A Case of the Left-sided Inferior Vena Cava
with the Single Column Type of Azygos Venous System

By

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(with one textfigure and three figures in one plate)

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Summary: A rare anomaly, in which the left-sided inferior vena cava was present, accompanied by the single column type of azygos venous system, was found in an 86-year-old Japanese female among cadavers for student dissection. The vein in this case appeared to be represented as a persistence of the left postrenal segment of the fetal inferior venae cavae, without any visceral transposition. Accordingly, this case may belong to type A-II-b-2 of Edwards' classification (1951), type C of Reis et al. (1959), I-type C of Chuang et al. (1974), type III of Takemoto et al. (1978), and type II of Yoshida et al. (1981), of variations of the inferior vena cava. Since both the hemiazygos and the accessory hemiazygos veins were lacking in the azygos venous system, this pattern belongs to the single column type of Seib (1934).

Findings

Cadaver: Japanese, 86-year-old female, subject for student dissection in 1984. The cause of death was unknown.

A. Left-sided inferior vena cava (Figs. 2, 4)

This vein (about 24 mm in width) began from the confluence between the left and right common iliac veins at the level of the superior margin of the fifth lumbar vertebra behind the left common iliac artery. It ascended lateral to the left margin of the vertebral column for about 70 mm and received the left renal vein (the vena cava at this point was about 13 mm in width) at the level of the inferior margin of the second lumbar vertebra. After that, this vein (about 24 mm in width) turned upwards to the right, and received the left suprarenal vein after passing about 10 mm. Anterior to the abdominal aorta, this vein (about 26 mm in width) continued to run obliquely across it, beneath the origin of the superior mesenteric artery, for about 32 mm up to its right side at the level of the superior margin of the second lumbar vertebra. At this position, the two right renal veins poured into this vena cava (about 29 mm in width), which turned upwards to follow the usual course of the inferior vena cava.
cava in the normal case. In other words, the intimate inferior vena cava was not present, but only the left-sided one.

1) Common iliac veins

The left common iliac (about 15 mm in width) ran upwards to the right for about 50 mm behind the corresponding artery in front of the fifth lumbar vertebra.

The right common iliac (about 18 mm in width; longer than the left one) ran upwards to the left, inferoposterior to the corresponding artery from the level of the promontorium up to the fifth lumbar vertebra for about 66 mm. En route this vein received the median sacral vein (about 2 mm in width) from below, about 30 mm distal to the inflow of the left common iliac vein.

2) Left renal vein

This vein (about 10 mm in width), formed of four radices emerging from the renal hilus, poured into the left-sided inferior vena cava at right angles after running medially anterior to the corresponding artery for about 10 mm. The left ovarian vein (about 3 mm in width) also emptied from the left and inferior into the left and anterior wall of this junction.

3) Left suprarenal vein

This vein (about 6 mm in width) ran inferomedially and poured into the superior wall of the inferior vena cava, immediately distal to the above-mentioned junction.

4) Right renal veins

Two veins were observed. The inferior one was a posterior radix (about 4 mm in width), which received the right ovarian vein (about 4 mm) and a longitudinal vessel (about 4 mm), which appeared to be the longitudinal vein described by Seib (1934), from below and behind. A swelling on this vein was seen immediately before the inflow to the vena cava, while the superior one, formed of the superior (about 9 mm) and inferior (about 7 mm) radices, poured into the right wall of the vena cava, immediately distal to the inflow of the inferior one mentioned above.

5) Right suprarenal vein

This vein (about 3 mm in width) ran transversely in front of the first lumbar vertebra to pour into the posterior wall of the inferior vena cava.

6) Left lumbar veins

Five veins were observed. All the lumbar veins poured into the left ascending lumbar vein which ran between the left common iliac and the subcostal veins longitudinally. The third and second lumbar veins poured directly into the posterior wall of the vena cava.

7) Right lumbar veins

Five veins were observed. All the lumbar veins, similar to the left, poured into the right ascending lumbar vein, part of which was missing between the levels of the third and second vertebrae. The fourth, third and second lumbar veins poured into the longitudinal vein, being located medial to the right ascending lumbar vein. The superior end of the longitudinal vein emptied into the inferior one of the right renal veins. The right ascending lumbar and the longitudinal veins were communicated by the fourth lumbar vein, which poured into the vena cava.

B. Azygos venous system (Figs. 2, 3)

This system in the present case consisted of a single azygos vein only. The hemi-azygos and all other accessory vessels were not found. The present pattern corresponded exactly to the single column type of Seib (1934).

The azygos vein appeared primarily to be a confluence between the intermediate roots (Seib) of the inferior vena cava and the subcostal veins. It was shifted to the left and upwards at the level between the eleventh and tenth thoracic vertebrae, and again to the right apparently beyond
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...the median line in front of the fifth thoracic vertebra, and poured into the superior vena cava in front of the fourth thoracic vertebra.

The subcostal vein on each side received the ascending lumbar vein to form the lateral root (Seib 1934), which received the intermediate root (Seib) of the inferior vena cava to pour into the eleventh intercostal vein. The remaining intercostal veins poured into the single azygos vein, appearing grossly as a symmetrical pattern shown in Fig. 2.

C. Other vessels and the ureter

The portal venous system revealed a normal pattern.

A supernumerary vessel was observed with the right renal artery. This arose laterally from the abdominal aorta at the level of the fourth lumbar vertebra, and entered the renal parenchyma below the renal hilus, after passing behind the right ovarian vein.

