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Anatomical Study on Course of the Azygos Vein: Descriptive Study

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ABSTRACT
Azygos systems of veins are not accompanied with the corresponding arteries. The azygos system communicate with the caval system infront and with the vertebral venous plexus behind. Then the formation and level of the formation of the azygos vein was noted. The compressed diameter of the trunk of the azygos vein was measured close to its formation and termination by sliding callipers. The level of the azygos arch was observed and noted. The course of the azygos vein was observed with reference to midline of the vertebral column and the level of inferior and superior crossing of the azygos vein with reference to the thoracic vertebral level was noted. The level of termination of the hemiazygos vein and accessory hemiazygos vein were noted for each specimen. The azygos vein, after beginning on the right side of the vertebral column ran upwards and to the left to cross the midline, having ascended a variable distance on the left side of the vertebral column, it returned to the right side, thus crossing the midline again to reach its normal termination in the superior vena cava. Thus the azygos vein crosses the midline twice showing inferior and superior crossing.

INTRODUCTION

Azygos system consists of two longitudinal venous channels, one on each side of the vertebral column. These channels receive the intersegemental veins of the body wall and are interconnected with each other across the vertebrae at the irregular intervals. The longitudinal channel on the right is a continuous vessel called azygos vein[1]. On the left, the channel usually consists of two veins: hemiazygos vein inferiorly and the accessory hemiazygos vein superiorly. These two veins on the left are interconnected with one another, and both empty independently into the azygos vein through one or more transverse connecting veins[2].

Azygos systems of veins are not accompanied with the corresponding arteries. The azygos system communicate with the caval system infront and with the vertebral venous plexus behind[3].

The azygos vein (Gr. *azygos=unpaired*) typically starts from the posterior aspect of the inferior vena cava, at or below the level of the renal veins, although the origin is not constant, when present, the lumbar azygos ascends anterior to the upper lumbar vertebrae[4]. It may pass behind the right crus of the diaphragm or pierce it, or it may traverse the aortic hiatus to the right of the cisterna chyli. Anterior to the twelfth thoracic vertebral body, the azygos is joined by a large vessel formed by the right ascending lumbar and subcostal veins that passes forward and to the right of the twelfth thoracic vertebra behind the right crus: in the absence of a lumbar azygos, this common trunk may form the azygos vein itself. Whatever its origin, the azygos vein ascends in the posterior mediastinum to the level of the fourth thoracic vertebra, where it arches forward above the right pulmonary hilum. It ends in the superior vena cava, before the latter pierces the pericardium. The azygos lies anterior to the bodies of the lower eight thoracic vertebrae, anterior longitudinal ligament and right posterior intercostal arteries. The azygos vein lies close to the right posterolateral aspect of the descending aorta; aortic pulsations may assist venous return in the azygos and hemiazygos veins[5,6].

MATERIALS AND METHODS

The Morphology of the Azygos vein was studied in 50 embalmed human cadavers irrespective of their sex. The specimens were obtained from the Department of Anatomy of medical colleges situated in and around Bangalore. Following the guidelines of Cunningham's manual of practical anatomy, volume two, thorax and abdomen, Volume two, Thorax and Abdomen fifteen edition. Anterior thoracic wall was dissected, the lungs and heart were removed. In the cavity of the thorax, the posterior intercostal veins were exposed. The Right posterior intercostal veins were followed to trace the azygos vein. The Hemiazygos vein and accessory hemiazygos vein were traced by following the course of left posterior intercostal veins.

Then the formation and level of the formation of the azygos vein was noted. The compressed diameter of the trunk of the azygos vein was measured close to its formation and termination by sliding callipers. The level of the azygos arch was observed and noted. The course of the azygos vein was observed with reference to midline of the vertebral column and the level of inferior and superior crossing of the azygos vein with reference to the thoracic vertebral level was noted. The level of termination of the hemiazygos vein and accessory hemiazygos vein were noted for each specimen. After observation, the moisture over the vein and nearby areas was removed with filter paper. All the specimens were duly numbered and photographed. The mean, standard deviation and chi's square test was calculated for the compressed diameter at the formation and termination of the azygos vein. The data obtained was recorded, analyzed and compared with that of previous studies.

RESULTS AND DISCUSSIONS

The azygos vein, after beginning on the right side of the vertebral column (RSV) ran upwards and to the left to cross the midline, having ascended a variable distance on the left side of the vertebral column, it returned to the right side, thus crossing the midline again to reach its normal termination in the superior vena cava. Thus the azygos vein crosses the midline twice showing inferior and superior crossing. The table 1 shows the various courses of the azygos vein with relation to the vertebral column.

Table 1: Showing the course of the azygos vein.

