Left superior vena cava with left azygos vein

By

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Summary: An incidence of a left superior vena cava with a left azygos vein was found in a cadaver during an Osaka Dental University student’s dissection practice session in 2002. The left superior vena cava began from the confluence between the right and left brachiocephalic veins, and extended directly into the left superior edge of the coronary sinus. No right superior vena cava was observed. The left azygos vein, receiving the bilateral intercostal veins, extended into the left superior vena cava. The developmental mechanism of the left superior vena cava was considered as follows; because the proximal part of the left anterior cardinal vein and the left common cardinal vein remained, and the proximal part of the right anterior cardinal vein and the right common cardinal vein degenerated and disappeared. The developmental mechanism of the left azygos vein was considered as follows; because the proximal part of the left posterior cardinal vein remained, and the root of the azygos vein was formed.

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Introduction

An incidence of the left superior vena cava with the left azygos vein was found in a cadaver during an Osaka Dental University student’s dissection practice session in 2002. The left superior vena cava began from the confluence between the right and left brachiocephalic veins, and descended vertically, and extended into the left superior edge of the coronary sinus. No right superior vena cava was observed. The left azygos vein began from the left subcostal vein, received the bilateral intercostal veins, and extended into the left superior vena cava.

Materials and Methods

This case was observed in an 83-year-old Japanese female cadaver. This cause of death was the metastatic liver cancer. The length of the vessel and the compressed diameter were measured with calipers (Pocket Calipers, SHINWA RULES CO., LTD, Niigata, Japan).

The protocol for the present research did not include any specific issue that needed to be approved by the ethics committees of our institutions. The present work conformed to the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh 2000).

Results

1. Left superior vena cava

The left superior vena cava (20.8 mm in diameter, 57.6 mm in length) began from the confluence between the right brachiocephalic vein (14.5 mm in diameter) and the left brachiocephalic vein (17.0 mm in diameter) at a level with the middle body of the third thoracic vertebra or at the left side of 26.0 mm from midline. This vena cava descended 30.7 mm vertically, received the left azygos vein (10.0 mm in diameter) on the left wall of this vena cava. Then, this vena cava descended 28.9 mm vertically, and extended directly into the left superior edge of the coronary sinus (Fig. 1).

2. Right superior vena cava

No right superior vena cava and this remnant were observed (Fig. 1).
3. Right brachiocephalic vein

The right brachiocephalic vein (14.5 mm in diameter, 63.6 mm in length) began from the confluence between the right internal jugular vein (4.8 mm in diameter) and the right subclavian vein (9.1 mm in diameter) at a level with the middle body of the third thoracic vertebra or at the right side of 34.2 mm from midline. This vein ran horizontally to the left on the anterior side of the aortic arch at a level with the middle body of the second thoracic vertebra (Fig. 1).

4. Left brachiocephalic vein

The left brachiocephalic vein (17.0 mm in diameter) began from the confluence between the left internal jugular vein (16.0 mm in diameter) and the left subclavian vein (10.2 mm in diameter) at a level with the middle body of the second thoracic vertebra or at the left side of 32.4 mm from midline. And then, this vein ran inferomedially 16.2 mm on the anterior side of the aortic arch (Fig. 1).

5. Azygos venous system

The azygos venous system in this case was a mirror image of a normal case. The left azygos vein (10.0 mm in diameter) began from the left subcostal vein, and ascended along to the left margin of the thoracic vertebra. The eleventh to fourth left intercostal veins (about 2.0 mm in diameter) extended into the left azygos vein. The left azygos vein ran across along the left wall of the thoracic aorta (20.0 mm in diameter) from the posterior to the anterior direction, and extended into the left wall of the left superior vena cava. The third to first left intercostal veins gathered in one, and extended into the left azygos vein. The right hemiazygous vein began from the right subcostal vein, received the eleventh to eighth right intercostal veins, extended into the left azygos vein at the anterior side of the ninth thoracic vertebra. The seventh to fifth right intercostal veins extended directly into the left azygos vein. The fourth and third intercostal veins gathered in one, and extended into the left azygos vein. We could not observe that the second and first intercostal veins extended into the left azygos vein (Fig. 2).

6. Heart

The heart (158 g in weight) was about half weights compared with usually (woman ≥ 70 years old: 329.1 ± 66.0 g)\(^1\)). The coronary sinus (67.6 mm in diameter) received the left superior vena cava (25.6 mm in diameter) at the left superior edge of this sinus. And then, the coronary sinus received three great cardiac veins (about 2.2 mm in diameter), the middle cardiac vein (1.9 mm in diameter), ran behind of the heat, and extended into the right atrium. The inferior vena cava (37.3 mm in diameter) and two small cardiac veins (about 2.0 mm in diameter) extended into the left azygos vein.

