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CASE REPORT

Duplication of the inferior vena cava with azygos continuation, retroaortic left renal vein and iliac vein variations

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Abstract: We present a rare complex variation of the inferior vena cava and internal iliac veins demonstrated by a multidetector computed tomography. It was shown that patient had double inferior vena cava with azygos continuation of the right inferior vena cava, retroaortic left renal vein and the left and right internal iliac veins converged and drained to the right external iliac vein through a common trunk. These variations of the inferior vena cava and iliac veins are important in the retroperitoneal surgery. We present multidetector computed tomography findings of this complex variation (Fig. 3, Ref. 12). Full Text in PDF *www.elis.sk.*
Key words: double inferior vena cava, azygos continuation, retroaortic left renal vein, iliac vein variation, multidetector computed tomography.

While retroperitoneal venous variations have been demonstrated during the dissection of cadavers in past years, with advanced radiologic techniques these variations have been demonstrated at an ever-increasing rate, particularly in asymptomatic cases (1). Awareness of the inferior vena cava (IVC) and pelvic venous variations would make a great contribution toward reducing or eliminating the risk for severe hemorrhage during abdominal surgery (2). Duplication of the IVC is a relatively rare anatomical variation (3, 4). In our case, in addition to IVC duplication, patient also had azygos continuation of the right IVC, retroaortic left renal vein and internal iliac vein variations demonstrated by a multidetector computed tomography (MDCT). The left and right internal iliac veins converged and drained into the right external iliac vein via a common trunk. The presence of combination of these venous variations in a patient is extremely rare. We present MDCT findings of this rare complex variation of the IVC and iliac veins.

Case report

46 year-old-woman with a complaint of suprapubic pain was referred to our radiology department for abdominal computed tomography examination. Abdominal MDCT (Somatom Sensation, Siemens, Erlangen, Germany) was performed after administration of intravenous contrast medium with 16x1.5 mm slice collimation, 5 mm slice thicknesses. On axial images, there was double IVC below the renal veins. The left renal vein was located posterior to the aorta. Suprarenal segment of the right IVC continued with the retrocrural enlarged azygos vein. In order to evaluate the IVC variation, raw data was reconstructed with a slice thickness of 2 mm at every 1.5 mm interval for interactive multiplanar image viewing on a workstation. On multiplanar projected reformation images it has been shown that the right and left internal iliac veins converged and drained into the right external iliac vein via a common trunk (Fig. 1). The right and left external iliac veins drained to the right and left IVC, respectively. Both of the IVC run upwards bilaterally lateral to the abdominal aorta as far as the renal veins. The left renal vein received the left IVC and crossed posterior to the aorta (Fig. 2). The right IVC received the left and right renal veins and continued superiorly as the enlarged azygos vein within the retrocrural space (Fig. 3). The hepatic veins drained into a stump of the IVC, which opened into the right atrium. The left ovarian vein drained into the left renal vein and right ovarian vein drained into the right IVC. No retrocaval ureter has been observed. Other than the venous variations, patient had multiple intramural and subserous leiomyomas in the uterus.

Discussion

The embryonic development of the IVC is a complex process that includes formation, regression and fusion of the three longitudinal pairs of veins (4, 5). During the fourth week of embryologic development, there are paired, symmetrical posterior cardinal veins that drain all but the cephalic portion of the embryo and remain dominant up to six weeks. The next pair of veins to develop is the subcardinals, which become dominant at seven weeks. The third pair of veins, the supracardinals develops medial and dorsal to the posterior cardinals, becoming the dominant venous system at eight weeks. The superior part of the posterior cardinal veins regresses and is progressively replaced by the supracardinal and subcardinal veins. Not regressed distal part gives rise to iliac confluence and the iliac veins. The right supracardinal vein develops into the infrarenal segment of the IVC while the left supracardinal vein

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Fig. 1. Coronal reconstruction image shows that the right internal iliac vein (RIIV) and left internal iliac vein (LIIV) converged and drained into the right external iliac vein via a common trunk. It also shows double IVC (v) and the aorta (a).

Fig. 2. Axial image shows retroaortic left renal vein (arrows) and the aorta (a).

