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Neurosurgery

AN ANALYTICAL STUDY OF INCIDENCE OF CRANIAL NERVE INJURY IN MILD HEAD INJURY

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ABSTRACT

INTRODUCTION: About 85% of the road traffic accidents occur in the developing countries being a major share of global burden. India accounts for about 10% of road accident fatalities worldwide. Cranial nerves injuries should be given adequate importance to avoid neurological morbidities that lead to compromise in quality of life.

AIM : The present study was undertaken to quantify magnitude of cranial nerve injury, distribution of various cranial nerve involvement and outcome.

MATERIALS AND METHODS: It is a prospective analytical study; study period was from september 2013 to February 2015 in the department of neurosurgery, Thanjavur medical college. Thousand consecutive patients admitted in our hospital trauma ward with mild head injury were studied. Regardless of age and sex, Patients with GCS 12 and less, pre-existing cranial nerve injuries were excluded

After initial rapid cranial nerve injures assessment and ruling out the need for emergency neurosurgical intervention, submitted for detailed clinical neurological examination. HRCT and MRI obtained to analyze nature of injuries. Patients were kept under monthly follow up to find out neurological recovery.

RESULTS: In this study the incidence of cranial nerve injuries in mild head injury is about 14.8. Road traffic accidents being the single leading cause for the cranial nerve injuries. The middle age male population has the highest predilection for head injury. Among mild head injuries-31.9% had GCS-15, 50 %had GCS-14 and 18.9%had GCS-13. In this study about 148patients out of 1000patients had cranial nerve injuries and about 26patients had multiple cranial nerve injuries which is about-2.6% of the total sample and 17.5%of patients who had cranial nerve injuries.

Conclusion: The incidence of cranial nerve injury in mild head injury is around 15%. The commonest cranial nerve involved is seventh cranial nerve, which was about 32.4 percent of cranial nerve injuries. Lower cranial nerve (Nine, ten, eleven and twelve) injuries were very rarely seen in mild head injuries. Road traffic accidents are the prime mode of injury and middle age male population were commonly injured. This study also emphasizes the value of meticulous clinical examination in head injury patients.

KEYWORDS : Head injuries, cranial nerve injuries,

INTRODUCTION

Road traffic accidents play a significant role in world wide mortality rate, which is about 2.1%[14]. About 85% of the road traffic accidents occur in the developing countries being a major share of global burden. India accounts for about 10% of road accident fatalities worldwide

An injury to head may cause various types of impact over the brain and calvarium. Although cranial nerves injuries is not of prime concern in emergency department, cranial nerves injuries should be given adequate importance to avoid neurological morbidities. The present study was undertaken to quantify magnitude of cranial nerve injury, distribution of various cranial nerve involvement, radiological correlation and outcome.

Aim of the study

Quantify magnitude of cranial nerve injury, distribution of various cranial nerve involvement, radiological correlation and outcome

MATERIALS AND METHODS

It is a prospective analytical study; study period was from september 2013 to February 2015 in the department of neurosurgery, Thanjavur medical college. Thousand consecutive patients admitted in our hospital trauma ward with mild head injury were studied.

After initial rapid cranial nerve injures assessment and ruling out the need for emergency neurosurgical intervention, all thousand patients were submitted for detailed clinical neurological examination. Methods adapted from DeJong's The Neurological examination and Localization in Clinical Neurology by PAUL W. BRAZIS MD[16] HRCT and MRI obtained to analyze nature of injuries. Patients were kept under monthly follow up to find out neurological recovery.

Inclusion criteria

- Regardless of age and sex, patients who were willing to participate in the study with mild head injury.

Exclusion criteria

- Patients with GCS 12 and less
- Patients with pre-existing cranial nerve injuries.

Approval for the study was obtained from the college ethical committee.

Patients who were subjected for study submitted for detailed clinical neurological examination on daily basis till discharge. Patients were kept under monthly follow up to find out neurological recovery and HRCT, MRI and necessary electrophysiological monitoring done

Observation

Incidence of cranial nerve injuries, Distribution of various cranial nerve injuries, and Outcome of various cranial nerve.

