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Hemorrhage Detection In Patients With Traumatic And Non-Traumatic Brain Injuries Through Multidetector Computed Tomography

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Abstract

Background: Brain injuries, including traumatic brain injuries (TBI) and non-traumatic brain injuries (nTBI), are significant causes of morbidity and mortality worldwide. Intracranial hemorrhages, including subdural, epidural, subarachnoid, and intraparenchymal types, are critical complications that require prompt diagnosis. Multidetector computed tomography (MDCT) is a rapid and reliable imaging modality for detecting and assessing these hemorrhages in terms of type, volume, and location.

Objective: To evaluate the role of multidetector computed tomography in detecting types of hemorrhages and their anatomical region in traumatic and non-traumatic brain injuries.

Methods: A cross-sectional study was conducted from June 2025 to November 2025, including 67 patients (46 TBI, 21 nTBI) who underwent non-contrast MDCT scans of the brain. Data on hemorrhage type, region, volume, and patient demographics were collected using a self-structured proforma and analyzed with SPSS v27.

Results: Among the 67 patients, 68.7% had TBI and 31.3% had nTBI. Subdural hemorrhage was the most common type (58.2%), followed by intraparenchymal (22.4%), epidural (10.4%), and subarachnoid hemorrhages (9.0%). The most frequent hemorrhage volume ranged from 41–50 cc, and the left frontal lobe was the most commonly affected region (17.9%). The majority of cases were male (73.1%).

Conclusion: Subdural hemorrhage is the most prevalent intracranial hemorrhage in both TBI and nTBI patients, with the left frontal lobe being the most frequently involved region. MDCT provides a rapid and reliable means to assess hemorrhage type, volume, and location, which is critical for clinical decision-making. Further studies with larger sample sizes and multiple centers are recommended to enhance generalizability, especially for non-traumatic brain injuries.

Introduction

Brain injury is a major global health problem associated with high morbidity, mortality, and long-term disability (1). It occurs when trauma or pathological processes affect normal brain function, resulting in altered consciousness, neurological deficits, or cognitive impairment. Brain injuries are broadly classified into traumatic brain injuries (TBI) and non-traumatic brain injuries (nTBI) (2). TBI results from external mechanical forces such as road traffic accidents, falls, assaults, sports injuries, and firearm-related trauma, whereas nTBI develops due to non-traumatic causes including stroke, tumors, infections, hypoxia, vascular abnormalities, and metabolic disorders. Young adults, particularly males, are more frequently affected by TBI, leading to significant social and economic burdens worldwide (3,4). Intracranial hemorrhage is one of the most serious complications of both traumatic and non-traumatic brain injuries and can rapidly become life-threatening if not diagnosed early (5).

Traumatic brain injury refers to structural or functional damage to the brain caused by external force. It may range from mild concussion to severe neurological impairment and is considered a leading cause of injury-related death worldwide (6). Secondary complications such as seizures, hydrocephalus, and vascular injury further worsen patient outcomes. In contrast, non-traumatic brain injuries arise from internal pathological conditions including ischemic or hemorrhagic stroke, meningitis, encephalitis, hypoxia, aneurysmal rupture, tumors, and toxic or metabolic insults. Both TBI and nTBI may result in intracranial bleeding and require prompt radiological evaluation for accurate diagnosis and management (7).

Intracranial hemorrhage refers to bleeding within the cranial cavity involving the brain parenchyma or surrounding meningeal spaces. It commonly occurs due to trauma, hypertension, vascular malformations, aneurysms, coagulopathies, or cerebral amyloid angiopathy. The major types of intracranial hemorrhage include epidural hemorrhage (EDH), subdural hemorrhage (SDH), subarachnoid hemorrhage (SAH), and intraparenchymal hemorrhage (IPH). Epidural hemorrhage usually results from arterial bleeding between the skull and dura mater, while subdural hemorrhage commonly occurs because of rupture of bridging veins between the dura and arachnoid mater (8). Subarachnoid hemorrhage is typically associated with ruptured cerebral aneurysms, whereas intraparenchymal hemorrhage involves bleeding directly into brain tissue. Early identification of hemorrhage type and anatomical location is essential because delayed diagnosis may lead to increased intracranial pressure, brain herniation, permanent neurological damage, or death (9).

