

Repair of a thoracoabdominal aortic aneurysm in the presence of a left-sided inferior vena cava

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Venous anomalies are not infrequently encountered during aortoiliac reconstruction, because of the complexity of development of the venous system. Retroaortic left renal veins, duplicate inferior vena cava (IVC), and left-sided IVC are occasionally found. Left-sided IVC has been reported with infrarenal aortic aneurysms. We report successful repair of a thoracoabdominal aneurysm in a patient with a left-sided IVC. The embryology and intraoperative management are discussed. (*J Vasc Surg* 2004;40:161-3.)

Left-sided inferior vena cava (IVC) has previously been reported with infrarenal aortic aneurysms.¹⁻⁶ We report successful thoracoabdominal aortic aneurysm (TAAA) repair in a patient with a left-sided IVC and discuss the intraoperative management.

CASE REPORT

A 49-year-old man underwent repair of a descending TAAA at another institution 3 years before presentation with persistent upper abdominal pain. The original operation was complicated by significant paraparesis that rendered the patient non-ambulatory. There was no history of blunt trauma, and family history was noncontributory. Examination revealed a well-healed thoracotomy scar, a nontender abdomen, and no lower extremity edema. The patient was barely able to raise his lower extremities against gravity. Computerized tomography (CT) scans revealed a 5-cm type III TAAA extending from the distal end of the previous graft (mid-descending thoracic aorta) to the aortic bifurcation and a left-sided IVC (Fig 1). The left-sided IVC continued proximally to the level of the left renal vein (Fig 2), where it crossed anterior to the aorta and continued cephalad in the normal location (Fig 3).

After thorough evaluation the patient was prepared for elective repair. A double-lumen endotracheal tube was placed with bronchoscopy, and a lumbar drain was placed for cerebrospinal fluid drainage. A limited thoracotomy was made two intercostal spaces superior to the previous incision for placement of a proximal clamp. The previous thoracotomy was extended medially across the costal margin and continued paramedially inferior to the umbilicus. The left kidney was mobilized and retracted to the patient's right side in standard fashion. The proximal graft, celiac axis, and superior mesenteric and left renal arteries were mobilized and controlled. The left renal vein and the vena cava were widely mobilized by ligating and dividing all posterior and lateral branches. A Penrose drain was placed around the IVC and left renal vein confluence. The operation was performed with the clamp-

and-sew technique and an in-line mesenteric shunt.⁷ An intercostal button was created at the T9-T10 level.

After completion of the left renal artery reconstruction, attention was turned to the anomalous vena cava. The distal end of the 28-mm graft (Hemashield; Boston Scientific) was tunneled under the IVC and left renal vein confluence. Before completing the distal anastomosis at the aortic bifurcation the caudal portion of the anomalous IVC was retracted laterally to the patient's left side. A renal vein retractor on a fixed retractor provided adequate exposure of the aortic bifurcation for completion of the distal end-to-end anastomosis.

After repositioning of the left kidney in the renal fossa, the vena cava remained free from the graft without evidence of compression or kink (Fig 4). Postoperatively there was no evidence of lower extremity edema or deep venous thrombosis. The patient continues to do well more than 2 years after the operation.

DISCUSSION

In the fifth week of gestation three pairs of major veins are identified: the vitelline veins, the umbilical veins, and the cardinal veins. From a division of the cardinal veins, the subcardinal veins, the lower portion of the IVC is formed.⁸ The subcardinal system is composed of paired veins on either side of the developing abdominal aorta. The left subcardinal vein typically regresses to form the left gonadal vein and the left renal vein.⁹ If this left subcardinal system does not regress, it forms a duplicate IVC that typically crosses the aorta at the level of the left renal vein. If the right subcardinal system regresses and the left remains, a left-sided vena cava, also termed a "transposed IVC," is formed.

As a result of the complex embryologic development of the venous system in the retroperitoneum, major venous anomalies relevant to aortoiliac surgery are not rare, occurring in 5.65% of patients in one large series.¹⁰ The most common variations are duplicate IVC, retroaortic renal veins, and circumaortic venous rings.¹¹ The incidence of double IVC is 0.2% to 3.0%.^{1,8} However, left-sided IVCs are rare, with a reported incidence of only 0.2% to 0.5%.¹⁰

Routine CT has dramatically decreased the incidence of intraoperative diagnosis of major venous anomalies and thus the risk for inadvertent injury and potentially life-threatening hemorrhage in aneurysmal disease.^{1,2} However, venous anomalies can still present difficulty during emergency operations or operations performed to treat