Statistical analysis

Statistical analysis was performed by using chi-square test. Multivariate analysis of variance (chi-square test) is a statistical test procedure for comparing multivariate means of several groups. A statistically significant difference was indicated by a p-value of less than 0.05.

RESULTS

TOTAL SAMPLE	1000	%
PATIENTS WITH CRANIAL NERVE INJURIES	148	14.8%
PATIENTS WITH SINGLE CRANIAL NERVE INJURIES	122	12.2%
PATIENTS WITH MULTIPLE CRANIAL NERVE INJURIES	26	2.6%

INCIDENCE OF CRANIAL NERVE INJURY-TABLE-1

INCIDANCE OF CRANIAL NERVE BASED ON GCS	NO	%
PATIENTS CRANIAL NERVE INJURIES WITH GCS 13	28	18.91%
PATIENTS CRANIAL NERVE INJURIES WITH GCS 14	74	50%
PATIENTS CRANIAL NERVE INJURIES WITH GCS 15	46	31.09%

CRANIAL NERVE INJURIES ON VARIOUS GCS-TABLE-2

SEX RATIO	MALE FEMALE RATIO	
	NUMBER	PERCENTAGE
TOTAL SAMPLE	853:147	85.3%:14.7%
CRANIAL NERVE INJURED	129:19	12.9%:1.9 %
SINGLE CRANIAL NERVE INJURED	103:19	84.4%:13.6%
MULTIPLE CRANIAL NERVE INJURED	26:0	26%:0%

ANALYSIS OF SEX DISTRIBUTION-TABLE-3

NAME OF THE CRANIAL NERVE INJURED	NUMBER OF PATIENTS INJURED
OLFACTORY NERVE	22
OPTIC NERVE	32
OCULOMOTOR NERVE	22
TROCHLEAR NERVE	13
TRIGEMINAL NERVE	06
ABDUCENS NERVE	24
FACIAL NERVE	48
VESTIBULOCOCHLEAR NERVE	14
GLOSSOPHARYNGEAL NERVE	00
VAGUS NERVE	00
ACCESSORY NERVE	00
HYPOGLOSSAL NERVE	00

DISTRIBUTION OF CRANIAL NERVE INJURIES-TABLE-4

CRANIAL NERVE INVOLVED	NUMBER OF PATIENTS
II,III,IV&VI	2
II&III	6
II&VI	4
III,IV&VI	3
VII&VIII	11

DISTRIBUTION OF MULTIPLE CRANIAL NERVE INJURIES-TABLE-5

ANALYSIS OF OLFACTORY NERVE

TOTAL CRANIAL NERVE INJURY	148
OLFACTORY NERVE INJURY	22

INCIDENCE OF OLFACTORY NERVE INJURY-TABLE-6

CT SCAN FINDING	NUMBER OF PATIENTS	RECOVERY STATUS		p-VALUE	ODDS RATIO [CI]
		NUMBER	PERCENTAGE		
OCCIPITAL BONE FRACTURE	05	03	60%	0.611	1.698
NASOETHMOIDAL COMPLEX FRACTURE	13	05	38.5%	0.193	0.313
OTHER SCAN FINDING	04	03	75%	0.269	3.750
TOTAL NUMBER OF PATIENTS	22	11	50%	--	--

CORRELATION BETWEEN SCAN FINDING AND OUTCOME-TABLE-7

ASSOCIATED FINDING	TOTAL NUMBERS	RECOVERY STATUS		P-VALUE	ODDS RATIO [C-I]
		NUMBERS	PERCENTAGE		
CSF RHINORRHOEA	09	00	0%	0.002	--
EXTRA DURAL HAEMOTOMA	03	00	0%	0.002	--
FRONTAL CONTUSION	09	04	44.4%	0.665	0.686[0.124-3.784]

