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Original Research Article

VARIATIONS IN FORMATION AND TERMINATION OF AZYGOS VEIN IN SOUTH INDIAN POPULATION

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ABSTRACT

Objectives: To study the variations in formation, termination and its level of azygos vein in embalmed human cadavers.

Materials and Methods: The present study sample comprised of thorax of 50 embalmed human cadavers irrespective of their sex and age. The specimens were studied by dissection method at the Department of Anatomy, KIMS Bengaluru and other medical colleges in around the Bengaluru.The parameters were noted meticulously and the data processed.

Results: Out of 50 specimens studied, in 42 specimens (84%) azygos vein formed only by lateral root, by 2 roots in 5 specimens (10%). All the three roots, the lateral, intermediate and medial roots together formed the azygos vein in 3 specimens (6%).In all the specimens the azygos vein was terminating into superior vena cava. Formation of azygos vein was at the lower border of T12 in 28 specimens (56%) and termination was at the upper border of T5 in 43 specimens (86%).

Conclusion: The result of the study showed the variations in the formation of azygos vein and its level of formation and termination. The variation has been discussed in detail and this knowledge forms the basis for surgical and other radiological procedures in the posterior mediastinum.

KEY WORDS: Azygos vein, Formation, Termination, Levels, Radiological procedures.

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INTRODUCTION

Azygos system of veins is the system of unpaired veins comprising of azygos vein and its main tributary, the hemiazygos vein. They form a system of parallel veins flanking the vertebral column, which absorb the intercostals, oesophageal and bronchial venous flow[1].

Frequently the azygos vein arise from the posterior aspect of Inferior vena cava at or below the level of renal vein as lumbar azygos vein, passing behind the right crus of the diaphragm or pierce it. Anterior to 12th thoracic vertebral body, it is joined by large vein formed by right ascending lumbar vein and right subcostal vein, in absence of lumbar azygos vein, form the azygos vein itself [2].

The formative tributaries are considered as the roots of the azygos vein and is described that azygos vein has three roots such as lateral, intermediate and medial. Right ascending vein and

right subcostal vein join to form the lateral root. The intermediate root is formed by lumbar azygos and the medial root is formed by small plexiform veins closely associated with the ventral side of the lumbar vertebral bodies. The azygos vein arises from lateral, intermediate and/or medial roots or from any combinations [3].

The lower part of the azygos vein is usually connected to the back of inferior vena cava by a small vein or fibrous cord [4]. Azygos vein is not an exception for the variations in its formation, level of formation and termination. Identifying the variations in its origin is important, since some surgical procedures may require the use of this pathway, as in the case of ligature of the inferior vena cava during trauma surgery [5].

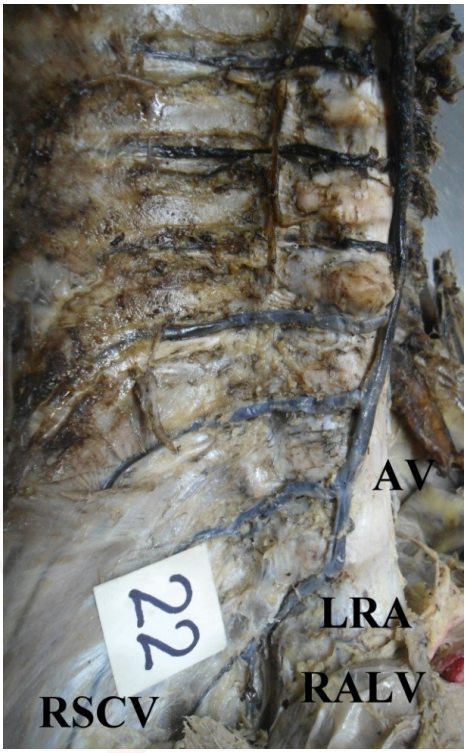
Azygos vein vary greatly not only in the formation, also in its course, tributaries and anastomoses. It is important to report and document different variations of the azygos system because, especially in CT and MRI scans of the mediastinum, some anomalies of the azygos venous system can easily be confused with the pathological conditions such as aneurysms, tumours, and enlarged lymph node [6]. Furthermore the surgeon should be aware of the possibility of variations of the azygos venous system during mediastinal surgery to prevent error. Hence the present study was taken up to note the variations of azygos vein in terms of formation, termination and its levels.

MATERIALS AND METHODS

50 embalmed human cadavers irrespective of their sex and age which were allotted for medical undergraduates in Department of Anatomy, Kempegowda Institute of Medical Sciences Bengaluru, Bangalore Medical College and Research institute, Bengaluru, MS Ramaiah Medical College, Bengaluru, Mysore Medical College and Research Institute, Mysore, and Mandya institute of Medical Sciences, Mandya were taken for the present study.

