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Knacks and pitfalls of retroperitoneal sarcoma surgery, part 3: resection of tumors involving large retroperitoneal vessels

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ABSTRACT

Retroperitoneal sarcomas (RPSs) often involve major vessels such as the iliac arteries/veins, inferior vena cava (IVC), and abdominal aorta, posing significant surgical challenges. Resection of RPSs involving large vessels requires advanced vascular techniques and multidisciplinary collaboration. In Part 3 of this series, technical strategies, pitfalls, and case-based insights for managing RPSs with large vessel involvement are described based on operative experience at a high-volume sarcoma center. Surgical approaches to iliac vessels, IVC resection with or without tumor thrombus, and aortic contact are described. Iliac vessel involvement may require in situ or staged vascular grafting. IVC resection with or without reconstruction is feasible in the presence of a thrombus or direct invasion, but the resection depends on hemodynamic tolerance and collateral circulation. Tumors with IVC thrombus extending into the right atrium require cardiopulmonary bypass. Preoperative arterial embolization and intraoperative ultrasound help minimize blood loss and guide resection margins. Dissection without aortic resection is often possible even when the tumor is close to the abdominal aorta. RPSs with vascular invasion can be safely resected using tailored strategies if the institution is prepared. Surgical expertise in retroperitoneal vascular anatomy and collaboration across specialties are essential to ensure safe and effective oncologic outcomes.

Keywords: large vessel involvement, tumor thrombus, cardiopulmonary bypass

Abbreviations:
RPS: retroperitoneal sarcoma
IVC: inferior vena cava

INTRODUCTION

Large retroperitoneal sarcomas (RPSs) may severely contact or invade retroperitoneal organs, including the kidneys, ureters, adrenal glands, liver, pancreas, and duodenum. In addition, RPSs often involve major retroperitoneal blood vessels such as the inferior vena cava (IVC), abdominal aorta, and right and left internal and external iliac arteries/veins. The involved vessels

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sometimes need to be removed and reconstructed in conjunction with tumor resection. Thus, vascular surgeons must be included in the operation. Resections of tumors extending into the IVC may require extracorporeal circulation, requiring collaboration with cardiothoracic surgeons. Such surgeries are invasive and may cause massive bleeding. Thus, surgical procedures must be thoroughly discussed before the operation with the relevant surgical departments, the anesthesiology department, and the medical safety management department.

This article describes surgeries to resect RPSs with large vascular involvement. The knacks and pitfalls of such surgeries are discussed along with specific cases experienced at Nagoya University Rare Cancer Center (NURCC). Indications for surgery, especially for high-risk surgeries, should be carefully evaluated through discussion among a multidisciplinary sarcoma team. Age, physical status, and comorbid diseases should be considered when determining whether surgery is indicated. However, surgery should be considered whenever possible to achieve optimal physiological and oncological outcomes.

TUMORS WITH ILIAC ARTERIOVENOUS INVOLVEMENT

Managing iliac arteries

In RPSs arising near the lower abdomen, the common iliac artery and the internal and external iliac arteries are often entrapped by the tumor (Fig. 1A, B). If the tumor is confined to

