Original Research Article

MASSIVE TRANSFUSION PROTOCOL: A BOON FOR SALVAGING PATIENTS OF MASSIVE OBSTETRIC HEMORRHAGE

ABSTRACT

BACKGROUND: Maternal mortality remains a major global health issue, with obstetric hemorrhage as the primary cause. Timely and effective blood transfusion is crucial for maintaining organ perfusion and oxygenation. This study seeks to evaluate maternal outcomes, focusing on survival rates and life-threatening complications following massive blood transfusion.

MATERIALS AND METHODS: A prospective, observational study was conducted between July 2022 to January 2024 in the Department of Obstetrics and Gynecology of Shree Krishna Hospital, Karamsad, Gujarat, India which is a rural tertiary care institute catering to Anand and Kheda districts of Central Gujarat. Data included in the study were age, socioeconomic status, parity, weeks of gestation, underlying comorbidities, cause of hemorrhage, mode of management, number and ratio of blood products transfused, and complications of MT.

RESULTS: The MT utilization rate of our institute was 2.74%. The mean age of the study group was 27.3yrs with 84% belonging to the rural population. Out of all 58% were antenatal cases majority being multipara- 61.7%. PPH was the most common cause of massive obstetric hemorrhage i.e. 42%. At the same time, the average time for issuing the first blood product was 12 min. Most cases could be managed conservatively -31 out of 81 using oxytocics and timely blood transfusion. Amongst the operative interventions, obstetric hysterectomy was done in 23.4 % of cases. The overall ratio of PCV: FFP: PC: CP in the study was **1:1.02:0.8:2**. In 46% of the cases patients did not suffer from any MT-related complications, while in 41% of the cases, patients had developed MODS. TACO was seen in 16% and TRALI in 7.4%. The mortality rate was 5%. Blood transfusion-related complications are observed more with PC, followed by FFP and RCC.

CONCLUSIONS: Postpartum hemorrhage (PPH) was the leading cause of obstetric hemorrhage. Maternal morbidity and mortality can be significantly reduced through early referral to a tertiary care center, prompt administration of oxytocics, and the timely initiation of massive transfusion and surgical interventions for uncontrolled bleeding. Maintaining a blood product ratio of approximately 1:1.02:0.8 for packed red blood cells (PRBCs), fresh frozen plasma (FFP), and platelets helps prevent coagulopathy, ensures adequate tissue perfusion, and shields the patient from the detrimental cycle of sepsis, hypothermia, hemodilution, and shock. PRC transfusion was maximally responsible for TRALI.

Keywords: massive transfusion protocol, post-partum haemorrhage, obstetric haemorrhage, maternal morbidity, maternal mortality

1. INTRODUCTION

The Massive Transfusion Protocol represents a revolutionary approach to early, proactive hemostatic resuscitation for patients at high risk of substantial blood loss over a short timeframe. Massive transfusion is defined as administering more than 4 units of red cell concentrates (RCC) within 1 hour or over 10 units within 24 hours, with massive blood loss defined as exceeding 150 ml/hr or one blood volume within 24 hours[1,2]. Severe obstetric hemorrhage is a major global issue, significantly contributing to maternal morbidity and mortality. Causes of obstetric hemorrhage include placenta previa, placenta accreta, atonic and traumatic postpartum hemorrhage (PPH), uterine rupture, placental abruption, and uterine inversion. There is a notable increase in the incidence of massive obstetric hemorrhage, often associated with a higher rate of cesarean sections[3].

Haemostatic Resuscitation is a key approach that focuses on achieving local surgical haemostasis and mitigating coagulopathy by preventing hypothermia, acidosis, and ensuring the timely replacement of coagulation factors such as fibrinogen. In the context of massive obstetric hemorrhage (MOH), extensive bleeding leads to reduced blood flow to the uterus. This diminished perfusion causes tissue hypoperfusion, which in turn increases the production of thrombomodulin by vascular endothelial cells. Thrombomodulin activates protein C, setting off a cascade of irreversible events that result in elevated fibrinogen degradation products and impaired uterine contractions.[4,5] These effects are common in both atonic and traumatic postpartum hemorrhage (PPH), leading to rapid deterioration of the patient's condition. Consequently, implementing a Massive Transfusion Protocol (MTP) becomes a crucial strategy for effectively managing MOH.

