



Inferior Vena Cava (IVC) Resection Without Reconstruction for a Large IVC Leiomyosarcoma

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Received: 3 April 2022 / Accepted: 30 April 2022 / Published online: 17 May 2022
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Abstract

Background Retroperitoneal tumours arising from the inferior vena cava (IVC) are rare tumours often requiring large vessel resection for complete surgical excision. Limited exposure to such tumours often discourages surgeons from offering surgical resection to these patients, depriving them of the only potentially curative modality. We present here the surgical technique for resection of a large IVC sarcoma without IVC reconstruction.

Methods A 53-year-old lady presented with a large retroperitoneal sarcoma encasing the infra-hepatic IVC with tumour thrombus extension into the hepatic cloaca as well as the left renal vein. Surgical resection was planned as the disease remained stable after 2 cycles of neoadjuvant chemotherapy with adriamycin and ifosfamide.

Results Complete surgical excision of the tumour was achieved by performing a resection of the entire length of infra-hepatic IVC and right kidney, without IVC reconstruction. Left renal vein was divided after careful preservation of a draining collateral. Tumour thrombus was extracted from the hepatic cloaca, and proximal IVC stump closure was achieved with preservation of right hepatic vein insertion. Total blood loss during the procedure was 2300 mL, and the patient recovered without compromise of renal function or development of lower limb oedema.

Conclusion IVC resection without reconstruction can be safely performed for large retroperitoneal sarcomas involving major vascular structures. Familiarity with the retroperitoneal, retro-hepatic and supra-hepatic anatomy is paramount to achieving good surgical outcomes.

Keywords Retroperitoneal sarcoma · IVC sarcoma · Leiomyosarcoma · IVC resection · IVC ligation

Introduction

Retroperitoneal leiomyosarcomas arising from the great vessels are a rare entity, and complete surgical resection offers the only curative modality for these patients, with studies showing R2 resection having significantly poorer survival outcomes.^{1,2} However, surgical resection of these tumours entails complex surgical procedures necessitating multi-visceral resection along with major vascular resection and reconstruction,

technical expertise for which may not be widely available. In large tumours with long-term obstruction of the inferior vena cava (IVC), resection without reconstruction of the IVC is feasible and safe, without potential adverse post-operative consequences.^{1,2} Our institute is a high-volume centre for retroperitoneal tumours, with extensive experience in procedures involving complex vascular resections. We demonstrate here in detail the operative technique for complete surgical resection of a leiomyosarcoma of the infra-hepatic IVC with an IVC thrombus extending into the hepatic cloaca and the left renal vein, which was managed with resection of the IVC and left renal vein without reconstruction.

Case Summary

A 53-year-old lady, with no co-morbidities, presented with complaints of vague abdominal pain, discomfort and weight loss for the past 6 months. Abdominal examination revealed

