



Macroanatomy of the Azygos Vein: A Comparative Description between Human, Dog and Sheep

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ABSTRACT

In this study, the macroanatomy of the azygos vein in the dog and sheep were compared to those of human. The obtained results showed that in dog it originates from cranial vena cava on the right side of thoracic cavity and the segmental veins arise from that as dorsal intercostal veins for draining blood from the vertebral column. In sheep the azygos vein lies on the left side of the thoracic cavity and originates from the coronary sinus of the right atrium. In human specimens, the azygos vein arise opposite the vertebra LI or LII at the junction between the right ascending lumbar vein and the right subcostal vein. The hemiazygos vein form on the left side from the lower three posterior intercostal veins, then ascends anterior of the vertebral column to the eighth thoracic level then cross the vertebral column posterior to the aorta, esophagus and thoracic duct and ends in the azygos vein. It concluded that the most anatomical similarities were seen between the azygos vein of the dog and human. However, the most anatomical differences were existed between the azygos vein of the sheep and human.

Key words: Azygos vein, human, sheep, dog

INTRODUCTION

Azygos comes from the Greek A (without) and Zygos (pair) and is applied to all non-paired organs. several organs, such as the liver and the hypophysis receive venous blood supply. Therefore, veins not only remove metabolites from the tissues, but also supply those tissues with the metabolites and hormones [1]. The azygos system of veins consists of a series of longitudinal vessels on each side of the body that drain blood from the body wall and move it superiorly to empty into the superior vena cava [2]. This system functions as an additional drainage way when high pressure and obstruction occurs in most of the veins that inferior vena cava vein drains [3,4]. The thoracic wall and upper lumbar region are drained by the posterior intercostal and lumbar veins into the azygos system of veins. The azygos vein is a vascular structure of extreme importance that drains blood from the posterior walls of the thorax and abdomen and unites the superior vena cava (SVC) to the inferior vena cava (IVC). The aim of this study was to compare the anatomical characteristics of the azygos vein between human, sheep and dog and provide a precise knowledge of its anatomy with exist differences and similarities between animals and human. This will be helpful to select a suitable animal model for medical and surgical research.

MATERIALS AND METHODS

In this study, five dog and five sheep were considered to compare with human as representatives of carnivores and ruminants species respectively. The animals and cadavers were formalin-fixed through routine fixation methods in dissection room of faculty of veterinary medicine, Razi University and Kermanshah University of Medical Science.

After opening the lateral wall of the abdominal cavity and thoracic cavity, the azygos vein was dissected and evaluated for topographic position and its branches.

RESULTS AND DISCUSSION

In the dog, the azygos vein was arised from that part of the cranial vena cava which lies close to the insertion of the pericardium and still contains heart muscle tissue on the right side of the thoracic cavity (Figure 1). Then, it rises in a cranially convex curve to the thoracic vertebral column, crossing the trachea and esophagus on their right side. Then, lying to the right and dorsal of the thoracic aorta, it accompanies this vessel and the thoracic duct through the hiatus aorticus. The right azygos vein of carnivores may give off a left hemiazygos vein in the caudal half of the thorax [5]. In this study, none of the animals had hemiazygos vein. Each hemiazygos vein supplements, or substituets for the azygos vein. In the dog the segmental veins arise from the right azygos vein as dorsal intercostal veins and drains blood from the vertebral column (Figure 1).

In all examined sheep, the azygos vein was lied on the left side of the thoacic cavity as left azygos vein. It was arised from the coronary sinus of the right atrium. It runs dorsally over the left atrium, then swings to the left of the polmunary artery and dorsal to the aorta. Curving caudad it accompanied the thoracic aorta along the origins of the intercostal arteries from the thoracic vertebra onwards (Figure 2). Together with the aorta it passes through the aortic hiatus to join the first lumbar veins, their common vessel of origin. However, it often terminates in the caudal half the thorax. Before then, or sometimes even from its terminal part, it may gives off a right hemiazygos vein. The latter vessel may, however, already have been given off the continuation of the right azygos vein [5]. In dissected sheep, the segmental veins arise from the left azygos vein, but it could be originates from both right and left azygos vein since in that species both veins may occasionally exist simultaneously.