The left ureter descended in front of the left-sided inferior vena cava.

Discussion

There are nine reports in the literature on the presence of a left-sided inferior vena cava in Japanese: one case each by Tadokoro (1929) and by Aso (1931), four cases by Adachi (1940), and one case each by Takemoto et al. (1978), by Kita-mura et al. (1980) and by Yoshida et al. (1981). The frequency of appearance of left-sided inferior vena cava has been estimated to be as follows: 0.54% by Seib (1934), 0.26% by Adachi and 0.2% by Reis et al. (1959).

As regards the cause of appearance of left-sided inferior vena cava, an embryological hypothesis has been suggested by McClure and Butler (1925) as follows. By the fourth week of the embryo, the posterior cardinal, the subcardinal and the supracardinal veins bilaterally begin to appear in turn, and some segments of them subsequently grow strongly, while others are reduced or disappear since anastomoses develop between these veins. According to their description, the formation of left-sided inferior vena cava under such conditions can be considered as follows. The postrenal segment of the left-sided inferior vena cava arises through the disappearance of the right supracardinal vein and persistence of the left fellow, since the left ureter was found anterior to the vena cava and the left ovarian vein poured into it (Fig. 1).

Variations of the inferior vena cava have been classified in various ways. The present case belongs to type A-II-b-2 of Edwards (1951), type C of Reis and Esenther (1959), I-type C of Chuang et al. (1974) and type...
III of Takemoto et al. (1978). Further, variations of the left-sided inferior vena cava were grouped into five types by Yoshi-da et al. (1981), and the present case probably belongs to their type II, since partial persistence of the right supracardinal vein was seen. They included such cases in which there was accompanying complete heterotaxia, and reported them as type IV. However, their analysis may not be adequate since this vessel in association with all organs occurred in transposition during the developmental process of the embryo. The inferior vena cava found in such individuals should not be treated as so-called "left-sided". The present authors thus wish to express a definite opinion concerning the so-called left-sided inferior vena cava, as follows. This type of vena cava is not only located on the left side but also any vessel corresponding to such a vein is defective on the opposite side, and the so-called oblique segment which passes beyond the median line to the right side should be present.

The azygos system in the present case consisted of a single azygos vein alone. This may have been formed as follows. The right supracardinal vein persisted throughout the embryological term, whereas the left fellow (the left medial sympathetic vein of Seib 1934) may be lacking in its thoracic portion. The azygos vein in this case began with the lateral and intermediate roots. The former was formed from the confluence between the ascending lumbar and the subcostal veins on each side. The left intermediate root is originally the intermediate hemi-azygos root (the left lumbar azygos vein of Gladstone 1929), and the right fellow is the intermediate azygos root (the right lumbar azygos vein of Gladstone). The intermediate hemiazygos root in the present case is considered to be a remnant of the left supracardinal vein (the lumbar portion of the left medial sympathetic vein) since the left second lumbar vein poured into the subcostal, immediately superior to its inflow into the left-sided inferior vena cava. The intermediate azygos root is considered to be a remnant of the right supracardinal vein. Finally, each intermediate root may be a remnant of the supracardinal vein in an area superior to the supracardinal-subcardinal anastomosis during the development of the inferior vena cava on each side.

On the right side, the longitudinal vein was located medial to the right ascending lumbar vein. This vein is considered to be a remnant of the lumbar portion of the right supracardinal vein (the right medial sympathetic vein of Seib) since it poured into the posterior wall of the right renal vein (Fig. 1).

Variations of the azygos system have been grouped into three types: the double column, the transitional and the single column of Seib (1934), based on the number of breaks in the hemiazygos vein. In addition, the origins of the azygos vein were grouped by him, based on the existence of the intermediate roots, as follows: type B with both the intermediate azygos (IAR) and hemiazygos (IHAR) roots, type R with only the IAR, type L with only the IHAR, and type N with neither. According to these classifications, the present case would belong to the single column and type B.

Based on the gross classification of variations in the azygos system of Japanese, the present case would belong to the modified type of Hatta (1932), type IV of Hashimoto (1940), Tokudome (1951), Rokutanda (1959) and Murakami et al. (1980).

The causes of the variations observed in both the left-sided inferior vena cava and the azygos system in the present case are thus comprehensible, although the embryological developmental patterns are very close to each other.

However, the inferior vena cava has
several advantages on the left side over the right one, while the azygos vein was found in a reverse pattern. This is an interesting feature of the present case but no indication of its reasons. In the literature, cases previously reported with left-sided inferior vena cava were not accompanied by statements regarding variations of the azygos system, apart from three cases. In only one of these three cases, was such a variation of this system described by Yoshida et al. (1981). Thus, when any variations of the inferior vena cava are found, the patterns of the azygos system should be observed carefully in association with the vena cava.

References

### Abbreviations

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<thead>
<tr>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>a</td>
<td>Abdominal aorta</td>
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<td>al</td>
<td>Ascending lumbar vein</td>
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<td>az</td>
<td>Azygos vein</td>
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<td>Common iliac artery</td>
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<td>Longitudinal vein</td>
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<td>Ureter</td>
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PLATES
Explanation of Figures

Plate I

Line drawing and photographs of the present case.

Fig. 2. The left-sided inferior vena cava and the azygos venous system.

Fig. 3. The azygos venous system. The aorta and the diaphragm were removed.

Fig. 4. The left-sided inferior vena cava.