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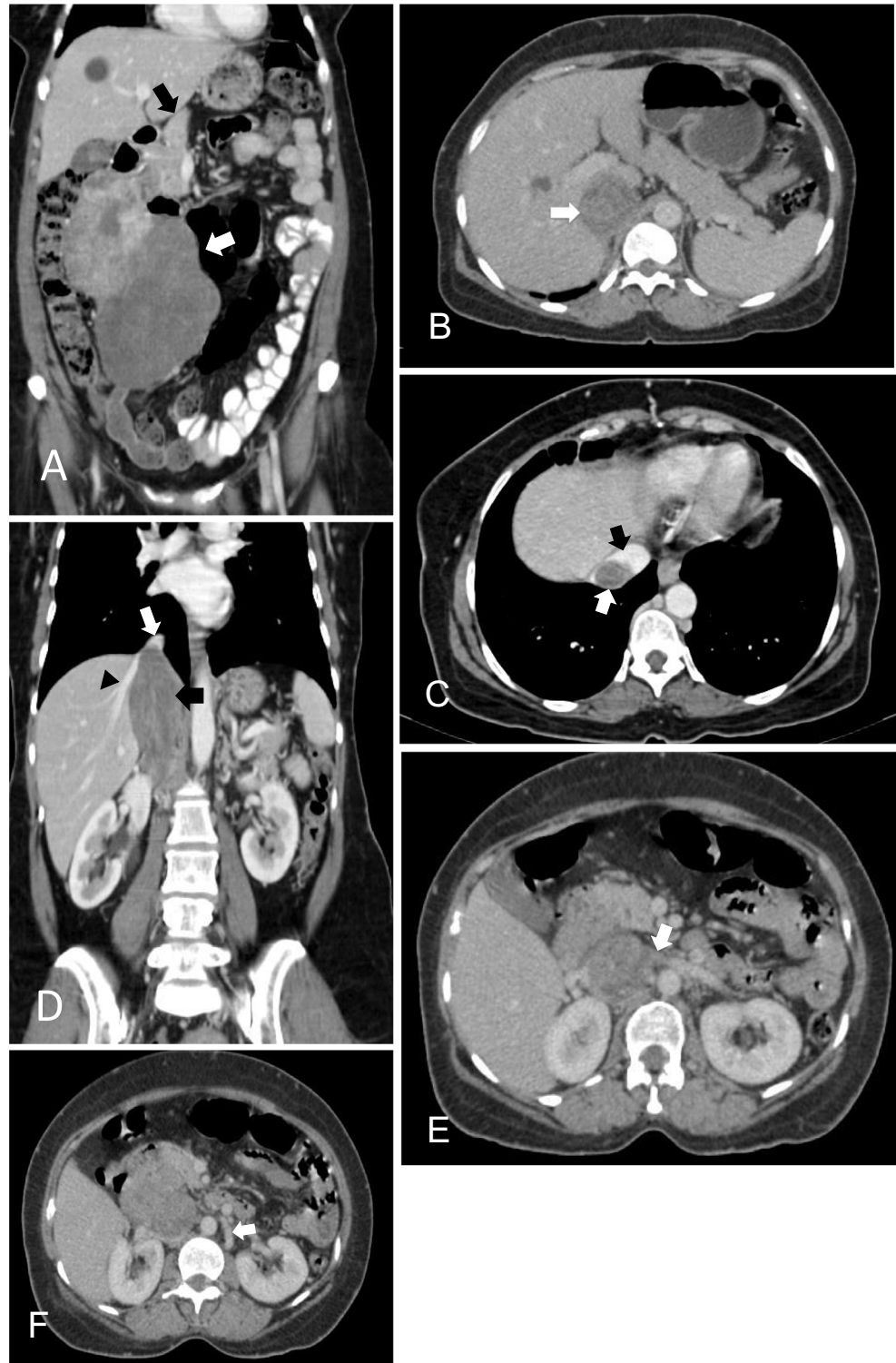
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a palpable mass occupying the central and right-sided quadrants of the abdomen. General examination was otherwise unremarkable, and performance status was ECOG-1. Contrast enhanced CT scan showed a well-defined, lobulated, heterogeneously enhancing mass lesion measuring 20 cm, encasing the infra-hepatic IVC with an intra-luminal IVC thrombus extending cephalad up to the hepatic cloaca as well

as into the left renal vein (Fig. 1). A large collateral draining the left renal vein was identified, which later allowed for safe ligation of the left renal vein without consequence. Biopsy of the tumour showed a spindle cell tumour with myogenic differentiation. On immunohistochemistry (IHC), the tumour was positive for SMA and desmin and negative for CD-34, S-100p, and DOG-1. Absence of metastatic disease was

Fig. 1 Contrast enhanced CT imaging. **A** Coronal section showing tumour extent: white arrow, extraluminal component; black arrow, extra-hepatic component. **B** Tumour showing complete encasement of IVC: white arrow, tumour replacing entire IVC lumen. **C** Intraluminal thrombus: white arrow, IVC thrombus; black arrow, IVC. **D** Superior extent of tumour thrombus: white arrow, hepatic cloaca; black arrow, IVC tumour with thrombus; black arrow-head, right hepatic vein. **E** Renal vein involvement: white arrow, tumour thrombus extending into left renal vein. **F** Collateral drainage of left renal vein: white arrow, large collateral draining left renal vein



confirmed by a PET-CT. The patient received 2 cycles of neoadjuvant chemotherapy with ifosfamide and adriamycin. Repeat imaging revealed stable disease; hence, the patient was planned for a curative resection.

