Original Article

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Thrombocytopenia and Coagulopathy in Indian Patients With Isolated Head Trauma

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ABSTRACT

Background: Patients with head injury, a leading cause of morbidity and mortality worldwide are susceptible to the early development of coagulopathy. As its presence further contributes to an adverse outcome, early identification assumes importance. This study aimed to assess the prevalence and nature of hemostatic abnormalities in Indian patients with isolated head trauma and correlate them with outcome.

Methods: Complete blood counts with platelet count and screening tests of hemostasis PT, APTT, TT were performed on 100 patients with isolated head trauma admitted within 12hrs of injury. The severity of injury was assessed by Glasgow coma score (GCS).

Result: Based on the GCS, head injury was classified as mild (GCS 13-15, n=45), moderate (GCS 9-12, n=28) and severe (GCS 3-8, n=27). Thrombocytopenia was present in 48% patients. Coagulopathy [prolonged PT (>14 sec) and/or APTT (>34 sec)] was present in 39% patients. Twenty-six patients died. Mortality was significantly ($p<0.001$) higher in patients with coagulopathy and/or thrombocytopenia. Platelet count was significantly lower and PT, APTT, TT significantly ($p<0.001$) higher in non survivors as compared to survivors. Platelet count significantly ($p<0.05$) decreased while PT, APTT and TT increased with increasing severity of injury. Seven (17.9%) patients with mild injury also had coagulopathy.

Conclusion: Coagulopathy and thrombocytopenia were associated with a significantly higher mortality and was present even in patients with mild head injury. Measurement of hemostatic parameters in these patients irrespective of severity of injury will help in identification of patients at poor risk thus aiding better management and improved survival.

Keywords: *Coagulopathy, Head Trauma, Prothrombin Time, Activated Partial Thromboplastin Time, Thrombocytopenia*

Introduction

Traumatic brain injury (TBI), an acute brain injury arising from external physical force to the head is a major health problem worldwide[1] and results from falls, vehicular accidents, blunt impact and assaults.[2] It is a leading cause of morbidity and mortality and also causes a substantial economic burden with high per-patient hospital costs.[2]Patients with head injury are susceptible to the early development of coagulopathy.[3] The incidence of coagulopathy has been reported to vary between 10-40%[4] with an increase in incidence with increasing severity of injury.[5] The release of tissue thromboplastin present in high concentration in the brain, activates the extrinsic coagulation pathway. Damaged endothelium activates platelets and the intrinsic coagulation pathway to form an intravascular thrombus thus depleting platelets and coagulation factors.[4]Patients with head injury who develop coagulopathy have a poor outcome.[4]Coagulopathy is associated with the development of delayed injury. Intracranial hemorrhage and post traumatic cerebral infarction have been observed in these patients which further contribute to mortality.[6]While severe forms of coagulopathy are apparent clinically, patients with mild-moderate coagulopathy are asymptomatic. Early identification of coagulopathy in these patients is hence important as it will aid in better management and improved prognosis.

The present study, aimed to ascertain the prevalence of thrombocytopenia and coagulopathy in Indian patients with isolated head trauma and correlate abnormal test parameters with severity of trauma and outcome.

Materials and Methods

This cross sectional study was done on 100 patients with isolated head trauma admitted within 12 hrs of injury. Patients with poly trauma/ clinical evidence of infection/ those on anticoagulant therapy were excluded from the study. A detailed history was taken with special attention to the time of injury, mode of trauma, any pre-existing illness and medication received. The severity of injury was assessed by Glasgow coma score (GCS).[7] A written informed consent was obtained from all patients. The study received clearance from the Institutional Ethics Committee for human research.

Complete blood counts with platelet count (Automated hematology analyzer LH500) and tests of hemostasis

(using commercially available kits) including PT (Thromborel S, Siemens Healthcare Diagnostics Products), APTT (Siemens Healthcare Diagnostics Products) and TT (Tulip Diagnostics) were done in all patients. The laboratory value of PT and APTT of control plasma are 11 sec and 28sec respectively. Coagulopathy was defined as a prolonged PT (>14 sec) and/or APTT (>34 sec).[5] All patients were followed up till the time of discharge/death.

Statistical analysis: SPSS (20.2) software was used for Mean, Standard deviation and Median values of the quantitative parameters and for all qualitative parameters, their frequencies were obtained. For comparison between survivors and non-survivors, chi-square test/ Fisher's exact test was employed for the qualitative parameters and unpaired T-test for the quantitative parameters. A p value <0.05 was considered significant.

