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COAGULATION PROFILE AS PREDICTOR OF RECOVERY STATUS IN PATIENTS OF HEAD INJURY

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ABSTRACT

Early identification of traumatic coagulopathy to initiate timely management in head injury patients for better recovery is important. Therefore, we conducted this prospective randomized study to establish predictable changes in the coagulation factors and the effect of early transfusions in such patients. In all 42 head injury patients, severity assessed by Revised Trauma Scale (RTS), underwent emergency evacuation procedures. Patients with Score of < 4 were considered to be severely injured. Intra-operative transfusions of blood components were given to every patient, irrespective of their initial coagulation profile. Their coagulation profile was reviewed again after 24 hours. Out of 42 patients with Revised Trauma Score < 4; 11.9%, 20.5% and 48.5% had abnormal Prothrombin Time (PT), Activated Partial Thromboplastin Time (aPTT), Fibrin Degradation Products (FDP) and D-dimer levels respectively, whereas 4.2%, 7.14% and19.06% of patients with RTS >4 had deranged coagulation profile. Thus, this indicates that a normal initial coagulation profile does not rule out underlying coagulopathy and an early transfusion promotes better recovery.

Keywords: Head injury, Revised Trauma Score, Coagulation Profile

INTRODUCTION

Hemorrhage requiring massive transfusion remains a major cause of potentially preventable deaths after trauma. Trauma and massive transfusions are associated with coagulopathy secondary to tissue injury. Hypo-perfusion, dilution and consumption of clotting factors, platelets and coagulopathy, together with hypothermia and acidosis, form a lethal triad [1] to which many trauma patients succumb. Massive blood transfusion (> 10 units of PRBC within 24 hours and not accounting for other blood component therapy) carries a mortality rate between 20-50%, with most patients dying within 6-12 hours of hospitalization. Damage control surgery has evolved as an aggressive treatment strategy to avoid the development of this triad in massively transfused patients by early control of the cause of bleeding by temporary non definitive means [2]. Hemostatic resuscitations provide transfusions with plasma and platelets in addition to blood. The current transfusion guidelines have been challenged and the concept of hemostatic control resuscitation (red blood cells, platelets, and plasma) to critically injured patients in an immediate and sustained manner, had been proposed [3, 4]. The hemostatic response to trauma is delineated by Gando [5]. Trauma induces the immediate activation of the coagulation system through the up regulation of tissue factor and extensive thrombin generation. Damage to brain causes activation of not only extrinsic and intrinsic pathways but also enhances the release of corticosteroids and catecholamines which in turn enhance platelet activity and vascular damage. A significant association between brain injury and coagulopathy has been reported.

The degree of coagulopathy after head injury appears to be related to the extent of severity. Since brain is rich in tissue thromboplastin, severe damage can release thromboplastin into general circulation and activate the extrinsic pathway. Direct trauma causes endothelial injury which activates the intrinsic pathway. Once these two pathways are activated, a vicious cycle results [6,7]. Consequently, acute traumatic coagulopathy is characterized by systemic anti-coagulation/ coagulopathy in conjunction with hyperfibrionolysis [8]. The volume of the clotting status (thromboplastin) presented to the vascular system is one of the main determinant for development of Disseminated Intravascular Coagulopathy (DIC). The thromboplastin released into the circulation in conjugation with the patient's vascular system volume status and the acidemia determines the likely hood of development of DIC. In the final phase of DIC, D-dimer levels are also increased. The widespread activation of clotting cascade with the depletion of the

procoagulant factors can be measured by evaluating prothrobin time (PT) and Activated Partial Thromboplastin Time (aPTT). In this manuscript, comparison of complete coagulation profile in freshly admitted trauma patients before and after early transfusion has been put forth.

