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MAGNETIC RESONANCE IMAGING INNEUROVASCULAR CONFLICTS

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ABSTRACT

Background: Neurovascular compression syndromes are caused by arteries that directly contact the cisternal portion of a cranial nerve. All cases of neurovascular contact are not clinically symptomatic. The transition zone between the central and peripheral myelin is the most vulnerable region for symptomatic neurovascular compression syndromes. Determining the presence of vascular compression may help surgeons decide whether MVD is the most appropriate procedure for patients. Magnetic resonance imaging (MRI) is the standard preoperative imaging modality for these patients. **Materials and Methods** This Hospital-based prospective study consists of 59 patients with clinical suspicion of neurovascular conflict referred to the department of radiodiagnosis, Government General Hospital, Kurnool, over a period of 6months .All the 59 cases were imaged on a PHILIPS 1.5 tesla MRI scanner with routine sequences including MR axial T2, T1, DWI, GRE along with FIESTA and MR angiography . **Results:** Out of 59 patients studied, 29 patients did not have neurovascular contact. So, a total of 30 cases were selected for the study. Out of 30 cases,19(63.4%)cases were females, whereas 11 (36.6%)cases were males. Incidence in females (63.4%) was found to be more common than in males(36.6%). Incidence was more commonly seen in age group between 50-60 years followed by 40-50 years. Out of 30 cases , 23 were diagnosed with trigeminal neuralgia, 5 with hemifacial spasm and vestibular paroxysmia, rest 2 were diagnosed with glossopharyngeal neuralgia. Out of 30 cases 26had contact of vessel with nerve and 4 cases showed displacement or atrophy of nerve. Most common vessel causing conflict was found to be ipsilateral superior cerebellar artery followed by the ipsilateral anterior inferior cerebellar artery. Conclusion: 3D steady state and angiographic MR sequences represent nowadays the most sensitive tools available to radiologists, allowing an optimal identification of the vascular compression of the cranial nerve'sREZ.

Keywords: Neurovascular compression syndrome, trigeminal neuralgia, hemi facialspasm , glossopharyngeal neuralgia

INTRODUCTION

Neurovascular compression syndromes are usually caused by arteries that directly contact the cisternal portion of a cranial nerve. All cases of neurovascular contact are not clinically symptomatic. The transition zone between the central and peripheral myelin is the most vulnerable region for symptomatic neurovascular compression syndromes. It is defined as a direct contact with mechanical irritation of cranial nerves by blood vessels. The most common neurovascular compression syndromes are trigeminal neuralgia (TN; compression of CN V), hemifacial spasm (HFS; CN VII), vestibulocochlear neuralgia (CN VIII), and glossopharyngeal neuralgia (GN; CN IX). Neurovascular contacts are frequent imaging findings in asymptomatic patients, so several factors will determine whether a neurovascular contact may become symptomatic. Arteries are more likely to cause symptomatic NVCS than veins, presumably due to the higher pressure and pulsatility. The anatomic location of the neurovascular contact can also be a relevant factor.Determining the presence of vascular compression may help surgeons decide whether MVD is the most appropriate procedure for patients. Magnetic resonance imaging (MRI) is the standard preoperative imaging modality for these patients, often used to not only detect vascular compression but also to identify the potential presence of secondary causes of TN such as multiple sclerosis, tumors, or vascular malformations.

AIMS & OBJECTIVES

1) To determine the best MR imaging protocol in the assessment ofneurovascular conflict
2) To provide a systematic approach in order to detect a neurovascular conflict and present the key MR imaging features

MATERIALS & METHODS

This Hospital-based prospective study consists of 59 patients with symptoms of trigeminal neuralgia, hemifacialspasm, glossopharyngealneuralgia, tinnitus, vertigo, headache referred to the department of radiodiagnosis, Government General Hospital, Kurnool,over a period of 6months from Feb 2023 to July 2023 from department of Neurology.

All the 59 cases were imaged on a PHILIPS 1.5 tesla MRI scanner withroutine sequences including MR axial T2, T1,

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DWI, GRE along with FIESTA and MR angiography .

