International Journal of Research in Medical Sciences
Jadhao S et al. Int J Res Med Sci. 2022 Oct;10(10):2139-2143
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20222347

Original Research Article

Impact of coagulopathy in geriatric traumatic brain injury

Suraj Jadhao, B. L. Bairwa, Vinod Sharma, Sanjeev Chopra*

Department of Neurosurgery, SMS Medical College, Jaipur, Rajasthan, India

Received: 15 August 2022
Revised: 29 August 2022
Accepted: 30 August 2022

***Correspondence:**
Dr. Sanjeev Chopra,
E-mail: surajjadhav199152@gmail.com

ABSTRACT

Background: Traumatic brain injury (TBI) is the leading cause of death in trauma patients in various parts of the world including India. Coagulation cascade is affected in TBI. The severity of coagulopathy correlates with degree of primary injuries thus affecting the prognosis of geriatric patients. Since the prognosis of isolated TBI can be a challenge to predict at times. AIM: we wanted to study the potential of international normalized ratio (INR) test, prothrombin test (PT), platelet count as a prognostic tool in isolated TBI.
Methods: INR, PT, platelet count reflects the coagulation status. In most trauma cases, it is a routine test as well. We collected the INR, PT, platelet count value at admission of 200 isolated geriatric TBI cases over a period of three months. Then, patients were followed-up and their outcome at three months from admission is scored using Glasgow outcome scale (GOS). The relationship of INR, PT, platelet count with GOS was studied.
Results: From our limited study, we found that INR of 1.52, PT 17 sec or more and platelet count less than 1.10 lac predicts poor prognosis in cases of isolated geriatric TBI.
Conclusions: It is important to early diagnose and early manage the coagulation abnormalities in isolated geriatric head injury patients.

Keywords: Geriatric TBI, INR, Prognostic tool, Glasgow coma scale, GOS

INTRODUCTION

Increased risk of mortality is recognized in patients of head injury with hemostatic abnormalities. Uncontrolled bleeding and life-threatening coagulopathy are common clinically unresolved problems in trauma patients.[1] TBI is also known as acquired brain injury.[2] In geriatric patients, falls are common. Older age at injury is associated with worse functional outcomes after TBI, regardless of injury severity.[3,4] Increased age was associated with higher mortality and greater disability among survivors. Even small head injury like fall can cause significant intracranial bleeding which also cause increase in coagulopathy and increased morbidity like vicious cycle. Mortality TBI can be classified in several ways. One such way is primary and secondary injuries. A primary injury is due to mechanical force and occurs instantly whereas secondary injury is not mechanically induced and it may be delayed from the moment of impact. These in turn cause anatomical and physiological impairment. Secondary injury on the other hand is due to decrease in cerebral blood flow as TBI ignites a viscous cascade of events, ultimately leading to neuronal death.

Many changes occur following a TBI. One that concerns our study is traumatic injury-associated coagulopathy.[5] It is also known as acute traumatic coagulopathy (ATC). This condition has been reported significantly higher in patients with TBI despite the fact there is lesser bleeding in restricted receipt of volume of fluids in isolated TBI cases. This abnormal clotting occurs in 10-20% of head-injured patients.[6] One of it is the tissue factor hypothesis. Brain tissue is rich in thromboplastin, and TBI activates the extrinsic pathway and leading to initial transient hypercoagulable state. This in turn leads to secondary consumptive coagulopathy resulting in a hypo-coagulable

state.[7,8] The other proposed mechanism is explained via over-activation of protein C pathway.[9] INR is a measure of extrinsic pathway of coagulation, hence determining clotting tendency of blood. INR investigation is part of the routine investigation for all trauma patients in our hospital. Since the prognosis in isolated TBI is variable and difficult to judge, we wanted to further explore the potential of INR, PT, platelet count in predicting the prognosis in isolated TBI. It though it is possible that some geriatric patients may have had significant liver disease or had been taking anticoagulant medication, which also affect the outcome of the patients.

Aim

Aim of the study was to know the impact of coagulation profile (INR, PT, platelet count) derangements on the outcome of geriatric head injury patients.

METHODS

A study was of pilot prospective observational study.

Patients of head-injury aged 60 and above who admitted from January 2020 to January 2022 in trauma hospital, SMS included in present study. Following information obtained regarding age, sex, mode of injury, other associated injuries, other health co-morbidity, Glasgow coma score (GCS) on admission and on discharge. Samples for complete haemogram (CBC), prothrombin time (PTI), INR drawn. Blood collected by venepuncture in EDTA vacutainers as well as PT tubes containing anticoagulant sodium citrate and processed immediately.

