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Original Research Article

MORPHOLOGICAL AND MORPHOMETRIC STUDY OF JUGULAR FORAMEN IN MAHARASHTRIAN POPULATION

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ABSTRACT

Background: The jugular foramen, the bony opening on the base of skull, is an opening through which pass the ninth, tenth, and eleventh cranial nerves, two dural venous sinuses, and the meningeal branches of the occipital and ascending pharyngeal arteries. The increasing use of modern diagnostic procedures and new surgical approaches has created a need for much more detailed anatomical studies and explanations. This article reveals some additional features.

Material and Methods: 80 jugular foramina of skulls of unknown age and gender were examined from the Department of Anatomy at IIMSR,Warudi Tq,Badnapur,Dist.Jalna .The morphological characteristics of all the investigated jugular foramina were described, measured, and compared, taking into consideration their side.

Results: Jugular foramina were studied for a review of its morphology, morphometry and its comparison with previous studies. The lengths, widths and distance of sylomastoid foramena from the outer margin of jugular foramen were determined.

Conclusions: The bony growth from jugular fossa which converted the foramen into a slit like appearancIt produces some neuro vascular diseases, glomus, jugular meningiomas, Jugular tumors and even a nodule reducing size of jugular foramen in Varicella-Zoster virus infection.The involvement of IX, X and XI cranial nerves at jugular foramen is known as Vernet's Syndrome, which might occur in this case due to narrowing of the jugular foramen. As jugular foramen is a large deeply placed aperture. The need for familiarity with detailed anatomy of this region becomes greater importance for a neuro surgeon to approach this region.

KEY WORDS: Jugular Foramen, Jugular Bulb, Internal Jugular Vein.

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INTRODUCTION

The Jugular formen (JF) it consists of two borders upper border is irregular and it allows the glosspharyngeal nerve through the notch. Lower border is smooth it allows posterior sigmoid sinus and whichcontinuous has an internal jugular foramen. Jugular foramen is a large opening which is placed above and lateral to the foramen magnum in the posterior end of the petro-occipital fissure. The anterior part of jugular foramen is allows the cranial nerves IX , X, XI the direction of the nerves from behind

forwards within the jugular foramen and sometimes jugular tubercle it has acted as a groove and later it becomes enter of the foramen. Sometimes inferior petrosal sinus might have been accompanied by meningeal branch of ascending pharyngeal arteries simultaneously sigmoid sinus accompanied by meningeal branch of occipital arteries and the posterior part of jugular foramen allows occipital and ascending pharyngeal arteries [1].

The jugular foramen is the main route of venous outflow from the skull and is characterised by laterality based on the predominance of one of the sides [2]. Ligation of the internal jugular is sometimes performed during radical neck dissection with the risk of venous infarction, which some adduce to be due to ligation of the dominant internal jugular vein. The 9th, 10 th and 11 th cranial nerves exit the cranial cavity through the JF. In the syndrome of the JF (Vernet's syndrome), there is paralysis of the 9 th , 10th and 11 th cranial nerves. These, along with paralysisof the 12th cranial nerve (Villaret's syndrome), occur with a retropharyngeal lesion invading the posterior fossa. In some instances, involvement of two or more of these nerves in other combinations is encountered (as Jackson's vagoaccessory hypoglossal paralysis, Schmidt's vagoaccessory syndrome and Tapia's vagohypoglossal palsy) [3] Intracranial and extracranial lesions may affect the jugular foramen in addition to intrinsic abnormalities. Pathological processes affecting JF include intracranial meningiomas, paragangliomas (*glomus jugulare*, from the jugular ganglion of the vagus nerve), schwannomas, metastatic lesions and infiltrative inflammatory processes from surrounding structures such as the middle ear [4-6].

Surgical resection is the treatment of choice in the majority of these cases. Advances in microsurgical techniques have made possible the removal of advanced JF lesions, which were once assumed to be inoperable[7]. As neurosurgeons become bolder in approaching this region, so the need for familiarity with the detailed anatomy of this region becomes greater. The study was embarked on to examine the anatomy of the JF, including its dimensions, and to discover the degree of predominance, if any, of this opening in adult skull in Maharshtrian population.

