Study of Coagulopathy after Mild Traumatic Brain Injury and its Effect on Patient's Outcome

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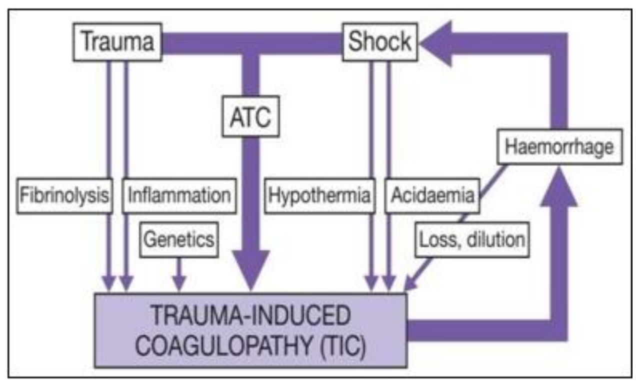
Abstract: ***This prospective cohort study investigates the relationship between coagulopathy and mild traumatic brain injury (mTBI) in patients admitted to the neurosurgery and emergency departments of a medical institute. Over a period of 1.5 years, data from 90 mTBI patients were analyzed to determine if coagulopathy influences patient outcomes. Key findings include the relationship between age, Glasgow Coma Scale (GCS) scores, and coagulopathy indicators, with results showing a weak but notable correlation between age and INR levels upon admission. The study concludes that while mild TBI may present certain coagulation abnormalities, these factors do not significantly impact patient discharge outcomes. Result: No positive association between coagulopathy after mild traumatic brain injury***

Keywords: Traumatic brain injury, Coagulopathy, Glasgow Coma Scale, Head trauma, Patient outcome

1. Introduction

Coagulopathy frequently develops following traumatic brain injury (TBI) and can significantly influence patient outcomes and post-injury complications. While most research has focused on severe traumatic brain injuries, coagulopathy can also affect patients with mild traumatic brain injury (mTBI). Depending on how mTBI is defined, it accounts for 70% to 90% of TBI cases. Some researchers describe mTBI as neurotrauma causing mild, temporary changes in consciousness without evident structural abnormalities on neuroimaging, while others debate whether mTBI exists as a distinct clinical condition. Additionally, concussion is sometimes considered synonymous with mTBI, as per guidelines from the Brain Trauma Foundation. Indicators of concussion, such as disorientation, impaired balance, slower reaction times, and memory difficulties, are commonly used to identify mTBI. Much of the research in this area has been informed by studies on military personnel and athletes, particularly those involved in contact sports. Between 2000 and 2016, mTBI represented 82.4% of all TBI cases in the military. (1)

Despite extensive research, particularly from civilian and military centers, trauma- induced coagulopathy (TIC) remains an incompletely understood phenomenon. The molecular mechanisms driving TIC are still unclear, with various studies suggesting a complex interplay between procoagulant, anticoagulant, and fibrinolytic pathways, leading to platelet dysfunction and depletion of clotting factors. Acute traumatic coagulopathy (ATC), a form of TIC, often occurs in response to tissue damage and hypovolemic shock, developing rapidly in up to 25% of trauma patients and being linked to a fourfold increase in mortality. ATC results from a combination of shock and tissue trauma and is considered a multifactorial component of TIC. (2)



The relationship between TBI and coagulopathy was first recognized almost 60 years ago and has been demonstrated in cases of both blunt and penetrating trauma. Coagulopathy in TBI patients is common and is associated with poorer outcomes, with numerous studies highlighting the prevalence of coagulopathy in these patients. However, much of this research has concentrated on patients with severe TBIs. This study aims to examine whether coagulopathy also occurs in patients with mTBI and to assess whether this coagulopathy affects their prognosis and overall recovery. By focusing on mTBI, the study seeks to fill a gap in the literature and further understand the clinical significance of coagulopathy across the full spectrum of TBI severity. (3)

2. Aim & Objective

Aim:
This study aims to explore the association between coagulopathy and mild traumatic brain injury and assess how these factors affect the outcomes of patients admitted with Mtbi

Objective:
Understanding the link between coagulopathy and mTBI outcomes is essential for improving patient management and potentially reducing adverse outcomes, as even mild brain injuries can lead to significant complications when coagulopathy is present

