

## ORIGINAL ARTICLE

# THE PREVALENCE AND MORPHOLOGY OF INTERNAL JUGULAR VENOUS VALVES

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## ABSTRACT

**Background:** Catheterization of the internal jugular vein (IJV) is common and used for several clinical procedures. Internal jugular venous valves are the only barrier between the heart and the brain. The presence and structure of these valves is variously described in the literature. The purpose of the current study was to explore the presence of IJV valves, their location and structure.

**Methods:** Observations for the unilateral or bilateral presence or absence, exact location and number of cusps of the IJV valves were recorded by dissection on 62 formalin-fixed adult male and female cadavers.

**Results:** IJV valves were found in 76.62% subjects. Most common of these valves were bicuspid (68.54%) while the least common were the tricuspid valves (0.80%). Unicuspid valves (collectively 7.25 %) were more common on the right side in the male while the same was true for the females on the left side. Only one tricuspid valve was observed on the right side in a female. Valves were mostly inferior to the clavicle (54.73 %) followed by posterior (38.94 %) while the least common position was superior (6.31 %). In the male the commonest location was inferior to the clavicle (70.00 %) followed by posterior (28.33%) while in the female the more common location was posterior (57.14%) followed by inferior (28.57%); the difference was significant. Superior position in the male was the least common (01.66%) while being relatively more common in the female (14.28%); the gender difference was statistically significant.

**Conclusion:** The prevalence of internal jugular venous valves, their types and location are variable and probably reflect a genetic and racial attribute

**KEY WORDS:** Internal jugular vein, valves, morphology, anatomy, cannulation, catheterization

## INTRODUCTION

Catheterization of the internal jugular vein (IJV) is common and an everyday procedure to obtain central venous access not only for hemodynamic monitoring but also for the administration of fluids, nutrition, drugs and hemodialysis<sup>1</sup>. The jugular venous system provides not only intracranial but also a collateral communication across midline of the neck due to its interconnections to deep jugular and subclavian veins. This region is especially important in cases of unilateral occlusion of the brachiocephalic vein<sup>2</sup>.

Harvey (1578 – 1657) and his teacher were well aware of the presence of valves in the IJV and produced some excellent drawings of the same, in fact Harvey wrote in 1628 that, "the edges of the valves in the jugular veins hang downwards, and are so contrived that they prevent blood from rising upwards"<sup>3</sup>. Interestingly the IJV valves are the only barrier between the heart and the brain. Incompetence of these valves may therefore lead to increased intracranial pressure<sup>4</sup>. This fact has recently been realized and described as chronic cerebrospinal venous insufficiency (CCSVI) characterized by multiple areas of venous stenosis of the IJV and the azygos veins in patients with multiple sclerosis.<sup>5,6</sup>

Questions have been raised whether the incompetence of IJV valves and consequent venous engorgement could

possibly play a central role in several neurological disorders. Reliable information therefore is germane to the diagnostician and clinician working in this area. In the wake of inconsistent and even conflicting data presented by various authors<sup>7, 8</sup> the current study was planned to explore the prevalence of IJV valves, their types, location and position.

## METHODS

The study was conducted on 62 embalmed and formalin-fixed cadavers (40 males and 22 females). The age range was from 46 to 74 years. Approval by the ethical committee of the faculty was obtained prior to the initiation of the study. Data on the unilateral or bilateral presence or absence, exact location and number of cusps of the IJV valves was recorded by dissection on cadavers during the regular course of dissection sessions for students. It was checked from the record that the subjects had had no history of cerebrovascular disorders, pulmonary disease or right heart failure, neurological disease, any trauma to the region or had undergone any operative procedure in the area of observation. Observations as to the presence or absence of the valves, their location with reference to the clavicle and the distance from the bifurcation of the IJV as it joins the brachiocephalic trunk and the number of cusps was recorded. All

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measurements were taken to the nearest millimeter using sliding digital Verniercalipers (Mitutoyo America Corporation, USA). The data was organized and statistically analyzed; comparisons were made for significance at  $p \leq 0.05$ .

