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Variability of the azygos vein system in human foetuses

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The aim of the study was to examine the variability of the azygos vein system and to determine the location of the veins with reference to the vertebral midline and the skeletopy of their termination. The research material consisted of 32 human foetuses (14 male, 18 female) from 21st to 24th week of intrauterine life, fixed in 10% neutral formalin solution. Conventional anatomical — radiographic methods were used. 5 different configurations of the azygos vein system were found. In the 1st configuration there were 3 azygos veins, with both the left side veins, the hemiazygos vein (HV) and the hemiazygos accessory vein (HAV), joining the azygos vein (AV) separately. In the 2nd configuration the HV and the HAV were joined to the AV together. In the 3rd configuration the HAV was missing, and the 4th to 8th left intercostal veins were joined to the AV separately. In the 4th configuration the HV was missing. In the 5th configuration there was the AV only, which coursed along the vertebral midline. In these 4 configurations (1–4) the AV was located on the right side (90.6%) and in the 5th configuration the AV was located in the vertebral midline. The termination of the AV projected mostly on Th_4 (81.25%). The junction of the HV and the AV was found the most frequently at Th_8 (35.7%), and the junction of the HAV and AV most frequently at Th_7 (41.6%).

key words: azygos vein, hemiazygos vein, hemiazygos accessory vein, human configuration, foetuses

INTRODUCTION

The azygos vein system develops on the basis of multiple transformation of the subcardinal veins, which causes its great variability, especially on the left side [4, 6]. Azygos veins are important cavo-caval and porto-caval junctions, thus forming collateral circulation in caval vein occlusion and in portal hypertension [1].

The aim of the study was to examine the variability of the azygos vein system and to determine the location of the veins with reference to the vertebral midline and skeletopy of their termination.

MATERIAL AND METHODS

The research material consisted of 32 human foetuses from the collection of the Department of Normal Anatomy. The foetuses, 14 male and 18 female and from 21st to 24th week of intrauterine life, were fixed in 10% neutral formalin solution. In this research conventional anatomical — radiographic methods were used. After cutting the sternum in midline and pulling the ribs aside, the chest organs were removed and the azygos vein system prepared. Photographic documentation in situ was performed with a Nikon Coolpix Digital Camera. After marking

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the termination of the 3 veins, P-A radiograms of this vascular area were made with Unipan 401 apparatus.

RESULTS

Configurations

5 different configurations of the azygos vein system were found in the material studied. In the 1st configuration (65.6%) there were 3 veins, both of those on the left, the hemiazygos vein (HV) and the hemiazygos accessory vein (HAV), joining the azygos vein (AV) separately (Fig. 1). The remaining 4 configuration views were observed with a different frequency. In the 2nd configuration (6.25%) the HV and the HAV were joined to the AV together (Fig. 2). In the 3rd configuration (12.5%) the HAV was missing (Fig. 3), and 4th to 8th left intercostals veins were joined to the AV separately. In the 4th configuration (6.25%) the HV was missing (Fig. 4). In the 5th configuration (9.4%) there was only the AV, which coursed along the vertebral midline (Fig. 5), and the posterior intercostals veins from both sides were attached to the AV.

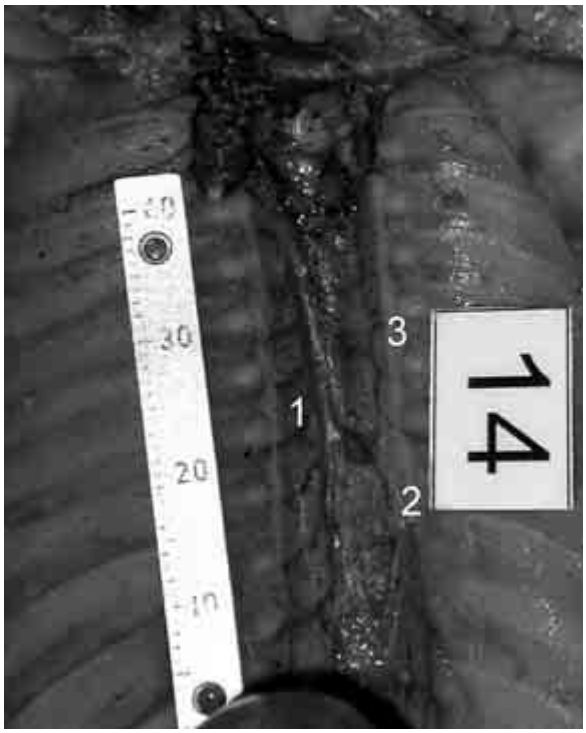

Figure 2. 2nd configuration of the azygos vein system; 1 — AV, 2 — HV, 3 — HAV.

