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ORIGINAL ARTICLE

Frequency of Anterior Inferior Cerebellar Artery Vascular Loops Using CISS Sequence on 3.0T MRI in the Otologic Symptomized Patients

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ABSTRACT

Aim: To estimate the frequency of vascular loops in the anterior inferior cerebellar artery in the otologic symptomized patients using CISS sequence on 3.0 Tesla MRI" in Pakistani populations.
Methodology: Cross sectional descriptive study was conducted in Armed Forces Institute of Radiology and Imaging, Military Hospital Rawalpindi from 12th April 2019 to 11th October 2019. One hundred patients of both genders between age of 20-60 years were presented with otologic symptoms i.e. tinnitus, dizziness and hearing loss (unilateral/bilateral) and advised MRI brain. Patients with any diagnosed arterial, venous and arterio-venous cause of otologic symptoms, severe claustrophobia and with internal cardiac pacemakers or any other metallic foreign body were excluded. Patients were undergone MRI brain on 3.0 Tesla. TIWS, T2WS and CISS sequences were taken along with post-contrast T1WS images.
Results: There was 20 to 60 years of patients range of age having mean age of 38.38±12.05 years and majority of patients 65% between 20-40 years. There were 53(53%) males and 47(47%) females and having 1.2:1 ratio of male to female. Frequency of anterior inferior cerebellar artery vascular loops in the otologic symptomized patients using CISS sequence on 3.0 Tesla MRI was seen in 59(59%) patients.
Conclusion: The frequency of anterior inferior cerebellar artery vascular loops in the otologic symptomized patients using CISS sequence on 3.0 Tesla MRI is very high.
Keywords: Anterior inferior cerebellar artery vascular loops, Magnetic resonance imaging, Otologic symptoms

INTRODUCTION

Patients presenting with otologic symptoms may present in multiple ways i.e; tinnitus, hearing loss, dizziness, vertigo. Tinnitus may be pulsatile or non-pulsatile and subjective or objective in origin. Causes of pulsatile tinnitus may be abnormal intra or extra cranial vessels (arterial, venous, or arteriovenous transition). Symptoms in patients like vascular compression syndromes is one class of otologic symptoms, belonging to the class of diseases which is initiated by direct contact among a cranial nerve and a blood vessel. In a study among a total of 64 assessed ears no vascular loop was presented in 28 patients (43.75%), anterior inferior cerebellar artery (AICA) vascular loop were presented in 36 (56.25 %).[1]

Vascular loops in the cerebellopontine angle is the most common vascular variant having neurovascular contact with the vestibulocochlear nerve leading to otologic symptoms[2].

Cranial nerves relationship in the posterior cranial fossa with the cerebellar arteries, brainstem and cerebellar surface needs to be clearly understood. Three neurovascular complexes at this level are specified, the neurovascular complex in the middle relates to anterior inferior cerebellar artery (AICA) with the upper complex related to superior cerebellar artery (SCA) and lower complex related to posterior inferior cerebellar artery (PICA). At the pontine level AICA begins, travels alongside the abducens nerves, vestibulocochlear, and facial until it reaches the middle cerebellar peduncle. From there, along the cerebellopontine fissure it travels and by feeding the petrosal surface of the cerebellum it comes to an end. AICA loops in the cerebellopontine cistern have been found to be causing auditory and vestibular symptoms, as well as hemi facial spasm (HFS), resulting from compression of the VII and VIII cranial nerves. Every patient presenting with clinical features of tinnitus should be considered and evaluated for vascular pressure[3].

Patient may present with symptoms of disabling long standing persistent unilateral vertigo and tinnitus without any hearing loss are shown to have intrameatal compression of the AICA on CN VIII. In addition, it is important to evaluate for a sign of vascular compression at the contact point the presence of angulation of eighth CN and vascular contact[4].

High-resolution axial thin-section MRI with the most efficient technique for evaluating internal auditory canal and neurovascular structures in the CPA, and constructive interference in steady state (CISS) is T2-weighted gradient echo sequence. T2 is performed with the CISS sequence[5].

Per operative findings are seen in consistent with radiological findings. Patient improved after surgery without any significant hearing loss[6].

