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Case report

Incidental discovery of duplicated inferior vena cava in a septuagenarian: the radiologist's viewpoint[☆]

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ABSTRACT

Duplication of the inferior vena cava is a rare malformation, normally without clinical impact, explained by abnormal development and regression of certain segments of the venous system during embryonic life. However, its presence and type should be systematically reported in the radiological report because of its potential implications for diagnostic and interventional procedures. This observation describes the case of a 77-year-old man with a complete asymmetric duplication of the inferior vena cava (type III IVC according to Natsis) that was incidentally discovered on CT-scan.

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Introduction

The inferior vena cava (IVC) is a large vein located primarily in the abdomen, arising from the union of the two common iliac veins and opening into the right atrium of the heart. The normal IVC is composed of four segments: hep-

atic, suprarenal, renal and infrarenal. It drains the part of the body below the diaphragm, i.e. the lower limbs, perineum, pelvis and abdomen [1]. Duplication of the inferior vena cava is rare, present in 0.2% to 0.3% of the population with per operative results between 0.2% and 0.6% [2]. It is one of the congenital anomalies of the IVC of post renal topography, resulting from the persistence of the right and left supracar-

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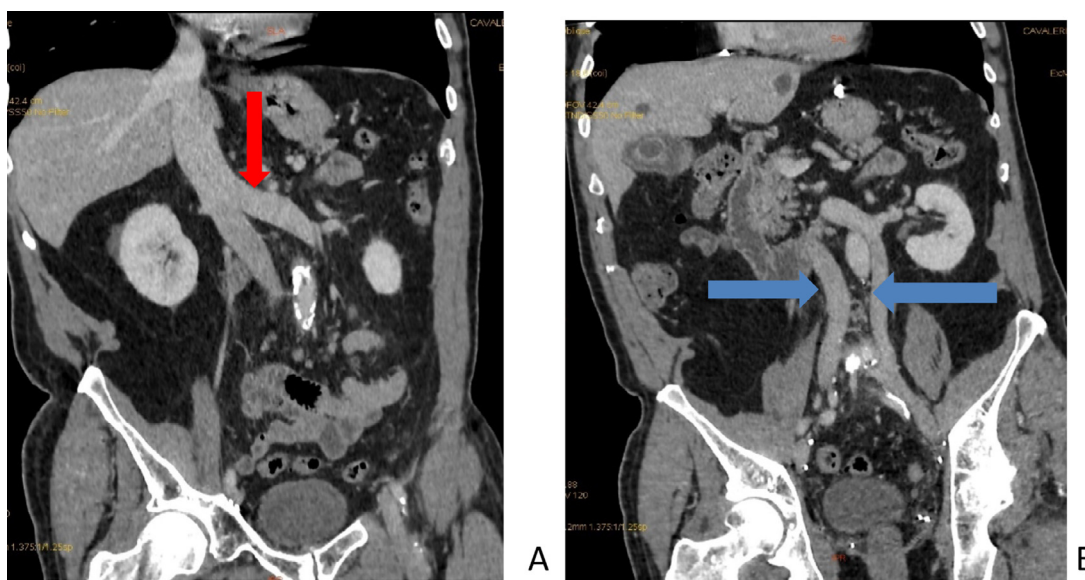


Fig. 1 – Abdomino-pelvic CT scan in coronal slices in the portal phase: asymmetric complete duplication of type III IVC according to Natsis [2] (A: red arrow: MPAT; B: blue arrows:right and left IVC). (Color version of the figure is available online.)

dinal veins. We report the case of a septuagenarian with a complete asymmetric duplication of the inferior vena cava of type III according to Natsis [2] of incidental discovery on CT scan.

Case presentation

A 77-year-old man was referred by the emergency department for an abdominal-pelvic CT scan with clinical information on cytotoxicity, cholestasis, suspicion of gallstone migration and search for a pancreatic neoplastic obstruction.

On physical examination, the man presented with fluctuating pain in the right hypochondrium for 04 days, without associated fever or biological inflammatory syndrome. The serum lipase level was normal.

