Section: Miscellaneous

Original Research Article

AN EVALUATION OF MASSIVE TRANSFUSION PRACTICES AND COAGULATION CHANGES IN MAJOR OBSTETRIC HEMORRHAGE AT A TERTIARY CARE CENTRE

R Manju[1], J Lavanya[2], S.Nithya[3], Varnisha T[4], Rakesh MK[5]

[1]Assistant Professor, Blood Bank, Kalaignar Centenary Super Speciality, India
[2]Assistant Professor, Blood Bank, Kalaignar Centenary Super Speciality, Government hospital, Chennai, Tamil Nadu, India
[3]Consultant- Transfusion Medicine, Iswarya Cancer Centre, OMR, Chennai, Tamil Nadu, India
[4]Assistant Professor, St Peter Medical College and hospital, Tamil Nadu, India
[5]Assistant Professor, Blood Bank, Kanyakumari Government Medical College, Aasaripallam, Tamil Nadu, India

Received *: 10/04/2026*
Received in revised form *: 20/05/2026*
Accepted *: 06/06/2026*

Corresponding Author:
Dr. R Manju,
Assistant Professor, Blood Bank, Kalaignar Centenary Super Speciality, India.
Email: drmanju@gmail.com

DOI: 10.70034/ijmedph.2026.2.550

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (2); 3321-3328

ABSTRACT

Background: Major obstetric hemorrhage is an important cause of maternal mortality and morbidity worldwide. In MOH early recognition, prompt intervention & resuscitation with a multidisciplinary approach is essential. Massive transfusion protocol provides early access to red blood cells, plasma, and platelets for parturients experiencing severe postpartum hemorrhage, which when followed by targeted therapy according to the individual's needs play an important role in preventing coagulopathy. TEG and RCoT together provide a comprehensive overview of the impaired hemostasis, which helps in guiding us to provide appropriate blood components in life-saving obstetric hemorrhage events. The objective is to evaluate the coagulation changes and massive transfusion practices in major obstetric hemorrhage patients.

Materials and Methods: This longitudinal study was conducted over one year (NOVEMBER 2020 to OCTOBER 2021). It includes 46 obstetric patients who developed major obstetric hemorrhage and received massive transfusion at the Institute of Obstetrics and Gynaecology (IOG), Egmore, Chennai, Tamil Nadu. We evaluated the coagulation changes and utilization of blood component packs in Major Obstetric Haemorrhage patients, requiring Massive Transfusions. Analysis of improvements in post-resuscitation hematologic and coagulation indices was done.

Results: In our study, 46 patients had massive transfusions for major obstetric hemorrhage. At the time of activation of massive transfusion protocol, the patients' estimated blood loss was more than 1000 ml and there was an ongoing blood loss or patients were in shock. MTP was activated for 6(13%) referred patients, also for 12(26%) anticipated high-risk parturients and unanticipated parturients 28(60.8%) who were in-patients experiencing MOH. The mean turnaround time of 1st pack was 15 minutes. In our study, the mean calculated blood loss was 2819.4±315ml. Blood component utilization in our study was as follows- mean of PRBC 4.7 units, FFP 6.2 units, platelets (SDP 1 unit and RDP 4.9 units), and cryoprecipitate 6 units. The TEG results in our study with average alpha angle: 38.4±7° and MA: 41±8.3 mm revealed significant hypofibrinogenemia and thrombocytopenia during massive hemorrhage. The mean fibrinogen level during PPH before resuscitation was 142±31.3mg/dl, follow up after 24 hours as 317±25mg/dl. Transfusion practice of PRBC and FFP in the ratio of 1: 1.3 was observed. Surgical intervention was performed in 58.6% of patients. Favorable hematologic and coagulation indices were observed post-resuscitation. Prompt blood component therapy (MT) by

quantification of coagulation parameters, thereby reducing maternal morbidity and improving outcomes.

Conclusion: Major obstetric hemorrhage is a preventable cause of maternal mortality. The adequate availability and easy accessibility of blood components play a vital role in the management of this acute catastrophe. The knowledge of reconstituted blood components in correct proportion and practice of Massive Transfusion Protocol saves the precious life of the mother at the brim of death. Since in a country like India, the demand is always more than supply, adequate and anticipated blood inventory management at blood banks dealing with obstetric care units is crucial. The urgency of care forces every member of the team in massive transfusion protocol to reduce turnaround time as far as possible, even shorter than the expected turnaround time. It is imperative to educate, train and practice every member in MTP at all obstetric care centers across the country to reduce maternal mortality further.

Keywords: Major Obstetric Hemorrhage, Massive Transfusion, Massive Transfusion Protocol, Coagulation changes, TEG, RCoT.