MATERIALS AND METHODS

42 fresh head injury (within 6 hours) patients between the age of 18-60 years of either sex, who underwent emergency evacuation procedures, with no history of recent transfusions with GCS 3/15 or more were taken up for the study. Patients on anti tubercular treatment (ATT), steroids, chemotherapeutic agents and drugs which impair the coagulation profile or suffering

from systemic diseases were not considered for the study. At the time of admission, the severity of the injury was assessed by Revised Trauma Scale (RTS). Patients with RTS < 4 were considered to be severely injured and needed urgent aid at designated trauma centre. After initial stabilization of patient and informed consent from the relatives of patients, 4ml blood was collected in citrated (3.2 gms/dl) vacutainer for the assessment of Prothrombin Time (PT),[9] Activated Partial Thromboplastin Time (aPTT),[10] Fibrin Degradation Products (FDP), D-dimer[11] and Fibrinogen level[12]. Fresh smears were prepared for platelet counts and 2ml EDTA blood was collected for estimation of Hemoglobin concentration[13]. All patients received transfusion of two units of fresh frozen plasma (FFP), three platelet concentrates (PLT) and packed red blood cells (PRBC). The surgical and hematological parameters were corrected simultaneously and the complete coagulation profile was rechecked after 24 hours.

RESULTS

Only head injury patients were included in this study and all received intra operative transfusions irrespective of their normal initial coagulation profile screening. Severity of the trauma was assessed by RTS which is calculated by summation of Glascow Coma Scale (GCS), systolic blood pressure (SBP) and respiratory rate (RR). For hospitalized patients, the RTS is calculated by using formula: RTS = 0.9368 GCS + 0.7326 SBP + 0.2908 RR[14].

Patients scoring RTS < 4 (Table 1) were considered to be severely injured, indicating the need for urgent therapeutic measures. Out of 42 patients, 33 (78.57%) were severely injured with RTS < 4 and the

remaining 9 (21.43%) sustained minor injury with RTS > 4. Patients segregated on the basis of RTS (Table 2) *vis-a vis* normal and abnormal blood coagulation profile. Neglible abnormalities (< 3%) were found in the fibrinogen levels, whereas maximum percentage of patients (48.5%) showed abnormal FDP and D-dimer followed by aPTT (20.5%), PT (11.9%) and platelets (7.14%), in patients having RTS <4. On the other hand, patients with RTS > 4, 11.9%) of patients showed abnormal FDP and D-dimer levels. It was also observed that normal initial coagulation profile (Platelet, PT, aPTT) was found in approximately 56% patients with RTS < 4 and in approximately 26% patients with RTS > 4. FDP and D-dimer were normal in 21% of patients with RTS < 4 and in 12% of patients with RTS > 4 (Table 2).

The results obtained after transfusing the requisite volume of blood products showed that except for one patient (2.38%) scoring RTS < 4, in rest of the patients (97.62%) normal hemostatic profile could be achieved (Table 2).

Table 1: Assessment of severity of injury based on Revised Trauma Score (RTS).

Coded value	GCS	SBP(mm/Hg)	RR/min	RTS	Severity
0	3	0	0	0	Severe
1	4-5	<50	<5	1.9602	Severe
2	6-8	50-75	5-9	3.9204	Severe
3	9-12	76-90	>30	5.8806	Severe
4	13-15	>90	10-30	7.8408	Normal

GCS=Glasscow Coma Scale; RR=Respiratory Rate; SBP=Systolic Blood Pressure.

Table 2: Coagulation profile of patients before transfusion categorized on RT score basis.

RTS	Platelets/mm³		PT (secs)		aPTT (secs)		FDP & D dimer (ng/ml)		Fibrinogen (mg/dl)	
	N %	Ab %	N %	Ab %	N %	Ab %	N %	Ab %	N %	Ab %
* <4	61.90	7.14	57.14	11.9	48.54	20.5	20.54	48.5	69.04	NIL
* >4	26.16	4.80	26.76	4.2	23.72	7.14	11.9	19.06	28.06	2.9
** <4	69.04	NIL	69.04	NIL	66.66	2.38	69.04	NIL	69.04	NIL
** >4	30.96	NIL	30.96	NIL	33.34	NIL	30.96	NIL	30.96	NIL

Abbreviations used: RTS=Revised Trauma Score, Ab=Abnormal percentage of patients, N= normal percentage of patients, PT=Prothrombin Time, aPTT=Activated Partial Thromboplastin Time, FDP=Fibrin Degradation Products, *= pre transfusion values, **= post transfusion values.

