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Role of Magnetic Resonance Imaging in Evaluating Various Causes of Trigeminal Neuralgia

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Abstract: ***The main aim of our study was to evaluate various cases of trigeminal neuralgia by magnetic resonance imaging and to correlate MRI findings with clinical data. This study was conducted in the Department of Radiodiagnosis, Maharajah's Institute of Medical Sciences, Vizianagaram. Fifty patients in the age group between 30-65 years who came to the outpatient department with trigeminal pain were included in this study. MRI of the brain with dedicated trigeminal nerve protocol was conducted. Contrast was given in some cases according to the findings in the conventional scan. The etiology of trigeminal pain could be detected by MRI in 31 out of 53 patients, 22 patients had idiopathic type trigeminal neuralgia. Nine patients had tumors, 12 patients had vascular anomalies. Six patients had post-trigeminal injury pains. Three patients had demyelination and one patient had postherpetic trigeminal neuralgia. Cisternal portion was the most common intracranial portion involved, followed by the brain stem. MRI brain is a useful modality and is helpful to detect various causes of trigeminal neuralgia in association with clinical findings.***

Keywords: Trigeminal neuralgia, MRI, neurovascular conflict, tumors

1. Introduction

Aims and objectives

The trigeminal nerve is the largest of all cranial nerves and is responsible for the perception of sensations of the face [1]. Trigeminal neuralgia is a debilitating disorder that presents with a sudden onset of paroxysmal unilateral, severe lancinating pain in one or more of the distributions of the trigeminal nerve[17]. It may be triggered by activities such as speaking, chewing, brushing the teeth, swallowing, or touching the face.

The incidence of TGN is about 4.3 per 100,000 people and females are predominantly affected. The causes usually include vascular compression of trigeminal nerve roots, demyelinating or inflammatory causes and intracranial tumors[2].

The trigeminal nerve is commonly involved in various disease processes and modern imaging techniques are useful in their evaluation [3,4]. MRI is considered the primary imaging modality for evaluating patients with symptoms related to the trigeminal nerve like trigeminal neuralgia [5].

The main aim of our study was to evaluate various causes of trigeminal neuralgiawith the help of MRI.

2. Materials and Methods

Patients:

A prospective study was done in a time period of one year from September 2016 till August 2017 including 50 patients in Maharajah's institute of medical sciences, Vizianagaram.

Inclusion criteria:

Patients with persistent facial pain in the distribution of trigeminal nerve ± other neurological symptoms or signs were included in our study.They were clinically assessed by Neurologist or Neurosurgeon and MRI brain was done in all of them.

Exclusion criteria:

Pain due to any other reason like referred pain including referred cervical myalgia or dental pains and patients having contraindication to MRI were excluded from our study. Written and informed consent was obtained from all the patients.

MR technique

The examination was conducted using 1.5 T MR imaging unit Philips ingenia 3x. The imaging protocol includes (a) An axial FLAIR sequence of the brain, (b) Coronal and axial T2-weighted sequences for the posterior fossa and brainstem, (c) Sagittal T1 weighted sequence of whole brain d) Whole-brain three-dimensional DRIVE pulse sequences, (e) 3D TOF for circle of Willis, (f) Postcontrast T1 imaging after intravenous administration contrast if any space occupying lesions or inflammatory pathologies were suspected. Post examination condition of patients was normal.

Interpretation of images

Two experienced radiologists who were blinded to the study interpreted the images.The whole intracranial course of the trigeminal nerve starting from its origin in the brain stem till the cavernous parts was scanned and examined. The cisternal portion was examined with special attention for the presence of any vascular loop or neurovascular conflicts and any secondary change in trigeminal nerve was looked for. Other parts of the trigeminal nerve were assessed for the presence of any demyelinating disease, space occupying lesionsand inflammatoryor vascular pathologies.The imaging findingswere correlated with clinical data and any other relevant investigations.

3. Results

Out of the fifty patients, 29 patients had trigeminal pain associated with other neurologic symptoms and/or signs, the other 24 patients presented with only trigeminal pain.

Depending on the underlying cause, 22 patients had no underlying pathology, nine patients had tumors and twelve patients had vascular anomalies including anatomical variants, vascular loops, and vascular malformations, six patients had pain due to previous trigeminal injury.

Three patients had inflammatory/demyelinations. Postherpetic trigeminal neuralgia was seen in one patient.

The most frequent segment involved was the cisternal portion (21 cases) (tumors, vascular lesions and injuries), followed by the brain stem (7 cases) (tumors, inflammatory/demyelinating and vascular malformation).

