



Evacuation Technique of Left-Sided Inferior Vena Cava for a Successful Open Repair of a Large Juxtarenal Aortic Aneurysm

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We report a case of successful open repair of a 7.5-cm juxtarenal abdominal aortic aneurysm (AAA) in the presence of a left-sided inferior vena cava (LS-IVC) crossing the aorta at the level of the renal arteries in a 72-year-old man. The orifice of the right renal artery was slightly caudal to that of the left renal artery and concomitant occlusive diseases of both iliac arteries were present. Based on the imaging and intraoperative findings, repair of the juxtarenal AAA was performed with mobilization of the LS-IVC, which was encircled twice with soft silicone rubber vessel loops on both sides of operating field and the blood content of the LS-IVC was temporarily evacuated. This procedure allowed proximal control with inter-renal clamping of the aorta and placement of an aortobifemoral polytetrafluoroethylene graft.

Key Words: Abdominal aortic aneurysm, Inferior vena cava, Vascular grafting

Received November 17, 2020

Revised February 3, 2021

Accepted February 19, 2021

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Vasc Specialist Int 2021;37(1):41-45 • <https://doi.org/10.5758/vsi.200073>

INTRODUCTION

Abdominal aortic aneurysm (AAA) is most often asymptomatic until rupture occurs, which leads to death approximately 75% of the patients. The disease is approximately four times more frequent in men than in women, with an incidence between 1.3% and 8.9% depending on the population risk factors and age.

A left-sided inferior vena cava (LS-IVC) is a relatively infrequent developmental abnormality or anomaly, with a reported prevalence of 0.2% to 0.5% in the general population [1]. LS-IVC requires special attention during aortic surgery. It can be injured during dissection of the aorta, causing bleeding and even death. Moreover, LS-IVC requires technical maneuvers such as dissection of the LS-IVC and retraction away from the anastomosis area to prevent injury. Alternatively, transection of the LS-IVC with re-

anastomosis at the end of the procedure after creation of the aortic anastomosis has been reported in the literature. Therefore, the presence of an LS-IVC can lead to technical difficulties during repair of an aneurysm and pose a formidable challenge.

We report a successful repair in a rare case of large juxtarenal AAA in the presence of an LS-IVC and iliac occlusive disease using an aortobifemoral bypass graft. LS-IVC was managed with an original technique using soft silicone rubber vessel loops. Both the sides of the dissected part of the LS-IVC were encircled twice using the rubber loops within the operating field. Temporary evacuation of the LS-IVC blood content was performed with snug tightening of the vessel loops to allow proximal control and anastomosis. The embryology, diagnosis, and intraoperative management of LS-IVC are also discussed in this report. The case report was approved by the Institutional Review Board of

the University Hospital of Patras (IRB no. 29/11-07-2018).

CASE

A 72-year-old man was admitted to our hospital for elective repair of an asymptomatic 7.5-cm AAA. The AAA was first diagnosed two years ago (6.5 cm) during hospitalization for lung tuberculosis and AAA repair was deferred for unknown reasons. His medical history included dyslipidemia, hypothyroidism, and chronic obstructive pulmonary disease. His surgical history included appendectomy during childhood. He was allergic to amoxicillin. He was taking 62 µg T4 once daily (OD) and inhalable *indacaterol/glycopyrronium bromide* 85/43 µg OD. He had a history of smoking (95 pack-years), but had stopped smoking 16 years ago.

On physical examination, he appeared in good general condition. A palpable AAA and a full complement of peripheral pulses were noted. Results of routine laboratory tests including renal function tests were within the normal limits. Computed tomography angiography revealed a 7.5-cm juxtarenal AAA with a mural thrombus and the presence of an LS-IVC crossing the aorta at the level of the renal arteries (Fig. 1A, B). The diameter of the LS-IVC was 1.8 cm and the left renal vein drained directly in the LS-IVC. The orifice of the right renal artery was slightly lower than that of the left renal artery (Fig. 1A). The distance between the orifices of the upper left renal and superior mesenteric artery (SMA) was 5 mm.

