

Cranial Nerves Damage Due To Head Injury-A Review

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ABSTRACT

The 12 pairs of cranial nerves are nerves that emerge from the cranium and provide sensory and motor innervations for the head and neck. The incidence of head injury varies between 5%- 23% and is the most common cause for the lesions occurring among all the 12 cranial nerves.

Lesions on these cranial nerves would cause various conditions such as anosmia, oculomotor palsies, trigeminal neuralgia, Abducens palsies, Bell's palsy, hearing loss, Glossopharyngeal neuralgia, Vagus nerve palsy and sternocleidomastoid and trapezius muscle paralysis according to the injury to their respective nerves. The Trochlear nerve injury is usually accompanied by injury to other ocular motor nerves. Hypoglossal nerve and Optic nerve are one of the least injured nerves in head injury.

Studies had been done on the lesions of the cranial nerves related to head injury. It was mentioned that injury to Olfactory, Optic and Oculomotor nerves are the most commonly injured nerves while the least common injured are Vagus, Hypoglossal and Trigeminal nerves.

Keywords: Cranium, Cranio-cerebral, Cranial nerves

INTRODUCTION

The 12 pairs of cranial nerves are nerves that emerge from the cranium and provide sensory and motor innervations for the head and neck [1].

The 12 cranial nerves are Olfactory, Optic, Oculomotor, Trochlear, Trigeminal, Abducent, Facial, Vestibulocochlear, Glossopharyngeal, Vagus, Accessory and Hypoglossal nerves. The Olfactory neurons are bipolar neurons. Damage to this nerve will lead to anosmia [1,2].

The Optic nerve is a special sensory nerve of vision arising from the ganglion cells of the retina which passes through the optic foramen and enters in middle cranial fossa. The 2 nerves then cross at the hypothalamus forming the optic chiasma [1].

The Oculomotor nerve innervates the levator palpebrae superioris muscles which function to elevate the eyelid, the sphincter pupillae and ciliary muscles [1]. This nerve passes through the superior orbital fissure and is lateral to the optic nerve [3]. Damage to the oculomotor nerve causes ptosis,

squinting, dilation of the pupil, loss of light reflex, proptosis and diplopia [1].

Trochlear nerve is a motor nerve only to the superior oblique muscle [2]. It is the smallest cranial nerve and is the only nerve that comes out from the dorsum of the brain. This nerve is liable to be injured in the case of injury to the head [1]. Trigeminal nerve is a mixed nerve that consists of motor and sensory components. The motor component innervates the muscles for mastication while the sensory component innervates the face [1]. The Trigeminal nerve is the largest cranial nerve that consists of 3 branches such as Ophthalmic branch, Maxillary branch and Mandibular branch [2].

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Damage to the nerve will result in difficulty in biting, chewing, lateral jaw movement and loss of sensation from the face [1].

The Abducent nerve is a motor nerve to the lateral rectus muscle of the eyeball that abducts the eye. It pierces through the superior orbital fissure to reach the orbit [3]. Damage to this nerve causes difficulty in abduction of the eye and causes diplopia [1].

The Facial nerve is also a mixed nerve that goes through the stylomastoid foramen [1]. The motor component supplies the muscles of the face and scalp while the sensory component sends sensory information for taste from the anterior two-thirds of the tongue and the palate to the brain [2]. Damage to the facial nerve will lead to loss of taste sensation and decreased in salivary production [1].

The Vestibulocochlear nerve is a special sensory nerve for hearing and balancing which goes through the internal auditory meatus from the the posterior cranial fossa [2]. It is special because it will not exit the skull. It has 2 parts which are vestibular nerve and cochlear nerve that function for equilibrium and hearing respectively. Damage to this nerve may cause tinnitus, impairment of hearing and vertigo [1].