3. Methodology

This study focuses on patients admitted to the neurosurgery department with traumatic brain injuries (TBI), categorized as mild to moderate based on a Glasgow Coma Scale (GCS) score greater than 12. Upon admission, patients underwent comprehensive laboratory investigations, including a complete blood count (CBC), liver function tests (LFT), and a coagulation panel consisting of bleeding time (BT), clotting time (CT), prothrombin time (PT), international normalized ratio (INR), and activated partial thromboplastin time (aPTT). These tests were repeated at discharge. The inclusion criteria encompassed patients aged 18-60 years who presented within 24 hours of injury with a GCS over 12, regardless of head CT findings, and had open wounds or contusions. Key laboratory inclusion parameters were thrombocytopenia (platelet count <100,000/mm³) and prolonged coagulation times, such as an INR beyond the normal range (0.91–1.10) or an aPTT of 30-40 seconds. Exclusion criteria were patients with known coagulation disorders, anticoagulant use, chronic liver or kidney disease, chronic alcoholism, those who had undergone surgery, or polytrauma cases.

4. Results

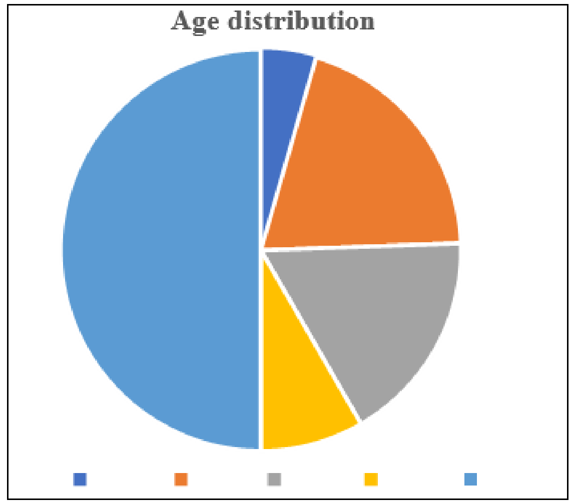
Table 1: Gender Distribution

Sex	Number	Percentages
Male	62	68.8
Female	28	31.1
Total	90	100

In this study there are 62 males and 28 females and male to female ratio is 2.21. The most common age group is 20-30 years [40%], followed by 30-40 years [34.44%] patients. Mean age group is 31.12 years found in our study.

Table 2: Age distribution

Age [years]	Numbers	Percentages
10-20 yrs	8	8.88
20-30 yrs	36	40
30-40 yrs	31	34.44
40-50 yrs	15	16.6
Total	90	100



Graph 1

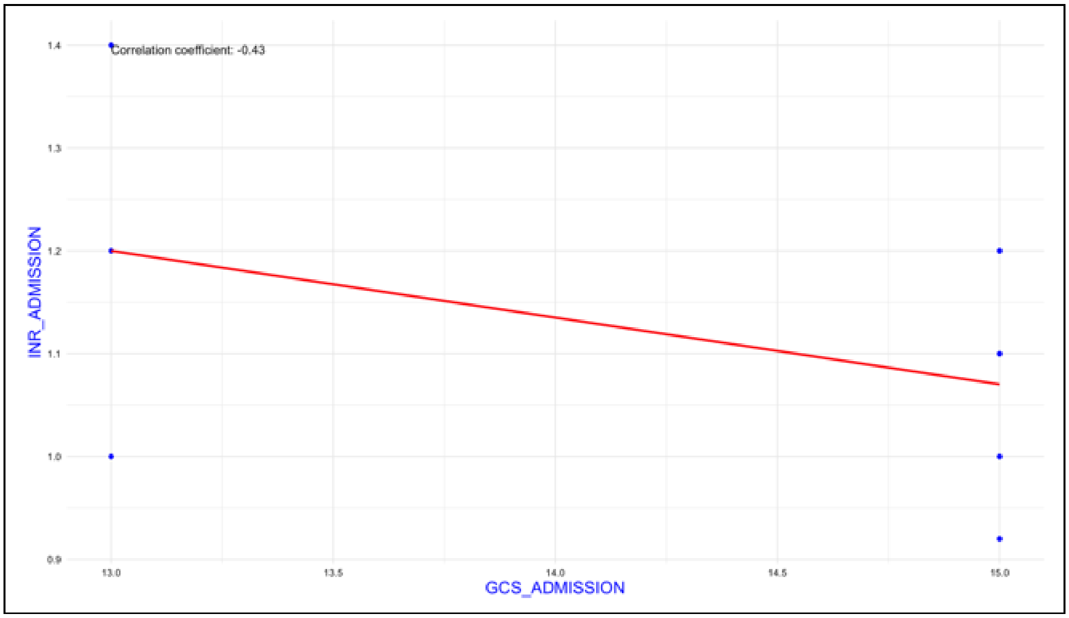
In my study GCS on admission is mostly found 15 [71.1%], 14 [8.88%] and 13 [20%] patients. At the time of discharge all patient's GCS is found to be 15.