His main medical history was a prostatic neoplasia operated with radiotherapy afterwards for recurrence due to an increase in circulating PSA levels; he was also a peripheral vasculopathy with ischemic heart disease who had undergone iliac and coronary angioplasty.

The abdominal ultrasound previously performed showed multiple gallstones without clear signs of cholecystitis.

The CT scan was performed on a device with 16 detector rows; the PDL (Product Dose Length) was 1338 mGy.cm. An acquisition of the abdomen in spontaneous contrast, of the liver at arterial phase, and of the abdomen and pelvis at portal phase of a 90 ml injection of Xenetix 350 were performed successively.

Analysis of the CT scans showed 03 cholesterol-like vesicular gallstones without evidence of gallbladder inflammation, hepatic biliary cysts, nondilated intra- and extra-hepatic bile ducts without pancreatic mass syndrome, and a small patch of splenic ischemia underneath the inferior polar capsular; the prostatic compartment was empty with multiple surgical clips within the pelvic excavation.

Incidentally, a fusion defect of the right and left common iliac veins with a duplication of the inferior vena cava was demonstrated, each common iliac vein draining into the ipsilateral inferior vena cava and the two vena cava running on either side of the aorta.

The left IVC, after receiving the ipsilateral renal vein at L2, continued into a major preaortic trunk (MPAT) that moved obliquely in front of the aorta under the emergence of the superior mesenteric artery. At the level of L1 the MPAT emptied into the right IVC which received at the same level the right renal vein (Figs. 1,2 and 3).

There was no positional abnormality of the ureters or anastomosis between the iliac veins or the inferior vena cava. The hepatic and suprarenal portions of the IVC were normal.

The left and right IVC had a transverse diameter of 13 and 19 mm, respectively, compared with 34 mm for the MPAT (Figs. 4).

In total, it was a complete asymmetric duplication of type III IVC according to Natsis [2] because it involved both the renal segment and the infrarenal segment with a left IVC of smaller diameter (Figs. 5 and 6).

The patient received 2 weeks later a laparoscopic cholecystectomy; the surgery was carried out without incident or complications. The IVC anatomy was observed and confirmed at the surgery. The patient was released the same day.

Discussion

The formation of the IVC is a complex process involving anastomosis, degeneration and growth from three pairs of parallel veins between four and eight weeks of life, the posterior cardinal, subcardinal and supracardinal veins [3]. This irregular vascular network, which is constantly modified during

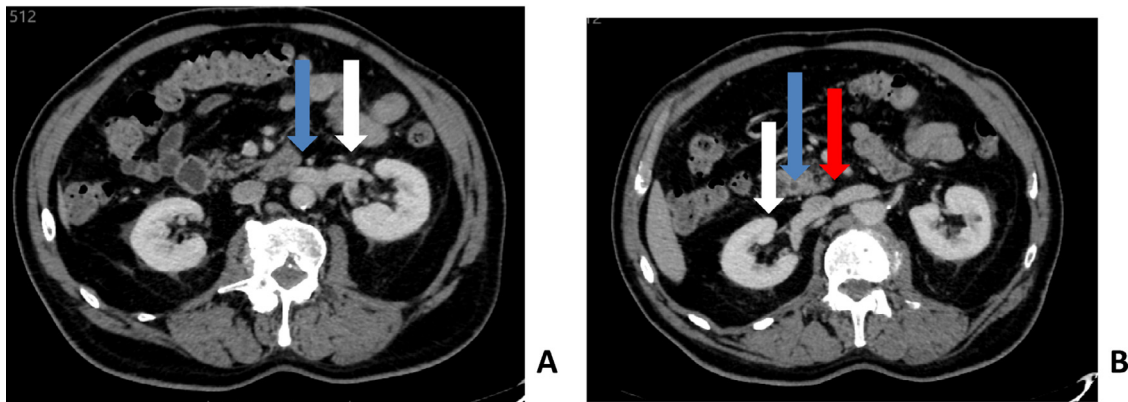


Fig. 2 – Abdomino-pelvic CT in axial slices in the portal phase: A: left IVC (blue arrow) receiving the left renal vein (white arrow) at the level of L2; B: Right IVC (blue arrow) receiving at L1, the major pre-aortic trunk (MPAT) (red arrow) and the right renal vein (white arrow). duct (Color version of the figure is available online.)