**RESULTS**

Internal jugular veins in both male and female subjects and on the right and left sides had valves in 76.62%. Most common of these valves were bicuspid (68.54%) while the

least common were the tricuspid valves (0.80%). Unicuspid valves (collectively 7.25 %) were more common on the right side in the male while the same was true for females on the left side. Only one tricuspid valve was observed on the right side in a female (Table 1).

With reference to clavicle collectively the position of valves was mostly inferior (54.73 %) followed by posterior (38.94 %) while the least common position was superior (6.31 %). In the male the commonest location was inferior to the clavicle (70.00 %) followed by posterior (28.3

**Table 1: The presence and number of cups in the IJV valves**

Male (n=40)								Female (n=22)							
Right side				Left side				Right side				Left side			
None	Uni	Bi	Tri	None	Uni	Bi	Tri	None	Uni	Bi	Tri	None	Uni	Bi	Tri
11	04	25	0	9	3	2	0	4	0	17	1*	5	2*	15	0
27.50 %	10.00 %	62.50 %	0	22.50 %	7.50 %	70 %	0	18.18 %	00%	77.27 %	4.55 %	22.72 %	9.09 %	68.18 %	00 %
None				Unicuspid				Bicuspid				Tricuspid			
29				9				85				1			
23.38%				7.25%				68.54				0.80%			

\*significant at  $p < 0.05$  (comparisons were made between the right and left sides of each group)

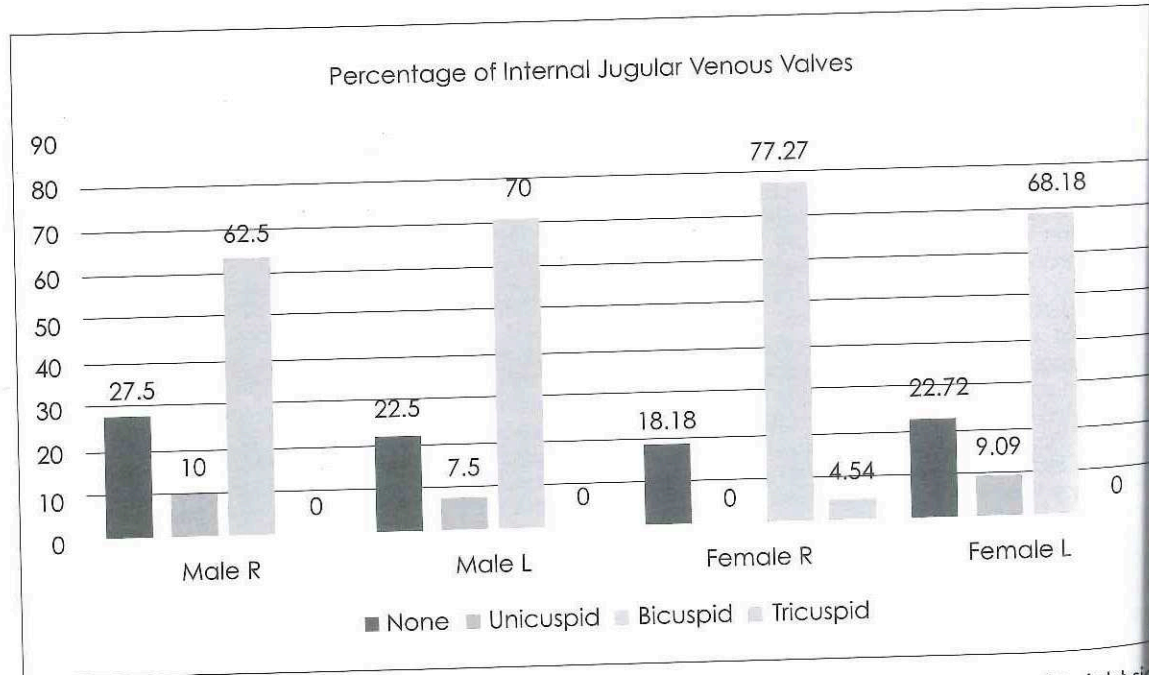


Figure 1: Showing the prevalance of internal jugular venous valves in maes and females (R: right side L: left side)