INTRODUCTION

Major obstetric hemorrhage (MOH) is an important cause of maternal mortality and morbidity worldwide. Blood flow to the uterus is around 700ml/min at term and bleeding can be dramatic & rapidly fatal. Morbidity due to MOH has higher long-term complications. Hence in MOH early recognition, prompt intervention & resuscitation is essential. MOH is variously defined as Loss of more than one blood volume within 24 hours (around 70ml/kg, > 5litres in a 70kg adult) 50% blood loss in less than three hours. Risk factors include Postpartum hemorrhage (PPH) especially uterine atony, placenta previa& placental abruption. According to RCOG, PPH can be classified as minor (blood loss of 500-1000ml) or major (more than 1000ml).[1]

Major PPH has been further divided into moderate (1000-2000ml of blood loss) and severe (more than 2000ml of blood loss) Massive transfusion is described as, any obstetric patient receiving >or= 8units RBC transfusion within 24hours, 50% blood volume loss within 3hours transfusion of >or= 4 RBC units within one hour. The balance between coagulation and anticoagulation is vital in pregnant women. In normal pregnancy, the women are in a hypercoagulable state which is important to reduce postpartum hemorrhage and to limit other complications.[1]

The diverse etiology of postpartum hemorrhage, high volumes of reported blood loss, and the high rate of blood product usage suggest that an MTP as an important therapeutic measure for managing anticipated and unanticipated bleeding.2 Massive transfusion protocol provides early access to red blood cells, plasma, and platelets for patients experiencing unanticipated or severe postpartum hemorrhage. The MTP incorporates a structured system wide process for early delivery of sufficient amount and types of blood products from the transfusion service to the obstetric service,[2] Administration of FFP, platelets & cryoprecipitate units along with PRBC plays a key role in MOH as recommended by RCOG Guidelines.[1] Therefore, understanding the coagulopathy of MOH that results in Massive Transfusion (MT) is fundamental in improving outcomes.

Laura Green et al. described the hematological features and transfusion management of women who required massive transfusion for major obstetric hemorrhage in the UK: a population-based study, coagulation changes during MT of MOH differ depending on the cause, median platelet count fell to $<75 \times 10^9$ & median fibrinogen below the normal range in most cases of MOH.[3]

MOH-induced coagulopathy is not a uniform coagulation disorder. Altering the FFP & Packed cell ratio (FFP: PRBC ratio) using TEG and RCot results in significant correction of coagulation, thereby reducing complications. This study will help us to measure the coagulopathic changes in MOH and appropriate utilization of blood components in the management of severe PPH through massive transfusion protocol guidelines.

MATERIALS AND METHODS

This Longitudinal Study was conducted obstetric patients who developed major obstetric hemorrhage and received massive transfusion at the Institute of Obstetrics and Gynaecology (IOG), Egmore, Chennai, TamilNadu. The study was approved by The TN MGR Medical University and Institutional Ethics Committee. Study period was 1 year (NOVEMBER 2020- OCTOBER 2021)

Inclusion Criteria

The study includes obstetric patients with either singleton or multiple pregnancies, ≥24 weeks gestation who had an ongoing PPH (blood loss >500 mL vaginal delivery, or >1000 mL for cesarean delivery) occurring in the first 24 hours after delivery and requiring an assessment of coagulation, who also require massive transfusion support and massive transfusion protocol activation.

Exclusion Criteria

Exclusion criteria were patients with inherited or drug-acquired coagulopathy, pre-existing medical disease conditions like heart disease at the time of

delivery, and those mothers requiring single-unit transfusions of PRBCS, and those who are not willing to participate in the study.

Sample Size: It includes 46 patients (n= 46) with major obstetric hemorrhage and who received massive transfusion during the study period at (IOG), Egmore, Chennai.

Data Collection: After getting the informed consent from the patients, qualitative variables and clinical history were collected from the patient‘s In-Patient records and antenatal check- up notebooks, and complications that arise due to pregnancy were obtained from the Institute of Obstetrics and Gynaecology, Egmore, Chennai.

Methodology: Complete information of the patients which includes name, age, weight, the IP number of the patient, Blood Pressure measurement, risk factors, predelivery hemoglobin, hematocrit, blood grouping typing, treatment history will be obtained from the patient’s In-Patient record, and patients antenatal check-up notebook.

According to RCOG guidelines when blood loss is greater than 1000ml with continuing obstetric hemorrhage or the patient is in shock, MTP is activated. Call for help, Blood bank informed of MTP, Vital signs monitored, identifying the cause of bleeding, collecting blood samples for CBC & coagulation parameters, TEG, arrest blood loss by uterotonics, antifibrinolytics, surgical intervention & resuscitation by transfusion of appropriate blood components simultaneously will be done. Our study Evaluation is Based on RCOG standardized model (RCOG Green-top Guideline No 52).

The Massive Transfusion Protocol [MTP] framed by the institution is based on RCOG guidelines.

In our study indication for massive transfusion protocol activation was based on blood loss >1000 ml with patients currently bleeding & at risk for uncontrollable bleeding or in Shock.

Clinicians do not wait for the shock to manifest in majority/ Activate MTP — call (Additional Obstetrician, Nursing staff, Anaesthetist, blood bank, laboratory) proceeded with obstetric emergency blood ordering of transfusion packs.