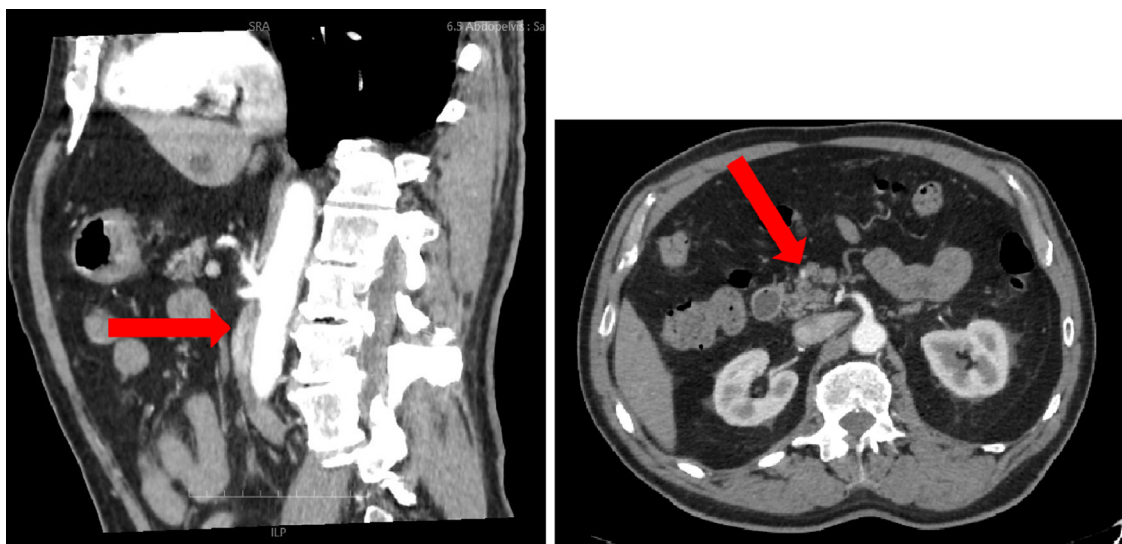


Fig. 3 – Abdomino-pelvic CT in sagittal and axial sections in arterial phase: major pre aortic trunk (MPAT) (red arrow) crossing obliquely in front of the aorta, in the aortomesenteric clamp with a physiological angle of about 90 degrees. (Color version of the figure is available online.)

the embryonic stage, explains in part the high prevalence of abnormalities in this system [4]. Indeed, there are 14 types of congenital malformations of the IVC that can be divided into 4 groups: pre-renal, renal, postrenal and multisegmental. Duplication of the IVC (DIVC) is part of the postrenal anomalies by persistence of the right and left supracardinal veins. It is rare, as shown by the prospective anatomical study of Klinkhachorn [5] in Virginia, USA, who evaluated 129 cadavers for variations of the inferior vena cava. One of the 129 cadavers (0.78%) had a double inferior vena cava.

Yano [6], in his work on 02 cases of the double IVC in 2000 in Japan, labeled them the first and second cases among 808 cadavers in the Gifu University Medical School and the 93rd and 94th cases in Japan since 1901.

Clinically, these malformations are often asymptomatic, discovered incidentally on imaging, as was the case in our patient.

CT scan is the method of choice for imaging the IVC [7]. Indeed, CT offers the advantages of being a non-invasive technique, available, fast and which allows to obtain volumetric images of high spatial resolution, with possibilities of 3D reconstructions.

From a technical point of view, the inferior vena cava is difficult to opacify as a whole on CT; this is due to the fact that the renal veins and the suprarenal part of the inferior vena cava opacify rapidly at about 70 seconds and the sub-renal part of the IVC opacifies only after the passage of the contrast medium in the lower limbs, i.e., 2 minutes or more [8]; This constraint is rapidly lifted thanks to the two acquisitions at the arterial and portal phases of the iodinated contrast injection, as was the case in our observation.