Using a fixed ratio of red cell concentrate (RCC) to fresh frozen plasma (FFP) at 1:1, and a RCC:FFP ratio of 1:1:1, has been shown to provide a survival advantage within the first 6-24 hours of massive hemorrhage, where mortality is primarily associated with hypovolemic shock and its effects[6]. Since the pathophysiology of obstetric bleeding is similar to that of severe trauma, applying a Massive Transfusion Protocol (MTP) with FFP/RCC or RBC ratios similar to those used in trauma care could be beneficial for managing obstetric hemorrhage[7]. To improve non-trauma MTPs, further prospective studies are needed to validate these ratios and to develop screening or prediction tools that can identify which patients will benefit most from MTP activation.

1.1 Aims

Our study aimed to primarily know the maternal outcome- survival and life-threatening complications after a massive blood transfusion. Also to know the causes of massive obstetric haemorrhage, mode of management, optimum blood product ratio, and audit the time of receiving the blood products.

2. MATERIALS AND METHOD

2.1 Studydesign

This is a prospective, observational study conducted in the Department of Obstetrics and Gynecology in Pramukh Swami Medical College, Karamsad, Gujarat, India from July 2022 to July 2024.

2.2 Study Subjects

Only Obstetric patients, both antenatal and postpartum, who had undergone massive obstetric hemorrhage necessitating Massive Tranfusion Protocol were included in the study. Patients with gynecological hemorrhage were excluded in the study.

2.3 Setting

This prospective, observational study was conducted in the Department of Obstetrics and Gynaecology of Shree Krishna Hospital Pramukh Swami Medical College, Bhaikaka university, Karamsad, Anand, Central Gujarat, India. This is a 750-bedded tertiary care institute that caters to Anand and Kheda districts, over an area of about 50 km radius.

Karamsad is situated 45 km from Vadodara district and 70 km from Ahmedabad. It covers about 45 lacs population. All complicated deliveries are being referred here for HDU and ICU management and need of blood transfusion.

2.4 Data Setting

Data of the patients who had received MT was retrieved from our files and A.D. Gorawala blood bank. The following details about the patient were collected. The patient's detailed performa included patient ID number, age, profession, socioeconomic status, gravida, parity, details of current pregnancy, type of delivery, the timing of delivery, cause of obstetric haemorrhage, coagulation profile, treatment of hemorrhage including medical treatment, surgical treatment received by the patients, the timing of onset of haemorrhage to the onset of MT interval, number of blood products transfused, its relative ratio of RBC:FFP: Platelets and cryoprecipitates, hospital stay, ICU stay, the occurrence of complications like TRALI (transfusion-associated acute lung injury), TACO (transfusion-associated circulatory overload), Acute Renal Shutdown, Blood transfusion reaction, the need for mechanical ventilation, the need of dialysis, mortality or survival were be noted.

2.5 Ethical Clearance

The data collection was started after approval of the institutional ethics committee- **IEC/BU/136/Faculty/1/293/2022**, as it was a prospective and descriptive study, a waiver of consent was requested.

2.6 Statistical analysis

Descriptive and multivariate logistic regression were used to analyse data.

3. RESULTS AND DISCUSSION

The study was conducted between July 2022 to January 2024. There were total 2956 obstetric admissions out of which 81 patients required massive blood transfusion which accounts for 2.74% of the MTP utilization rates. Highlighting the demographical data, the minimum age of the patients requiring MTP was 19yrs and the maximum age was 38yrs. The mean age of the study population was 27.3 years.

Table 1 shows that out of the total 81 cases, 68 cases i.e. 84 % cases belonged to rural area. Maximum number of patients belonged to middle class socioeconomic status i.e. 51 cases out of the total 81 cases (63%). Amongst the study cases, antenatal patients were in the majority with 47 (58%) of the total cases, while the rest were post-partum patients. Majority of the patients were multipara-50 (61.7%) followed by primipara cases being 21 (26%). Parity of more than 4 were considered to be grand multipara.