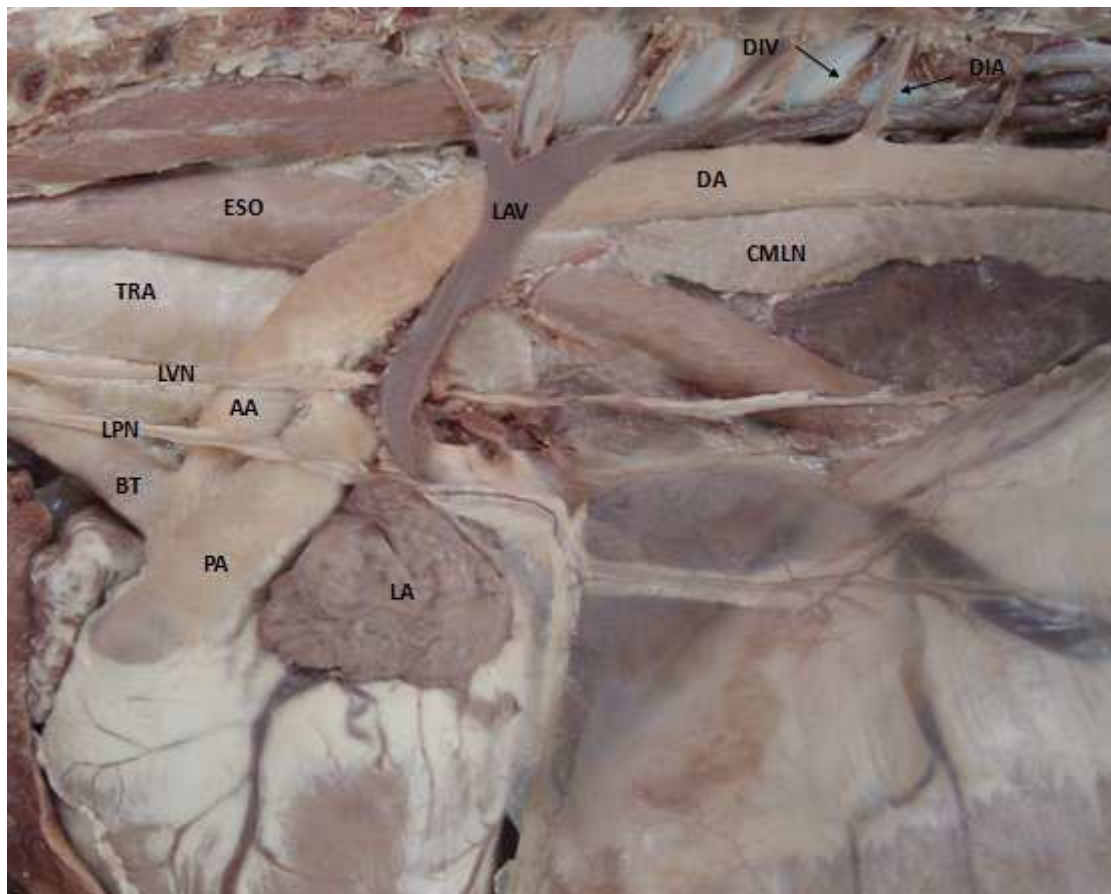


FIGURE 1: Left lateral view of thoracic cavity in sheep. CMLN: Coudal Mediatinel Lymph Node, LAV: Left Azygos Vein, LVN: Left Vagus Nerve, TRA: Trachea, ESO: Esophagus, LA: Left Auricle, LPN: Left Phrenic Nerve, IDV: Dorsal Intercostal Vein, IDA: Dorsal Intercostal Artery, AA: Aortic Arch, DA: Descending Aortic, BT: Brachiocephalic Trunk, PA: Polmonary Artery.



FIGURE 2: Right lateral view of the thoracic cavity in dog. RAV: Right Azygos Vein, DIV: Dorsal Intercostal Vein, DIA: Dorsal Intercostal Artery, GB: Gall Bladder, RPN: Right Phrenic Nerve, CaVC: Caudal Vena Cava, CrVC: Cranial Vena Cava, RML: Right Medial Lobe of liver, CLLL: Cranial Lobe of Left Lung.