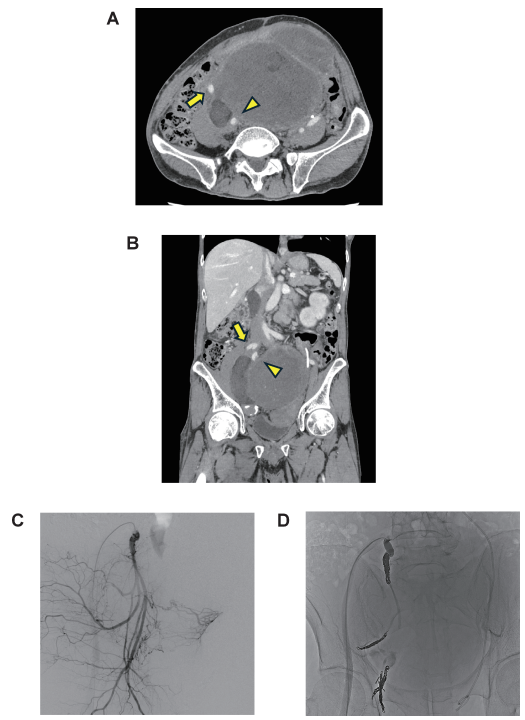

Fig. 1 A case of right-sided intrapelvic dedifferentiated liposarcoma
The computed tomography images from axial (A) and coronal (B) scans indicate a tumor involving the right internal (arrowhead) and external (arrow) iliac arteries. The right internal iliac artery, which mainly feeds the tumor, was embolized at its peripheral and proximal portions by a radiologist before surgery (C, before embolization; D, after embolization).

the external iliac artery, the internal iliac artery can be preserved, and the external iliac artery can be resected and replaced with a prosthetic graft. When the tumor involves the internal iliac artery, the internal iliac artery can be ligated and dissected with the tumor. However, ligating the affected side at the main trunk root will result in abundant blood backflow from the contralateral side because the right and left internal iliac arterial systems form a network on the pelvic floor. In such cases, radiologists should perform selective embolization of the major feeding vessels to the peripheral vessels one or two days before surgery (Fig. 1C, D).

Three options are available for resection of the iliac artery with a prosthetic graft: femoro-femoral bypass, axillo-femoral bypass on the affected side, and in situ reconstruction to directly connect the defective vessel to a prosthetic graft. During extra-anatomical femoro-femoral and axillo-femoral bypasses, the bypass vessel is not exposed in the surgical field during tumor resection. Therefore, the affected vessels can be ligated upstream and downstream of the tumor during the resection. However, during a femoro-femoral bypass, the prosthetic graft passes through the suprapubic margin, restricting the midline skin incision in the lower abdomen. Similarly, in an axillo-femoral bypass, the prosthetic graft passes subcutaneously in the lateral abdominal wall, limiting the transverse incision on the affected side. Large RPSs may require a wide midline incision from the xiphoid process to the pubis and a wide transverse incision extending to the back. However, the restricted incision for the prosthetic graft may make obtaining a sufficient surgical field difficult. The 5-year vessel patency rate for extra-anatomical bypass is approximately 65–70%,[1,2] which is inferior to the in situ reconstruction patency rate of 85%.[3]

Although recommended based on the superior patency rate, in situ reconstruction has disadvantages, including graft contamination if the abdominal cavity is contaminated. Therefore, in

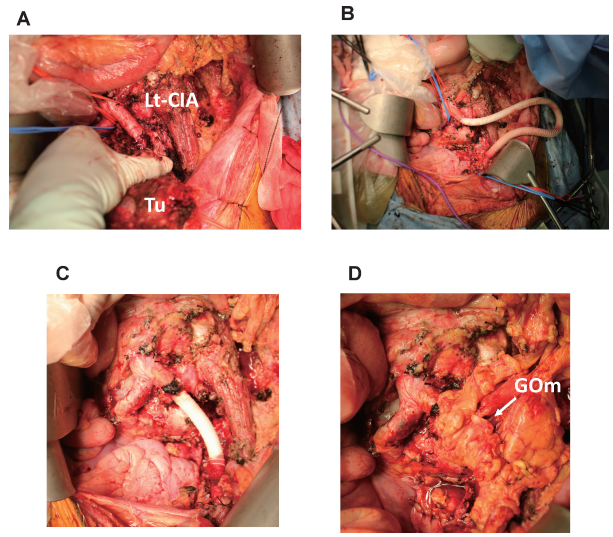

Fig. 2 Two-step arterial reconstruction for a case of left-sided dedifferentiated liposarcoma that required combined resection of the left iliac artery