Table 3

GCS	Number	Percentages
13	18	20
14	8	8.88
15	64	71.1
Total	90	100

In my study PT/INR at the time of admission ranges from 0.9 to 1.4 and mean PT/INR valueis found to be 1.1, while at the time of discharge PT/INR value ranges from 0.92 to 1.2 and mean value is found to be 0.995.

It is observed that as age increases, there is a tendency for INR levels on admission to also increase slightly, but the relationship is not very strong.

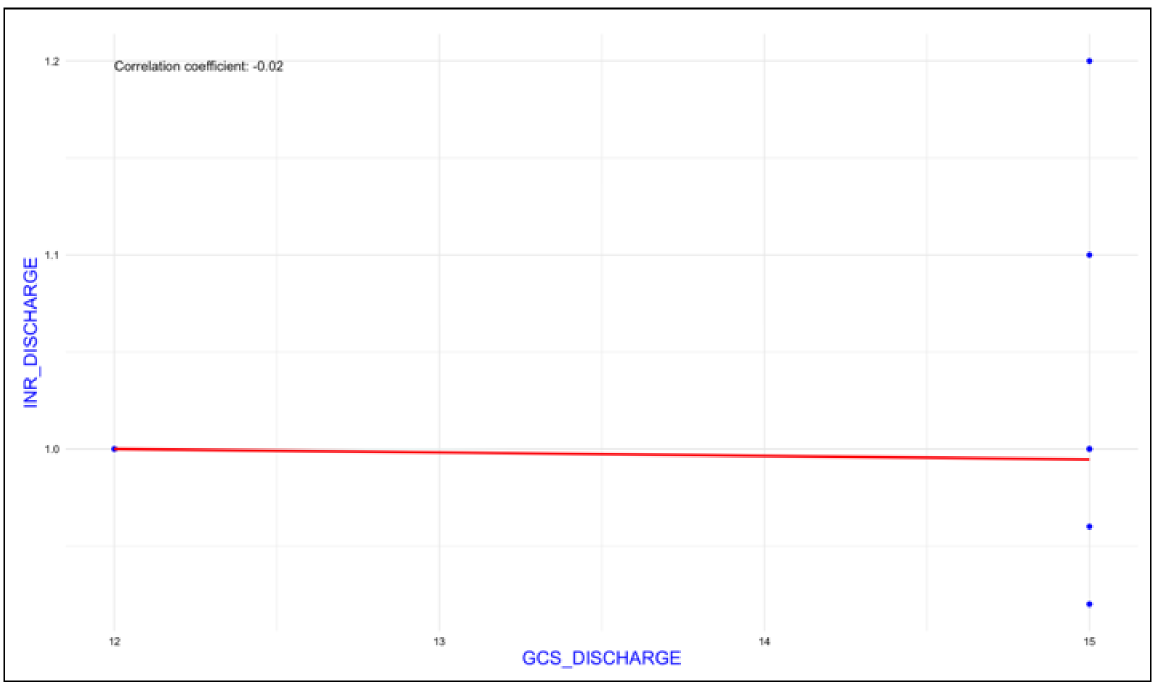


Graph 2

GCS value and INR value at the time of admission

Correlation coefficient of -0.43 indicates a moderate negative linear relationship between GCSon admission and INR on admission. This means that as GCS on admission decreases (indicating lower levels of consciousness), there is a tendency for INR levels on admission to increase, and vice versa. However, the relationship is not extremely strong, but it's significant enough to suggest a noticeable association between the two variables.

