

Research Article

The Evaluation of Frequency of Intracranial Haemorrhage in Patients of Head Trauma with GCS 10-15 on Computed Tomography Scan

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Abstract: Traumatic head injuries are a prominent cause of death. The privilege of intracranial hemorrhage is one of the fatal problems. CT-scan is considered the gold standard for the traumatic brain injuries diagnosis. GCS of the patients is helpful in patient evaluation. Patient with high GCS are neglected but it may be considered that they can develop significant problems. However, it is controversial whether to perform CT-scan in patients that have 13-15 GCS or not. **Purpose:** I hereby to evaluate the patients of head trauma with high GCS 10-15 on CT-scan that may be neglected but they may develop symptoms. My aim of study was to determine whether it is safe to discharge such patients or performing CT scan is safe. Besides this, I mainly found the frequency of different types of ICH in 50 patients that have 10-15 GCS. **Approach:** 50 patients of head trauma injuries were evaluated on computed tomography. All the patients had undergone non-contrast computed tomography scan of brain with the axial images and slice thickness of 5mm from foramen magnum to vertex. A Performa was filled for patient's name, age, gender and other findings. Any statistical variables were correct by putting some exclusion criteria i.e. bleeding disorder and anti-coagulant therapy so that it might not influence the desired conclusions. **Results:** Out of 50 patients 22 (44.00%) patients had intracranial hemorrhage. Out of these 22 patients 9 (40.91%) had EDH, 9 (40.91%) had subdural, 2 (9.09%) had SAH and 2 (9.09%) had ICrH. **Conclusion:** This study demonstrates that the frequency of ICH is 44% and the incidence of SDH and EDH is equally higher than other types. Patients with RTA have higher risk of ICH and it is more in females than in males. Data analysis for different variables was done by using Microsoft excel 365. Graphs and charts were used to explain the results.

Keywords: Intracranial haemorrhage, GCS, Epidural haemorrhage, subdural haemorrhage, Head trauma, Computed tomography.

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INTRODUCTION

Head trauma is a major cause of neurological disability. In each year, approximately 2 million head injuries occur [1, 2]. The privilege of intracranial hemorrhage is one of the fatal problem. According to one estimation conducted by Johan S. the value of ICH increasing with increasing the age and with decreasing the GCS [3]. In 2016 research conducted in Khyber teaching hospital the incident of intracranial haemorrhage is 15.3% from which the percentage of subdural haemorrhage is highest 36%. [4] Although the brain is protected by a hard outer covering and is cushioned by CSF but it may get injured by a sudden impact, any severe blunt trauma on the rigid skull exerts pressure on the brain. The cranio-cerebral trauma causes contusions, hemorrhagic lesions, herniations, infarction etc. Intracranial haemorrhage (internal bleeding) occurs by the trauma or cerebral vascular lesions. [5] In 80-90% of patients, skull fracture is an overlying cause of

epidural haemorrhage. The patients may present with a period of unconsciousness followed by lucid interval and rapid neurological deterioration may develop. Skull x-ray presents a linear fracture with crossing the middle meningeal artery groove while CT-scan shows a well-defined lesions [1, 6]. SDH is the accumulation or collection of blood in the space present between the dura and arachnoid membrane. After acute SDH, patient may suffer a lucid period initially with neurological deficits. On CT images SDH appears as a crescent shaped homogeneous hyperdense extraaxial cerebral lesions that spreads and diffuses entirely on the affected hemisphere. The treatment and management for SDH is early surgical interventions but still the mortality rate for SDH is 37-57% [7-10]. In severe head injury the occurrence of SAH is highest among all the other type of haemorrhages [11]. Intra cerebral hemorrhage occurs due to stroke which cause due to the pooling of blood in intracranial tissues. It is most common in patients with hypertension. GCS is the