4. Discussion

Facial pain can be caused by a variety of etiologies. Frequent causes of pain in the face account to Eye, ENT and dental disorders. The annual incidence of trigeminal neuralgia is 4.3[2] in 100,000. Trigeminal neuralgia is defined by The International Association for the Study of Pain defined trigeminal neuralgia as a sudden, usually unilateral, severe, brief, stabbing, and recurrent episodes of pain in the distribution of one or more branches of the V^{th} nerve[6].

Many causes such as tumors, vascular disorders or demyelination caused by multiple sclerosis result in trigeminal nerve compression and neuralgia.

Cerebello-pontine angle tumors accounted to three cases (5.66%) with different pathologies in our study.

In a case series published by Shulev et al. in 2011, only 14 patients out of 242 cases (5.8%) presented with trigeminal neuralgia secondary to cerebello-pontine angle tumors [7]. In Our study, around 5.66% of cases had tumors at the cerebello-pontine angle. Thus the findings are concordant with Shulev et al.

In a study done by EmanA.Sh.Geneidi et al. in 2016, 2 patients out of 45 cases presented with trigeminal neuralgia secondary to cerebellopontine angle tumors which accounted to 4.44% which was concordant to the findings of our study [8].

Trigeminal neuralgia can be due to a focal disease in the brain stem (either vascular or neoplastic) or more generalized conditions like multiple sclerosis. Multiple sclerosis may cause trigeminal neuralgia in about 1–2% of patients with the disease[9,10]. Multiple sclerosis can be identified on MRI as typical demyelinating plaques.

The main cause of compression of trigeminal nerve at the cisternal segment is due to neurovascular compression. Elongated superior cerebellar artery is responsible for compression in the majority of cases (60–90%) [10].

Less frequently, compression due to vertebrobasilar dolichoectasia, an elongated anterior inferior cerebellar artery, or venous compression is found. Some degree of contact between the V^{th} nerve and a blood vessel in about 90–100% of patients with TN in autopsy studies[11,12].

Histopathological studies in postoperative specimens of patients with TN due to neurovascular compression have revealed demyelination and focal axonal degeneration.[10].

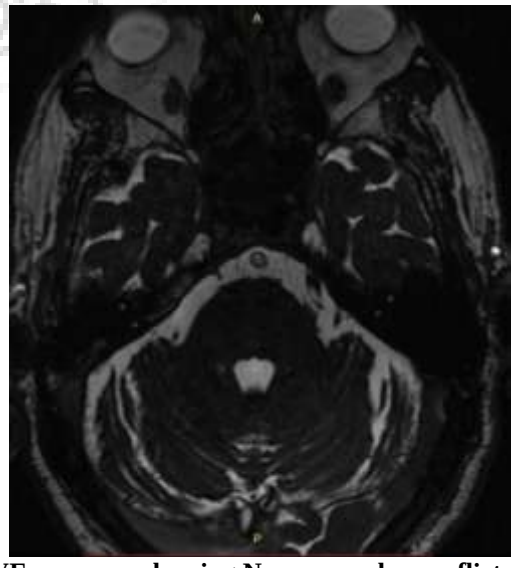
In our study we used 3D DRIVE sequence to improve resolution and to maximize the detection of vascular compression of the trigeminal nerve. DRIVE, also called FRFSE(fast recovery fast spin echo), is a fast spin echo sequence which uses an application of additional -90° recovery pulses at the end of echo train, reverting the remaining transverse magnetization back to the longitudinal axis. This allows heavily T2-weighted images to be acquired within a shorter TR and considerably reduces the scan time. The shortened TR also reduces flow void artifacts, thus increasing the brightness of fluids[13]

In our study, twelve patients (22.6%) were found to have a vascular loop causing compression on trigeminal nerve roots. This is well evaluated by the DRIVE sequence, which allows exact identification of the vascular loop and demonstrates thinning at the root entry zone.

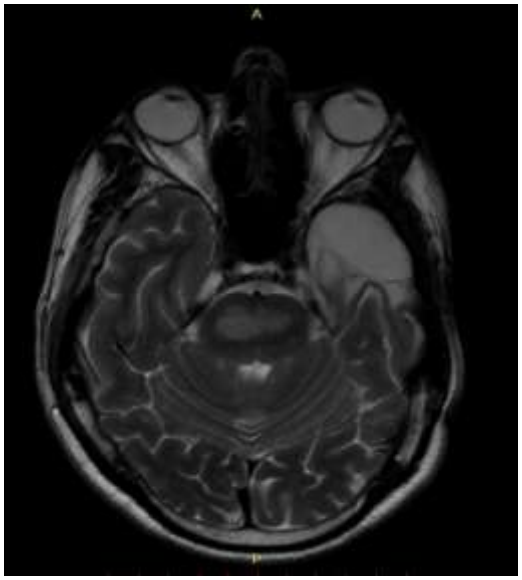
In our study, six patients (11.32%) had post-traumatic neuralgia either due to peripheral nerve root injury due to facial trauma or due to skull base fracture which was similar to the study done by EmanA.Sh.Geneidi et al. in 2016, which accountedto 11.11% [8].Two patients out of 63 cases accounting to 3.01% of post-traumatic trigeminal neuralgia had pain due to other causes in Penarrocha et al's, study of which most were related to dental trauma and or procedures [14].

