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Original Research Article

A Study to Explore the Extent of Coagulation Profile and its Correlation with the Severity of TBI

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Abstract

Aim: The aim of the present study was to explore the extent of coagulation profile derangements, its correlation with the severity of TBI, and clinical outcome.

Methods: The study was performed on patients with isolated head injury in department of General Surgery for one year . A total of 100 patients in the age group of 20 to 70 years were studied.

Results: Majority of the patients belonged to the age group 41-50 years followed by 51-60 years. 80% were male and 20% were females in the present study. Road traffic accident was the primary (75%) mode of injury. In patients with MHI, 64% of the study population had coagulopathy while 48% of the patients with SHI were found to have coagulation abnormalities. The patients with SHI were divided into two groups. The first group included 40 patients and had GOS 1 or GOS 2. The second group included 8 patients and had GOS 5. p-Value for DIC score was < 0.001 and is statistically significant. p-Value in both PT and APTT was < 0.05 and was significant. However, it was not significant for D-dimer, fibrinogen, and platelet counts. In patients with MHI, p-value in case of DIC score, platelet count, APTT, and D-dimer was < 0.001 and was highly significant. p-Value in PT was < 0.05 and found to be statistically significant, however, it was not significant for fibrinogen.

Conclusion: The patients of isolated head injury are at high risk of developing coagulation abnormalities. Coagulopathy is directly associated with the severity of TBI, GCS, and is independently associated with poor outcome. DIC score is a useful parameter in the prediction of prognosis of head injury patients. The timely intervention in such patients can help improve prognosis. The analysis of coagulation parameters are useful predictors of outcome and can be used to explain the relatives about prognosis and course of the patient during the hospital stay.

Keywords: coagulopathy, TBI, DIC score, head injury

Introduction

Traumatic brain injury (TBI) remains a leading cause of death and disability worldwide. [1] The initial insult often results in disruptions of the cerebral vasculature and pathological alterations of the blood–brain barrier (BBB) which may evolve into haemorrhagic lesions. In addition, TBI-associated factors may disturb the body's haemocoagulative capacity and alter the delicate balance between bleeding and thrombus formation leading to a substantial exacerbation of the initial injury sustained. [2-5]

Recent evidence suggests that the acute phase after TBI is rather characterised by dysfunction of the coagulation cascade and hyperfibrinolysis, both of which likely contribute to haemorrhagic progression. This may then be followed by platelet dysfunction and decreased platelet count while the clinical implication of these alterations remains unclear. At later stages, a poorly defined prothrombotic state emerges, partly due to fibrinolysis shutdown and hyperactive platelets.[6-8] Haemostatic alterations, in particular those during the acute phase after TBI, have been associated with higher mortality and more unfavourable outcome than in non-coagulopathic TBI patients. [2,4,9-11]

Coagulation abnormalities frequently occur following TBI and the incidence of the disturbance in the coagulation parameters varies considerably. [2,9] Goodnight et al [12] first recognized that tissue thromboplastin, of which brain is a rich source, is released into the circulation resulting in uncontrolled activation of clotting factors leading to depletion of

coagulation proteins, which may eventually result in disseminated intravascular coagulation characterized by systemic coagulopathy, intravascular coagulation and hemorrhage after the clotting factors are consumed. Stein et al [13] found a strong association between severity of coagulopathy and density of intravascular coagulation. This insult to hemostatic system is further aggravated by the infusion of large number of colloids, crystalloids and massive blood transfusion resulting in dilutional coagulopathy. Further, acidosis and hypothermia, which commonly follow traumatic injury, also add on to the hemostatic insult forming a vicious triad of coagulopathy, acidosis and hypothermia. Coagulopathy has a significant impact on morbidity and mortality of patients with TBI. [14] Mortality in patients with severe head injury with coagulopathy is found to be four times higher than in patients with head injury without any coagulopathy. [15]

The aim of the present study was to explore the extent of coagulation profile derangements, its correlation with the severity of TBI, and clinical outcome.

Materials and Methods

The study was performed on patients with isolated head injury at department of General Surgery in Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India for one year. A total of 100 patients in the age group of 20 to 70 years were studied. Patients having other associated injuries (extracranial trauma) like long bone fractures, chest injuries, and abdominal injuries were not included in the study. Those with pre- existing coagulopathy or on anticoagulants, hypertension, diabetes, hepatic and renal dysfunction, or any other comorbidities were excluded.