DISCUSSION:

The occurrence of coagulopathy after head injury is well known. Diagnostic criteria for coagulopathy are inconsistent in the literature. Numerous investigators have used levels of fibrinogen, D-dimer, Von Willebrand factor, factor VIIIC, antithrombin, protein C, plasminogen, and tissue-type plasminogen activator to evaluate coagulopathy. The criteria, we used for coagulopathy, included elevated PT/aPTT, platelets <100,000/mm³, elevated levels of FDP, D-dimer and fibrinogen levels. These laboratory tests have been shown to reliably identify early coagulopathy, assess its severity, monitor its course, and follow the progress of any therapeutic intervention.

Jacoby et al [15] found a significant decrease in both platelet count and hematocrit in head injury patients over 72-hour study period. They also showed that platelet function correlated inversely with death from severe head injury. The platelet counts and

hematocrit in patients, who died from severe head injury, were not significantly different from those patients who survived. In addition, they showed a decrease in platelet function despite increased platelet activation. These data support the possibility of a process that down-regulates platelet function specifically and coagulation in general. The down-regulation of platelet function in severe head injury may be a protective mechanism, as extensive micro-vascular thrombosis can lead to worsening of brain injury. Holcomb et al [16] found that the highest survival level was established in patients who received both high platelet PRBC and high FFP: RBC ratio. Furthermore, in multiple regression analysis, platelet transfusion is associated with survival**.** Our study states that only a few patients (11.98%) suffered from thrombocytopenia and their platelet levels returned to normal levels after transfusion of blood products.

Many studies identified the presence of an early coagulopathy of trauma using prothrombin time (PT) and activated partial thromboplastin time (aPTT) for diagnosis [17-21]. More patients have an abnormal PT than aPTT, but the aPTT appears to be more specific for predicting outcome. In the Miami study, 28% of patients had an abnormal PT compared with 8% of patients with an abnormal aPTT [18]. In the study conducted by Brohi, [8] the aPTT correlated better with low protein C levels than the PT, which is expected from the inhibitory effect of activated protein C on both factors V and VIII. In our study, patients exhibited more abnormalities in the levels of aPTT than PT in both the groups of patients.

Further, an elevated level of FDP denotes accelerated fibrinolysis. The development of

DIC after head injury is related to the release of the tissue thromboplastin. Higher levels are found in brain destruction rather than brain compression. Similar to other studies, we found that 48.1% of patients showed an increased FDP and D-dimer levels with severe head injury (RTS < 4). The increased levels were not confined to severe head injury as 11.9% patients with RTS > 4 with normal initial hemostatic profile also had elevated levels of FDP and D-dimer. Unsurprisingly, patients with an acute coagulopathy have increased transfusion requirements in the first 24 hours of admission. The current transfusion guidelines have been challenged and the concept of haemostatic control of resuscitation, i.e. supplementing large transfusions of RBC with FFP and platelet (PLT) to critically injured patients in an immediate and sustained manner, has been proposed [3,4]. The rationale for balanced administration of blood products is that it mimics the composition of circulating blood and hence, the transfusion of RBC, FFP and PLT in a unit for unit ratio is likely to both prevent and treat coagulopathy due to massive hemorrhage. Zink et al[22] showed an increased survival rate in patients who received high PLT:RBC transfusions when compared to patients who received FFP : RBC transfusions. In our study, all the patients received intra operative transfusions of blood products (PLT, FFP and RBC) irrespective of their initial coagulation profile. The coagulation parameters were studied again. There are many studies which studied different ratio of FFP: RBC: PLT transfusion to the survival of patients. The optimal ratio of FFP: RBCs remains to be established. The implementation of massive transfusion protocol is associated with

reduction in mortality without affecting the overall FFP: RBC and PLT: RBC ratios but the time until the administration of RBC, FFP and PLT was reduced, indicating that blood product availability is important.

CONCLUSION:

Coagulopathy, upon hospital admission, is a frequent finding in adult patients after head injury and represents a powerful and independent predictor related to prognosis. Patients with severe head injury (RTS < 4) should not be misleaded by their normal initial coagulation profile as they might have underlying abnormal FDP and D-dimer. These patients also warrant early transfusion to free them from the dangers of hidden coagulopathy. We feel that more prospective clinical trials should be conducted to determine these beneficial effects of early treatment of trauma associated coagulopathy.

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