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Pattern of Injury and Computed Tomography Findings in Patients with Cranio-Cerebral Trauma

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Abstract

Introduction: Traumatic brain injury (TBI) is the leading cause of fatalities from trauma and the main cause of disability under the age of 40 years. The estimated incidence of TBI in Nepal slightly surpasses the global average of 369 per 100,000. This study aims to identify the types of head trauma and patterns of CT scan findings, which will be beneficial in managing the patients and modifying the treatment protocol accordingly.

Methods: The study was conducted in the department of Radiology of Western Regional Hospital, Pokhara Academy of Health Sciences, from March to August 2024. This was a descriptive cross-sectional study conducted with 220 patients of all age groups coming for a CT scan of the head due to trauma to assess the causes and pattern of injuries.

Results: The mean age of the patients was 37.29±21.75 years and males were twice in number compared to females. More than 50% of patients had head injuries from road traffic accidents and 48.18% had fall injuries. The CT scan findings demonstrated that scalp hematoma was seen in 61.36% and skull fracture in 29% of patients. Amongst intracranial findings, contusion was seen in 6.82% of patients, subdural haemorrhage in 5.91%, epidural haemorrhage in 3.64%, and subarachnoid haemorrhage in 2.73%.

Conclusion: Almost 74% of people with head injuries who underwent a CT scan had some type of abnormal findings, where extra-cranial hematoma was more common than intracranial hematoma. Preventive strategies should be developed to minimize head injuries, and effective treatment planning is essential.

Keywords: CT scan, haemorrhage, intracranial bleeding, skull fractures, traumatic brain injury

Introduction

Cranio-cerebral trauma is a notable public health concern, and it includes range of injuries, from mild concussions to severe traumatic brain injuries (TBIs), with varying clinical presentations and outcomes.[1]

The World Health Organization (WHO) estimates that nearly 90% of fatalities resulting from trauma occur in low- and middle-income countries (LMICs), which house 85% of the global population.[2,3] Among these fatalities, TBI is the leading cause and the main cause of disability under the age of 40 years.[2,4,5] TBI and spinal cord injury (SCI) together make a significant portion of the injuries occurring globally, primarily arising from falls and road injuries.[6] The Southeast Asian and Western Pacific regions bear the highest collective burden of this health issue, and it is a major cause of mortality and disability in Nepal.[1] The estimated incidence in Nepal is 382 per 100,000[7] but this can be an understatement as many injured people might not seek hospital care.[8]

In the assessment of head trauma patients, cranial computed tomography (CT) scan allows for the visualization of intracranial structures, aiding clinicians in making critical decisions regarding patient management,[9] and the advances in CT technology have established it as the gold standard for evaluating head injuries.[10]

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Understanding the patterns and prevalence of cranial CT findings in patients with head injury is crucial for improving clinical outcomes. This study aims to identify the types of head trauma and patterns of CT scan findings, which will be beneficial in managing the patients and modifying the treatment protocol accordingly.

Methods

This was a descriptive, cross-sectional study conducted among the population of all age groups requiring a CT scan for the diagnosis of head injury. The study duration was from March to August 2024. The study was conducted in the department of Radiology of Western Regional Hospital, Pokhara Academy of Health Sciences. The site is a major referral center of the Gandaki Province, and it provides services to the patients of TBI. Some of the patients are also referred to the center to perform CT scans from adjoining hospitals.

Precision-based [$n= z^2 p (1-p)/d^2$] sample size was calculated with reference proportion (p) being 17.1% for the cerebral contusion as per Adhikari et al.[11] Using this formula, the required sample size of 218 was calculated. A total of 220 participants presenting with known or suspected head injury of all age groups were enrolled. The census sampling technique was followed to enroll all the eligible and consenting patients till the sample size was obtained. Patients of all ages undergoing cranial CT scans with known or suspected cranio-cerebral trauma were included in the study. However, patients undergoing a CT scan of the head for the pre-existing cranial pathologies were excluded from the study. A patient undergoing a CT scan for cranio-cerebral trauma was the sampling unit. For the unconscious patients, not in the state of providing consent, or minors, i.e. less than 18 years of age, the nearest relatives attending the patients were approached for the consent.