The Glossopharyngeal nerve is a mixed nerve. It passes through the jugular foramen [1]. The most important component of this nerve is the sensory component which is essential for the sensation from the pharynx, tonsil, posterior one-third of the tongue and for the blood pressure within the carotid arteries through the carotid sinus. The motor component innervates a small muscle of the pharynx and the parotid gland that induces salivary secretion [3]. Lesion of this nerve will result in loss of sensation of the posterior of the tongue and loss of gag reflex [1].

The Vagus nerve has a mixed component which enters the jugular foramen and the neck next to the carotid arteries that will travel into the abdomen [2]. It's motor components innervate the voluntary muscles of the pharynx, vocal cords, larynx, heart, lungs and digestive organs whereas the sensory components cause salivary production of all the glands of the pharynx, trachea, bronchii, lungs, esophagus and abdominal visceral [3]. Lesion to this nerve causes palpitation of the heart, tachycardia, vomiting, slowed respiration, suffocation and vocal cords and larynx paralysis [1].

The Accessory nerve is a motor nerve that passes through the jugular foramen and innervates the muscles of the pharynx, palate, sternocleidomastoid and trapezius muscles [3]. Damage to this nerve will lead to paralysis of the sternocleidomastoid that result in difficulty of turning the head to the opposite side [1]. Paralysis of the trapezius muscle also results in the dropping of the shoulder outward [1].

The Hypoglossal nerve passes through the hypoglossal canal [3]. It contains only the motor compartment that innervates all the muscles of the tongue, thyroid cartilage and hyoid bone [2]. Lesion to this nerve will lead to unilateral paralysis of the tongue and atrophy of the same side [1].

Many studies have been done regarding the lesions and injuries of cranial nerves. My aim is to conclude the commonest nerve damaged in the patient of head injury.

LITERATURE REVIEW

The cranial nerves lesions have always been a matter of concern in a review of a patient with head injuries. The incidence of cranial nerve injury in craniocerebral trauma varies between 5% – 23% [4].

Head injury is the commonest cause of loss of olfaction, due to disruption of the olfactory fibres prior to their decussation [5,6] and olfactory nerve is the commonest cranial nerve damaged in head injury [7]. Based on research, about 2 million Americans suffer from olfactory dysfunction whereby at least 1% of those below 65 years old and more than 50% among those older than 65 years old are affected. A lesion on one side of the olfactory cortex produces partial anosmia as their fibers travel to both cerebral hemispheres [8]. Bilateral anosmia is usually caused by olfactory mucous membrane disease whereas diseases affecting the olfactory bulb or tract cause unilateral anosmia [1].

Optic nerve injury is described as a rare injury [9] whereby an incidence of 2.78% [8] was recorded in India. It was first demonstrated in an autopsy showing optic canal fracture and optic sheath hemorrhage by Berlin in 1879 [9]. Hughes in 1962 described various types of optic nerve injury and hypothesized the pathogenesis of the nerve damage by microvascular thrombosis and ischaemia [12].

Lesions on the Oculomotor nerve accounts for 8-16% of all oculomotor palsies whereas it is seen in 2.9% of all head injuries [13], including patients with multiple cranial nerve involvement [10]. Usually, oculomotor palsy occurs together with that of other ocular motor nerves contained in the cavernous sinus in case of skull base fracture. Injury at superior orbital fissure, orbit or maxillofacial injury can result in injury to superior or inferior divisions of the nerve [14]. Complete lesion on this nerve paralyzes the eye completely. Incomplete lesions are more common based on research and may spare the extraocular muscles [1].

Around 2.14% of head injuries involve Trochlear nerve and is often accompanied by injury to other ocular motor nerves [10]. Trochlear nerve may be injured in isolation in its subarachnoid course and can occur in dorsal midbrain, or in the free edge of the tentorium. Bilateral Trochlear nerve injury is always due to trauma. Commonly, patients complain of diplopia, Bielchowsky, hypertropia and alternating hyperdeviation [14].

During severe maxillofacial and skull base injury, branches of Trigeminal nerve are often injured [14]. Lesions of the ophthalmic division will cause the cornea and conjunctiva to be insensitive to touch. Based on research, about 14000 people suffer from Trigeminal neuralgia each year in the United States and are more common among patients with multiple sclerosis and among women and patients who are above 50 years old [15,16].