INR, PT and platelet count at admission were recorded. GOS used to assess progress of patients. GOS score 1-3 are categorized as poor outcome where 4-5 as good outcome. The distinguishing cut-off that separates group 3 and 4 into different outcome categories is the patient's independence in carrying out daily activities of life.[10]

Glasgow coma scale of the patients was also recorded. It was divided into two groups too; high risk and non-high-risk groups.[10,11] High risk group included GCS of 3-8 while the non-high-risk group included GCS 9-15. Data was analyzed using commercial software SPSS version 16.0. The relationship of both INR, PT and platelet count with GCS and INR, PT and platelet count with GOS is studied using Spearman's rank correlation coefficient test, a non-parametric test.

Data analysed using commercial software SPSS version 16.0. Median values of INR, PT and platelet count in different groups obtained using Mann Whitney U test, a non-parametric test as well. Statistical analysis done by using chi-square method. $P<0.05$ taken as significant.

Coagulopathy was defined as platelet counts<100,000 cells/mm^2 and PTI >15 seconds or INR >1.5.

Inclusion criteria

All the patients admitting in Sawai Man Singh hospital, Jaipur aged more than 60 years were included in the study.

Exclusion criteria

All patients with age <60 years were excluded. Also, the patients who could not be revived and died in the casualty itself before admission to either the ICU or ward were excluded from the study. Geriatric patients with chronic illness, which adversely affect the outcome in patients of head injury; harboring any other injury (like fractured long bones or fat embolism), which interferes with the results of the laboratory tests; history of coagulopathy diseases, on anti-coagulation therapy and history of liver diseases were excluded as these conditions affect the coagulation pathway. The time period of the study was a period of 2 years from January 2020 to January 2022.

RESULTS

Age

Maximum number of patients was found in 60-65 years age groups (57.5%) followed by 65-70 years age groups (22.5%), 70-75 years age groups (10.5%), 75-80 years age groups (6%) and >80 years age groups (3.5%).

Gender

Male was 69.5% and female was 30.5%. The 200 patients with isolated TBI have been grouped as follows:

Table 1: Groups based on risk category.

Risk category	GCS	N	Percentage (%)
Non-high	9-15	134	67
High	3-8	66	33
Total		200	100

Table 2: 2 Groups based on outcome.

Outcomes	GOS	N	Percentage (%)
Good	4-5	143	71.5
Poor	1-3	57	28.5
Total		200	100

Table 3: GCS and GOS cross-tabulation.

Groups based on risk category	Groups based on outcome category (%)		Total (%)
	Good	Poor	
High risk	35 (53.03)	31 (46.97)	66 (100)
Non high risk	111 (82.83)	23 (17.17)	134 (100)
Total	146 (73)	54 (27)	200 (100)

Table 4: Relationship of GOS with GCS.

Parameters	GOS	GCS
Correlation coefficient	1.00	0.234
P value	<0.001	

Table 5: Relationship of GCS with INR, PT, platelet.

Parameters	GCS	INR value	Platelet	PT
Correlation coefficient	1.00	-0.304	-0.214	-0.331
P value		0.002	0.034	0.022

Table 6: Relationship of GOS with INR, PT, platelet.

Parameters	GOS	INR value	Platelet	PT
Correlation coefficient	1.00	-0.185	-0.228	-0.134
P value		0.048	0.041	0.015

Table 7: Median values of INR of non-high risk and high-risk groups.

Parameters	Median (Inter-quartile range)		P value
	Non-high-risk group	High risk group	
INR value	1.23 (1.10, 1.30)	1.52 (1.44, 1.72)	0.016
Platelet (Lac)	1.10 (1 to 1.20)	0.84 (0.80-0.88)	0.031
PT (Sec)	16 (15-17)	19 (18-20)	0.019

Table 8: Median values of INR of good and poor outcome groups.

Parameters	Median (Inter-quartile range)		P value
	Good outcome	Poor outcome	
INR value	1.29 (1.18, 1.40)	1.50 (1.42, 1.70)	0.012
Platelet (Lac)	1.14 (1 to 1.28)	0.88 (0.80-0.96)	0.024
PT (Sec)	15 (14-16)	20 (19-21)	0.032

Table 9: Platelet, PT, INR.