Blood samples collected and Stat lab tests before transfusion were sent with an obstetric emergency label for Cross Match, CBC, RCOT, additional tests, and TEG. Meanwhile, medical management with drugs and warm crystalloids or colloids are infused. Oxygen on flow. Minimum two IV access with 14G or 16G cannula secured.

Minimum of One to two MTP packs of PRBC: FFP: Platelets are received within 10-15 min due to near vicinity of the blood bank, labor ward, ICU, and OT. Give 1-2 units O-negative PRBCs if group not known or Group-specific uncross matched PRBCs. For elective LSCS and anticipated high risk for bleeding patients Cross matched blood if available. Transfuse blood components as soon as possible.

Blood components transfused in the same order as PRBCs followed by FFP and Platelets, as fast as even 5 to 10 min depending on the rate of ongoing bleeding through a 14G or 16G cannula and nursing the patient warm using appropriate available measures. Monitor vitals.

Meanwhile, TEG tracing results start appearing which guides us further in targeted treatment with blood components of second and third packs especially FFP, Cryoprecipitate, and Platelets.

CBC and RCOT values are received, with which we can estimate approximately the blood loss and Coagulopathy. Monitor temperature, Spo2, PR, RR, BP, and Urine output.

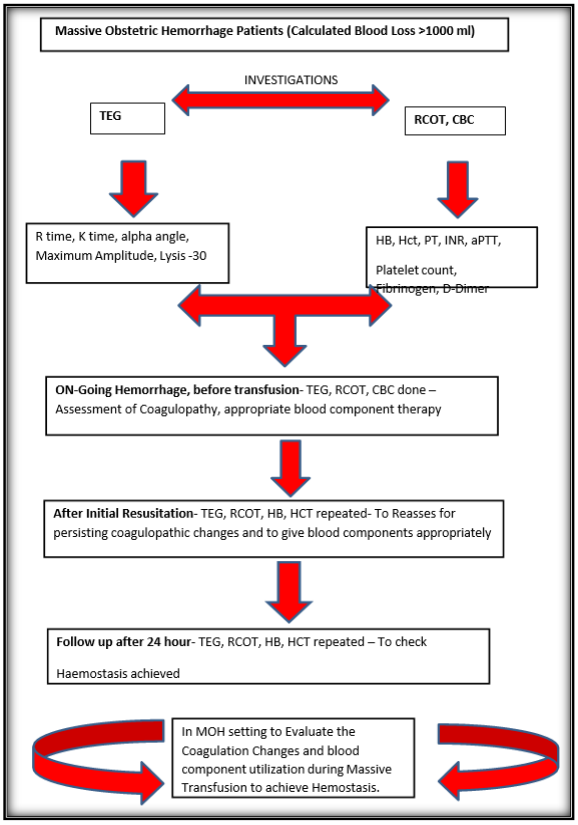
Meanwhile necessary cross-matched group-specific units are received and transfused, steps to initiate surgical intervention are initiated. Recording of vital parameters on a flow chart.

If bleeding is not controlled with drugs, manoeuvres, and appropriate blood components, then surgical intervention is performed.

After initial resuscitation, reassessing the amount of bleeding and necessary blood components transfused, especially FFP, cryoprecipitate, and platelets are given, if necessary, based on repeat CBC,TEG and RCOT values. Consider shifting patient to ICU after initial resuscitation.

The common goals for massive transfusion are to achieve Haemoglobin >7 g/dl, Platelet count >75 × 109/l, PT and aPTT<1.5 × mean control, and Fibrinogen> 2.0 g/l. Finally, Massive transfusion is stopped when hemostasis is achieved and clinical improvement.

Vitals stabilized and haemostasis achieved. Improvements in post-resuscitation hematologic and coagulation indices are assessed 24 hours after massive transfusion.



Statistical Analysis: The collected data were analyzed with IBM SPSS Statistics for Windows, Version 23.0. (Armonk, NY: IBM Corp). To describe the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables, and the mean & S.D were used for continuous variables. To find the significant difference in the bivariate samples in Paired groups the Paired sample t-test was used. In multivariate analysis for repeated measures, the Repeated measures of ANOVA was used with Bonferroni correction to control the type I error on multiple comparisons. To assess the relationship between the variables Pearson's Correlation was used. In all the above statistical tools the probability value .05 is considered a significant level.

RESULTS

In our study, on evaluation of massive transfusion practices and coagulation changes in major obstetric hemorrhage, 46 patients had a massive transfusion. The Massive Transfusion Protocol framed by the institution based on RCOG guidelines was followed to evaluate the objectives of our study. At the time of activation of massive transfusion protocol, the patients' estimated blood loss was more than 1000 ml and there was an ongoing blood loss or in shock. The patients were received in the labor ward and shifted to the obstetric emergency care unit either directly or from the Operation Theatre or labor room depending on the time of onset of massive hemorrhage. To control the bleeding and replace the lost blood components, the obstetricians along with medical management, simultaneously initiate steps to intervene surgically and activate massive transfusion protocol.