The patient was operated in a supine position. A midline incision with a right subcostal extension was used to gain wide exposure to the abdominal cavity (Fig. 2). A large well defined lobulated mass measuring approximately 25 cm was seen to occupy the entire right retroperitoneum. The right colon and duodenum were mobilized off of the mass by performing a Cattell-Braasch manoeuvre. The left renal vein was looped after preserving the draining collateral seen on pre-operative imaging (Fig. 3). The distal IVC was dissected and looped just above the confluence of the common iliac veins (Fig. 3). Dissection was carried along the right border of the aorta to identify and ligate the right renal artery. The right liver lobe and right half of the caudate lobe were mobilized completely to expose the retro-hepatic IVC. The coronary and right triangular ligaments were dissected to expose the hepatic cloaca and supra-hepatic IVC. Vascular control of the supra-hepatic IVC, right hepatic vein, and middle hepatic veins was obtained with vascular tapes (Fig. 3). A vascular tape was passed around the hepatoduodenal ligament in preparation for a Pringle's manoeuvre. The left renal vein and distal IVC were then divided with vascular staplers (Fig. 3). Stay sutures were taken on the IVC just below the insertion of the right hepatic vein. The supra-hepatic IVC, middle hepatic vein, and hepatic inflow were occluded by tightening the vascular loops passed around them. The anterior wall of the retro-hepatic IVC was then incised just below the stay-sutures to expose the IVC thrombus (Fig. 4). The thrombus was extracted intact from the hepatic cloaca, and the remaining IVC was cut circumferentially while preserving the RHV insertion. Proximal and distal margins of the IVC were confirmed to be free of tumour on intra-operative frozen section. The proximal IVC was then sutured in a continuous fashion with 4–0 Prolene sutures (Fig. 4). Vascular occlusion was released to check backflow and integrity of the vascular stump prior to final suture placement. Total Pringle time was 15 min.

Total blood loss during the procedure was 2300 mL, with a total operative time of 250 min. Post-operatively, there was an intra-abdominal bleed, with a CT scan showing a 12 × 8 cm hematoma in the right retroperitoneum. She underwent an emergency exploratory laparotomy with evacuation of the retroperitoneal haematoma; however, no active source of bleed could be found. There was no compromise of renal function or lower limb oedema. The remainder of her recovery was uneventful, and she was discharged 21 days after the primary surgery.

Final histopathology showed the tumour to be a high grade leiomyosarcoma arising from the IVC with no regional lymph node metastases. Adventitial margins were free from tumour on microscopic examination. She has been planned for further adjuvant chemotherapy.

At 3-month follow-up after her surgery, she displays no signs of lower limb venous congestion, or renal dysfunction.

Discussion

The main challenge faced during the initial assessment was extension of the tumour thrombus into the retro-hepatic IVC as well as into the left renal vein. The pre-operative imaging suggested that the tumour was not adhered to the wall of the IVC at the level of the hepatic cloaca (Fig. 1C); however, the potential involvement of the RHV and its subsequent resection remained a significant cause for concern. In the event that such a resection became necessary, we were prepared for a veno-venous bypass with reconstruction of the IVC and had a cardio-vascular surgeon on stand-by at the time of surgery. The second point of concern was the involvement of the left renal vein. Although a draining collateral was identified pre-operatively, and preserved intra-operatively, compromised renal function encountered after the renal vein clamping test would have necessitated reconstruction of the IVC along with re-implantation of the left renal vein, an eventuality we were prepared for. We have recently published our data regarding IVC resection without reconstruction in which 17 out

Fig. 2 Incision and exposure. **A** Midline incision with right subcostal extension. **B** Abdominal exposure after retraction of abdominal wall flap and application of fixed retractor