TABLE 1: DEMOGRAPHIC VARIABLES

VARIABLES	NO. OF PATIENTS (n=81)	PERCENTAGE (%)
AGE		
15-20	6	7.4
21-25	22	27.2
26-30	33	40.7
31-35	14	17.3

36-40	6	7.4
LOCALITY		
Rural	68	84
Urban	13	16
SOCIOECONOMIC CLASS		
Upper middle class	7	8.6
Middle middle class	51	63
Lower class	23	28.4
PREGNANCY STATUS		
ANC	47	58
PNC	34	42
PARITY		
Nullipara	10	12.3
Primipara	21	26
Multipara	44	54.3
Grand multipara	6	7.4

Atonic postpartum hemorrhage (PPH) was more common among multiparous women. Among the 47 antenatal cases (58%) that required massive blood transfusion, the majority occurred between 28 and 37 weeks of gestation, with 23 out of 47 cases, representing 46.5%. Thus, most patients were near term, between 28 and 42 weeks, accounting for 80% of the cases. The category of patients under 20 weeks included those with missed or incomplete abortions, ruptured ectopic pregnancies, abdominal pregnancies, and early-diagnosed placenta accreta syndrome.

At Shree Krishna Hospital, the largest proportion of patients requiring Massive Transfusion Protocol (MTP)—26 cases, or 32%—had undergone a lower segment cesarean section (LSCS). Most of these cases were complicated by antepartum hemorrhage, including placenta previa, placental abruption, and placenta accreta syndrome, necessitating either emergency or elective LSCS.

Additionally, 9 patients (11.1%) in the laparotomy category underwent procedures such as uterine rupture repair, hemoperitoneum drainage, stepwise devascularization, or obstetric hysterectomy. These cases included uterine rupture, ruptured ectopic pregnancy, abdominal pregnancy, placenta accreta spectrum, and traumatic PPH.

TABLE 2 : CAUSES OF HEMORRHAGE

CAUSES OF HEMORRHAGE	NO. OF CASES	PERCENTAGE
ATONIC/ TRAUMATIC PPH	29	37

ABRUPTIO PLACENTA	17	21
DIC/ HELLP/ THROMBOCYTOPENIA	17	21
PLACENTA ACCRETA SYNDROME	8	9.8
PLACENTA PREVIA	4	5
RUPTURED ECTOPIC	3	3.7
RUPTURED UTERUS	2	2.5
ABDOMINAL PREGNANCY	1	1.2
TOTAL	81	100

Table 2 shows that the most prevalent cause of massive obstetric hemorrhagewas postpartum hemorrhage (PPH), accounting for 37% of cases. This category includes those cases specifically associated with atonic and/or traumatic PPH. Other contributors to PPH, such as thrombin defects and retained placenta, are detailed in separate sections: DIC/HELLP/thrombocytopenia (17 cases, 21%) and placenta accreta spectrum (PAS) (8 cases, 9.8%).

For cases of antepartum hemorrhage (APH), the most common cause was placental abruption, occurring in 17 cases (21%), while placenta previa was observed in 4 cases (5%). Abdominal pregnancy was the least common, with only 1 case out of the total 81 cases, and ruptured ectopic pregnancy was noted in 3 cases.

Many patients presented with multiple overlapping comorbidities. A significant portion, 66.6%, exhibited deranged coagulation profiles, which included conditions such as HELLP syndrome, DIC and thrombocytopenia. Among those with hypertensive disorders of pregnancy, preeclampsia was the most common condition necessitating massive transfusions, affecting 43.2% of the cases. Additionally, 31% of the patients had a history of previous lower segment cesarean sections (LSCS). Sepsis was observed in 24.7% of the patients upon admission, often associated with atonic, traumatic, or secondary postpartum hemorrhage (PPH), particularly in cases involving multiple per vaginal examinations. Four patients had pre-existing cardiac conditions, including rheumatic heart disease with post-valve replacement, ongoing anticoagulant therapy, as well as, peripartum cardiomyopathy (PPCM). Acute kidney injury (AKI) was present in 14.8% of patients on admission, characterized by elevated serum creatinine levels exceeding 1.5 mg/dL, primarily due to pre-renal factors like acute blood loss. Furthermore, 29.6% of patients were diagnosed with multiorgan dysfunction syndrome (MODS) upon admission, attributable to underlying conditions such as HELLP syndrome, preeclampsia, and eclampsia. This often involved the simultaneous impairment of multiple systems, including hematological, renal, liver function, cardiac, respiratory, and/or central nervous systems (CNS).