(A) Before tumor resection. (B) Temporary arterial reconstruction with a long prosthetic graft to provide a sufficient surgical field for tumor resection while maintaining blood flow to the legs. (C) Reconstruction of the iliac artery with an appropriate length prosthetic graft (two-stage arterial reconstruction). (D) Wrapping the prosthetic graft with the greater omentum.
Tu: tumor
Lt-CIA: left common iliac artery
GOm: greater omentum

situ reconstruction is not recommended when intestinal resection and anastomosis are required. An in situ reconstruction also obstructs the surgical field during tumor resection. When in situ reconstruction is necessary, the common iliac artery and external iliac artery should be bypassed with a long prosthetic graft to prevent obstruction of the surgical field (Fig. 2A) and maintain blood flow to the lower extremities while resecting the tumor (Fig. 2B). A two-step arterial reconstruction is performed to replace the prosthetic graft after the tumor is resected (Fig. 2C).[4] After in situ reconstruction, the prosthetic graft is wrapped with the greater omentum to prevent contamination of the graft (Fig. 2D). Postoperative anticoagulants and antiplatelet agents are generally unnecessary after prosthetic graft reconstruction for the iliac artery because the diameter of the prosthetic graft is large.

Managing iliac veins

The iliac venous system is often concomitantly affected in tumors involving the iliac arterial system. The external iliac vein may be occluded by large RPSs, resulting in lower extremity edema. If the venous system is difficult to preserve, ligation and dissection without reconstruction is acceptable. The affected leg may become edematous, but the edema gradually resolves after surgery as collateral veins develop. In our experience at the NURCC, edema often disappears within one to two months after surgery if patients undergo appropriate rehabilitation and leg compression with stockings. If the external iliac vein is not ligated or dissected, venous perfusion increases after tumor resection, and deep vein thrombi in the lower extremities may scatter and cause pulmonary embolism. Therefore, it is important to perform leg ultrasonography to identify venous thrombus before surgery.

TUMORS INVOLVING THE IVC

Surgery for RPS with IVC involvement

The IVC is sometimes involved in right-side RPSs. In preoperative computed tomography (CT) images of large tumors, the IVC may be flattened by the tumor or invisible, and distinguishing between tumor compression and tumor infiltration is difficult (Fig. 3A, B). Therefore, the decision to preserve the IVC or perform combined resection is often made during surgery (Fig. 3C, D).

The right quadratus lumborum muscle is visible first when dissecting right-sided RPSs from the lateral side toward the medial side. The right psoas major muscle appears next. Then, the dissection reaches the right vertebral body (Fig. 3D). The dissection should be performed carefully because the tumor feeding and drainage vessels are often connected to the sides of the vertebral body. The IVC can be identified on the ventral side of the vertebral body. At this point, the possibility of separating the tumor from the IVC can be determined. If the IVC can be preserved, the tumor should be carefully dissected while avoiding damage to the fragile venous wall. Removing the tumor will relieve compression of the IVC and restore blood flow. Thus, the patient should be monitored for pulmonary embolism due to scattering of deep vein thrombosis.

If the tumor is difficult to separate from the IVC, a combined IVC resection should be performed. In such cases, blood flow in the IVC is highly restricted before surgery by severe compression or invasion by the tumor. Thus, blood pressure during surgery will not significantly fluctuate even if the IVC is severed. The IVC should be severed carefully while sharing information about hemodynamic changes with the anesthesiologist. During the combined resection, the IVC upstream and downstream of the tumor should be secured with tape (Fig. 4A–D). Depending on the tumor condition, the caudal side of the IVC should be transected downstream of the confluence of the left and right common iliac veins. The site of the cranial side transection

varies depending on the condition of the tumor. If the tumor extends downstream of the left renal vein confluence, the left renal vein should be severed downstream of the left ovarian vein and left adrenal vein confluence (Fig. 4E). Because blood flow in the left renal vein is returned from these veins, no postoperative left renal perfusion disorder develops after this procedure.