Inclusion crieria:
All clinically suspected cases of neurovascular conflict

Exclusion criteria :

- Patients with cerebellopontine angle lesions, past history of microvascular decompression surgery, multiple sclerosis, nerve sheath tumors,secondaries, meningiomas, skull-based lesion and patients with herpetic infection of trigeminal nerve (trigeminal herpes zoster).
  - Patients with general contraindications to MRI

RESULTS
A total of 59 patients with neuralgias are referred to our department for MRIbrain with cranial nerves.
29 patients did not have neurovascular contact. So, a total of 30 cases were selected for the study. Out of 30 cases, 19(63.4%)cases were females, whereas 11 (36.6%)cases were males.
Both ipsilateral and contralateral sides were evaluated for the presence ofneurovascular contact.

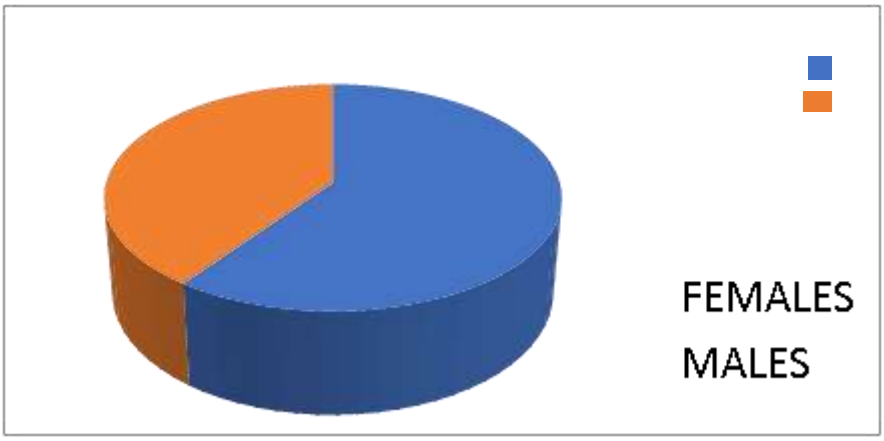

Fig 1. Gender distribution

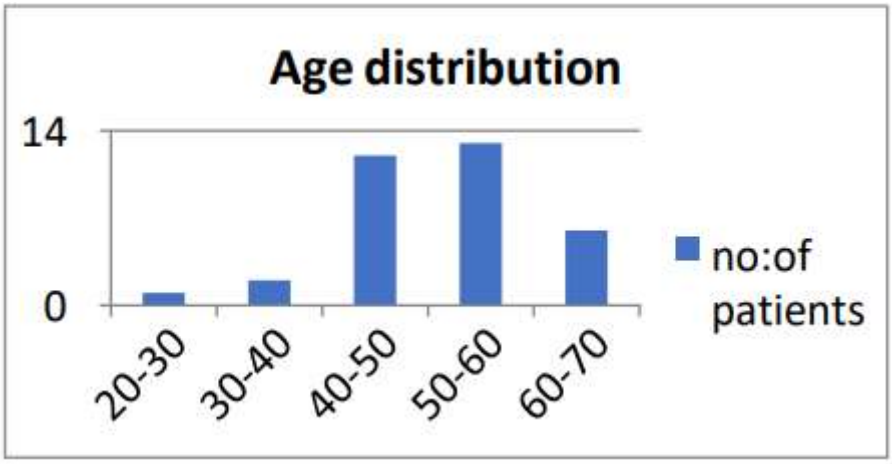

Fig 2. Age distribution

Table 1.Following cases were considered:

CLINICAL DIAGNOSIS	MALES	FEMALES
• TRIGEMINALNEURALGIA	7(30.5%)	16(69.5%)
• HEMIFACIAL SPASM ANDVESTIBULAR PAROXYSMIA	3(60%)	2(40%)
• GLOSSOPHARYNGEAL NEURALGIA	1(50%)	1(50%)