CORRELATION BETWEEN ASSOCIATED SCAN FINDING AND OUTCOME-TABLE-8

ANALYSIS OF OPTIC NERVE

TOTAL CRANIAL NERVE INJURY	148
TOTAL OPTIC NERVE INJURY	32
ISOLATED OPTIC NERVE INJURY	20
ASSOCIATED WITH OTHER NERVES	12

INCIDENCE OF OPTIC NERVE INJURES-TABLE-9

LEVEL OF VISION	NUMBER OF PATIENTS	LEVEL OF RECOVERY STATES						P-VALUE
		COMPLETE		PARTIAL		STATIC		
		NO	%	NO	%	NO	%	
PERCEPTION OF LIGHT ABSENT	05	01	20%	00	0%	04	80%	< 0.05
PERCEPTION OF LIGHT PRESENT	08	01	12.5%	02	25%	05	62.5%	
HAND MOVEMENT	11	04	36.4%	01	19.1%	06	54.5%	
FINGER COUNT	08	06	75%	01	12.5%	01	12.5%	

TOTAL CRANIAL NERVE INJURY	148
TOTAL OCULOMOTOR CRANIAL NERVE INJURY	22
ISOLATED OCULOMOTPR NERVE INJURY	11
ASSOCIATED WITH OTHER NERVES	11

CORRELATION BETWEEN VISUAL PERCEPTION ON ADMISSION AND OUTCOME-TABLE-10

NATURE OF FRACTURE	TOTAL NUMBER	RECOVERY STATUS						p-VALUE
		COMPLETE		PARTIAL		STATIC		
		NO	%	NO	%	NO	%	
NORMAL CT	02	01	50%	0	0%	01	50%	< 0.05
MULTIPLE COMPLEX FRACTURE	10	01	10%	01	10%	08	80%	
MEDIAL WALL ORBIT FRACTURE	08	04	50%	02	25%	02	25%	
LATERAL WALL ORBIT FRACTURE	12	08	66.7%	01	8.3%	03	25%	

CORRELATION BETWEEN NATURE OF ORBIT FRACTURE AND OUTCOME-TABLE-11

ANALYSIS OF OCULOMOTOR NERVE INJURIES

INCIDENCE OF OCULOMOTOR INJURY-TABLE-12

NATURE OF FRACTURE	TOTAL NUMBER	RECOVERY STATUS						P-VALUE
		COMPLETE		PARTIAL		STATIC		
		NO	%	NO	%	NO	%	
NORMAL CT SCAN	03/22	03	100%	00	0%	00	0%	< 0.05
ORBITAL FRACTURE	14/22	04	28.6%	03	21.4%	07	50%	
OTHERS	05/22	03	60%	01	20%	01	20%	

CORRELATION BETWEEN SCAN FINDING AND OUT COME-TABLE-13

ANALYSIS OF TROCHLEAR NERVE INJURIES

TOTAL CRANIAL NERVE INJURY	148
TOTAL TROCHLEAR NERVE INJURY	13
ISOLATED TROCHLEAR NERVE INJURY	08
ASSOCIATED WITH OTHER NERVES	05

INCIDENCE OF TROCHELEAR INJURY-TABLE-12

NATURE OF FRACTURE	NUMBER OF PATIENTS	RECOVERY STATUS						P-VALUE
		COMPLETE		PARTIAL		STATIC		
		NO	%	NO	%	NO	%	
NORMAL CT SCAN	02/13	02	100%	00	0%	00	0%	< 0.05
ORBITAL BONE FRACTURE	08/13	01	12.5%	02	25%	05	62.5%	
OTHERS	03/13	03	100%	00	0%	00	0%	

CORRELATION BETWEEN SCAN FINDING AND OUT COME-TABLE-13

ANALYSIS OF TRIGEMINAL NERVE INJURIES:

