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Examining the Incidence of Cranial Nerve Injuries in Patients with Mild Traumatic Brain Injury at a Tertiary Healthcare Centre

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Abstract: ***Introduction/Aims**: To study cranial nerves injuries (CNIs) incidence in patients with mild traumatic brain injury (TBI) in a tertiary healthcare Centre. **Methods**: In this study, 181 patients with mild TBI were included during a period from December 2019 to June 2021. The incidence of CNIs was immediately performed on the patients and they were examined daily until the day of discharge. TBI severity was evaluated using Glasgow Coma Scale (GCS) score. The incidence of CNIs and their correlation to the mode of injury, the type and severity of head injury, and radiological findings were investigated. **Results**: The incidence of CNIs in patients with mild TBI was 55.8%. The incidence of single CNI resulted 30.9%, whereas multiple CNIs was reported in 24.9% of patients with mild TBI. The most common cranial nerve injured was the olfactory nerve (28.2%), followed by the seventh cranial nerve (23.28%). Cranial nerve injury associated with skull fracture had a relatively poor outcome. In mild head injury, the involvement of 5th and lower cranial nerve (nine, ten, eleven and twelve) injuries is quite rare. **Discussion**: The main cause of CNIs is motor vehicle accidents and middle - aged males are disproportionately affected. This study also emphasizes the significance of a thorough clinical examination for cranial nerve injury in head injury patients and the urgency of prompt medical intervention.***

Keywords: cranial nerve injuries, mild traumatic brain injury, tertiary healthcare centre, incidence, examination

1. Introduction

Traumatic brain injury (TBI) impacts up to 2% of the population per year and constitutes the fundamental cause of death and high disability among younger populations, as it is mainly associated with road accidents.1TBI is frequently associated with brain contusions, subarachnoid hemorrhage, subdural hemorrhage, extradural hemorrhage, cranial bone fractures, cranial nerve injury (CNI), scalp and cranio - facial trauma.2Shearing forces, rapid acceleration or deceleration, trauma to the base of the skull, and penetrating brain injuries are all causes of CNIs.3CNI may go unnoticed in the emergency room where the patient is admitted after enduring a TBI, however cranial nerves deficits have sizable social and occupational effect over the affected person.4 During the initial evaluation, the patient's history, records, clinical examination and neurological testing are all used to accurately estimate the patient's sensorium (oriented/ disoriented), cortical functions and hemodynamic status. Additionally, the condition of the cranial nerves can be quickly assessed based on pupil size, eye movements, facial symmetry, and laryngeal functions.5A detail examination of the patient's cranial nerves may not be possible in a comatose or sensorium - altered patient. When a patient is unconscious, objective information cannot be obtained.

The current study aims to report the CNIs occurring in neurotrauma cases in a tertiary healthcare center, to quantify the effect of cranial nerve damage, distribution of diverse cranial nerve involvement and its radiological correlation. So, the major objectives of this study are (1) to evaluate the incidence of CNIs among patients with mild TBI and (2) to study the neurological function of cranial nerve and its status at last follow - up.

2. Methods

Study Design and Selection of Samples

This prospective observational analytical study was performed in KIMSDU Hospital, Karad, Maharashtra from December 2019 to June 2021.181 consecutive patients were admitted at Krishna Hospital, Karad Neuroscience department in ICU and with mild TBI to study the incidence, type, mode and outcome of different CNIs. This study received ethical approval from the institutional ethics committee.

Outcome assessment

TBI severity was evaluated using Glasgow Coma Scale (GCS). The incidence of CNIs and their correlation to the mode of injury, the type and severity of head injury, and radiological findings were investigated. All patients were