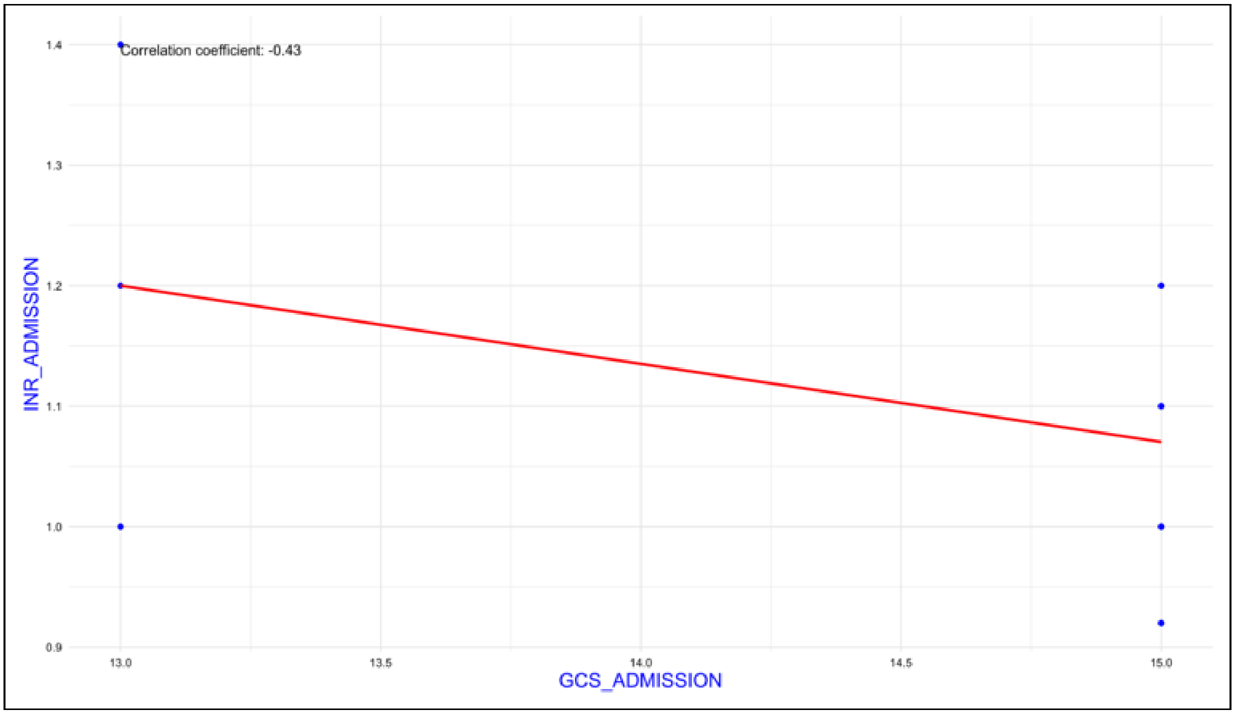
It is also found that as age increases, there is a tendency for INR levels at discharge to also increase slightly, but the relationship is not very strong.



Graph 3: Value of GCS and INR on discharge

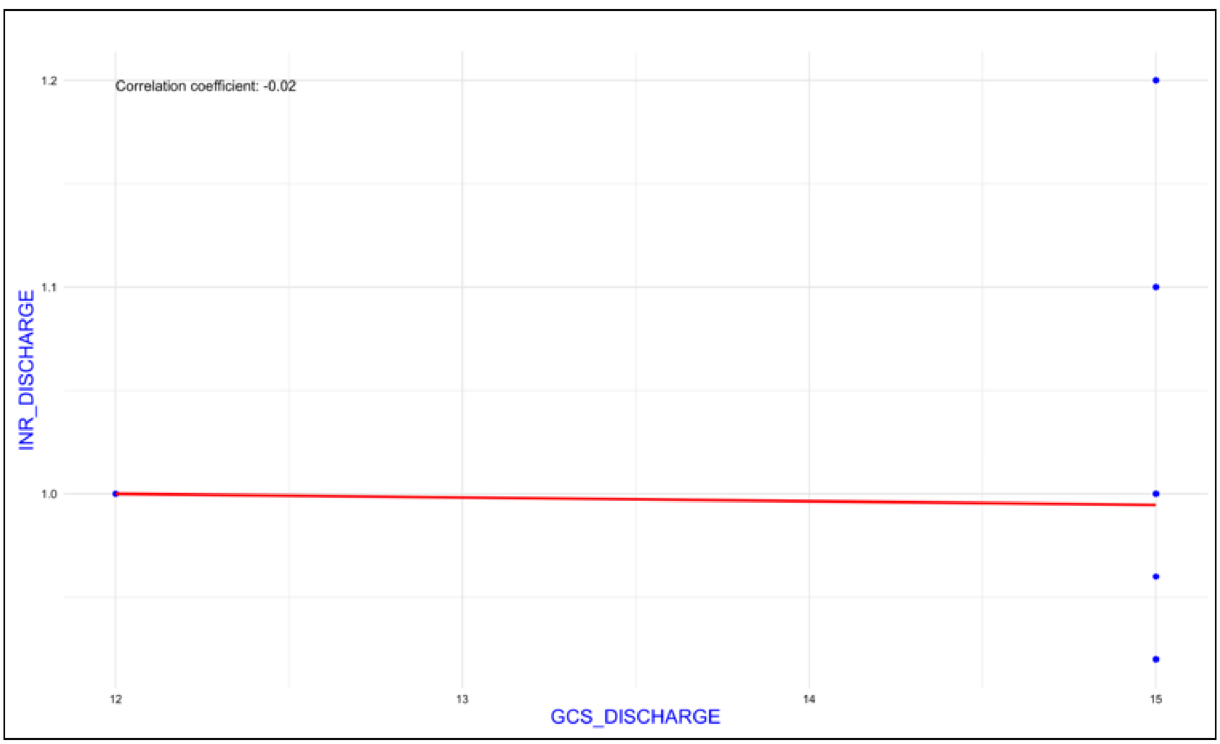
Correlation coefficient of -0.02 indicates a very weak negative linear relationship between GCS at discharge and INR at discharge. This means that there is almost no systematic linear relationship between these two variables.

