



A Variation of Azygos Venous System with the Absence of Hemiazygos and Accessory Hemiazygos Veins: A Case Report

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ABSTRACT

Introduction: The structure of the azygos venous system often has different variations. There are many variations in origin, course, tributaries, anastomosis, and termination in the azygos vein. Embryologically, the azygos venous system originates from subcardinal veins, and changes in the azygos venous system development create several variations.

Case Presentation: The azygos vein system was evaluated in the cadaver of a 55-year-old man whose hemiazygos and accessory hemiazygos veins could not be found. The right posterior intercostal veins directly opened into the azygos vein. There was no variation in the right side, while there was a variation in the drainage of the left posterior intercostal veins. The first left posterior intercostal vein was directly drained into the brachiocephalic vein, while the second, third, and fourth left posterior intercostal veins were drained to the azygos vein through the left superior intercostal vein. Besides, a connection was formed between the fifth and sixth left posterior intercostal veins before being drained to the azygos vein. There was also a short connection between the seventh and eighth left posterior intercostal veins. The connection between the tenth and eleventh left posterior intercostal veins was formed on one anastomotic circle and this common trunk was opened to the azygos vein near the entrance to the ninth left posterior intercostal vein.

Conclusion: The present case was consistent with type III in the Anson classification system with the prevalence of 1-5%. Variations of the hemiazygos and accessory hemiazygos veins were confirmed by means of computerized tomography. This could precisely clarify one of the variations of the mediastinal vessels. The embryological pattern of the azygos system for this variation was discussed, as well.

1. Introduction

Considerable variations may be detected in the azygos venous system, which vary greatly in their origin, course, tributaries, anastomosis, and termination (1).

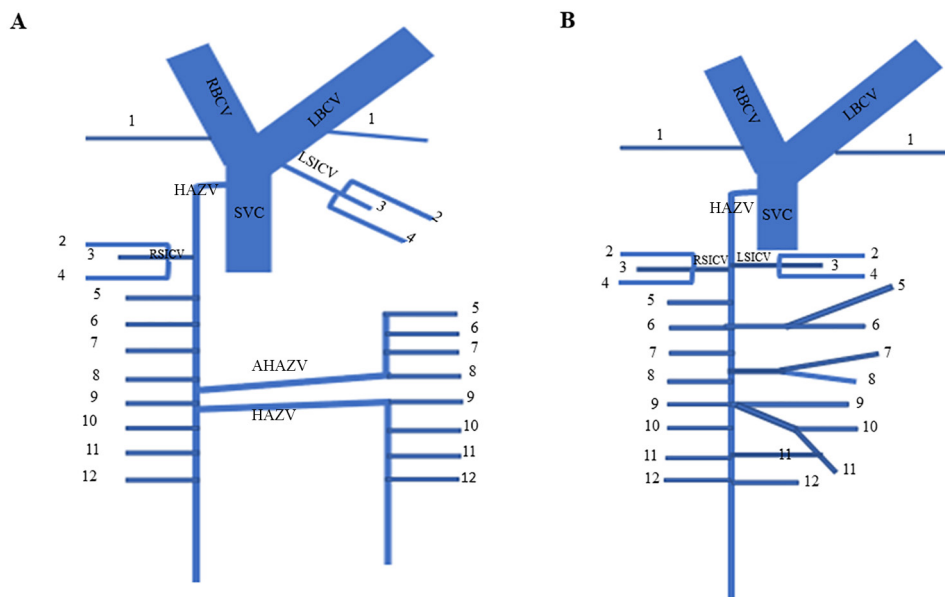
Based on anatomical sciences, the azygos vein is formed by the union of the right ascending lumbar vein and the right subcostal vein at the level of the first lumbar vertebra. It usually ascends on the right side of the vertebral column and drains into the superior vena cava (2). Most of the veins in the thoracic region such as the right superior intercostal, fifth to eleventh right posterior intercostal,

hemiazygos, accessory hemiazygos, bronchial, pericardial, and esophageal veins drain to the azygos vein (2).