NERVE INJURED	CAUSE OF INJURY	NUMBER OF PATIENTS
SUPRAORBITAL	FRONTAL BONE FRACTURE	2
INFRAORBITAL	MAXILLA FRACTURE	2
MANDIBULAR	MANDIBULAR FRACTURE	2

CORRELATION BETWEEN SCAN FINDING AND OUT COME-TABLE-14

ANALYSIS OF ABDUCENS NERVE INJURIES:

TOTAL CRANIAL NERVE INJURY	148
TOTAL ABDUCENS NERVE INJURY	24
ISOLATED ABDUCENS NERVE INJURY	15
ASSOCIATED WITH OTHER NERVES	09

INCIDENCE OF ABDUCENS NERVE INJURY-TABLE-15

NATURE OF FRACTURE	NUMBER OF PATIENTS	RECOVERY STATUS						p-VALUE
		COMPLETE		PARTIAL		STATIC		
		NO	%	NO	%	NO	%	
NORMAL CT SCAN	06/24	04	66.7%	01	16.7%	01	16.7%	>0.05
ORBITAL BONE FRACTURE	07/24	04	57.1%	01	14.3%	02	28.6%	
OTHERS	11/24	05	45.5%	02	18.3%	04	36.4%	

CORRELATION BETWEEN SCAN FINDING AND OUT COME-TABLE-16

ANALYSIS OF FACIAL NERVE INJURIES

TOTAL CRANIAL NERVE INJURY	148
TOTAL FACIAL NERVE INJURY	48
ISOLATED FACIAL NERVE INJURY	37
ASSOCIATED WITH OTHER NERVES	11

INCIDENCE OF FACIAL NERVE INJURY-TABLE-17

NATURE OF TEMPORAL BONE FRACTURE	TOTAL NUMBER	INITIAL GRADING												P-VALUE
		GRADING I		GRADING II		GRADING III		GRADING IV		GRADING V		GRADING VI		
		NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	
TRANSVERSE	17	00	0%	03	17.6%	11	64.7%	03	17.6%	00	0%	00	0%	0.002
HORIZONTAL	18	00	0%	00	0%	01	5.6%	13	72.2%	04	22.2%	00	0%	0.003
OBLIQUE	09	00	0%	00	0%	00	0%	00	0%	05	55%	04	44.4%	0.001
NORMAL CT SCAN	04	00	00	03	75%	01	25%	00	0%	00	0%	00	0%	0.002

CORRELATION BETWEEN TEMPORAL BONE FRACTURE AND INITIAL PRESENTATION-TABLE-18

NATURE OF TEMPORAL BONE FRACTURE	TOTAL NUMPER	FINAL GRADING												P-VALUE
		GRADING I		GRADING II		GRADING III		GRADING IV		GRADING V		GRADING VI		
		NO	%	NO	%	NO	%	NO	%	NO	%	NO	%	
TRANSVERSE	17	05	29.4%	09	52.9%	03	17.6%	00	0%	00	0%	00	0%	0.002
HORIZONTAL	18	00	0%	08	44.4%	10	55.6%	00	0%	00	0%	00	0%	0.003
OBLIQUE	09	00	0%	00	0%	04	44.4%	02	22.2%	03	33.3%	00	0%	0.001
NORMAL SEAN	04	02	50%	02	50%	00	00%	00	0%	00	0%	00	0%	0.002

CORRELATION BETWEEN TEMPORAL BONE FRACTURE AND FINAL PRESENTATION-TABLE-19

ANALYSIS OFVESTIBULOCOCHLEAR NERVE

TOTAL CRANIAL NERVE INJURY	148
TOTAL VESTIBULOCOCHLEAR NERVE INJURY	14
ISOLATED VESTIBULOCOCHLEAR NERVE INJURY	03
ASSOCIATED WITH OTHER NERVES	11

