

Magnetic resonance venography of double inferior vena cava

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ABSTRACT

Duplication of the inferior vena cava (IVC) is the most common anomaly affecting the vena cava. Variations of the IVC are diagnosed in routine dissection studies, in retroperitoneal surgeries, or in radiological studies for various reasons. In this paper, we present a case of double IVC with its magnetic resonance imaging findings.

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Venous anomalies are frequently observed and are mainly resulting from errors of the embryological development. Venous anomalies of the retroperitoneal region have been described extensively by anatomists, radiologists and surgeons operating in this region. These anomalies have plenty of clinical implications. Inferior vena cava (IVC) develops in a complex process beginning from the fourth week of conception through the embryonic period and ends at approximately the eighth week. There is an interconnected venous system of the embryo draining the lower portion and consisting of 3 pairs of parallel veins. These are the postcardinal veins, the subcardinal veins and the supracardinal veins. The IVC is formed from these 3 parallel veins that subsequently appear and regress. Main venous drainage system of the embryo is maintained by the cardinal veins. The posterior cardinal veins are first to develop, being the vessels of the mesonephron and disappear with these transitory kidneys. The only adult derivatives of the posterior cardinal veins are the root the azygos vein and the common iliac veins. The subcardinal veins appear on the fifth week. They are connected with

each other through the subcardinal anastomosis and with the posterior cardinal veins through the mesonephric sinusoids. The subcardinal veins form the stem of the left renal vein, the suprarenal (adrenal) veins, the gonadal veins and the prerenal segment of the IVC. Lastly, the supracardinal veins develop. They are united by anastomosis that is represented in the adult by the azygos and the hemiazygos veins. The infrarenal portion of the IVC is formed by the persistence of the right supracardinal vein and the renal veins are formed by the anastomosis between the subcardinal and the supracardinal veins. Caudal to the kidneys, the left supracardinal vein degenerates but the right one becomes the IVC. The final development of the "normal" right-sided IVC is a reflection of the persistence of the right subcardinal veins as the prerenal segment, the subsupracardinal vein (anastomosis between subcardinal and supracardinal veins) as the renal segment, the right supracardinal vein as the postrenal segment and the posterior cardinals as the iliac bifurcation and iliac veins.^{1,2} Duplication of IVC is the most observed anomaly having been estimated to occur in 2-3%.¹

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Case Report. A 40-year-old man presented with a right sided flank pain. Ultrasound was performed. No renal stone was noted, however, a hypochoic lesion was seen adjacent to the left side of the abdominal aorta. Abdominal magnetic resonance (MR) and gadolinium-enhanced MR venography were performed. Coronal T1 weighted images and 3D gradient echo images with 3 mm thickness were obtained before and after administration of intravenous gadolinium at 20th, 40th and 60th seconds. Sagittal and coronal multiplanar reformatted images of venous phase were obtained at a workstation. The images revealed an accessory of the left IVC as well as a normal vena cava (VC) on the axial sections. Both VC were formed from the corresponding common iliac veins ascending on both sides of the abdominal aorta to the level of the left renal vein (Figure 1 & 2). They join to form a common trunk at the suprarenal level and continue cranially as a single IVC to the right atrium. On the coronal MR venography images, the vena cavae are seen as duplicate in their full course to the level of the renal veins (Figure 3 & 4). Superior to this level is the left VC that turns obliquely to the right and unites with the right one to form the suprarenal VC (Figure 5).

Discussion. Double IVC occurred due to the persistence of the left supracardinal vein.³ The most major anomalies that the IVC encountered are; duplication of the IVC, transposition of IVC (left IVC), circumaortic (left) renal vein, retroaortic (left) renal vein and the absence of the hepatic portion of the IVC.^{1,2} Duplications of the IVC constitutes the major portion having a prevalence of 2-3%.¹ The double IVC in the presented case is considered as persistence of both right and left supracardinal veins. Associated anomalies reported with duplication of the abdominal VC includes cloacal extrophy, congenital absence of the right kidney, right retrocaval ureter, left retrocaval ureter and the congenital absence of iliac anastomosis.^{1,4,5} anomalous drainage from the left arm⁶ and ostium primum and ostium secundum with abnormal left atrial drainage.⁷ Faer et al⁸ denotes that the understanding of the anatomical variations of the IVC has a significance in the cross-sectional images, radio nuclide venography or catheterization and opacification of the IVC. Errors may result in misinterpretation of the anomalous venous drainage as a mediastinal mass or paravertebral lymphadenopathy. Thus, when an anomaly of the IVC is suspected by a radiologic finding on abdominal computed tomogram (CT) or ultrasound, it is necessary to perform an inferior venogram or MR imaging study to outline precisely the vena caval system. Venous anomalies of the retroperitoneal region should be one of the concerns