initial parameter to detect the severity of the head injury. However, it is a controversy in best scoring between the neurosurgeons and non-neurosurgeons as they both have different way to scoring. Some neurosurgeons score the patients after stabilizing the hypoxia or hypertension but others score them within 1 hour regardless of any hypoxia etc. such differences make it difficult to interpret the severity of injury on the basis of GCS. There is need to recognize the international policy for scoring [12, 13]. GCS alone is not recommended for assessing the brain injuries' severity or to forecast coma and outcomes [14]. Computed tomography brain scan is a gold standard for the early detection of ICH, as it is the first line investigation for trauma patients. Unenhanced CT-brain and enhanced CT-brain are both valuable for diagnosis. CT-brain with axial slice of 5mm thickness from foramen magnum to vertex is taken. To investigate the epidural haemorrhage CT-brain with bone window can also be preferred if the hematoma is localized along the bone [1, 15, 16]. I will hereby to evaluate intracranial haemorrhage in patient with high GCS 10-15 and may be neglected but they may develop symptoms. My aim of study is to determine whether it is safe to discharge such patients or performing scan is safe. The increasing ratio of road traffic accident is the major cause of TBI. Thus by finding the incidence and cause of ICH, better treatment plans and precautions can be made.

MATERIAL AND METHOD

Study Design

It is an observational study.

Duration of Study

Probably four months (October 2019 to January 2020).

Inclusion Criteria

- All age groups
- All genders
- Head trauma
- Patients with GCS 10-15

Exclusion Criteria

- Patient on anti-coagulant therapy
- Patients with bleeding disorder

Data Collection Procedure

150 patients of head trauma who had GCS 10 or more than 10 (10-15), arrival upon hospital, were registered in this study. CT-brain was performed for all those patients from radiology department. For data collection or its utilizes, permission was taken from hospital's administration committees. All the patients executed the above-mentioned inclusion criteria visiting the Emergency and Neurosurgery department of Allied Hospital Faisalabad and the Radiology department of Mujahid Hospital Faisalabad for CT-scan, treatment and surgery, in that probable duration were recognized.

12 patients were from the OPD of Mujahid hospital and 132 patients were from the neurosurgery department and 6 patients were from the emergency department of Allied Hospital Faisalabad. Hospital records and patients' files were groped for patient's personal information; mode of injury, type of injury etc and consent was taken by them or their guardians.

These patients were divided into four different age groups i.e. 1-25 years old patients were included in group 1, 26-50 years into 2nd group, 50-75 years into 3rd and above 76 years into 4th group. Computed tomography scan of brain without IV contrast in axial plane and slice thickness of 5mm from foramen magnum to vertex was performed to find any abnormality. Only patient's 1st CT-scan of brain and GCS scoring which was on the arrival of patient in hospital was considered. For patient's name, age, gender and head injury and CT findings, a Performa was filed by myself. An exclusion criterion was set to prevent any bias or confounding variable. The patients which was excluded from this study i.e. had bleeding disorder and anticoagulant therapy, have higher risk of developing intracranial hemorrhage spontaneously. If these were included in this study the result of study would be affected as it acted as confounding variable.

Data Analysis Procedure

All the data were analysed using Microsoft excel 365. Mean and percentages were calculated for the entire numerical or quantitative variable such as age, gender, frequencies of intracranial haemorrhage, mode of injury, GCS and CT findings. Graphs, tables, component and multiple bar charts and pie chart used to express different frequencies.

RESULTS

150 patients were divided into four age groups into which 1st age group ranged 1-25 were 66 (44.00%), 2nd age group ranged 26-50 were 51 (34.00%), 3rd group ranged 51-75 were 21 (14.00%) and 4th group ranged >76 were 12 (8.00%) in number (Table-3).

Table-1: Age Distribution

Age (Years)	Number of Patients	Percentage
1-25	66	44.00
26-50	51	34.00
51-75	21	14.00
>76	12	8.00

Out of these 150 patients 117 (78.00%) were male and 33 (22.00%) were female presented with head injuries (Fig-5). From these 150 patients the patients which had history of road traffic accident (RTA) were 99 (66.00%), H/O fall were 45 (30.00%) and 6 (4.00%) had different history of head injuries i.e. domestic abuse and firearm injuries etc (Table-4).