The hemiazygos vein has a similar pathway to the azygos vein in the lower part and is formed by the union of the left ascending lumbar vein and left subcostal vein (3). It ascends to the level of the eighth thoracic vertebra and drains into the azygos vein, while it receives the ninth, tenth, and eleventh left posterior intercostal veins. The accessory hemiazygos vein receives blood from the fourth or fifth to the eighth left posterior intercostal vein and drains into the azygos vein at the level of the seventh thoracic vertebra, while most right posterior intercostal veins open to the azygos vein, except for the first, second, third, and fourth veins (4) (Figure 1 A, B). In some cases, the hemiazygos and accessory hemiazygos veins may drain into the azygos

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Figure 1. Schematic Figure of the Azygos Venous System; 1 to 12 Show the Posterior Intercostal Veins in Normal Position (A) and Variation Position (B).



AZV, azygos vein; HAZV, hemiazygos vein; AHAZV, accessory hemiazygos vein; SVC, superior vena cava; RBCV, right brachiocephalic vein; LBCV, left brachiocephalic vein; RSICV, right superior intercostal vein; LSICV, left superior intercostal vein.

vein through a common trunk (5).

The azygos–hemiazygos system is subject to a wide range of variations in its pathway (6). For instance, a variation of the azygos venous system was observed during cadaver mediastinal dissection, in which both hemiazygos and accessory hemiazygos veins were absent. Thus, having knowledge in this field may be useful to surgeons, radiologists, and other clinical disciplines.

2. Case Presentation

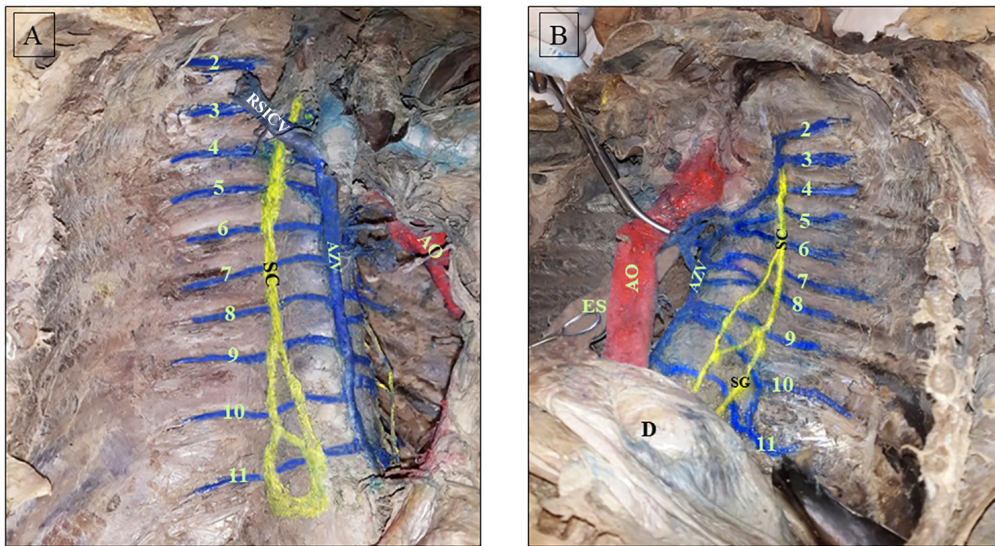
An azygos venous system variation was observed in an adult male cadaver aged approximately 55 years. In this case, the azygos vein tended to the midline and the hemiazygos and accessory hemiazygos veins were absent. Therefore, the left intercostal veins crossed the posterior to the thoracic aorta and esophagus, directly reaching the azygos vein. Moreover, the right posterior intercostal veins directly opened into the azygos vein, and there were no variations in the right side (Figure 2A). Noticeably, the azygos vein was formed as usual by the union of the right subcostal and ascending lumbar veins in front of the twelfth thoracic vertebra. The first left posterior intercostal vein directly drained into the brachiocephalic vein and the second, third, and fourth left posterior intercostal veins opened into the left superior intercostal vein. Then, the left superior intercostal vein drained to the azygos vein. Besides, a connection was formed between the fifth and sixth left posterior intercostal veins before being drained to the azygos vein. A small vein also connected the seventh and eighth left posterior intercostal veins. Finally, the tenth and eleventh left posterior intercostal veins formed one common trunk, which opened to the azygos vein near the entrance of the ninth left posterior intercostal vein (Figure 2B). In spite of the existence of a closed connection between the adjacent left posterior intercostal veins, there were no

hemiazygos and accessory hemiazygos veins. Moreover, the left posterior intercostal veins drained directly to the azygos vein, which was placed in the midline position.

