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Any changes in recent massive transfusion practices in a tertiary level institution?☆

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ABSTRACT

Background & objectives: A previous review of transfusion practices in our institution between 1998 and 2008 showed a trend of high ratios of red cells (RC) to plasma (FFP) and platelets to RC towards the later years of review period. The aim of the study was to further evaluate transfusion practices in the form of blood product usage and outcomes following massive transfusion (MT)

Methods: All adult patients with critical bleeding who received a MT (defined as ≥10 units of RC in 24 h) in 2008 and between January 2010 and December 2014 were identified. Blood and blood products transfused, in-hospital mortality, 24 h and 90-day mortality were analysed for the period 2010–2014. Blood and blood product usage, massive transfusion protocol (MTP) activation and use of ROTEM between 2008 and 2014 were compared.

Results: A total of 190 MT including surgical (52.1%), gastro-intestinal bleeding (25.3%), trauma (11.6%) and obstetric haemorrhage (5.8%) episodes were identified between 2010 and 2014. The overall in-hospital mortality was 26.7% with a significant difference in 24 h ($p = 0.04$) and 90-day mortality ($p = 0.02$) between diagnostic groups. Comparing 2008 ($n = 33$) and 2014 ($n = 23$), there was no significant difference in median RC, FFP and platelet units, cryoprecipitate doses and RC:FFP ratio; however there was an increase in number of patients who used cryoprecipitate (54.5% vs 87%, $p = 0.01$).

Conclusion: Aligned with haemostatic resuscitation, the trend continues in the form of increased use of plasma and higher RC:FFP transfusion ratios including an increase in number of patients receiving cryoprecipitate.

1. Introduction

Massive haemorrhage remains a major cause of mortality in massively bleeding patients. Anticipating haemorrhage, managing coagulopathy and guiding transfusion is critical to managing massive haemorrhage. Advances in resuscitation using the concept of damage control, use of scoring systems to predict MT, early replacement of coagulation factors and improved laboratory testing have improved outcomes.

The key findings from the initial review of massive transfusion practices in our institution between 1998 and 2006 were (a) one third of the patients were coagulopathic at the start of MT episode; (b) significant differences in laboratory parameters and transfusion practices between pre-Intensive Care (ICU) and ICU phase of MT episode; (c) MT patients with early deaths were coagulopathic at the start and on ICU admission and did not correct coagulopathy [1]. This led to the implementation of MTP in our institution in 2008. When transfusion practices were reviewed between 1998 and 2008, there was a trend towards early and aggressive resuscitation to correct coagulopathy based on the use of high ratios of plasma to RC (1:1 or 1:1.2) and platelets to RC (1:1 or 1:2) including the use of haemostatic agents (recombinant factor VIIa), thawed plasma and prothrombinex-VF during the latter part of the review period [2].

Haemostatic resuscitation consists of early delivery of coagulation therapy (plasma and platelet transfusion) as a part of a massive haemorrhage protocol combined with permissive hypotension and early haemostatic control [3]. Haemostatic resuscitation of patients with massive haemorrhage has shifted towards earlier administration of higher ratios of plasma and platelets to RCs [4,5]. In addition to the ratios of blood products, fibrinogen containing products in the form of fibrinogen concentrate and cryoprecipitate and anti-fibrinolytic agents such as tranexamic acid are being used increasingly in trauma and non-trauma resuscitation. A recent

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study found that a high platelet or plasma to RC ratio, and use of tranexamic acid were associated with a decreased need for MT and increased survival in injured patients with bleeding [6].

The objective of this study was to further evaluate recent transfusion practices in the form of blood and blood product usage and outcomes following MT in our institution after 2008. We hypothesised that the use of MTP and ROTEM would lead to changes in blood product use in MT patients.

2. Methods

A retrospective study of patients from Flinders Medical Centre, a 560 bed tertiary care hospital and trauma and liver transplant centre was undertaken. All adult patients with critical bleeding who received a MT (defined as ≥10 units of RC in 24 h) in 2008 and between January 2010 and December 2014 were identified. Blood and blood products transfused, in-hospital mortality, 24 h and 90-day mortality were analysed for the period 2010–014. Blood and blood product usage, MTP activation and use of ROTEM between 2008 and 2014 were compared.

2.1. Transfusion practice

Issue of blood products by the transfusion laboratory was performed through locally implemented MTP. Upon activation of the massive transfusion response, and if the patient's blood group were not known, 5 units of blood O Rh negative RC, 4 units of blood group AB thawed FFP and 1 unit of apheresis or pooled platelets were sent to the patient's location in an appropriate transport shipper. The transfusion laboratory continued to prepare pre-designed massive transfusion packs with addition of cryoprecipitate in the second pack. All blood components met Australian specifications including leucodepletion. Plasma was thawed and issued to order. In cases where plasma was not used it was returned to stock and stored at 4 °C for 5 days from thawing. Emergency group A plasma was not used during the review period for non-group A patients. A standard dose of cryoprecipitate was defined as 10 units of whole blood cryoprecipitate or five units of apheresis cryoprecipitate

Coagulation management was guided by laboratory tests including haemoglobin level, platelet count, international normalised ratio (INR), partial thromboplastin time (APTT), fibrinogen and ROTEM. ROTEM when implemented in 2010 in our institution was used for monitoring coagulation and transfusion of blood products mainly for patients undergoing liver transplantation. Over time ROTEM was used in other clinical groups. Transfusion of FFP, platelets or cryoprecipitate based on a pre-defined ROTEM algorithm was not a part of MTP rather replacement was based on the ROTEM results and at the clinician's discretion.