investigated with non - contrast computed tomography (CT) head scan at the time of admission. Clinical examinations of cranial nerves were done meticulously daily. Detailed history was taken and record onset of loss of smell, visual loss, hearing loss, diplopia, facial pain/ deviation, incomplete closure of eyes, change in voice, difficulty in swallowing, duration, association with pain, any previous attack and history of any other neurological symptoms. In the emergency room, the pupillary reflex was clinically checked on all patients. Even in patients with moderate - to - severe head injuries, relative afferent pupillary defect (RAPD) is a fairly accurate test to identify unilateral optic nerve injury.6 For grading facial nerve injury, the House - Brackman (HB) 6 - point scale was used.7, [8] There are three levels of clinical recovery following cranial nerve injury: No recovery (no objective clinical improvement in nerve function), Partial recovery (some clinical improvement) and complete recovery (at the end of the follow - up period, the patient was asymptomatic).9 Recovery was also reported and compared to the demographic profile, related radiological findings, specific treatment, such as surgical decompression, steroid administration, and specific rehabilitation measures undertaken.

Inclusion and exclusion criteria

The major inclusion criteria for this study were patients who were willing to participate in the study with GCS 13, 14 and 15. The exclusion criteria were (1) Patients with Glasgow coma scale (GCS) ≤ 12; (2) patients with pre - existing CNIs and other non - traumatic causes of cranial nerve palsies like bell`s palsy.

Statistical analysis

The statistical analyses were performed using the SPSS software version 21. Data were expressed as mean ± standard deviations (SD) for continuous variables. Frequency and proportions were reported for categorical variables. The p - value of < 0.05 was considered statistically significant using Chi - square test.

3. Results

Correlation of head injury and cranial nerve injury with age group, gender and cause of injury

Among all 181 patients admitted to our hospital, 101 patients reported at least a single CNI. CNIs were most observed in the 36–45 - year - old group of patients (22.77%), followed by the 26–35 - year - old group and the 46 - 55 year old group (21.78%). CNIs were most common observed in males (52.48%) (Table 1). It was observed that the major incidence of CNIs is associated with road traffic accidents (RTA) (78.22%) followed by fall (13.86%) and by assault (7.92%) (Table 1). Single CNI occurred in 55.4% of patients with CNIs, whereas a double CNI was observed in 38.6% of patients with all patients with CNIs. Table 2 shows all the details.

Distribution of cranial nerve injuries and CT scan findings

The olfactory nerve was the most common nerve to be involved in mild TBI in this study (28.2 of cases) and followed by facial (23.2%), oculomotor (11.6%) and vestibulocochlear nerves (11.6%). In mild TBIs lower cranial nerve involvement was very rare. On CT head scan thecribriform plate fracture was observed in 7.2% of cases. Contusion, subarachnoid hematoma, temporal bone fractures and epidural hematoma were observed in 5%, 4.4%, 2.5% and 2.2%, respectively. Most common clinical neurological presentations correlated with cranial nerve was anosmia (5.5%). The other clinical findings were loss of vision (1.7%), loss of accommodation reflex (1.7%), ptosis (1.1%), diplopia (2.2%), loss of nasolabial fold (1.1%), incomplete closure of eye (2.2%), mouth deviation (1.7%) and hearing loss (1.7%). It was observed that olfactory and oculomotor nerve injury severity were significant at the time of discharge (Table 3). Similarly subdural hematoma and cerebral contusion at CT scan findings were significant at the time of discharge (Supplementary Table 4), whereas only anosmia, among clinical findings, was significant at time of discharge (Supplementary Table 5).

