Blood Components Load in Post-operative Neurosurgical Patients Suspected with Disseminated Intravascular Coagulation

M. Kotru¹ · S. S. Munjal² · M. Singh² · T. Seth¹ · H. P. Pati¹

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Abstract Neurosurgical patients with suspected DIC receive large amount of transfusion support in form of red cell concentrates (RCC), platelet rich plasma (PRP) and fresh frozen plasma (FFP). However, there are very few studies which have studied the effect of blood components load in the outcome of the patient. We conducted a prospective observational study on 61 post operative neurosurgery patients suspected with DIC and had at least one deranged haemostatic parameter namely platelet count, prothrombin time, partial thromboplastin time and thrombin time. Their blood components load was co-related with the outcome and with the hemostatic derangements. Twenty-eight patients died in our study group. 19/28 died patients had DIC. The red cell load was significantly more in patients who died compared to those who were alive ($p = 0.041$). On the other hand, load of PRP as well as FFP was significantly different between the patients who were alive and dead. This difference was further heightened when the DIC deaths were compared with the other patients. This is especially true for FFP transfusion which was significantly higher in DIC deaths ($p = 0.006$). Also, the number of FFPs received by neurosurgical patients suspected with DIC was significantly more in patients >2 coagulation abnormalities ($p = 0.008$). However, no correlation was found between PRP and RCC received and number of coagulation abnormalities present. To conclude, the load

of FFP was maximum in patients with DIC deaths and the load of RCC was associated with overall mortality.

Keywords Disseminated intravascular coagulation · Outcome · Post-operative neurosurgical patients · Brain tumors · Red cell concentrate · Fresh frozen plasma · Random donor platelets · RDP · PRP

Introduction

Disseminated intravascular coagulation (DIC) is an extreme form of coagulation activation that may complicate a myriad of clinical situations. It is most often associated with sepsis, shock, major trauma, malignancy (adenocarcinoma, leukemia), and obstetric complications (abruptio placenta) [1, 2]. 30–50% of patients with sepsis may develop DIC [3]. DIC is a common complication in neurosurgical patients. This is primarily because the brain cortex contains large amounts of thromboplastin, which is released in high amounts after head trauma as well as surgical interventions in the brain. Thromboplastin acts as a trigger for coagulation and hence leads to DIC [4, 5].

The neurosurgical patients who develop DIC may have a high degree of mortality [6]. However in practice, the clinical outcome of DIC is variable and depends a lot on the transfusion support given to the patient. This transfusion therapy is guided a lot by monitoring the laboratory hemostatic parameters like platelet count (PC), prothrombin time (PT) and partial Thromboplastin time (PTT). However, there are limitations. These haemostatic parameters are variably affected as they are altered due to the transfusion being received. Therefore they are not a reliable guide to the management.

✉ H. P. Pati
harappati@yahoo.co.in

¹ Department of Hematology, All India Institute of Medical Sciences, Ansari Nagar, New Delhi 110029, India

² Department of Neurosurgery, All India Institute of Medical Sciences, Ansari Nagar, New Delhi 110029, India

It is noticed that such post operative neurosurgical patients receive a large amount of transfusion support in form of red cell concentrates (RCC), platelet rich plasma (PRP) and fresh frozen plasma (FFP). The world literature mainly concerns the pathogenesis of DIC and its outcome. There are very limited studies on the transfusion load of these patients and their affect the clinical outcome. The present study was aimed to study the effect of blood components load in the outcome of the post-operative Neurosurgical patients.

Material and Methods

We conducted a prospective observational study on 61 post operative neurosurgery patients who needed transfusion support post-operatively and had at least one deranged haemostatic parameter namely platelet count (PC), prothrombin time (PT), partial thromboplastin time (PTT) and thrombin time (TT). None of these patients had any known pre-existing hemostatic disease, stroke, and vasculitis. Their blood components load was co-related with the outcome i.e. death or discharge.