In this study, the majority of postpartum hemorrhage (PPH) cases were attributed to uterine atony - 50.6% . Traumatic PPH was observed in 12.3% . Additionally, 7.4% of cases involved both atonic and traumatic PPH. Coagulation disorders were present in 17.3% of the cases, encompassing issues such as clotting factor abnormalities and thrombocytopenia. Secondary PPH, occurring between 24 hours and 6 weeks postpartum, was identified in 5 out of 81 cases. Other causes of PPH included ruptured ectopic pregnancies, placenta accreta spectrum (PAS), and abdominal pregnancies.

The shock index was the most frequently used parameter for assessing overall blood loss in patients. This index is calculated by dividing the pulse rate by the systolic blood pressure (SBP). In the majority of cases, 52% of patients had a shock index greater than 1. Those presenting with severe shock typically had experienced a loss of more than 30% of their total blood volume.

The average time from the collection of the blood sample to the issuance of the first blood product was 12 minutes, in this desperate requisition O Negative blood was issued.

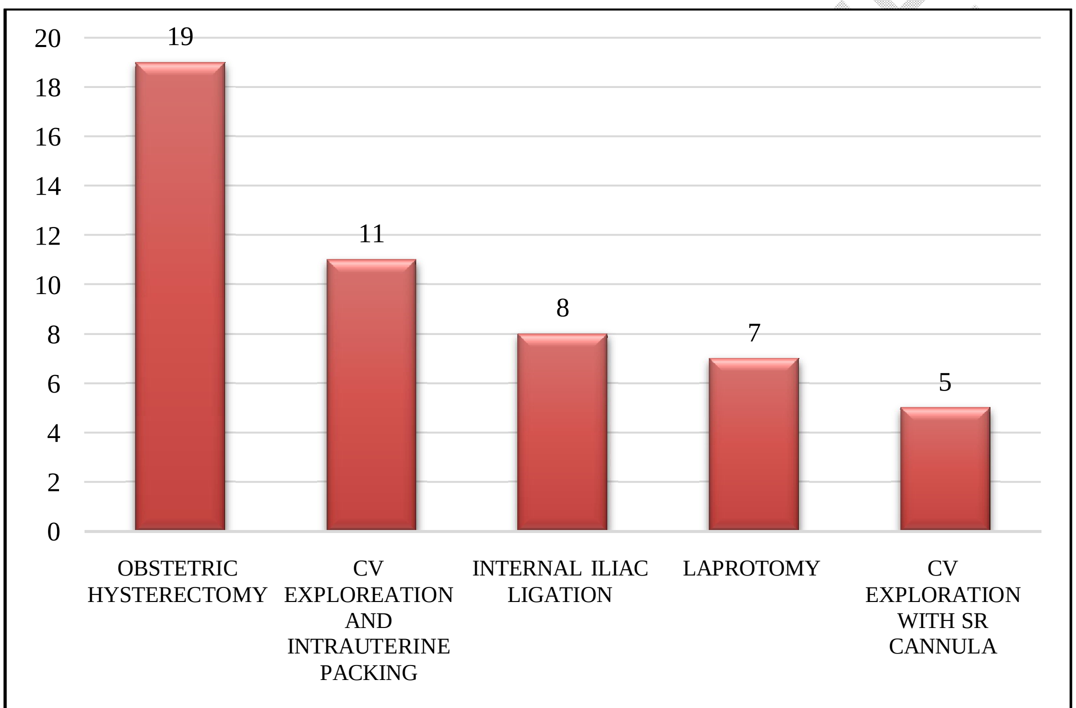

FIGURE 1 : SURGICAL INTERVENTIONS

In the majority of cases, specifically 31 (38.2%), massive bleeding was successfully managed through the timely administration of oxytocics and the implementation of a massive blood transfusion protocol. This approach was crucial in preventing complications such as hypothermia, acidosis, and disseminated intravascular coagulation (DIC). As per Figure 1 when surgical interventions were necessary, obstetric hysterectomy was the most commonly performed procedure, with 16 total and 3 subtotal hysterectomies. Additionally, cervicovaginal exploration and intrauterine packing were used in 13.6% of the cases (11 cases). Among the 81 cases reviewed, the SR cannula—a novel technique for managing atonic postpartum hemorrhage (PPH)—was employed in 5 cases (6.2%).

