The role of 3D CISS MRI in the evaluation of primary trigeminal neuralgia

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Abstract

Background: Trigeminal neuralgia (TN) is the most common form of facial neuropathic pain characterized by recurrent episodes of unilateral brief electric shock-like pains localized to the sensory supply areas of trigeminal nerve.

Aim of study: to study the role of axial and coronal 3D CISS MRI in the diagnosis of primary TN.

Methods: this study is a cross sectional analytic study conducted in the MRI department at AL_Immamain AL_kadimian medical city during October 2017 and August 2018. The study included 30 patients with the clinical diagnosis of unilateral primary TN. Exclusion criteria were secondary cause of TN as brain tumor, MS, and other contraindication of MRI. MRI examination was done using 3 TESLA super conducting system. The patient were examined in the supine position by the following sequences: T1WI sagittal, T2WI axial, T2W FLIAR coronal, DWI, MRA /MIP MRA and 3D CISS (FFE/M) in axial and coronal orientation.

Results: Right and left sided complains represented 63.3% and 36.7%, respectively. Mean complain duration was 2.5±2.4 years. The compression was absent in 1 patient, arterial compression in 18 (60%) and venous compression in 11 (36.7%) patients. Arterial compression was related to superior cerebral artery in 83.3% and anterior inferior cerebral artery in 16.7%. A significant lower mean distance between compression vessels and root entry zone between symptomatic and control sides ($p<0.001$),. The appropriate cut off level for distance between compression vessels

and REZ in prediction of primary TN was 3.1mm with 96.7% sensitivity and 96.6% specificity.

Conclusions: The 3D CISS MRI is an accurate imaging technique in diagnosis and evaluation of primary TN. The distance between compression vessels and REZ at symptomatic side is lower than opposite asymptomatic side.

Key wards: 3D CISS MRI, primary trigeminal neuralgia.

INTRODUCTION

Trigeminal neuralgia (TN) is the most common form of facial neuropathic pain with an annual incidence of 4 to 5 new patients per 100,000 [1]. It is characterized by recurrent episodes of unilateral brief electric shock-like pains localized to the sensory supply areas of trigeminal nerve and has been considered as one of the most serious pains that can experience [2]. It is usually unilateral, affects older aged group. Occasional reports of bilateral primary TN reflect successive episodes of unilateral pain that move to the opposite side of the face rather than pain episodes that occur simultaneously on both sides [3]. Attacks usually last only seconds but may recur repeatedly within short period of time. The attacks are often precipitated by mild sensory stimulation (trigger zones), which may be located anywhere within the territory of the affected trigeminal nerve. Typical antecedent stimuli include light touching, draughts of wind, eating, drinking, washing, shaving and applying make-up. The neuralgia tends to occur in bouts over a period of weeks or months, with subsequent spontaneous remission that may last months or years. In time, however, attacks usually become more frequent and the pain more sustained [4].

Idiopathic or classical TN is mainly caused by neurovascular compression of trigeminal nerve at its root entry zone [5]. In the early 20th century, Harvey Cushing studied the etiology of TN and proposed the hypothesis of mechanical compression, which was further improved by W.E. Dandy by proposing the vascular compression theory in 1932 [6], hypothesizing the presence of arterial compression of the root entry zone (REZ) at the root of the trigeminal nerve. However, TN is not confined to arterial compression at the root of the trigeminal nerve. The causes of pain are complex and diverse. Various types of compression from the offending vessels,

including arterial compression, venous compression, or even no neurovascular compression (NVC) have been found in clinical practice [7].

Three D CISS (stands for Constructive Interference in Steady State), is part of fast gradient echo sequences and considered to be superior to the conventional MRI [8], CISS is used in the assessment of the anatomical variations and for different pathologies involving the cranial nerves and CNS [9] . The CISS has been shown to be useful in spinal imaging too mainly in the cases of AVM. The main roots of trigeminal nerve especially at root entry zone and the gasserian ganglion can be depicted by CISS in the pre-pontine cistern and in Meckel's cave, respectively. In cases of TN it plays an important role in searching for vascular compressions [10].