All the selected patients were divided into subgroups of MHI and SHI based upon their Glasgow Coma Scale (GCS). Patients with GCS of 9 to 13 were classified as having MHI and < 8 as SHI. Investigations including complete hemogram, prothrombin time (PT), activated partial thromboplastin time (APTT), D-dimers, fibrinogen, computed tomography head, and ultra- sonography of chest and abdomen were done. The blood was collected at the triage area itself upon arrival of the patient without any delay and processed immediately.

All the blood investigations used to calculate DIC score (modified) were based on parameters as outlined by the International Society on Thrombosis and Haemostasis (ISTH) scoring system. APTT was also evaluated. The result of all the above blood investigations was graded on a score of 0 to 3 according to the range of normal values for a healthy population in the same laboratory. The sum of all the five blood investigations for a given patient was regarded as a DIC score. After calculation of the DIC score, the severity of DIC was graded.

Coagulopathy was defined as platelet counts less than 100,000 and PT > 15 seconds, APTT > 35 seconds, or a DIC score of more than 4. The outcome in each group was measured as per the Glasgow Outcome Scale (GOS).

Results

Table 1: Laboratory parameters with scoring system

Severity	Platelet count (in lacs)	PT (in seconds)	APTT (in seconds)	D-dimer (ng/mL)	Fibrinogen (g/L)	Score for laboratory parameter	DIC score
Normal	> 1.5	13.5	26–34	< 1,000	> 2	0	0–3
Mild derangement	1–1.5	13.5–15.0	> 34	1,000–2,000	< 2	1	3–6
Moderate derangement	0.6–1.0	15–18	> 39	2,000–4,000	< 1.5	2	7–10
Severe derangement	< 0.60	> 18	> 54	> 4,000	< 1	3	> 10

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Table 2: Demographic data

Gender	Male	Female	Total
Age group in years			
20-30	10	4	14
31-40	12	6	18
41-50	26	7	33
51-60	22	2	24
61-70	10	1	11
Total	80	20	100
Mode of injury			
RTA	63	12	75
Fall	16	4	20
Others	1	4	5
Total	80	20	100

Majority of the patients belonged to the age group 41-50 years followed by 51-60 years. 80% were male and 20% were females in the present study. Road traffic accident was the primary (75%) mode of injury.

Table 3: Incidence of coagulopathy in moderate head injury (MHI) and severe head injury

Incidence of coagulopathy	Normal	Coagulopathy
Moderate head injury	12	32
Severe head injury	8	48
Total	20	80

In patients with MHI, 64% of the study population had coagulopathy while 48% of the patients with SHI were found to have coagulation abnormalities.

Table 4: Comparison of mean values and SD of DIC score as well as individual laboratory tests in expired and discharged patients of the SHI group

Parameters	Expired or vegetative (Group 1)	Discharged (Group 2)	p-Value	Mean value
DIC score	6.3 ± 1.97	4.0 ± 2.44	< 0.001	5.91 ± 2.18
Platelet	1.64 ± 0.58	1.55 ± 0.31	> 0.05	1.63 ± 0.54
PT	15.25 ± 2.98	12.92 ± 1.48	< 0.05	14.87 ± 2.90
APTT	35.84 ± 6.38	28.8 ± 3.85	< 0.05	34.67±6.53
Fibrinogen	0.71 ± 0.84	0.40 ± 0.284	> 0.05	0.66 ± 0.65
D-dimer	2812 ± 1351	2616 ± 1703.86	> 0.05	2779.73 ± 1375.57

The patients with SHI were divided into two groups. The first group included 40 patients and had GOS 1 or GOS 2. The second group included 8 patients and had GOS 5. p-Value for DIC score was < 0.001 and is statistically significant. p-Value in both PT and APTT was < 0.05 and was significant. However, it was not significant for D-dimer, fibrinogen, and platelet counts.

Table 5: Comparison of DIC score as well as individual laboratory tests in expired and discharged (GOS 3–5) patients of the MHI group

Parameter	Expired (Group 1)	Discharged (Group 2)	p-Value	Mean value
DIC score	8.0 ± 1.4	3.92 ± 2.33	< 0.001	4.23 ± 2.51
Platelet	0.9 ± 0.42	1.75 ± 0.328	< 0.001	1.69 ± 0.40
PT	17.05 ± 1.76	13.75 ± 2.13	< 0.05	14.01 ± 2.26
APTT	24.05 ± 4.03	34.93 ± 10.71	< 0.001	34.1± 10.72
Fibrinogen	0.47 ± 0.60	0.68 ± 0.66	> 0.05	0.66 ± 0.78
D-dimer	4122 ± 883.17	1829.23 ± 1385.15	< 0.001	2005.63 ± 1478.05

In patients with MHI, p-value in case of DIC score, platelet count, APTT, and D-dimer was < 0.001 and was highly significant. p-Value in PT was < 0.05 and found to be statistically significant, however, it was not significant for fibrinogen.

