Aortobifemoral bypass for occlusive aortic disease in a patient with a duplicate inferior vena cava

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ABSTRACT

We present the case of a 66-year-old woman with severe aortoiliac occlusive disease (TASC-D) and an incidental finding of a left sided inferior vena cava, discovered on the preoperative computed tomography scan. This uncommon congenital finding can create intraoperative challenges to the vascular surgeon. In this case report, we have described this anatomic variant and elaborated on our surgical technique to suggest a few tips and tricks for addressing these cases. (J Vasc Surg Cases Innov Tech 2022;8:261-4.)

Keywords: Aortoiliac occlusive disease; Duplicate; Inferior vena cava; Left sided

Congenital venous abnormalities such as a left sided (duplicate) inferior vena cava (D-IVC), a retroaortic left renal vein, and a circumaortic left renal vein pose an interesting challenge to operating surgeons.[1] A D-IVC will usually be asymptomatic and detected incidentally on imaging studies. The incidence of D-IVC has been reported to be ~0.3% to 3.0% and was first reported in 1916.[2-5] In this report, we have described a case of aortoiliac occlusion in a patient with D-IVC who underwent aortobifemoral bypass.

CASE REPORT

A 66-year-old woman with a history of peripheral arterial disease, coronary artery disease with coronary artery bypass grafting, renal artery stenosis with stenting, type 2 diabetes mellitus, hypertension, hyperlipidemia, and a 5 pack-year smoking history had presented to our department for bilateral lower extremity chronic limb-threatening ischemia with rest pain (left more than right). Noninvasive ankle brachial index and toe brachial index studies showed a right of 0.3 and 0.2 and a left of 0.2 and 0.1, respectively. She was taking aspirin, clopidogrel, and atorvastatin. Preoperative computed tomography angiography showed an occlusive infrarenal aorta not amenable to endovascular repair with a TASC-D aortoiliac lesion and incidental type I D-IVC (Figs 1-4). The periaortic anatomy showed that the renal arteries originated at the top of the L2 vertebral body, with the left IVC crossing the aorta at the base of L1. The left renal vein was solitary and entered the left IVC at the level of L2 without crossing the aorta. We found no evidence of retroaortic or circumaortic renal vein branches or accessory renal arteries.

We elected to proceed with aortobifemoral bypass. Transabdominal midline laparotomy was performed, with care taken to identify the major venous structures and infrarenal aorta (Fig 5). A D-IVC was seen, beginning at the confluence of the common iliac veins, crossing along the anterolateral aspect of the occluded aorta, and, ultimately, joining with the left renal vein. We began careful dissection distally along the anterior aortic border at the aortic bifurcation, and multiple vena comitantes joining the two cava were carefully ligated. The left renal vein and left D-IVC were then reflected to the left and retracted with a vessel loop without the need for ligation because adequate exposure was obtained. We freed all adhesions between the D-IVC and the anterior surface of the aorta until both renal arteries had been exposed and adequate control established. The proximal aortic clamp was placed within a minimally calcified segment of the infrarenal aorta. Careful dissection of both occluded iliac arteries was performed, and it was noted that the left common iliac vein ran along the anteromedial border of the left common iliac artery. The bypass was then performed using a 14- × 7-mm Dacron graft (end-to-side, distal to the D-IVC/aorta crossover, anterior to the aorta, and without the graft overlaying the D-IVCs), and both limbs were tunneled routinely to the common femoral arteries. Her abdomen was closed in the standard fashion. We encountered minimal bleeding, with an estimated blood loss of 75 mL. Postoperatively, she did not require a blood product transfusion or vasopressor support. We resuscitated the patient at 125 mL/kg/h with normal saline for the first 48 hours postoperatively, with a transition to maintenance fluids thereafter. She was discharged home on postoperative day 4 without complications. The patient provided written informed consent for the report of her case details and imaging studies. She denied lifestyle limiting claudication or rest pain at her 8-week follow-up and continued to have triphasic Doppler signals.

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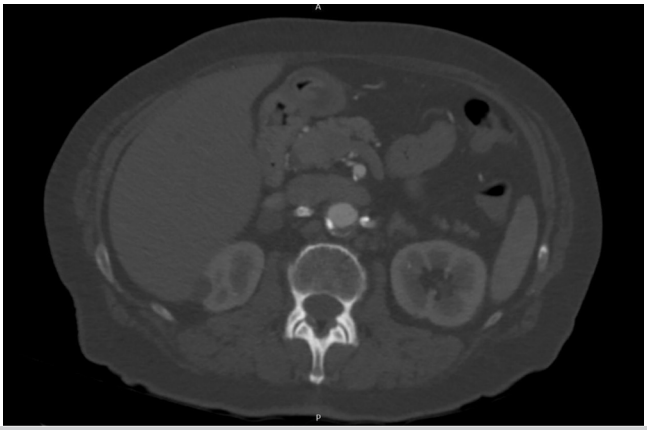

Fig 1. Duplicated inferior vena cava (D-IVC), axial view, demonstrated at the upper level of the L2 vertebral body.