Based on the imaging findings, repair of the juxtarenal AAA was performed with mobilization of the LS-IVC and inter-renal clamping of the aorta. Under general anesthesia,

a standard transperitoneal approach was used. The anterior wall of the aneurysm was identified and dissection was performed toward the neck of the AAA above the renal arteries. The LS-IVC was identified, dissected, and mobilized after division and ligation of the left adrenal vein. Retraction of the LS-IVC was attempted, but it was not deemed an effective or safe option. The LS-IVC was then encircled twice with soft silicone rubber vessel loops on both the sides of

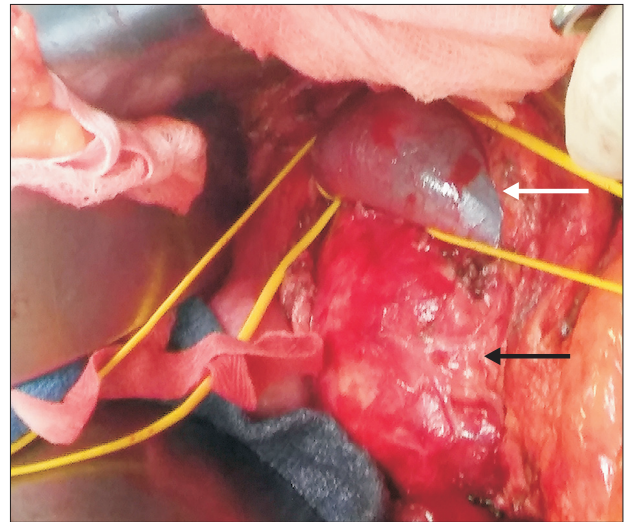


Fig. 2. Intraoperative photograph shows the left-sided inferior vena cava (white arrow) encircled twice with soft silicone rubber vessel loops on the right side of the operating field and also on the left side (not shown) to evacuate its blood content and allow proximal dissection of the supra-renal aortic neck of the juxtarenal aneurysm (black arrow).

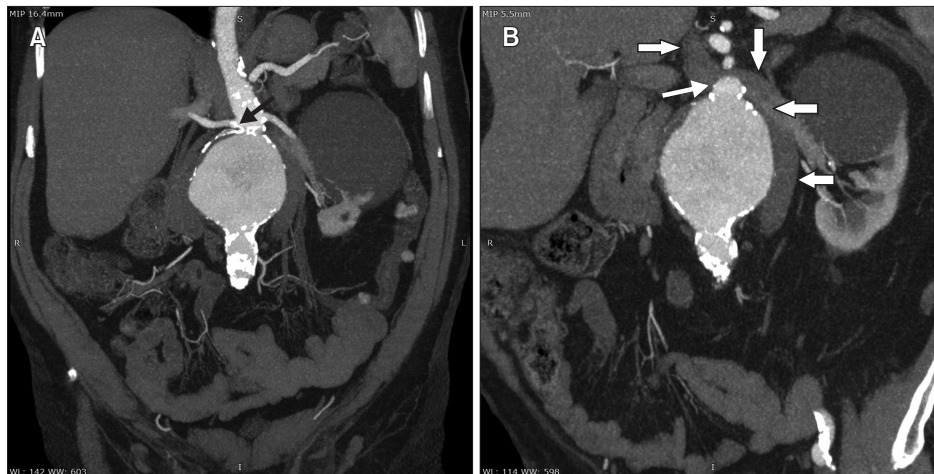


Fig. 1. (A) Computed tomography angiography (coronal thick-slab maximum intensity projection) showed a large juxtarenal aortic aneurysm. The origin of the right renal artery is relatively caudal compared to that of the left renal artery (arrow). (B) Computed tomography angiography showed the presence of a left-sided inferior vena cava (thick arrows). The vessel crosses the midline at the level of the aneurysmal neck (thin arrow).

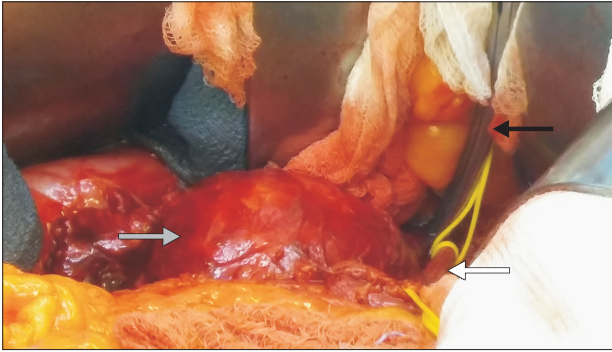


Fig. 3. Intraoperative photograph shows the evacuation of the blood content of the left-sided inferior vena cava (white arrow). This condition was maintained with snug tightening of the vessel loops to allow proximal control with an aortic clamp (black arrow) placed caudal to the left-sided inferior vena cava and applied between the left renal artery and the right lower renal artery due to the lack of a formal infrarenal neck of the juxtarenal aneurysm (gray arrow).