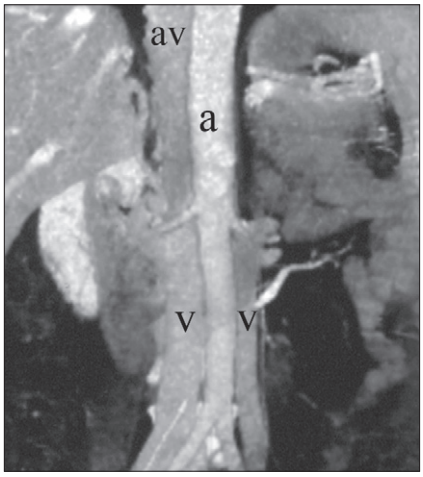

Fig. 3. Coronal reconstruction image shows double IVC (v), azygos continuation of the right IVC (av) and the aorta (a).

regresses. In the thoracic region, supracardinal veins give rise to the azygos and hemiazygos veins. Multiple anastomoses occur between supracardinal, subcardinal and posterior cardinal veins. The renal segment of the IVC develops from the right supra-subcardinal anastomosis. Intersupracardinal anastomosis posterior to the aorta regresses and intersubcardinal anastomosis anterior to the aorta gives rise to the left renal vein anterior to the aorta. The right subcardinal vein develops into the suprarenal segment of the IVC by the formation of the subcardinal-hepatic anastomosis. The hepatic segment of the IVC is derived from the vitelline vein (4, 5).

The embryological final form of the right-sided adult IVC is composed of five segments: 1 – the iliac segment from the posterior cardinal veins, 2 – the infrarenal segment from the right supracardinal vein, 3 – the renal segment from the right supra-subcardinal anastomosis, 4 – the suprarenal segment from the right subcardinal vein, 5 – the hepatic segment from the vitelline vein. Our case had a complex variation in multiple segments of the IVC including suprarenal, infrarenal and iliac segments. The prevalence of double IVC, azygous continuation of IVC and retroaortic left renal vein are 0.2 – 3 %, 0.6 % and 2.1 % respectively (3, 4, 6). The presence of combination of these venous variations in a patient is extremely rare.

Double IVC results from a persistence of both the right and left supracardinal veins. Recognition of double IVC is important during abdominal aorta aneurysm surgery, when surgical ligation of the IVC or the placement of an IVC filter is to be performed for thromboembolic disease. A failure to diagnose the double IVC may lead to recurrent pulmonary embolism. The awareness of double IVC prevent radiologist from a misdiagnosis of thrombosed venous variations, such as lymphadenopathy, especially in patients with testis tumor (7).

Azygos continuation of IVC results when there is a failure to form the subcardinal-hepatic anastomoses. In this variation, blood flow is directed into the supracardinal venous system via the subcardinal-supracardinal anastomosis. Blood reaches the superior vena cava via the azygos vein, which is derived from the right supracardinal vein. The hepatic veins drain into the right atrium via the hepatic segment of the IVC, which is derived from the vitelline vein. It is important to recognize the enlarged azygos vein at the confluence with the superior vena cava and in the retrocrural space to avoid misdiagnosis as a right-sided paratracheal mass or retrocrural adenopathy (6). The preoperative knowledge of anatomy of this variation may be important in planning cardiopulmonary bypass and to avoid difficulties in catheterizing the heart (8).

The left renal vein is normally derived from the intersubcardinal anastomosis, which passes anterior to the aorta. The retroaortic left renal vein results when there is a regression of the anterior intersubcardinal anastomosis and persistence of the posterior intersupracardinal anastomosis, resulting in a left renal vein that passes posterior to the aorta. It is important to be aware of the location and anatomy of the renal vascular pedicle during surgical procedures. The presence of retroaortic left renal vein may also cause clinical symptoms such as abdominal/flank pain and hematuria (9). It is postulated that a compression of the left renal vein between the aorta and vertebra leads to hematuria due to elevated pressure in the left renal vein, resulting in congestion of the left kidney and venous communications (10).