The treatment of trigeminal neuralgia can be medical, gamma knife and microvascular decompressionor percutaneous ablation of the Gasserian ganglion. Clinical information in combination with imaging findings is critical to correctly identify candidates for microvascular decompression [15].

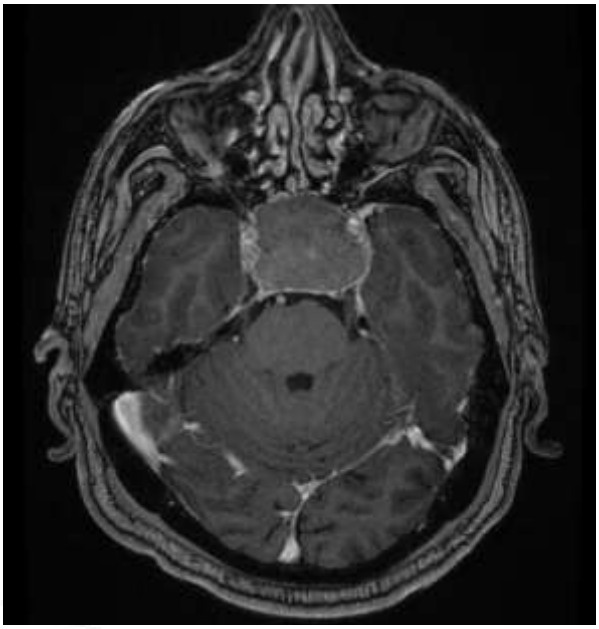
No structural abnormality was visualized on MR imaging in 22 patients accounting to 41.5% in our study, and these were classified to be of idiopathic type of trigeminal neuralgia. This was similar to the study done by EmanA.Sh.Geneidi et al. in 2016, in which 20 patients had no structural abnormality on MRI which accounted to 44%[8]; and according to Zakrzewska and McMillan, most of the causes of trigeminal neuralgia are idiopathic, but a small percentage are secondary to causes like tumours or multiple sclerosis which can be diagnosed by CT or MRI[16].



DRIVE sequence showing Neurovascular conflict of left superior cerebellar artery over trigeminal nerve

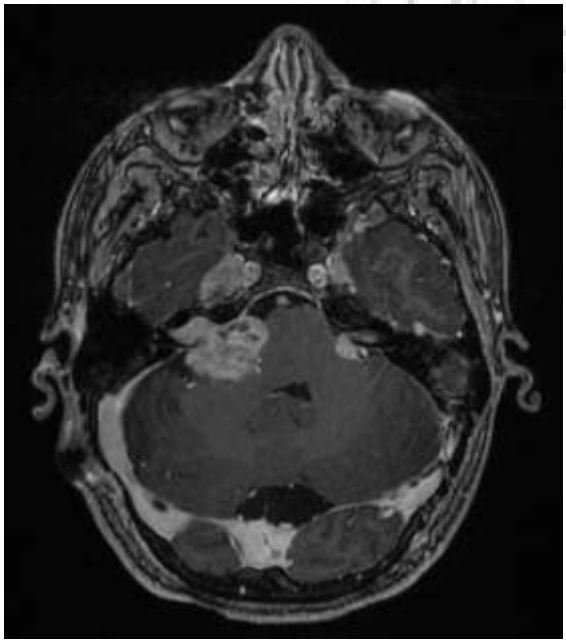


T2WI showing Pontine glioma



Contrast enhanced T1WI showing pituitary macroadenoma invading cavernous sinuses

Contrast enhanced T1WI showing hemangioma in left CP angle compressing left half of pons



T1C+ showing Right sided vestibular schwannoma

5. Conclusion

Majority of the cases of trigeminal neuralgia do not have a visible lesion on MRI. Of the detected lesions, neurovascular conflict is a frequent cause of trigeminal neuralgia.However, other lesions like tumors compressing or invading the trigeminal nerve, injury to trigeminal nerve and its branches also cause trigeminal neuralgia. Thus, scanning the entire course of nerve is necessary to detect the lesion.

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