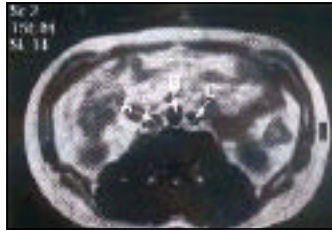


Figure 1 - Abdominal magnetic resonance image showing: (A) right inferior vena cava (IVC), (B) abdominal aorta, (C) left IVC.

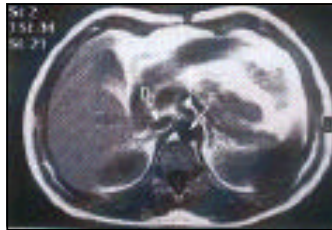


Figure 2 - Abdominal magnetic resonance image showing: (D) right inferior vena cava, (E) celiac trunk, (F) abdominal aorta.

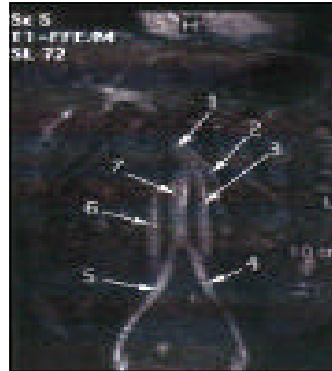


Figure 3 - Coronal magnetic resonance venography image showing: (1) common inferior vena cava (IVC), (2) left gonadal vein, (3) left IVC, (4) left common iliac artery, (5) right common iliac artery, (6) right IVC, (7) abdominal aorta.

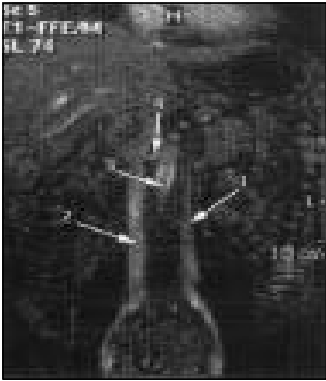


Figure 4 - Coronal magnetic resonance venography image showing: (1) left inferior vena cava (IVC), (2) right IVC, (3) abdominal aorta, (4) right renal artery.

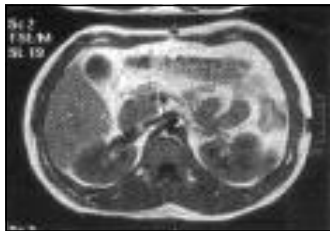


Figure 5 - Abdominal magnetic resonance image showing: (1) abdominal aorta, (2) common trunk of inferior vena cava, (3) right renal vein.

of the surgeon operating in this area. Recognition of the anomalies before the operation prevents the patient from the hazards of significant venous hemorrhage and helps the surgeon maintain the vascular anastomosis. Another surgical implication insists on a whole organ transplantation or radical nephrectomy to be carried out.^{1,9} Magnetic resonance venography allows detailed description of the vascular anatomy and its relationship to the collecting system and parenchyma to facilitate the surgeon's decision making.¹⁰ These findings of MR venography are more specific than the CT venography and conventional venography. Laissy et al¹¹ conclude that contrast-enhanced MR

venography should be useful in supplementing standard MR examination in monitoring venous invasion in renal carcinoma. Awareness of the possibility of duplication of IVC is also of clinical importance in staging for testicular neoplasms as the anomaly may be misinterpreted as being a lymphatic metastasis of the primary tumor.¹² In addition, the lymphatic drainage also has unusual patterns since the lymphatics tend to follow the vascular pattern. This is especially important in the lymph node dissection.⁹

In conclusion, although venous anomalies are rare, they have particular importance for various interruptions, as in retroperitoneal surgery, thoracic surgery and in the treatment of thromboembolic diseases. In addition, radiologists should be aware of the venous anomalies in order not to interpret them as a pathological finding.

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