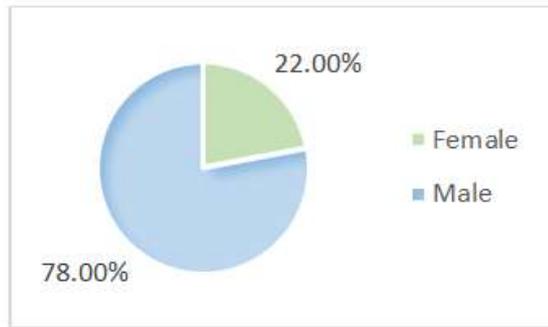


Fig-1: Gender Distribution

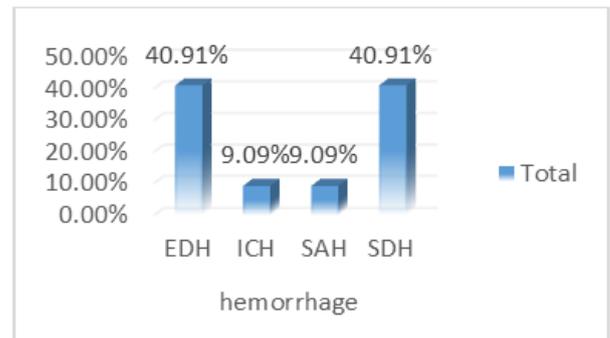


Fig-2: Frequency of Types of Intracranial Hemorrhage

Table-2: Mode of Head Injury

Mode of injury	Frequency	Percentage
RTA	99	66.00
H/O fall	45	30.00
Other modes of trauma	6	4.00
Total	150	100

9 patients had brain edema, 15 had contusion, 24 had skull fractures, 33 were normal, 3 had cerebral swelling and 66 patients had intracranial hemorrhage. From these 33 normal patients, 18 had spinal injuries but no head injuries despite trauma from which CT-brain had not been performed for 15 patients because they had GCS 15.

The frequency of intracranial hemorrhage evaluated on CT was 66 (44.00%) out of 150 patients (Table-3). From 66 patients of ICH, patients with epidural hemorrhage (EDH) were 27 (40.91%), subdural hemorrhage (SDH) were also 27 (40.91%), subarachnoid hemorrhage were 6 (9.09%) and intracerebral hemorrhage (ICrH) were also 6 (9.09%) (Fig-3). According to different age groups, the highest incidence of intracranial hemorrhage was among the 26-50 age group which was 30 from 22 patients. Patients with history of RTA had higher rate of ICH (77.26%) than other causes of head injuries.

Table-3: Age Distribution in Patients with Intracranial Hemorrhage

Age	ICH	Percentage
1-25	21	31.82
26-50	30	45.45
51-75	9	13.64
>76	6	9.09
Total	66	100.00

According to the data the ratio of head injuries were highest among males (78.00%) as compared to females (22.00%) as well as the ratio of ICH was also higher in males 81.82% than in females 18.18% (Fig-4).



Fig-3: Gender Distribution in ICH

Table-4: Mode of Injury in Patients with Intracranial Hemorrhage

Mode of injury	Hemorrhage	Percentage
RTA	51	77.26
H/O fall	9	13.64
Others	6	9.00
Total	66	100.00

The most important criteria of this study on which the whole study is mainly based is CGS scoring. Out of 150 patients 15 (10.00%) patients had 10 GCS, 15 (10.00%) had 11, 24 (16.00%) had 12, 27 (18.00%) had 13, 12 (8.00%) had 14 and 57 (38.00%) had 15 GCS. The percentage of ICH varies among GCS 10-15 were 9 (13.64%) in patients with GCS 10, 9 (13.64%) in GCS 11, 12 (18.18%) in GCS 12, 12 (18.18%) in GCS 13, 9 (13.64%) in GCS 14, 15 (22.73%) in GCS 15 (Table-5).