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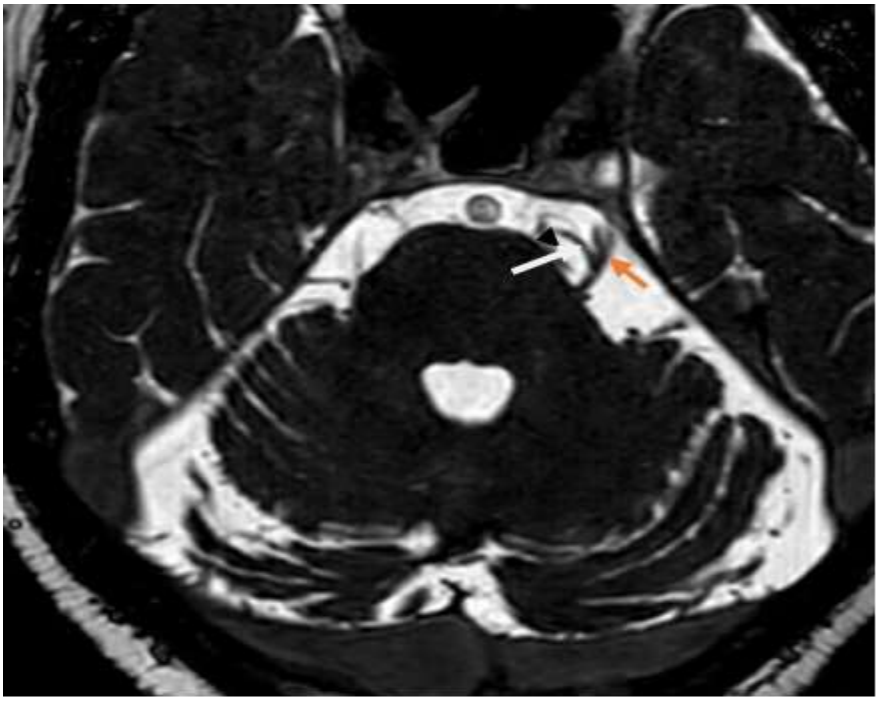
Table 2. Following findings were observed:

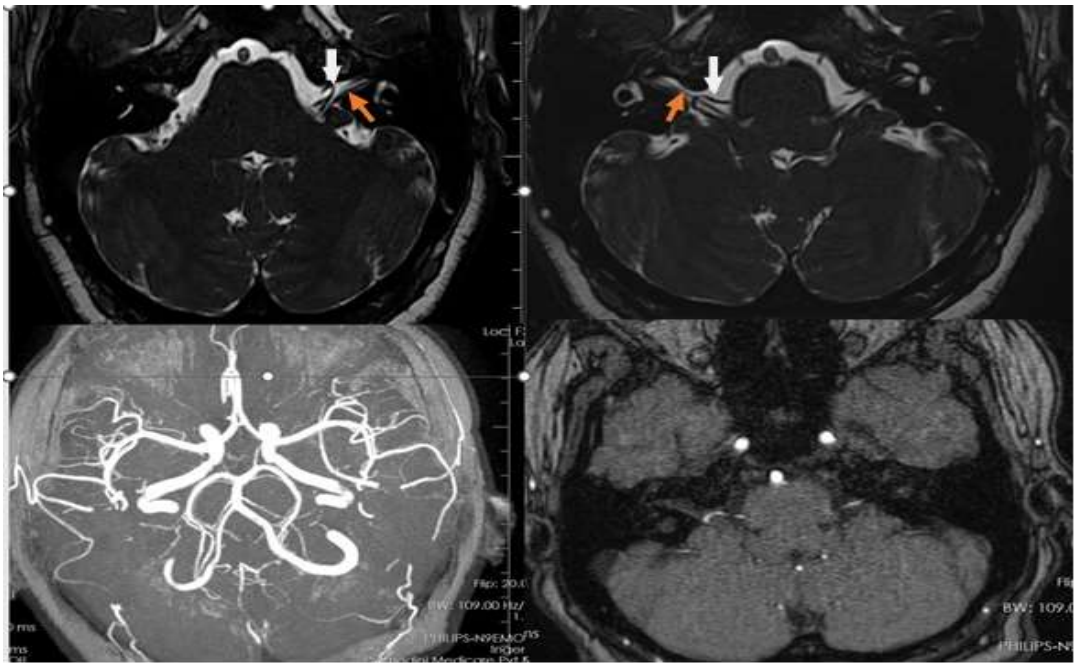
NVCS	NO:OF CASES
Contact of vessel with nerve	26(87%)
Displacement or atrophy of nerve at transitionzone	4(13%)