Discussion

Traumatic brain injury (TBI) is a global health burden that affects people of all socioeconomic groups. It is a leading cause of mortality, morbidity, and disability in patients of trauma. Coagulopathy associated with TBI is well known for a long time; however, the exact pathophysiology is still poorly understood. [6,16] However, several reports suggest coagulation derailments following TBI occur secondary to the release of tissue fac- tor which is the physiological initiator of local and systemic coagulation and fibrinolytic pathways. Coagulopathy following TBI is a dynamic process of hypercoagulability followed by hemorrhagic diathesis. [17-19]

Majority of the patients belonged to the age group 41-50 years followed by 51-60 years. 80% were male and 20% were females in the present study. Road traffic accident was the primary (75%) mode of injury. In patients with MHI, 64% of the study population had coagulopathy while 48% of the patients with SHI were found to have coagulation abnormalities. The factors responsible for coagulopathy in TBI patients are probably different from extracranial injury. Although isolated TBI does not have massive blood loss to induce coagulopathy, still it is commonly seen in clinical practice. [20] This suggests that TBI-induced coagulopathy follows a distinct pathogenic pathway that remains elusive. This also explains why the treatment and prevention of coagulopathy in TBI largely remains ineffective even today.31 The coagulation abnormalities in TBI have been studied earlier; however, the majority of them have included patients who sustained extracranial trauma too. The scoring system of ISTH was reviewed. Authors also added APTT in the study, the usefulness of which has been reported by multiple studies including Bakhtiari et al [21], Yuan et al [22] also observed a significant correlation of APTT with poor outcome and mortality compared with other coagulation parameters.

The patients with SHI were divided into two groups. The first group included 40 patients and had GOS 1 or GOS 2. The second group included 8 patients and had GOS 5. p-Value for DIC score was < 0.001 and is statistically significant. p-Value in both PT and APTT was < 0.05 and was significant. However, it was not significant for D-dimer, fibrinogen, and platelet counts. In patients with MHI, p-value in case of DIC score, platelet count, APTT, and D-dimer was < 0.001 and was highly significant. p-Value in PT was < 0.05 and found to be statistically significant, however, it was not significant for fibrinogen. Saggar et al [23] also reported higher INR values in expired (2.28 ± 0.59) patients compared with the discharged group (1.33)± 0.47. The IMPACT study (International Mission on Prognosis and Analysis of Clinical Trials) in TBI found that prolonged PT at admission was present in 26% of patients and was associated with a 64% increase in mortality risk. [24] In the meta-analysis by Epstein et al [25] retrospective and prospective cohort studies were analyzed and an incidence of 35.2% of coagulopathy in TBI patients was found.

Conclusion

The patients of isolated head injury are at high risk of developing coagulation abnormalities. Coagulopathy is directly associated with the severity of TBI, GCS, and is independently associated with poor outcome. DIC score is a useful parameter in the prediction of prognosis of head injury patients. The timely intervention in such patients can help improve prognosis. The analysis of coagulation parameters are useful predictors of outcome and can be used to explain the relatives about prognosis and course of the patient during the hospital stay.

References

1. Hyder AA, Wunderlich CA, Puvanachandra P, Gururaj G, Kobusingye OC. The impact of traumatic brain injuries: a global perspective. NeuroRehabilitation. 2007 Jan 1;22(5):341-53.
2. Harhangi BS, Kompanje EJ, Leebeek FW, Maas AI. Coagulation disorders after traumatic brain injury. Acta neurochirurgica. 2008 Feb; 1 50:165-75.
3. Hoyt DB. A clinical review of bleeding dilemmas in trauma. InSeminars in hematology 2004 Jan 1 (Vol. 41, pp. 40-43). WB Saunders.
4. Zhang J, Jiang R, Liu L, Watkins T, Zhang F, Dong JF. Traumatic brain injury-associated coagulopathy. Journal of neurotrauma. 2012 Nov 20;29(17):2597-605.
5. Maegele M, Schöchl H, Menovsky T, Maréchal H, Marklund N, Buki A, Stanworth S. Coagulopathy and haemorrhagic progress -sion in traumatic brain injury: advances in mechanisms, diagnosis, and management. The Lancet Neurology. 2017 Aug 1;16(8):630-47.
6. Laroche M, Kutcher ME, Huang MC, Cohen MJ, Manley GT. Coagulopathy after traumatic brain injury. Neurosurgery. 2012 Jun 1;70(6):1334-45.
7. Chen H, Xue LX, Guo Y, Chen SW, Wang G, Cao HL, Chen J, Tian HL. The influence of hemocoagulation disorders on the development of posttraumatic cerebral infarction and outcome in patients with moderate or severe head trauma. BioMed research international. 2013 Oct;2013.
8. Sun Y, Wang J, Wu X, Xi C, Gai Y, Liu H, Yuan Q, Wang E, Gao L, Hu J, Zhou L. Validating the incidence of coagulopathy and disseminated intravascular coagulation in patients with traumatic brain injury–analysis of 242 cases. British journal of neurosurgery. 2011 Jun 1;25(3):363-8.