As per the need and institution protocol, the blood bank will always keep one MTP pack which consists of one unit each of FFP, Platelet Concentrate and Cryoprecipitate from AB Blood Group along with 1-2 units of O Rh D negative PRBC ready, for immediate transfusion within 5 to 10 minutes. Meanwhile, the blood samples received from the patient will be processed for issuing group compatible cross matched blood components from the 2nd MTP pack onwards based on RCoT & TEG values within 45 minutes to 1 hour. If condition warrants within 45 minutes another MTP pack consists of blood components as that of 1st pack will be issued.

In the present study,46 antenatal mothers had to undergo Massive Transfusion during the Peripartum period due to Major Obstetric Hemorrhage.

The age distribution of cases varied from 19-37 years. The peak incidence of MOH in our study was between 26 and 30 years (39.1%) followed by 21-25 years (28.3%).

Table 1: Comparison of Estimated Blood Loss/Total Volume Transfused by Paired sample t- test

	N	Mean(ml)	SD(ml)	Mean Difference	t-value	p-value
Estimated Blood Loss	46	2819.41	315.12	53.8	2.081	0.043 *
Total Volume Transfused	46	2873.26	375.13			
* Significant at p < 0.05 level						

The above table shows Comparison of Estimated Blood Loss/ Total Volume Transfused by Paired sample t-test where the t-value=2.081, p-value=0.043<0.05 which shows less Statistical difference between Estimated Blood Loss/ Total Volume.

Table 2: Descriptive Statistics of TEG and RCOT - Before Transfusion

Descriptive Statistics					
Before Transfusion	**N**	**Minimum**	**Maximum**	**Mean**	**SD**
HB	46	3.7	5.2	4.44	.42
Hct %	46	11.2	16.3	13.68	1.19
R TIME	46	10.2	27.7	16.24	4.66
K TIME	46	5.2	17.2	9.82	2.92
ANGLE	46	21.6	59.6	38.38	6.99
MA	46	26.1	61.1	41.19	8.34
LY30	46	1.0	26.0	7.49	7.26
PC	46	26000.0	74500.0	44510.8	9546.66
PT	46	14.0	37.0	26.4	5.36
PT INR	46	1.30	18.00	2.0	2.42
APTT	46	38.0	76.0	53.04	8.37
FIBRINOGEN	46	101.0	226.0	141.82	31.27
D-DIMER	46	.10	1.90	.79	.67

Table 3: Descriptive Statistics of TEG and RCOT After Initial Resuscitation

Descriptive Statistics					
After Initial Resuscitation	**N**	**Minimum**	**Maximum**	**Mean**	**SD**
HB	46	4.5	6.9	5.61	.67
Hct %	46	13.5	21.0	17.38	1.85
R TIME	46	8.1	18.5	10.98	1.78
K TIME	46	3.6	11.9	5.91	1.73
ANGLE	46	34.4	67.4	49.49	7.60

MA	46	34.2	81.6	57.46	9.70
LY30	46	0.0	14.0	3.07	3.39
PC	46	39000	99500	63956.5	14895.4
PT	46	14.0	27.0	18.69	3.17
PT INR	46	1.1	1.6	1.3	.1208
APTT	46	31.0	52.0	41.91	5.27
FIBRINOGEN	46	124.0	289.0	199.78	32.35
D-DIMER	46	.10	1.30	.34	.271

Table 4: Descriptive Statistics of TEG and RCOT after 24 hours of transfusion

Descriptive Statistics					
After 24 hours	**N**	**Minimum**	**Maximum**	**Mean**	**SD**
HB	46	6.8	8.4	7.32	.3683
Hct %	46	18.8	25.8	22.2	1.4
R TIME	46	4.1	9.7	7.2	1.4
K TIME	46	1.1	4.9	2.4	.92
ANGLE	46	46.70	75.10	62.8	5.2
MA	46	44.5	79.2	68.37	6.6
LY30	46	0.0	4.5	1.035	1.0
PC	46	62500	136500	103358	21955.6
PT	46	10.0	16.5	12.9	1.6
PT INR	46	.9	1.2	1.0	.08
APTT	46	27.0	39.0	32.4	3.1
FIBRINOGEN	46	249.0	364.0	316.6	25.1
D-DIMER	46	.10	1.00	.20	.14

Table 5: Correlations of R Time, K Time, Angle, MA, LY30- at Before Transfusion

Correlations							
Before transfusion		**PC**	**PT**	**PT INR**	**APTT**	**Fibrinogen**	**D-DIMER**
R Time	r-value	-.306*	.494**	.154	.248	-.091	.534**
	p-value	.038	.0005	.306	.096	.547	.0005
K Time	r-value	-.337*	.551**	.001	.364*	-.214	.553**
	p-value	.022	.0005	.997	.013	.153	.000
Angle	r-value	.319*	-.449**	-.039	-.338*	.709**	-.465**
	p-value	.031	.002	.796	.022	.0005	.001
MA	r-value	.731**	-.057	-.016	-.164	.015	-.343*
	p-value	.000	.707	.916	.276	.920	.019
LY30	r-value	-.404**	.319*	-.051	.491**	-.250	.716**
	p-value	.005	.030	.737	.001	.094	.0005
# No Statistical Significance at p > 0.05, * Statistical Significant at p<0.05, ** Highly Significant at p < 0.01							

The above table shows Correlations of R Time, K Time, Angle, MA, LY30- at Before Transfusion.