Variables	Platelet		PT		INR	
	N	%	N	%	N	%
Deranged	56	28	42	21	44	22
WNL	144	72	158	79	156	78
Total	200	100	200	100	200	100

The 200 patients have been separated into groups based on risk and outcome. Patients with good outcome were 146 patients (73.0%) and 54 patients (27.0%) had poor outcome. In terms of risk, 134 patients (67.0%) have been classified as non-high risk and 66 patients (33.0%) as high risk. GOS and GCS showed a positive relationship; 0.234 with p<0.001. Only 17.17% of non-high risk group patient had poor outcome as compared to 34.85% of high-risk group. This implies that the lower the GCS score, the poorer the outcome. GCS and INR and PT showed a negative relationship; -0.384 correlation coefficient with p=0.004 for INR and -0.331 correlation coefficient and p=0.022 for PT. The median value of INR in non-high risk and high-risk groups are 1.23 and 1.52 respectively with p=0.036. And for PT median values are 16 seconds and 19 seconds for non-high-risk groups and high-risk groups respectively with p=0.019. High risk group of patients had higher INR and prothrombin time values. This supports the fact that the TBI is associated with a hypocoagulable state. GCS and platelet count positive relationship. With 0.214 correlation coefficient and p=0.034. The median value of platelet count in non-high risk and high-risk groups are 1.10 lac and 0.84 lac respectively with p=0.031. This also support fact that traumatic geriatric brain injury associated with thrombocytopenia having low GCS INR, PT and GOS also showed a negative relationship; -0.185 correlation coefficient with p=0.048 for INR and -0.134 correlation coefficient and p=0.015 for PT. The median values of INR in good and poor outcome are 1.24 and 1.50 respectively with p=0.012. Thus, a lower value of INR is likely to be associated better outcome of patients. And for PT median values are 15 seconds and 20 seconds in good and poor outcome respectively with p=0.032. Poor outcome patients had higher INR and prothrombin time values. GOS and platelet count had positive relationship. With 0.228 correlation coefficient and p=0.031. The median value of platelet count in good and poor outcome patients are 1.14 lac and 0.88 lac respectively with p=0.024. This also support fact that in traumatic geriatric brain injury poor outcome associated with thrombocytopenia

DISCUSSION

In our study, higher 57.5% patients were found in 60-65 years age groups followed by 66-70 years, 22.5% patients and 71-80 years, 16.5% patients and above 80 years, 3.5% patients. 69.5% patients were male and 30.5% patients were female. Fall (23%) and RTA (57.5%) were higher in the study.

In present study, at admission, severe GCS (GCS less than 8) was present in 33% of the patients; moderate GCS (GCS: 9-12) was present in 29.5% of the patients and mild GCS (GCS13-15) was present in 37.5% of the patients.

Patients in geriatric head injury were divided into 4 groups based on 2 scale. First one is Glasgow coma scale and second one is GOS.

Patients were classified in 2 subgroup each as mentioned above. Relationship of GCS and GOS were compared each other. And impact of INR, PT and platelet count on GCS and GOS.

In the present study, 67 % patients were present in non-high-risk category (GCS 9-15) and 33% were in high-risk category (n=66) (GCS <8). GCS and GOS showed positive correlation. our finding was comparable to finding with study by Velayudhan et al.[12]

In the current study, we found that INR, PT and platelet count had significant impact on GCS and GOS. Mean INR was 1.23 and 1.29 in patients with non-high risk and patients with good outcome; 1.58 and 1.56 in patients with high risk and poor outcome group respectively. Which was comparable with study by Fuller et al.[7] Mean PT was 19 sec and 20 sec in patients having high risk and patients with poor outcome. The 16 sec and 15 sec mean was observed in patients non high risk and good outcome which was comparable with Gupta et al.[13] Platelet count mean was 0.84 lac in patients with high-risk category and 0.88 lac in patients with poor outcome which was comparable with study by Saggar et al.[14] And mean platelet count in non-high category patient was found 1.14 lac and 1.10 lac in patients with good outcome category.

GCS is the most widely used tool for the clinical assessment to determine the severity of TBI at presentation. Risk assessment was important to establish relationship between blood coagulation parameter like INR, PT, platelet count with GCS and GOS. In current study, it was clear that higher INR and PT value patients had poor outcome with significant p=0.048 and 0.041 respectively. Similarly, platelet count had negative correlation, patients with platelet counts less than 1.10 lac had poor outcome and had low GOS score more in patients with platelet count 0.84 lac with significant p=0.041. Also, patients with higher values of INR, PT and low platelet count were more from high-risk group with significant p value.