Multidetector computed tomography (MDCT) is a rapid and highly sensitive imaging modality widely used in the evaluation of brain injuries and intracranial hemorrhage. MDCT provides high-resolution cross-sectional images with excellent spatial and temporal resolution, enabling accurate detection of hemorrhage type, extent, and anatomical location (10). Modern MDCT scanners allow thin-slice imaging, multiplanar reconstruction, and three-dimensional visualization, which improve diagnostic accuracy and reduce scanning time. Due to its speed, accessibility, and ability to detect acute hemorrhagic lesions, MDCT has become the imaging modality of choice in emergency neuroimaging for both traumatic and non-traumatic brain injuries (11).

The aim of this study is to evaluate the role of multidetector computed tomography in detecting different types of hemorrhages and their anatomical distribution in patients with traumatic and non-traumatic brain injuries .

MATERIAL AND METHODS

A descriptive cross-sectional study was conducted in the Department of Radiology at Maqsood Medical Complex, a tertiary care hospital equipped with multidetector computed tomography (MDCT) facilities, over a period of six months. The study population included patients presenting to the emergency department or referred for

MDCT head scans for evaluation of suspected traumatic and non-traumatic head injuries. Patients aged 18 years and above of both genders who underwent MDCT examination were included in the study, while patients with incomplete clinical or imaging records, prior neurosurgical interventions, known unrelated brain pathology, or refusal to provide consent were excluded. total of 67 patients was enrolled in the study. The sample size was calculated using the standard prevalence formula: $n = (Z^2 \times P \times (1 - P)) / d^2$, where $Z = 1.96$ at a 95% confidence interval, P represented the expected prevalence from previous literature, and d was taken as 5% margin of error. Similar studies supported the selected sample size, and the number of cases was considered feasible during the study duration. Data were collected prospectively using a structured proforma after obtaining informed consent. Demographic and clinical details including age, gender, history of trauma, presenting complaints, and Glasgow Coma Scale (GCS) score were recorded. All patients underwent head MDCT using a 64-slice Siemens SOMATOM scanner with 5 mm slice thickness. The MDCT images were reviewed by radiologists to identify findings such as skull fractures, epidural hematoma, subdural hematoma, subarachnoid hemorrhage, intraparenchymal hemorrhage, cerebral edema, midline shift, contusions, diffuse axonal injury, infarcts, tumors, and other pathologies. The imaging findings were categorized into traumatic and non-traumatic brain injuries. The collected data was entered and analyzed using IBM SPSS Statistics version 27. Descriptive statistics including mean, standard deviation, frequencies, and percentages were used to present demographic and clinical characteristics. Ethical approval for the study was obtained from the Institutional Review Board of Superior University. Informed consent was obtained from all participants or their legal guardians, and patient confidentiality was maintained throughout the study.

RESULT

This study included a total sample size of 67 patients with traumatic and non-traumatic brain injury evaluated on multi detector computed tomography (MDCT). Table 4.1 depicts a distribution of demographic and clinical characteristics of the patients Out of the total cases, traumatic brain injury (TBI) was significant, more common representing 68.7% (n=46) of the sample and non-traumatic brain injury (nTBI) were 31.3% (n=21). Trauma was the number one reason for MDCT referrals during the study period. According to the findings obtained from MDCT, it found out that subdural hemorrhage was the most common hemorrhage found in 58.2% (n=39). Usually, subdural bleeding occurs due to high-force trauma or venous tearing. The greater incidence of trauma cases in this study supports this. In our study, 15 of the subjects, constituting 22.4%, were afflicted with intraparenchymal hemorrhage, which may be either traumatic contusion or non-traumatic. Non-traumatic cause may be hypertension or infarction. Epidural bleeding was seen in 10.4% (n=7) and subarachnoid bleeding was the least common (9%, n=6).

The analysis of the causative factors of these injuries revealed that the most common mechanism of injury, the road traffic accident (RTA), was responsible in 43.3% (n=29) cases. History of falling (HOF) accounted for 25.4% (n=17) of the second most common injury. The aetiologies that are non-traumatic are infarction (9%), vomiting (11.9%), loss of consciousness (7.5%), tuberculous meningitis (3%) etc. Thus some non-traumatic conditions may also bleed. In terms of presentation time, the majority of patients (68.7%, n=46) underwent MDCT scanning on the same day of injury, reflecting acute and emergency presentations. About 20.9% (n=14) of patients presented after one week, while smaller proportions reported after two weeks (6%) or one to two months (4.5%), indicating delayed or chronic presentations. Gender distribution showed a clear male predominance, with 73.1% (n=49) males and 26.9% (n=18) females. This imbalance can be attributed to greater exposure of males to outdoor activities, traffic-related risks, and occupational hazards, which are major contributors to traumatic injuries.