Table-5: The GCS Distribution in Head Injury and ICH

GCS	No. of Patients	No. of patients with ICH	Percentage of head injury	Percentage of ICH
10	15	9	10.00	13.64
11	15	9	10.00	13.64
12	24	12	16.00	18.18
13	27	12	18.00	18.18
14	12	9	8.00	13.64
15	57	15	38.00	22.73

For GCS 10, there was 4.55% EDH, 4.55% ICrH and 4.55% SAH but no patient presented with SDH. For GCS 11, 4.55% ICrH and 9.09% SDH but 0.00% EDH and SAH.

In patients with GCS 12, 4.55% EDH, 4.55% SAH and 9.09% SDH but 0.00% ICrH. Patients who had GCS 13 had 4.55% EDH and 13.64% SDH but 0.00% ICrH and SAH. Patients with GCS 14 had only 13.64% EDH, but no one presented with SAH, SDH and ICrH. For GCS 15, 13.64% EDH and 9.09% EDH. All these data predicted that the patients presented with EDH were highest among GCS 14 and 15 as compared to other types but SDH had highest ratio among GCS 13. The other two types are not so common.

DISCUSSION

The major cause of worldwide morbidity is head injury [17] and the major cause of neurological disability is traumatic brain injuries [18]. Almost 65% of traumatic patients have head injuries [4]. Nearly, 52,000 US deaths per year are due to traumatic brain injury [17]. In Pakistan the mortality rate due to brain injuries is 15% with the annual rate 81 per 100,000 [19]. The most common and fatal result of brain injuries is intracranial hemorrhage [20]. In the MRC CRASH trial, which involved mild to severe traumatic brain injury patients, 56% of trial participants had at least 1 intracranial hemorrhage [21]. The incidence of intracranial bleeding differs with the severity of injury, patient age, presence and absence of associated skull fracture and the site of injury classified anatomically i.e. frontal, temporal, parietal and occipital regions [22].

Since for a long time CT had been widely used for the neuromonitoring of head trauma, according to a multicenter survey in Japan [23]. Computed tomography is the most common modality used for the evaluation of ICH after trauma and also provides information for the structural damages of brain [20]. Axial non-contrast acute CT is considered as gold standard for traumatic patients [24]. To eliminate superfluous hazards and to improve affordability optimal use of CT for emergency physician is a key point [25]. CT findings in traumatic patients may be contusion, intra cerebral and extra cerebral hematomas or hemorrhages, shearing injury of cerebral white matter and focal and general cerebral swelling. Presence of intracranial bleed, midline shift and the mass effect on CT are the diagnostic criteria for ICH [26].

Regarding the frequency (values between 0% and 6%) of delayed intracranial hemorrhage (ICH) confliction is present and hence, there is need of repeated CT or this group [27]. More precise result estimate would be expected by using the worst CT scan, as it would capture any possibly harmful lesion development [28]. As reported by Kim *et al.*, the HU of

brain tissue is <40, hemorrhagic cells have <80 HU and the CSF has HU between 0 and 15 [29]. An elevation in global CT HU values is caused extra-axial hematoma, which distort intracranial contents; while surgical decompression is accompanying with lower global CT HU values [30].

In 2005, the Rotterdam computed tomography scoring was introduced, adding intraventricular hemorrhage and traumatic subarachnoid hemorrhage (tSAH) in Marshall CT classification for the purpose of reweighting the components of Marshall Classification and to create ordinal score [31]. Components from the Rotterdam CT score today an integral part of the International Mission for Prognosis and Analysis of Clinical Trials in TBI (IMPACT) outcome model for TBI patients [22].

