Role of MRI in Evaluation of Cranial Nerve Pathologies

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ABSTRACT

Introduction: The human body has 12 pairs of cranial nerves that control motor and sensory functions of the head and neck. The anatomy of cranial nerves is complex and its knowledge is crucial to detect pathological alterations in case of nervous disorders. MRI brain using cranial nerve protocol is routinely used in evaluating patients presenting with cranial nerve related symptoms and pathology. It is also a non-invasive study. **Material & Method:** Retrospective observational study was done in the 60 patients over a course of 1 year from April 2022 to 31 st march 2023 at department of radiodiagnosis, SVP hospital, NHLMMC, Ahmedabad with Siemens MagnetomSkyra using CISS protocol and contrast images. **Result:** Out of 60 patients having cranial nerve related symptoms, 52 showed abnormal finding/ pathology in MRI scan. The most commonly observed abnormality was vascular pathology causing nerve compression followed by compression by mass lesion. **Conclusion:** Because of its high resolution and no radiation exposure, MR imaging is the gold standard investigation in visualising cranial nerves & identifying pathologies in patients having cranial nerve related symptoms. Its ability in identifying subtle lesions & its extent is excellent.

Keywords: MRI in Cranial Nerve, CISS Protocol, Atrophy And Demyelination

INTRODUCTION

There are 12 pairs of cranial nerves for control of head and neck motor and sensory functions in the human body. The anatomy of cranial nerves is complex and its knowledge is crucial to detect pathological alterations in case of nervous disorders.[1] Therefore, it is necessary to know the pathologies that may involve cranial nerves and recognize their typical characteristics on imaging. Cranial nerve dysfunctions may be the result of pathological processes of the cranial nerve itself or be related to other pathologies like tumors, inflammation, infectious processes, or traumatic injuries of adjacent structures. Magnetic resonance imaging (MRI) is considered the gold standard in the study of the cranial nerves.[2] Computed tomography (CT) allows, usually, indirect evidence of involvement of the nerve and is useful to demonstrate the intraosseous segments of cranial nerves, the foramina through which they exit the skull base and their pathologic changes. It is useful for radiologists as well as neuroradiologists to review the anatomy and the important pathologies that involve cranial nerves.[3]

AIMS AND OBJECTIVES

- To study the role of MRI in identifying site, type of pathology of cranial nerves, extent and characterization of the lesion.
- To study the role of cranial nerve related symptoms and imaging finding on MRI

- To evaluate outcome of the surgical resection of the lesion and their follow up study to rule out residual or recurrent lesions.

MATERIAL & METHODS

Retrospective observational study was done in the department of radio-diagnosis, NHL MMC, Ahmedabad with Siemens MagnetomSkyra MRI machine using cranial nerve protocol includes, T1&T2 weighted sequences, CISS sequence, DWI–FLAIR sequences and post-gadolinium T1-weighted sequences (eventually with fat suppression). After taking informed consent, About 60 patients having cranial nerve related symptoms were studied with MRI brain using cranial nerve protocol who were referred to our department over a course of 1 year from 1st April 2022 to 31 st march 2023.

Magnetic resonance allows visualization of denervation changes on both T1WI and T2WI images. The differentiation is best visualized on T1WI. Anatomical definition and invasion of fat planes by the lesion is best visualised on T1-weighted sequences.

Ciss sequence is most useful to identify cisternal course of the nerve and other neurovascular conflict caused by lesion affecting nerve.Ischemic lesions are better characterised by DWI-FLAIR sequences.

Enhancement of the nerve, perineural spread and meningeal infiltration of the lesion is best characterised by Post-gadolinium T1-weighted sequences.

Duration of study : From 1st april 2022 to 31st march 2023

Study title: Department of Radio-Diagnosis; Smt. NHL MMC; Ahmedabad.

Inclusion criteria: Patients referred to our department having cranial nerve related symptoms, irrespective of ages and gender.

Exclusion criteria: Those patients who have contraindications of MRI investigations like patients with clips or devices in the brain, metallic fragments in eye and spinal canal, cardiac pacemakers, insulin pumps, neurotransmitters and cochlear implants, claustrophobic patients.

RESULTS

1. A brief summary of pathologies that may involve cranial nerves :
2. Neurovascular compression, aneurysm
3. Ischemia
4. Hemorrhage
5. Neoplasm:Primary neural tumor, Compressive mass (sellar, paracavernous, bone tumor), Leptomeningeal or perineural spread of tumor[4]
6. Inflammation: Optic neuritis, Multiple sclerosis, neuromyelitis-optica spectrum disorders, Pseudotumor (Tolosa-Hunt syndrome), Sarcoidosis, Vestibular neuritis, labyrinthitis[5]
7. Infection :Abscess, encephalitis, meningitis, thrombophlebitis, viral neuritis (Ramsay-Hunt syndrome), Skull base osteomyelitis
8. Trauma
9. Vascular

On MRI study using cranial nerve protocol, most of the above mentioned pathologies shows findings like:

- Abnormal T2WI/FLAIR hyperintensity& diffusion restriction.
- Abnormal post contrast enhancement[6].
- Thinning or displacement of cranial nerves.

