



MORPHOLOGICAL AND MORPHOMETRIC STUDY OF JUGULAR FORAMEN IN WESTERN RAJASTHAN POPULATION

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ABSTRACT

Introduction

The jugular foramen (JF) lies at the base of the skull between the occipital bone and the petrous part of the temporal bone. It allows for the passage of important nervous and vascular elements, such as the gloss pharyngeal, vagus and accessory nerves, and the internal jugular vein. Glomeric tumors, schwannomas, metastatic lesions and infiltrating inflammatory processes are associated with this foramen, which can account for injuries of related structures. The jugular foramen is difficult to understand and to access. It is difficult to conceptualize because it varies in shape and size because of its complex irregular shape, its curved course, its formation by two bones and numerous nerves and venous channels that pass through it.

Morphometric measurement is helpful in neurosurgery.

Material and Methods

100 jugular foramina of persons of unknown age and gender were examined in Dr.S.N Medical College, Jodhpur. The morphological characteristics of all investigated jugular foramina were described, measured, and compared, taking into consideration their side. Metric measurements were taken by using **Vernier calipers**. The mean standard deviation and range of each dimension and derived index were compared. Right and left side differences were analyzed.

Result

Jugular foramina were studied for review of its morphology, morphometry and its comparison with previous studies. Different shapes and sizes of jugular foramen were seen. In 65% cases the right foramina were larger than the left, in 25% of cases the left foramina were larger than right and in 10% cases they were equal in size on both sides.

The mean length of the foramen on the right and left were 17.19 ± 3.66 mm and 15.47 ± 3.25 mm; the width measured 6.68 ± 1.99 mm and 5.78 ± 2.07 mm on the right and left respectively; the mean area on the right was 382.22 ± 179.18 mm² and on the left 292.47 ± 147.14 mm².

Conclusion

There was statistical significance between the two sides in the length and area but there was no significant difference between the two sides in the width. There was a positive correlation between length and width on each side. Statistical analysis did show significant positive correlation between the width and length Of the skull and the length of the jugular foramen on both the sides.

Key Words: Skull, Jugular foramen, Anatomy, Morphometry, Neurosurgery.

INTRODUCTION

The jugular foramen of the human skull is a complex bony canal, which transmits vessels and nerves from the posterior cranial fossa through the skull base into the carotid space. It is the most complex of the foramina through which cranial nerves pass and also difficult to access surgically.

Jugular foramen is a large aperture in the base of the skull. It is located behind the carotid canal and is formed by the petrous part of the temporal bone and behind the occipital bone. The 9th, 10th and 11th cranial nerves exit the cranial cavity through jugular foramen.

The jugular foramen is the main route of venous outflow from the skull .Sigmoid sinus continues as internal jugular vein in posterior part of jugular foramen. It is generally said that although the jugular foramen is larger on the right side compared to the left, its size as well as its height and volume vary in different racial groups and sexes.

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. Intracranial and extracranial lesions may affect the jugular foramen in addition to intrinsic abnormalities. Pathological processes affecting jugular foramen include intracranial meningioma, schwannomas, metastatic lesions and infiltrative inflammatory processes from surrounding structures such as middle ear. 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. 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.

MATERIAL AND METHODS

The present study was conducted in the Department of Anatomy, Dr.S.N Medical College, Jodhpur, Rajasthan, India. A total of 100 jugular foramina were examined from 50 dry skulls. The length, width and Area of the jugular foramina were determined. Metric measurements were taken by using Vernier Calipers. The mean standard deviation and range of each dimension and derived index were computed. Right and left side differences are analysed. A comparison was made of the dimension using the Student's t-test. The association between continuous variables was investigated by means of pearson's correlation co-efficient.

RESULTS**Morphology**

The jugular foramen is located between the temporal bone and the occipital bone.

Its intracranial orifice is below the internal auditory meatus and superolateral to the intracranial orifice of the hypoglossal canal. It is situated with its long axis oriented from anteromedial to posterolateral parallel to the petroclivial fissure, being configured around the sigmoid and inferior petrosal sinuses.

One cannot see through the foramen when viewing the skull directly from above or below because of its roof, formed by the lower surface of the petrous temporal bone. It has large oval lateral component, the sigmoid sinus, and a small medial part, termed the petrosal part, which receives the drainage of the sigmoid sinus, and a small medial part, termed the petrosal part, which receives the drainage of the inferior petrosal sinus.

The view of the JF from below reveals the part of the temporal bone forming the dome of the jugular bulb rather than a clear opening. The intrajugular process partly divides the foramen into an anteromedial pars nervosa and a larger posterolateral pars vascularis.



A.External view of Jugular Foramen from the base of the skull.

B.Endocranial view of jugular Foramen

Jugular Foramen DIMENSIONS AND RELATIONS

The mean length of the foramen on the right and left were 17.19 ± 3.66 mm and 15.47 ± 3.25 mm; the width measured 6.68 ± 1.99 mm and 5.78 ± 2.07 mm on the right and left respectively; The mean area on right was 383.22 ± 179.18 mm and on the left 292.47 ± 147.14 mm. The size of the jugular foramina varied on two sides.

