Report of two cases of double inferior vena cava with an emphasis on embryogenesis and clinical relevance

Introduction
Double inferior vena cava (IVC) is a congenital variation caused by an unusual embryological development of the inferior vena cava [1, 2] with a prevalence of 0.2-3% [3]. Knowledge of the embryogenesis of the IVC is helpful for understanding its variation. The inferior vena cava originates between the 6th and 8th weeks from a dynamic process of development, regression, anastomosis, and replacement of the vitelline vein, subcardinal and supracardinal veins. When the left supracardinal vein fails to regress, it results in a double IVC. Although this variation is not common, it becomes significant when planning surgical and radiological vascular procedures.

Case Report
The first case was a 22-year-old woman who referred to emergency clinic with recurrent lower abdominal pain. Physical examination and laboratory tests provided no significant findings. Abdominal contrast enhanced computed tomography depicted double IVC (Figure 1). In addition to the usual right-sided IVC, another IVC was seen on the left side of the abdominal aorta with smaller size compared the right IVC (Figure 1). The left IVC draining the left renal vein, crossed the aorta anteriorly, and joined the right inferior vena cava (Figure 2). Both IVC were formed from the respective common iliac veins. No other vascular variations were noted.

The second case was a 59-year-old man with acute abdominal pain. We proceeded with CT imaging of the abdomen which revealed portal vein and superior mesenteric vein thrombosis associated with ischemic change in the ileocecal region. We incidentally observed a double IVC (Figure 3), on both sides of the aorta. As in the first case, he had a right-sided IVC and a vascular structure on the left side of the aorta draining the left renal vein which resulted to be the duplicated IVC (Figure 4).

Discussion
Different variations of the IVC have been described [3]. Study of embryology of inferior vena cava allows for explaining its multiple anatomical variants. The inferior vena cava originates between the 6th and 8th weeks from a dynamic process of development, regression, anastomosis, and replacement of the vitelline vein, subcardinal and supracardinal veins. The posterior cardinal vein appears first and disappears except for the distal segment that becomes the iliac bifurcation.
During the fifth week the subcardinal veins, which drain the mesonephrons, are formed. The anastomosis between the subcardinal veins forms the left renal vein. The left subcardinal vein disappears and the right subcardinal vein becomes the renal segment of the IVC. One week later, during the sixth week the supracardinal veins are formed. While the left supracardinal vein regresses, the right supracardinal vein becomes the infrarenal portion of inferior vena cava. The right vitelline vein forms the hepatic segment of the IVC. It connects to the renal segment and the infrarenal segment and the IVC is complete. When the left supracardinal vein fails to regress, a duplicate IVC results. Radiologically the characteristic CT appearance of double IVC is a normal inferior vena cava along the right side of the spine and a left-sided IVC ascending to the level of the renal veins to join the right-sided IVC through a vascular structure that may pass either anteriorly or posteriorly to the aorta at the level of the renal veins. In our two cases the IVCs were situated bilaterally to abdominal aorta. In both cases the double IVC is considered to be a persistence

Figure 1. Case 1. Contrast-enhanced axial CT shows double inferior vena cava, the first one at a normal anatomic location (IVC) and the second one (DIVC) on the left side of the abdominal aorta with smaller size compared the right inferior vena cava.

Figure 2. Case 1. Coronally reformatted CT image shows double inferior vena cava, bilateral to the aorta. The left IVC (DIVC) draining the left renal vein, crossed the aorta (Ao) anteriorly, and joined the right inferior vena cava (IVC).

Figure 3. Case 2. Contrast-enhanced axial CT in the second patient shows a vascular structure on the left side of the aorta draining to the left renal vein which resulted to be the duplicated IVC. (IVC: inferior vena cava; DIVC: double inferior vena cava)

Figure 4. Case 2. Coronally reformatted CT image shows double inferior vena cava seen running on both sides of aorta (Ao). (IVC: inferior vena cava; DIVC: double inferior vena cava)
of both the right and left supracardinal veins. Although, double IVC variation is not common, it has clinical importance consequence in certain setting. Radiologically double IVC can be mistaken with a retroperitoneal mass or paravertebral lymph-node enlargement [4, 5] and lack of knowledge of these variations might result in a misinterpretation of the radiologic images of double IVC, leading to surgical errors such as bleeding during retroperitoneal lymph node dissections. These diagnostic pitfalls can be avoided by performing helical CT with IV contrast administration. Also patients with IVC variations have high risk of developing deep vein thrombosis through an inadequate blood return which increase the blood pressure in vein with venous stasis and consequent venous thrombosis of the lower extremities [6, 7] Treatment of patients with peripheral thromboembolic diseases include double IVC observation, placing filter in either system or coil-embolization of the duplicated segment plus placing a filter in the right IVC. Failure to diagnose the double IVC may lead to recurrent embolism in these patients [8, 9]. Recognition of a double IVC is also important during whole organ transplantation or radical nephrectomy. Imaging examination, CT or MRI plays an important role in the diagnosis of different variations of inferior vena cava.

Conclusion
Double IVC is an uncommon congenital variation. Detailed knowledge of this variation becomes significant to differentiate it from other pathologic conditions and is of extreme importance for surgeons to avoid complications during retroperitoneal surgery or interventional procedures [10].

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References