



Sri Lankan study on morphology of the Azygos Venous System; A preliminary study

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Abstract

The anatomical description of the azygos venous system is well known and its abnormalities are often reported. However, to the best of our knowledge there were no studies have been performed to find out variable patterns of the azygos venous system in Sri Lankan population. This knowledge is important in clinical practice as some of the anatomical variants have significant clinical implications for computed tomography image assessment and mediastinal surgery. Therefore, we decided to embark on a preliminary research study on the azygos venous system using thirteen cadavers. This study was aimed to find out common variations of the azygos venous system in Sri Lankan population. The most of the variants found in this particular study were described in standard textbooks. However, this study shows the azygos vein takes different positions in relation to the vertebral bodies in its course in the posterior mediastinum. There were variations even at the origin and termination of the vein. The knowledge on the course and variation of the azygos system in the posterior mediastinum is essential for surgeries and clinical imaging. Therefore, further evaluation of this subject is very essential.

Keywords: morphology, azygosvein, Sri Lanka

Introduction

The posterior thoracic wall, an area drained by the azygos venous system, is a common site for surgical intervention. The anatomical description of the azygos venous system is well known and is available in any standard anatomy textbooks. However, exact position of the vein in the posterior mediastinum is not properly sited. Some describe it is on the right side of the vertebral bodies¹. Others mention the vein is on the vertebral bodies^{2,3}. Some may tend to imagine it is on the right side of the vertebral bodies, as it originates at right side form the Inferior Vena Cava (IVC) and end on the right side in the Superior Vena Cava (SVC). According to our knowledge, there are no quantitative measurements done in our population to say exact position of the vein. On the other hand, there are multiple abnormal patterns of this system sited in literature^{4,5}. Despite of this the azygos vein is used for some interventional vascular procedures e.g. endocardial pacing⁵. Because of the above reasons, we assume that it is important to research on this particular topic. Therefore, we decided to embark on a preliminary research project on this subject to evaluate

its variations. The data is useful in operative surgery and clinical imaging such as computerizes tomography scanning.

Material and Methods

Thirteen cadavers from the department of Anatomy, Faculty of medicine, Karapitiya were used for the study. The azygos venous system was dissected in all these cadavers in the thorax and the abdomen. The origin of the azygos vein and its drainage on to the SVC was noted. The different patterns of the venous system were observed. Following measurements were made using calipers, scaled in millimeters. The measurements were obtained without mobilizing the vein or its tributaries. All the cadavers have been placed in supine position. The parameters that were studied of the azygos vein include;

1. Level of origin
2. Deviation from the midline (Position of the vein at - T₁₂, T₉, T₆)
3. Tributaries

4. Vertebral level at which azygos vein joins the SVC
5. Total length
6. The height of the subject
(T = thoracic vertebra)

Results

Table 1. Level of origin of the azygos vein

Level of origin	Number of veins
T ₁₁	2 (15%)
T ₁₂	9 (70%)
L ₁	2 (15%)

Table 2. Deviation of the azygos vein from the midline (Position of the vein at - T₁₂, T₉, T₆)

Cadaver number	Deviation from midline at;		
	T ₁₂	T ₉	T ₆
1	5mm - R	2mm - R	3mm - R
2	6mm - R	3mm - R	5mm - R
3	3mm - R	5mm - L	1mm - R
4	7mm - R	6mm - L	5mm - L
5	8mm - L	3mm - L	5mm - R
6	12mm - L	9mm - L	10mm - L
7	4mm - R	7mm - L	Midline
8	8mm - L	midline	4mm - R
9	9mm - L	6mm - L	3mm - R
10	8mm - R	4mm - R	4mm - R
11	Midline	4mm - L	3mm - R
12	Midline	Midline	Midline
13	Midline	3mm - L	9mm - R

(5mm-R = the vein is deviated to 5mm to the right from the midline)

(Midline = No deviation)

