Epidemiology and Health System Journal
doi:10.34172/ehsj.2023.21 2023Summer;10(3):131-135 http://ehsj.skums.ac.ir

Original Article

Prevalence of Pathological Lesion Due to Mild Head Trauma in Computed Tomography Scan of Patients' Brains

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Abstract

Background and aims: This study investigated the prevalence of pathological lesions on the computed tomography (CT) scans of the brains of patients with mild head trauma based on the New Orleans-Canadian criteria at Shahrekord Ayatollah Kashani Hospital, Iran.

Methods: All patients referred to the Emergency Department of Shahrekord Ayatollah Kashani Hospital in 2019 with a history of head trauma were included in this cross-sectional, descriptive-analytical study according to the criteria of mild head trauma. Then, the relevant checklist was used to record the patients' level of consciousness, demographic information, and cause of trauma. Finally, the data were analyzed using SPSS 18, and the patient's lesions were reported accordingly.

Results: Out of 143 patients, 89 were males, and 54 were females in this study. Falling from a height was the cause of head trauma in most patients (43.3%). Among all patients, the CT scans of six patients were abnormal and had lesions. The vomiting had a significant relationship with the results of the CT scan, and for patients with mild head trauma, the Canadian and New Orleans indices had the same clinical importance.

Conclusion: According to the results of the present study, the New Orleans index could identify more patients as CT scan candidates than the Canadian index; however, there was no difference in the final result (the presence of a pathological lesion in the CT scan) between these two indices. The New Orleans index has more features than the Canadian index, but its results are not different from the Canadian index. Thus, we believe that using the Canadian index can reduce imaging rates, costs, and protection from the side effects of radiation.

Keywords: Brain CT X-ray, Mild trauma, Canadian-New Orleans criteria

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Received: November 8, 2022
Accepted: August 26, 2023
ePublished: September 29, 2023

Introduction

Brain injury is one of the most common types of trauma and the most important cause of death and disability caused by trauma in victims of various accidents.[1,2] Most of these patients can be discharged after a short period of care, and a small proportion are worse off and require neurosurgical intervention to treat intracranial hematoma.[3-5] The prevalence of these injuries is estimated at 200 per 100 000 in developed countries and more than 500 per 100 000 in the United States.[2,6-8]. It is estimated that 3.5 million Americans have disabilities caused by traumatic brain injury,[9] ranging from mild and reversible to severe and life-threatening with a permanent disability. Mild brain injuries cause no structural changes, and patients usually have a level of consciousness between 13 and 15 (according to the Glasgow Coma Scale).[10] Mild trauma or minor head trauma disrupts the physiological function of the brain. The patient's level of consciousness (Glasgow Coma Scale, GCS) is between 13 and 15 and has at least one of the following symptoms[2]:

- Any period of loss of consciousness lasting less than 30 minutes
- Any memory loss for events immediately before or after the accident (post-accident forgetfulness should have lasted less than 24 hours)
- Any change in the state of consciousness at the time of the accident
- Focal neurological disorders that may be transient or permanent

In 1998, 1 215 000 brain trauma cases were registered in the United States, of which 220 000 were hospitalized. In 2003, these numbers reached 1 565 000, of which 1 224 000 were mild traumas and 290 000 were hospitalized.

In 2003, those numbers reached 1 565 000, of which 1 224 000 were mild traumas and 290 000 were hospitalized. Statistics show a 22% reduction in mortality, but no

