CASE REPORT

Variant ventral intrahepatic course of inferior vena cava: volume-rendering and maximum intensity projection CT findings

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ABSTRACT. Anatomically, the inferior vena cava (IVC) courses through the liver posteriorly and drains into the right atrium. We describe an extremely rare case of the anterior intrahepatic course of the IVC that drained into the right atrium seen on a CT scan of a healthy 26-year-old female who presented to the emergency room with abdominal pain. The anterior intrahepatic segment was bridged to the posteroinferior portion of the IVC by an oblique segment. Associated renal and arterial anomalies were also observed in our patient.

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Since the development of cross-sectional imaging, congenital anomalies of the inferior vena cava (IVC) and its tributaries have been encountered more frequently in asymptomatic patients [1, 2]. Vascular structures are usually readily identified on CT scans of the abdomen and pelvis obtained with intravenously administered contrast material.

Multiple congenital anomalies of IVC have been described in the literature including left-sided IVC, double IVC, azygos continuation of the IVC, circumaortic left renal vein and retroaortic left renal vein [3, 4]. Other anomalies include the absence of the infrarenal IVC or the entire IVC. Some variations are associated with congenital heart disease, but detection of unusual IVC system in patients without any clinical symptoms by CT is not uncommon [5].

We describe an extremely rare case of an anteriorly located variant intrahepatic course of the IVC with an oblique segment bridging this anterior intrahepatic segment with the posterior inferior segment of the IVC. In reporting this case, we have used maximum intensity projection (MIP) imaging to depict the structural relationship of IVC to adjacent viscera.

Case report

A 26-year-old female presented to the emergency room with a 3 day history of generalised abdominal pain and vomiting. Medical and surgical histories were unremarkable. The patient had no known history of IVC dissection or iatrogenic IVC injuries. Laboratory values were within normal limits. A contrast-enhanced CT scan was performed to exclude bowel pathology.

Incidentally, CT imaging showed an intrahepatic portion of the IVC coursing anteriorly through the liver and the diaphragm with anatomical insertion into the right atrium (Figure 1a). This anterior intrahepatic segment was bridged to the posteroinferior portion of the IVC by an oblique segment (Figure 1d). The inferior phrenic veins were not well visualised. The hepatic veins were seen traversing anteriorly to insert into the ventrally located intrahepatic IVC (Figure 1c). The renal veins were seen coursing anteriorly to drain into the oblique segment (Figure 1b). Normal morphology was observed within the portal venous system. The infrarenal IVC demonstrated a normal retroperitoneal course and calibre without any associated anomalies. The ovarian veins demonstrated a normal drainage pattern with the left ovarian vein draining into the left renal vein and the right ovarian vein draining into the infrarenal IVC. The lumbar veins were not enlarged and demonstrated a normal course. The common iliac veins along with external and internal iliac veins showed a normal course and morphology. The kidneys were noted to be located in an unusually superior position just below the diaphragm (Figure 1a), while the spleen was seen in an overly anterior position. Additionally, the superior mesenteric artery and the coeliac axis shared a common origin from the abdominal aorta. Otherwise, CT examination did not reveal any significant acute intrabdominal pathology.

Discussion

Embryologically, the normal IVC is composed of four segments: hepatic, suprarenal, renal and infrarenal. The hepatic segment is derived from the vitelline vein. The right subcardinal vein develops into the suprarenal segment by the formation of the subcardinal-hepatic anastomosis. The renal segment develops from the right suprasubcardinal and post-subcardinal anastomoses.

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Figure 1. (a) Contrast-enhanced axial maximum intensity projection (MIP) CT image demonstrates an anteriorly located inferior vena cava (IVC) (solid white arrow) in close proximity to the anterior abdominal wall. Note the immediate subdiaphragmatic anomalous location of the kidneys. (b) Axial MIP CT image demonstrates renal veins (solid black arrow) draining into the oblique segment of the IVC. (c) Oblique sagittal MIP CT image shows hepatic veins (dashed black arrow) coursing anteriorly to drain into the IVC. (d) Oblique sagittal MIP image depicting the obliquely orientated segment (dashed white arrow) of IVC bridging the anterior and posterior IVC.

It is generally accepted that the infrarenal segment derives from the right supracardinal vein, although this idea is somewhat controversial [6]. In the thoracic region, the supracardinal veins give rise to the azygos and hemiazygos veins. In the abdomen, the post-cardinal veins are progressively replaced by the subcardinal and supracardinal veins but persist in the pelvis as the common iliac veins. The aberrant development of these venous systems, for unknown reasons, causes anomalies of the IVC system [7].

Anomalies of the IVC occur in less than 1% of patients and can be readily recognised on multidetector row CT and MR angiography [7]. With advances in non-invasive vascular imaging, anatomical variants and anomalies of the IVC have become more commonly recognised in routine practice.

In patients with a congenital anomaly of the IVC, concomitant arterial abnormalities should be considered [8]. First-degree relatives may be at risk of congenital vascular anomalies. Our case did not illicit any known family history of congenital anomalies of the vascular system contrary to the cases reported by Obernosterer et al [8]. In addition, patients did not have any documented associated congenital cardiac anomalies, which are frequently associated with IVC anomalies.

Gayer et al [9] proposed a possible association of IVC anomalies with right renal hypoplasia or aplasia in a small series of patients. Our case did not demonstrate any evidence for renal hypo- or aplasia. However, on review of the literature, it is unclear whether the unusual immediate subdiaphragmatic location of the kidneys observed in our case was an incidental finding or if it has any linkage to the anatomical IVC variations.

To our knowledge, this variant anterior intrahepatic course of IVC has not been described previously along with associated immediate subdiaphragmatic location of kidneys. The case presented here possibly represents an aberration of the normal developmental anastomosis between the right subcardinal vein and the right vitelline vein. This anatomical variant may potentially increase the risk of traumatic injuries to the IVC owing to an unusually anterior location. It has been previously suggested that the pre-operative diagnosis of the vascular anomalies reduces the complication rate of abdominal vascular procedures [10, 11]. An accurate diagnosis of such a congenital variant, as well as other anatomical variations of the IVC, may have increased importance in planning abdominal surgery, liver or kidney transplantation as well as interventional or diagnostic procedures such as IVC filter placement, varicocele sclerotherapy and renal venous sampling. MIP contrast-enhanced CT imaging not only provides a non-invasive method of diagnosing anatomical IVC variations but may also accurately describes its relationship to the adjacent viscera.

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