Result

General characteristics: The age of the patients ranged from 7.0-82.0 years with a Mean ± SD of 33.7 ± 13.6 years . Majority (59 %) of patients were between 21-40 years. The study comprised of 78 (78%) males and 22 (22%) females. The most frequent (74%) mode of head injury was Road traffic accident. Thirteen (13%) patients each sustained injury due to fall from a height and physical assault.

Severity of injury: Based on the GCS, head injury was classified as mild (GCS 13-15), moderate (GCS 9-12) and severe (GCS 3-8). There were 45 (45%), 28 (28%) and 27 (27%) patients with mild, moderate and severe injury respectively.

Hematological parameters: The hematological parameters of patients are shown in Table 1.

Anemia[8] was present in 66 (66%) patients, being mild in the majority (63/66, 95.5%). Forty-five (45%) patients had leucocytosis. Differential leucocyte count showed neutrophilia in 59 (59%) patients.

Thrombocytopenia and Coagulopathy : Table 2 shows the range, Mean ± SD and median of platelet count and tests of hemostasis and the abnormality detected in each of them. Thrombocytopenia was observed in 48 (48%) patients being mild in majority (56.2%). PT, APTT and TT were prolonged in 31 (31%), 26 (26%) and 25(25%) patients respectively. According to the criteria used[5], coagulopathy was present in 39 (39%) patients. Thirty (76.9%) of 39 patients had associated thrombocytopenia. Eighteen patients had thrombocytopenia without associated coagulopathy. Thrombocytopenia and/or coagulopathy were present in 57(57%) patients.

Outcome: Seventy-four (74%) patients were discharged after recovery while 26(26%) patients died.

Mortality in patients with and without coagulopathy and/or thrombocytopenia: Mortality in patients with coagulopathy and/or thrombocytopenia was significantly ($p<0.001$) higher (45.6%) than in patients without coagulopathy/ thrombocytopenia (0%). (Table 3)

When patients with thrombocytopenia and deranged screening tests of hemostasis were compared with patients in whom these parameters were normal, a significantly ($p<0.001$) higher mortality was seen in the former as compared to the latter. (Table 4)

Coagulopathy and severity of injury: The prevalence of coagulopathy and thrombocytopenia increased with increasing severity of injury. (Table 5) A highly significant ($p<0.001$) association was seen between GCS and coagulopathy as also thrombocytopenia.

Discussion

Head injury is a leading cause of morbidity in developed countries and it's incidence is progressively increasing in developing countries also. About 42% of patients with traumatic brain injury need hospitalization leading to a substantial economic burden.[9] TBI also results in serious disability which is often permanent including long term psychological impairments.[10]

Table 1: Range and Mean ± SD of Complete blood counts (n=100)

Parameter	Range	Mean ± SD
Hb (g/dl)	7.0-15.6	11.9 ± 2.0
Hct (%)	21.6-46.8	36.1 ± 6.1
MCV (fl)	60.0-118.0	85.9 ± 10.7
MCH (pg)	22.5-37.2	30.3 ± 2.7
MCHC (g/dl)	26.0-36.4	32.1 ± 2.2
TLC ($x10^9$/L)	4.6-20.7	11.1 ± 2.8

Table 2: Platelet count and screening tests of hemostasis

Parameter	Range	Mean± SD	Median	Abnormality(%)
Platelet count(x10^9/L)	46.0-274.0	152.8 ± 58.4	151.5	<150 : 48
PT (sec)	10.9-52.6	14.4 ± 5.5	12.6	>14 : 31
INR	1.0-4.8	1.3 ± 0.5	1.4	>1.3 : 27
APTT (sec)	28.0-61.0	32.5 ± 5.0	31.0	>34 : 26
TT (sec)	8.0-22.7	11.1 ± 2.7	10.0	>11: 25

Table 3: Mortality in patients with and without coagulopathy and/or thrombocytopenia

Parameter	Non survivors		Survivors	
	No	%	No	%
Coagulopathy&/or thrombocytopenia(n=57)	26	45.6*	31	54.4*
No coagulopathy &/or thrombocytopenia(n=43)	0	0*	43	100*

*p<0.001

Table 4: Survival and mortality in patients with normal and deranged hemostatic parameters

Parameter	Survival (%)	Mortality (%)
Platelet count Thrombocytopenia (n=48) Normal (n=52)	 50 96.2	 50 3.8
PT Prolonged (n=31) Normal(n=69)	 25.8 95.6	 74.2 4.4
APTT Prolonged (n=26) Normal (n=74)	 38.4 86.4	 61.6 13.6
TT Prolonged (n=25) Normal (n=75)	 28 89.3	 72 10.7

p <0.001 for all parameters

Table 5: Coagulopathy and thrombocytopenia in varying severity of injury

Severity of injury(GCS)	Coagulopathy		Thrombocytopenia	
	No	%	No	%
Mild (13-15)	7	17.9	14	29.2
Moderate (9-12)	9	23.1	10	20.8
Severe (3-8)	23	59.0	24	50.0
Total	39	100	48	100

