

Is Cervical CT Imaging Justified along with CT Head in Traumatic Head Injury Patients?

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ABSTRACT

Background: In traumatic injury patients, mild cervical spine lesions are usually overlooked as a simultaneous damage to other body areas. An accurate and early diagnosis is necessary to prevent subsequent neurological damage in these patients.

Objective: To identify associated cervical spinal injuries in head-injured patients and justify the routine use of cervical CT scans in head trauma cases to prevent missed diagnoses and ensure early intervention for better patient outcomes.

Methodology: This retrospective review was conducted in the Department of Radiology at Liaquat National Hospital, Karachi, analyzing records from January to July 2024. Records of 197 trauma patients who had undergone CT scans for head injuries and had positive CT head findings were retrieved. The data were analyzed using SPSS version 27.

Results: The current study analyzed 197 patients in total, of whom 80% were men and 20% were women. Among them, 47.2% were between 20 and 40 years old. Of the 197 patients, 87.3% had been involved in a traffic accident, with 5.8% patients had concurrent cervical spine injury. 10.6% of the patients in our study had concurrent C spine injuries. Concurrent C-spine injuries were also observed in 18.6% and 9.7% patients with contusions and diffuse axonal injury, respectively.

Conclusion: Our study highlights a considerable incidence of cervical spine injuries (CSI) in traumatic brain injury patients, often concomitant with contusions, subdural hematomas, and subarachnoid hemorrhages. These findings underscore the importance of concurrent cervical imaging with CT head to ensure timely diagnosis and management of CSI.

Keywords: Traumatic brain injury, cervical spine injury, computed tomography, intracerebral hemorrhage, epidural hematoma, subdural hematoma, subarachnoid hemorrhage, diffuse axonal injury.

INTRODUCTION

Though spinal fractures constitute a minority of all traumas, the prevalence of cervical traumatic injury has a significant association with moderate to severe head and facial injuries, and their severity is also directly proportional to each other [1]. However, because mild cervical spine lesions are usually overlooked as simultaneous damage to other body areas, concurrent cervical spine injuries in these trauma patients were not commonly documented [1, 2]. However, one should not undervalue the significance of this kind of harm [3]. Spinal cord injuries are an important cause of disability among young adults with high liability for both individuals and society [1-4].

With the advent of CT scanning for the C-spine in head-injured patients, it has been identified that about 1 in 10 patients with significant head injury have a C-spine injury, usually associated with fracture or dislocation [5].

Male gender, the presence of thoracic injury, and hypotension on admission were independent risk factors associated with cervical spinal injuries. Injuries in older people usually result from even low-energy trauma,

such as falling from standing because of osteoporosis and stiffening in the aging spine [5, 6].

According to trauma guidelines, every unstable patient with a traumatic head injury should undergo a craniocervical examination to look for cervical spine injury [5]. Being an underdeveloped state, it is not a very usual practice. The diagnosis of C-spine injuries is thought to be possible using standard cervical radiography. Compared to CT, which has a sensitivity of 98%, and ordinary radiography, which has a sensitivity of 54%, although easily accessible, there is a 15% chance of missing injuries [6, 7].

It is seen that road traffic accidents are the major cause of traumatic head injury in the young population. According to some theories, cord damage mostly affects young individuals, primarily men, and causes substantial morbidity as well as huge financial and human losses [8]. After that, the majority of patients suffer from permanent disabilities that impact society on a psychological, social, and economic level [9].

They may also need specialist care for the rest of their lives. Identification of unstable CSI is therefore an essential aspect of the trauma evaluation in preventing subsequent neurological damage [10].

This study aimed to identify associated cervical spinal injuries in head-injured patients and the importance of a

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concomitant CT scan of the cervical spine. It has also been observed that CT is much more efficient than radiography in identifying cervical fractures. Spinal injuries involve complex components with different traumatic susceptibility and healing capabilities. An accurate and early diagnosis is needed to avoid any neurological damage in unstable fractures. Missed, incorrect, or delayed diagnoses all affect outcomes.

METHODOLOGY

We performed a retrospective analysis of 197 trauma patients who had undergone CT scans for head injuries and cervical spine trauma at the Department of Radiology, Liaquat National Hospital, Karachi, analyzing records from January to July 2024. They all had positive CT head findings. They were then evaluated for cervical spine injury. However, head trauma patients with normal CT scan findings or with already known cervical spine injury were excluded from the study.