hospitalization has changed.[11] However, in brain computed tomography (CT) scans, pathological findings are observed in about 5-8% of patients who go to the emergency room with mild traumatic brain injury and full consciousness. Meanwhile, the prevalence of life-threatening lesions requiring surgical intervention was reported to be 0.01%-0.5% in fully conscious patients and 1% in patients with a level of consciousness of 13-15.[12] Therefore, brain imaging for all patients with mild head trauma is used in some centers to manage these patients. In addition, monitoring patients and performing imaging in case of changes in the level of consciousness have been considered an alternative method in other centers.[13,14] Given the potential hazards of ionizing radiation, including X-rays, to living tissues, these rays are recommended only in exceptional cases for patients and examinees.[15] According to American doctors, the unnecessary use of CT scans in the next two to three decades in the United States can cause more than three million people to develop cancer. Today, researchers believe that one-third of the CT scans performed in US medical centers are useless without considering the patient's needs, which has no scientific justification. Cerebral palsy is one of the most common types of trauma, varying from mild and reversible to severe and life-threatening, with permanent disability. In cases of mild head trauma, patients usually have a level of consciousness between 13 and 15, and in a few instances, pathological lesions are observed on brain CT scans. Although most of these patients have normal brain CT scans, they are all sent for CT scans despite the high costs, dangers caused by ionizing radiation, specific indications for this imaging, and pathological findings that have not been reported. Some recommend frequent examinations and patient monitoring to change the level of consciousness to perform a CT scan. Considering the high number of cases of this type of trauma, it is necessary to further focus on the prevalence of pathological lesions in the CT scans of these patients to recommend or not recommend imaging in all patients. The necessity of conducting this study was felt considering the increase in the cost of the patients, the increase in the wear and tear of the device, the increase in the risk of cancer caused by ionizing rays, overcrowding of the radiology unit, lack of timely access, and delay in performing CT scans required by emergency patients. It should be noted that the operator does not request the CT scan, but according to the New Orleans and Canadian criteria, it is checked whether patients with mild trauma need a CT scan or not, and if not, what is the reason for doing it? Therefore, this study aimed to determine the prevalence of pathological lesions in the CT scans of the brain performed in patients with mild head trauma based on the New Orleans and Canadian criteria at Shahrekord Ayatollah Kashani hospital in 2019.

Materials and Methods

This cross-sectional, descriptive-analytical study was done in Shahrekord Ayatollah Kashani hospital, Iran, 2019. To determine the prevalence of lesions caused by trauma, a brain CT scan was performed in patients with mild head trauma. One hundred sixty-eight patients who had mild head trauma and were referred to Shahrekord Ayatollah Kashani Hospital in 2019 were included in the study by the census. The inclusion criteria were patients who had mild head trauma but were not stable and patients who had risk factors such as focal neurological findings and irregular pupil skull fracture in clinical examinations, multiple trauma history of seizures, history of bleeding disorders, and loss of consciousness.

First, the severity of the trauma (severe, moderate, or mild) was measured. Then, the patients who had mild head trauma (a trauma that causes a disturbance in the physiological function of the brain and symptoms such as decreased levels of consciousness and loss of immediate memory) before or after the accident and focal neurological disorders cause GCS 13 to 15. CT scans of the patient's brain were checked according to the Canadian and New Orleans criteria. Data on age, gender, type of trauma (traffic accidents, falls, and assaults), and brain CT scan results from the radiologist's report (with lesions, without lesions) were collected in the relevant checklist. Canadian criteria include GCS less than 15 two hours after the accident, suspicion of open or sunken skull fracture, any symptoms of basilar skull fracture (hemotympanum, rhinorrhea, otorrhea, battle mark, and raccoon eyes), and vomiting more than once and age 65 and above. New Orleans criteria include headache, vomiting, age over 60 years, alcohol or drug intoxication, permanent forgetfulness of the anterograde, trauma to the upper clavicle, and seizures [16].

The data were analyzed using SPSS version 18.0 (IBM SPSS Statistics for Windows). Descriptive statistics were used to describe the data, including frequency and relative frequency distribution tables. The normal distribution of quantitative variables in each group was confirmed using the Kolmogorov-Smirnov test. The independent t-test and chi-square test were utilized to analyze the data.

Results

Of 168 patients with head trauma, 25 patients (20 patients due to less than 13 consciousness levels and five patients due to severe head trauma and instability of vital signs) were excluded from the study, and the data of 143 patients with mild head trauma and consciousness level of 13-15 were collected and analyzed finally. Out of 143 patients, 89 were males with a mean age of 36.38 ± 22.02 years and 54 were females with a mean age of 45.46 ± 23.44 years, and the average age of the total participants was 39.81 ± 22.92 years.