Table 4.1: Distribution of Brain Injury Type, Hemorrhage Patterns, Causes of Injury, Time Duration, and Gender

Variable	**Category**	**Frequency (n)**	**Percent (%)**
Brain Injury Type	Traumatic	46	68.7
	Non-traumatic	21	31.3
Hemorrhage Type	Subdural hemorrhage	39	58.2
	Epidural hemorrhage	7	10.4
	Intraparenchymal hemorrhage	15	22.4
	Subarachnoid hemorrhage	6	9.0
Cause of Brain Injury	Road Traffic Accident (RTA)	29	43.3
	History of Fall (HOF)	17	25.4
	Tuberculous meningitis	2	3.0
	Loss of Consciousness (LOC)	5	7.5
	Vomiting	8	11.9
	Infarction	6	9.0
Time Duration Since Injury	Same day	46	68.7
	1 week	14	20.9
	2 weeks	4	6.0
	1–2 months	3	4.5
Gender	Male	49	73.1
	Female	18	26.9

The most frequently identified hemorrhage was subdural hemorrhage, observed in 39 patients (58.2%), making it the predominant type. Intraparenchymal hemorrhage was the second most common type, detected in 15 patients (22.4%), followed by epidural hemorrhage in 7 patients (10.4%). The least common was subarachnoid hemorrhage, found in 6 patients (9.0%). Overall, the results indicate that subdural hemorrhage accounted for more than half of all cases, while subarachnoid and epidural hemorrhages were relatively uncommon (Figure 4.1).

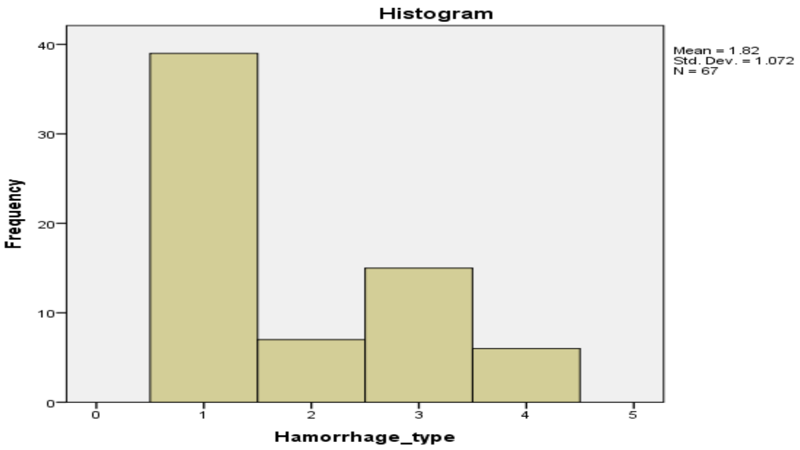

Figure 4.1 Hemorrhagic type

The left frontal lobe was involved in 12 (17.9%) of cases the most common region to be involved In blunt trauma, the anterior fossa is frequently affected, and due to its damage to the vascular event is represented too. Other areas having identical frequencies were bilateral frontal lobe (9%) lateral and third ventricles (9%) left basal ganglia (9%) chronic right-sided subdural hemorrhage (9%). Intracranial injuries have clinically significant and variable distribution as per these findings. Other areas involved were right basal ganglia (6%), right temporal lobe (6), left lateral ventricle (6), right parietal with left posterior parietal region (6) left basal ganglia with bilateral subdural hemorrhage (6%). Occasionally involved areas were the parietal lobe with basal ganglia and left temporal lobe. Each of these was involved in 4.5%.The bilateral medial frontal lobe was affected in 7.5% of cases, indicating deep frontal involvement in a subset of patients. Hemorrhage volume was categorized into five subgroups. The largest proportion of patients (29.9%, n=20) had a hemorrhage volume between 41–50 cc, followed by 28.4% (n=19) with volumes between 21–30 cc. A moderate hemorrhage volume of 31–40 cc was present in 17.9% (n=12) of cases. Smaller hemorrhage volumes were less common, with 14.9% (n=10) having 11–20 cc, and only 9% (n=6) having small bleeds between 1–10 cc. These findings suggest that a substantial number of patients presented with moderate to large intracranial hemorrhages, consistent with the acute nature of most injuries (Table 4.2).