To analyze and evaluate the frequency of AICA vascular loop in contact with the eighth CN in the cerebellopontine angle (CPA) causing vascular compression syndrome and to facilitate otolaryngology surgeons to carry out microvascular decompression (MVD) surgery to relief symptoms in patients without any significant hearing loss was the aim of this study.

MATERIALS AND METHODS

Armed Forces Institute of Radiology and Imaging (AFIRI), Military Hospital, Rawalpindi departments were used. Patient presented with otologic symptoms i.e., tinnitus, dizziness and hearing loss (unilateral/bilateral) and advised MRI brain, age group of 20-60 years of either sex were included. All patients with any diagnosed arterial, venous and arterio-venous cause of otologic symptoms and severe claustrophobia and with internal cardiac pace-makers or any other metallic foreign body in whom MRI is contra-indicated were excluded.

All patients meeting our inclusion criteria were enrolled for acquisition study after taking informed consent. By holding them in exclusion criteria all confounding variables were excluded. Patients were undergone MRI brain on 3.0 Tesla. TIWS, T2WS and CISS sequences were taken along with post-contrast T1WS images. MRI scan was shifted from console and reported by viewing on PACS by classified Radiologist (having 5 years post FCPS experience). For analyzing the data, SPSS-20 was used. Chi-

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square test was employed post stratification. Significant P value <0.05 was observed.

RESULTS

The study's participants ranged in age from 20 to 60, with a mean age of 38.38 12.05 years. According to Table I, the majority of the patients (65%) were aged 20 to 40, out of 100 patients, 53(53%) were men and 47(47%) were women, a ratio of 1.2:1 for male to female. Table-I also indicate the patient distribution by tinnitus and hearing loss. Frequency of anterior inferior cerebellar artery vascular loops in the otologic symptomized patients using CISS sequence on 3.0 Tesla MRI" was seen in 59(59%) patients. Table-II illustrates the stratification of anterior inferior cerebellar artery vascular loops according to age, gender, tinnitus, and hearing loss.

Table 1: Distribution of patients (n=100)

Distribution		n	%age
Age (years)	20-40	65	65
	41-60	35	35
Gender	Male	53	53
	Female	47	47
Tinnitus	Yes	67	67
	No	33	33
Hearing Loss	Yes	54	54
	No	46	46

Table 2: Stratification of the findings of MRI

Distribution		Vascular loops in the anterior inferior cerebellar artery		p-value
		Yes	No	
Age (years)	20-40	40	25	0.482
	41-60	19	16	
Gender	Male	29	24	0.355
	Female	30	17	
Tinnitus	Yes	37	30	0.274
	No	22	11	
Hearing Loss	Yes	28	26	0.115
	No	31	15	

Table 3: Types of AICA Vascular loop according to its location

Type	Location of Vascular loop
I	AICA loop present within the CPA but outside the IAC
II	AICA loop extending into the IAC less than < 50 %
III	> 50 % extension of AICA loop into the IAC

DISCUSSION

Neurological problems have been attributed to vascular loops and their connections in the cerebellopontine angle (CPA) and cranial nerves. Hemifacial spasm and trigeminal neuralgia, are the most frequent manifestations of their consequences, which are most frequently caused by trigeminal and facial nerves compression and abutment. Dandy is credited with being the first to describe trigeminal nerve vascular compression, which causes trigeminal neuralgia, in 1934[7]. The vestibulocochlear (CN VIII) nerves and face cranial nerve (CN) VII may be compressed by vascular loops created by the anterior inferior cerebellar artery (AICA), which has a variety of segments. There has been discussion on the potential impact of vascular loops on facial spasm, hearing loss, and tinnitus[8,9].

This study was carried out to ascertain the occurrence of anterior inferior cerebellar artery vascular loops in the population of Pakistan using CISS sequence on 3.0 Tesla MRI. The study's participants ranged in age from 20 to 60, with a mean age of 38.38 12.05 years. The majority of the patients (65%) were in the 20–40 age range. A ratio of 1.2:1 male to female existed among the 100 patients, with 53(53%) men and 47(47%) women. The frequency of anterior inferior cerebellar artery vascular loops was observed in 59(59%) of the patients utilizing the CISS sequence on 3.0 Tesla MRI.