Aim of study

To study the role of axial and coronal 3D CISS MRI in the diagnosis of primary TN.

PATIENTS and METHODS

This is a cross sectional analytic study conducted in the MRI department at AL_Immamain AL_kadimian medical city /Baghdad /Iraq from October 2017 to August 2018. The study included 30 patients (22 female and 8 male, mean age 54.2 ± 16.5 years) with the clinical diagnosis of unilateral primary TN.

Exclusion criteria: secondary cause of TN as brain tumor, MS, … etc., other contraindication of MRI

All patients were subjected to full history and clinical examination. MRI examination was done using 3 TESLA super conducting system (Achieva 3, Philips medical system, Netherland). The patient were examined in the supine position using maximum gradient capability and circularly polarized head coil, all the patient were examined by the following sequences: T1WI (parameter: TE 4.76ms, TR 232ms, slice thickness 4mm, sagittal orientation, FOV 214mm, matrix 256 X256). T2WI (parameter: TE 80ms, TR 2.8ms, slice thickness 4/1.9mm, axial orientation, FOV 230 mm, flip angle 90̊). T2W FLIAR (parameter: TE 120ms, TR 11ms, flip angle 90̊ degree, coronal orientation, FOV 230mm). DWI (parameter: TE98ms, TR 4.0ms, flip angle 90̊, axial orientation, slice thickness 4.0/1.0mm, FOV 230mm). MRA /MIP MRA (parameter: TE 3ms, TR 23ms, flip angle 18̊, slice thickness 1.4/-0.7mm, axial orientation, FOV200mm, matrix 256X512). 3D CISS (FFE/M) (parameter: TE 3ms,

TR 6ms, slice thickness 1.0/-0.5mm, axial and coronal orientation, flip angle 45°, FOV180mm, matrix 512 X512).

Image evaluation was done by two independent radiologists to decrease inter-observer error, NVC considered being present if the CSF fluid amount was severely decreased or not visible between the trigeminal nerve and the aberrant vessels in axial and coronal CISS images, MRA is used to confirm whether the compressed vessels artery or vein , then we measure the shortest distance between the trigeminal nerve on the symptomatic side (at REZ region) and the blood vessels at site of neuro-vascular compression (NVC) (whether the contact is laterally or medially), measured distance for each patient was compared with the contralateral side as a control.

STATISTICAL ANALYSIS: the data were analyzed by Microsoft program and statistical package for social sciences version 23. Outcome of analysis were arrange in scale variables (mean and standard deviation) and in categorical variable. Fisher's exact test and Independent sample t-test were used for comparison between the categorical data. The level of significant (P value) was set as≤ 0.05.

RESULTS

Thirty patients with primary TN were included with mean age of 54.2±16.5 years; Female to male ratio as 2.7:1. Right side complains represented 63.3% while left sided complain represented 36.7%. Mean complain duration was 2.5±2.4 years; 23.3% of them had duration of less than 1 year, 70% of them had duration of 1-5 years and 6.7% of them had duration of more than 5 years. The compression was absent in 1 patient, arterial compression was observed in 18 (60%) patients and venous compression was observed in 11 (36.7%) patients. Arterial compression was related to superior cerebral artery (SCA) in 83.3% and anterior inferior cerebral artery (AICA) in 16.7%. Mean distance between compression vessels and REZ at symptomatic side was 2.4±0.5 mm and mean distance between vessels and REZ at control side was 5.4±1.2 mm. All these findings were shown in table 1.

Table 1: MRI findings of neurovascular compression in patients with primary TN.