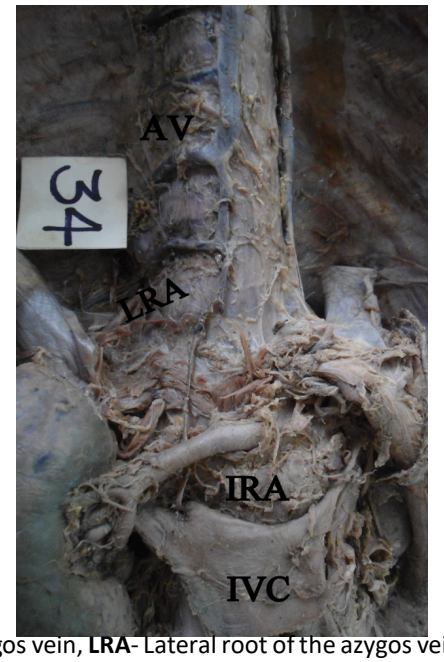
Following the guidelines of cunningham's manual of practical anatomy, Volume two, Thorax and Abdomen fiftheen edition anterior thoracic wall was dissected; the lungs and heart were removed. In the cavity of the thorax, the posterior intercostal veins were exposed. The right posterior intercostal veins were followed to trace the azygos vein. Then the formation and termination of azygos vein was noted. In addition, the level of formation and termination of the vein noted. All the specimens were duly numbered and photographed.

Fig. 1: In this specimen the azygos vein is formed by single root that is by **LRA.**



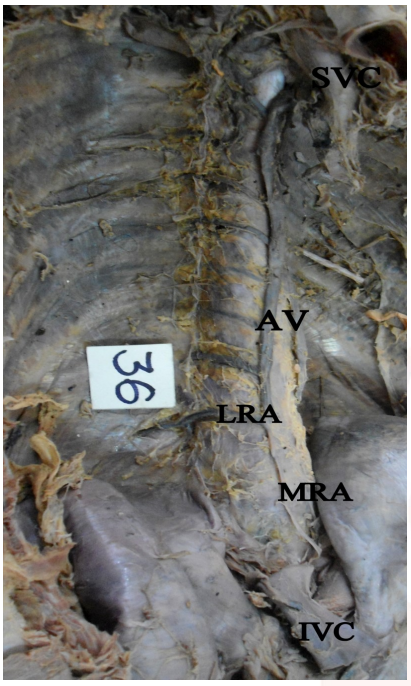
AV- azygos vein, **LRA**- Lateral root of the azygos vein, **RALV**- Right ascending lumbar vein, **RSCV**- Right subcostal vein.

Fig. 2: In this specimen the azygos vein is formed by 2 root, that is by **LRA and IRA.**



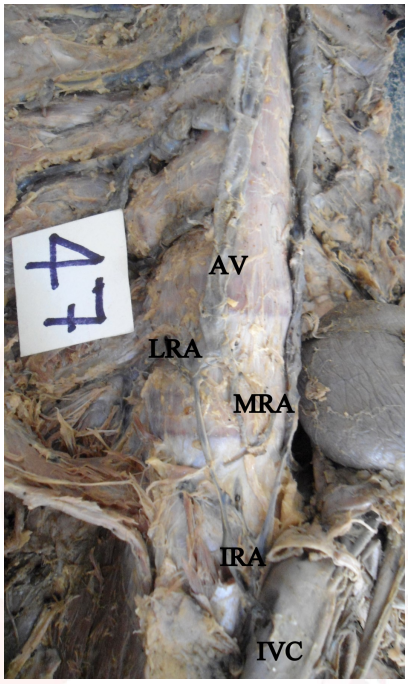
AV- azygos vein, **LRA**- Lateral root of the azygos vein, **IRA**- Intermediate root of azygos vein, and **IVC**- Inferior vena cava

Fig. 3: In this specimen the azygos vein is formed by 2 roots, that is by **LRA and MRA.**



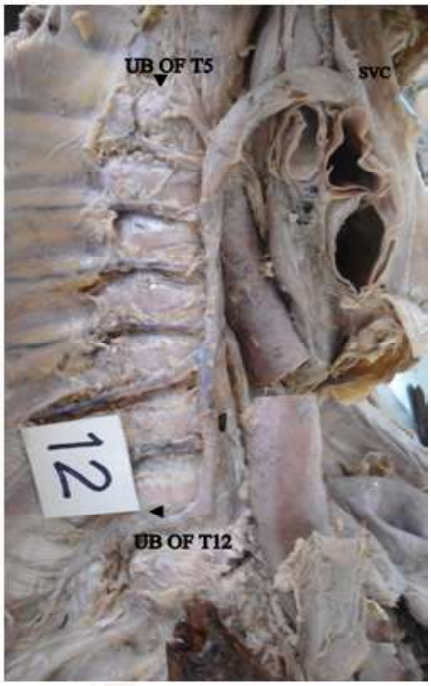
AV- azygos vein, **LRA**- Lateral root of the azygos vein, **MRA**-Medial root of azygos vein, and **IVC**- Inferior vena cava.