Mortality from TBI remains a major public health concern. As the initial cerebral damage cannot be modified, minimizing secondary insults will lead to a better outcome in these patients. Both thrombocytopenia and coagulopathy are systemic factors which cause secondary brain insults and are known to contribute to an adverse outcome.[5]

The present study assessed the prevalence of thrombocytopenia and/or coagulopathy in Indian patients with isolated head trauma and correlated them with outcome and severity of injury. Majority (59%) of patients were between 21-40 years of age with RTA being the most common cause (74%) of injury. Similar results have been observed in other studies.[11,12,13] Based on the GCS, there were 45%, 28% and 27% patients of mild, moderate and severe injury respectively. Mild injury reportedly constitutes the majority of head injuries (131 per 100,000 population) with moderate and severe TBI reported in 29/100,000 population.[5]

In the present study, thrombocytopenia and/or coagulopathy were present in 57 (57%) patients.

A variable incidence of thrombocytopenia has been reported in patients with TBI. Hanes et al observed thrombocytopenia in 41% patients.[14] In a study on 100 Indian patients with isolated brain trauma, thrombocytopenia was reported in 3% patients only.[15] The reported incidence of coagulopathy in TBI varies between 10 to 97%.[11,16,17,18] In a study on 4110 patients with blunt trauma, thrombocytopenia and/or coagulopathy were seen in 26% patients at admission which increased to 52% within the first 3 days after injury.[5] Similar results were reported by Greuters et al.[19] In contrast, Chiaretti et al observed coagulopathy in 10% patients with TBI.[4] Other authors have observed an equal incidence of thrombocytopenia and coagulopathy in patients with TBI.[5]

The variable prevalence of thrombocytopenia and coagulopathy is attributed to different study designs, inclusion of patients with varying severity of injury, criteria used to define coagulopathy and testing of coagulation parameters at different times after injury.[19]

Of the screening tests of hemostasis, an elevated PT was the most frequent abnormality present in 31% patients. An isolated prolonged PT was seen in 13(13%) patients; both PT and APTT were prolonged in 18(18%) patients. Eight(8%) patients had isolated prolongation of APTT. Similar results were reported by Carrick et al.[5] In a study on patients with severe TBI, elevated PT and APTT were seen in 72% and 27% patients respectively.[20] In a study on 100 patients with head injury, PT was found to be an important parameter in reflecting severity of head injury and also as a prognostic parameter.[21]Some studies have observed a prolonged APTT more frequently than PT.[22]

The mortality in this study was 26%. A significantly($p<0.001$) higher (45.6%) mortality was seen in patients with coagulopathy and/or thrombocytopenia than in patients without coagulopathy(0%).When patients with thrombocytopenia and coagulopathy were compared with patients in whom these parameters were normal, a significantly ($p<0.001$) higher mortality was seen in the former group as compared to the latter. The mortality increased significantly($p<0.001$) with increasing severity of injury as assessed by GCS.

Coagulopathy has a significant impact on mortality of patients with TBI. It has been reported that mortality in patients with severe head injury with coagulopathy is several times higher than patients of head injury without coagulopathy.[23,24,25] Both thrombocytopenia and coagulopathy lead to bleeding and secondary complications thus increasing mortality and patients length of stay in the hospital.

Comparison of platelet count, PT and APTT in survivors and non survivors revealed a significantly ($p<0.001$) lower platelet count and a significantly(<0.001) higher PT and APTT in the latter as compared to the former. In a study on patients with blunt trauma, it was observed that of those who died, 67% were thrombocytopenic and 62% had coagulopathy. Amongst survivors, thrombocytopenia and coagulopathy were present in 40% and 28% patients respectively. These observations have been confirmed in other studies.[25,26,27]

This study observed a highly significant ($p<0.001$) association between GCS and coagulopathy as also thrombocytopenia. May et al observed that 81% patients of TBI and GCS score <7 were coagulopathic at admission while all patients with a GCS score <5 were coagulopathic. The authors recommended that all patients with GCS <7 should be given empiric treatment.[28]. Similiar results have been observed in children.[29]

Conclusion

Thrombocytopenia and coagulopathy have been reported frequently in patients with moderate and severe TBI, but in this study both were observed in patients with mild injury also. As routine tests of coagulation can identify the earliest signs of coagulopathy and assess it's severity; their measurement in patients with TBI irrespective of severity of injury will help identify patients with poor outcome. Initiation of timely management will aid in better recovery and help in reducing morbidity and mortality.

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