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Case Report

A left inferior vena cava with crossover to the right: a case report

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Abstract

Vascular variants are a known entity in the field of surgical anatomy, with many of the conditions compatible with life. These variants have clinical implications, especially when they are symptomatic. Identification and definition of specific conditions is vital for their specific management.

A case of a left-sided inferior vena cava (IVC) with crossover to the right was found on routine dissection of the abdominal region. This was in an adult, African, male cadaver. This left-sided IVC crossed over, obliquely from the level of fourth lumbar vertebra (L4) to the second lumbar vertebra (L2). It continued its course on the right side of the abdominal aorta, receiving a tributary from a fusion of the right testicular vein and the right ascending lumbar vein at the level of L3.

This case illustrates the importance of careful routine dissection in human gross anatomy study. With background knowledge of human embryology, one is able to document all variants encountered.

Key words [left inferior vena cava] [variant] [cross-over] [African male] [cadaver]

Introduction

Variations of the anatomy of the inferior vena cava (IVC) are quite common given the complex nature of the embryologic development of the venous system [1–3]. Cases of absent IVC [4], double IVC, transposition of IVC (also known as a left IVC) have all been documented [5]. Other well-founded variations are a persistent left IVC [1] and malformations associated with right renal aplasia, renal hypoplasia and hypertrophic kidneys [3–5].

Case Report

The finding was in an adult, African male. The cause of death was not known. This observation was made during routine gross anatomical dissection of the abdomen. Still digital photographs were taken for illustration. The organs and vasculature of the thorax were essentially normal and positioned in their most regularly locations. Abdomino-pelvic organs were also as usual in structure and position. The heart and pericardium had been dissected out, previously.

The peculiar presentation was a left infrarenal IVC (diameter: 2 cm) arising from the two common iliac veins posterior to the left common iliac artery. It ascended to the level of an area about the midpoint of L4 vertebrae where it begun a crossover course from left to right, obliquely (Figure 1). Above the point of commencement of the crossover, it fused with the left renal vein (diameter: 1.5 cm). The crossover was complete at the level of L2 where it received the right renal vein (diameter; 1.5 cm). The IVC then continued its ascent and traversed the diaphragm in the usual anatomical position. Its terminus in the chest could not be clearly appreciated due to the earlier dissection.

An ascending right lumbar vein and a right testicular vein united at the level of L4 and joined the IVC at L2-3 vertebrae junction (Figure 2). No other vascular variants were found within the abdomino-pelvic region.

Discussion

Embryologic development is the cause of variations of the IVC [1–4]. The most frequently occurring ones are: an absent IVC with or without an azygos system variance; a double IVC with a persistent left supracardinal vein [3]; transposition or left sided IVC; and a persistent left IVC. Venous system developmental variations take shape during the vulnerable embryonic period –3rd to 8th week of intrauterine life [3].

The IVC develops from the cardinal veins. There is an anastomosis between the left and right sides. The left sacrocardinal veins give rise to the left common iliac vein while those on the right side give the definitive IVC. Thus, normally the IVC commences to the right side (2.5 cm from the median plane) of L5 vertebra by the union of the common

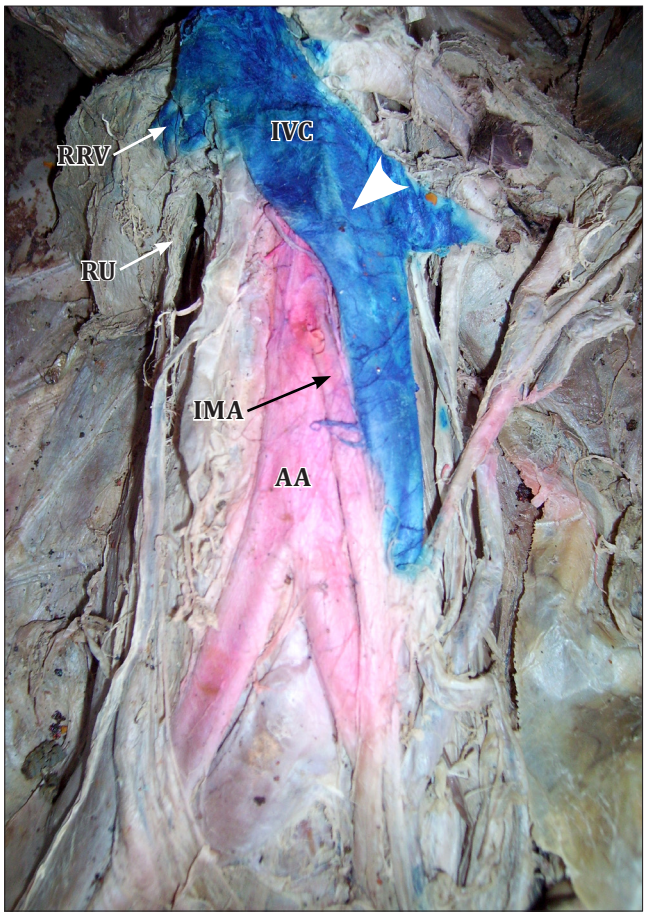

Figure 1. *Inferior vena cava (**IVC**)* and its relationship with the *abdominal aorta (**AA**). (**White arrowhead**: oblique crossover of IVC from left to right; **RRV**: right renal vein; **RU**: right ureter; **IMA**: inferior mesenteric artery; **pink-shading**: arteries; **blue-shading**: veins)*

iliac veins. It should lie inferior to the aortic bifurcation and posterior to the proximal part of the right common iliac artery [1, 3].