Fig. 4: In this specimen the azygos vein is formed by 3 roots, that is by LRA, MRA and IRA.



AV- azygos vein, **LRA**- Lateral root of the azygos vein, **MRA**- Medial root of azygos vein, **IRA**- Intermediate root of azygos vein, & **IVC**- Inferior vena cava.

Fig. 5: The specimen showing the azygos vein levels of formation and termination.



UB- Upper border, **LB-** Lower border

RESULTS

In 42 specimens (84%), the azygos vein was formed by a single root that is the lateral root (Figure 1) which is formed by right ascending lumbar vein and right subcostal vein.

In 5 specimens (10%), the azygos vein was formed by 2 roots, the lateral root and intermediate root (Figure 2) which is arising from inferior vena cava contributed to the formation in 4 specimens (8%) and the lateral root and medial root (plexiform veins closely associated with the ventral side of the lumbar vertebral bodies dorsal to the aorta and its lumbar segment or vein communicating with the inferior vena cava or left renal vein) contributed to the formation in 1 specimen (2%) (Figure 3). All the three roots, the lateral, intermediate and medial roots together formed the azygos vein in 3 specimens (6%) (Figure 4). Formation of azygos at the level of T12 in 48 specimens (96%) and at the level of intervertebral disc between T11 and T12 in 2 specimens (4%). Invariably in all specimens the azygos vein terminated into superior venacava. In 45 specimens (90%) the termination was at the level of T5, in 2 specimens (4%) at the level of intervertebral disc between T4 and T5 and in 3 specimens (6%) at the level of T4.

Table 1: Showing the trunk type in the formation of the azygos vein.

Sl No	Trunk	Number	Percentage (%)
1	Single root (LRA)	42	84
2	Two roots (LRA and IRA)	4	8
3	Two roots (LRA and MRA)	1	2
4	Three roots (LRA,IRA and MRA)	3	6
	Total	50	100

Table 2: Showing the level of formation of the azygos vein.

Sl No	Level	Number	Percentage (%)
1	LB of T12	28	56
2	Between UB and LB of T12	5	10
3	UB of T12	15	30
4	IVD of T11 and T12	2	4
	Total	**50**	**100**
Inference		**Lower border of T12 is more prevalent**	

Table 3: Showing the level of the azygos vein termination.

Sl No	Level	Number	Percentage %
1	B/w UB and LB of T5	2	4
2	UB of T5	43	86
3	IVD of T4 and T5	2	4
4	B/w UB and LB of T4	1	2
5	UB of T4	2	4
	Total	**50**	**100**

Table 4: Showing the comparison of incidence of root of the azygos vein found in earlier studies with that of the present study.

Author	LRA (%)	IRA (%)	MRA (%)
George AS(1934)	85	45	66
Ronald AB et al(2012)	85	34	38
Woodburne(7th Ed)	94	45	30
Present study (2013)	100	14	8

Table 5: Showing the comparison of the level of termination the azygos vein found in earlier studies with that of the present study.

Author	T2-3	T2	T3-4	T3	T4	T5-4	T5
Kutoglu T et al (2012)	12.50%	12.50%	6.30%	62.50%	-	-	-
Kanchana L et al (2013)	-	-	-	8.50%	91.50%	-	-
Present study (2013)	-	-	-	-	4%	6%	90%

DISCUSSION

The azygos vein arises from lateral, intermediate and/or medial roots or from any combination of the three. Lateral root is formed by union of the ascending lumbar vein and subcostal vein, the intermediate arises from the dorsal side of the inferior vena cava near the level of the second lumbar vein and often as a common trunk with the segmental or right renal vein. The medial root is small plexiform veins closely associated with the ventral side of the lumbar vertebral bodies dorsal to the aorta and its lumbar segmental branches[3].

The data obtained in the present study with respect to formation of azygos vein was compared with other studies. The level of formation of the vein could not be compared due to non-availability of literature.

Formation of the azygos vein: According to Kanchana Latha et al, the formation of the azygos vein was only by lateral root that is 100%, where the vein was formed by the right ascending lumbar and right subcostal in 88% & by only right subcostal vein in 12% [7].