TABLE 3: SPECIFIC COMPLICATIONS AFTER MASSIVE BLOOD TRANSFUSION

COMPLICATIONS	NO. OF CASES	PERCENTAGE
TACO	**13**	**16**
TRALI	**6**	**7.4**
ELECTROLYTE IMBALANCE	**2**	**2.4**
MODS	**41**	**50.6**

Many of the complications are overlapping with patients showing more than 2 complications at a time. Table 3 shows among those who developed complications, 13 patients (16%) had transfusion-associated circulatory overload (TACO), and 6 patients (7.4%) had transfusion-related acute lung injury (TRALI). Fluid management was closely monitored using the inferior vena cava (IVC) status via bedside echocardiogram in the ICU. It is noteworthy that 46 patients (56.8%) had no complications.

The most prevalent complication was multiple organ dysfunction syndrome (MODS), which affected 41 patients (50.6%) due to the severity of their underlying conditions. Acute kidney injury (AKI) occurred in 6.2% of cases, primarily due to acute blood loss and delayed referral; 33% of these AKI cases progressed to chronic renal failure (CRF) requiring dialysis. Sepsis was observed in 7 patients (8.6%) by the end of the massive transfusion (MT), resulting from either the progression of existing sepsis or secondary infections related to prolonged hospital stays and invasive treatments like ventilator-associated pneumonia (VAP). About 20% of the cases involved acute febrile reactions, managed with antipyretics and antihistamines. The incidence of dilutional coagulopathy decreased with the administration of blood products in a ratio of **1:1.02:0.8** for packed cell volume (PCV), fresh frozen plasma (FFP), and platelets (PLT). Most post-MT complications were overlapping and related to the patients' underlying comorbidities.

Our study depicts that the maximum chances of TRALI and TACO are with PC with OR- 1.351 (95% CI, 0.964 to 1.892, p value- 0.08). The overall ratio among the blood products given in MTP to patients with massive obstetric haemorrhage in our institute between PCV: FFP: PC: CP was **1:1.02:0.8:2.** Also, the odds ratios for developing TRALI were 1.351 for platelet transfusions, 1.303 for FFP, 1.105 for PRBCs, and 1.047 for cryoprecipitate. Dilutional coagulopathy was barely observed in any of cases, as the PCV:FFP ratio was maintained at 1:1:1.

The average number of days for total hospital stay that the patients requiring massive blood transfusion was 8.9 days. In 95% of the cases patients required intensive care monitoring as well in ICU. Average days for ICU admission were 3.6 days. Many of the patients required mechanical ventilation. Average number of days required for mechanical ventilation was on an average 1.9 days.

Out of the 81 cases, 95% were successfully treated due to the timely administration of oxytocics, higher antibiotics, and the effective support of a well-equipped blood bank and laboratory. This was possible due to multidisciplinary approach and efficient wok of obstetricians, anesthesia, intensive care team and blood bank. While maintaining proper aseptic precautions thus minimizing hospital acquired infections. In 4 (5%) cases, patients succumbed to irreversible shock and could not be salvaged. In 60% of the cases baby could be saved due to prompt decision of LSCS. While 31% of the cases were IUFD more commonly due to APH – abruption more than placenta previa. 9% of the abortal cases include ectopic pregnancy, abdominal pregnancy and incomplete/ missed abortion with PAS.

TABLE 4 : COMPARISON OF RATIOS BETWEEN DIFFERENT STUDIES

STUDIES	YEAR	CASES	PROTOCOL
Bonnet MP et al.[8]	2011	38	FFP/RBC ratio exceeds 1 at 12 h following the onset of obstetric haemorrhage.
Matsunaga S et al.[9]	2012	196	The medically necessary FFP/RCC ratio is 1.3 in obstetric haemorrhage.
Gutierrez MC et al.[10]	2012	26	MTP was defined as a combination of 6 units of O-negative RBC, 4 units of FFP (liquid AB plasma or thawed type-specific plasma), and 1 apheresis platelet (PLT) unit.
Green L et al.[11]	2016	181	FFP/RBC ratio ≥ 1 is required during massive obstetrics haemorrhage.
Tanaka H et al.[12]	2016	52	Transfusion of FFP/RBC ratio ≥ 1 reduces mortality

Table 4 compares the ratio of fresh frozen plasma (FFP) to red blood cells (RBC) across various studies. In present study, the ratio of FFP to packed cell volume (PCV), packed cells (PC), and cryoprecipitate (CP) was 1.02:1:0.8:2. Several retrospective studies have indicated that a higher plasma-to-RBC ratio in massive transfusion (MT) is linked to improved survival rates in patients with traumatic injuries. Since 2007, there has been a growing adoption of higher plasma-to-platelet-to-RBC ratios in MT therapy.