According to Burney *et al.* [9], only magnetic resonance imaging (MRI) allows the study of the IVC.

For others [10,11], CT and MRI have the same value.

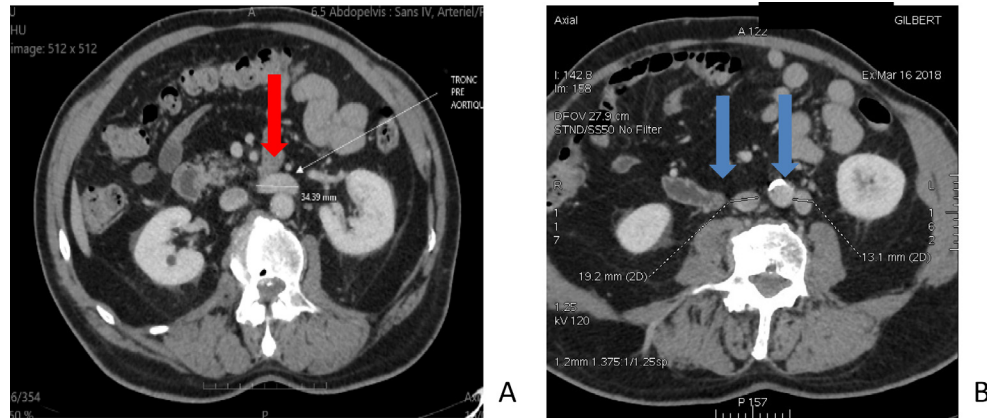


Fig. 4 – Abdomino-pelvic CT in axial slices in the portal phase: The left and right IVC (B: blue arrows) had a transverse diameter of 13 and 19 mm, respectively, compared with 34 mm for the MPAT major pre-aortic trunk (A: MPAT: red arrow). (Color version of the figure is available online.)

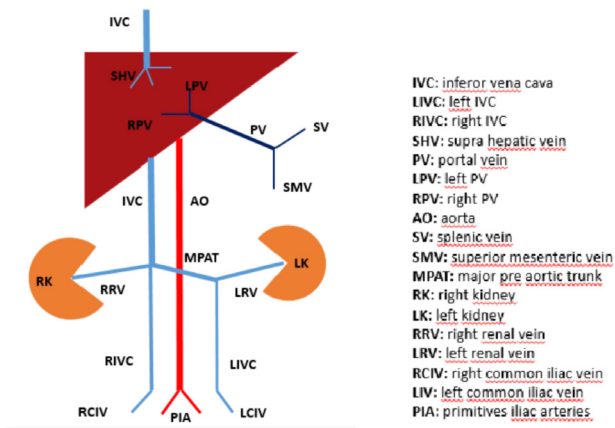


Fig. 5 – Diagram showing the IVC anatomy in the patient

We found a complete asymmetric duplicated IVC of type III according to Natsis [2]. This classification, based on the gross appearance of the preaortic anastomotic trunk between the left and right IVC as well as on the underlying embryological features, is proposed: incomplete bilateral duplication of the IVC and complete bilateral duplication of the IVC. The latter can be further divided into three types: major, minor and asymmetric.

-Major duplication (Type I) comprises two bilaterally symmetrical and approximately of the same caliber trunks and a preaortic trunk of the same caliber.

-Minor duplication (Type II) comprises two bilaterally symmetrical and approximately of the same caliber trunks, but is smaller in comparison to the preaortic trunk.

-Asymmetric duplication (Type III) comprises small left IVC, larger right IVC and even larger preaortic trunk or small left IVC, larger preaortic trunk and even larger right IVC.