INCIDENCE OF VESTIBULOCOCHLEAR NERVE-TABLE-20

NATURE OF FRACTURE	TOTAL	RECOVERY STATUS						P-VALUE
		COMPLETE		PARTIAL		STATIC		
		NO	%	NO	%	NO	%	
TRANSVERSE	03	03	100%	00	00%	00	0%	0.032
HORIZONTAL	03	02	66.7%	01	33.3%	00	0%	0.023
OBLIQUE	08	00	0%	02	25%	06	75%	0.004

ANALYSIS OF TEMPORAL BONE FRACTURE AND OUTCOME-TABLE-21

TYPE OF HEARING LOSS	TOTAL	RECOVERY STATUS						P-VALUE
		COMPLETE		PARTIAL		STATIC		
		NO	%	NO	%	NO	%	
CONDUCTIVE	04	03	75%	01	25%	00	00%	0.088
SENSORINEURAL	06	03	37.5%	02	25%	03	37.5%	0.881
MIXED	04	00	0%	01	25%	03	75%	0.184

ANALYSIS OF TYPE OF HEARING LOSS AND OUTCOME-TABLE-22

DISCUSSION

In this study the incidence of cranial nerve injuries in mild head injury is about 14.8%. RTA being the single leading cause for cranial nerve injuries. The middle age male population has the highest predilection for head injury.

In this study about 148 patients out of 1000 patients had cranial nerve injuries and about-26(2.6%) patients had multiple cranial nerve injuries. Contrary to the existing literature olfactory is not the commonest nerve injured in our study[1]. This is already highlighted by Puravpatel et al[1], who stated that tertiary care population show less incidence of traumatic olfactory nerve injury. The olfactory nerve

injury in this study was about 2.2% of the total sample and among who sustained to have cranial nerve injury it was about 14.8%. This is the second most common isolated cranial nerve injury in this study.

Optic nerve is the second most commonly involved cranial nerve in mild head injury as per our study. This is about 3.2% of total study population and 21.6% of the persons who had cranial nerve injuries. Optic nerve has the strongest association with multiple cranial nerve injuries. Optic nerve is most commonly injured due to the complex orbital bone fracture extending from orbital roof to optic canal, seen in about 31.25% seen in our study. In patients who had medial and lateral wall of the orbital bone fracture, the optic nerve was injured about 35.5% and 25% respectively. Poor outcome was observed in patients who had poor vision at the time of injury. Patients who had lost the vision due to multiple complex fractures showed no recovery[11].

The incidence[1, 2,4,9] of oculomotor nerve injury was about 2.2% in total study population and 14.8% of patient who sustained cranial nerve injury in this study. Out of 22 patients 11 patients had isolated oculomotor nerve injury, which is about 50% and in remaining 50% that is 11 patients had multiple cranial nerve injuries. In the latter sub group, two patients with oculomotor nerve injury also had optic, trochlear, and abducens nerve injury. Three patients had associated trochlear and abducens nerve injury. Remaining six patients had optic nerve injury. The above results of this study compared with other studies[1,4](A. F. Coello et al and Puravpatel et al).

Trochlear nerve injury was seen in 1.3 % of the total study population and 8.78% of the sub group with cranial nerve injuries. Isolated trochlear nerve injury seen in 61.5% (08 patients) and 38.5 % (5patients) of patients had multiple cranial nerve injuries. In the latter sub group, two patients had associated optic, oculomotor and abducens nerve injury and three patients had associated oculomotor and abducens nerve injury.

Orbital bone fracture is the single most common cause for trochlear nerve injury, which is about 61.5% (8/13 patients), followed by other CT findings in about 23.07% (3 patients) and normal CT findings in about 15.30% (2patients).

Binocular diplopia is the commonest symptom associated with trochlear nerve injury, and middle aged male patients were common victims. Skull bone fracture associated with trochlear injury had a poor outcome, which was about 12.5% (1/8 patient). Patients who had no fractures regardless of other findings in the CT had a better outcome. The above factors were statistically significant. This study results compares well with A. F. Coello et al and Puravpatel et al[1, 4] .

