

Anatomical variations of Jugular Foramen & its clinical implication: CT Study

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Introduction: Skull base is a complicated region with number of foramina providing the only portal of access to otherwise closed cranium. The jugular foramen (JF) lies at the posterior end of petro-occipital fissure. It is divided into 2 compartments Pars nervosa (PN) and Pars vascularis (PV) by bony processes arising either from temporal or occipital bone.

The structures passing through PN include glossopharyngeal (IX cranial nerve), inferior petrosal sinus, and PV include internal jugular vein, vagus nerve (X Cranial nerve) and accessory nerve (XI cranial nerve). Other structures passing through JF are inferior petrosal sinus, meningeal branches of ascending pharyngeal and occipital artery. Sigmoid sinus continues as internal jugular vein through posterior part of this foramen. The cranial nerves are medial to the jugular vein. Small dehiscence within the jugular fossa wall allow the passage of the tympanic branch of the glossopharyngeal nerve (Jacobson nerve) and the auricular branch of the vagus nerve (Arnold nerve). Various important structures surround the JF. It is separated from the hypotympanum by a bony plate and is medial to the descending facial canal and inferomedial to the posterior semicircular canal. The jugular foramen is separated from the anteromedial carotid canal by the caroticojugular spine and from the inferomedial hypoglossal canal by the jugular tubercle.

Any intrusion in this foramen may lead to the obstruction and impingement of the structures present within, presenting clinically like Vernet's syndrome due to meningiomas; obstruction can be caused by paragangliomas.

Computerized tomography (CT Scan) is the best modality to demonstrate bony anatomy of skull base foramina. Cross sectional imaging with CT enables physician to see with great detail the structure of skull base. Recognition of normal anatomy is crucial in detecting & fully evaluating any pathological conditions affecting this important region.

The most common JF lesions seen are of cancerous and non-cancerous origin. In tumors, paragangliomas or metastasis is seen. In non-tumoral pseudo lesions, most common are asymmetrically enlarged JF or protruding jugular bulb. In the later, CT shows smooth and preserved margins of JF.

When one considers the delicate neurovascular structures that traverse their narrow confines, knowledge of the variations of these foramina become an important part of diagnostic & surgical medicine.

Objectives

To conduct the morphometric analysis and variations of anatomy of the Jugular foramen in north Indian population

Materials & Methods: This study examined 200 Computerized tomography (CT) (110 males, 90 females) head in axial section with no evidence of disease, that might alter foramina anatomy, from picture archiving & communication system (PACS) of Dr RMLIMS, Lucknow. The Computer-assisted measurements of foramina parameters were obtained on both right and left sides.

Exclusion criteria:

- Technically suboptimal scans.
- Disease or tumor involving skull base.
- Patients with skull base fracture.
- Any congenital anomaly involving skull base.
- Patient who underwent surgery for skull base.

- Patients age less than 1 year.

The following parameters of JF have been observed & measured in millimetres (mm).

Variations in shape, size, location, symmetry, septation, presence or absence of foramen & relationship of structures to each other.

- Medio-lateral or transverse diameter (TR) and antero-posterior (AP) diameters of the foramen. It may be noted that these two diameters will be perpendicular to each other.
- The distance from medial edge of paired foramina to mid sagittal plane (MSP).
- Frequency of occurrence of accessory foramina.

Jugular foramen (JF): The parameters were calculated at the level where the rounded external opening of carotid canal can be clearly visualised in HRCT. JF was divided further into pars nervosa and pars vascularis with help of bony spur.

Overall transverse diameter- line was drawn between 2 most widely situated points along the long axis of JF.

Distance from MSP- the mid-point of the inner surface of medial wall was marked and a perpendicular was drawn to the MSP.

PN:AP diameter- a straight line was drawn from distal points in anterior and posterior aspect, parallel to MSP and measured.

TR diameter- a transverse line was drawn from medial wall to lateral wall with maximum girth (perpendicular to the MSP).

PV: AP diameter-line was drawn at margins, between 2 most distant points along the long axis of PV.

TR diameter- a line was drawn from mid-point of lateral-posterior wall to JT.

The results were statistically analysed by using an unpaired t-test, paired t-test, and ANOVA.

Result

Shape of JF was irregular in all CT scans.

Only in 3 % cases, jugular foramen was not divided into Pars Nervosa and Pars Vascularis.

JF: The overall mean, transverse diameter, anteroposterior diameter & distance from midsagittal plane in males were 12.70 ± 2.02 , 7.83 ± 2.02 & 21.65 ± 2.19 , and in females, measurements were 12.99 ± 2.27 , 9.46 ± 1.79 & 20.76 ± 2.10 respectively.

Symmetry: In this study, the values of transverse diameter & anteroposterior diameter were found to be greater on the right side. Significant difference seen among males between left and right side for-

- Overall Transverse diameter p-value = 0.001
- Distance from MSP p-value < 0.001

Gender-variation: Significant difference present between males and females for distance from MSP (p-value = 0.004).

PN: The mean, transverse diameter and anteroposterior diameter on right side in males were 4.22 ± 1.67 and 4.16 ± 1.90 , and in females, measurements were 3.97 ± 2.24 and 4.38 ± 1.95 respectively.

The overall mean, transverse diameter and anteroposterior diameter on left side in males were 4.47 ± 1.70 and 4.21 ± 1.44 and in females, measurements were 4.32 ± 1.97 and 4.36 ± 1.82 respectively.

No significant differences seen in symmetry or gender-wise in pars nervosa.

The overall mean, transverse diameter and anteroposterior diameter on right side in males were 6.83 ± 2.00 and 7.80 ± 2.40 and in females, measurements were 7.06 ± 2.56 and 7.49 ± 2.84 respectively.

The overall mean, transverse diameter and anteroposterior diameter on left side in males were 5.58 ± 1.44 and 7.84 ± 2.38 and in females, measurements were 6.29 ± 2.12 and 7.60 ± 2.40 respectively.

Symmetry: Significant difference observed between left and right side, for TR diameter, p-value < 0.001 and = 0.016 for males and females respectively.

Gender-variation: Significant difference present between males and females for TR diameter of PV (p-value = 0.034).

On reviewing the literature, significant variation is seen in population worldwide regarding metrical dimensions of JF. Shape of JF was irregular in all CT scans consistent with the studies done in past.

The gamut of variations found in JF, the variations in its size and shape, the correlation of the critical neural and vascular structures which pass through it, and the surgical approaches to this key part of the skull base, attracts medical personnel to examine it.

Conclusion: Our study will be targeted to analyse dimensions of Jugular Foramen as a whole; PN and PV separately; septation, if any, analysing sex variation on the go and state comparative analysis with the available data. Knowledge of these variations may help in diagnosis & management of neuralgia, nerve compression diseases & newer microsurgical techniques.