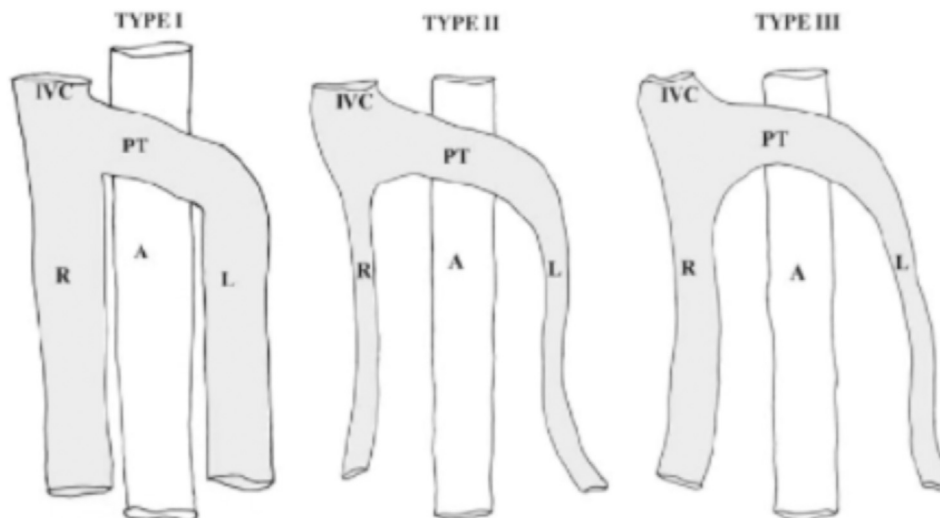


Fig. 6 – Schematic drawings of the three types of IVC duplication according to Natsis []

Yano [6] in his study also found duplicated IVC of the same type III. In the first case (70-year-old man), the calibers of the right and left IVC were 15 mm and 13 mm, respectively. In the second case (86-year-old man), the calibers of the right and left IVC were 15 mm and 10 mm, respectively.

Nakatani [12] in his work on the Japanese cadavers of a 91-year-old man and a 71-year-old woman showed typical incomplete duplicated IVC; the left IVC was much smaller than the right one and flowed into the left renal vein. In one case, the right IVC was twice the diameter of the left IVC, and in the other, it was five times larger.

In 2020, Klinkhachorn [5] proposed in his report, a variation in which the diameter of the left IVC is larger than that of the right IVC. De facto, this new variation, not corresponding to any of the Natsis classification types, was labeled type IV.

In our observation, the MPAT moved obliquely anterior to the aorta under the emergence of the superior mesenteric artery to empty into the right IVC at L1. This aspect should not be confused with the "nutcracker" syndrome, which is a stenosing compression of the left renal vein (LRV), either anteriorly in the aortomesenteric clamp with an angle less than 35 degrees or posteriorly in the aortovertebral clamp.

In our patient, it was the MPAT that passed through in the aortomesenteric clamp with a normal angle of approximately 90 degrees.

The recognition of these abnormalities and in particular of the duplication of the IVC is crucial for the radiologist and should be included in his report because of its implications in diagnostic, surgical and interventional procedures [13].

Indeed, patients with these IVC abnormalities are predisposed to deep vein thrombosis (DVT) [14], with these abnormalities associated with approximately 5% of DVT cases. The etiology is thought to be slow circulation. No history of DVT was found in our patient.

In imaging, IVC malformations, including duplicated IVC, should not be confused with other pathologies, in particular retroperitoneal adenomegaly, at the risk of leading to diagnostic error and its therapeutic corollary [15]. Posttreatment with multiplanar and vascular reconstructions generally rectify the diagnosis.

In patients eligible for any abdominal surgery in general, such as our patient, the presence of these anomalies must absolutely be reported by the radiologist in view of the potential severe hemorrhagic complications [16] which may jeopardize the patient's vital prognosis.

Conclusion

Notwithstanding the obvious rarity of congenital anomalies of the IVC in general and duplicated IVC in particular, their importance should not be underestimated. The radiologist should be familiar with the different types of duplicated IVC in order to recognize them easily. The injected abdominal-pelvic CT is the examination of choice for diagnosis, provided that the technique is rigorous. These abnormalities, especially duplicated IVC, must be reported on the radiology report in order to avoid potentially fatal intraoperative or interventional complications.

Author contributions

Writing: DTG

Critical review and revision: DTG and AEBBT

Final approval of the article: all authors

Responsibility for all aspects of the work: all authors

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