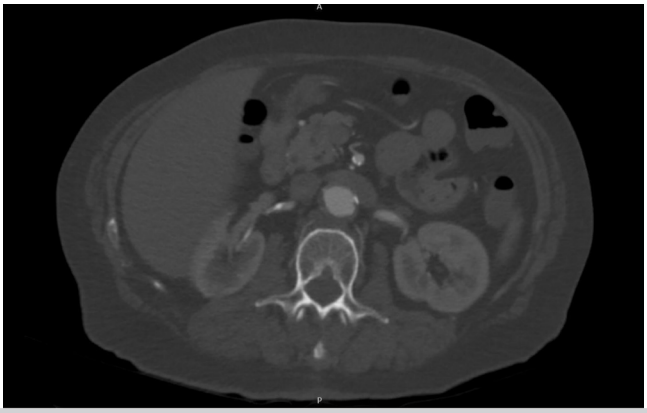

Fig 2. Duplicated inferior vena cava (D-IVC), axial view, demonstrated at the lower level of the L2 vertebral body.

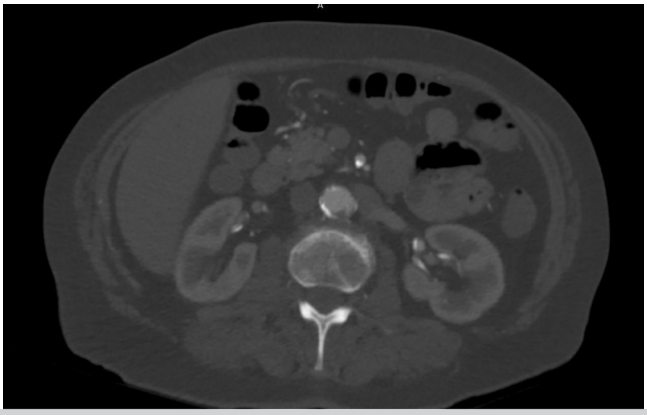

Fig 3. Duplicated inferior vena cava (D-IVC), axial view, demonstrated at the level of the L3 vertebral body.

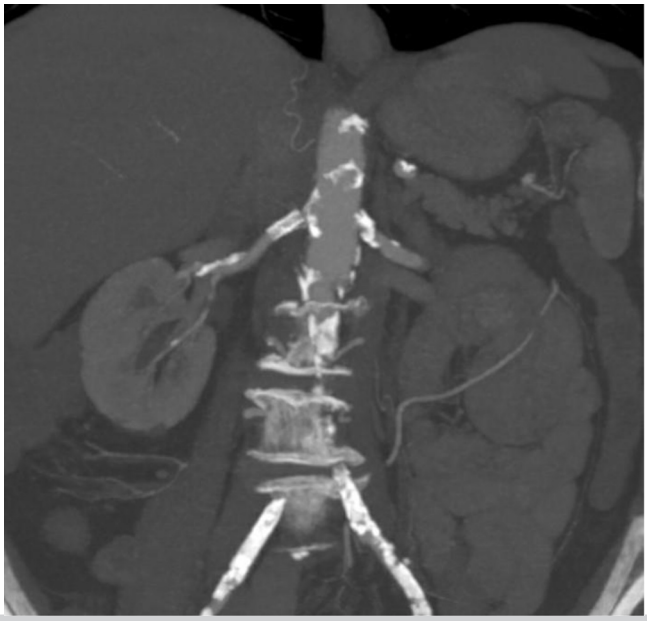

Fig 4. Duplicated inferior vena cava (D-IVC), coronal view, demonstrating the left renal vein confluence.

DISCUSSION

The overall incidence of D-IVCs ranges from 0.04% to 3.0%.[6] There are three types of D-IVCs. Type I, or a major duplication, has two bilateral, symmetric trunks with a preaortic trunk of the same diameter. Type II, or a minor duplication, has two symmetric trunks, although the duplicate trunk is smaller than the preaortic trunk. Type III, or an asymmetric duplication, occurs when a small left IVC and a larger right IVC are presnt.[7] D-IVCs typically occur early in gestation and result from failed regression of the left supracardinal vein.[8] In one study, the incidence of combined IVC and iliac vein anomalies occurred in 2% of patients with IVC anomalies.[9] Venous congenital anomalies are important to recognize before any retroperitoneal surgery, especially during aortic clamping.

In patients with a D-IVC, care must be taken during dissection and clamping of the aorta, because anomalous venous branches and irregular tissue planes between the D-IVCs and the aorta are a significant risk of unconventional intraoperative bleeding. Retroperitoneal venous anomalies will typically be thin walled and less tolerant of manipulation without major wall trauma and hemorrhage.[10] As described by Stefańczyk et al,[11] their aorta bifemoral bypass repair of a symptomatic infrarenal aortic aneurysm with a D-IVC led to 400 mL of intraoperative blood loss from an injury within the proximal segment of the left D-IVC.