After clinical examination by a neurophysician and neurosurgeon, patients were referred to the radiology department. In our department, a Helical Multi-detector Computed Tomography machine, a 16-slice CT scanner, was used to scan people in the supine posture from the base of the neck to the vertex of the skull. After reconstruction, the acquired images were transferred to PACS (picture archiving and communication system).

Due to the suboptimal accuracy of CT in detecting vertebral ligament injuries, our focus is mainly on fractures. Vertebral body fractures and dislocations, odontoid fractures, compression and burst fractures, disco-ligamentous complex, and cord compression were the typical CT findings of cervical spine injuries. Intracerebral hemorrhage (ICH), epidural hematoma (EDH), subdural hematoma (SDH), subarachnoid hemorrhage (SAH), cerebral edema, cerebral contusion, midline shift, skull fracture, scalp laceration/swelling, and facial bone fractures are among the predictable intracranial injuries.

Using PACS, a radiology specialist assessed the pictures. The frequency and kind of injuries, age, gender distribution, and the incidence of cervical spine injuries with head trauma and concurrent injuries were all examined in the records. Data input was done using the proforma that was already created. Both the descriptive and inferential statistical analyses were conducted using SPSS version 25. The frequency and mean±SD were used to represent the quantitative and qualitative variables, respectively, along with percentages. When applicable, Fisher’s exact test or the Chi-square test was employed to examine the relationship between

categorical variables. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

The current study included 197 patients in total, of whom 79.18% were men and 20.8% were women. Of the patients, 17.7% were younger than 20 years old, 47.2% were between 20 and 40 years old, 25.3% were between 40 and 50 years old, and 9.6% were older than 50.

Of the 197 patients, 87.3% had been involved in a traffic accident, 6.09% had been physically assaulted, 5.07% had fallen from a height, and 1.52% had fallen off a heavy object on their head. Skull fractures were observed in 14.2% of patients, contusions in 21.8%, extradural hemorrhage in 10.1%, subdural hemorrhage in 6.09%, subarachnoid hemorrhage in 12.6%, pneumocephalus in 8.12%, cerebral edema in 6.09%, and diffuse axonal damage in 20.8% of patients. 10.6% of the patients in our study had concurrent C spine injuries. Detailed descriptive statistics are presented in Tables 1 to 3, respectively.

Concurrent C spine injuries occurred in 9.6% of male patients and 20% of female patients. Concurrent C spine injuries were discovered in 14.2% of patients under the age of 20, 8.6% of patients between the ages of 20 and 40, 6% of patients between the ages of 40 and 50, and 26.3% of patients above the age of 50 years. Concurrent C spine injuries occurred in 5.8%, 41.6%, 40%, and 66.6% of patients who had been in a car accident, were physically abused, had fallen from a height, or had fallen onto their head from a heavy object, respectively. Concurrent C spine injuries were observed in 3.5%, 18.6%, 5%, 16.6%, 16%, 6.25%, and 9.7% of patients with skull fractures, contusions, extradural hemorrhage, subdural hemorrhage, subarachnoid hemorrhage, pneumocephalus, and diffuse axonal injury. Detailed

Table 1: Frequency and association of gender and age with concurrent c-spine injury.

Patients’ Features	No. of Patients n(%)	Concurrent C-Spine Injuries		p-value
		Yes n(%)	No n(%)	
Age				
<20 years	35(17.7)	05(14.2)	30(85.7)	0.074
20-40 years	93(47.2)	08(8.6)	85(91.3)	
40-50 years	50(25.3)	03(6)	47(94)	
>50 years	19(9.6)	05 (26.3)	14(73.6)	
Total	197	21(10.6)	176(89.3)	
Gender				
Male	156(79.18)	15(9.6)	141(90.4)	0.354
Female	41(20.8)	6(14.6)	35(85.4)	
Total	197	21(10.6)	176(89.3)	

Table 2: Mechanism of injury in patients with concurrent C-spine injury.