Table 4.2: Distribution of Brain Regions Involved and Volume of Hemorrhage

Variable	**Category**	**Frequency (n)**	**Percent (%)**
Region of Brain Involved	Right basal ganglia	4	6.0
	Right temporal lobe	4	6.0
	Left basal ganglia & bilateral subdural	4	6.0
	Both lateral & 3rd ventricle	6	9.0
	Bilateral frontal lobe	6	9.0
	Left frontal lobe	12	17.9
	Left lateral ventricle	4	6.0
	Parietal lobe & basal ganglia	3	4.5
	Right parietal & left posterior parietal	4	6.0
	Left basal ganglia	6	9.0
	Chronic right-side subdural hemorrhage	6	9.0
	Left temporal lobe	3	4.5
	Bilateral medial frontal lobe	5	7.5
Volume of Hemorrhage (cc)	1–10 cc	6	9.0
	11–20 cc	10	14.9
	21–30 cc	19	28.4
	31–40 cc	12	17.9
	41–50 cc	20	29.9

TYPES OF HEMORRHAGE BASED ON THEIR VOLUME:

Subdural hemorrhage is the most frequent hemorrhage in every volume category and in 41-50 cc hemorrhage it was 14. As per the findings, the highest frequency was observed. In the group with the smallest volume (1–10 cc), there were 2 case of subdural hemorrhage with more (4) cases of intraparenchymal hemorrhage. In the group of moderate volume (11-20 cc), again subdural hemorrhage predominantly constituted 6 cases followed by intraparenchymal hemorrhage (3 cases) and 1 case of epidural hemorrhage. The types of bleeding in this range included subdural (9 cases) and intraparenchymal (7 cases), with fewer cases of epidural and subarachnoid hemorrhage. As the volume increased to 31–40 cc, subdural hemorrhage remained common (8 cases), while subarachnoid hemorrhage also appeared more prominently (2 cases). The largest volume category (41–50 cc) showed the highest overall frequency, with 20 patients, predominantly subdural hemorrhage (14 cases), along with 3 epidural and 3 subarachnoid hemorrhage cases.(Table 4.3)

Table 4.3: Types of Hemorrhage Based on Their Volume

Volume (cc)	**Subdural Hemorrhage**	**Epidural Hemorrhage**	**Intraparenchymal Hemorrhage**	**Subarachnoid Hemorrhage**	**Total (n)**
1–10 cc	2	0	4	0	6
11–20 cc	6	1	3	0	10
21–30 cc	9	2	7	1	19
31–40 cc	8	1	1	2	12
41–50 cc	14	3	0	3	20
Total	**39**	**7**	**15**	**6**	**67**

Table 4.4 shows the distribution of hemorrhages by anatomical site and type. Among the 67 cases, 39 were of subdural hemorrhages, which was the most common. 58% of patients showed subdural hemorrhage mostly in the frontal lobe including left frontal lobe, bilateral frontal lobe, and bilateral medial frontal. The observation of chronic right-sided subdural hemorrhages is also noted as it occurs in elderly people or in cases of recurrent trivial trauma. Fifteen cases (22%) showed Intraparenchymal hemorrhages involving the basal ganglia and lateral ventricle, which is in keeping with their usual association with hypertensive or vascular pathology. Epidural hemorrhages occurred less often with 7 cases (10%) and were mostly in the temporal lobes, as one may expect from local trauma or fractures. Subarachnoid hemorrhages were the least common, accounting for 6 cases (9%), all situated in the ventricular system, which is indicative of severe intracranial pathology such as aneurysmal rupture or traumatic injury. Overall, the data demonstrates that different types of hemorrhages exhibit distinct regional predilections, with subdural hemorrhages being the predominant type, while epidural, intraparenchymal, and subarachnoid hemorrhages show specific localization patterns related to their underlying etiology (Table 4.4).