4. Discussion

Cranial nerve injuries are commonly associated with TBI. In this study, the incidence of CNIs in mild head injury is about 55.8%. The literature states that the incidence of CNIs was about 5 to 23%.9 - [11] The middle age male population have the highest incidence for mild TBI and CNIs. This study showed the RTAs account for about 78.2% of head injury. The male female ratio in the study population was about 1.1: 1. Among mild TBI 47.52% had GCS 15, 43.57 % had GCS 14 and 8.91% had GCS 13.56 patients out of 181 patients (30.9%) had one single CNI, whereas 24.9% of patients reported more than one CNIs. Contrary to the existing literature facial is not the most common nerve injured in present study, [9, 12] whereas olfactory nerve was the most common nerve injured. Patel et al.1[3]reported a low incidence of traumatic olfactory nerve injury in a tertiary care population. The most common cause for olfactory nerve injury is direct impact over the cribriform plate. It also gets injured during the contrecoup impact over the occipital region due to acceleration and deceleration effect over the olfactory bulb or olfactory nerve. Olfactory nerve injury occurring due to cribriform plate fracture has a poor prognosis as compared to occipital bone fracture and frontal contusion due to coup - counter coup injury and best outcome seen when it is due to local hematomas. Facial nerve is the second most involved cranial nerve in mild TBI (41.58%). Poor outcome was observed in patients who had complete nerve transection seen on CT/MRI brain or delayed recovery with bony fractures. In the preset study, optic nerve injury was 8.8% among patients with mild TBI. Poor prognosis was observed in patients who had poor vision at the time of injury. Patients who had lost vision due to multiple complex fracture showed no recovery. The limitation of this study is that the sample size is small, and it is a single - center study, for which the sample size will be expanded to carry out multicenter research in future studies.

5. Conclusion

The incidence of CNIs in mild TBI is around 58.8%. The incidence of single CNI was 30.9% and multiple CNIsresulted 24.9% in patients with mild TBI. Among all CNIs, the olfactory nerve injury was the most common cranial nerve injury (28.2%) and had better prognostic outcome in our study. CNIs associated with skull bone

fracture had a relatively poor outcome and was found to be statistically significant. The second most common cranial nerve involved in mild TBI is the facial nerve (23.2%). This study also emphasizes the value of meticulous clinical examination in head injury patients and the urgency of prompt medical intervention.

References

[1] Hurlbert RJ, Ball JR, Winn HR (2011): Youmans neurological surgery. Elsevier.
[2] Ventura RE, Balcer LJ, Galetta SL (2014) The neuro - ophthalmology of head trauma. The Lancet Neurology. Lancet Publishing Group, 13 (10): 1006 - 16
[3] Pathi R, Surendra Kumar C, Manda VV, Kadali S, Prahalad P (2021) Traumatic Cranial Nerve Injuries in Mild to Moderate Head Trauma - An Institutional Experience. International Journal of Current Medical and Applied Sciences 30: 2
[4] Huckhagel T, Riedel C, Rohde V, Lefering R (2022) Cranial nerve injuries in patients with moderate to severe head trauma – Analysis of 91, 196 patients from the Trauma Register DGU® between 2008 and 2017. Clinical Neurology and Neurosurgery: 212
[5] Damodaran O, Rizk E, Rodriguez J, Lee G (2014) Cranial nerve assessment: A concise guide to clinical examination. Clinical Anatomy 27 (1): 25–30.
[6] Steinsapir KD, Goldberg RA (1994) Traumatic Optic Neuropathy. Survey of Ophthalmology 38 (6): 487 - 518.
[7] Brackmann DE, Barrs DM (1984) Assessing recovery of facial function following acoustic neuroma surgery. Otolaryngology Head and Neck Surgery 92 (1): 88 - 93.
[8] House JW (1983) Facial nerve grading systems. Laryngoscope, 93: 1
[9] Coello AF, Canals AG, Gonzalez JM, Martín JJ (2010) Cranial nerve injury after minor head trauma. J Neurosurg Case Lessons 113 (3): 547–555
[10] Col Bhatoe HS (2007) Trauma to the cranial nerves. Indian Journal of Neurotrauma 4 (2): 89–100
[11] Keane JR, Baloh RW (1992): Posttraumatic cranial neuropathies. The Neurology of Trauma 10 (4): 849–68
[12] Levin HS, High WM, Eisenberg HM (2010) Impairment of olfactory recognition after closed head injury. Brain 108, (3): 579 - 911985
[13] Patel P, Kalyanaraman S, Reginald J, Natarajan P, Ganapathy K, Suresh Bapu K, Balamurugan M (2005) Post - traumatic cranial nerve injury. The Indian Journal of Neurotrauma 2 (1): 27–32

Table 1: Correlation of TBI and CNIs with age (a), gender (b) and cause of injury (c) data