Table 6: Correlations of R Time, K Time, Angle, MA, LY30- at After initial resuscitation

Correlations							
After initial resuscitation		**PC**	**PT**	**PT INR**	**APTT**	**Fibrinogen**	**D-DIMER**
R Time	r-value	-.311*	.497**	.265	.438**	-.101	.313*
	p-value	.035	.0005	.075	.002	.504	.034
K Time	r-value	-.394**	.461**	.331*	.402**	-.330*	.285
	p-value	.007	.001	.025	.006	.025	.055
Angle	r-value	.402**	-.128	-.188	-.206	.460**	-.355*
	p-value	.006	.397	.211	.169	.001	.015
MA	r-value	.709**	-.017	.009	-.076	.192	-.241
	p-value	.000	.909	.951	.616	.201	.107
LY30	r-value	-.340*	.253	.085	.367*	-.366*	.735**
	p-value	.021	.089	.573	.012	.012	.0005
# No Statistical Significance at p > 0.05, * Statistical Significant at p<0.05, ** Highly Significant at p < 0.01							

Table 7: Correlations of R Time, K Time, Angle, MA, LY30- at Follow up at 24 hours after transfusion

Correlations							
Follow up at 24 hours after transfusion		**PC**	**PT**	**PT INR**	**APTT**	**Fibrinogen**	**D-DIMER**
R Time	r-value	-.283	.470**	.214	.421**	-.530**	.120
	p-value	.057	.001	.153	.004	.0005	.427
K Time	r-value	-.453**	.529**	.247	.496**	-.522**	.303*
	p-value	.002	.0005	.099	.000	.0005	.041
Angle	r-value	.319*	-.453**	-.028	-.536**	.431**	-.261
	p-value	.031	.002	.854	.0005	.003	.080
MA	r-value	.594**	-.323*	-.067	-.174	.534**	-.070
	p-value	.0005	.029	.660	.247	.0005	.645

LY30	r-value	-.506**	.418**	.283	.361*	-.200	.300*
	p-value	.0005	.004	.056	.014	.183	.043
# No Statistical Significance at p > 0.05, * Statistical Significant at p<0.05, ** Highly Significant at p < 0.01							

The above table shows the Correlations of R Time, K Time, Angle, MA, LY30- at Follow up at 24 hours after transfusion.

DISCUSSION

In a study by Goodnough et al, access to the MTP improves lines of communication for ordering and transportation of blood products from the transfusion services department to the labor and delivery unit. It warrants the ongoing availability of blood products in hemorrhagic parturients until surgical and hemostatic control of bleeding has been achieved. The transfusion services department of their institution will issue a pack containing MTP blood products to a courier within 5–10 minutes of receiving the verbal order.[4]

The age distribution of cases correlated well with the study done by Rajeshwari, Sreelatha S, et al,[5] in India where the incidence of PPH seen commonly in patients of age group 25 to 29 years (44.3%) followed by 20- 24 years (31.6%).

In our study, the incidence of MOH in primigravida is 47.8% as against 52.2% of multigravida. In another comparable study by Shaffi et al., 147 (49.2%) and 152 (50.8%) were primigravidas and multigravida respectively.122 In another study by Shailesh B. Patil et al parity distribution was 54.3% in primi & 45.7% in multi in PPH group.[6]

In the present study, the Mode of Delivery distribution was 34.8% is LSCS, 65.2% is NVD, equivalent to another study by Sailesh B Patil et al,[6] where NVD is 60% and LSCS in 40% of patients. In our study the Blood Group distribution was 23.9% is A, 8.7% is AB, 34.8% is B, 32.6% is O and the RH Typing distribution was 95.7% is Rh-Positive, 4.4% is Rh-Negative. Our results are comparable to another south Indian study by Sesahsai et al, with the Blood Group distribution observed as 22.4% is A, 4.2% is AB, 31.6% is B, 37% is O and 5.6% were Rh-negative.[7]

Among our study population, 6 patients referred from other peripheral centers with retained placenta and ongoing bleeding, the MTP protocol was activated within 5 to 10 minutes and started transfusion of blood components from the 1st pack within 15 minutes in the order of PRBCs, FFP, Platelets followed by cryoprecipitate. For 4 patients another pack of components like 1st pack was transfused within 45 minutes. The crossmatched packs were issued and transfused twice in all 6 patients. Simultaneous manual removal of retained placentae for all 6 patients along with uterine artery ligation in 2 patients was done and the patients were stabilized. The turnaround time of 1st pack was 15-20 minutes. Within the Stanford Transfusion Service, turnaround times for cross-matched RBC take longer than for O-negative uncross-matched RBC (approximately more than 15 min versus 5–10 min), as studied by Gutierrez et al.[2]

