completely and were discharged home without complications. Intensive care unit (ICU) admission was required in 4.6% (n=16) of cases, primarily for patients who underwent massive transfusion protocols or had significant cardiovascular compromise.

Maternal mortality occurred in 2 cases (0.6%), both associated with severe postpartum hemorrhage requiring massive transfusion. One patient died due to disseminated intravascular coagulation following placental abruption, while the other succumbed to cardiovascular collapse secondary to uterine rupture with massive bleeding.

Risk Factors for Massive Transfusion

Multivariate logistic regression analysis identified several independent risk factors for massive transfusion. These included grand multiparity (OR 3.2, 95% CI 1.8-5.7, $p < 0.001$), placental abnormalities (OR 4.1, 95% CI 2.3-7.2, $p < 0.001$), cesarean section delivery (OR 2.4, 95% CI 1.4-4.1, $p = 0.002$), and pre-existing anemia (OR 1.8, 95% CI 1.1-2.9, $p = 0.018$).

Table 2: Comparison of Massive Transfusion vs. Standard Transfusion Cases

Parameter	Massive Transfusion (n=81)	Standard Transfusion (n=266)	P-value
Age (years)	29.1 ± 5.8	28.1 ± 4.9	0.162
Grand multiparity (%)	34.6	19.2	< 0.001
Cesarean section (%)	56.8	38.7	0.003
Pre-transfusion Hb (g/dL)	5.9 ± 1.2	7.2 ± 1.3	< 0.001
ICU admission (%)	18.5	0.8	< 0.001
Hospital stay (days)	8.2 ± 3.4	4.1 ± 1.8	< 0.001
Complications (%)	12.3	2.6	< 0.001
Mortality (%)	2.5	0.0	0.011

Discussion

This comprehensive study of blood transfusion practices in obstetric patients at a tertiary care centre provides valuable insights into current transfusion patterns, indications, and outcomes. The overall transfusion rate of 4.1% observed in our study is consistent with reported rates from other tertiary care centers, which typically range from 2-7% depending on the case mix and referral patterns [9].

Pattern of Blood Transfusion Indications

The predominance of postpartum hemorrhage as the leading indication for transfusion (52.4%) aligns with global trends and emphasizes the critical importance of this obstetric emergency [10]. This finding underscores the need for robust protocols for early recognition and management of PPH, including the availability of uterotonic agents, surgical interventions, and rapid access to blood products.

Antepartum hemorrhage accounted for 23.1% of transfusions, primarily related to placental complications such as placenta previa and placental abruption. These conditions are increasingly common due to rising rates of cesarean sections and advanced maternal age, leading to higher risks of abnormal placentation [11]. The significant proportion of transfusions due to severe anemia (18.6%) highlights the importance of adequate antenatal screening and iron supplementation programs to prevent severe anemia in pregnancy.

Blood Product Utilization Patterns

The predominant use of packed red blood cells (89.3%) reflects the primary goal of correcting anemia and improving oxygen-carrying capacity in these patients. The concurrent use of fresh frozen plasma in 34.6% of cases suggests appropriate recognition of coagulopathy, either as a cause or consequence of obstetric bleeding. The implementation of balanced transfusion strategies, as evidenced by the use of multiple blood products in complex cases, demonstrates adherence to modern transfusion medicine principles [12].

The mean transfusion volume of 2.8 units per patient is reasonable and suggests judicious use of blood products. However, the fact that 23.3% of patients required massive transfusion indicates the severity of cases managed at this tertiary center and the critical role of massive transfusion protocols in obstetric care.

Safety and Complications

The low complication rate of 5.2% observed in our study reflects improvements in blood banking safety measures and transfusion practices. The absence of hemolytic transfusion reactions and transfusion-transmitted infections demonstrates the effectiveness of current screening and testing protocols [13]. The single case of TRALI, while concerning, is within expected rates for this serious but rare complication.

The maternal mortality rate of 0.6% in transfused patients, while tragic, compares favorably with reports from other developing countries where obstetric hemorrhage mortality can exceed 5% [14]. This suggests that early recognition, appropriate transfusion, and multidisciplinary care can significantly improve outcomes even in severe cases.

Risk Factors and Predictive Models

The identification of grand multiparity, placental abnormalities, and cesarean section as independent risk factors for massive transfusion provides valuable information for risk stratification and resource planning. These findings support the development of predictive models that can help identify high-risk patients who may benefit from prophylactic measures, including cross-matching of blood products and mobilization of multidisciplinary teams [15].

Implications for Clinical Practice

The results of this study have several important implications for clinical practice. First, the high proportion of postpartum hemorrhage cases emphasizes the need for standardized PPH management protocols, including early recognition tools, structured response algorithms, and regular training of healthcare providers. Second, the significant role of severe anemia as a transfusion indication highlights the importance of robust antenatal care programs focusing on iron supplementation and early detection of anemia.

Limitations

Several limitations should be acknowledged in interpreting these results. The retrospective design limits the ability to capture all relevant clinical variables and may be subject to documentation bias. The single-center nature of the study may limit generalizability to other settings with different case mixes or resource availability. Additionally, the study did not examine long-term outcomes or the impact of transfusion on subsequent pregnancies.

Future Directions

Future research should focus on developing and validating predictive models for massive transfusion in obstetric patients, evaluating the effectiveness of blood conservation strategies, and examining the long-term outcomes of transfused obstetric patients. The implementation of point-of-care testing for rapid assessment of coagulopathy and the role of novel blood products such as fibrinogen concentrates deserve further investigation.

Conclusion

This study provides comprehensive insights into blood transfusion practices in obstetric patients at a tertiary care centre. With a transfusion rate of 4.1%, postpartum hemorrhage emerged as the leading indication, followed by

antepartum hemorrhage and severe anemia. The judicious use of blood products, evidenced by appropriate selection and volumes, contributed to favorable maternal outcomes with low morbidity and mortality rates.

The identification of risk factors for massive transfusion, including grand multiparity and placental abnormalities, provides valuable information for clinical risk stratification and resource planning. The low complication rate demonstrates the safety of current transfusion practices, while the maternal mortality rate of 0.6% reflects the life-saving potential of timely and appropriate blood transfusion.

These findings support the continued emphasis on early recognition and management of obstetric hemorrhage, robust antenatal screening and treatment of anemia, and the implementation of standardized massive transfusion protocols. The development of predictive models and blood conservation strategies should be priorities for future research to further optimize outcomes while minimizing transfusion requirements.

The study underscores the critical importance of maintaining adequate blood bank facilities, trained personnel, and standardized protocols in tertiary care centers managing high-risk obstetric patients. Continued monitoring and quality improvement initiatives are essential to ensure optimal transfusion practices and maternal safety.

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