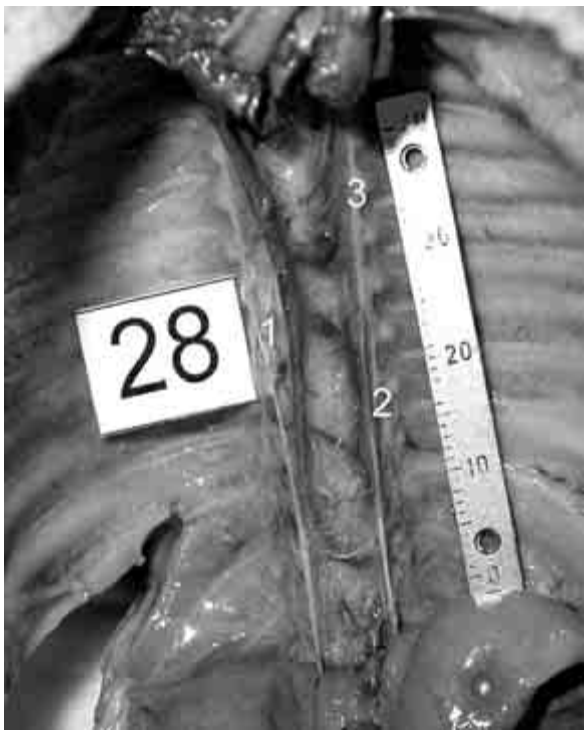

Figure 1. 1st configuration of the azygos vein system; 1 — AV, 2 — HV, 3 — HAV.

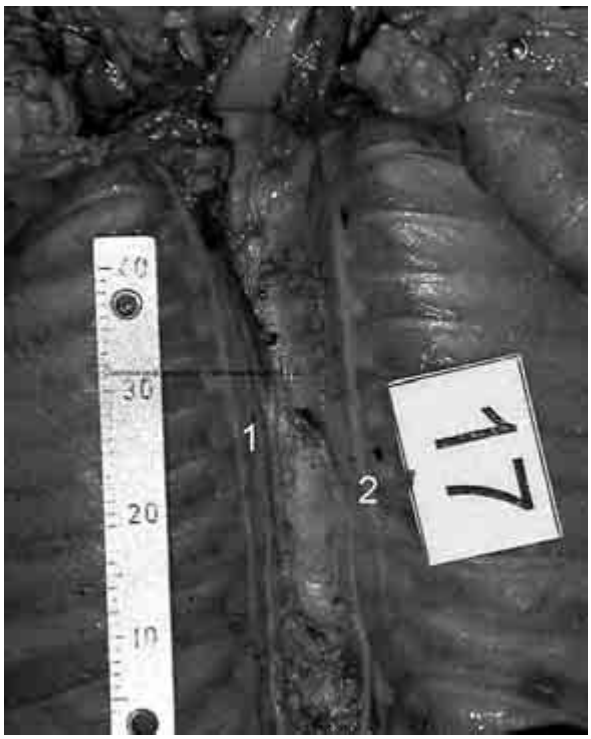

Figure 3. 3rd configuration of the azygos vein system; 1 — AV, 2 — HV.

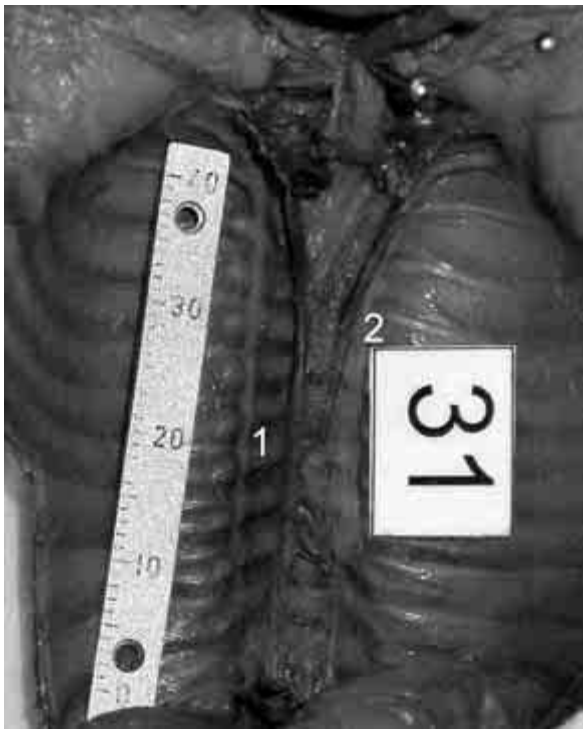

Figure 4. 4th configuration of the azygos vein system; 1 — AV, 2 — HAV.