There is association between the GCS, the severity of brain injury and the CT findings. Sometimes it considered that the patients with high GCS >10 would be normal and may not able to develop severe brain defects but this concept may be controversial. Because patients with GCS>10 can develop significant brain damages. GCS is affected by a number of factors such as sedative medications [32] and drugs, its dynamic behavior [33] and its subjective nature during the 1st day [34], so it is indeterminate discriminator. Therefore, it predicts that the classification of brain injuries based on GCS may cause fatal consequences. For this purpose, acute CT brain of the patients must be necessary.

In this study, 150 patients were involved from the emergency department, neurosurgery ward and OPD. Patients with high GCS ≥ 10 (10-15) or normal to mild GCS were enrolled and evaluated by non-enhanced acute computed tomography to evaluate the frequency of intracranial hemorrhage and the frequency of its types. From these 150 patients, 66 patients had intracranial hemorrhage. The frequency was 44.00%. It was compared with a number of studies. In diagnosing ICH and the patient early management non-contrast CT is accurate investigation [35].

According to the study performed by Racadio *et al.*, the frequency of intracranial hemorrhage was 46%. Whereas in a study conducted at Shifa International hospital in 2008 found 0.6% of cases of head trauma had intracranial hemorrhage [36]. In the crash trial which was considered the largest trial carried out for traumatic patients of head injury, 56% of the patients had different types of intracranial hemorrhage and 27% had subdural hemorrhage (SDH) which had higher incidence along EDH in the following study [35].

As compared with the study conducted in the Shifa Hospital my study has higher incidence which is 44% but it is comparable with study performed by Racadio *et al.*, [38].

Another study conducted by Rosenthal and colleagues at head trauma patients; patients were scanned and found that 16% of patients had ICH [19] which also has a lower incidence as compared to my study. In the same way, Ruiz *et al.*, found 23% of intracranial hemorrhage in 160 patients of head injury [24]. Recently another study included the traumatic patients of brain injury reported by Russo and colleagues found that 51% patients had intracranial hemorrhage which predicts a higher incidence rate as compared to this study.

Four commonest type of intracranial hemorrhages were considered in this study that are epidural hemorrhage (40.91%), subdural hemorrhage (40.91%), subarachnoid hemorrhage (9.09%) and intracerebral hemorrhage (9.09%) (Fig). These results are comparable with other studies which depict the increased rate of subdural hematomas and epidural hematoma in patients of head injury.

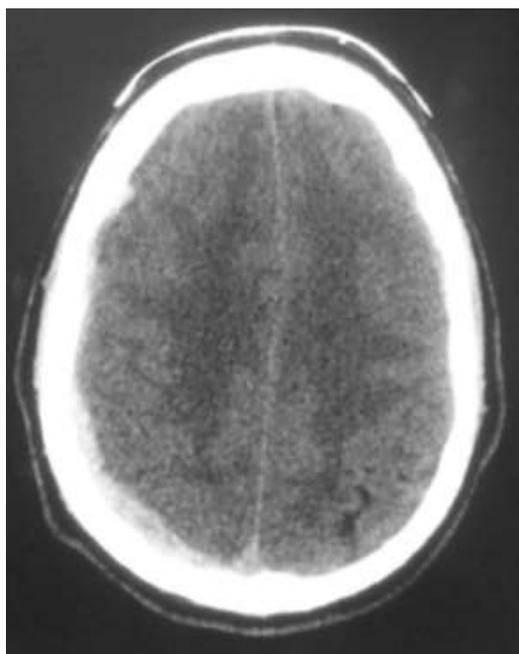


Fig-4: CT scans Brain showing Small Hyper dense Subdural Hematoma along Right Cerebral Convexity