4.DISCUSSION

Obstetric hemorrhage is the leading cause of maternal mortality, accounting for 27% of all maternal deaths worldwide each year, with postpartum hemorrhage (PPH) being the primary contributor. The World Health Organization (WHO) reports that around 14 million women experience PPH annually. Reducing the incidence and impact of PPH is crucial for lowering maternal mortality and morbidity. Improving maternal healthcare to prevent and manage complications such as PPH is essential for meeting the health targets set by the Sustainable Development Goals (SDGs).

Trauma and obstetric patients have markedly different physiological profiles, which affect hemorrhage management strategies. During pregnancy, physiological changes such as hemodilution and increased cardiac output can mask significant bleeding, delaying detection until hemoglobin and hematocrit levels drop significantly. Additionally, pregnancy-related comorbidities can elevate the risk of severe bleeding, consumption coagulopathy, and the early onset of organ failure and multiple organ dysfunction syndrome (MODS). These factors necessitate distinct approaches to managing hemorrhage in obstetric cases compared to trauma patients.

According to the RCOG's "Green-top Guideline: Blood Transfusion in Obstetrics" (October 2006), the recommended dosage for fresh frozen plasma (FFP) is 12-15 ml/kg for every 6 units of red blood cells (RBC). The guideline emphasizes using prothrombin time (PT) and activated partial thromboplastin time (APTT) from coagulation tests as the primary indicators for determining FFP requirements, with target levels set at 1.5 times the normal range for PT and APTT, and a fibrinogen level of 150 mg/dl or higher. It also advises regular monitoring of these tests and blood counts in cases of prolonged bleeding. Additionally, the guideline recommends administering cryoprecipitate in two sets of five units to maintain fibrinogen levels at or above 150 mg/dl.

The ACOG (May 2015) guidelines recommend an early and aggressive transfusion strategy with a 1:1:1 ratio of red blood cells (RBC), fresh frozen plasma (FFP), and platelets (PC) during massive transfusions. This approach aims to address coagulopathy, hypothermia, and acidosis, which are critical factors that significantly increase the risk of patient mortality[13].

Poor outcomes following massive obstetric hemorrhage (MOH) and massive transfusion (MT) are often due to delayed treatment, unavailability of blood products, inaccurate blood loss estimation, lack of treatment protocols, and poor communication among team members. In contrast, our study highlights that present institute has a benefit of a well-organized multidisciplinary approach. This includes an equipped trauma care center, dedicated obstetric team, efficient laboratory and blood bank services, anesthesia, operating theaters, and a critical care team with ICU centers and dialysis units, all operating 24/7.

In the current study, 81 out of 2,956 obstetric admissions required massive blood transfusion (MT), resulting in a utilization rate of 2.74%. This is higher than the 0.7% reported by Ochiai D et al. in Japan[14] but lower than the 3% observed by Paul I. Ramler et al. in the Netherlands[15]. Notably, a 2020 study by S. Anuraga et al. in Puducherry[16], India, reported a much higher MT rate of 20%. The previous study at the same institute by Rumi Bhattacharjee et al[17]. in 2017 had an MT rate of 2.4%. Regarding case distribution, the prior study showed 60.9% antenatal and 39.1% postnatal cases, while the current study reports 58% antenatal and 42% postnatal cases. This slight shift, along with varying MT rates, suggests evolving practices or patient profiles in obstetric care.