(a) Correlation of head injury and cranial nerve injury with age group			
Age group	Patients (n°)	CNIs (n°)	Percentage (%)
≤ 25	17	10	9.91
26 - 35	38	22	21.78
36 - 45	38	23	22.77
46 - 55	37	22	21.78
56 - 65	23	11	10.89
≥ 66	28	13	12.87
(b) Correlation of head injury and cranial nerve injury with gender			
Male	101	53	52.48
Female	80	48	47.52
(c) Correlation of head injury and cranial nerve injury with cause of injury			
RTA	111	79	78.22
Fall	54	14	13.86
Assault	16	8	7.92

Table 2: The incidence of cranial nerve injuries, proportion of single and multiple cranial injuries among the total cranial nerve injuries and distribution with age

Age	Patients	Patient with single CNI	Patient with double CNIs	Patient with triple CNIs	Patient with more than 3 CNIs
≤ 25	10	4	5	0	1
26 - 35	22	10	11	0	1
36 - 45	23	11	10	1	1
46 - 55	22	16	5	1	0
56 - 65	11	7	3	0	0
≥ 66	13	8	4	1	0
TOTAL	101 (%)	56 (55.44)	39 (38.62)	3 (2.97)	3 (2.97)

Table 3: Correlation of nerve injured with severity at time of discharge. It was observed that when p value is < 0.05 then it is statistically significant (*) relation with severity at time of discharge and in significant with severity at time of discharge when p value is > 0.05.

Nerve involved (injured)		Outcome of CNI		Total	p value
		GCS 15 - 14	GCS 13		
Olfactory Nerve	Present	45	6	51	0.31*
	Absent	47	3	50	

Optic Nerve	Present	15	1	16	0.74
	Absent	79	8	87	
Oculomotor Nerve	Present	21	0	21	0.11*
	Absent	71	9	80	
Abducens Nerve	Present	4	0	4	0.52
	Absent	88	9	97	
Facial Nerve	Present	39	3	42	0.599
	Absent	53	6	59	
Vestibulocochlear Nerve	Present	19	2	21	0.912
	Absent	73	7	80	

Supplementary Table 4: Correlation of CT findings with severity at time of discharge. It was observed that when p value is < 0.05 then it is statistically significant (*) relation with Severity at time of discharge and in significant with Severity at time of discharge when p value is > 0.05.

CT Findings		Outcome of CNI		Total	p value
		GCS 15 - 14	GCS 13		
Normal	Present	12	1	13	0.89
	Absent	80	8	88	
Cribriform Plate Fracture	Present	13	2	15	0.51
	Absent	79	7	86	
Orbital Floor Fracture	Present	1	0	1	0.75
	Absent	91	9	100	
Temporal Bone Fracture	Present	4	0	4	0.52
	Absent	88	9	97	
Epidural Hematoma	Present	4	0	4	0.52
	Absent	88	9	97	
Subdural Hematoma	Present	8	0	8	0.36*
	Absent	84	9	93	
Contusion	Present	9	0	9	0.33*
	Absent	83	9	92	

Supplementary Table 5. Correlation of clinical finding with severity at time of discharge. It was observed that when p value is < 0.05 then it is statistically significant (*) relation with Severity at time of discharge and in significant with Severity at time of discharge when p value is > 0.05.

Clinical Findings		Outcome of CNI		Total	p value
		GCS 15 - 14	GCS 13		
Anosmia	Present	8	2	10	0.195*
	Absent	84	7	91	
Loss of Vision	Present	3	0	3	0.58
	Absent	89	9	98	
Loss of Accommodation Reflex	Present	3	0	3	0.58
	Absent	89	9	98	
Ptosis	Present	2	0	2	0.66
	Absent	90	9	99	
Diplopia	Present	4	0	4	0.52
	Absent	88	9	97	
Loss of Nasolabial Fold	Present	2	0	2	0.66
	Absent	90	9	99	
Incomplete Closure of Eye	Present	4	0	4	0.52
	Absent	88	9	97	
Mouth Deviation	Present	3	0	3	0.58
	Absent	89	9	98	
Hearing Loss	Present	3	0	3	0.58
	Absent	89	9	98	