Mechanism of Injury	No. of Patients n(%)	Concurrent C-Spine Injury		p-value
		Yes n(%)	No n(%)	
Road Traffic Accident	172(87.3)	10(5.8)	162(94.1)	* < 0.001
Physical Assault	12(6.09)	05(41.6)	07(58.3)	
Fall from Height	10(5.07)	04(40)	06(60)	
Fall of Heavy Object on the Head	03(1.52)	02(66.6)	01(33.3)	
Total	197	21(10.6)	176(89.3)	

* Significant at 0.05 level

Table 3: Percentages of types of intracranial injuries with cervical spine injuries.

Types of Intracranial Injury	No. of Patients n (%)	Cervical Spine Injuries		p-value
		Yes N(%)	No N(%)	
Skull Fracture	28(14.2)	01(3.5)	27(15.3)	0.004*
Contusions	43(21.8)	08(18.6)	35(19.9)	
Extradural Haematoma	20(10.1)	01(5)	19(10.8)	
Subdural Haematoma	12(6.09)	02(16.6)	10(5.7)	
Subarachnoid Haemorrhage	25(12.6)	04(16)	21(11.9)	
Pneumocephalus	16(8.12)	01(6.25)	15(8.4)	
Cerebral Edema	12(6.09)	00	12(7.0)	
Diffuse Axonal Injury	4(20.8)	04(9.7)	37(21.0)	
Total	197	21(10.7)	176(89.9)	

* Significant at 0.05 level.

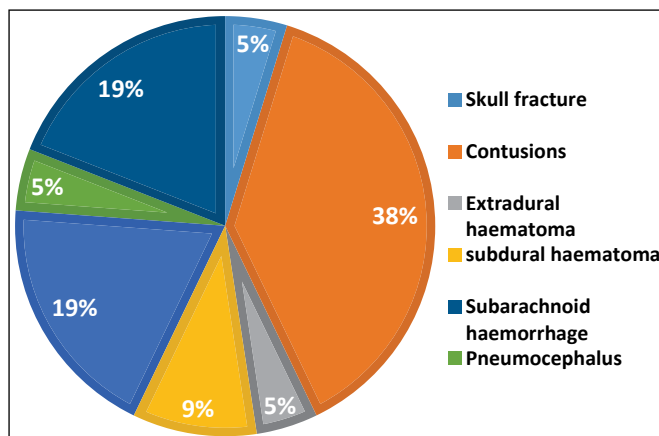


Fig. (1): Percentages of types of intracranial injuries with cervical spine injuries.

descriptive statistics of concurrent C spine injuries are presented from Tables 1 to 3, respectively.

The percentage of types of intracranial injuries with cervical spine injuries is presented in Fig. (1). We found a significant association of Concurrent cervical spine injuries with the Mechanism of injury (p=0.000) and

types of intracranial injury p=0.004), as presented in Tables 1 to 3, respectively.

DISCUSSION

Cervical spine injuries (CSI) in patients with head trauma can lead to serious consequences if not identified early. When someone suffers a head injury, there’s always a risk that the neck (cervical spine) could also be hurt. If these injuries are missed, they can lead to serious consequences, like paralysis or even death [10].

In these cases, CT scans become incredibly important, allowing attending physicians to see injuries that aren’t visible from the outside. This discussion highlights the need for whole craniocervical CT scans in all head trauma patients. We’ll explore how using CT scans early can save lives and prevent lifelong disabilities, especially in patients who may have difficulty expressing symptoms due to unconsciousness or cognitive impairment [10, 11].

Studies have shown that people with head injuries found on a CT scan are twice as likely to have injuries to their cervical spine [12]. This means clinical examination can miss these injuries, putting patients at serious risk. Early detection with CT scans can help prevent dangerous outcomes, like spinal cord damage [13].

The link between brain and spine injuries remained the question of all medical professionals and patient attendants. Few studies showed that 45.2% of patients who had head CT scans due to trauma also had injuries to their neck [14]. This number is particularly high in cases of severe accidents, like car crashes. In situations where the body is violently shaken, the head and neck are often injured together. This finding reinforces the idea that if someone experiences a high-impact injury, CT scans should be done to check for both head and neck injuries [15].

Patients with severe brain injuries, like diffuse axonal injury (DAI), are much more likely to have damage to their necks [14, 15].