In the current study, the mean age of patients requiring massive blood transfusion (MT) was 27.3 years, with a range of 19 to 38 years. This is consistent with the mean age reported in Puducherry, India, but lower than the 36.8 years observed in Japan and the 32 years in the Netherlands. The previous study at the same institute noted that most patients were in the 21-30 years age group. These findings suggest that younger women are more commonly affected in Asian countries, potentially due to earlier marriages and childbearing compared to developed countries. Supporting this, Patricia et al. found that females under 20 years are more susceptible to pregnancy complications, such as poor fetal growth and postpartum hemorrhage (PPH). Additionally, a study on elderly primigravidas indicated that 3% experienced antepartum hemorrhage and 3% had PPH, further highlighting the impact of age on pregnancy outcomes.

As per the Quality Improvement Program survey conducted in American College of surgeons, 2013 during the pre-hospital resuscitation the most common blood products used were RBCs and plasma, while the most common intravenous hemostatic agent is Tranexamic Acid. Hypotension with SBP<=100mmhg was the most common MTP trigger. Laboratory values were infrequently used to initiate MT. Amongst the blood products plasma is immediately available in <5 minutes. most common plasma type used is thawed plasma. The most common FFP:RBC ratio in the first cooler is >/=1. Use of cryoprecipitates is also enocouraged in MT. In the present institute the shock status of the patients was assessed by shock index of the patient (Pulse/ SBP), urine output and by calculating the average amount of blood loss of the patient. In the present institute the average time interval between the blood collection and issuing of the first blood product is 12 min. The most common hemostatic agent used is injectable TRANEXAMIC ACID followed by injectable

HEMOCOAGULASE (BOTROPACE). The facility of TEG (thromboelastography) is not currently available in present institute.

Le Bas et al.[18] recently highlighted that during pregnancy, the normal shock index (pulse rate divided by systolic blood pressure) is typically higher compared to non-pregnant adults. This increase is due to a higher pulse rate and a decrease in systolic blood pressure. An obstetric shock index (OSI) greater than 1 is associated with a higher likelihood of requiring a blood transfusion following postpartum hemorrhage (PPH). Consequently, the OSI can serve as a useful bedside clinical tool for assessing the degree of blood loss, offering a more reliable measure than visual estimation, which is prone to significant observer variability. The latest Green Top Guideline from the Royal College of Obstetricians and Gynaecologists underscores the importance of the OSI in identifying women at risk of adverse outcomes. In the present study, 26% of patients were categorized with moderate shock (SI between 1 and 1.39), while another 26% were in severe shock (SI ≥1.4). On average, patients with severe shock experienced blood loss exceeding 30% of their total blood volume.

As per literature, the proportion of patients with previous caesarean sections varies, with Ramer et al. reporting 23%, S. Anuraga et al. indicating 33.3%, and the current study showing a rate of 31%. A history of caesarean sections, along with prior myomectomy or dilatation and evacuation, is linked to increased risks in subsequent pregnancies. These risks include uterine rupture, dense adhesions, placenta previa, and placenta accreta syndrome. Notably, the risk of placenta accreta syndrome rises with the number of previous caesarean sections, thereby increasing the likelihood that a patient may require an obstetric hysterectomy in future pregnancies.

Among the causes of obstetric hemorrhage the single most common cause is post-partum hemorrhage – which includes all the 4Ts -tone, thrombin, tissue and trauma. In the present study (year 2022 to 2024) atonic PPH accounts for 50.6% of the cases while it was 33.5% in previous study of the same institute (year 2014 to 2017 published in 2019). It was 58.3 % in the study conducted in Japan and 57% in Netherlands study.

In the present study, peripartum hysterectomy was necessary in 23.4% of cases involving obstetric hemorrhage. The primary causes for this intervention were atonic postpartum hemorrhage (PPH), traumatic PPH, followed by placenta accreta syndrome and uterine rupture. This rate is comparable to the 23% reported by Rumi Bhattacharjee et al. (2017) but higher than the 11% observed in a study conducted in Puducherry. In contrast, rates in developed countries vary significantly, with Ochiai D et al. reporting 4.2% and Paul I. Ramler et al. reporting 30%. Peripartum hysterectomy is generally considered a last-resort surgical intervention, employed when patients do not respond to aggressive medical management and conservative organ-preserving techniques.