9. Talving P, Benfield R, Hadjizacharia P, Inaba K, Chan LS, Demetriades D. Coagulopathy in severe traumatic brain injury: a prospective study. Journal of Trauma and Acute Care Surgery. 2009 Jan 1;66(1):55-62.
10. Yuan Q, Sun YR, Wu X, Yu J, Li ZQ, Du ZY, Wu XH, Zhou LF, Hu J. Coagulopathy in traumatic brain injury and its correlation with progressive hemorrhagic injury: a systematic review and meta-analysis. Journal of neurotrauma. 2016 Jul 15;33(14):1279-91.
11. Zhang D, Gong S, Jin H, Wang J, Sheng P, Zou W, Dong Y, Hou L. Coagulation parameters and risk of progressive hemorrhagic injury after traumatic brain injury: a systematic review and meta-analysis. BioMed research international. 2015 Oct;2015.
12. Goodnight SH, Kenoyer G, Rapaport SI, Patch MJ, Lee JA, Kurze T. Defibrination after brain-tissue destruction: A serious complica-tion of head injury. N Engl J Med. 19 74 May 9;290(19):1043-7.
13. Stein SC, Chen XH, Sinson GP, Smith DH. Intravascular coagulation: a major secondary insult in nonfatal traumatic brain injury. J Neurosurg. 2002 Dec;97(6):1373-7.
14. Lapointe LA, Von Rueden KT. Coagulopathies in trauma patients. AACN Clin Issues. 2002 May;13(2):192-203.
15. Bellamy RF, Maningas PA, Vayer JS. Epidemiology of trauma: military experience. Ann Emerg Med. 1986 Dec;15(12):1384-8.
16. van Gent JAN, van Essen TA, Bos MHA, Cannegieter SC, van Dijck JTM, Peul WC. Coagulopathy after hemorrhagic trau- matic brain injury, an observational study of the incidence and prognosis. Acta Neurochir (Wien) 2020;162(2):329–336.
17. Stein SC, Smith DH. Coagulopathy in traumatic brain injury. Neurocrit Care 2004;1 (4):479–488.
18. van der Sande JJ, Emeis JJ, Lindeman J. Intravascular coagu- lation: a common phenomenon in minor experimental head injury. J Neurosurg 1981;54(1):21–25.
19. Scherer RU, Spangenberg P. Procoagulant activity in patients with isolated severe head trauma. Crit Care Med 1998;26(1): 149–156.
20. Zhang J, Zhang F, Dong JF. Coagulopathy induced by traumatic brain injury: systemic manifestation of a localized injury. Blood 201 8;131(18):2001–2006.
21. Bakhtiari K, Meijers JC, de Jonge E, Levi M. Prospective val- idation of the International Society of Thrombosis and Haemostasis scoring system for disseminated intravascular coagulation. Crit Care Med 2004;32(12):2416–2421.
22. Yuan Q, Yu J, Wu X, et al. Prognostic value of coagulation tests for in-hospital mortality in patients with traumatic brain injury. Scand J Trauma Resusc Emerg Med 2018;26(1):3
23. Saggar V, Mittal RS, Vyas MC. Hemostatic abnormalities in patients with closed head injuries and their role in predicting early mortality. J Neurotrauma 2009;26(10):1665–1668.
24. Van Beek JG, Mushkudiani NA, Steyerberg EW, et al. Prognostic value of admission laboratory parameters in traumatic brain injury: results from the IMPACT study. J Neurotrauma 2007;24(2):315–328.
25. Epstein DS, Mitra B, O'Reilly G, Rosenfeld JV, Cameron PA. Acute traumatic coagulopathy in the setting of isolated traumatic brain injury: a systematic review and meta-analysis. Injury 2014;45(5):819–824.