The multiple lumbar veins connected to the dorsal side of the IVC should be simultaneously dissected while resecting the IVC. Therefore, the level at which these veins are located should be verified on contrast CT images before surgery. Ligating and dissecting the lumbar vein behind the IVC is difficult, but can be performed relatively easily by first severing and lifting the upstream IVC with the tumor to the ventral side. In general, more lumbar vein branches occur upstream of the junction of the left and right renal veins, and fewer branches occur on the dorsal side of the liver. To safely secure the IVC on the dorsal side of the liver (behind the caudate lobe) with tape, the right and left lobes of the liver should be fully mobilized. The short hepatic veins between the caudate lobe and the IVC should be managed to leave the area around the IVC free. Generally, the IVC in this area roughly adheres to the retroperitoneum, and blunt dissection is relatively easy and safe.

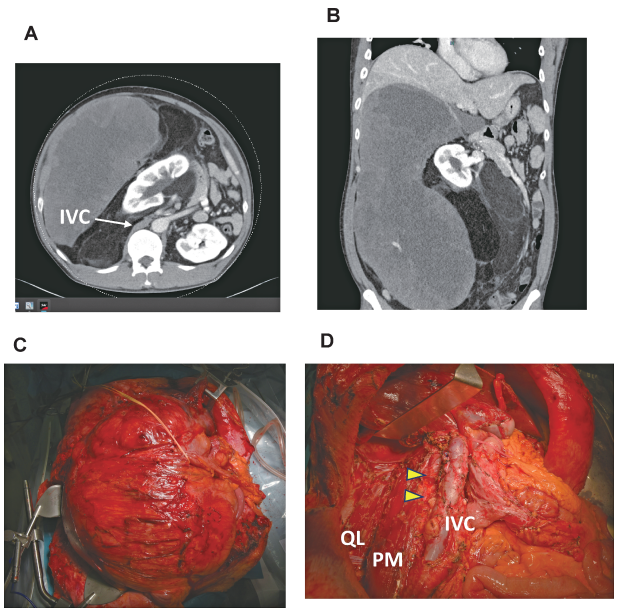

Fig. 3 A case of right-sided dedifferentiated liposarcoma
The computed tomography images from axial (A) and coronal (B) scans indicate a large tumor. The IVC was severely compressed by the tumor. Intraoperative photo of the tumor (C). After tumor resection (D), the right side of the vertebral body is visible (arrowheads).
IVC: inferior vena cava
QL: quadratus lumborum
PM: psoas major

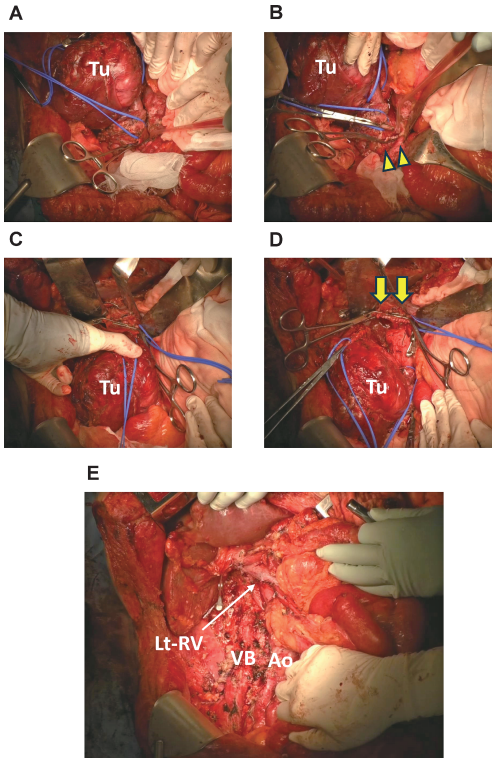

Fig. 4 A case of recurrent right-sided dedifferentiated liposarcoma involving the inferior vena cava (IVC) and pancreatoduodenum
(A) The IVC upstream of the tumor was taped. (B) The upstream IVC was transected and closed (arrowheads). (C) The IVC downstream of the tumor was taped. (D) The downstream IVC was transected and closed (arrows). (E) After tumor resection (a combined resection of IVC and pancreaticoduodenectomy was performed).
Tu: tumor
Ao: aorta
VB: vertebral body
Lt-RV: dissected stump of the left renal vein