The data was collected using a structured data collection tool designed with reference to previous studies in the Nepalese context.[12,13] and customized further by the expert radiologist's suggestions. The demographic information and the details of the events of the injury were also collected. The patients had undergone CT scans, and the details of the findings were collected after the reporting by the consultant radiologist on duty in the department. The potential interpreter bias was minimized by the reporting from two different radiologists independently.

Data was entered in Microsoft Excel and exported to STATA 15.1 for the analysis. Mean, standard deviation, and frequency were calculated. Ethical approval was obtained from the Institutional Review Committee of Pokhara Academy of Health Sciences. (Ref no 224/080 dated 21 Feb 2024).

Results

The baseline findings of the study participants undergoing CT scan of the skull are shown in Table 1. The mean age of the patients was 37.29 years with a standard deviation of 21.75 years, and two-thirds were male. Table 1 has also shown that more than half (51.82%) of patients had trauma due to road traffic accident (RTA) opposed to 48.18% with fall injury. Among the patients undergoing CT scans, 73.64% had some abnormality due to trauma.

Table 1: Baseline patterns of injuries and findings of CT skull (n=220)

CT findings	Categories	Frequency	Percent
Sex	Female	74	33.64
	Male	146	66.36
Cause of trauma	Fall Injury	106	48.18
	RTA	114	51.82
Abnormality in CT findings	No	58	26.36
	Yes	162	73.64
Scalp hematoma	No	85	38.64
	Yes	135	61.36
Skull fracture	No	156	70.91
	Yes	64	29.09
Epidural hematoma (EDH)	No	212	96.36
	Yes	8	3.64
Subdural hematoma	No	207	94.09
	Yes	13	5.91
Subarachnoid haemorrhage (SAH)	No	212	96.8
	Yes	7	3.2
Intra ventricular haemorrhage (IVH)	No	214	97.27
	Yes	6	2.73
Cerebral contusions	No	205	93.18
	Yes	15	6.82
Midline shift	No	218	99.09
	Yes	2	0.91

The most common type of impact of trauma was extra-cranial injury in the form of scalp hematoma among 61.36%, followed by skull fracture among almost 30% of the patients. Other intracranial CT findings were seen as subdural, epidural, and subarachnoid haemorrhage, and as cerebral contusions and midline shift. Among intracranial haemorrhage, subdural was the most common, seen in 5.91%, and cerebral contusions in almost 7% of patients.

Table 2: Locations of CT findings in skulls trauma (n=220)

Types and locations of injury		Frequency	Percent
Fractures	No fracture	156	70.91
	Facial bones	38	17.27
	Cranial bones	24	10.91
	Both cranial and facial	2	0.91
Epidural Haemorrhage Location	Frontal	1	0.45
	Left parietal	2	0.91
	Parietal temporal	1	0.45
	Right frontal	3	1.36
	Right parietal	1	0.45
Subarachnoid haemorrhage location	Bilateral frontotemporal	1	0.45
	Basal cistern	1	0.45
	Frontal lobe	1	0.45
	Right frontal	2	0.91
	Right temporal	1	0.45
	Temporal	1	0.45

Approximately 30% of the patients had fractures of either facial bones, cranial bones, or both facial and cranial bones together. Facial bone fracture was seen among 38 (17.27%) patients in all. It was also seen that the most common site of both epidural and subarachnoid haemorrhage was the right frontal region, as was seen among 1.36% and 0.91% of the patients, respectively.

Discussion

This was a descriptive, cross-sectional study conducted among the population of all age groups requiring a CT scan for the diagnosis of head injury with the objectives of identifying the types of head trauma and patterns of CT scan findings.