In the present study, Out of 50 specimens studied, in 42 specimens (84%), the azygos vein was formed only by a single root that is the lateral root. In 5 specimens (10%), the azygos vein was formed by 2 roots. Out of 5 specimens the lateral root and intermediate root contributed to the formation in 4 specimens (8%) and the lateral root and medial root contributed to the formation in 1 specimen (2%). All the three roots, the lateral, intermediate and medial roots together formed the azygos vein in 3 specimens (6%). Incidence of lateral root was 100%, incidence of intermediate root was 14% and incidence of medial root was 8%.

According to George AS study, the incidence of the LRA was 85%, IRA was 45% and MRA was 66%, in accordance to Ronald AB et al, the incidence of the LRA was 85%, IRA was 34% and MRA was 38% and in accordance with Woodburne, the incidence of the LRA was 94%, IRA was 45% and MRA was 30%. In the present study, the incidence of the LRA is 100%, IRA is 14% and MRA is 8% [8].

In Elton Correia Alves et al study, in 30 cadavers, formation of azygos vein by single root was seen in 15(50%) of cases in which the most frequent formation was as continuation of the right subcostal vein seen in 13(43.33%) cases, formed by the confluence of the right subcostal and right ascending lumbar vein in 03(10.00%) cases, by the right subcostal vein with a contribution from the inferior vena cava (IVC) in three cases (10.00%) by the right subcostal with a contribution from the IVC and right ascending lumbar vein in three cases (10.00%); by the right and left subcostal veins in two cases (6.66%); by the right and left subcostal veins and a contribution from the IVC in one case (3.33%); by the right and left subcostal veins and left accessory renal vein in one case (3.33%); by the left renal vein in one case (3.33%); by the right subcostal and left gonadal veins with a contribution from the IVC in one case (3.33%); by the right subcostal and left renal veins in one case (3.33%); and composed by the continuation of the 11th posterior intercostal vein in one case. In 09(30%) of cases, azygos vein formed by two roots and in 06(20%) of cases by three roots.

Embryological basis: The medial root, the plexiform veins, developed due to persistence of subcentral veins which the transitory veins are lying dorsal to primitive dorsal aorta. The intermediate root is formed by the right lumbar azygos which develop from the right azygos line vein. This right azygos line vein caudally communicate with subcardinal vein which later give rise to renal segment of the inferior vena cava. The lateral root of the azygos is formed by the union of the right subcostal vein and right ascending vein. The right subcostal vein is

derived from the right 12th thoracic segmental vein & the right ascending lumbar vein developed from the supra cardinal vein (thoracolumbar vein). So the persistence of the vein which is supposed to disappear as well as disappearance of vein which is supposed to persist results in the variations of the azygos vein formation.

Level of azygos vein formation: Not much of data was available to discuss about the level of azygos vein formation.

Azygos vein termination: Azygos vein, in all specimens terminated to superior venacava.

Level of azygos vein termination: At the level of 4th thoracic vertebra, the azygos vein arches anteriorly over the root of the right lung to end into superior vena cava just before it pierces the pericardium [11].

Kutoglu T et al studied the level of termination of azygos vein in 48 cadavers aging between 27-70 years. In that study, the level of termination of azygos vein was at T3 in 30(62.5%) specimens, the level of termination of the azygos vein was at T2-3 in 06(12.5%) specimens and at T2 in 06(12.5%) specimens, the level of termination of azygos vein was at T3-4 in 03(6.7%) specimens.

Kanchana L and Raju S studied the level of termination of azygos vein in100 cadavers consisting of 82 adults, 10 children and 8 fetuses. In that study, the level of termination of azygos vein in adult specimens was at T4 in 75 specimens and at T3 in 7 specimens, the level of termination of azygos vein in children was at T5 in 07 specimens and T4 in 2 specimens, at T3 in specimens and the level of termination of azygos vein in fetuses was at T4 in 8 specimens.

In the present study, the level of termination of azygos vein with respect to T5 was observed in 45(90%) specimens. In 3(6%) specimens, level of termination of azygos vein was at of T4 and in 2(4%) specimens at the level of intervertebral disc of T4 and T5.

The results of our study does not correlate with above studies, as in the present study, majority of specimens showed the level of termination of azygos vein at T5, where as in Kutoglu T et al study, majority at the level of T3 and in Kanchana L and Raju S study, in adult specimens, majority at T4 level, in children, majority at T5, in fetuses, all at T4 level.

CONCLUSION

The present study has brought out the variations in the formation of the azygos vein and its level of formation and termination. So the knowledge about the variations is crucial for carrying out any procedures in the mediastinum and also the surgeries of thoracic vertebral column.

ABBREVIATIONS

AV- azygos vein,

LRA- Lateral root of the azygos vein

RALV- Right ascending lumbar vein,

RSCV- Right subcostal vein.

MRA- Medial root of the azygos vein

IRA- Intermediate root of the azygos vein

IVC –Inferior venacava

UB- Upper border

LB- Lower border

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Conflicts of Interests: None

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