Head injury accounts for nearly 3-15% of abducens palsies [13]. Recently, a series from India has found the incidence to be 3.02%, majority of whom had multiple cranial nerve injury, making it the most frequently injured ocular motor nerve [10]. Patients usually experience diplopia with convergence of visual axes and lateral rectus palsy. In an unconscious patient, the eyeball can be seen adducted with no oculocephalic response [14].

Head trauma and Bell's palsy are the more common causes of facial paralysis. Bell palsy is a dysfunction of the facial nerve which is usually unilateral and is often idiopathic. Head injury is a deceleration injury, and facial nerve is injured at its site of tethering. This nerve is generally completely transected as shown in a research whereby 45%-50% of patients experience facial palsy after a gunshot wound [14].

Following head injury, hearing loss can occur due to damage to the nerve, end organ or the conducting elements [14]. The Vestibulocochlear nerve is divided into Vestibular nerve and Cochlear nerve. Lesions on the Vestibular nerve usually lead to hearing loss, vertigo and nystagmus. Lesions of the Cochlear nerve include acoustic neuroma and trauma will lead to deafness and tinnitus. Also, lesions of the internal ear include Meniere disease, acute labyrinthitis and trauma [1].

Lesions of the Glossopharyngeal nerve are glossopharyngeal neuralgia and are usually accompanied by lesions to the Vagus nerve. Lesions in the motor portion of the Vagus nerve may elicit difficulty in swallowing. Pain, bradycardia and syncope are usually seen among patients with glossopharyngeal neuralgia [1] which is an idiopathic condition [17]. Glossopharyngeal neuralgia affects people above 40 years old and is common among the men though it is a rare disorder.

Lesions on the Vagus nerve will lead to vagal nerve palsy. Usually, unilateral lesions of the Vagus nerve will not show gag reflex. Hoarseness of the voice is a common symptom of vagal nerve palsy in the posterior cranial fossa [9]. Also, the deviation of the uvula from the side of the lesion and failure of palate elevation will be seen among patients with Schizophrenia [6].

Lesions of the spinal part of the Accessory nerve will lead to paralysis of the sternocleidomastoid and trapezius muscles. Common symptoms are atrophy of the sternocleidomastoid muscle and trapezius muscle including weakness in turning the head to the opposite side and difficulty in raising the arm

above the horizontal level [9]. Usually, the trio of lower cranial nerves (Glossopharyngeal, Vagus and Accessory nerves) are injured together due to their close proximity with one another in the jugular foramen [15].

Hypoglossal nerve is one of the least injured nerves in head injury but lesions may occur anywhere along its course. Lesion on the lower motor neuron will cause the tongue will deviate toward the paralyzed side which will experience atrophy. If the lesion is on the corticonuclear fibers, atrophy of the tongue will be absent [15].

DISCUSSION

According to Doty RL, et al. the most common cranial nerve damaged during head injury is the Olfactory nerve [5,14,1] but another study done by Jin H, et al. on 312 patients suggested that the commonest nerve injured is the Optic nerve [18]. A study conducted by Patel P. et al concluded that the oculomotor nerve is the more commonly injured nerve during head injury [10].

Studies done by Col Harjinder S Bhatoe suggested that the Hypoglossal nerve is the least common injured during head injury [14]. However, studies done by Jin H. et al suggested that the Trigeminal nerve is the least common injured nerve during head injury [18].

Jin H et al. concluded the frequency of cranial nerves in the most common to the least common order as Optic, Olfactory, Oculomotor, Facial, Abducens, Accessory, Vestibulocochlear, Glossopharyngeal, Trochlear, Vagus, Hypoglossal and Trigeminal nerves.

CONCLUSION

According to the studies conducted in the past, the common cranial nerves injured during head injury are the Olfactory, Optic and Oculomotor nerves in the order of sequence while the least common nerves injured are Vagus, Hypoglossal and Trigeminal nerves.

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