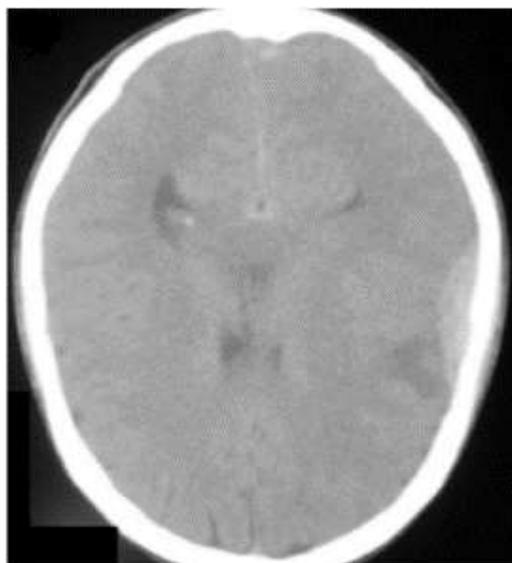


Fig-5: Axial CT Brain Image of a trauma patient showing left parietal extradural hematoma and small adjacent insular contusion

Ravindran *et al.*, found that 20% of patients had subdural hematomas [37]. In 2010 a study was conducted on 9 randomized clinical trials in patients of head trauma, the range of frequency of EDH and SDH was 7-8% and 8-9%, respectively which is lower as compared to this study [35].

According to another research 30% were subdural hemorrhage and 22% were epidural and intracerebral hemorrhage each [38]. In 2009, a study conducted at Radiology department of Dow University of Health Sciences according to which the rate of EDH was 48% [19] as compared to other types of hemorrhages which is comparable with my study. According to Rashid *et al.*, another study, the frequency of subdural hemorrhage was 22 out of 38 patients (58%) and 39% intraparenchymal bleed [39]. According to Tenny *et al.*, in the patients of head injuries epidural hematoma is account for approximately 2% which is 5% to 15% fatal. 85% to 95% of EDH has underlying skull fractures^[40] which are against the result of my study.

Out of 150 patients enrolled in this study 22% were females and 78% were males which predict that the ratio of males was higher than females because the males have encountered the road traffic accident more than females. According to the study reported in Dow University Karachi the prevalence of head injuries is predominant in males 90% than in females 10% [19].

There is evidence that the extent of bleeding increase progressively within 24-48 hours after injury. Rose and colleagues studied two CT scans of the patients which were carried out within 24 hours of injury which depict the progressive increase in bleeding [18].

This study was conducted based on GCS, the patients who had GCS ≥ 10 included in this study. The patients with the highest GCS (15) which is considered normal and not pondered is might be critical too. As in these study patients with GCS 10-15 had 44.00% chances to develop intracranial hemorrhage which is a significant ratio and it cannot be ignored. Likewise, the patients with GCS 15 had a higher incidence of ICH as compared to the 10-14 GCS which is 22.73%. According to the study conducted by the Nayebaghayee *et al.*, the use of GCS score for the determination of level of injury may not be sufficient and thus CT findings are considered as gold standard [41].

CONCLUSION

According to my study it is concluded that the frequency of intracranial hemorrhage among all type of brain injuries is 44.00% in patients of head trauma. Epidural hemorrhages and subdural hemorrhages have the same frequency but most frequent type of hemorrhages in this study. The frequency of intracranial hemorrhage is higher in males than in females. Patients with history of road traffic accidents have greater chances to develop intracranial hemorrhage than any other traumatic injuries. The reliability of GCS is not sufficient as CT is necessary for diagnosis and confirms the patient condition.

1. In outlook of my results, it is recommended that the patients come with head trauma should investigate on acute non-contrast CT for the early management. As there are no adverse reactions of contrast media and the duration of scan is short. It is valuable even in unconscious patients and patients who had allergic problems.
2. Patients with road traffic accidents have a high ratio of intracranial haemorrhage while with domestic trauma are minimal. The history of patient should be assessed in detail regarding the mode of injury
3. A follow up scan after 24-48 hours of injury should be carried out to check the extent of bleeding
4. The GCS scoring is not only enough for classification of injury. It is recommended that CT should be performed as 1st line investigation for such patients.

Disclosure: I state that there is no conflict of interest.

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