etoperitoneal venous anomalies are relatively uncommon, but can be troublesome during open abdominal aortic surgeries, retroperitoneal dissections and renal operations. Horseshoe kidneys pose technical difficulties during open repairs of abdominal aortic aneurysms (AAA) because of limited access to the distal aorta, multiple arteries, anteriorly located ureters. Several sporadic cases of horseshoe kidney with venous anomalies have been reported. In this issue of the Journal, Ichikawa et al. evaluate 105 patients with horseshoe kidney, using multidetector row computed tomography (CT). The incidence of inferior vena cava (IVC) anomalies with horseshoe kidney was 5.7%, which is higher than in patients without a horseshoe kidney, while the incidence of renal vein anomalies with a horseshoe kidney was 22.9%, which is similar to that in normal patients.

Knowledge about retroperitoneal venous anomalies and the embryological bases of them are important for an appropriate interpretation of images and better planning of operation. The opinions expressed in this article are not necessarily those of the editors or of the Japanese Circulation Society.

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The IVC and iliac veins develop from 3 pairs of embryonic veins between the 6th and 10th weeks of gestation (Figures 1,2). First, the posterior cardinal veins appear and eventually regress, but persist distally as the future iliac veins. Next, the subcardinal veins appear and anastomose with the posterior cardinal veins. The left subcardinal vein regresses, and the right subcardinal vein anastomoses with the hepatic segment of the IVC, which is derived from the vitelline veins, and develops into the suprarenal IVC. The supracardinal veins appear last and make multiple anastomoses with the posterior cardinal and the subcardinal veins. The left supracardinal vein then regresses, and the right supracardinal vein forms the infrarenal IVC. The supracardinal veins give rise to the aygous and hemiazygous veins. The renal segment of the IVC develops from the right suprasubcardinal and postsubcardinal anastomoses.

The renal venous collar is formed around the aorta from anastomoses among the 3 embryonic veins. Paired ventral and dorsal veins initially drain the embryonic kidneys. Ordinarily, both dorsal veins regress. On the right side, the ventral vein is incorporated into the lateral wall of the renal segment of the IVC. On the left side, the ventral vein and the anterior arch of the renal collar form the left renal vein.
Venous Anomalies

Double IVC: 0.2–3%  Double IVC occurs when the right and left supracardinal veins persist. The left IVC mostly ends at the left renal vein, which crosses anterior to the aorta to join the IVC. Left IVC: 0.2–0.5%  Left IVC is seen when the left supracardinal vein persists and the right supracardinal vein regresses. This vein runs up to the left renal vein, which crosses anterior to the aorta and unites with the right renal vein to form the suprarenal IVC. Retroaortic Left Renal Vein: 2.1%  This anomaly occurs when the dorsal arch of the renal collar persists and the ventral arch regresses so that a single left renal vein passes posterior to the aorta. In 1 type, the retroaortic vein enters the IVC in an orthotopic position, whereas in the 2nd type the vein runs more caudal and joins the IVC, gonadal and ascending lumbar veins, typically at the L4–L5 level. Circumaortic Left Renal Vein: 8.7%  Both the ventral and dorsal arches of the renal collar persist. Azygos Communication of the IVC: 0.6%  This anomaly results from a failure to form the right subcardinal-hepatic anastomosis. Blood is shunted through the retrocaval azygos vein. Retrocaval Ureter (Circumcaval Ureter): 0.001–0.1%  This is formed when the right supracardinal vein fails to develop, while the right posterior cardinal vein persists as the IVC. The ureter is trapped dorso-laterally to it. Preaortic Venous Confluence  Complex venous rings appear around the aorta and common iliac arteries. Their dorsal part is formed from the posterior cardinal veins and ventral part develops from the subcardinal veins. By the 10th week of gestation, the ventral part normally disappears. The persistence of the ventral part and regression of the dorsal part give rise to the preaortic common iliac veins confluence. 5,8  The embryogenesis of the kidney and its venous drainage into the IVC occur simultaneously. Thus, the development of a horseshoe kidney and venous anomalies may interact. 5,9  Clinical Implications  Retroperitoneal vessels are usually identified on CT scans with contrast media. However, the veins may be imaged during the arterial phase, when little contrast material is present in the veins. Therefore, familiarity with venous anomalies is essential for correct interpretation of images to avoid erroneous diagnosis of retroperitoneal masses or lymphadenopathy and to prevent fetal complications. 1,4  In a series of 2,427 patients with AAA treated at the Mayo Clinic, 10  8 of 35 patients with venous anomalies had significant venous hemorrhage because of injury to the anomalous veins, with 7 of these patients not having a preoperative diagnosis of the anomaly.

Awareness of retroaortic and circumaortic left renal vein is important during dissection and clamping of the aorta in order not to injure the vein. 3 Preaortic venous confluence carries a risk of injury during open repairs of ruptured AAA. 5,7,8  Double IVC or left IVC should be recognized when placing an IVC filter. And double IVC should be considered in cases of recurrent pulmonary embolism following placement of an IVC filter. 4,3,5  There have been reported AAAs with horseshoe kidney treated with open surgery 9 and endovascular repair. 11,12  The coexistence of horseshoe kidney and venous anomalies is very rare, but increases the hazards of open surgeries. Endovascular repair may be proposed in cases of AAA with venous anomalies or/and horseshoe kidney, and adequate anatomical conditions. Chaudhuri reported a case of successful endovascular treatment of an AAA in a patient with a horseshoe kidney and pre-isthmic right IVC. 12  Vascular surgeons need to keep the various venous anomalies in mind, because they are more frequently associated with a horseshoe kidney.

References

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