The RCoT and TEG values were deranged at the time of admission and gradually corrected as the patients were stabilized. In patients who develop severe postpartum hemorrhage, Charbit et al, reported that early changes in the coagulation profile occur during the early period of blood loss, including decreased fibrinogen, factor V, and increased PT and thrombin–antithrombin levels.[8]

40 of the 46 patients in our study were admitted to our institution for delivery. For 12 of the 40 patients, excess bleeding was anticipated because of the pre-existing precipitation factors. The group compatible components were kept ready for these patients. Based on clinical signs and symptoms following hemorrhage, the MTP protocol was activated within 5 minutes for these patients. The transfusion of 1st pack of cross-matched components started within 8 to 15 minutes in these patients. This was similar to a study by Laura Green et al, where a median of 15 minutes was noted as the timing of the first RBC transfusion in MOH for those who delivered electively.

The number of MTP and cross-matched packs ranging from 4 to 7. Along with surgical and other modalities of treatment the patients were stabilized. 3 of these patients needed more than 4 MTP packs because of ongoing hemorrhage and uncorrected RCoT & TEG value. For 1 of these 3 patients, there was a difficulty in inventory management as number packs were more than 4 and the patient belonged to the AB blood group. A similar study by Gutierrez et al, acknowledges that the transfusion of pre-ordered cross-matched RBC has advantages in reducing utilization of O-negative RBC inventory.[2] In the above-mentioned study, most (12/13) of their patients who underwent a pre-delivery- type and crossmatch and MTP activation were subsequently transfused with cross-matched and MTP blood products.

The remaining 28 of the 40 patients, the massive hemorrhage was unanticipated. 23 of them had severe PPH due to uterine atony and the rest 5 of them had traumatic PPH. The timing of MTP activation varied from 15 min to 4 hours post-delivery. In a similar study by Gutierrez et al, the timing of the initial transfusion of MTP products varied in the postpartum period with 31% of their patients receiving MTP products between 2 and 24 h post-delivery.[2] As the timing of postpartum hemorrhage presentation may vary, MTP protocols should be in place not just in the labor and delivery unit but all other hospital locations providing care for postpartum in-patients.

Among the 23 patients, 17 were multigravida, and the remaining were primi. Since the bleeding was unanticipated, sudden onset, and profuse, the MTP

had to be activated immediately from the labor room, ward, or Operation Theatre. The IOG blood bank catering exclusively for the institute of obstetrics does expect such cases and is prepared to face the situation by better inventory management, Hence, the obstetricians started uncross matched components from 1st pack within 10 minutes. To manage acute bleeding for 12 of these patients' 2nd pack of uncross matched blood components were transfused within 45 minutes, which is followed by crossmatched blood component packs.

The number of MTP and crossmatched packs vary from 4 to 8 with 3 patients with more than 5 packs of transfusion, one patient belonged to B Rh D negative blood group; there was difficulty in arranging group identical crossmatched blood components for her. McClain et al state the process of obtaining RBC and other blood products for emergent transfusion in the management of severe, unanticipated obstetric hemorrhage can be logistically challenging and time-consuming.[9]

The 46 patients requiring massive transfusion had diverse etiology with uterine atony 50% found to be most common. It is followed by 13.0% is Retained Placenta and 13.0% Pre-eclampsia, traumatic PPH 10.9% and trailed by 8.7% Abruptio Placenta, 2.2% Placenta Accreta and 2.2% Placenta Previa.

In our study, we identified placental problems (retained placental tissue and abnormal placentation) that has caused more than 25% of severe PPH. 15.3% abnormal placentation and retained placenta 13%. Furthermore, abnormal placentation may have been present for some cases diagnosed as retained placenta. Since IOG being a tertiary care center catering exclusively for obstetrics and gynecology majority of high-risk mothers are referred here for better patient management. Therefore assessing risk factors associated with obstetric hemorrhage is crucial.

The risk of atonic uterine hemorrhage increased rapidly with increasing BMI. There was a twofold increased risk of obesity. The risk for receiving blood transfusions increased markedly with increasing maternal BMI. Marie Blomberg, Sebire et al studied pregnancy outcomes among 31,276 obese women (BMI 30 or more) and found an increased risk of major postpartum hemorrhage (OR 1.16, 99% CI 1.12 – 1.21).10 In our study mothers with BMI of 18.5 to 24.9 were 10.9%, 25-29.5 were 65.2% and BMI more than 30 were 6.5%. Average Estimated Blood loss in our study is2667.5 ± 170ml, 2868 ± 339ml and 2991.7ml respectively in each BMI group, and Total transfused volume was 2697.7 ± 207ml, 2922.7 ± 401ml, 3140 ± 475ml. This shows the progressive increase in estimated blood loss and transfused volume with increasing BMI. It is important to assess the blood loss as a proportion of patients' blood volume. Since small women have small blood volume and proportionate blood loss.