MATERIALS AND METHODS

A total of 80 JF were examined from 40 adult dry Skulls of unknown sex and age were obtained from the osteological collection of the department of Anatomy, at, IIMSR, Warudi, Jalna. Skulls showing pathological changes were excluded from the study. The lengths, widths and distance of sylomastoid foramena from the outer margin of jugular foramen were determined. Metric measurements (sagittal and transverse diameters) were taken using Vernier calipers with a precision of 0.1 mm. Each dimension was measured thrice and the mean figure recorded. The data collected was checked for errors prior to analysis. Data analysis was performed with SPSS version 11. The mean standard deviation (SD) and ranges of each dimension and derived index were computed. Right and left differences were analysed. A comparison was made of the means of the dimensions using the Statistical analysis was done by using SPSS for windows and Z-test.

Fig. 1: Jugular Foramen (Exterior Of The Base Of Skull – Norma Basalis).

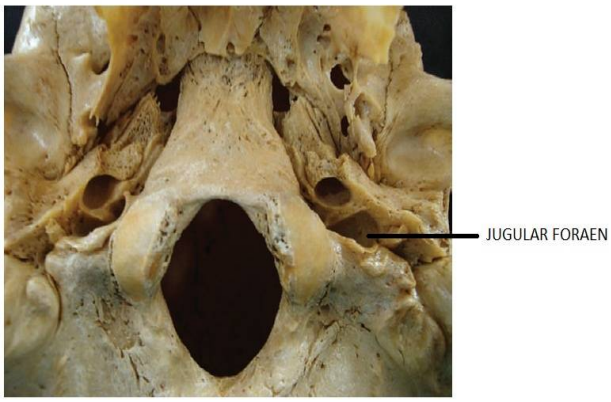

Table 1: The size of the jugular foramen varied on the two sides.

	lenght	lenght	Rtw	ltw	Distance	
Mean+SD	Rt	Lt			Rt	Lt
	14.31±2.31	13.64±2.12	9.26±1.8	7.96±2.2	4.82±1.26	5.72±2.20
Minimum	10.26	9.86	6.28	5.86	3.8	2.75
Maximum	18.36	16,86	12.18	10.82	7.2	6.8
P value	0.06	0.08	0.09	**0.03***	0.18	0.15

Rt – right , Lt - left , Rt W – right width, LTW – left width, SD- standard deviation, All measurements in mm * statistically significant

Distance- distance of stylomastoid foramina from the outer margin of jugular foramen

The mean length of the foramen on the right and left were 14.31±2.31mm and 13.64±2.12mm; the width measured 9.26±1.8 mm and 7.96±2.2mm on the right and left respectively; the mean distance of sylomastoid foramena from the outer margin of jugular foramen on the right was 4.82±1.26mm and on the left 5.72±2.20 mm

DISCUSSION

The shape and size of the jugular foramen is obviously related to the size of the internal jugular vein and the presence or absence of a prominent superior bulb. It might be expected that the right foramen would usually be larger than the left, since the textbooks classically describe the superior sagittal sinus as draining into the right transverse sinus, but there is a very wide variation in the anatomy of the intracranial venous sinuses [8,9]; which accounts for variation in size and shape of jugular foramina. The difference in size of the two internal jugular veins, when present, is already visible in the human embryo at the 23 mm stage (8 weeks post-conception) and probably results from differences in the pattern of development of the right and left brachiocephalic veins [10].

In our study mean length of jugular foramen on the right and left were 14.31mm (range: 10. 26–18.36 mm) and 13.64mm (range: 9.86- 16.86mm) respectively, while their width measured 9.26mm (range: 6.28-12.18 mm) and 7.96 mm (range: 5.86–10.82mm) on the right and left respectively. The statistically significant difference was observed between the two sides in length and width (p<0.01).Both values are more on right side. While the mean distance of sylomastoid foramena, to outer margin of the jugular foramen, the right was 4.82±1.26mm and on the left 5.72±2.20 mm.