Total 60 people were included in our study, out of which 33 were males (56 %) and 27 were females (44 %). Youngest patient in our study was 12 years old and the oldest patient was 80 years old.Maximum patients (14) were in the age group of 51-60.

Out of 60 patients having cranial nerve related symptoms, 52 showed abnormal finding/ pathology in MRI scan. In 8 patients no abnormal findings were detected on MRI scan.

Table 1 : The various pathologies present Lin the study

PATHOLOGY	FREQUENCY
Vascular pathology causing nerve compression	25
Mass lesion	14
Optic nerve atrophy	8
Demyelinating disorder	3
Infective/inflammatory	2

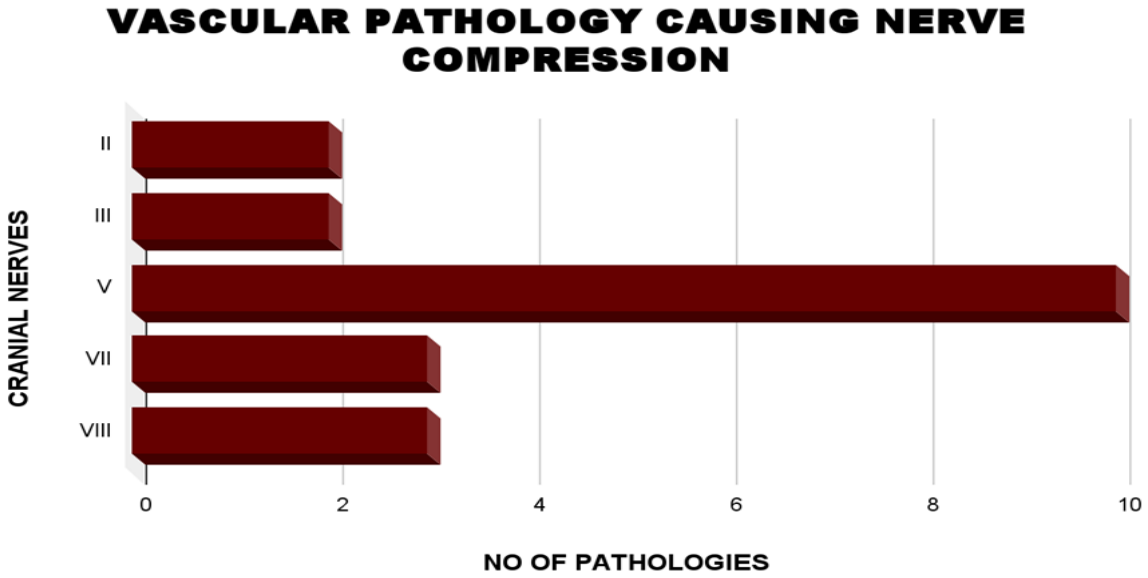
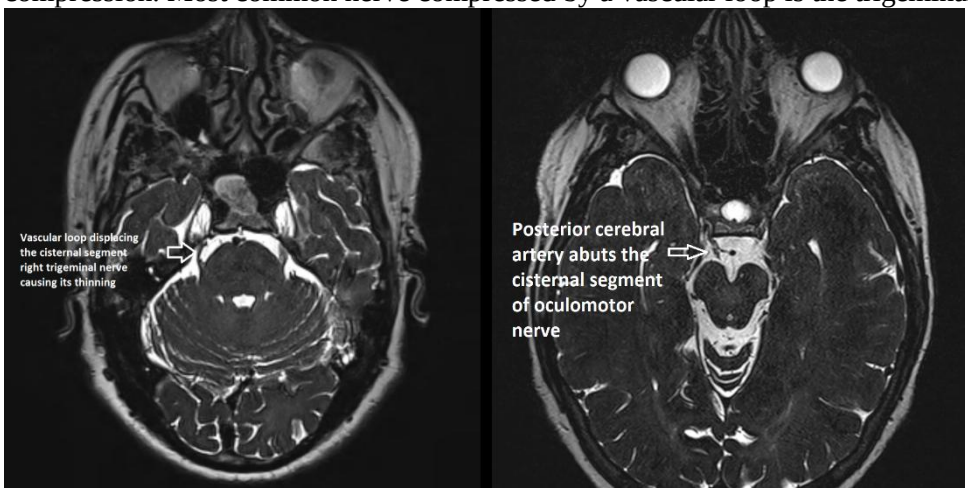