Course of the azygos vein with reference to vertebral column	Number	(%)
Only on RSV	01	02
From RSV to MLV and retain in MLV	12	24
From RSV to MLV-LSV	13	26
From RSV to MLV-LSV-MLV	03	06
From RSV to MLV-RSV	09	18
From RSV to MLV-LSV-RSV	12	24
Total	50	100

RSV-Right Side of Vertebral column, LSV-Left Side of Vertebral Column, MLV-Right Side of Vertebral Column: In 1 specimen (2%) the azygos vein was lying on right side of vertebral column without crossing the midline. In 13 specimens (26%), the azygos vein was coursing from right side to midline and to left side of vertebral column and terminated into superior vena cava. The azygos vein crossed the midline and ascended in the midline in 12 specimens (24%). Thus the azygos vein did not cross the vertebral column in 1 specimen (2%), crossed once in 25 specimens (50%), crossed twice in 24 specimens (48%). The level of first crossing of the azygos vein was observed in 49

specimens as in one specimen, the azygos vein was lying on the right side only.

Table 2: Showing the level of first crossing of the azygos vein.

Level	No.	(%)
T12	09	18.36
IVD of T11 and T12	02	4.08
T11	16	32.65
IVD of T10 and T11	06	12.24
T10	09	18.36
IVD of T9 and T10	01	2.04
T9	02	4.08
IVD of T8 and T9	02	4.08
T8	02	4.08
Total	49	100

16 specimens (32.65%) showed first crossing of the azygos vein at T_{11} level, 9 specimens (18.36%) showed first crossing of the azygos vein at T_{12} and T_{10} level. The azygos vein crossed the midline second time in 24 specimens and the level was noted and tabulated below.

Table 3: Showing the level of second crossing of the azygos vein.

`Level	No.	(%)
T5	07	29.16
T6	09	37.50
T7	08	33.33
Total	24	100

In 7 specimens (29.16%), showed second crossing level was at T_5, in 9 specimens (37.5%) was at the level of T_6, 8 specimens (33.33%) was at the level of T_7. Hemiazygos and accessory hemiazygos veins are main the tributaries of the azygos vein.

Table 4: Showing the main tributaries of the azygos vein (Hazv and Ahazv).

Tributaries	No.	(%)
Presence of both Hazv and AHazv	30	60
Presence of Only Hazv	03	06
Presence of Only AHazv	10	20
Absence of both Hazv and AHazv	07	14
Total	50	100

Majority of specimens showed the presence of both hemiazygos and accessory hemiazygos veins which was observed in 30 specimens (60%), absence of both hemiazygos and accessory hemiaccessory vein was observed in 7 specimens (14%). In 33 specimens (66%), the hemiazyos vein was present and accessory hemiazyos vein in 40 specimens (40%).

Table 5: Showing the level of termination of the Hemiazygos vein into the azygos vein.

Level	No.	(%)
T^{10}	01	3.0
T^{9}	16	48.5
T^{8}	14	42.42
T^{7}	02	6.0
Total	33	100

The level of termination of the Hemiazygos vein was absent in 17 specimens, terminated at T_9 level in 16 specimens (48.5%), terminated at T_8 level in 14 specimens (42.42%), terminated at T_{10} level in 1 specimen (3%) and terminated at T_7 level in 2 specimens (6%). The below table shows the levels of termination of the Accessory hemiazygos vein into the azygos vein.

Table 6: Showing the level of termination of the Accessory hemiazygos vein into the azygos vein.

Level	No.	(%)
T^{9}	02	5
T^{8}	08	20
T^{7}	22	55
T^{6}	08	20
Total	40	100

The level of termination of the accessory hemiazygos vein was absent in 10 specimens (20%), terminated at T7 level in 22 specimens (55%). terminated at T_8 level in 8 specimens (20%). terminated at T_9 level in 2 specimens (5%) and terminated at T_6 level in 8 specimens (20%). In the thorax, the azygos ascends along the right side of the vertebral column[12]. The following table shows the comparison of the course of the azygos vein in the present study with earlier studies.

Table 7: Showing the comparison of the course of the azygos vein in adults found in earlier studies with that of the present study.