The youngest patient was three months old, while the oldest one was 90. In most patients (43.4%), the cause of head trauma was falling from a height. In addition, the CT scan of six patients (4.2%) was abnormal and had a lesion (Table 1). Table 2 compares age, gender, trauma mechanism, decreased alertness, vomiting, headache,

Table 1. Patients' Demographic and Clinical Characteristics

Variables		Number (%)	*P* Value*
Gender	Male	89 (62.2)	0.951
	Female	54 (37.8)	0.835
Mechanism of trauma	Traffic accidents	49 (34.3)	0.840
	Falling from a height	62 (43.4)	0.320
	Invasion	27 (18.9)	0.954
	Other	5 (3.5)	0.134
Brain CT scan	Normal	137 (95.8)	0.944
	Abnormal	6 (4.2)	0.0015
Focal defects on examination	Yes	2 (1.39)	0.733
	No	141 (98.6)	0.824
Normal pupil	Yes	142 (99.3)	0.325
	No	1 (0.7)	0.568
Headache	Yes	7 (4.9)	0.134
	No	136 (95.1)	0.366
Vomiting	Yes	22 (15.4)	0.001
	No	121 (84.6)	0.736
Convulsion	Yes	0 (0)	0
	No	143 (100)	0.650
History of coagulation disorder	Yes	1 (0.7)	0.345
	No	142 (99.3)	0.433
Previous neurological disorder	Yes	2 (1.4)	0.650
	No	141 (98.6)	0.865
Skull fracture	Yes	3 (2.1)	0.432
	No	140 (97.9)	0.450
Multiple trauma	Yes	37 (25.9)	0.650
	No	106 (74.1)	0.832

Note. CT scan: Computed tomography scan.

Table 2. Comparison of Evaluated Indices in Patients With Mild Head Trauma Based on CT Scan Results

Variables		CT Scan Results		*P* Value*
		Abnormal (6 = n)	Normal (137 = n)	
Age (years, Mean ± standard deviation)		98.21 ± 33.47	98.22 ± 48.39	0.428
Gender	Male	4 (7.66)	85 (62)	0.819
	Female	2 (3.33)	52 (38)	
Mechanism of trauma	Traffic accidents	2 (3.33)	47 (3.34)	0.960
	Falling from a height	3 (50)	59 (1.43)	
	Invasion	1 (7.16)	26 (19)	
	Other	0 (0)	5 (6.3)	
Decreased alertness	Yes	0 (0)	4 (9.2)	0.671
	No	6 (100)	133 (1.97)	
Vomiting	Yes	2 (3.33)	10 (6.14)	0.009
	No	4 (7.66)	117 (4.85)	
Headache	Yes	1 (7.16)	6 (4.4)	0.172
	No	5 (3.83)	131 (6.95)	
Injury time	Less than 24 hours	3 (100)	136 (3.99)	0.834
	More than 24 hours	0 (0)	1 (7.0)	

Note. CT scan: Computed tomography scan. * Intergroup difference ($P<0.05$).

and injury time between patients with abnormal and normal CT scans. Based on the data, only vomiting had a significant relationship with the results of the CT scan ($P=0.009$), and in most people who vomited, the CT scan did not have a pathological lesion; however, age, gender, mechanism of trauma, decreased alertness, headache, and the time of injury were not significantly associated with the results of the CT scan ($P>0.05$).

Table 3 provides the patients' symptoms according to the Canadian-New Orleans criteria. According to Canadian standards and the New Orleans criteria, 41 patients and 89 patients with mild head trauma were indicated for a brain CT scan, respectively.

Discussion

The present study sought to investigate the prevalence of pathological lesions in patients with mild head trauma based on Canadian and New Orleans criteria. In the present study, most people with head injuries were men. Yousefzadeh et al, in their research, stated that men are three times more likely than women to experience trauma.[17] In one study in western Sweden, men accounted for 59% of head trauma patients[18]; in another study, men suffered 2.6 times more head injuries than women.[19]