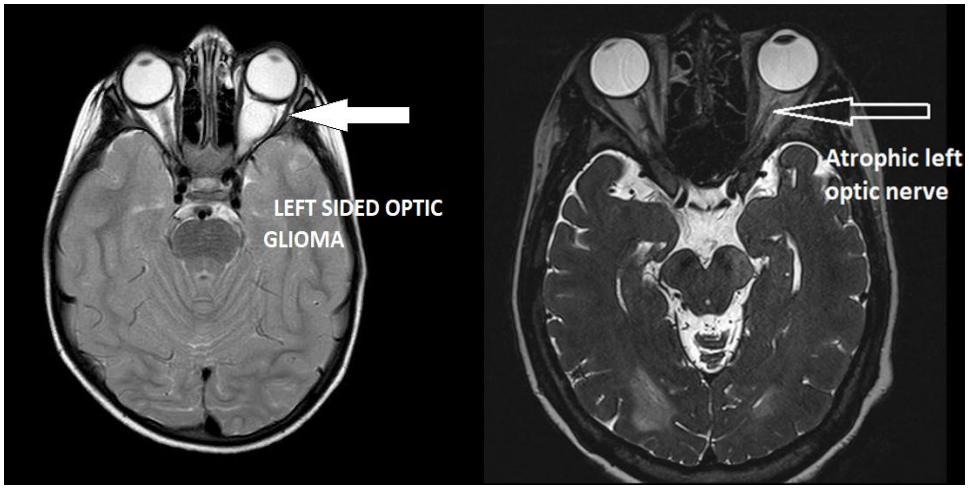
Figure 1: Vascular pathology causing nerve compression

The most commonly observed abnormality was vascular pathology causing nerve compression. Most common nerve compressed by a vascular loop is the trigeminal nerve.



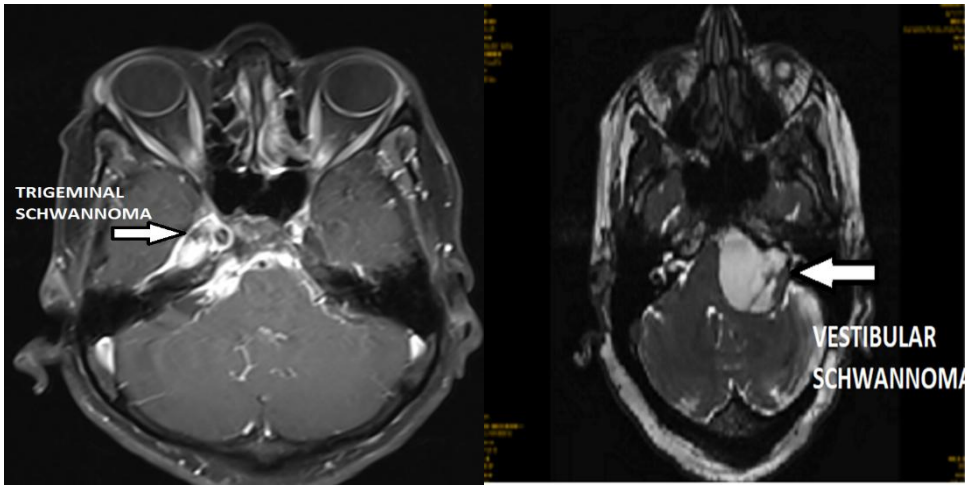
(A) (B)

Figure 2: (A) Vascular loop displacing Trigeminal nerve, patient presented with fascial pain.(B) Vascular loop abutting Oculomotor nerve, patient presented with ptosis.



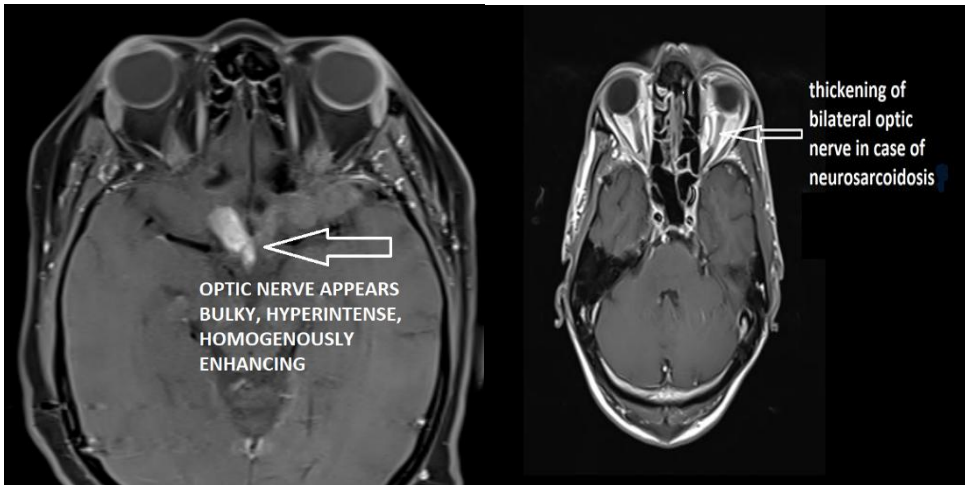
(A) (B)