The knowledge of the calculated blood loss is important to the obstetric community. Hct is important to continue hemodynamic resuscitation and prevent the morbidities associated with under-resuscitation as in the study by Hernandez et al,[11] In our study the mean calculated blood loss 2819.4±315ml, which almost equates to the total Transfused volume 2873.2±375ml. A strong correlation between estimated blood loss (EBL) with the total number of RBC units transfused from the MTP and the mean estimated blood loss was 2842 ml in a similar study by M. C.Gutierrez et al.

TEG variables reflecting clot stability were decreased in women with massive obstetric hemorrhage and Laboratory analyses for RCoT also showed impaired hemostasis, but TEG provided results faster for earlier intervention which is similar to a study done by Karlsson et al.[12] The statistical analysis shows Positive correlation between RCoT and TEG values as follows: PT, aPTT and R time, Aptt and K time, Fibrinogen and Angle, Platelet count and Maximum Amplitude, LY30 and D-Dimer similar to the study by Karlsson et al.

The plasma components used were mainly based on R Time, K Time, α angle, MA, and LY30 values. In 46 cases, FFP was used in 45(97.8%) cases to correct R time and K time. Cryoprecipitate was used in 39(84.8%) cases to correct alpha(α) angle, Platelet Concentrates RDP was used in 39(84.8%) cases and SDP was used in 7(15.2%) to correct platelet counts and MA based on TEG results. These results provide useful information with regards to the progression of hemostatic changes during Major obstetric hemorrhage.

During PPH, when coagulation assessment is indicated, TEG provides rapid and reliable detection of hypofibrinogenemia ≤2 g/L corresponding to decrease in α angle and thrombocytopenia≤80,000/mm3 corresponding to decrease in MA which is helpful for the appropriate blood component utilization which is highlighted in the study done by Agnes Rigouzzo, MD et al.[13] In her study during MOH the parameters K-Angle, K-MA of the Kaolin assay were significantly lower in the blood samples with a hypofibrinogenemia and/or a thrombocytopenia K-Angle: 49.2° [13.1°]; K- MA: 40.5 mm [23.5 mm] equivalent to the results in our study with average TEG angle: 38.4±7° and MA: 41±8.3 mm.

The fibrinogen level at the time of diagnosis of PPH can be used to guide the management of PPH. When it is below 2 g/L, clinicians should be aware that there is a high risk of severe bleeding. This is particularly useful because the fibrinogen concentration is determined by a simple assay that is available in most institutions on an emergency basis and the risk for severe PPH was 2.63-fold higher for each 1 g/L decrease of fibrinogen. Corresponding to this finding, in our study, we found the mean fibrinogen level during PPH before resuscitation as 142±31.3mg/dl, follow up after 24 hours 317±25mg/dl.B. CHARBIT et al calculated the negative predictive value of a fibrinogen concentration >4 gL was 79% and the positive predictive value of a concentration <2 gL was 100% in severe PPH mothers. Thus, they

concluded that the decrease of fibrinogen is an early predictor of the severity of postpartum hemorrhage.[8] Of the 46 MOH patients, 11 (26%) had an LY30 of 3% or greater, and 14 (6.8%) had an LY30 of 7.5% or greater in our study and there was positive correlation between D-Dimer and Lysis 30 levels. Evident hemorrhage or surgical oozing increases the clinician's index of suspicion of an impending massive transfusion requirement when applying the LY30 parameter as a predictive test. Fibrinolysis greater than 3% is the critical value for initiation of antifibrinolytic therapy in a study by Michael P. Chapman et al. The WOMAN Trial (World Maternal Antifibrinolytic Trial): recommends tranexamic acid for the treatment of postpartum hemorrhage. In our study 16 (34.8%) patients had received Injection Trapic especially when Lysis 30 of TEG was greater than 7.5%.

In a study by Shiffi Fazal et al, in an MOH setting where appropriate supplementation of coagulation factors is essential, the transfusion practice of PRBC and FFP in the ratio of 1: 1.4 –2 was observed in their institution. Similarly, the transfusion practice of PRBC and FFP in the ratio of 1: 1.3 was observed in our study.

The total ratios of transfused packed red blood cell and FFP/ cryoprecipitate and platelet units varied from the initial infusion ratio of 1:1:1, due to progressive resuscitation with blood components guided by TEG and RCOT, resulting in favorable maternal outcomes. When rapid laboratory investigation of hematologic and clotting parameters along with POCT like TEG are available, careful use of this information may facilitate safe modification of an initial fixed transfusion ratio based on the etiology of the hemorrhage and individual patient response. Mean (SD) post-resuscitation hematologic indices were: hemoglobin 10.3 (2.4) g/dL, platelet count 126 (44) · 109 /L, and fibrinogen 325 (125) mg/dL in a study by M.C. Gutierrez et al., however in our study we observed post-resuscitation hemoglobin 7.3 (0.4) g/dL, platelet count 103(21) · 109 /L, and fibrinogen 316 (25) mg/dL.