**Table 2: Location of the IJV valves when present with reference to the clavicle**

Male (n=60)						Female (n=35)					
(n=22) Right side			Left side (n=38)			Right side (n=14)			Left side (n=21)		
Superior	Posterior	Inferior	Superior	Posterior	Inferior	Superior	Posterior	Inferior	Superior	Posterior	Inferior
1	5	16*	0	12	26*	3*	8*	3	2	12	7
4.54%	22.72%	72.7%	00%	31.57%	68.4%	21.42%	57.14%	21.4%	9.52%	57.14%	33.33%
Male( Combined on both sides) n=60						Female( Combined on both sides) n=35					
Superior		Posterior		Inferior		Superior		Posterior		Inferior	
1		17		42		5*		20*		10*	
01.66%		28.33%		70.00%		14.28%		57.14%		28.57%	
Total(n= 95)											
Superior				Posterior				Inferior			
6				37				52			
6.31%				38.94%				54.73%			

\*significant at p< 0.05

**Table 3: Distance (mean ± S.E.) of the IJV valve when present from the bifurcation (in cm.)**

Male (n= 60)		Female (n= 35)	
Right side (n=30)	Left side (n=30)	Right side (n=30)	Left side (n=30)
2.6 ± 0.32 cm*	1.1 ± 0.29 cm	2.3 ± 0.41* cm	1.9 ± 0.23 cm

\*significant at p<0.05 (values compared between the right and left sides in the same group)

while in the female the more common location was posterior (57.14%) followed by inferior (28.57%); the difference was significant. Superior position in the male was the least common (01.66%) while being relatively more common in the female (14.28%); the gender difference was statistically significant. (Table 2)

**DISCUSSION**

The presence of IJV alves is common knowledge since classical anatomical dissections. However, there is conflicting data concerning their type and prevalence. Therefore most authors ended up regarding these as embryological residues and underestimated their hemodynamic role<sup>9</sup>. More recent studies using IJV catheterization and Echo-Doppler on the contrary found that most valves were competent and functional implying that a malfunction could possibly have a role in cerebral air embolism, pulmonary hypertension and transient global amnesia<sup>10,11</sup>.

In our study of sixty two male and female adult cadavers we found that most IJVs (66.77%) had valves which were mostly located inferior (54.73 %) and posterior (38.94 %) to the clavicle in both male and female. Furukawa et al<sup>12</sup> in their cadaveric observations have described the incidence of IJV valves as 96.7% in their study. Similarly Valecchiet al<sup>9</sup> using echo-color-Doppler echography has reported the presence of valves in 88% of cases. An incidence close to 90% has been reported in older works by Harmon and Edwards<sup>13</sup> and Anderhuber<sup>14</sup>. These studies were carried out on subjects of Caucasian<sup>9,13,14</sup> or Japanese<sup>12</sup> origin. Our observations in this context are

different and much lower from these workers raising the question whether genetic and racial attributes could be considered as the possible factors.

The valves were largely bicuspid (68.54 %) some being unicuspid (7.25 %) while tricuspid (0.80 %) were the least common type (in fact we found only one tricuspid valve in a female on the right side). The location of the valves when present was on an average 2-1.5 cm before the bifurcation. These observations are generally in agreement with previous workers<sup>9, 12-14</sup>.

Whereas Valecchi<sup>9</sup> in her color-Doppler echography study described the average location of the valves at 2.8 cm from the jugular-subclavian junction we found the distance to be close to but significantly different between the two sides of the male subjects.

**CONCLUSION**

Despite their undeniable clinical importance the prevalence of internal jugular venous valves, their types and location are variable and probably reflect a genetic and racial attribute. Further studies with a larger sample are therefore suggested in this direction.

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