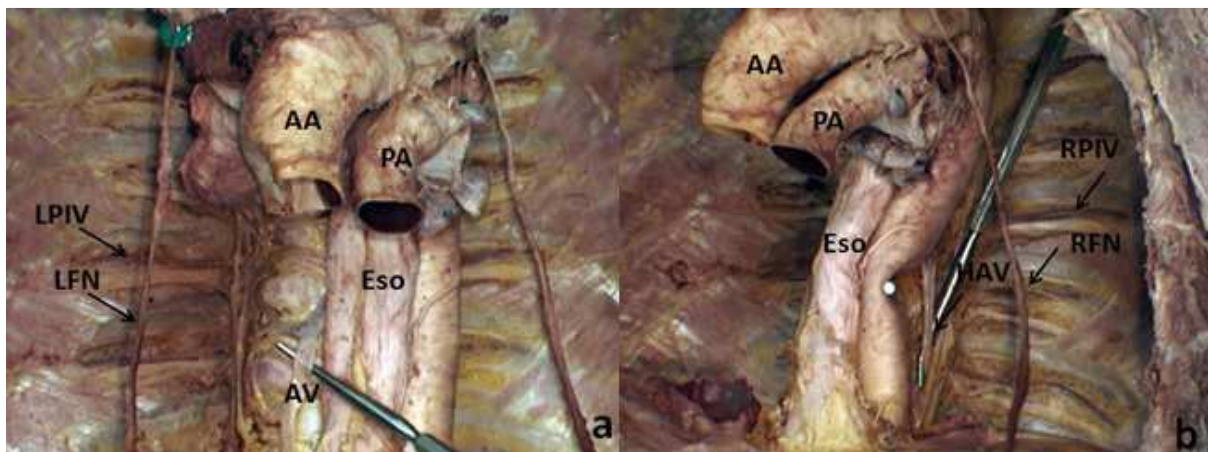


FIGURE 3: Posterior view of thoracic cavity in human. AA: Aortic arc, PA: Pulmonary Artery, Eso: Esophagus, LFN: Left Phrenic Nerve, LPIV: Left Posterior Intercostal Vein, AV: Azygos Vein, HAV: Hemiazygos Vein, RFN: right Phrenic Nerve, RPIV: Right Posterior Intercostal Vein.

In human specimens, the azygos vein was arisen opposite the vertebra LI or LII at the junction between the right ascending lumbar vein and the right subcostal vein (Figure 3a). It may also arise as a direct branch of the inferior vena cava, which is joined by a common trunk from the junction of the right ascending lumbar vein and the right subcostal vein [2]. The azygos vein was entered the thorax through the aortic hiatus of the diaphragm then was ascended through the posterior mediastinum, to the right of the thoracic duct. At approximately vertebral level TIV, it curved anteriorly, over the root of the right lung, to join the superior vena cava before the superior vena cava enters the pericardial sac. Tatar *et al.* [6] has reported that the azygos vein terminates at the level of TV in most cases. Congenital absence of the azygos vein is rare [7]. In congenital obstruction of the inferior vena cava, the azygos vein provides the venous flow of the lower body half [8]. The hemiazygos vein was formed on the left side from the lower three posterior intercostal veins, a common trunk formed by the left ascending lumbar and subcostal

veins, and by esophageal and mediastinal tributaries. It was ascended anterior of the vertebral column to the eighth thoracic level then crossed the vertebral column posterior to the aorta, esophagus and thoracic duct and ends in the azygos vein (Figure 3b). The accessory hemiazygos vein (superior hemiazygos vein) descended on the left side from the superior portion of the posterior mediastinum to approximately vertebral level TV III . At this point, it was crossed the vertebral column to join the azygos vein, and in two cases was terminated in the hemiazygos vein. Usually, it also has a connection superiorly to the left superior intercostal vein [2].

In azygos vein system, there are many differences from person to person and from animal to animal because of the different division, adjunction and closure of ten longitudinal and more transverse veins of which embryologically it developed, many combinations occur [9,10]. The embryology of the azygos–hemiazygos system is controversial, but the azygos vein is considered to derive from the upper right supracardinal vein, the azygos arch from an upper segment of the right posterior cardinal vein, and the hemiazygos vein from the upper left supracardinal vein. although it is impossible to consider all the variations, attention is drawn to the fact that these azygos veins are usually valveless and form a functional connection between the cranial (superior) and caudal (inferior) vena cavae.

CONCLUSION

In conclusion, As the results of this study shows, the most anatomical similarities were seen between the azygos vein of the dog and human. However, the most anatomical differences were existed between the azygos vein of the sheep and human. These findings is expected to serve as a guide for appropriate selection of animal model for surgical researches.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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