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Morphometric Analysis of Jugular Foramen

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Abstract: ***Aim: The aim of this study is to morphometricallyanalyse the dimensions of jugular foramen. Objective: This study is to establish the normal range of variation in relative size of the right and left jugular foramina. Background: The jugular foramen is one of the most fascinating foramen present at the base of the skull attracting the imagination of many worldwide anatomists as many important structures pass through it, and amongst them the intriguing structure is internal jugular vein. The shape and size of the jugular foramen is related to size of the internal jugular vein and the presence or absence of a prominent superior bulb.***

Keywords: jugular foramen; superior bulb; internal jugular vein; skull

1. Introduction

The jugular foramen (JF) lies between the occipital bone and the petrosal portion of the temporal bone in the posterior end of the petrosal-occipital structure, and it is long and irregularly shaped. It is anteriorly separated from the inferior carotideal opening by a crest and it is laterally related to the medial face of the styloid process covering, and separated from the hypoglossal channel through a thin bone bar. Its axis is projected antero-medially, with the right foramen being often bigger. Its anterior portion has the inferiorpetrosal sinus and the intermediate portion or neural compartment involves the glossopharyngeal, the vagus and the accessory nerves; and its posterior portion or vascular compartment includes the internal jugular vein and the meningeal branches of the ascending pharyngeal and occipital arteries. The neural and vascular compartments are usually divided by a bone projection called the intrajugular process [1].

It is generally said that its height and volume vary in different racial groups and sexes [2,3]. The foramen's complex shape, its formation by two bones, and the numerous nerves and venous channels that pass through it further compound its anatomy. 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 [3]. 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, 10th and 11th cranial nerves exit the cranial cavity through the JF. In the syndrome of the JF (Vernet's syndrome), there is paralysis of the 9th, 10th and 11th cranial nerves. These, along with paralysis of 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 in Jackson's vagoaccessory hypoglossal paralysis , Schmidt's vagoaccessory syndrome and Tapia's vagohypoglossal palsy) [4]. Intracranial and extracranial lesions may affect the jugular foramen in addition to intrinsic abnormalities. Pathological processes affecting JF include intracranial meningiomas, paragangliomas (glomusjugulare, from the jugular ganglion of the vagus nerve), schwannomas, metastatic lesions and infiltrative inflammatory processes from surrounding structures such as the middle ear [5,6,7]. 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 [8]. As neurosurgeons become bolder in approach- ing 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 see the presence of any septum in it.

2. Materials and Methods

51 adult unsexed, dry human skulls were examined from the Department of Anatomy of Saveetha Dental College and hospital, Chennai. All the skulls were normal and were devoid of any malformation. The skulls were used for tutorial teaching for dental students. A simple verniercalliper was used to measure the antero-posterior and transverse dimensions. Each dimension was measured thrice and the mean figure recorded. The data collected was checked for errors prior to analysis. Incidence of bone septum, either on the right side and the left side regardless of genus of the skull, was also recorded, being either uncompleted or completed when present.

3. Results

JF dimensions and relations

The JF mean length on the right was 9.96mm and on the left, it was 9.27mm while their mean breadth measured 12.29mm on the right and 12.039mm on right. 19% of the left jugular foramen showed the presence of septum while the number of right jugular foramen that showed the presence of septum was 25%. The range of antero posterior on the left jugular foramen is 5-13 and for transverse it is8-15. The range of antero posterior on the right jugular foramen is 5-14 and for transverse it is 7-16.

	Left jugular foramen		Right jugular foramen	
	anteroposterior	transverse	anteroposterior	Transverse
mean	9.27mm	12.03	9.96mm	12.29
range	5-13mm	8-15mm	5-14mm	7-16mm
Presence of septum	19%		25%	

Using simple vernier caliper, measurements were taken

Presence of septum in jugular foramen

4. Discussion

Hovelacque [9] was the first to propose the subdivision of JF. The foramen is divided by a fibrous or bony septum that joins the jugular spine of the petrous bone to the jugular process of the occipital bone, the anteromedial compartment (pars nervosa) and a posterolateral compartment (pars vascularis). The pars nervosa receives the 9th cranial nerve, inferior petrosal sinus and the meningeal branch of the ascending pharyngeal artery, while the remaining structures pass via the pars vascularis.

The shape and size of the jugular foramen is obviously related to the size of the internal jugular vein. It might be expected that the right foramen would be larger than the left,since the superior saggital sinus drains into the right transeversesinus,but there is a wide variation in the anatomy of the intra cranialvenoussinuses which accounts for variation in size and shape of jugular foramina.

The difference in the size of the two internal jugular veins,when present it,is already visible in the human embryo at 23mm stage(8 weeks post-conception)and probably, results from differences in the pattern of development of the right and left brachiocephalic veins (Padget, 1957).

According to Sturrock (1988), the size and shape of the jugular foramen is related to the size of the internal jugular vein and the presence or absence of a prominent superior bulb. The difference in size of the two internal jugular veins, according to Sturrock (1988), is already visible in the human embryo at 23mm stage. Hatiboglu& Anil (1991) had studied 300 Anatolian skulls from the 17 & 18 centuries and had found that in 61.6% the foramen was larger on the right side and in 26% it was larger on the left side. Sturrock (1988) also had observed that from his study of jugular foramen, 68.6% were large on right sideand23.1%onleft sideand8.3%ofequal size. The present study had observed 60.4% ofjugular foramen were larger on right side and 15.4% were larger on left side, whereas the right and left jugular foramen were found to be of equal size in 24.2% cases which is quite a large margin as compared with Hatiboglu& Anil (1991) and Sturrock (1988). The dome which is special feature of jugular foramen was present in 30.1% on right side, in 6.4% on left side and in 54% bilaterally, according to Sturrock (1988). He found the dome to be absent bilaterally in 9.6% of skulls. Hatiboglu& Anil (1991) also presented with almost similar readings as the presence of dome bilaterally in 49% and on right side in 36% and on the left side in 6% only and they found the dome to be absent bilaterally in 10.3% of skulls. The present study had observed the dome to be present on right side in 29% of skulls and to be present on left side in 19% of skulls. Thus there is marked difference between the present study and the studies by Sturrock (1988) and Hatiboglu& Anil (1991).Hatiboglu& Anil (1991) in their discussion part have described many phrases and segments as was described and put forth by Sturrock (1988). Moreover as Hatiboglu& Anil (1991) had stated in their discussion that their values of size of foramen and dome of foramen as described above are very close to the of values by Sturrock (1988). Another important observation regarding septation of jugular foramen by Sturrock (1988) suggested complete septation on both sides in 3.2% of skulls and partial septation in 1.3% on right side and 10.9% on left side.

5. Conclusion

The clinical significance of jugular foramen is very important during surgeries. Therefore, the dimensions of jugular foramen is very much necessary.

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