Variables		No.	%
Compression	Arterial	18	60
	Venous	11	36.7
	No compression	1	3.3
	Total	30	100
Arterial compression	SCA	15	83.3
	AICA	3	16.7
	Total	18	100
Distance between compression vessels and REZ at affected side: mean ±SD (2.4±0.5mm)			
Distance between blood vessels and REZ at control side: Mean ± SD (5.4±1.2mm)			

There was a highly significant difference in distance between compression vessels and REZ between symptomatic side and control side detected by MRI ($p<0.001$), the mean distance was significantly lower among symptomatic side. These findings were shown ion table 2

Table 2: Distribution of distance between compression vessels and REZ according to symptomatic and control sides.

Variable	Symptomatic side	Control side	P value
Distance between compression vessels and REZ: (Mean± SD in mm)	2.4±0.5	5.4±1.2	**<0.001***

**Independent sample t-test*.

The appropriate cut off level for distance between compression vessels and REZ in prediction of primary TN were shown to be 3.1mm with 96.7% sensitivity and 96.6% specificity. Figure 1 and 2 show MR images of some 2 patients with TN.

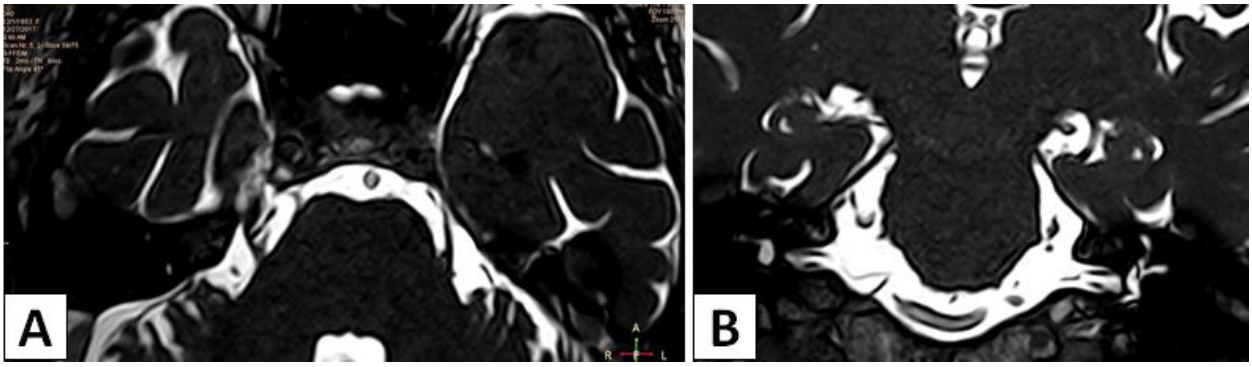

Figure 1: 65 years female with Rt. TN for 12 years with history of Gamma knife radio surgery, (A) axial view and (B) coronal view which show NVC.

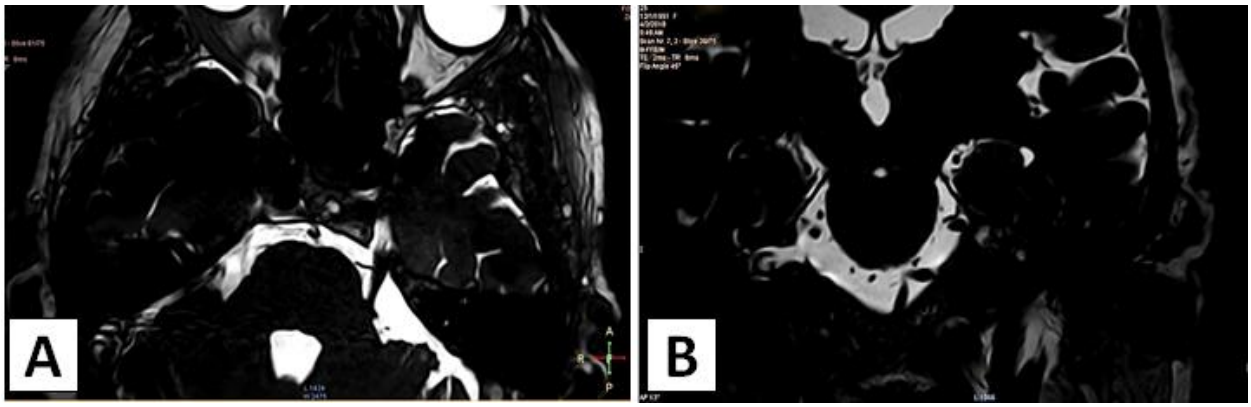

Figure 2: 67 years female with Lt. TN for 9 years. (A) axial view and (B) coronal view which show NVC (SCA).