For patients who are unconscious or unable to speak after an injury (with a Glasgow Coma Scale score of 8 or less) the Glasgow Coma Scale (GCS), which measures how alert and aware a person is after trauma, is also a strong predictor of cervical spine injury, and the risk of missing a neck injury is even higher. These patients can’t tell doctors what hurts, so relying on CT scans becomes even more critical [15]. This allows healthcare teams to make sure nothing is missed. Although injuries like skull fractures may not always show a strong connection with CSI, the risk is still present. This means

that even if the brain injury seems minor, doctors cannot rule out a spine injury without further imaging [16].

Identifying High-Risk Patients for CT Scans

Certain injury types carry a higher risk of cervical spine damage. For instance, motor vehicle collisions (MVCs) account for 30.6% of spine injuries, so people involved in these crashes should be carefully checked using CT scans. Additionally, a study showed that the majority of patients with both head and spine injuries were involved in high-energy trauma, such as falling from a height [16, 17].

Elderly people who experience ground-level falls are another group at risk. Even though their injuries might seem minor, they are more prone to spine injuries than head injuries. Therefore, it's important to prioritize CT scans for elderly patients, even when the trauma seems less severe [18].

The Balance between CT Scan Benefits and Radiation Risks

A key concern with CT scans is radiation exposure, especially when patients need multiple scans to assess both head and spine injuries. Although the radiation risks are real, studies emphasize the need to focus on patient safety first. In high-risk cases—such as those involving severe head trauma, high-energy injuries, or elderly patients—the benefits of detecting injuries early far outweigh the risks from radiation, ensuring no injury is overlooked, and offering patients the best chance for a full recovery [19, 20].

In our study, the data revealed a significant correlation between head trauma and cervical spine injuries (CSI). Patients with positive findings on CT scans were likely to have cervical spine injuries, highlighting the importance of imaging for both regions after trauma. The study also showed that CSI was seen in around 10% of the patients having diffuse axonal injury (DAI), underscoring the need for thorough evaluation in these cases.

Motor vehicle collisions (MVCs) contributed to 5.8% of all CSIs in our sample, further emphasizing the high risk posed by high-energy impacts. Elderly patients who sustained ground-level falls were another high-risk group, with more than one-third (40%) being diagnosed with CSI. Additionally, patients with a fall of a heavy object onto the head had a 66.6% likelihood of also having CSI, making early CT imaging crucial in severe trauma cases. Our data strongly support the routine use of CT scans in head trauma cases to prevent missed

diagnoses and ensure early intervention for better patient outcomes, and managing concurrent injuries in head trauma patients.

During our analysis, we noted several interesting trends regarding the comparative types of intracranial injuries and the presence of cervical spine injuries (CSI) in patients. This study demonstrated that 10.7% of patients had CSI. Almost all skull fractures were SDH-based skull fractures, and the correlation of skull fractures with CSI was statistically significant.

For contusions, extradural hematomas, and subdural hematomas, there was no significant association with cervical spine injuries. Pneumocephalus and conditions like cerebral edema were less common in this group but also did not show any clear association with CSI. These data suggest that attention should be paid to the spinal status of patients with TBI.

CONCLUSION

Our study highlights a considerable incidence of cervical spine injuries (CSI) in traumatic brain injury patients, often concomitant with contusions, subdural hematomas, and subarachnoid hemorrhages. These findings underscore the importance of concurrent cervical imaging with CT head to ensure timely diagnosis and management of CSI. Early detection of such injuries can prevent adverse outcomes and improve overall patient prognosis. Incorporating this approach into standard trauma protocols could enhance the safety and quality of care for trauma patients.

ETHICS APPROVAL

Due to the retrospective nature of this study, an exemption letter was received from the Ethics Committee of Liaquat National Hospital, Karachi (Ref: App# 1167-2025-LNH-ERC). All procedures performed in studies involving human participants followed the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA

The data supporting the findings of this study are available within the article.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Declared none.

AUTHORS' CONTRIBUTION

Haroon Q: Designing of the study, critical review of the initial draft, and result analysis; Mansoor MA: study conceptualization and critical review of the initial draft; Ansari A: Designing of the study and manuscript writing; Shaikh A: Data collection and manuscript drafting.

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