In our study transfusion reactions were reported in 5 patients. Transfusion might be a lifesaving procedure but is not without risk. In our study majority of transfusion reactions were observed in patients receiving a higher number of blood components.

Treating Obstetricians and direct care nurses responsible for understanding the possible complications of massive transfusion and act quickly to recognize reactions at the bedside. This vital step helps ensure appropriate treatment and prompt reporting to the blood center for investigating the transfusion reactions and strengthening hemovigilance.

CONCLUSION

Major obstetric hemorrhage is a preventable cause of maternal mortality. The adequate availability and easy accessibility of blood components play a vital role in the management of this acute catastrophe. The knowledge of reconstituted blood components in correct proportion and practice of Massive Transfusion Protocol saves the precious life of the mother at the brim of death. Since in a country like India, the demand is always more than supply, adequate and anticipated blood inventory management in blood banks of obstetric care units is crucial. The urgency of care forces every member of the team in massive transfusion protocol to reduce turnaround time as far as possible, even shorter than the expected turnaround time. It is imperative to educate, train and practice every member of MTP in all obstetric care centres across the country to reduce maternal mortality further.

REFERENCES

1. Mavrides E, Allard S, Chandraharan E, Collins P, Green L, Hunt BJ, Riris S, Thomson AJ on behalf of the Royal College of Obstetricians and Gynaecologists. Prevention and management of postpartum haemorrhage. BJOG 2016;124:e106–e149.
2. Postpartum hemorrhage treated with a massive transfusion protocol at a tertiary obstetric center: a retrospective study M.C. Gutierrez, L.T. Goodnough,b M. Druzin,c A.J. Butwick, Stanford University School of Medicine, Stanford, CA, USAInternationalJournalofObstetricAnesthesia(2012)21,. http://dx.doi.org/10.1016/j.ijoa.2012.03.
3. Laura Green , Marian Knight , Frances Seeney.The haematological features and transfusion management of women who required massive transfusion for major obstetric haemorrhage in the UK: a population based study.British Journal of Haematology. 2016 Feb;172(4):616-24. doi: 10.1111/bjh.13864. Epub 2015 Dec 18.
4. Goodnough LT, Daniels K, Wong AE, et al. How we treat: transfusion medicine support of obstetric services. Transfusion. 2011; 51:2540–2548.
5. Rajeshwari, Sreelatha S, Shruthi K, Kumar S, Shruthi A, Malpurae P. A study on risk factors of post partumhemorrhage. The New Indian Journal of OBGYN. 2020; 6(2): 83-6
6. Shailesh B Patil & Milind B. Patil / Study of Prevalence and Risk Factors Associated with Obstetrics Haemorrhage,Indian Journal of Obstetrics and Gynecology Vol 6 Number 1, January - February2018
7. Blood transfusion in obstetric practice and outcome. Dr.T.Seshasai Professor OBG,R.Radharani Apollo Institute of Medical Sciences and Research, Chittoor, India.Volume-7| Issue-9 | September-2017 | ISSN - 2249-555X | IF : 4.894
8. B Charbit , L Mandelbrot, E Samain, G Baron, B Haddaoui, H Keita, O Sibony, The decrease of fibrinogen is an early predictor of the severity of postpartum hemorrhage.JThrombHaemost. 2007Feb;5(2):266-73.
9. McClain CM, Hughes J, Andrews JC, et al. Blood ordering from the operating room: turnaround time as a quality indicator. Transfusion. 2013; 53:41–48.
10. Maternal Obesity and Risk of Postpartum Hemorrhage Marie Blomberg, MD, PhD (ObstetGynecol 2011;118:561–8).
11. Hernandez JS, Alexander JM, Sarode R, et al: Calculated blood loss in severe obstetric hemorrhage and its relation to body mass index. Am J Perinatol 29(7):557, 2012
12. O. Karlsson,a A. Jeppsson,b M. Hellgrenc. Major obstetric haemorrhage: monitoring with thromboelastography, laboratory analyses or both? International Journal of Obstetric Anesthesia (2014) 23, 10–17 0959-289.samama CM, Ozier Y. Near-patient testing of haemostasis in the operating theatre: an approach to appropriate use of blood in surgery. Vox sanguinis. 2003;84(4):251-5
13. Rigouzzo, Agnes MD*; Louvet, Nicolas MD*; Favier, Rémi MD†; Ore, Marie- VirginieMD*;Assessment of Coagulation by Thromboelastography During Ongoing Postpartum Hemorrhage: A Retrospective Cohort Analysis. Anesthesia& Analgesia: February 2020 - Volume 130 - Issue 2 - p 416-425.