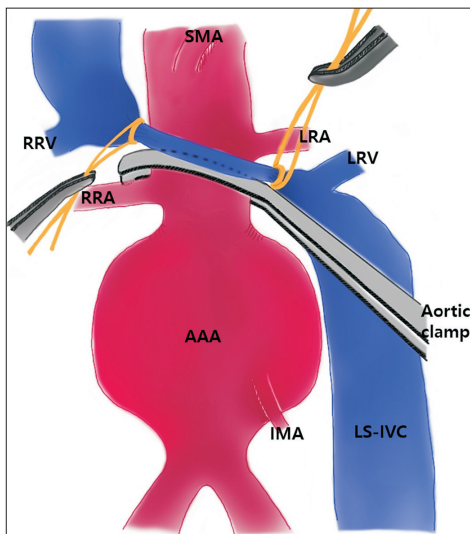


Fig. 4. A diagram shows the level of aortic clamping in relation to the anatomy of the renal arteries. RRV, right renal vein; SMA, superior mesenteric artery; LRA, left renal artery; RRA, right renal artery; LRV, left renal vein; AAA, abdominal aortic aneurysm; IMA, inferior mesenteric artery; LS-IVC, left-sided inferior vena cava.

the operating field (Fig. 2) and its blood content was temporarily evacuated to allow more window for proximal dissection of the suprarenal aorta between the renal arteries and the SMA. Subsequently, the distal part of the suprarenal aorta was dissected. We decided to put an inter-renal clamp between the renal arteries, followed by dissection in a distal direction toward the aortic bifurcation. Bilateral dissection of the common iliac artery was performed. The patient was

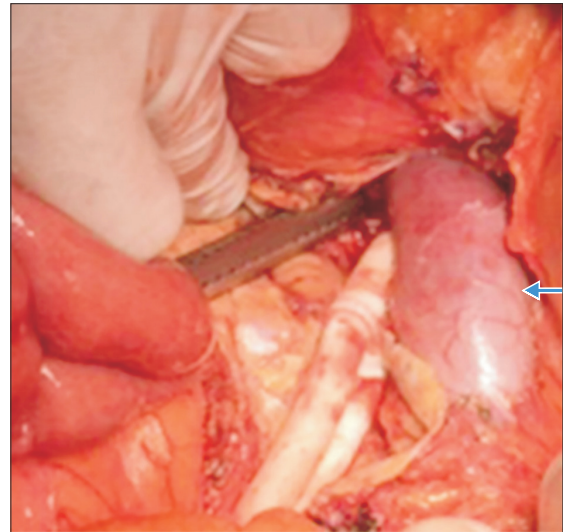


Fig. 5. Intraoperative photograph shows the bifurcated 18 mmx9 mm polytetrafluoroethylene vascular graft in relation to left-sided inferior vena cava (arrow), which was much larger in diameter.

administered 7,000 units of intravenous unfractionated heparin by an anesthesiologist. After a suitable period, the clamps were placed on both the common iliac arteries. The LS-IVC blood content was again evacuated temporarily and this condition was maintained with snug tightening of the vessel loops to allow proximal control with an aortic clamp placed caudal to the LS-IVC and applied between the left renal artery and the right lower renal artery (Fig. 3). The level of aortic cross-clamping in relation to the anatomy of the renal arteries is shown in Fig. 4. To minimize the impact of renal ischemia, adequate hydration was maintained with intravenous crystalloids before, during, and after aortic cross-clamping. The AAA was opened longitudinally and using a bifurcated 18 mmx9 mm polytetrafluoroethylene (PTFE) vascular graft (GORE-TEX Stretch Vascular Graft, W. L. Gore & Associates Inc., Flagstaff, AZ, USA) a proximal end-to-end anastomosis was performed with a #3-0 PTFE suture. The proximal aortic clamp was placed on the graft for an inter-renal aortic clamping duration of 20 minutes (Fig. 5). We intended to prepare the common iliac arteries for the distal anastomoses, but extensive calcified atheromatous ulcerated plaques were encountered, extending down to the external iliac arteries. Since construction of the anastomoses was impossible, we proceeded to ligate the common iliac arteries. Through standard longitudinal bilateral groin incisions, the common femoral arteries (CFAs) were dissected and tunnels were created in the retroperitoneum under direct visualization. After clamping the CFAs and their bifurcations, longitudinal arteriotomies of the anterior portion of the CFAs were performed, followed by