TUMORS FORMING IVC TUMOR THROMBI

Surgery for RPS with IVC tumor thrombus

RPSs may invade the vascular wall and cause tumor thrombus in the IVC. Cooperating with cardiovascular surgeons is essential when operating on these cases. Large tumor thrombi in the IVC may severely interrupt upstream blood flow and form large upstream thrombi. Thrombus formation occurs gradually during tumor growth, causing edema in the lower extremities. However, the symptoms gradually decrease due to the development of collateral blood circulation. These tumors can be resected, but special preparation is required for surgery. After blocking the tumor thrombus upstream, the IVC should be transected at the thrombus site. The tumor thrombus and non-tumor thrombus can usually be distinguished using intraoperative ultrasound.

Tumors invading the IVC always progress toward the downstream side; the tumor thrombus does not grow toward the upstream side. Thus, if the IVC is transected upstream of the tumor thrombus, the tumor will not be exposed at the detached portion. In addition, if the upstream IVC

is almost filled with thrombus, collateral circulation has already developed, and hemodynamics will not change, even if the IVC is severed. In contrast, if the IVC upstream of the tumor thrombus is not filled with thrombus and venous return needs to be maintained, reconstruction using a prosthetic graft may be necessary. In this case, special care should be taken to prevent pulmonary embolism caused by the thrombus in the lower extremity after improving the flow in the IVC. As mentioned above, lower extremity ultrasonography is crucial for identifying thrombi before surgery.

Surgical techniques for IVC tumor thrombus removal vary according to the extension level of the tumor thrombus tip and the thrombus formation upstream of the tumor thrombus. Therefore, surgical techniques based on real cases at the NURCC are described.

Case 1: A leiomyosarcoma originating from the left renal vein, forming a tumor thrombus and reaching the IVC

The large tumor thrombus originated from the left renal vein and grew into the IVC, blocking upstream blood flow (Fig. 5A), and a huge thrombus formed in the upstream IVC. The patient experienced severe edema of the lower limbs, but at the time of the initial hospital visit, the swelling had already subsided due to the development of collateral circulation. Right renal vein blood flow was obstructed by the tumor thrombus and was barely flowing (Fig. 5A). Resection of the left kidney was necessary, and the tumor received abundant blood flow from the left renal artery. Therefore, the left renal artery and tumor feeding vessels were embolized by the radiologists one day before surgery (Fig. 5B).

Preparations were made to prevent pulmonary embolism due to the detachment and scattering of tumor thrombi during surgery. The abdomen was opened with a large midline incision, and a cruciate horizontal incision was made. The cardiac surgeon made a median sternotomy and secured the IVC and superior vena cava (SVC) with tape in case cardiopulmonary bypass is necessary. The anesthesiologist inserted a transesophageal echocardiogram to check for right atrial overload by pulmonary embolism due to the detachment and scattering of tumor thrombi during surgery. The right renal vein, right renal artery, left renal vein (including the tumor thrombus), and the IVC upstream and downstream of the tumor thrombus were secured with tape (Fig. 5C).

Intraoperative ultrasound was used to visualize the boundary between the tumor thrombus and the associated upstream thrombus. The tumor thrombus usually extends downstream of the IVC, and upstream extension is highly unlikely. All blood vessels around the tumor thrombus were clamped, and the IVC was transected at the upstream thrombus. The IVC upstream of the tumor was almost entirely thrombosed. Thus, suturing the severed end was sufficient, and vessel reconstruction was not necessary. This procedure did not alter the hemodynamics because the IVC was already blocked by the thrombus upstream of the tumor.