Table 4.4: Types of Hemorrhage Based on Region

Region	**Subdural Hemorrhage**	**Epidural Hemorrhage**	**Intraparenchymal Hemorrhage**	**Subarachnoid Hemorrhage**	**Total**
Right Basal Ganglia	0	0	4	0	4
Right Temporal Lobe	0	4	0	0	4
Left Basal	4	0	0	0	4

Ganglia & Bilateral Subdural					
Both Lateral & 3rd Ventricle	0	0	0	6	6
Bilateral Frontal Lobe	6	0	0	0	6
Left Frontal Lobe	12	0	0	0	12
Left Lateral Ventricle	0	0	4	0	4
Parietal Lobe & Basal Ganglia	2	0	1	0	3
Right Parietal & Left Posterior Parietal	4	0	0	0	4
Left Basal Ganglia	0	0	6	0	6
Chronic Right-side Subdural	6	0	0	0	6
Left Temporal Lobe	0	3	0	0	3
Bilateral Medial Frontal Lobe	5	0	0	0	5
Total	39	7	15	6	67

DISCUSSION

This study evaluated 67 patients with either traumatic or non-traumatic brain injuries using multidetector computed tomography (MDCT). The results reveal meaningful patterns in hemorrhage type, volume, anatomical distribution, and underlying causes, which align with and extend findings in the existing literature.

Our research showed that there is a serious male sexual health issue around the world. 73.1% of the cohort was male meaning this study confirmed previous studies. A major retrospective analysis of traumatic brain injury (TBI) from Pakistan reported a male to female ratio of approximately 3.3:1. The leading causes were road traffic accidents

(RTAs) and falls (Zafar et al, 2013) The gender difference is most likely because males are more exposed to higher risk environments and behaviour (Zafar et al., 2013). In our study, road traffic accidents (RTAs) caused 43.3% of injuries and falls caused 25.4% of injuries. These findings are comparable to those reported in other traumatic brain injury (TBI) populations. Further, this further supports the global and regional significance of these trauma mechanisms (Zafar et al., 2013).

Most of the admissions were acute and emergent as shown by the fact that 68.7% of patients underwent MDCT on the day of injury. The 31.3% that presented after a week or longer may represent circumstances of evolving or chronic hemorrhages such as chronic subdural hematomas. Chronic subdural hemorrhages have a well-documented delayed presentation and commonly occur following seemingly innocuous trauma or in the elderly (StatPearls, 2024).

In our group of patients, subdural bleed (SDH) was the commonest (59.5%). This is consistent with studies of extra-axial hematomas, where subdural collections are usually more common than epidural ones. For example, autopsy data has shown that in blunt trauma deaths, subdural hematomas are more common than epidural (Badea, 2021).

Intraparenchymal hemorrhage (IPH) occurred in twenty-two point four percent of cases, mainly in basal ganglia and lateral ventricles This agrees with what we know: Deep structures of the brain are vulnerable to bleeds from high blood pressure as well as contusions from trauma (StatPearls, 2024). We observed that 10.4% of our cases showed localized epidural hemorrhages (EDH) to the temporal lobes. This suggests a link with arterial injury such as rupture of the middle meningeal artery and skull fracture, leading to epidural bleeding (Di Ieva, 2021). The least common injury was subarachnoid hemorrhage (SAH) (9%). It was primarily in the ventricular system. This may suggest a severe injury but may also have an aneurysmal pathology.

In our study, a high number of patients had moderate to large blood loss. 28.4% patients with 21 – 30 cc and 29.9% patients with 41-50 cc. Subdural hemorrhages, due to their larger volumes, can often cause mass effect and hence raised intracranial pressure. The link between hemorrhage volume and prognosis has been documented. In a big predictive study that used data from the Trauma Audit & Research Network (TARN), the presence of large (location independent) intracranial bleeding was shown to independently predict higher in-hospital mortality (Steyerberg, Mushkudiani, & et al., 2009).

In our population, smaller volumes (1-10 cc) were more likely to be intraparenchymal. This may be consistent with focal contusions or microvascular disruption described in previous CT-based outcome studies (Chestnut et al., 2011).

The left frontal lobe was the most affected area seen in 17.9% of cases and it is known that the frontal lobe is especially subject to blunt trauma injury. Injuries to the frontal lobe happen because of impact with bony protrusions. These may tear the bridging veins resulting in subdural hematoma (Badea, 2021). The support group highlights the importance of contact between family members of patients and convalescent patients. This is crucial for psychological support and for sharing experiences. Blood bleeding in the deep structures in particular, the basal ganglia – is consistent with prior imaging studies which demonstrate a predilection for deep bleeds in cases of hypertensive bleeding and traumatic bleeding (StatPearls, 2024).