Author		Only on Right %	Reaching Midline %	Crossing to Left %
Nathan H (1960)[7]	Adults	20	27	53
Kagami (1989)[8]	Adults	4	11	85
Present study (2013)	Adults	2	42	56

From above table, shows that in Nathan H study, in 20% of adult cadavers, the azygos vein was on the right, 27% reached the midline and 53% crossed to the left. In Kagami study, in 4% of adult cadavers, the azygos vein was on the right, 11% reached the midline and 85% crossed to the left. In the present study 2% were coursing on the right, 42% reached the midline and 56% crossed to the left In the present study, the azygos vein coursed to the left of the vertebral column in 28 specimens (56%), out of 28 specimens, 13 specimens (26%) showed course of the azygos vein ascending on the right side of vertebral column then to midline of vertebral column and then to left side of vertebral column and terminated into superior vena cava. Coursing of the azygos vein to the left may be due to the asymmetrical development of osteophytes in the vertebral column. The development of the osteophytes along the vertebral column with advancing age is due the mechanical stresses and strain acting on the vertebral column. The development of osteophytes is asymmetrical in the thoracic region may be due to an inhibitory influence on the development of osteophytes by the aorta which is along the left side of the vertebral column. In the lower thoracic and lumbar regions the aorta lies in midline, so the osteophytes develop symmetrical on both sides. Thus the

asymmetrical development of vertebral bodies seems to cause the deviation of the azygos vein by pushing it to the left. Knowledge of the displacement of the vein might be of importance with the development of new techniques and the increasing use of azygography as a diagnostic procedure. The fact that a displacement of the vein is considered to be a radiological sign of pathological processes in the thorax, such as mediastinal tumours, left atrial enlargement and pulmonary ateclectasis, obliges one to bear in mind the frequency with which the azygos vein may be found displaced in the absence of any of these pathological conditions[7].

A Level of Crossings of the Azygos vein with Respect to the Midline of the Vertebral Column: During the course of the azygos vein has a wide longitudinal arch convex to the left and twice crossing the midline[7].

B Level of first Crossing of the Azygos vein: In Nathan H study the first crossing was most frequently found at the level of the T_8, varying from the T_8-T_{11}. In present study, out of 50 specimens, in 49 specimens, the vein crossed the midline. The first crossing was at the level of the T_{11}, in majority of 16 specimens (32.65%), the level of crossing varied from the T_{12}-T_8.

C Level of second Crossing of the Azygos vein: According Nathan H, the second crossing was generally observed at the level of the T_6-T_7 at the level of the T_6 varying from the T_5-T_8. In the present study, second crossing of the azygos vein was noted in 24 specimens out of 49 specimens, the second crossing is most frequently found at the level of the T_6, observed in 9 specimens (37.50%), in remaining 15 specimens the level was varying from the T_5-T_7.

CONCLUSION

The variations of the course of the azygos vein in relation to the midline are described. In 1 specimen (2%) azygos vein was coursing only on the right side of the vertebral column without crossing the midline. In 13 specimens (26%), the azygos vein was coursing from right side to midline and to left side of vertebral column and terminated into superior vena cava.

The azygos vein crossed the midline and ascended in the midline in 12 specimens (24%). Thus the azygos vein did not cross the vertebral column in 1 specimen (2%), crossed once in 25 specimens (50%), crossed twice in 24 specimens (48%). 16 specimens (32.65%) showed first crossing of the azygos vein at T_{11} the level, 9 specimens (18.36%) showed first crossing of the azygos vein at T_{12} and T_{10} the level.

REFERENCES

1. Hollinshead, H.W. and C. Rosse, 1985. Text Book of Anatomy. In: Text Book of Anatomy., Hollinshead, H.W. and C. Rosse, (Eds.)., Harper and Row, Philadelphia, ISBN-14: 978-0443026720, pp: 570-572.
2. Romanes, G.J., 1986. Cunningham's Manual of Practical Anatomy. 15th Edn., Churchill Livingstone,, London, ISBN-13: 9780192631404, Pages: 75.
3. Özbek, A., C. Dalçik, T. Çolak and H. Dalçik, 1999. Multiple variations of the azygos venous system. Surg. Radiol. Anat., 21: 83-85.
4. Ernest, G. and J.G.R. Donald, 1975. Anatomy, A Regional Study of Human Structure. In: Anatomy, A Regional Study of Human Structure., Ernest, G. and J.G.R. Donald, (Eds.)., W B Saunders company,, Philadelphia, ISBN-14: 978-0721640181, pp: 327-328.
5. Woodburne, R.T., 1961. Essentials of Human Anatomy. In: Essentials of Human Anatomy, Woodburne, R.T., (Ed.)., Oxford: University press, Walton Street, Oxford, ISBN-14: 978-0195077278, pp: 356-357.
6. Seib, G.A., 1934. The azygos system of veins in American whites and American negroes, including observations on the inferior caval venous system. Am. J. Phys. Anth., 72: 147-148.
7. Kagami, H. and H. Sakai, 1990. The problems in the arrangement of the azygos vein. Okaj Folia Anat Jap., 67: 111-114.
8. Nathan, H., 1960. Anatomical observations on the course of the azygos vein (vena azygos major). Thorax, 15: 229-232.