Tributaries

The following patterns (Figure 1 and 2) were identified in the study

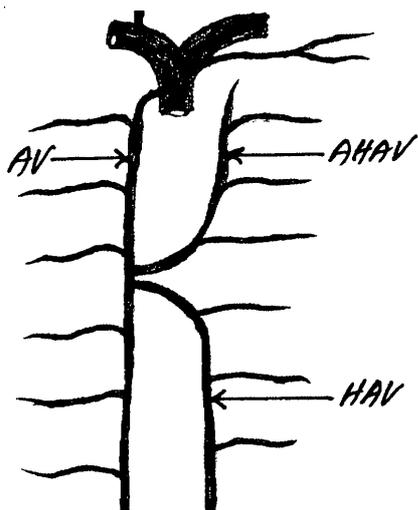


Figure 1. Separate accessory hemiazygos (AHAV) drain into azygos vein (AV), separate hemiazygos vein (HAV) drain to azygos vein. (7%)

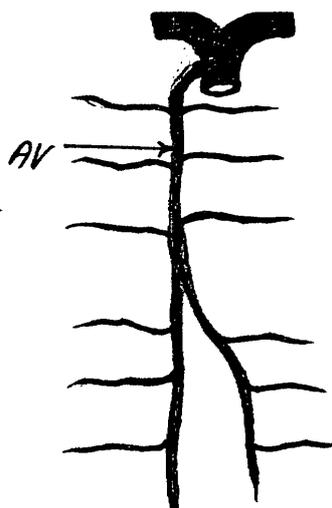


Figure 2. No accessory hemiazygos vein, hemiazygos drains to azygos vein separately. (15%)

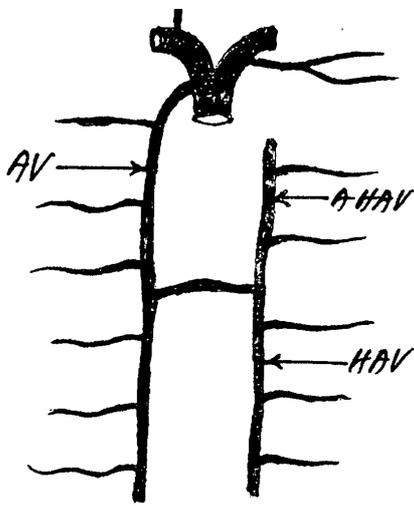


Figure 3. Accessory hemiazygos vein and the hemiazygos vein join and drain via common route. (23%).

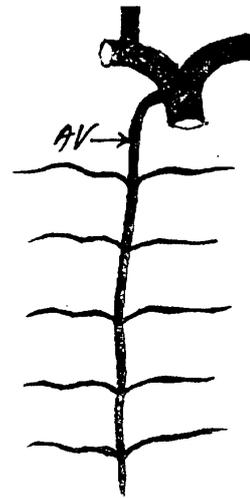


Figure 4. Azygos vein formed by multiple tributaries, No hemiazygos vein or an accessory hemiazygos vein (15%).

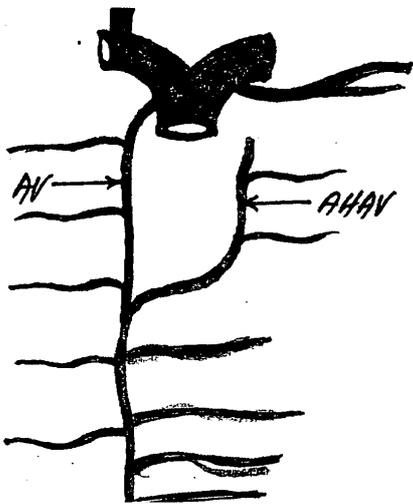


Figure 5. Accessory hemiazygos vein drain separately and no hemiazygos vein. Separate posterior intercostal veins drain to azygos vein (15%).

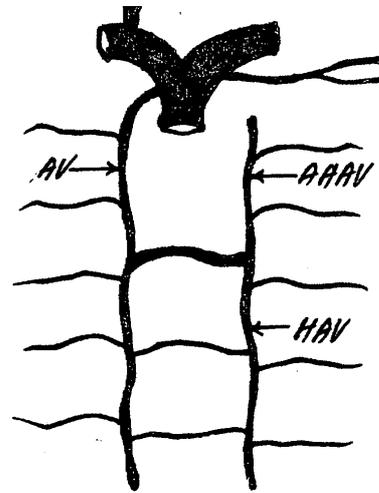


Figure 6. Hemiazygos and accessory hemiazygos veins join and drain via a common route, hemiazygos vein also have multiple routes. (15%).