The localization of epidural hemorrhages (EDH) in the temporal lobe in our series aligns with the findings of other neurosurgical series linking EDH to temporal bone fractures (Di Ieva, 2021). In our patients, subarachnoid hemorrhages were confined to the ventricular system, an observation that has been highlighted in severe injury cases as having a worse prognosis.

In our study, the majority of subdural hemorrhage agreed with previous regional and international studies. A CT-based head injury in study Pakistan, subdural hemorrhage was listed as the most common type of traumatic intracranial bleed (Siddique et al., 2016). The higher proportion of SDH in our population may be due to the age of patients and timing of imaging or selection criteria. The gender and mechanism-of-injury distributions in our cohort agree with larger epidemiological studies in TBI (Hashemian et al., 2015; Zafar et al., 2013). The increasing size of the hemorrhage as noted in prognosis-outcome studies. And it is important to measure the volume of the hemorrhage in acute neurotrauma (Steyerberg, Mushkudiani, et al. 2009).

These findings underscore the importance of MDCT in the rapid evaluation of suspected brain pathologies. It is essential for triaging, neurosurgical decisions and monitoring for secondary injury that one recognizes that subdural hemorrhage is most common and often massive. Intraparenchymal hemorrhages are usually located deep within the brain. This calls for vigilant monitoring of neurological status. The hemorrhages may not be easily amenable to surgery. Nonetheless, the bleeds can still cause significant morbidity.

As about 35% of injuries are caused by road traffic accidents, stronger preventive measures are necessary from the standpoint of public health. Road safety, helmet enforcement, and public education all need to be upscaled. The greater prevalence of males infers that targeted interventions may be particularly beneficial within gender-dominated occupational or recreational settings.

LIMITATIONS

Despite the insights gained, this study has limitations. The study's generalizability is limited due to a small sample size and mono-centric design. In addition, we did not assess long-term functional outcomes (e.g. Glasgow Outcome Scale, neurological deficits). Therefore, we cannot link imaging characteristics (type, volume, location) to prognosis. For the evaluation of hemorrhage patterns in the future, multicenter cohorts with outcome data should be utilized.

CONCLUSION

Examination of Four Types of Intracranial Hemorrhages in Traumatic and Non-Traumatic Brain Injuries by MDCT shows that Subdural Hemorrhage is Commonest. The hemorrhage of majority 21–30 cc exclusive for 28.4% cases. The left frontal lobe was the most commonly affected region; involvement occurred in 17.9% of patients. The research also indicated a deficiency in the literature on hemorrhages during traumatic and non-traumatic brain injury. Further research is needed to understand the relationship between hemorrhage characteristics across these groups. Future studies with larger sample sizes will enhance research outcomes' reliability and generalizability to the population.

RECOMMENDATIONS

This study was done to detect and characterize traumatic and non-traumatic brain injuries at Maqsood Medical Complex with the help of MDCT. For future research, the limitations of this study like the fewer number of cases that were nontraumatic, the short duration of the study, and the single-centre study may be overcome. Including additional hospitals with a larger pool and more diverse demographics of patients will aid in generating stronger data. In addition, prolonged follow-up and relationship with clinical results will help clear the beneficial effect of varying hemorrhage types, volumes, and anatomical sites.

REFRENCES

Khan G, Shah M, Saleem K, Khan SA, Rizwan M. Computed Tomography Findings of Traumatic Brain Injury and its Assessment in a Teaching Hospital. pakistan j neurol surg (quarterly)-official j pakistan soc neurosurgeons orig res 2024;28(2):162–9.

Allonsius F, de Kloet AJ, van Markus-Doornbosch F, Vliet Vlieland TPM, van der

Holst M. A longitudinal follow-up study of parent-reported family impact and quality of life in young patients with traumatic and non-traumatic brain injury. Disabil Rehabil 2024;46(11):2240–50.

Loqman Shah, Amir Afzal Khan, Rubina Fazal, Hina Gul, Gulzar Azam, Pashmina Afridi. Evaluation of Acute Intracerebral hemorrhage using Computed-Tomography and Magnetic Resonance imaging from Tertiary Care Hospital Peshawar. J Heal Rehabil Res. 2024;4(2)

Sarmiento K, Daugherty J, Lumba-Brown A, Klevens J, Miller GF, Waltzman D. Firearm-Related Traumatic Brain Injury Homicides in the United States, 2000-2019. Neurosurgery. 2023;93(1):43–9.