Post surgical data especially with reference to biochemical parameters, transfusion requirements and outcome were noted from the case records. The transfusion support was instituted in accordance with the departmental policy. The heamogram was done on Sysmex 1800i. PT, PTT and TT were done by using the kit (Diagnostica Stago) on Fully automated coagulometer. The normal values of PT, PTT and TT were 11–15, 29–35 and 16–20 s, respectively. Values of PT more than 3 s, PTT more than 5 s and TT more than 2 s from the control were considered abnormal. Statistical analysis was performed using Chi square tests, student *t* test, Kruskal–Wallis test along with multivariate tests using logistic regression and ROC curve analysis on SPSS Software.

Results

Correlation of Transfusion Load and Patient Outcome

Of the 61 patients, 33 patients were discharged and 28 died. 19/28 died patients had DIC. Table 1 gives a description of transfusion load of these patients. The multivariate analysis brings out the fact that red cell load was significantly more in patients who died compared to those who were alive ($p = 0.041$). But this difference was not significant whether the death was due to DIC or other causes. In other words, the need for red cell concentrates i.e. severity of anaemia significantly affected the overall mortality.

On the other hand, load of Random donor platelets/PRP as well as FFP was significantly different between the patients who were alive and dead. This difference was further heightened when the DIC deaths were compared with the other patients. This is especially true for FFP transfusion which was significantly higher in DIC deaths ($p = 0.006$).

Correlation of Transfusion Load and Hemostatic Parameters

There was no significant correlation of the type of laboratory abnormality with the type of transfusion received. Table 2 shows the average RCC, PRP and FFP received in each category. It shows that the number of FFP received had no significant correlation ($p = 0.146$) with the type/combination of coagulation parameters being deranged; suggesting that patients were getting FFP irrespective of the coagulation type/combination of coagulation parameters being deranged.

Further, the correlation was studied with the number of coagulation abnormalities present with the transfusion load. (Table 3) It showed that the number of FFPs received by neurosurgical patients suspected with DIC was significantly more in patients ≥ 3 coagulation abnormalities ($p = 0.008$). However, no correlation was found between PRP and RCC received and number of coagulation abnormalities present.

Discussion

DIC is a serious complication in post operative neurosurgical patients. A variety of factors are involved in determining the outcome of such patients. Amongst the many, increasing age, organ dysfunction and presence of haemostatic abnormalities has been studied as significant risk factors for death in acute DIC [7]. The outcome of these patients also depends on the timely and appropriate transfusion support. The Neurosurgical patients with suspected DIC receive variable transfusion support in form of RCC, PRP, FFP and single donor platelets occasionally. The patients in our study group received 10 units of FFP, 4 units of PRP and 2 units of RCC (median) with a wide range. There was a significant difference in the patients who were alive and dead (Table 1).

Transfusion load for RCC was significantly different in patients who survived and those who died, irrespective of the cause. No association of number of RCC received and deaths due to DIC was seen. This suggests that RCC had a bearing on the overall mortality. There are few studies which have studied the role of anaemia and the load of RCC in overall outcome in these patients. There is an occasional study which says that more RCC was related to

Table 1 Correlation between the transfusion load and the outcome

Transfusion load	Total N = 61	Alive (33)	Dead (28)	Significance	DIC deaths (19)	Significance
<i>RCC</i>						
Median	2	1	0	0.041	4	0.308
Range	0–10	0–10	0–10		0–10	
<i>PRP</i>						
Median	4	2	8	0.055	10	0.028
Range	0–58	0–58	0–39		0–39	
<i>FFP</i>						
Median	10	8	14.5	0.054	16	0.006
Range	0–52	0–52	0–38		0–38	

RCC red cell concentrate, *PRP* platelet rich plasma, *FFP* fresh frozen plasma

p value (bold) <0.05 is considered significant

Table 2 Isolated/combinations of coagulation abnormalities in patients and their transfusion/blood component load