After severing, the IVC was incised vertically to extract the tumor thrombus (Fig. 5D). The tumor originated from the left renal vein, and the tumor thrombus extending from the left renal vein to the IVC was manually detached. The tumor thrombus adhered to the IVC wall due to inflammation (Fig. 5D). The tumor thrombus was pulled out to the left side through the dorsal side of the superior mesenteric artery and vein and removed with the tumor. The left renal vein confluence and the transection of the IVC were closed. Direct closure would have caused stenosis in the right renal vein. Therefore, a bovine pericardial patch was used to create a stump (Fig. 5E).

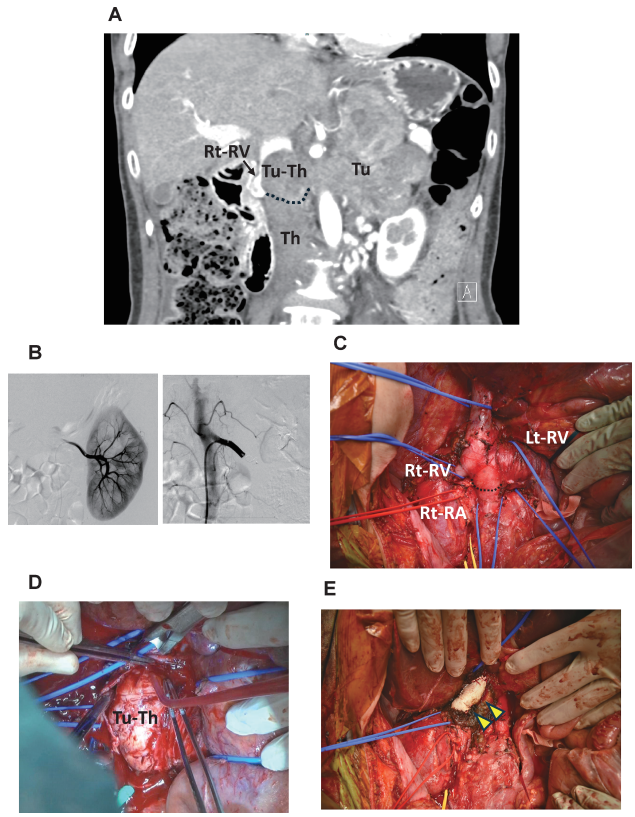

Fig. 5 A case of leiomyosarcoma originating from the left renal vein
(A) Computed tomography image from a coronal scan (dotted line, upstream border of the tumor thrombus). (B) The left renal artery and the tumor feeding artery were coil embolized before surgery (left panel, before embolization; right panel, after embolization). (C) Intraoperative photo of the tumor thrombus (dotted line, upstream border of the tumor thrombus). (D) Dissection of the tumor thrombus from the inferior vena cava wall. (E) A patch reconstruction of the inferior vena cava stump using a bovine pericardial patch.
Rt-RV: right renal vein
Rt-RA: right renal artery
Lt-RV: left renal vein
Tu: tumor
Tu-Th: tumor thrombus
Th: thrombus

Case 2: Primary leiomyosarcoma of the IVC forming a tumor thrombus

A primary leiomyosarcoma on the left side wall of the IVC formed a tumor thrombus, extending to the cranial side of the hepatic vein confluence (Fig. 6A, B). The tumor thrombus blocked hepatic venous blood flow. At the initial hospital visit, the patient was in critical condition with progressive congestive liver damage. In addition, the large tumor thrombus was blocking blood returning from the lower body. Thus, blood pressure dropped when the patient was in an upright position. Therefore, surgery was performed on a semi-urgent basis.

A thoraco-laparotomy was performed using a cruciate incision and a median sternotomy. The pancreaticoduodenum, right hemicolon, and small intestine were mobilized to expose the retroperitoneum (total retroperitoneal exposing mobilization). The right renal artery and vein, the

left renal vein, and the IVC upstream of the tumor were secured with tape (Fig. 6C). The left and right lobes of the liver were mobilized, and the short hepatic veins between the caudate lobe and the IVC were dissected as much as possible. Catheters were inserted into the IVC (through the right femoral vein) and the SVC. A third catheter was inserted into the main trunk of the superior mesenteric vein by cutting down the ileocolic vein to prepare for long-term hepatoduodenal ligament clamping and to avoid long-term congestion of the intestine upstream of the superior mesenteric vein.