Dimensions of the Jugular Foramen

	Rt L	Lt L	Rt W	Lt W	Rt A	Lt A
Mean	17.19	15.47	6.68	5.78	382.22	292.47
SD	3.66	3.25	1.99	2.07	179.18	147.14
Minimum	12	10.6	3	3	126.22	99.85
Maximum	24.3	22	10	10.1	879.2	681.85

Rt L-right length, Lt L-left length, Rt W – Right width, LTW – left width, Rt A-Right area, Lt A - Left area, SD- standard deviation, all measurement in mm

	t-test	p-value	r-value	p-value
Rt L- Lt L	2.482	0.0073	0.9173	.00001
Rt W - Lt W	2.191	0.0154	0.5341	0.00003
Rt A – Lt A	2.737	0.0036	0.674	.00000004
Rt L – Rt W	13.03	<0.00001	0.5836	0.000004
Lt L– Lt W	17.74	<0.00001	0.5005	0.0001

Rt L-right length, Lt L-left length, Rt W – Right width, LTW – left width, Rt A-Right area, Lt A - Left area, r- pearson correlation coefficient. $P < 0.05$

		Rt L	Lt L	Rt W	Lt W	Rt A	Lt A
Rt L	r		0.9173	0.5836	0.497	0.834	0.743
	p		0.00001	0.000004	0.00012	<0.00001	<0.00001
Lt L	r	0.9173		0.499	0.5005	0.700	0.791
	p	0.00001		0.0001	0.0001	0.00000001	<0.00001
Rt W	r	0.5836	0.499		0.5341	0.854	0.573
	p	0.000004	0.0001		0.00003	<0.00001	0.00000684
Lt W	r	0.497	0.5005	0.5341		0.536	0.910
	p	0.00012	0.0001	0.00003		0.00003	<0.00001
Rt A	r	0.834	0.700	0.854	0.536		0.674
	p	<0.00001	0.00000001	<0.00001	0.00003		0.00000004
Lt A	r	0.743	0.791	0.573	0.910	0.674	
	p	<0.00001	<0.00001	0.00000684	<0.00001	0.00000004	

Rt L – right length, Lt L- left length, Rt W – right width, Lt W – left width, Rt A- right area, Lt A – left area , r –

Pearson correlation coefficient, $p < 0.05$.

DISCUSSION

The size and shape of jugular foramen is obviously related to the size of internal jugular vein and the presence or absence of a prominent superior bulb. The right foramen is usually larger than the left.

There is a very wide variation in the anatomy of the intracranial venous sinuses which accounts for variation in size and shape of jugular foramen. In the present study the mean length of the foramen on the right and left were 17.19 ± 3.66 mm and 15.47 ± 3.25 mm; the width measured 6.68 ± 1.99 mm and 5.78 ± 2.07 mm on the right and left respectively;

The mean area on right was 383.22 ± 179.18 mm and on the left 292.47 ± 147.14 mm.

The size of the jugular foramina varied on two sides.

In the study of Roma Patel and C.D.Mehta, the mean transverse diameter of jugular foramen on the right and left were 12.17 mm (range; 4.5-16.5mm) and 11mm (range: 5-16mm) Respectively, while their sagittal diameter measured 7.9 mm (range; 3-12.5 mm) and 6.2 mm (range: 3-12.5mm) and 6.2 mm (range: 3-12.5mm) On the right and left respectively.

Both diameters are more on right side. 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 (11.6-17.0mm) and 14.11 mm (9.2-20.2mm) 10.22mm (6.8-14.4mm) and 9.57mm (7.4-12.8mm) on the right and left respectively .According to study done on turks skull by Ekinici and Unur, the sagittal and transverse diameters of the left jugular foramen were 7.6 and 15.5mm, respectively.

Pereira ,GAM studied total 111 skulls and it was noticed that mean transverse diameter was 15.82 mm on right side and 15.86 mm on left side; mean sagittal diameter was 9.21mm on right side and 8.65mm on left side respectively. According to study done on turks skull by Ekinici and Unur, the sagittal and transverse diameters of the left jugular foramen were 7.6 and 15.5 mm, respectively, and on the right 8.4mm and 16 mm, respectively. 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. In study of Hussain Saheb et al, it was found that the mean length of jugular foramen on the right and left were 23.62mm and 22.86mm, while their widths measured 7.83mm

and 6.83mm respectively. The mean area on the right was 584.36mm and on the left was 493.30mm. predominance of one of the two foramina appeared in 89.6% of cases. Predominance on the right was 64.8% and 24.8% on the left.10.4% cases were equal on both sides.

CONCLUSION

The present study observed variation in the size of jugular foramen sizes. The foramen is larger on the right than the left in Indian population. The morphometric sizes of jugular foramen may help neurosurgeons in their clinical practice.

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