The common causes of head injury that have been reported are road traffic accident (RTA) and fall injuries.[14] We found that slightly more than half of patients with head trauma were due to RTA, and about half of head trauma was due to fall injury. We are discussing head injury because it is one of the important health concerns affecting the public in many LMICs. The reason is TBI is the major cause of all the disability (15-20/100,000 population per year) among people under forty years of age.[2,4,5] This study found the mean age of the people undergoing a CT scan of the skull after injury was 37.29 years with a standard deviation of 21.75. Furthermore, the percent of males (66.36%) was almost twice the percent (33.64%) of females who had head injuries according to this study. The result is similar to that presented in another region of Nepal, which reported 66% of males against 34% of females who had head injury, and the mean of the trauma was below 40 years.[13] The reason may be that the males under 40 years are a major segment of the workforce and earning members of the family in Nepal who drive to work and are prone to RTA.

For the visualization of intracranial structures and early diagnosis of the effect of brain injury, CT scans have been serving as the gold standard modality and have been helping in patient management.[9] This study also utilized a CT scan for the diagnosis of the trauma. We conducted a CT scan of the skull to assess the pattern of injury and found that extracranial injury–scalp trauma was the most common finding, followed by skull bone fractures. Among intracranial bleeding, cerebral contusion was the commonest among 6.82%, followed by subdural hematoma among 5.91% of patients. Cerebral contusions are commonly associated with the types of skull bone fractures. This aligns with the studies conducted in Nepal and other countries.[12,13,15,16]

We also assessed the fractured bones and the location of the epidural and subarachnoid haemorrhage. The common site of these two bleedings was the right frontal region followed by the parietal region. Some previous study had reported that the most common site of fracture was the anterior cranial fossa, which also verifies the location of bleeding.[17]

The limitations of the study include its cross-sectional design and non-follow-up of the patients to examine the outcome of the trauma. This can pave a pathway for the future study to plan for the nature of the treatment provided and its outcomes, taking into consideration, the comparison of the pattern and severity of head injury.

Conclusion

The CT scan has shown that RTA was the most common way of head injury blended with fall injury. The extra cranial injury was more common than the intra-cranial injury. Scalp hematoma was the most common finding, followed by skull bone fracture. The common site of bleeding was the frontal region. The findings can be utilized to plan for the preventive strategies and for the treatment planning process, understanding the common injuries that can be caused by trauma to the head.

This study serves as a foundation and provides evidence that road traffic accidents (RTAs) should be controlled. A further multi-centered study should be conducted to determine the timing and types of vehicles involved in RTAs, which would help in formulating traffic regulations and developing infrastructure to minimize accidents.

References

1. Dewan MC, Rattani A, Gupta S, Baticulon RE, Hung YC, Punchak M, et al. Estimating the global incidence of traumatic brain injury. J Neurosurg. 2018;130(4):1080-97. DOI: 10.3171/2017.10.JNS17352 PMID: 29701556

2. Kamal VK, Agrawal D, Pandey RM. Epidemiology, clinical characteristics and outcomes of traumatic brain injury: evidences from integrated level 1 trauma center in India. J Neurosci Rural Pract. 2016;7:515-25. DOI: 10.4103/0976-3147.188637 PMID: 27695230

3. Capone-Neto A, Rizoli SB. Linking the chain of survival: trauma as a traditional role model for multisystem trauma and brain injury. Curr Opin Crit Care. 2009;15:290-4.d DOI: 10.1097/MCC.0b013e32832e383e PMID: 19528797

4. Fleminger S, Ponsford J. Long term outcome after traumatic brain injury. BMJ. 2005;331:1419-20. DOI: 10.1136/bmj.331.7530.1419 PMID: 16356951