The iliac bifurcation and iliac veins derived from the non-regressed distal part of the posterior cardinal veins. Iliac vein variations result from the maldevelopment of the posterior cardinal system during the separation of the iliac veins. Among the numerous variations of these veins, the right and left internal iliac veins usually drain towards the contralateral external iliac vein (11). However, the junction of two internal iliac veins and opening as a common trunk into the external iliac vein is much less common. Pelvic venous variations are important for retroperitoneal interven-

tion on the pelvis such as the retroperitoneal lymphadenectomy, hypogastric neurectomy, anastomosis during a kidney transplant and hysterectomy. Our patient had multiple leiomyomas in the uterus and may need a hysterectomy in future. In hysterectomy, a surgical interference with these iliac veins may compromise venous drainage and precipitate edema of one or both legs (12).

In the evaluation of IVC variations, venography remains the most accurate diagnostic method but has the disadvantage of being an invasive procedure. The most useful non- invasive diagnostic tests include Doppler ultrasound, CT and MRI. Doppler ultrasound is operator dependent and often of limited value in obese patients. MRI is not a preferred method because of high cost, moderate availability, movement artifacts, and contraindications for patients with cardiac pacemakers and claustrophobia. The recent technical developments have revolutionized the capability of CT and as a result its clinical applications. The introduction of MDCT allowed faster scanning, thinner slice, increased spatial resolution and better image quality of both axial and multiplanar reconstruction and 3D angiography – venography images and replaced conventional angiography and venography in most clinical condition. In our case, MDCT with multiplanar imaging clearly demonstrated the complex IVC and iliac vein variations.

In conclusion, retroperitoneal venous variations should be kept in mind of anatomist, radiologist and surgeons who are to manipulate in this anatomic area. Although most of them do not cause functional damage, these venous variations should be taken into account during the application of imaging techniques and various retroperitoneal surgeries.

References

1. Koc Z, Ulusan S, Oguzkurt L, Tokmak N. Venous variants and anomalies on routine abdominal multi-detector row CT. Eur J Radiol 2007; 61: 267–278.

2. Shaw MB, Cutress M, Papavassiliou V, White S, Thompson M, Sayers R. Duplicated inferior vena cava and crossed renal ectopia with abdominal aortic aneurysm: preoperative anatomic studies facilitate surgery. Clin Anat 2003; 16: 355–357.

3. Chuang VP, Mena CE, Hoskins PA. Congenital anomalies of the inferior vena cava. Review of embryogenesis and presentation of a simplified classification. Br J Radiol 1974; 47: 206–213.

4. Phillips E. Embryology, normal anatomy, and anomalies. In: Ferris EJ, Hipona FA, Kahn PC, Phillips E, Shapiro JH (Eds). Venography of the Inferior Vena Cava and its Branches. Baltimore, Md: Williams &Wilkins, 1969, 1–32.

5. McClure CFV, Butler EG. The development of the vena cava inferior in man. Am J Anat 1925; 35: 331–383.

6. Ginaldi S, Chuang VP, Wallace S. Absence of hepatic segment of the inferior vena cava with azygous continuation. J Comput Assist Tomogr 1980; 4:112–114.

7. Evans JC, Earis J, Curtis J. Thrombosed double IVC mimicking paraaortic lymphadenopathy. Br J Radiol 2001; 74:192–194

8. Mazzucco A, Bortolotti U, Stellin G, Gallucci V. Anomalies of the systemic venous return: a review. J Card Surg 1990; 5: 122–133.

9. Karaman B, Koplay M, Ozturk E, Basekim CC, Ogul H, Mutlu H, Kizilkaya E, Kantarci M. Retroaortic left renal vein: multidetector computed tomography angiography findings and its clinical importance. Acta Radiol 2007; 48: 355–360.

10. Beinart C, Sniderman KW, Saddekni S, Weiner M, Vaughan Ed Jr, Sos TA. Left renal vein hypertension: a cause of occult hematuria. Radiology 1982; 145: 647–650.

11. Bergman RA, Thompson SA, Afifi AK, Saadeh FA. Compendium of Human Anatomic Variation. Baltimore: Urban & Schwarzenberg, 1988.

12. Williams PL, Bannister LH, Berry MM, Dyson M, Dussec JE, Ferguson MWJ. Gray's Anatomy, 38th ed. Edinburgh: Churchill-Livingstone, 1995, 1598–1599.

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