Asiri A, Algoblan D, Asiri E, Albishi S, Al Salamah M. Trends of maxillofacial and mandibular fractures in level I and II trauma patients in a tertiary hospital in Saudi Arabia. Saudi Dent J.

Eze K, State A. Radiology of Traumatic. 2020;.

Happonen T, Nyman M, Ylikotila P, Merisaari H, Mattila K, Hirvonen J. Diagnostic yield of emergency MRI in non-traumatic headache. Neuroradiology [Internet]. 2023;65(1):89–96.

Müller-Jensen L, Ploner CJ, Kroneberg D, Schmidt WU. Clinical Presentation and Causes of Non-traumatic Spinal Cord Injury: An Observational Study in Emergency Patients. Front Neurol. 2021;12(August):1–12.

Farzaneh N, Williamson CA, Jiang C, Srinivasan A, Bapuraj JR, Gryak J, et al. Automated segmentation and severity analysis of subdural hematoma for patients with traumatic brain injuries. Diagnostics. 2020;10(10).

Eze K, State a. radiology of traumatic. 2020;(September).

Ali A, Malik MA. Helmet wearing saves the cost of motorcycle head injuries : A case study from Karachi , Pakistan. 2021;573–81.

Ahmad I, Raza MH, Abdullah A, Saeed S, Khadim S, Bano S, et al. Intracranial CT Scan Findings in the Patients of Head Injury : An Early Experience at Dera Ghazi Khan Teaching Hospital. 2020;24(3):248–52.

Maksuda Khatun DM, Shahin Akter DM, Shahnawaz Parvin DS, Towrit Reza DM. Traumatic Brain Injury And Its Findings On Computed Tomography; A Tertiary Care Hospital Experience. J Radiol Clin Imaging. 2023;06(02):3–6.

Khan M, Yaqoob U, Hassan Z, Uddin MM. Emergency Department Referral Profile of Traumatic Brain Injury Records at a Tertiary Care Hospital of. Emerg Med [Internet]. 2021;1(1):10–6. Available from: http://uemjournal.com/index.php/UEM/article/view/7

Jaber M, Muyini A, Turki A, Almalki A, Yahya A, Fafi A, et al. Role of Multi-Detector Computed Tomography in Evaluating Traumatic Brain Injuries in Taif City , Kingdom of Saudi Arabia. 2024;6798:948–52.

Pradesh GU. Role of the Multi Detector Computed Tomography Imaging For Traumatic Head Injury in Rural Area. 2024;12(5):496–501.

Kamalian S, Avery L, Lev MH, Schaefer PW, Curtin HD, Kamalian S. Nontraumatic head and neck emergencies. Radiographics. 2019;39(6):1808–23.

Kumar A, Lalwani S, Ch DAM, Rautji R, Dogra TD. Fatal road traffic accidents and their relationship with head injuries : An epidemiological survey of five years. 2008;5(2):63–7.

Siddique U, Gul H, Nawab K, Roghani IS, Afridi z. original article intracranial hemorrhage in patients with head trauma on computed tomography scan. 2016;26(september):189–97.

Colantonio A, Gerber G, Bayley M, Deber R, Yin J, Kim H. Differential profiles for patients with traumatic and nontraumatic brain injury. J Rehabil Med. 2011;43(4):311–5.

Fang MC, Go AS, Chang Y, Hylek EM, Henault LE, Jensvold NG, et al. Death and Disability from Warfarin-Associated Intracranial and Extracranial

Hemorrhages. Am J Med. 2007;120(8):700–5.

Jennett B. Epidemiology of head injury. 1996;362–9.

Tabish A. The profile of head injuries and traumatic brain injury deaths in Kashmir. 2008;9:1–9.

Yadav AK, Dev B, Taparia S, Kumar P, Mandal R, Vaidya B. Multidetector computed tomography (MDCT) evaluation of traumatic brain injury in head trauma patients in tertiary hospital of eastern region of Nepal. Birat Journal of Health Sciences. 2021;6(1):1352–7.

Zhao M, Hu Y, Jiang R, et al. Deep-learning tool for early identification of non-traumatic intracranial hemorrhage etiology and application in clinical diagnostics based on computed tomography (CT) scans. PeerJ. 2025