In the study done by Idowu on Nigerian skull, he found mean transverse diameter of jugular foramen on the right and left were 13.90 mm (11.6–17.0 mm) and 14.11 mm (9.2–20.2 mm), while their sagittal diameter measured 10.22 mm (6.8–14.4 mm) and 9.57 mm (7.4–12.8 mm) on the right and left respectively. Although the Jugular Foramen was larger on the right, it was not statistically significant [10]. There is statistically significant difference between our study and Edowu's study (p<0.01). According to study done on Turks skull by Ekinci and Unur, the sagittal and transverse diameters of the left jugular foramen were 7.6 and 15.5 mm, respectively, and on the right 8.4 and 16 mm, respectively [11]. Pereira, GAM. studied total 111 skulls (of southern Brazil) and it was noticed that mean transverse diameter was 15.82mm on right side and 15.86mm on left side; mean sagittal diameter was 9.21mm on right side and 8.65mm on left side [13]. In this study the size of the jugular foramen varied on the two sides [12].

In Sturrock's investigation of 156 skulls the right foramen was larger in 68.6%, the left larger in 23.1% and equal on both side in 8.3%. The jugular fossa was present in 30.1% cases on the right side, 6.4% cases on the left side, and 53.9% cases bilaterally and absent bilaterally in 9.6% of cases [13].

Hatiboglu and Anil studied 300 Anatolian skulls from the 17th and 18th centuries and observed that in 61.6% the foramen was larger on the right side and in 26% it was larger on the left side and in the reminder of equal size. Presence of jugular fossa was observed bilaterally in 49%, on the right only in 36%, on the left only in 4.7% and absent bilaterally in 10.3% of skulls [14].

Patel and Singel studied 91 Indian skulls (Saurashtra region) and observed in 60.4% cases larger right foramen, in 15.4% larger left foramen and in 24.2% equal on both sides. The jugular fossa was observed in 38.5% cases on the right side, 14.3% cases on the left side, and 21% cases bilaterally and absent in 25.3% of skulls [15]. Thus there is marked difference between our study and the studies by Sturrock and Anil & Hatiboglu in respect to presence or absence of dome. But the findings are somewhat near to Patel and Singel study. Hussain Saheb S. studied 125 skulls (south india) and observed that in 64.8% the foramen was larger on the right side and in 24.8% it was larger on the left side and of equal size in 10.4%. The jugular bulb dome was present bilaterally in 49.6%, on the right side only in 27.2%, on the left side only in 8.8%, and absent in 14.4% of skulls [16].

It appears that compartmentalization of JF might be a part of ongoing evolutionary process. It may be also due to racial and genetic factors. This study provides detailed anatomy of jugular foramen. Knowledge of morphology, compartments and morphometry is important for neurosurgeons dealing with space occupying lesions in jugular foramen.

CONCLUSION

In conclusion variations in the size, shapes and compartments of jugular foramen might be a part of the ongoing evolutionary process. During the past few decades, biological consideration of discrete cranial traits such as their ontogeny, asymmetry, sex differences and intertrait association have been addressed to assess a possible genetic background. Knowledge of morphology, compartments and arrangement of structures within the foramen helps in deducing position of various structures from the available data of jugular foramen depicted by this study.

The knowledge may also be utilized by the clinicians to understand clinical presentations and progression of the lesions of the jugular foramen lesions and planning for the possible approaches for the operations. Existence of genetic factors in the expression of the bridging trait is known, the bridging trait can thus be studied in anthropological studies in different study populations. These findings will also be of help to understand the involvement / sparing of neurovascular structures in the Jugular foramen lesions and the interpretation of images of the Jugular foramen. The bony growth from jugular fossa which converted the foramen into a slit like appearance It produces some neuro vascular diseases, glomus, jugular meningiomas, Jugular tumors and even a nodule reducing size of jugular foramen in Varicella - Zoster virus infection.The involvement of IX, X and XI cranial nerves at jugular foramen is known as Verne's Syndrome, which might occur in this case due to narrowing of the jugular foramen. As jugular foramen is a large deeply placed aperture. The need for familiarity with detailed anatomy of this region becomes greater importance for a neurosurgeon to approach this region.

The distance of the stylomastoid foramen the jugular foramen will serve as guide for operating surgeons for rerouting of facial nerve.

Conflicts of Interests: None

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