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

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1. Introduction

Considerable variations may be detected in the azygos venous system, which vary greatly in their 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.

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. 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.

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. 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. In some cases, the hemiazygos and accessory hemiazygos veins may drain into the azygos venous system.
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 and hemiazygos veins 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,
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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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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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