	<i>RCC</i>		<i>PRP</i>		<i>FFP</i>	
	Mean ± SD	range	Mean ± SD	range	Mean ± SD	Range
↓PC + ↑PT	3.06 ± 3.0	0–10	10.6 ± 13.2	0–58	11.5 ± 10.3	0–42
↑PT + ↑PTT	0.75 ± 1.5	0–4	2.5 ± 3.5	0–8	9 ± 7.7	2–25
↑PT + ↑PTT + ↑TT	2.5 ± 3.2	0–5	11.5 ± 3.5	9–14	15 ± 1.4	14–16
↓PC + ↑PT + ↑PTT + ↑TT	4.83 ± 3.4	1–10	16.8 ± 15.9	2–39	26 ± 15.9	10–52
↓PC + ↑PT + ↑PTT	2.5 ± 2.1	0–6	5.0 ± 6.4	0–14	15.8 ± 13.7	5–37
↓PC	3 ± 0	3–3	14 ± 0	14–14	4 ± 0	4–4
↑PT	0 ± 0	0–0	0 ± 0	0–0	1 ± 0	1–1
Significance (<i>p</i> value)	0.284		0.357		0.104	

RCC red cell concentrate, *PRP* platelet rich plasma, *FFP* fresh frozen plasma, *PC* platelet count, *PT* prothrombin time, *PTT* partial thromboplastin time, *TT* thrombin time

p value <0.05 is considered significant

Table 3 Number of coagulation abnormalities in patients and their transfusion/blood component load

Transfusion load	Total patients (61)	≤2 abnormalities in hemostatic parameters (43)	>2 abnormalities in hemostatic parameters (18)	Significance <i>p</i> value
<i>RCC</i>				
Mean	2	2	3	0.221
Range	0–10	0–10	0–10	
<i>PRP</i>				
Median	4	4	6	0.543
Range	0–58	0–58	0–39	
<i>FFP</i>				
Median	10	8	16	0.008
Range	0–52	0–42	0–52	

RCC red cell concentrate, *PRP* platelet rich plasma, *FFP* fresh frozen plasma

p value (bold) <0.05 is considered significant

worse overall outcome [8]. In our previous study, we showed that drop in haemoglobin levels post operatively affected the outcome. So probably RCC requirement only indicates the severity of drop in haemoglobin levels, which

is affecting the patient outcome [9]. Our study brings out the fact that the number of RCC received had a significant effect on the survival of the post operative neurosurgical patients independent of whether they had DIC or not.

In our cohort, FFP and PRP were received in a significantly larger proportion of patients who died with DIC as compared to those who did not die of DIC or those who survived. Hence, FFP significantly correlated with the outcome. Matvosyan et al. in his study of 25 patients showed that a mild prolongation of INR (up to 1.7) have hemostatically normal levels of important coagulation factors and thus do not require FFP. However, our patients showed that those with mild abnormalities also died due to DIC [10]. Moreover transfusion load was not related to the type of coagulation abnormality. Nevertheless, there was significant increase in number of FFPs received with increases in number of coagulation abnormalities ($p = 0.008$). This indicates that clinical requirement of FFP was far more when number of coagulation abnormalities was more.

Our study brings out the fact that the number of RCC received had a significant effect on the survival of the post operative neurosurgical patients independent of whether they had DIC or not. On the other hand, however, FFP and PRP were received in a significantly larger proportion of patients who died with DIC as compared to those who did not die of DIC or those who survived.

There are proponents of both liberal as well as the judicious use of blood transfusion especially in traumatic brain injury [11]. however, in our study, increase transfusion requirement in post-operative neurosurgical patients is a predictor of mortality, more likely because of severe derangement of underlying pathobiology. The study cannot however comment on whether the use of the blood products was appropriate. More studies/randomised control trials are required for the same.

Compliance with the Ethical Standards

Conflict of interest None.

Ethical requirement Ethical clearance taken from institutional ethics committee. This was a retrospective study involving only the study done from the records.

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