3. Discussion

Multiple transformations occur in subcardinal veins during the azygos venous system development (7). Embryologically, the azygos venous system develops from subcardinal veins. The arch of the azygos vein originates from the cephalic part of the right posterior cardinal vein and its caudal end joins the corresponding subcardinal vein close to the level of the intersubcardinal anastomosis (8). The hemiazygos vein creates the left subcardinal vein. Additionally, the accessory hemiazygos vein as well as the left superior intercostal vein are derived from the left posterior cardinal vein (9). Besides, the accessory hemiazygos and hemiazygos veins are linked to the azygos vein with two transversely oriented veins at the levels of the seventh and eighth thoracic vertebrae, respectively. These transverse veins embryologically originate from the connections between the right and left posterior cardinal veins (8). However, development of the azygos venous system is controversial (10). In the present case, the transverse connections between the right and left posterior cardinal veins were probably undeveloped and the left posterior intercostal veins opened to the azygos vein directly and/or by the common trunk.

It is important to identify the azygos venous system variations, especially in situations like invasive mediastinal operation procedures or surgery of large vessels. These variations should be evaluated by imaging methods such as Computerized Tomography (CT) scan and Magnetic Resonance Imaging (MRI), because they may easily be confused with lymphadenopathy, aneurysm, and other anomalies like tumors. In pathological situations such as obstruction and high pressure of the inferior vena cava,

Figure 2. The Posterior Thoracic Wall Veins on the Right Side (A) and the Left Side (B).

The dissection of the mediastinal organs, azygos vein (AZV), aorta (AO), diaphragm (D), esophagus (ES), first to eleventh posterior intercostal veins (PICV), sympathetic chain (SC), sympathetic ganglion (SG), and right superior intercostal vein (RSICV).

this system may act as a collateral pathway joining the whole venous drainage below the diaphragm, except for the gastrointestinal system (11). This system connects intercostal veins to cerebral veins and vertebral venous plexuses. This connection is important in venous metastatic pathways in thoracic region cancers (12).

The most variable vein in the azygos venous system is the accessory hemiazygos, which may drain into the azygos, hemiazygos, or left brachiocephalic vein (10). Transvertebral connections from the accessory hemiazygos and hemiazygos veins to the azygos vein are greatly variable, as well. This transverse segment of veins crossed in front of the vertebral column is called the “interazygos vein” (13).

In case the hemiazygos and accessory hemiazygos veins are absent, the relevant intercostal veins cross the anterior part of the vertebral bodies and drain into the azygos vein separately (14). The azygos system is subject to a wide range of variations. A previous study indicated that the hemiazygos vein was undeveloped in a 60-year-old male cadaver and the posterior fourth, fifth, sixth, and seventh intercostal veins joined and formed two superior and inferior trunks that separately drained into the azygos vein (15). Another study reported a case, in which there was no complete accessory hemiazygos vein and the posterior intercostal veins drained bilaterally to the azygos vein (10). Additionally, Cossina et al. found two azygos veins that continued with the inferior vena cava (16). In line with the present study, a previous study revealed the absence of the hemiazygos vein in a 60-year-old cadaver (17). In another investigation, a variation of the azygos vein covered the sympathetic chain, which might pose a high risk for endoscopic thoracic sympathectomy (18). A case of the total absence of the azygos vein was also reported in another research (19).

Up to now, different arrangements of the azygos venous system have been introduced. One of the most common classifications is Anson classification system, which divides the azygos venous system to 3 types and 11 subgroups based

on the vertical and horizontal vein connections. The present case was consistent with type III (it had a single azygos vein that lied on the anterior surface of the vertebral column), with the prevalence of 1 - 5% (20).

Normally, the superior intercostal vein is created through the connection of the second, third, and sometimes fourth posterior intercostal veins, and the left superior intercostal vein opens to the brachiocephalic vein (21). In the current cadaveric case, however, the left superior intercostal vein was drained into the azygos vein. In addition, the hemiazygos and accessory hemiazygos veins were absent and the left posterior intercostal veins drained to the azygos vein located in the midline position.

Considering the high prevalence of variations in the azygos venous system, it is important for surgeons to pay attention to the presence of variations in this system.

3.1. Informed Consent

This study was performed on a Cadaver of male about 55 years old. Before dissecting the cadaver in the Qom University of Medical Sciences, obtained informed consent from his family.

Ethical Approval

This study was approved by the local Ethics Committee (IR.MUQ.REC.1400.237).

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Authors' Contribution

Study concept and design: M.S.F and F.H.; drafting of the manuscript: R.S and M.A.; critical revision of the manuscript: R.S and S.A.