The findings also demonstrated that in developed countries, the highest prevalence of stroke occurs in people in their third decade of life.[20,21] This can be partly explained by the presence of more men, especially at a young age, outdoors, and the occurrence of risky behaviors. The results of this study showed that the most common cause of head trauma (43.4%) was falling from a height, followed by traffic accidents (34.3%). Similarly, Fazel et al determined the causes and frequency of trauma-induced brain injuries in Kashan hospitals, and among 4290 patients with head trauma who were included in the study within 24 months, traffic accidents, falls, and attacks were the most common causes of head injuries. Of the trauma cases, 92.7%, 2.5%, and 4.8% were mild, moderate, and severe, respectively.[22] Studies by Rutland-Brown et al and Faul et al also revealed that the leading cause of head trauma was falling from a height.[11,23] Of the 143 CT scans performed on patients with mild head trauma, only six cases of pathological findings were observed; of these, one case (16.7%) had a headache, two cases (33.3%) vomited, and none had post-traumatic decreased alertness. However, only vomiting was significantly associated with CT scan results, and other symptoms were not significantly different between the groups with normal and abnormal CT scans. Therefore, in patients with mild head trauma, the presence of only one sign, including vomiting, headache, or decreased alertness, does not indicate a pathological lesion in the chest, and to prevent high CT scan requests, such patients can be monitored for a while—severity or increase in the symptoms of a CT scan of the brain. In mild head trauma, two evidence-based criteria, Canadian and New Orleans, prevent unnecessary and routine increases in CT scan requests.

Table 3. Patients' Symptoms According to Canadian and New Orleans Criteria

		Criteria	CT Scan Results	
			Abnormal	Normal
Canadian criteria	GCS	GCS=13	1 (0.69)	0
		GCS=14	0	1 (0.69)
		GCS=15	0	3 (2.09)
	Suspicion of open or sunken skull fracture		0	3 (2.09)
	Any signs of a basilar skull fracture		0	2 (1.39)
	Vomiting	Twice	1 (0.69)	20 (13.9)
		More than twice	1 (0.69)	0
	Age of 65 and over		3 (2.09)	23 (16.08)
New Orleans criteria	Headache		1 (0.69)	7 (4.89)
	Vomiting		1 (1.39)	20 (13.9)
	Age of over 60 years		3 (2.09)	34 (23.77)
	Alcohol or drug poisoning		0	3 (2.09)
	Permanent forgetfulness of the anthrax		0	0 (0)
	Trauma to the upper clavicle		0	19 (13.28)
	Convulsions		0	0 (0)

Note. GCS: Glasgow Coma Scale.

Patients who meet the Canadian and New Orleans criteria are more likely to have a pathological lesion due to trauma on a CT scan.[15] In a study by Stiell et al, which compared the sensitivity and specificity of the Canadian and New Orleans criteria in performing the CT scans of the brain in patients with minor head trauma, in patients with GCS 15, both criteria had the same sensitivity to diagnose the need for surgery and essential clinical care. Nonetheless, the Canadian standard had a higher specificity and, therefore, would reduce the number of cases of CT scans.[24] Stiell et al also conducted a study to determine the sensitivity of Canadian criteria in diagnosing the need for CT scans in patients with mild head trauma; they found that this criterion was 100% and 98.4% sensitive for high-risk people and people with moderate-risk, respectively, and is a standard and good criterion for determining the need for a brain scan.[25] In this study, after examining the patients for these two criteria, they were sent for a brain CT scan. The findings indicated that both criteria can be equally effective in diagnosing brain lesions. Alzuhairy also reported that both criteria had almost the same predictive capability for detecting abnormal CT scans,[26] which is in line with the result of the present study.

Conclusion

According to the results of the present study, the New Orleans index identified more patients as CT scan candidates than the Canadian index; however, no difference was found in the final result (the presence of a pathological lesion in the CT scan) between these two indices. The New Orleans index has more features, but its results are not different from the Canadian index; thus, we believe that using the Canadian index can decrease imaging rates, costs, and protection from the side effects of radiation.

Acknowledgments

This study is the result of a part of the dissertation by Parna Alikhani, Shahrekord University of Medical Sciences in 2020. The authors wish to express their deepest gratitude and warmest appreciation to all the medical ethicists and emergency medicine specialists who, in any way, have contributed to this research and inspired the researchers.

Authors' Contribution

Conceptualization: Abdolrahim Sanei, Mohammad Ali Dayani, Seyed Mehdi Pourafzali, Afsaneh Malekpour, Parna Alikhani, Aida Amiripour.
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Competing Interests

The authors declare that there is no conflict of interests.

Ethical Approval

This study was approved by Shahrekord University of Medical Sciences in 2019 with ethics code IR.SKUMS.REC.1398.146.

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