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Original Articles

Variations in the Structure of the Jugular Foramen of Human Skull

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Abstract:

Context: *The jugular foramen is one of the most fascinating foramen present at the base of the skull attracting the imagination of many Anatomists worldwide as many important structures pass through it, and amongst them the intriguing structure is the internal jugular vein. The shape and size of the jugular foramen is related to the size of the internal jugular vein and the presence or absence of a prominent superior bulb. As most of the textbooks of Anatomy describe that the right jugular foramen is usually larger than the left jugular foramen. Henceforth the present study was undertaken in 55 skulls from the dept. of Anatomy. Measurements were taken with the help of sliding vernier caliper.*

Study type: C*ross-sectional descriptive type.*

Place and period of study: *Department of Anatomy, Rajshahi Medical College, Rajshahi and Pabna Medical College, Pabna from April 2010 to June 2011.*

Materials and Methods: *Total fifty five (55) human adult skulls were collected from the Anatomy department of Rajshahi Medical College, Rajshahi and Pabna Medical College, Pabna at different times of the study period. The study was conducted to observe variations in the structure of the jugular foramen of the human's skull.*

Result: *Out of 55 skulls (110 foramina) studied, the presence of dome indicating the presence of jugular bulb was found bilaterally in 100% of cases. 58.18% of cases showed that the size of right foramina were larger than the left foramina whereas 20% of cases showed that right foramina were equal to the left and in 21.82% of cases the left foramina were larger than the right side foramina. An important observation in the present study was the presence of either complete or partial septation in the jugular foramen.*

Conclusion: *The findings of the study reveals that there are some differences among some parameters. The variations are might be due to the geographical variations of the skeletons. It needs further study with larger sample size from different geographical areas of Bangladesh.*

Keywords*: Jugular foramen, Skull, Septation.*

Introduction:

Ancient textbooks and literature cites jugular foramen in their own way that adheres well with the word jugular and the contents passing through the jugular foramen, often relating to the variability of the size of the foramen marked with the absence or the presence of septation or dome.

In Gray's Anatomy it is stated that the lower posterior borders of the jugular foramen are smooth and its upper border being sharp and notched; sometimes the margins of the notch extend to divide the foramen into two or three compartments. Even in the textbook of Quain's elements of Anatomy, the jugular foramen is described as being divided into three compartments by two marked constrictions; the lateral transmits the internal jugular vein, the middle transmits the glossopharyngeal, vagus & spinal accessory nerves; and the most anterior sometimes completely separated by a spicule of bone (the intrajugular process) transmits the

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inferior petrosal sinus.

In the Cunningham's textbook of Anatomy, the jugular foramen is described as follows; the edge of the occipital bone forms a jugular notch and the petrous temporal is excavated to form a jugular fossa, which accommodates the superior bulb of the jugular vein.

The jugular foramen may be partly or completely divided into three compartments by small spicules of bone; the anteromedial compartment transmits inferior petrosal sinus and meningeal branch of ascending pharyngeal artery, the middle compartment contains ninth, tenth & eleventh cranial nerves; whilst the large, posterolateral compartment transmits the sigmoid sinus on its way to become the jugular vein and meningeal branch of occipital artery. The jugular foramen was also extensively studied by Hatiboglu & Anil (1991) on 300 dried Anatolian skulls in seventeenth & eighteenth centuries.

Materials & Methods:

Fifty five (55) adult, human skulls were collected from the Department of Anatomy, Rajshahi Medical College, Rajshahi, and Department of Anatomy, Pabna Medical College, Pabna.

All the skulls were normal and devoid of any malformations. The skulls were used for tutorial teaching for medical students. With the help of simple vernier caliper the antero-posterior dimension of jugular foramen were measured; and the skulls were observed for the presence of dome and septation in jugular foramen.

Results:

On examination of the skulls, it became apparent that one extreme of normality consisted of a large foramen (> 10mm antero-posterior diameter) with no evidence of complete bony septation but the presence of domed bony roof. The other extreme of normal variation was complete septation of the part of the foramen which transmitted internal jugular vein and whose antero-posterior diameter was less than 6mm. Most foramina lay somewhere between the two extremes. A common variation was the absence of a domed roof, with the bony channel which had been in contact with the internal jugular vein resembling a curved, inverted gutter. Partial septation was observed in about 32.73%of the total skulls examined in both right and left jugular foramen whereas complete septation was observed in around 76.36% on right side and 90.91% on left side. The jugular foramen was usually larger on the right. A dome indicating the presence of a jugular bulb, was present bilaterally in all of the skulls.

Table – I

Comparison of the findings of jugular foramen of present study with the findings of other researchers

		Presence of Dome				Septation of jugular foramen				Size of foramina		
		Bilateral	Right side	Left side	Absent	Complete		Partial		R>L	R<L	R=L
						Right side	Left side	Right side	Left side			
Present study(2011)		55	00	00	00	42	50	13	5	32	12	11
No.												
Percentage		100	00	00	00	76.36	90.91	23.64	9.09	58.18	21.82	20
Patel M.M(2007)		19	35	13	23	21	16	45	54	55	14	22
No.												
Percentage		21	38.5	14.3	25.3	23.1	17.6	49.5	59.3	60.4	15.4	24.2
Sturrock R.R(1988)	No.	84	47	10	15	5	5	2	17	107	36	13
Percentage		53.9	30.1	6.4	9.6	3.2	3.2	1.3	10.9	68.6	23.1	8.3