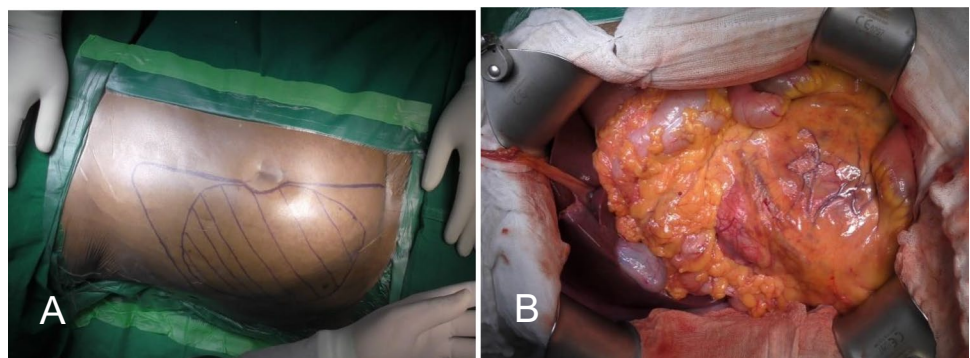


Fig. 3 Vascular control and division. **A** Left renal vein isolation and collateral preservation: white arrow, left renal vein; black arrow, draining collateral. **B** Distal IVC control: white arrow, distal IVC; black arrow, aortic bifurcation. **C** Suprahepatic vascular control: black arrow, suprahepatic IVC; white arrow, right hepatic vein. **D** Left renal vein clamp test. Left renal vein was clamped for 10 min and urine output tracked prior to division. **E** Distal IVC stump

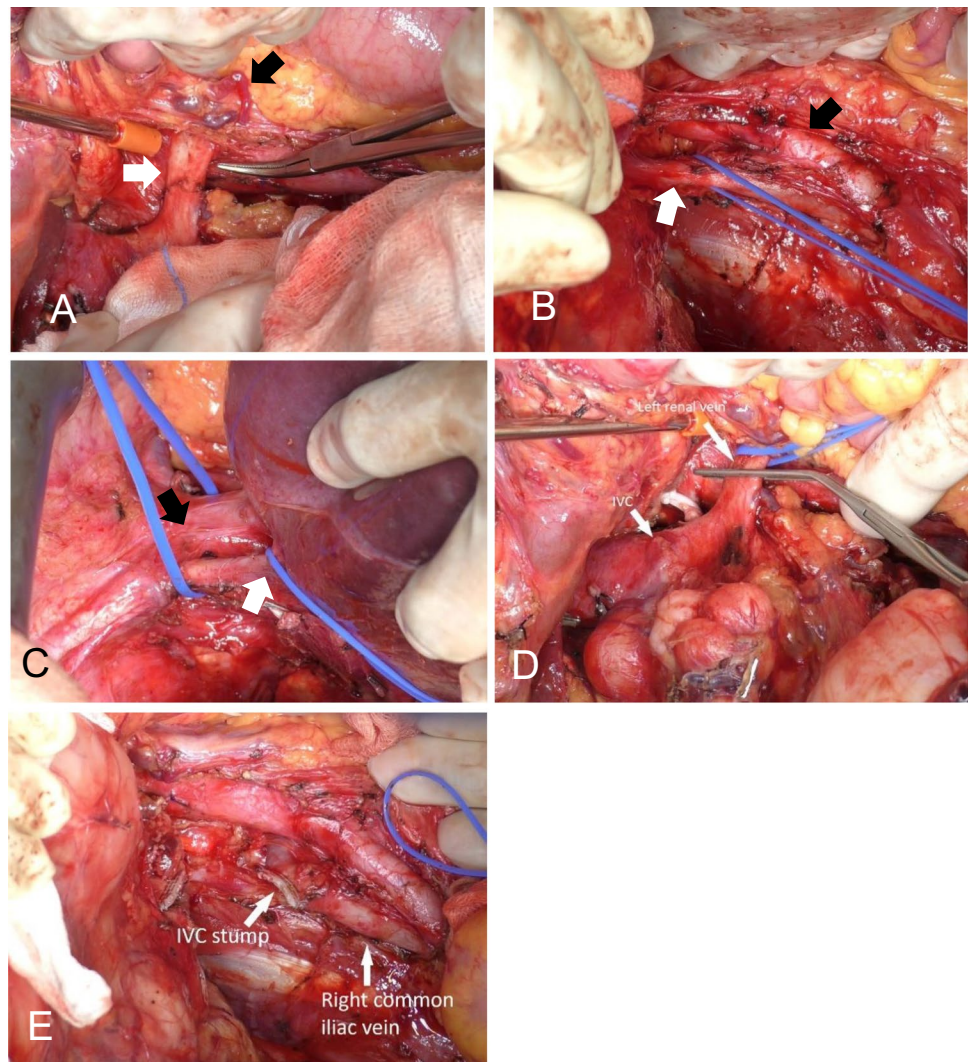
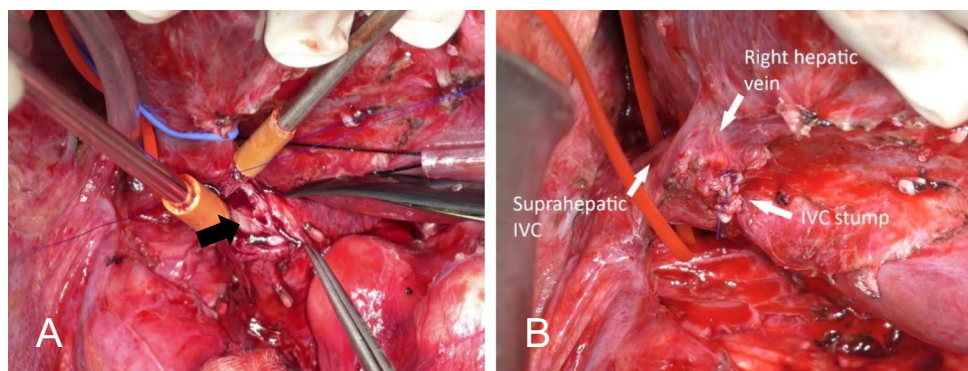