In the initial years of review period where only MTP was used, RC, plasma and platelets were transfused empirically during the MT episode. In the latter years, with the use of MTP and ROTEM it was a combination of empirical transfusion and ROTEM based transfusion. The transfusion threshold for blood products using ROTEM was – If EXTEM CT was >100, FFP was transfused. If EXTEM MCF >20–<45 and FIBTEM MCF >8, platelets were transfused. If EXTEM MCF >20–<45 and FIBTEM MCF <8 cryoprecipitate was transfused. If EXTEM MCF was <20 and FIBTEM MCF <8, both cryoprecipitate and platelets were transfused.

2.2. Data collection

Data collected included blood and blood product use, patient demographics, in-hospital mortality, and ICU and hospital length of stay (LOS). Blood and blood products transfused, in-hospital mortality, 24-h and 90-day mortality were analysed for the period 2010–2014. Since the previous review of MT included the year 2008 we compared blood and blood product usage, MTP activation and use of ROTEM between 2008 and 2014 were compared.

2.3. Statistics

Continuous data were presented as medians and interquartile ranges (IQRs). Continuous variables between the groups were compared with the Mann–Whitney test and categorical variables were compared with Pearson's Chi-square. p values <0.05 were considered statistically significant. All statistical analyses were undertaken using the Statistical Package for Social Sciences 20.0.

3. Results

A total of 190 MT episodes were identified during 2010–2014. The main causes of MT included gastro-intestinal haemorrhage (GIB) (48/190, 25.3%), trauma (22/190, 11.6%), cardiothoracic surgery (29/190, 15.3%) followed by other surgery (29/190, 15.3%), liver transplant/surgery (23/190, 12.1%), vascular surgery (18/190, 9.5%), obstetric haemorrhage (11/190, 5.8%), medical/other (10/190, 5.3%). Patients had a median age of 60 (IQR 45–73) and 62% were males. Eighty five per cent of patients were admitted into ICU with a median LOS of 82 (IQR 19–262) hours. The median length of hospital stay and intensive care stay was 18 (7–35) days and 99 (38–325) hours respectively.

Overall, patients received a median of 13 (IQR 11–18) units of RC, 10 (IQR 7–14) units of FFP, 3 (IQR 2–4) units of platelets, 1 (IQR 0–3) dose of cryoprecipitate during 24 h of MT and 1:1.4 (IQR 1:1.6–1:1.8) FFP: RC ratio. A small proportion of patients also received Prothrombinex VF (11%) and recombinant factor VIIa (4.2%). There was no difference in blood and blood product usage between the different clinical groups except the use of platelets ($p = 0.01$) as summarised in Table 1. There was a trend towards higher use of cryoprecipitate ($p = 0.05$) mainly in the liver surgery and vascular surgery patients.

Table 2 & Fig. 2 summarise the blood and blood product transfused including the use of MTP and ROTEM through the 4-year period. Comparing 2008 and 2014, there was no a significant difference in the amount of RC, FFP and platelet use; however there was an increase in number of patients who used cryoprecipitate

Table 1
Summary of blood and blood product requirements for patients by clinical groups.

	Gastrointestinal haemorrhage ($n = 48$)	Other surgery ($n = 33$)	Cardiothoracic surgery ($n = 29$)	Trauma ($n = 22$)	Liver surgery ($n = 23$)	Obstetric haemorrhage ($n = 11$)	Medical/Other ($n = 10$)	Vascular surgery ($n = 18$)
RBC	12 (10–20)	12 (10.5–17)	12 (11–15.5)	12.5 (11.3–18.5)	13 (10.8–20.3)	14 (11–15)	13 (10.8–20.3)	17 (13.5–26.5)
FFP	10 (6–16)	9.5 (7–13.5)	9 (8–15.5)	10 (7–14.5)	11.5 (7.3–18.8)	8 (6–10)	11 (6–15)	10 (7.5–19)
Platelets	2 (2–4)	3 (2–4)	4 (3–5)	3 (2–4)	4 (2.3–5.8)	2 (1–2)	3 (1.8–5.3)	3 (1.5–5)
Cryoprecipitate (doses)	1 (0–2.8)	1.5 (0–4)	1 (1–2.5)	1 (0–4)	4 (2.3–6.8)	1 (1–2)	0.5(0–4.5)	2 (0–3)
Cryoprecipitate (n, %)	35 (72.9%)	20 (69%)	23 (79.3%)	15 (68.2%)	14 (87.5%)	9 (81.8%)	5 (50%)	11 (64.7%)
Plasma to RBC ratio	1:1.4	1:1.4	1:1.4	1:1.4	1:1.2	1:1.6	1:1.4	1:1.6
Mortality	18 (37.5%)	7 (24.1%)	11 (34.4%)	5 (22.7%)	2 (8.7%)	0 (0%)	5(50%)	7 (38.9%)