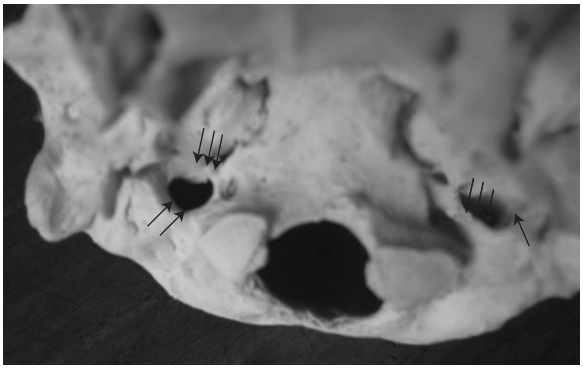

Fig.-1: *The single arrows show the gutter formation, double arrows point the dome formation and triple arrows mark the complete septation of jugular foramen.*

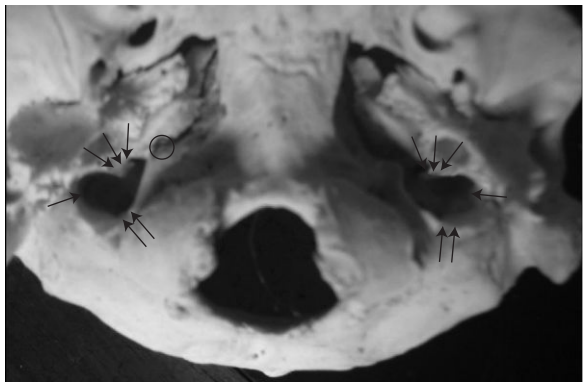

Fig.-2: *On the both side the single arrow points to the gutter formation in the jugular foramen; triple arrow indicates the incomplete septation; and double arrow indicates the formation of dome. On the right side the circle arrow points to the foramen for inferior petrosal sinus.*

Fig.-3: *The above photograph shows the single arrow on the right side jugular foramen pointing to the gutter formation; the triple arrow pointing to the complete septation of the left and incomplete septation of the right jugular foramen; and the double arrow pointing to the dome formation.*

Discussion:

According to Patel (2007) the presence of gutter even in those jugular foramen having had partial dome further suggesting a hypothesis that the size of gutter was inversely proportional to the size of dome for accommodation of superior jugular bulb of internal jugular vein.

Sturrock (1988) stated that 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 side and 23.1% on left side and 8.3% of equal size.

The present study had observed 58.18% larger jugular foramen on right side and 21.82% larger on left side, whereas the right and left jugular foramen were found to be of equal size in 20% cases which is quite a large margin as compared with Patel (2007), Hatiboglu & Anil (1991) and Sturrock (1988).

The dome which is special feature of jugular foramen was present in 38.5% on right side, in 14.3% on left side and in 21% bilaterally, according to Patel (2007). He found the dome to be absent bilaterally in 25.3% of skulls.

Sturrock (1988) found that the dome of jugular foramen was absent bilaterally in 9.6% of skulls. The dome was present in 30.1% on right side, in 6.4% on left side and in 53.9% bilaterally.

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.

Thus there is marked difference between the present study and the studies by Patel (2007), Sturrock

(1988) and Hatiboglu & Anil (1991) with respect to the absence of dome bilaterally. Their studies had found dome to be absent bilaterally in 25.3%, 9.6% and in 10.3% of skulls; whereas the present study had observed bilateral presence of dome in all of skulls.

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 that of the values by Sturrock (1988). Another important observation regarding septation of jugular foramen by Patel (2007) was complete septation in 23.1% on right side and 17.6% on left side of skulls and partial septation in 49.5% on right side and 59.3% on left side. Sturrock (1988) found 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.

Similarly Hatiboglu & Anil (1991) had observed incomplete septation on right side in 2.6% of skulls, on left side in 19.6% and complete septation on right side in 5.6% of skulls and on left side in 4.3% of skulls; which were quite similar with the readings by Sturrock (1988).

In the present study it had been observed that partial (incomplete) septation was in 23.64% of skulls on right side and in 9.09% of skulls on left side, complete septation in 76.36% of skulls on right side and in 90.91% of skulls on left side which differed from other studies.

There was no difference between the observations of Sturrock (1988) and Hatiboglu & Anil (1991), even the explanatory segment of the discussion by Hatiboglu & Anil (1991) was same as that mentioned in the discussion by Sturrock (1988).

Sturrock (1988) described the presence of curved, inverted gutter in those cases where there was absence of domed roof at the site where bony channel had been in contact with internal jugular vein. which was not observed by Hatiboglu & Anil (1991).

Patel (2007) postulates a hypothesis that the presence of size of gutter is inversely proportional with the size of dome to help in accommodating the superior jugular bulb of internal jugular vein.

The percentage of presence of complete and partial septations in the present study was large as compared to the studies by Patel (2007) Sturrock (1988) and Hatiboglu & Anil (1991). The above factor could be related with the size of jugular foramen; where the septations (complete) could be present in smaller sized jugular foramina and considering the various samples of skulls being used by different authors from across the various parts of globe having wide geographical differences; the above mentioned differences are bound to occur.

Hatiboglu & Anil (1991) observed the presence of another foramen which is completely separated by a spicule of bone and which transmits the inferior petrosal sinus in 5.6% of skulls on right and in 4.6% on left, while in the present study it was observed in 5 % only.

Conclusion:

The present study had observed the variations of jugular foramen which were different from the observations by Patel (2007), Sturrock (1988) and Hatiboglu & Anil (1991); because of the following reasons :

-The skulls taken for study by Patel (2007), Sturrock (1988), Hatiboglu & Anil (1991) and present study were from different geographical areas.

- So it needs greater sample size from different geographical areas for details findings of the jugular foramen.

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