endarterectomy and end-to-side anastomoses. Due to weak pulsations of the right limb of the graft, additional 3,000 units of heparin were administered and a successful thrombectomy was performed with a 4-Fr embolectomy catheter. After checking active Doppler signals on both the feet, the aneurysm sac and the retroperitoneum were closed. The groin and the abdomen were closed in the usual manner, with standard surgical stainless-steel staples for the skin. During the 585-minute duration of the surgery, 12 L of crystalloids and 3 units of packed red blood cells (RBCs) were administered.

Postoperative serum creatinine levels peaked at 2.3 mg/dL on the second postoperative day, but returned to preoperative levels (1.1 mg/dL) during hospitalization. Creatine phosphokinase levels peaked at 26,672 units/L and gradually decreased to 5,279 units/L before discharge. An additional unit of RBCs was transfused on the third postoperative day. Barring these events, the postoperative course was uneventful and the patient was discharged on the seventh postoperative day. One year later, the patient remained in good condition.

DISCUSSION

We have reported a unique case of a large juxtarenal AAA in the presence of an LS-IVC crossing the aorta at the level of the renal arteries. The LS-IVC was successfully decompressed using an original technique involving the use of vessel loops to facilitate proximal control and anastomosis.

LS-IVC results from a failure of the left supracardinal vein to regress during embryogenesis, with concomitant regression of the right supracardinal vein [2]. In patients with this anomaly, the IVC crosses anteriorly over the aorta from the left to the right side. Alternatively, there may be a duplication of the IVC with major caval stems running on both sides of the aorta and the left-sided component also crossing anteriorly over the aorta from the left to the right side at the level of the renal arteries.

In the present case, we employed an original technique to eliminate the bulge produced by a large LS-IVC overlying the aorta at the level of the renal arteries where we intended to make the anastomosis. The large diameter of the LS-IVC did not allow the use of a retractor. Usually, simple mobilization and retraction of an LS-IVC is sufficient to allow visualization of the infrarenal neck [3-5]. However, in the present case, the AAA was juxtarenal and the LS-IVC was overlying the area where we intended to make the anastomosis. As previously described, retraction was attempted, but it was not deemed a safe option. Alternatively, transection of the LS-IVC and re-anastomosis at the end of

the procedure or restoration of the IVC continuity using an interposition Dacron graft have been reported in the literature [1,4,6,7]. Ligation of the IVC would certainly have been a poor choice due to thrombosis and other potentially fatal complications [8]. An alternative would be a left retroperitoneal approach [9] with known limitations in managing right iliac artery pathologies such as aneurysms and occlusive diseases. Other technical options include the use of a right retroperitoneal approach [10] or right medial visceral rotation with the Cattell-Braasch maneuver [11].

The relevance of LS-IVC concerns not only the open AAA surgery but also aortofemoral bypass grafting [12]. Therefore, it is crucial for the aortic surgeon to seek preoperative imaging and to be prepared to manage an LS-IVC as well as similar developmental anomalies such as duplicated IVC, retroaortic left renal vein, and circumaortic left renal vein [13,14].

Our patient underwent repair of a juxtarenal AAA with aortic cross clamping between the two renal arteries. Depending on the individual anatomy of complex aneurysms, aortic cross-clamping may be supraceliac, suprarenal, or inter-renal. The strategy of placing the proximal clamp as low as feasible has been associated with reduced morbidity and mortality [15].

In conclusion, we achieved successful repair of a large juxtarenal AAA with LS-IVC. The LS-IVC was successfully decompressed using an original evacuation technique, allowing uneventful proximal control and creation of a proximal anastomosis.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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AUTHOR CONTRIBUTIONS

Concept and design: SKK. Analysis and interpretation: SKK. Data collection: SKK, PGA, KD, IN, CK, PZ. Writing

the article: SKK, PGA, KD, IN, CK, PZ. Critical revision of the article: Not applicable. Final approval of the article: SKK, PGA, KD, IN, CK, PZ. Statistical analysis: none. Obtained funding: none. Overall responsibility: SKK.

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