CASE 1



A 64 yr old female patient presented with typical history of trigeminal neuralgia over left half of face. Axial FIESTA image showing superior cerebellar artery (white arrow) impinging on cisternal segment of left trigeminal nerve(red arrow).

CASE 2.



- A 25 year old female presenting with clinical history of left sidedpulsatile tinnitus.

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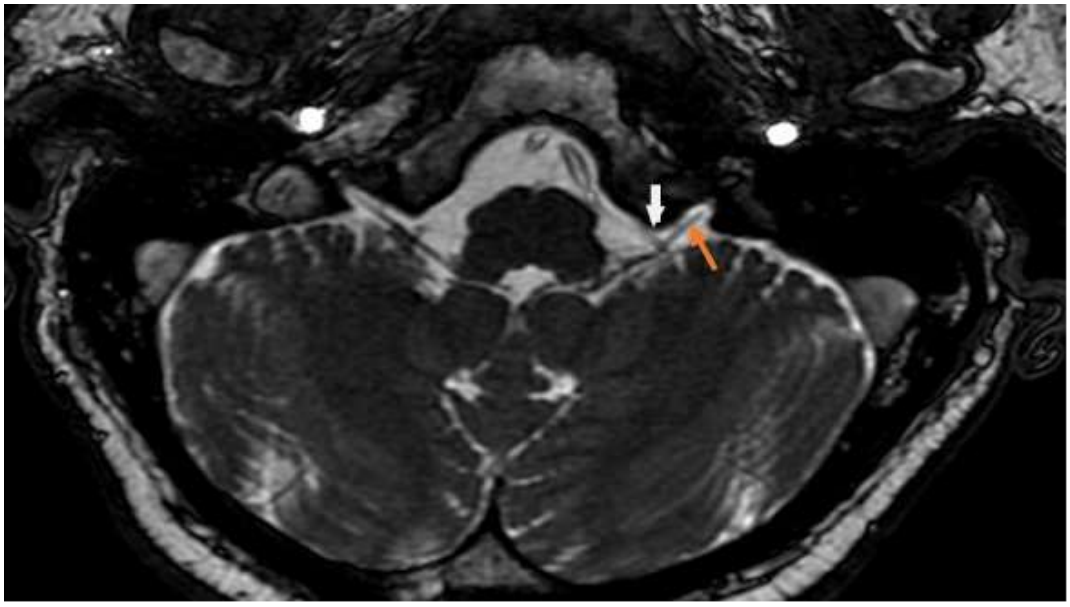
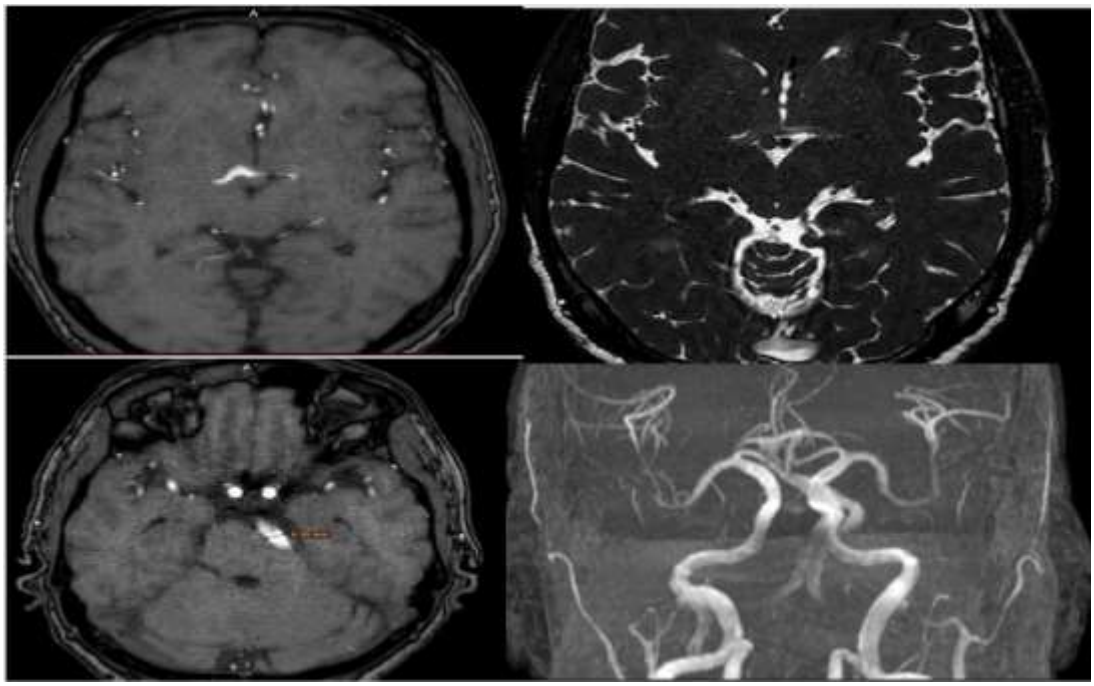
- Axial FIESTA sequence showing left Anterior inferior cerebellar artery loop (white arrow) noted insunuating into left internal auditory meatus (red arrow) but occupying less than 50% of IAM (chavda grade 2),Right AICA loop (white arrow) bordering the rightIAM (red arrow) (chavda grade 1).
- Axial and MIP TOF MRA showing bilateral AICA loops.