5. de Ramirez SS, Hyder AA, Herbert HK, Stevens K. Unintentional injuries: magnitude, prevention, and control. Annu Rev Public Health. 2012;33:175-91. DOI: 10.1146/annurev-publhealth-031811-124558 PMID: 22224893

6. GBD 2016. Traumatic Brain Injury and Spinal Cord Injury Collaborators. Global, regional, and national burden of traumatic brain injury and spinal cord injury, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol. 2019;18(1):56-87. DOI: 10.1016/S1474-4422(18)30444-7 PMID: 30497967

7. James SL, Theadom A, Ellenbogen RG, Bannick MS, Montjoy-Venning W, Lucchesi LR, et al. Global, regional, and national burden of traumatic brain injury and spinal cord injury, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol. 2019;18:56-87. DOI: 10.1016/S1474-4422(18)30415-0 PMID: 30497965

8. Newall N, Gajuryal S, Bidari S, Karki A, Karki P, Bodkin P, et al. Epidemiology and pattern of traumatic brain injuries at Annapurna Neurological Institute & Allied Sciences, Kathmandu, Nepal. World Neurosurgery. 2020;141:413-20. DOI: 10.1016/j.wneu.2020.04.250 PMID: 32407914

9. Ohaegbulam SC, Mezue WC, Ndubuisi CA, Erechukwu UA, Ani CO. Cranial computed tomography scan findings in head trauma patients in Enugu, Nigeria. Surg Neurol Int. 2011;2:182. DOI: 10.4103/2152-7806.91137 PMID: 22276236

10. Imtiaz AM. Trauma radiology: importance of computed tomography scans in acute traumatic brain injury. International Journal of Pharmaceutical Sciences and Business Management. 2016;4(4):7-15.

11. Paudel SS, Luitel R, Bista A, Baniya A, Panta DJ, Shrestha B, et al. Scenario of head injury patients in tertiary care hospital of Nepal. J Nepal Health Res Counc. 2020;18(1):112-115. DOI: 10.33314/jnhrc.v18i1.2276 PMID: 32335604

12. Adhikari K, Gupta MK, Pant AR, Rauniyar RK. Clinical patterns and computed tomography findings in patients with cranio-cerebral trauma in tertiary hospital in eastern Nepal. J Nepal Health Res Counc. 2019;17(1):56-60. DOI: 10.33314/jnhrc.v17i01.1269 PMID: 31110378

13. Suwal S, Karki S, Mandal D, Poudel RC. Computed tomographic evaluation of craniocerebral trauma in Dhulikhel Hospital. Kathmandu Univ Med J. 2017;15(57):71-4. PMID: 29446367

14. Lee ST, Lui TN, Chang CN, Wang DJ, Heimburger RF, Fai HD. Features of head injury in a developing country-Taiwan (1977-1987). Journal of Trauma and Acute Care Surgery. 1990;30(2):194-9. DOI: 10.1097/00005373-199002000-00010

15. Bordignon KC, Arruda WO. CT scan findings in mild head trauma: a series of 2,000 patients. Arquivos de neuro-psiquiatria. 2002;60:204-10. DOI: 10.1590/S0004-282X2002000200004 PMID: 12068346

16. Shackford SR, Wald SL, Ross SE, Cogbill TH, Hoyt DB, Morris JA, et al. The clinical utility of computed tomographic scanning and neurologic examination in the management of patients with minor head injuries. Journal of Trauma and Acute Care Surgery. 1992;33(3):385-94. DOI: 10.1097/00005373-199209000-00009 PMID: 1404507

17. Sivanandapanicker J, Nagar M, Kutty R, Sunilkumar BS, Peethambaran A, Rajmohan BP, et al. Analysis and clinical importance of skull base fractures in adult patients with traumatic brain injury. Journal of Neurosciences in Rural Practice. 2018 Jul;9(3):370-5. DOI: 10.4103/jnrp.jnrp_38_18 PMID: 30069094 PMCID: PMC6050782