Figure 3: (A) Left optic nerve glioma, patient presented with vision loss. (B) Atrophied left optic nerve in patient having progressive vision loss.



(A) (B)

Figure 4: (A)Trigeminal schwannoma in patient presented with facial pain and numbness. (B) Vestibular schwannoma in patient presented with hearing loss and tinnitus



(A) (B)

Figure 5: (A)Demyelinating optic neuritis, in patient presented with vision loss. (B) Bilateral optic nerve involvement in patient of neurosarcoidosis.

DISCUSSION

Patients presenting with cranial nerve related symptoms presented with a wide range of MR imaging abnormalities depending upon the etiology. MRI is a valuable tool for identifying site, type of pathology of cranial nerves, extent and characterization of the lesion so that further management can be planned accordingly.

The clinical history of each patient was recorded. The MR examination revealed, pathological findings in 52 out of 60 patients (86.66%).MR findings includes, vascular pathology causing nerve compression (48 %), mass lesions (26%), optic nerve atrophy (15%),demyelinating pathologies (5.76 %) and infections/inflammatory disorders (3.84%). MRI shows excellent anatomy and imaging findings of the cranial nerves. The study reveals most of the pathologies seem among older age group from 50-70 years as compared to younger age groups.

Compression of cranial nerve or abutment is a common pathology that is found in patients having cranial nerve related symptoms. It has been shown that the vascular loop of one of the vessels causes abutment of cranial nerve with resultant thinning or displacement of cranial nerve. Other less frequent pathologies include neoplastic etiology, demyelinating etiology, infective /inflammatory etiology.

25 patients (48%) revealed vascular pathology causing nerve compression on MRI study. Out of 25 patients, 14 patients revealed trigeminal nerve compression by vascular loops, 6 patients revealed optic nerve compression by sellar mass lesion most commonly pituitary macro adenoma, 3 patients revealed facial and vestibulocochlear nerve compression by vascular loop of superior cerebellar artery, 1 patient revealed oculomotor nerve compression by loop of posterior cerebral artery & 1 patient revealed oculomotor nerve compression by posterior communicating artery aneurysm.

Out of 52 patients 14 patients revealed cranial nerve neoplasm, most common mass lesion is acoustic neuromas of vestibulocochlear nerve and 2 cases of acoustic neuroma of trigeminal nerve. One case revealed optic nerve glioma and one case revealed optic nerve meningioma.

Among the demyelinating disorders, the most common disorder causing cranial nerve related symptoms is multiple sclerosis followed by neuromyelitisoptica spectrum related disorders. Most of the cases are associated with optic nerve atrophy.

Least common pathology causing cranial nerve related symptoms is infections. It includes tuberculous basal exudates, viral infection and lyme's disease.[7]

Accurate diagnosis of cranial nerve pathology is crucial for effective treatment. MRI has been shown to be highly sensitive and specific in identifying the underlying pathology in cranial nerve related disorder. With its high spatial resolution, excellent inherent soft tissue contrast, multiplanar imaging capability and lack of ionizing radiation, MR imaging has emerged as a versatile tool in the evaluation of patients with cranial nerve related symtoms.MR imaging not only identifies specific pathology but guides for specific treatment and predicts prognosis. Employing appropriate imaging protocols and reviewing the images in a systematic manner helps in the identification of subtle abnormalities like thinning, hyperintensity or enhancement of the cranial nerves.

This study was carried out in 60 patients with clinical symptoms related to cranial nerves. Magnetic resonance imaging was done to evaluate the spectrum of findings, various etiologic factors and imaging abnormality.

Study done by Alexandre Krainik &Jan W. Casselman shows MRI remains the best imaging modality for cranial nerve imaging, consistent with our study.[8]

CONCLUSION

Because of its high resolution and no radiation exposure, MR imaging is the gold standard investigation in visualising cranial nerves & identifying pathologies in patients having cranial nerve related symptoms. Its ability in identifying subtle lesions and its extent, is excellent.

Hence, we conclude that MRI plays a significant role in patients presenting with cranial nerve related symptoms and pathology.

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