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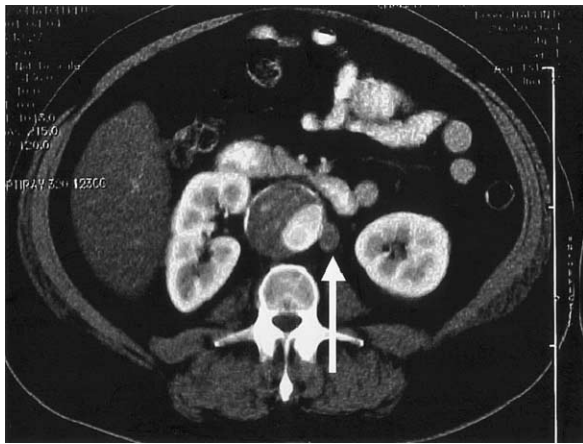


Fig 1. Preoperative axial computerized axial tomography scan. Note abdominal component of the thoracoabdominal aneurysm, left-sided inferior vena cava (*arrow*), and absence of a right-sided vena cava.



Fig 3. Preoperative axial computerized axial tomography scan. Note that the vena cava has crossed the midline anterior to the aorta and continues cephalad in the normal location.



Fig 2. Preoperative axial computerized axial tomography scan. Note the left-sided vena cava (*arrow*) ascending to the level of the left renal vein.

occlusive disease undertaken without preoperative axial imaging.⁴

Left-sided IVC in association with infrarenal aortic aneurysm is periodically reported.¹⁻⁶ Operative approaches have been varied. Nishimoto et al¹² used a right retroperitoneal approach. A transperitoneal approach with division of the aberrant IVC as it crosses the aorta with subsequent anastomosis has been suggested,⁶ and others have repaired the aneurysm through a left retroperitoneal incision.³

In our patient with a TAAA, neither a right retroperitoneal nor a transperitoneal approach was practical. We approached the aneurysm through a standard thoracoabdominal incision and widely mobilized the left renal vein-IVC confluence. With the left kidney elevated and rotated to the right, the anomalous venous structures are not problematic during creation of the proximal anastomosis or

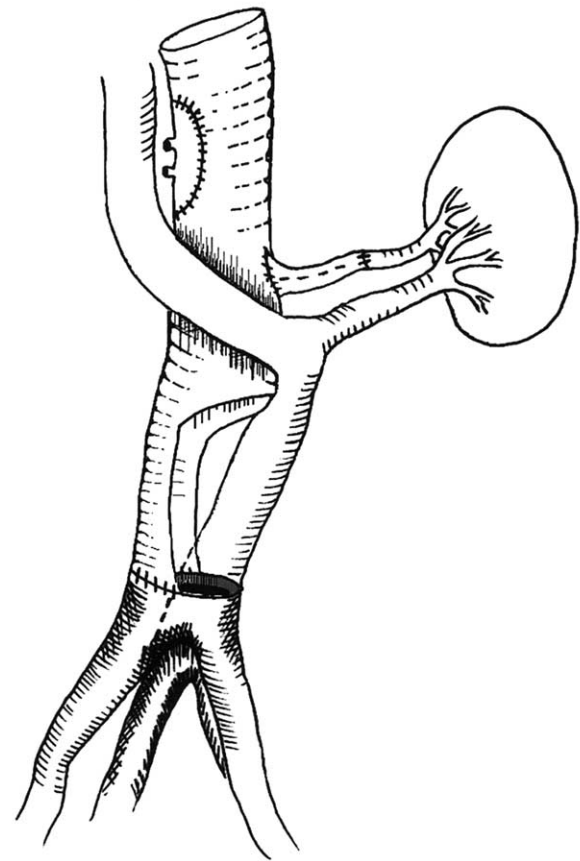


Fig 4. Sketch of the operative site after graft placement. Note left-sided inferior vena cava and left renal vein. A portion of the graft is cut away for clarity.

the visceral patch. Slight caudal traction on the IVC affords adequate exposure to safely perform the left renal artery bypass.

The left-sided IVC does compromise exposure of the aortic bifurcation. With a thin right-angled blade on a fixed retractor displacing the caudal portion of the IVC to the right, the aortic bifurcation is accessible, although exposure is limited. If required because of iliac occlusive disease or aneurysm, a bifurcated graft can be tunneled distally. When a bifurcated graft is needed it should be sewn end-to-end to the proximal tube graft before passing it deep to the IVC.

We present what we believe to be the first report of a TAAA repair associated with a left-sided IVC. Preoperative imaging and planning are essential for successful outcomes when confronted with major venous anomalies associated with aortic disease. Wide mobilization of the left renal vein and the anomalous left-sided vena cava are mandatory for safe completion of the distal anastomosis in this particular setting.

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