Blood was drained from the IVC, SVC, and superior mesenteric vein and returned to the right femoral artery using a cardiopulmonary bypass pump. The right and left subphrenic veins were ligated to prevent a large amount of venous return from the subphrenic vein into the IVC. All taped blood vessels were clamped, and the right atrium was incised to confirm the location of the tumor thrombus tip. The IVC was transected upstream of the tumor (Fig. 6D), and incised longitudinally on the right wall opposite the tumor site (Fig. 6E). The tumor thrombus was inverted and pushed from the right atrium to the caudal side (Fig. 6F). The IVC downstream of the tumor was transected to complete the resection (Fig. 6G). The defective IVC was reconstructed using a prosthetic graft (Fig. 6H).

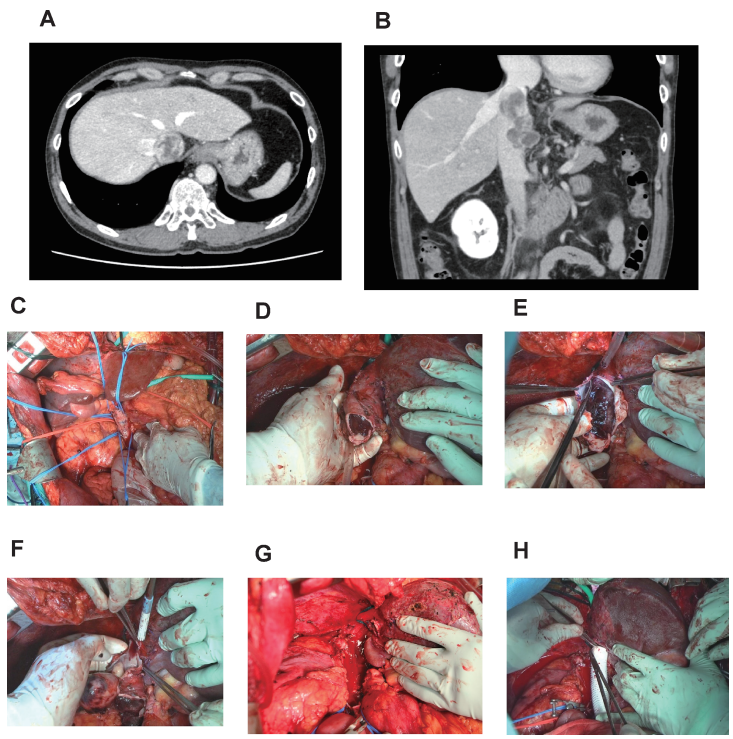

Fig. 6 A case of leiomyosarcoma originating from the left wall of the inferior vena cava (IVC)
The computed tomography images from the axial (A) and coronal (B) scans indicate a tumor thrombus in the IVC blocking hepatic venous flow. After taping the right renal artery and vein, the left renal vein, and the IVC upstream and downstream of the tumor (C). The upstream IVC was transected under extracorporeal circulation (D). The IVC was incised longitudinally on the opposite side of the tumor (E). The tumor thrombus was pulled out and inverted (F). After tumor resection (G). After reconstruction of the defective IVC with a prosthetic graft (H).

Case 3: A leiomyosarcoma originating from the right renal vein, forming an IVC tumor thrombus reaching the right atrium

The tumor formed a thrombus in the IVC, reaching the right atrium (Fig. 7A, B). Echocardiography showed the tip of the tumor thrombus protruding from the right atrium into the right ventricle through the tricuspid valve and returning. The tip of the tumor thrombus can break off and flow into the pulmonary artery, causing a pulmonary embolism and cardiac arrest. The IVC upstream of the tumor thrombus was thrombosed. Although the surgery was highly invasive and high-risk, the decision was made to perform the surgery after fully explaining the risks to the patient and the patient's family.