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References

- de Oliveira Gomes M, Nobeschi L, Dias DV, Palma LF, da Silva FS, Espindula AP, et al. Analysis of the territorial pattern of the azygos venous system and its variations in fixed cadavers. *Translational Research in Anatomy*. 2020;**21**:100077.
- Alves EC, Porciuncula Junior WR, Monte Bispo RF, Sousa-Rodrigues CFd, Rocha ACd. Formation of the azygos vein. *Int j morphol*. 2011;140-3.
- Kalyankar AG, Shingare PH, Kulkarni PR. Variation of hemiazygos vein with absence of accessory hemiazygos vein-a dissection study. *National Journal of Clinical Anatomy*. 2013;**2**(1):35.
- Nayak SB, Soumya K. Transposition and variant termination of azygos and hemiazygos veins: an extremely rare variation. *Surgical and Radiologic Anatomy*. 2020;**42**(11):1303-6.
- Badagabettu SN, Shetty P, D'Souza MR. A unique variation of azygos system of veins. *Journal of cardiovascular echography*. 2016;**26**(2):61.
- Atari M, Nakajima Y, Fukuhara M, Iijima Y, Kinoshita H, Minamiya Y, et al. An extremely rare case report of surgery of lung cancer with the absence of azygos vein. *Surgical and Radiologic Anatomy*. 2017;**39**(1):103-6.
- Nirmala BV, Teresa RS. Study of azygos system and its variations. *Journal of Evolution of Medical and Dental Sciences*. 2015;**4**(33):5652-8.
- Standring S, Ellis H, Healy J, Johnson D, Williams A, Collins P, et al. Gray's anatomy: the anatomical basis of clinical practice. *American journal of neuroradiology*. 2005;**26**(10):2703.
- Oliveira JD, Martins I. Congenital systemic venous return anomalies to the right atrium review. *Insights into Imaging*. 2019;**10**(1):1-17.
- Kutoglu T, Turut M, Kocabiyik N, Ozan H, Yildirim M. Anatomical analysis of azygos vein system in human cadavers. *Romanian journal of morphology and embryology = Revue roumaine de morphologie et embryologie*. 2012;**53**(4):1051-6.
- Mezzogiorno A, Passiatore C. An atypic pattern of the azygos venous system in man. *Anatomischer Anzeiger*. 1988;**165**(4):277-81.
- Meier A, Alkadhi H. Venous collateral pathways in superior thoracic inlet obstruction: a systematic analysis of anatomy, embryology, and resulting patterns. *American Journal of Roentgenology*. 2019;**213**(1):200-10.
- Ruggeri G, Fascetti-Leon F, Gregori G, Lima M. Anatomy of the Thorax. *Pediatric Thoracic Surgery*: Springer; 2013. p. 3-15.
- Standring S. *Gray's anatomy*. 40 ed. Churchill Livingstone: Edinburgh; 2008.
- Ozdemir B, Aldur MM, Celik HH. Multiple variations in the azygos venous system: a preaortic interazygos vein and the absence of hemiazygos vein. *Surgical and radiologic anatomy : SRA*. 2002;**24**(1):68-70.
- Coscina WF, Arger PH, Mintz MC, Coleman BG. Concurrent duplication and azygos continuation of the inferior vena cava. *The Journal of computed tomography*. 1986;**10**(3):287-90.
- Ozbek A, Dalcik C, Colak T, Dalcik H. Multiple variations of the azygos venous system. *Surgical and radiologic anatomy : SRA*. 1999;**21**(1):83-5.
- Sieunarine K, May J, White GH, Harris JP. Anomalous azygos vein: a potential danger during endoscopic thoracic sympathectomy. *The Australian and New Zealand journal of surgery*. 1997;**67**(8):578-9.
- Arslan G, Cubuk M, Ozkaynak C, Sindel T, Luleci E. Absence of the azygos vein. *Clinical imaging*. 2000;**24**(3):157-8.
- Kutoglu T, Turut M, Kocabiyik N, Ozan H, Yildirim M. Anatomical analysis of azygos vein system in human cadavers. *Romanian journal of morphology and embryology = Revue roumaine de morphologie et embryologie*. 2012;**53**(4):1051-6.
- Piciucchi S, Barone D, Sanna S, Dubini A, Goodman LR, Oboldi D, et al. The azygos vein pathway: an overview from anatomical variations to pathological changes. *Insights into imaging*. 2014;**5**(5):619-28.