Control of the venous branches or caval injuries in these situations is challenging. With diligent dissection and careful tissue manipulation, this risk will be minimized. In the present case, we elected to begin dissection of the aorta from an unconventional distal to proximal approach with the sole intention of controlling any anomalous distal venous branches that could be present within the tunneling plane and to allow for tension-free

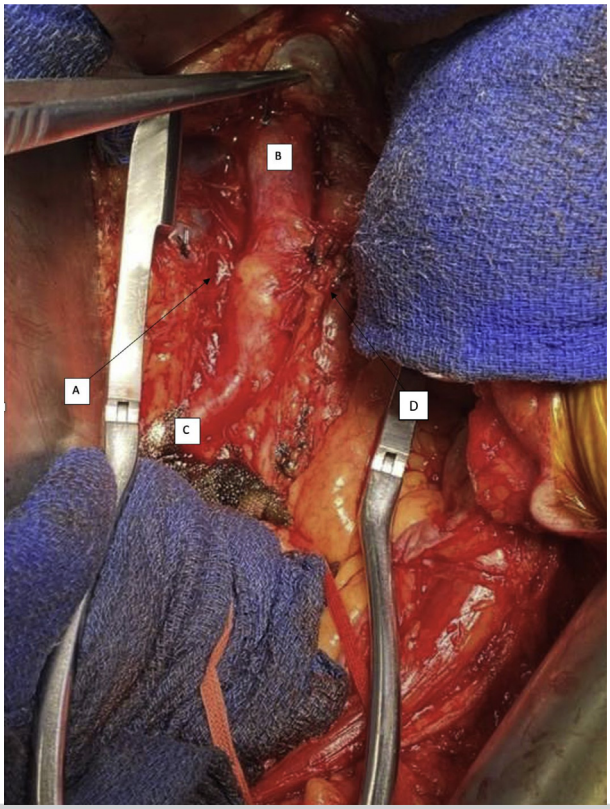

Fig 5. Intraoperative view of the skeletonized duplicated inferior vena cava (D-IVC) showing the right IVC **(A)**, infrarenal abdominal aorta **(B)**, right common iliac artery **(C)**, and D-IVC **(D)**.

retraction of the D-IVC with minimal risk of inadvertent iatrogenic injury. Although manipulation and increased dissection of any vascular field is well known to create a greater margin for vessel injury, the advantages of further control of venous comitantes and visualization of critical structures within the retroperitoneum proved advantageous to this operation. Our experience with this technique demonstrated no differences in intraoperative blood loss compared with more traditional anatomy, and no major iatrogenic venous injuries were created.

A common surgical technique for improving exposure to the perirenal aorta for dissection and proximal clamping is to divide the left renal vein if it is not possible to obtain adequate retraction on the vessel.[12] The anatomy of the D-IVC does not allow for that surgical freedom, because flow from the left D-IVC is often dependent on this branch.[8] It is our recommendation that all attempts to preserve the left renal vein should be taken to prevent any substantial lower extremity swelling or pelvic congestion postoperatively. In our case, the additional time dedicated to dividing the venous branches allowed for enough mobilization to successfully expose the aorta.

Although intraoperative bleeding is a major concern during open aortic surgery with a D-IVC, a documented association exists between D-IVC thrombosis and surgical manipulation.[13] No pathophysiology behind the phenomenon has been clearly documented; however, this should be considered, especially within the perioperative period. Our patient did not demonstrate any venous thrombosis, and our patient was treated routinely with pharmacologic medication, intermittent compression, and early ambulation for deep vein thrombosis prophylaxis.

Given the rarity of this anatomic variant, we have listed some considerations when planning for or performing open repair for occlusive aortic disease with a D-IVC in this patient population:

1. One should consider beginning dissection of the aorta from distally to proximally along the anterior aortic surface, moving laterally on either side with diligent identification of the tissue planes to fully visualize anomalous relationships between the D-IVC and other major retroperitoneal veins.
2. Mobilization of the D-IVC should be minimized before dissection of the branches, because the vessel is less resilient to manipulation without breakdown of the vascular wall, which would lead to rapid intraoperative blood loss.
3. Diligent review of the preoperative computed tomography scans is required, not only for venous anomalies, but also for anomalies of common structures found within the typical operative field.

CONCLUSIONS

Although venous anomalies can complicate exposure and clamping of the aorta, procedures that require these maneuvers in patients with a D-IVC can still be performed. Extra attention is required by the surgeon when performing retroperitoneal surgery to prevent potential catastrophic bleeding and ipsilateral lower extremity swelling. Appropriate preoperative planning, with computed tomography is recommended, because anatomic variants of the arterial and venous systems can be assessed and included in the operative plan. Special care should be taken intraoperatively; however, the presence of a D-IVC should not preclude patients from undergoing open surgical revascularization.

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