Fig. 4 IVC tumour thrombus extraction and division. **A** Anterior wall of IVC has been cut, exposing the tumour thrombus reaching up to hepatic cloaca: black arrow, IVC tumour thrombus. **B** Closure of IVC stump after complete thrombus extraction



of 24 patients did not require any reconstruction and were managed by IVC resection only, without major morbidity.² We would have a lower threshold for IVC reconstruction in the following circumstances: (1) type III IVC sarcomas (involving the supra-hepatic IVC); (2) involvement of the hepatic veins at the hepatic cloaca; (3) intra-operative

evidence of renal compromise after a clamp test; (4) intra-operative hypotension after IVC clamping; (5) resection of the right renal vein in left sided tumours, owing to its shorter length and relative absence of collateral drainage compared to the left renal vein; and (6) clinical evidence of insufficient collateral venous drainage.

Complete surgical excision of large vessel retroperitoneal leiomyosarcomas is associated with improved survival.^{1,2} However, extensive involvement of major intra-abdominal vessels and lack of expertise for large segment vascular reconstruction can often deter surgeons from attempting resection of these tumours, thereby depriving them of a potentially curative modality of treatment. Several reports demonstrate that large segment IVC resection can safely be performed without any vascular reconstruction, with equivalent post-operative outcomes compared to when reconstruction was performed.^{1,2} Comparable long-term outcomes too have been demonstrated in tumours with and without vascular involvement, when complete surgical resection was achieved. Moreover, vascular graft patency rates have been reported to be around 60%, without significantly increased morbidity seen in graft occlusion.³ The existing evidence only serves to strengthen the case for major venous resection, even without reconstruction for such tumours. Given the feasibility, efficacy, and rarity of such a surgical procedure, we deemed it vital to share our operative technique for such tumours, thus familiarizing surgeons with the relevant anatomy and surgical approaches to achieving complete and safe resection.

Conclusion

IVC resection without reconstruction can be safely performed in large retroperitoneal sarcomas with vascular involvement, enabling complete surgical excision. Familiarity of the surgeon with the retroperitoneal vascular anatomy, particularly in the retro-hepatic and supra-hepatic region, is vital for safe and complete excision of these tumours.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11605-022-05349-2>.

Author Contribution MG, SP, and AK performed the surgery with MG as the operating surgeon and SP and AK as the assisting surgeons. AK edited the video, recorded the audio narration for the video, and drafted the manuscript. MG and SP critically reviewed the video and the manuscript.

Declarations

Ethics Approval This study was conducted in accordance with the principles of the Declaration of Helsinki and approval obtained from the institutional ethics committee.

Consent and Patient Confidentiality A written informed consent was obtained from the patient for recording of clinical photographs, radiologic images, and intra-operative surgical video, as well as for sharing said images and video for academic publication. No patient identifiers have been used in the case summary, clinical photographs, radiology, or surgical video.

Conflict of Interest The authors declare no competing interests.

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