In this case, there is a left sided IVC, indicating a persistence of the left sacrocardinal veins' prominent role. It lies 2 to 3 cm from the median plane, to the left of the aorta. It is formed by the union of the right and left common iliac veins posterior to the left common iliac artery. At the level of L4 vertebrae, it begins an oblique crossover from left to right of the aorta, anterior to it. This course ends at the level between L2 and L3. On the right side there is a tributary at the level of L3 formed by the union of the ascending right lumbar vein and the right testicular vein. The azygos vein is normal and continuous with the right renal vein.

There are clinical implications of this condition. Clinical features related to hematologic and vascular complications are likely [6–8]. Pulmonary embolism is top of the list. It is estimated that deep venous thrombosis (DVT), a leading cause of embolism, occurs in one case per thousand patients, each year, and in up to 80% a risk factor can be identified [6]. Ruggeri et al. described four cases of absent IVC over a five-year period [9]. They had presented with idiopathic DVT in those below 30 years of age. This was estimated to represent 5% of cases of "idiopathic" DVT in young people. Venous kinking at the point of crossing over the vertebrae and aorta, causes a physical obstruction to blood flow and thus venous return. The resulting stasis of blood in the pelvic and lower limb deep veins predisposes to coagulation. This explains the DVT and further venous obstruction. Clinical features of IVC obstruction (lower limb swelling, "pitting" edema, varicose veins) may be present, with or without DVT. Individuals may otherwise be asymptomatic.

Radiological examination is important in venous variant and anomaly detection, along with associated complications [8–11]. Undiagnosed IVC variations may complicate operative surgery [1, 9–11].

Color Doppler ultrasound (US) scanning is a first line investigation that can be useful in this case. The most reliable non-invasive radiological methods for diagnosing IVC variants

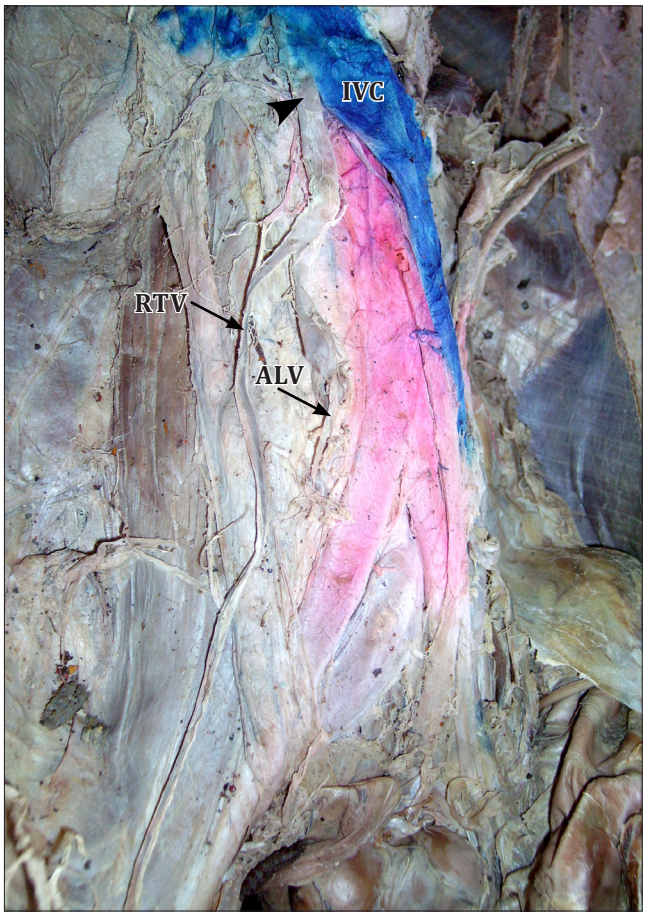

Figure 2. *Union (**arrowhead**)* of the *ascending lumbar vein (**ALV**)* and *right testicular vein (**RTV**)* as *inferior vena cava (**IVC**)* tributary. *(**Pink-shading**: arteries; **blue-shading**: veins)*

are computerized tomography (CT) with intravenous contrast or magnetic resonance imaging (MRI) [6, 10, 11]. A CT scan is a better imaging modality of the retro-peritoneal space, than US [11]. Another accurate, but invasive, imaging modality is venography, which is particularly useful if operative surgery is planned [11].

Patients with a left IVC with crossover should therefore be managed as follows:

- Clinical examination –note the presence of lower limb swelling, "pitting" edema and varicose veins; and radiological examination– Doppler US scanning of abdomino-pelvic vasculature. Cardiac, renal and hepatic disease should be excluded when considering edema. These conditions cause edema more commonly.
- Investigation of blood coagulation factors, and risk factors associated with thrombosis. These include lipid profiles and smoking, among others.
- Institution of anti-thrombotic agents for all individuals.
- Operative surgical intervention especially following thrombosis.

The surgical procedures for IVC variations/anomalies rotate around:

- IVC partial ligation, plication [1] and venous filter placement [12] to avoid embolism following thrombosis.
- Manipulation of displaced intervertebral discs that may be exerting pressure or causing injury to the IVC in its unusual position [1].

A left IVC can cause left sympathetic trunk obstruction as well [1]. Associated sympathetic impairment can be seen through spinal nerves' peripheral malfunction; warm extremities (vasodilatation) and lack of perspiration (anhydrosis).

It can thus be appreciated that surgical venous procedures to prevent embolism are important in case management. Medical anti-thrombotic therapy is instituted as well, following diagnosis.

In conclusion, it is important to document all anatomical variants found during routine dissection.

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