In the available literature Trigeminal[1, 2, 4] nerve is one of the least common nerves to be injured, as seen in this study. In this study the peripheral branches of trigeminal nerve were only injured in all six patients. None of the above patients showed any improvement.

Connel et al, suggested that the trigeminal nerve is the most vulnerable when the skull base fracture extends to the middle cranial fossa and involving the foramen ovale and foramen rotundum where the nerve is fixed proximally at meckel's cave.

Traumatic abducens nerve injury[1,4,9] was one of the common nerves to be involved seen in 2.4% (24 patients) of the total sample population and in about 16.21% (24 of 148 patients) of those who had cranial nerve injury. 15 patients (62.5 %) had isolated sixth nerve weakness and 9 patients (37.5 %) had multiple cranial nerve injury. Of the nine patients, two were associated with optic, oculomotor, and trochlear nerve injuries. Three of the nine multiple cranial nerve injured patients were associated oculomotor and trochlear nerve injuries. Four of the nine multiple cranial nerve injured patients had associated optic nerve injury. Orbital bone fracture is the most common reason for abducens nerve injury seen in about (45.8%) eleven out of twenty four patients. This study results correlated well with other studies made by A. F. Coello et al and Puravpatel et al [1,4,8] .

Facial nerve injury was the commonest nerve to be involved, seen in 4.8% (48 patients) of the total sample population and about 32.4% (48 of 148 patients) of those who sustained cranial nerve injury. 37 patients (77.08 %) had isolated seventh nerve weakness and 11patients (22.92 %) had multiple cranial nerve injury. All the patients who had multiple cranial nerve weakness had associated eighth nerve injury.

Petrous part of the temporal bone fracture is the single most reason for traumatic seventh nerve injury, seen in 34 patients (91.7%). Rest four patients had normal scan constituting 8.3% of the patients. Based on the nature of fracture, temporal bone fracture is classified as 1.Transverse, 2.Horizontal and 3.oblique. 17 (31.45%) patients with transverse fracture presented with facial nerve weakness, 18 (37.5%) of patient with horizontal fracture showed facial nerve weakness. 9(18.75%) of patients with oblique fracture presented with facial nerve weakness.

Based on the House Brackmann's grading system lesser grade better recovery

This study results compares well with others studies by A. F. Coello et al and Puravpatel et al [1,4.]

The traumatic Vestibulocochlear nerve injury accounts for 1.4% (14) of the total study population and 9.45% of the patients who had sustained cranial nerve. Facial nerve was the only other cranial nerve weakness associated with eighth nerve injury (78.5 %) the rest (21.5%) three patients had isolated eighth nerve injury.

In the patients with eighth nerve injury, eight patients had oblique temporal bone fracture, most did not recover, 25% patients had partial recovery. Three patients with horizontal fracture had a good outcome with 2 of them recovering completely and the other recovering, albeit with residual deafness. The last subgroup of three patients with transverse temporal bone fracture had a complete recovery. These results relate well with A. F. Coello et al and Puravpatel et al [1,4,7.]

In our study, the ninth, tenth, eleventh and twelveth cranial nerve injuries were not reported and the available literature also shows very minimal representation.

Conclusion

1. The incidence of cranial nerve injury in mild head injury is around 15%.
2. In olfactory nerve injury CSF rhinorrhea (dural tear) is the single most negative prognostic factor in this study.
3. In optic nerve injury visual evoked potential is the most important indicator for optic nerve recovery.
4. Cranial nerve injury (III, IV&VI) associated with skull bone fracture had a relatively poor outcome and was found to be statistically significant.
5. Trigeminal nerve injury is relatively uncommon.
6. The commonest cranial nerve involved is seventh cranial nerve.
7. Oblique type of temporal bone fracture is commonly associated Vestibulocochlear nerve injury.
8. Lower cranial nerve (Nine, ten, eleven and twelve) injuries were very rarely mild head injury.
9. RTA- prime mode of injury and middle age male population were commonly injured.
10. This study also emphasizes the value of meticulous clinical examination in head injury patients.

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