Makins et al[10] discovered no substantial variations in the presence of vascular loops between healthy (asymptomatic) ears and ears with clinical signs & symptoms, indicating that the appearance of vascular loops on MRI is not necessarily pathological and could instead be seen as an ordinary anatomic discovery. Comparable to this, Grocoske et al[11] discovered that the eighth cranial nerve's involvement in a neurovascular conflict on MRI scans was insufficient to fully describe the symptoms and signs of otoneurological seen in the participants evaluated.

AICA loops inside the ICA are found in human temporal bones in 12.3%, according to cadaveric research[12,13]. The observations in the cadaver following formaldehyde fixation, according to Fkuda et al[14] might, however, vary from others in the viable condition. Contact between AICA loops and ninth CN were about equally common in MR imaging studies across symptomatic and asymptomatic individuals (25% and 21.4% respectively)[15,16].

Consequently, eighth cranial nerve vascular compression may not always be indicated by the simple existence in the AICA of vascular loops. Remember that it may well be a straightforward anatomical variation. It is noteworthy that the majority of the participants in our sample (n=36) had vascular loops of Chavda grades I or II. Gultekin et al. found that the internal auditory meatus was involved in vascular loops in 72% of the controls (Chavda grade I)[17]. Though the evidence is still debatable, certain investigations have suggested that there is a connection among vascular loops and otologic complaints[18,19,20].

According to McDermott et al., there are three kinds of vascular loops of the AICA; type I occurs inside the CP angles, type II, when loop enters the IAC less than halfway and type III, when the loop enters the IAC more than halfway[21] illustrated in table III.

AICA vascular loop incidence varies across anatomical and radiological investigations. Ouaknine, et al. found AICA loops in cadaver samples in 97% of the cases[22]. One theory for the origin of tinnitus brought on by CN VIII compression is the connection between AICA loops and the IAM. It is thought that direct pulsatile compression with ephaptic discharges is what causes the symptoms of vestibulocochlear nerve compression[23].

One thousand, three hundred and twenty seven temporal bones were examined, and 12.3% of the patient samples had AICA loops in the IAM. The majority of patients who complained of peripheral vertigo lacked an arterial abnormality squeezing the vestibulocochlear complex, according to the investigators. They concluded that there is no causal relationship between the auditory symptoms that are present in a small percentage of individuals and the AICA's presence in the IAM. Most AICA loops are discovered outside the meatus in 50% of instances, approach the IAM orifice in 25% of cases, penetrate the IAM in 19% of cases and fill the center of the IAM in 6% of cases when they do appear.

Ninety-four percent of patients had an AICA loop, according to a blinded study of 167 CP angle MRI data. The number of loop types discovered was 196 type I, 106 type II, and 14 type III. Of those individuals, 66 experienced a unilateral hearing loss that had no known cause. Furthermore, there has been no correlation among the existence of a type II or type III vascular loop, IAC width, or unilateral hearing loss, validating the idea that the depth of an AICA loop extension into the IAC does not correspond to unilateral hearing loss[24].

CONCLUSION

This research concluded that the frequency of circulatory loops in the anterior inferior cerebellar artery in the otologic symptomized patients using CISS sequence on 3.0 Tesla MRI" is very high. So, we recommend that magnetic resonance imaging should be done in all patients with otologic symptoms to diagnose this problem on early stage to stop the progression of the disease and thus reduce the associated complications.

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Limitations of study: Not cost effective and an expensive study all patients can't afford. Small sample size as all patients presenting to Physician with symptoms are not screened/ underwent the study. Not all patients found to having this vascular loop underwent decompression surgery. Study cannot be performed using MRI machines having low magnetic field strength producing images with lesser/ poor resolution (due to relatively lesser signal to noise ratio), hence cannot be performed in small peripheral locality/ healthcare facility.

Authorship and contribution declaration: Each author of this article fulfilled following Criteria of Authorship:

1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.
   All authors agree to be responsible for all aspects of their research work.

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