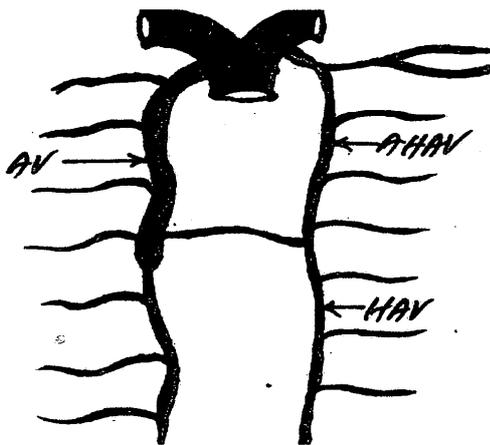


Figure 7. Accessory hemiazygos vein and hemiazygos veins join and drain to the left brachiocephalic vein via left superior intercostals vein. The lower half of the azygos vein is smaller than hemiazygos vein. (7%).

Vertebral level at which azygos vein joins the SVC

Vertebral level joined the SVC	Number of veins
T ₃	5 (38%)
T ₄	5 (38%)
T ₅	3 (24%)

Discussion

There are different patterns of arrangement of the azygos venous system⁷. An origin from the posterior aspect of the inferior vena cava at or below the level of the renal vein is to be expected from its development but it is not constant⁷. In this study, we found only two out of thirteen veins originated at the level of the renal veins (L₁).

Total length the vein vs. the height of the subject

Table 4.

Cadaver number	Length of azygos	Height
1	19.4cm	138 cm
2	17.7 cm	167cm
3	19.4cm	153cm
4	18.1cm	162cm
5	13.8cm	143cm
6	20.0cm	166cm
7	17.1cm	158cm
8	18.2cm	143.5cm
9	18.5cm	168cm
10	20.4cm	165.5cm
11	17.1cm	152cm
12	20.5cm	149cm
13	20.5cm	171cm

Other veins originated just above that level (at T₁₁ or T₁₂) by joining the ascending lumbar vein and subcostal veins. Similarly level of the veins joining the SVC also varies. It is stated T₄ level as the usual level of joining with SVC arching forward above the right pulmonary hilum^{3,6}. But there were only five veins joining the SVC at this level in this series. The other levels were T₃ (five veins) and T₅ (three veins). The length of the vein also was variable. This is mainly influenced by the level of origin and the end of the veins. There was no direct correlation between the height of the person and the length of the vein. So it varies much in its mode of origin and termination. Not only that but also we found that there are several variations in its course, tributaries and anastomoses.

The commonest arrangement of the system include draining of the accessory hemiazygos and hemiazygos veins separately in to the azygos vein⁷ (Fig.1). However, we observed this pattern only in one subject. In fact we found seven variable patterns. The commonest pattern was to form a common tract by joining the azygos and hemiazygos veins before joining the azygos vein (3/13) (Fig. 3). In one subject there were two complete venous channels (Fig.7). One formed by the azygos veins on the right side, the other by joining the hemiazygos, accessory hemiazygos and left superior intercostal vein on the left side. The latter channel drained to the left brachiocephalic vein. This variation is seen in 1-2% of subjects⁶.

Even though the vein ascends anterior to the thoracic vertebral bodies it can be deviated to the left or right from the midline. In our series we observed three

veins position on the right side of the vertebral bodies on its whole length. However there was one vein that ascends on the left side of the vertebral body and another that ascends on the middle of the vertebral bodies without deviation. All the other subjects the vein was deviated to left either at its lower part or at the middle. Commonly the deviation was to the left in the middle of its course. This left deviation is stated in some literature⁷ while some stated that the vein ascends on the right side of the vertebral bodies⁸. Our findings were not in agreement with the latter.

There have been very rare but clinically important variations reported^{4,7}. Left tributaries of the azygos vein passing anterior to the thoracic aorta and anomalous inferior vena cava with azygos continuations are such rare anomalies. The first anomaly mimics enlarge para-aortic lymph nodes in computerized tomography in the chest and cause misinterpretation while the latter one is reported to be associated with a case of acute thromboembolism⁷.

Finally we would like to state that azygos venous system is highly variable. There are no exactly similar arrangements. It is interesting to evaluate further on this subject firstly to find the common arrangements of this system in Sri Lankan subjects and secondly because some of the anatomical variants have significant clinical implications for computed tomography image assessment and mediastinal surgery.

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