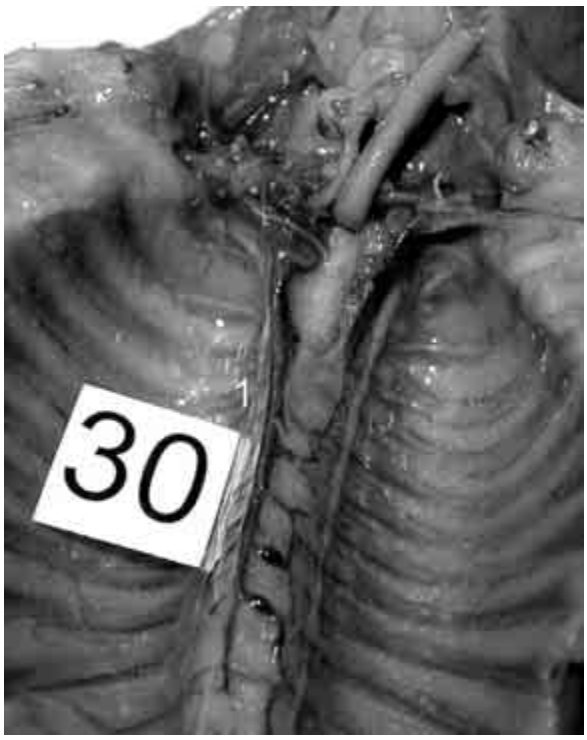

Figure 5. 5th configuration of the azygos vein system; 1 — AV.

Analysis of the azygos vein configurations indicates that the AV was found in all cases, the HV in 84.4%, and the HAV in 80% of cases. An azygos vein system consisting of 3 veins (1st and 2nd configurations) was observed in 71.85% of cases, of 2 veins (3rd and 4th configurations) in 18.75% of cases, and of 1 vein (5th configuration) in 9.4% of cases.

Skeletopic analysis

In 4 configurations (1st – 4th) the AV was located on the right side (90.6%). In the 5th configuration the AV was located in the vertebral midline. The junction of the AV and superior cava vein projected mostly on Th_4 (81.25%), in 12.5% of cases it projected on Th_3, and in 6.25% of cases on Th_5. The junction of the HV and the AV was found the most frequently (35.7%) at Th_8, less frequently at Th_9 (18.7%), Th_{10} (17.8%) and Th_7 (14.2%), and the most rarely (3.5%) at Th_5, Th_6, and Th_{11}. The junction of the HAV and the AV was most frequent at Th_7 (41.6%), less frequent at Th_6 and Th_8 (29.2% and 25%), and least frequent at Th_5 (4.2%).

DISCUSSION

Knowledge of the variability of the azygos vein system is an important anatomical signpost in radiological diagnosis (CT and MRI) and in the surgical treatment of thoracic aorta aneurysms and tumours of the posterior mediastinum [2]. In our own research the AV was constantly observed, the HV in 84.4% of cases and the HAV in 80% of cases. These results correspond to the research of Seib [9], who found that of these 3 veins, there is most variability in the HAV and the least variability in the AV. Hitherto there have been only 6 cases of absence of the AV published in anatomical-radiological literature [1, 5], the intercostal area being drained by the HV, which terminated on the left brachiocephalic vein. In all these cases the increased venous flow on the left side caused the enlargement of the left intercostal superior vein, which appears on radiological films as a small triangular "aortic nipple".

The single AV lying along the midline was observed in 9.4% of cases, and so was considerably more frequent than shown in Kadir's statistics [6].

In the findings of Grzybiak et al. [4] the HV was presented in foetuses in 60% of cases, in newborns in 70% and in adults in 90%. The HAV was presented in 50% of foetuses and newborns and in 56% of adults, considerably less frequently than observed

in our study. Hyperplasia of the HV located between the aorta and the oesophagus was named the interazygos vein [2]. In Seib's material [9] this vein was observed in 3.6% of individuals.

In this study in 90.6% of cases the AV was located on the right side and the HV and the HAV were located on the left side of the vertebral midline. In the remaining cases (9.4%) the single AV lay along the midline, which does not conform to Kadir's statistics [6]. Kagami and Sakai [7] found that in the foetus the AV is located on the right side of the vertebral column (6 cases) or along the midline (4 cases), moving to the left side with age. This hypothesis would be confirmed by the fact that in their material the AV projected on the left side in 85% of adults. However, other authors [3, 8] have observed that the location of the AV along the midline is more frequent (27–96.3%) than on the right side of the vertebral column (3.7–53%).

The results of our research on the skeletopy of the azygos vein system correspond to data from literature. The termination of the AV projects on Th_4 and Th_5 [6, 7], termination of the HV projects on Th_8 [2, 6, 9] and termination of the HAV on Th_7 [6].

CONCLUSIONS

1. There are 5 configurations of the azygos vein system.
2. There is least variability in the AV and the most variability in the HAV.
3. In human foetuses there is a right-sided (90.6%) or median (9.4%) location of the AV.
4. The termination of the AV projects most frequently on Th_4, the HV on Th_8 and the HAV on Th_7.

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