Low platelet (less than 1 lac) was present in 28% of the patients (n=76). Deranged INR (>1.5) was present in 22% of the patients (n=44). Deranged PT (more than 15 sec) was present in 21% of the patients. There was death in 19.5% of the patients (n=39). Out of these 39 expired patients, 24 (61.5%) patients had INR more than 1.5, comparable with study by Verma et al.[15] The 25 patients (64.10%) had PT more than 15 sec, and 28 patients (71.8%) had platelet count less than 1 lac.

Our study mainly focused geriatric patients. Though we excluded patients with deranged LFT, patients on oral anticoagulants, or known c/o blood disorder but still compared with other studies which mainly include patients with all age group, we mainly included patients above 60 years, who have compromised systemic functions including coagulation profile or may be early derangement in coagulation after injury as compared with young adults. Geriatric patients have normally higher side bleeding tendency due to fragile vessels leading to intracranial bleeding and consequently abnormality in coagulation parameter like INR, PT, platelets. Also, the other studies only considered fatal cases however, we included both the mortality and morbidity aspects and widening the range of patients considered as poor prognosis and narrowing the patients considered as good prognosis. Coagulopathy in TBI is usually transient and is variable over its course in the spectrum of TBI. Hence, clinical correlation plays a more significant role before deciding further interventions.

CONCLUSION

From the present study, we concluded that geriatric patients with isolated head injury are at a risk of development of coagulation abnormalities. INR, PT and platelet counts are important factors for outcome of the patients. Derangement of which associated with poor outcome. Based on our results we also emphasize the importance of early diagnosis and early management of coagulation abnormalities in isolated geriatric head injury patients. However, further studies are warranted to strengthen our study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Ragaller M. What's new in emergencies, trauma and shock? Coagulation is in the focus! J Emerg Trauma Shock. 2010;3:1-3.
2. Pangilinan PH, Kelly BM, Hornyak JE, Talavera F, Moichael T, Andary, et al. Classification and complications of Traumatic Brain Injury. Medscape. 2022.
3. Czosnyka M, Balestreri M, Steiner L. Age, intracranial pressure, autoregulation, and outcome after brain trauma. J Neurosurg. 2005;102:450-4.
4. Susman M, DiRusso SM, Sullivan T. Traumatic brain injury in the elderly: increased mortality and worse functional outcome at discharge despite lower injury severity. J Trauma. 2002;53:249-9.
5. Zhang J1, Jiang R, Liu L, Watkins T, Zhang F, Dong JF. Traumatic brain injury-associated coagulopathy. J Neurotrauma. 2012;29(17):2597-605.
6. Olson JD, Kaufman HH, Moake J. The incidence and significance of hemostatic abnormalities in patients with head injuries. Neurosurgery. 1989;24:825-32.
7. Fuller G, Pattani H, Chalmers A, Sperry D, Yeoman P. Coagulopathy predicts poor outcome in traumatic brain injury. Critical Care. 2008;12(2):P126.
8. Liu J, Tian HL. Relationship between trauma-induced coagulopathy and progressive hemorrhagic

injury in patients with traumatic brain injury. Chin J Traumatol. 2016;19:172e175.
9. Tian Y, Salsbery B, Wang M, Yuan H, Yang J, Zhao Z et al. Brain-derived microparticles induce systemic coagulation in a murine model of traumatic brain injury, Blood. 2015;27.
10. Jennett B, Bond M. Assessment of outcome after severe brain damage. Lancet. 1975;1(7905):480-4.
11. Teasdale G. Assessment of coma and impaired consciousness. The Lancet. 1974;304(7872):81-4.
12. Velayudhanl D, Nagaraj A. International Normalized Ratio (INR) as a Prognostic Tool in Isolated Traumatic Brain Injury (TBI). Asian J Basic Sci Res. 2021;3(1):16-23.
13. Gupta G, Wadhwa C. Impact of Coagulation Profile on Outcome of Head Injury. J Clin Diagnostic Res. 2016;10(1):PC04-6.
14. Saggar V. Hemostatic Abnormalities in Patients with Closed Head Injuries and Their Role in Predicting Early Mortality. J Neurotrauma. 2009;26:1665-8.
15. Verma A. International normalized ratio as a predictor of mortality in trauma patients in India. World J Emerg Med. 2014;5(3):193.

Cite this article as: Jadhao S, Bairwa BL, Sharma V, Chopra S. Impact of coagulopathy in geriatric traumatic brain injury. Int J Res Med Sci 2022;10:2139-43.