There are no deaths, all patients of mild traumatic brain injury have been discharged.



Graph 4: Relationship between GCS and INR on Admission

Correlation coefficient of -0.43 indicates a moderate negative linear relationship between GCS on admission and INR on admission. This means that as GCS on admission decreases (indicating lower levels of consciousness), there is a tendency for INR levels on admission to increase, and vice versa. However, the relationship is not extremely strong, but it's significant enough to suggest a noticeable association between the two variables.



Graph 5: Relationship between GCS and INR on Discharge

Correlation coefficient of -0.02 indicates a very weak negative linear relationship between GCS at discharge and INR at discharge. This means that there is almost no systematic linear relationship between these two variables.

5. Discussion

This two-year prospective cohort study was conducted at the Raipur Institute of Medical Science Hospital in Raipur, Chhattisgarh, focusing on patients with traumatic brain injury (TBI) admitted to the neurosurgery and emergency departments. A total of 90 patients with mild traumatic brain injury (mTBI) were included, consisting of 62 men and 28 women, yielding a male-to-female ratio of 2.21. The study population had a mean age of 31.12 years, with the most common age group being 20-30 years (40%), followed by 30-40 years (34.44%). Glasgow Coma Scale (GCS) scores upon admission were primarily 15 (71.1%), with smaller percentages of patients presenting with scores of 14 (8.88%) and 13 (20%). By discharge, all patients had improved to a GCS score of 15, indicating that the severity of mTBI diminished over time.

Coagulopathy associated with TBI has been well-documented, but most studies have focused on moderate to severe cases. A study by Gopal Krishna et al. in 2021 included 50 patients with moderate to severe TBI, finding that 62% of those with moderate injuries and 96% of those with severe injuries had coagulation abnormalities, with a strong correlation between injury severity and disseminated intravascular coagulation (DIC) scores. (4) Similarly, Joseph P. and Herbert et al., in a 2017 study, highlighted that TBI-induced coagulopathy remains a significant factor in early mortality among TBI patients.(5)

The current study observed that there was a weak positive correlation between age and INR at admission (correlation coefficient of 0.16), indicating a slight increase in INR with age. INR values ranged from 0.9 to 1.4 at admission (mean 1.1), but normalized by discharge with a mean of 0.995. A weak negative correlation was also observed between GCS at discharge and INR at discharge (correlation coefficient of -0.02), suggesting no strong linear relationship between these variables. However, a more noticeable association was seen between GCS at admission and INR at admission, with a moderate negative correlation (correlation coefficient of -0.43), indicating that as GCS decreased, INR increased. (8)

Several other studies have explored the relationship between coagulopathy and TBI. Kuo et al. found that patients with higher coagulopathy scores (CS) within 24 hours of injury were more likely to experience poor outcomes, with mortality rates increasing significantly for CS values of 4 or higher. (6) Additionally, Lustenberger et al. identified tissue hypoperfusion as a contributing factor to coagulopathy in severe TBI patients. (9) Halpern et al. further explained that the release of tissue factor (TF) is a key mechanism in trauma-induced coagulopathy, though their study found that PT levels normalized in TBI patients after 12 hours, while remaining elevated in non-TBI trauma cases. (10)

The study conducted by Selladurai et al. underscored the predictive significance of coagulation abnormalities in acute brain injury, particularly through prothrombin time, APTT, and fibrin degradation products (FDP). Cortiana et al. also identified DIC as a significant contributor to mortality in head trauma patients. (7)

While this study adds to the growing body of research on TBI-associated coagulopathy, its generalizability may be limited due to its single-site design, as regional factors such as healthcare practices and patient demographics may influence outcomes. (11)

6. Conclusion

This study highlights the relationship between mild traumatic brain injury and coagulopathy, revealing weak but identifiable correlations between patient age, GCS scores, and INR levels. Although the study found no strong association between coagulopathy and patient outcomes, further research may elucidate these findings, especially in varied patient demographics and settings.

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