Mortality rates following peripartum hysterectomy differ markedly between developed and developing countries. In developed nations, such as the Netherlands, mortality is low at 1.08%. However, in developing countries, rates are significantly higher, with 11.1% in Puducherry, 10% in a previous study from the current institute, and 5% in the present study. Common causes of mortality include MODS, ARDS, sepsis, and acute kidney failure. Research suggests that early activation of massive transfusion protocols (MTP) and improved antenatal care to identify high-risk patients can help prevent severe outcomes and reduce mortality

In the current study, among 81 cases, 46 (56.8%) did not experience complications related to massive blood transfusion. This favorable outcome is attributed to effective fluid management, monitored through the patient's IVC status using a bedside ECHO machine in the ICU. Among the complications, Multiple Organ Dysfunction Syndrome (MODS) was the most common, likely due to the underlying pathophysiology of the patients. Transfusion-related acute lung injury (TRALI) was observed in 7.4% of cases, while transfusion-associated circulatory overload (TACO) occurred in 16%.

The risk of TRALI varies by blood product, with one case per 5,000 PRBCs, one per 2,000 FFP, and one per 400 platelets[19-21]. A recent ICU study found an 8% incidence of TRALI, with platelet or FFP transfusions increasing the risk nearly threefold. In present study, the odds ratios for developing TRALI were 1.351 for platelet transfusions, 1.303 for FFP, 1.105 for PRBCs, and 1.047 for cryoprecipitate. Dilutional coagulopathy was observed in only 16% of cases, as the PCV:FFP ratio is maintained at 1:1:1. Fibrinogen replacement, through cryoprecipitate or fibrinogen concentrate, has proven effective in managing obstetric hemorrhage and other conditions, with several studies supporting its efficacy.

5.CONCLUSION –

In the present study, the utilization rate of the massive transfusion protocol (MTP) was 2.74%. Postpartum hemorrhage (PPH) emerged as the primary cause of obstetric hemorrhage. To enhance maternal morbidity and mortality outcomes, early referral to tertiary care centers, timely administration of oxytocics, and the prompt initiation of MTP and surgical interventions are crucial in managing cases of uncontrolled bleeding.

Maintaining a blood product ratio of 1:1.02:0.8 for PCV:FFP:Platelets proved effective in preventing coagulopathy, ensuring adequate tissue perfusion, and protecting patients from the detrimental cycle of sepsis, hypothermia, hemodilution, and shock. MT related complications were managed by assessing fluid status through chest auscultation and bedside ECHO for IVC status in the ICU, which provided valuable guidance in managing these complications.

Additionally, slightly increasing the proportion of FFP transfusion relative to PCV, as determined by interval blood testing, can support early hemostasis. This approach helps in optimizing the balance of blood products and improving overall patient outcomes during massive transfusions. All the facilities serving obstetric patients must have an established protocol so that prompt treatment of obstetric patients can improve their survival.

CONSENT

Thiswasanobservationalstudy. Dataofthepatientswerecollectedfromthefileofthepatients.

ETHICAL APPROVAL

The data collection was started after approval of the institutional ethics committee-**IEC/BU/136/Faculty/1/293/2022**, as it was a prospective and descriptive study, a waiver of consent was requested.

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ABBREVIATION

AKI	Acute Kidney Injury
ANC	Antenal Care
APH	Antepartum Hemorrhage
APTT	Activated Partial Thromboplastin Time
ART	Artificial Reproductive Techniques
ATLS	Advanced Trauma Life Support
CP	Cryoprecipitate
DIC	Disseminated Intravascular Coagulation
FFP	Fresh Frozen Plasma
Hb	Hemoglobin

HDU	High Dependency Units
INR	International Normalized Ratio
IVC	Inferior Vena Cava
LSCS	Lower Segment Cesarean Section
MODS	Multiorgan Dysfunction Syndrome
MOH	Massive Obstetric Hemorrhage
MT	Massive Transfusion
MTP	Massive Transfusion Protocol
OSI	Obstetrics Shock Index
PC	Platelet Concentrate
PCV	Packed Cell Volume
PLT	Platelet
PNC	Postnatal Care
PPH	Postpartum Hemorrhage
PPROM	Preterm Premature Rupture Of Membranes
PROM	Premature Rupture Of Membranes
PT	Prothrombin Time
RBC	Red Blood Concentrates
RCC	Red Cell Concentrate
SI	Shock Index
SR canula	Samarth Ram suction canula
TEG	Thromboelastography
WHO	World Health Organization