DISCUSSION

Primary TN is a compression syndrome in which one and more division of 5th cranial nerve is affected leading to characteristic paroxysmal facial pain [11]. Three D CISS-MRI is the appropriate choice in the evaluation and assessment [12].

Present study showed mean age of the patients with primary trigeminal neuralgia was 54.2 years with predominance of old age group (≥60 years). This finding is close to the results of Yaseen study [13] in Iraq which referred to increased age of patients with primary TN. Females with primary TN were more than males. This was similar to the results of Bee et al [14] study in Malaysia which reported high predominance of female gender. Inconsistently, Rai et al [15] study in India found that males were more common than females with mean age of 58.9 years. This difference might be attributed to the difference in risk factors for primary TN and difference in methodological inclusion and exclusions criteria. The Current study showed that right sided complain was most prevalent (63.3%). This finding coincides with results of Bangash et al study [16] in

Pakistan which revealed that 64% of patients had right sided complain. Mean complain duration of primary TN in our study was 2.5 years. This finding is close to results of Cruccu et al [17] study in UK which reported mean complain duration of 2.8 years.

In this study, previous history of central nervous surgery was seen in 2 patients with primary TN, Machet et al [18] study in France documented that there is an effect of previous history of CNS surgery on development of primary TN.

Zerris et al [19] study in USA 3D CISS-MRI could identify accurately 24 (96%) patients. Many authors examined the role of MRI in detection of primary NT and reported a sensitivity of 94–97% [20]. However, cases with asymptomatic vascular contact were also found to be high, for that, both MRI imaging and clinical evaluation must be used together [21]. Besta et al [22] stated that common advantages of 3D CSSI-MRI were long relaxation times that lead to additional signal, while the main disadvantage was the high cost as compared to conventional MRI.

In this study 3D CISS-MRI reported no vessels compression in 1 patient, 60% artery compression and 36.7% vein compression. Pecker et al [23] study in Turkey found that 86% had arterial compression (mainly SCA) while 14% had veinous compression. It is believed that compression of the nerve fibers causes hyperexcitability.

The most interesting finding of the present study was the significant difference in distance between compression vessels and REZ between symptomatic side and contralateral normal side ($p<0.001$), the mean distance was significantly lower among symptomatic side. This finding is in agreement with the results of Lang et al [24] study in Germany. Elaini et al [25] study in Egypt stated similar findings. In Denmark study conducted by Maarbjerg et al [26] similar findings were observed.

The Present study showed that appropriate cut off value for distance between compression vessels and REZ at symptomatic sided was 3.1 mm with sensitivity of 96.7% and specificity of 96.6%. These findings were similar to the results of many studies like Suzuki et al [27] study in Japan and Guclu et al [28] study in France.

CONCLUSIONS

The 3D CISS MRI is an accurate imaging technique in diagnosis and evaluation of primary TN. The distance between compression vessels and REZ at symptomatic side of primary TN is lower than distance at opposite asymptomatic side. Cutoff value in

detecting primary TN was 3.1 mm. the compression vessels were arterial more than venous.

Ethical Clearance : All ethical issues were approved by the scientific committee of the College. Signed informed consents were obtained from all participant patients and data were collected according to the declaration of Helsinki, 64th World Medical Association General Assembly of ethical principles for medical research involving human subjects,

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Conflict of interest: Nil

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