CASE 3



A 65 year old male patient presenting with typical history ofglossopharyngeal neuralgia.
Axial 3D FIESTA sequence showing posterior displacement of left glossopharyngeal nerve (red arrow) due to comression by left PICA(white arrow).

CASE : 4



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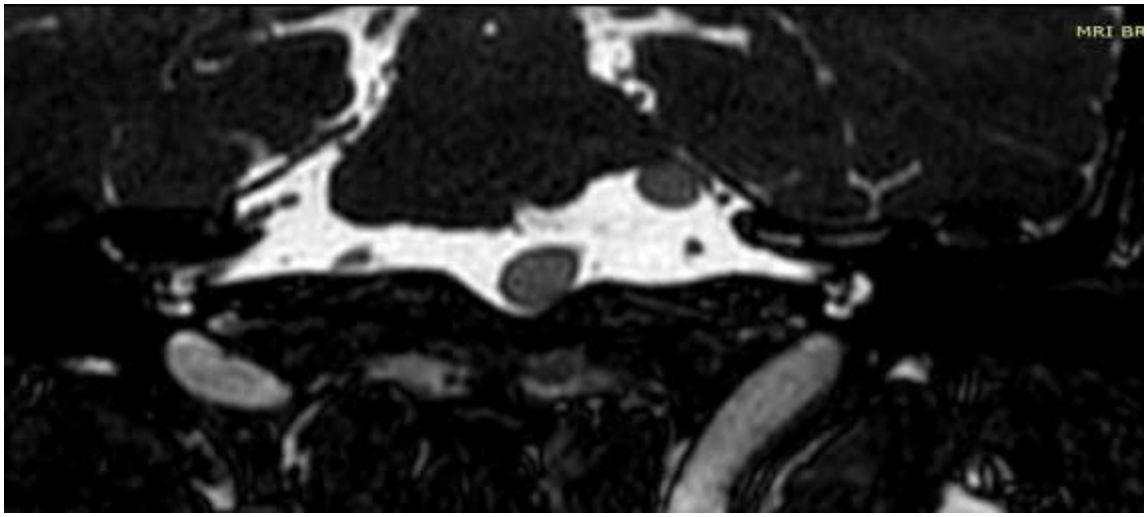
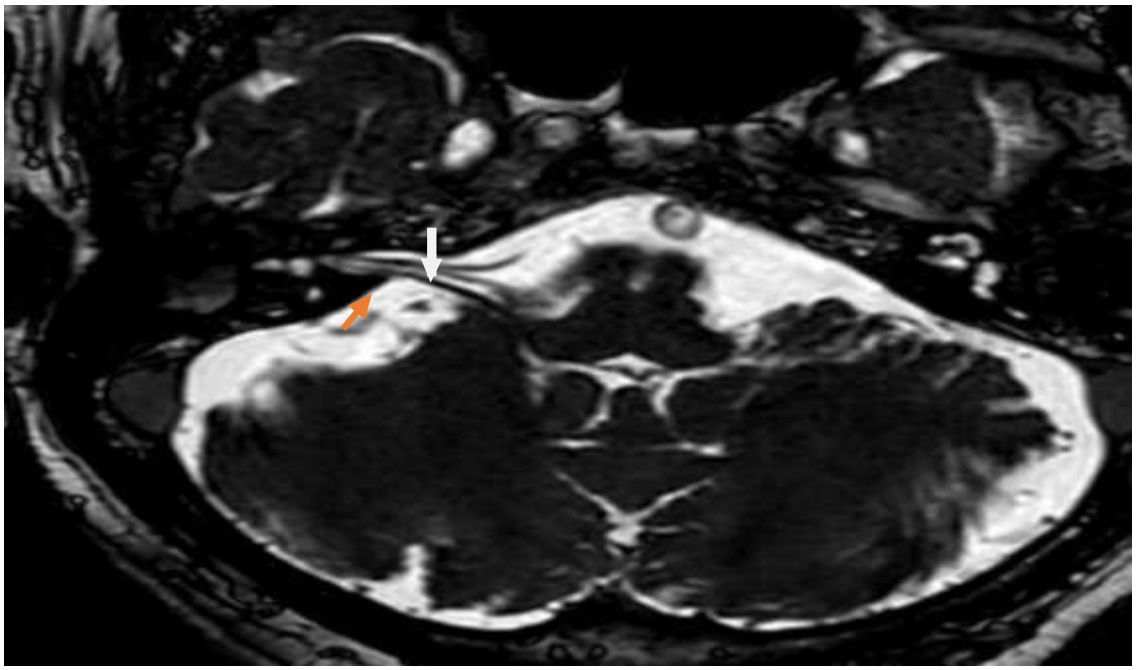


A 60 year old male patient presnted with complaints of trigeminal neuralgia.On axial FIESTA and on MIP TOF MR ANGIOGRAM, an elongated and tortuous basilar artery noted leading to compression of left trigeminal nerve,facial and vestibulochoclearnerves.Basilar artery bifurcation noted at level of floor of 3rd ventricle.

CASE 5



- Axial FIESTA sequence showing right Anterior inferior cerebellar artery loop (white arrow) noted insunuating into right internal auditory meatus(red arrow)

DISCUSSION

Neurovascular conflict (NVC) is defined as an “abnormal” contactbetween an artery and the REZ of a cranial nerve. REZ is the cisternal part of the nerve close to the entrance into the pons(or the exit from).

It represents a transition zone between the peripheral myelin, derived from Schwann cells, and central myelin, derived from oligodendroglia.

According to this anatomical organization, this junctional zone is thinnerand more vulnerable to vascular compression than the other nerve’s segments.

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The existing literature suggests that the vascular compression exerted on the nerve at the level of the REZ, leads to increased excitability, at least in some of the nerve fibers, and consequently to the dysfunction syndrome.