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Fig. 1. Photograph (A) and schematic illustration (B) showing the anterior view of the heart and the great vessels. aoa, aortic arch; asa, ascending aorta; bt, brachiocephalic trunk; lav, left azygos vein; lbv, left brachiocephalic vein; lca, left common carotid artery; liv, left internal jugular vein; lsa, left subclavian artery; lsv, left subclavian vein; lsvc, left superior vena cava; pa, pulmonary artery; rbv, right brachiocephalic vein; rca, right common carotid artery; riv, right internal jugular vein; rsa, right subclavian artery; rsv, right subclavian vein; ta, thoracic aorta; E, esophagus; H, heart; D, diaphragm; T, trachea.
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7. Other findings

The brachiocephalic trunk, the left common carotid artery, and the left subclavian artery arose directly from the aortic arch, which was a type A according to Adachi’s classification (1928). The right subclavian artery (12.0 mm in diameter) passed in front of the right scalenus anterior muscle. This artery arose from the brachiocephalic trunk (15.0 mm in diameter), ran superolaterally, and sequentially branched into the right vertebral artery (5.2 mm in diameter), the right costocervical trunk (1.5 mm in diameter), the right thyrocervical trunk (2.0 mm in diameter) superiorly, and the right internal thoracic artery (2.4 mm in diameter) inferiorly. No abnormality was observed the running and branching of the left subclavian artery (12.2 mm in diameter), the thoracic duct, the right lymphatic duct, the vagus nerves and the sympathetic trunks.

Discussion

We considered that 1. the frequency of the persistent left superior vena cava in anatomical field, 2. developmental mechanism of the left superior vena cava and 3. developmental mechanism of the left azygos vein, in order.

1. The frequency of the persistent left superior vena cava in anatomical field

Adachi (1933) reported that the incidence of the persistent left superior vena cava was 0.27% in the adult. The present case of the left superior vena cava was the first case of its kind in 298 cadavers (596 sides) studied in student’s dissection practice sessions at our facilities from 1994 through 2003 (10 years), which represents a 0.3% incidence ratio. The present case was classified as a type IV according to McCotter’s classification (1916), was the fourth report, after Wake (1954), Akiyama et al.

Fig. 2. Photograph (A) and schematic illustration (B) showing the anterior view of the azygos venous system. icv6–11, the 6–11th intercostal vein; lav, left azygos veins; lbv, left brachiocephalic vein; liv, left internal jugular vein; lsve, left superior vena cava; lv, left subclavian vein; rbv, right brachiocephalic vein; sub, subcostal vein; L1–L3, the 1–3rd lumbar vertebrae; Th6–12, the 6–12th thoracic vertebrae.
2. Developmental mechanism of the left superior vena cava

In a normal case, in the 4-week-old embryo, the common cardinal veins consisted of the paired anterior and posterior cardinal veins. The common cardinal veins extended into the sinus venous of the primitive heart. In the 7-week-old embryo, the anastomosis vein appeared between the right and left anterior cardinal veins. In the 12-week-old fetus, the proximal part of the left common cardinal vein became the coronary sinus, and extended into the right atrium. The remained left common cardinal veins were disappeared. The anastomosis vein became the left brachiocephalic vein. The right common cardinal vein became the superior vena cava.

In the present case, we considered the developmental mechanism of the left superior vena cava following described. In the 12-week-old fetus, the right common cardinal vein and the proximal part of the right anterior cardinal vein disappeared, the left common cardinal vein and anterior cardinal vein remained. And then, the anastomosis vein became the right brachiocephalic vein, and the left superior vena cava and the coronary sinus developed (Fig. 4).

3. Developmental mechanism of the left azygos vein

In a normal case, in the 6-week-old embryo, the bilateral supracardinal veins appeared, and extend into the posterior cardinal veins. In the 7-week-old embryo, the bilateral supracardinal veins developed inferiorly. In the 9-week-old fetus, the anastomosis vein appeared between the right and left supracardinal veins. In the 12-week-old fetus, the proximal part of the right posterior cardinal vein remained, and the root of the azygos vein was formed. The left supracardinal vein separated the hemiazygos and the accessory hemiazygos veins. The hemiazygos vein extended into the azygos vein via the anastomosis vein. The azygos vein extended into the superior vena cava.

In the present case, we considered the developmental mechanism of the left azygos vein following described. In the 12-week-old fetus, the proximal part of the left posterior cardinal vein remained, and the root of the left azygos vein was formed. The right supracardinal vein was separated the right hemiazygos and the accessory hemiazygos veins. The right hemiazygos vein extended into the left azygos vein via the anastomosis vein. The left azygos vein extended into the left superior vena cava (Fig. 4).
In this rare case, we observed the left superior vena cava. Additionally, we observed the abnormalities of the azygos venous system and the right subclavian artery. Therefore, we considered that it was necessary to note other abnormalities.

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