Vascular compression of REZ could be depicted as a “cross- compression”, a contact with variable angle between the two structures, or as a “sandwich compression” in which the nerve is entrapped between two different vessels. Commonly the offending vessel implicated is an artery of the vertebro-basilar system while is still debated, and highly unlikely, the role of veins in NVC.

Identifying contact between nerve and vessels is commonly seen in both asymptomatic and symptomatic patients. Neurovascular contact causing displacement and atrophy is highly associated with symptomatic cases of classical neuralgias.

A correct clinical evaluation is fundamental for the Patient’s management: moreover, the identification of the physiopathological process underlying the condition is of paramount importance because it may lead to the appropriate therapy. Role of imaging is essential to exclude secondary causes of dysfunction syndrome and can confirm the clinical suspect of NVC. Currently the NVC imaging relies predominantly on magnetic resonance imaging, while CT and angiographic techniques maintain an ancillary role in specific issues.

MRI imaging protocol is essentially based on two sequences: a 3Dsteady state and an angiographic sequence.

The 3D steady state sequences (CISS, FIESTA, DRIVE) are high- resolution heavily T2-weighted techniques and allow very good delineation of vascular structures and nerves in the CSF spaces. The anatomic course and complex vascular relationships of nerve’s cisternal segment can be visualised successfully by these sequences.
High-resolution 3D MRA (TOF-MRA) and/or contrast-enhanced MRA (CE-MRA), with careful analysis of MIP (maximum intensity projection), multiplanar reconstructions and source images, is the method of choice to evaluate the vascular anatomy of vertebro-basilarsystem.

- KEY IMAGING FINDINGS:

- The finding of an asymmetrical vessel with serpiginous shape at the ponto-cerebellar angle is of paramount importance, indicating the artery presumably responsible of the abnormal contact with the cranial nerve under investigation. An accurate assessment of the implicated nerve’s REZ and the offending vessels should be undertaken to obtain a correct diagnosis of neurovascular conflict.
- Therefore the following criteria have to be carefully considered:
- The offending vessel should be an artery
- The vessel must cross the nerve, at the REZ , perpendicularly
- At least one of nerve’s abnormalities stated below should be found:
  - Deformations and angulations of nerve’s course (“bending”)
  - Footprints on the surface of the nerve (“grooving”)
  - Partial nerve shearing by an arterial loop generating a deepindentation on the nerve surface ("stretching")
- Multiplanar reconstructions from 3D steady state sequences generally help to define the diagnosis of NVC in suspected cases.
- Identify a contact between a vessel and a nerve in patients both asymptomatic or with shaded symptoms is common . Therefore thecareful application of these criteria is essential to reach a correct diagnosis of neurovascular conflict and to avoid misinterpreting a simple contact between an artery and a nerve.

Chavda described a simple method for classification of AICA loops

- type I: lying only in the cerebellopontine angle (CPA), but notentering the internal auditory canal (IAC)
- type II: entering, but not extending >50% of the length of the IAC
- type III: entering and extending >50% of the length of the IAC

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TREATMENT

- Nowadays different therapies are available in the treatment of spasmodic hyperfunction generated by neurovascular conflict.
- Drugs represent generally the first approach; In those patients refractory to medical treatment, the surgical approach is mandatory.
- In the last decades several different surgical techniques have been used in the treatment of cranial neuralgia but microvascular decompression has shown the best results; the procedure consists in decompressing the nerve's REZ by the interposition of a small pieceof teflon between the nerve and the offending vessels.

CONCLUSION

- Imaging of neurovascular conflict requires a thorough understanding of the neuroanatomy, neurophysiology and main clinical aspect of cranial nerve dysfunction syndrome.
- 3D steady state and angiographic MR sequences represent nowadays the most sensitive tools available to radiologists, allowing an optimal identification of the vascular compression of the cranial nerve's REZ.
- A systematic approach and the accurate application of the suggested criteria represent essential requisites for Radiologists, in order to increase the diagnostic accuracy in the assessment of neurovascular conflict, therefore reducing the false negative and false positive rate.

Conflict of Interest:None

Funding Support: Nil

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