The approach was made via a midline abdominal incision, a transverse cruciate incision, and a median sternotomy. The pancreaticoduodenum, right hemicolon, and small intestine mesentery

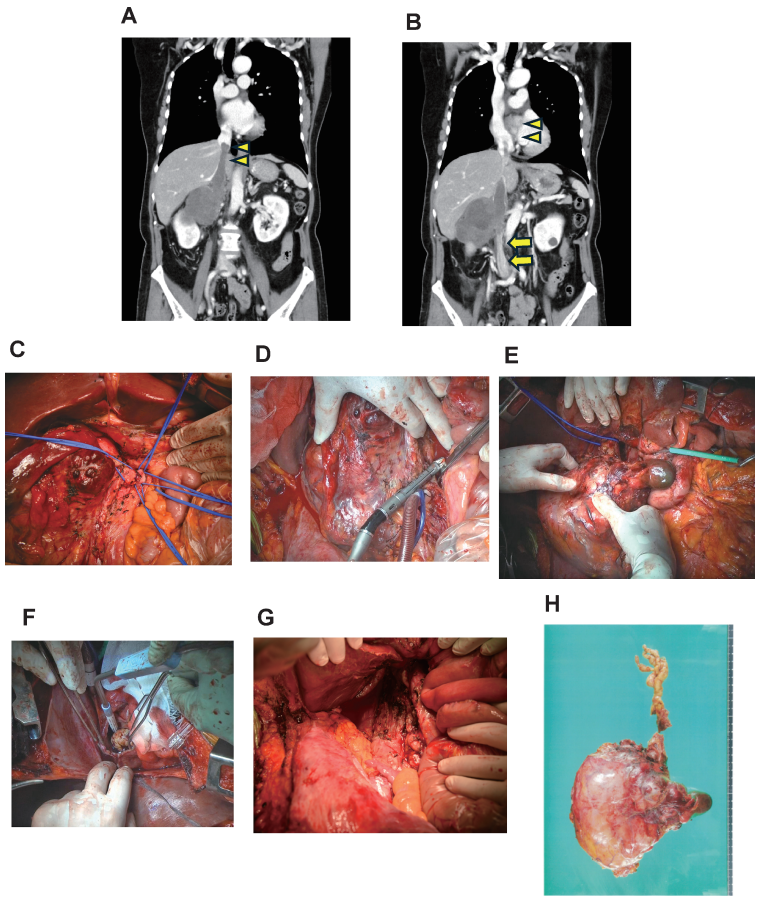

Fig. 7 A leiomyosarcoma originating from the right renal vein
The computed tomography image from a coronal scan, indicating a tumor thrombus (arrowheads) in the inferior vena cava (IVC) extending to the right atrium (A and B). The upstream area of the tumor thrombus was almost completely thrombosed (arrows). The left renal vein was taped and dissected at the confluence of the IVC (downstream of the central vein and left gonadal vein confluences; C). Transection of the IVC upstream of the tumor thrombus (D). Dissection of the tumor and IVC from the retroperitoneum (E). Under cardiopulmonary bypass, the tip of the tumor thrombus was pulled out, and the tricuspid valve was covered with gauze (F). After tumor resection (G). The defective IVC was not reconstructed. The resected tumor and tumor thrombus (H).

were fully mobilized to visualize the IVC (total retroperitoneal exposing mobilization). The right and left lobes of the liver were fully mobilized, and the short hepatic veins between the caudate lobe and the IVC were dissected to free the IVC. The left renal vein and the IVC upstream of the tumor thrombus were secured with tape (Fig. 7C). The left renal vein was dissected at the confluence with the IVC, preserving the left ovarian vein and the left adrenal vein confluences. This procedure facilitated the dissection of the right renal artery, which branches off from the right wall of the abdominal aorta. After dissecting the right renal artery, the right ovarian vein and ureter were dissected, and the right kidney and the tumor were mobilized from the retroperitoneum. Catheters were inserted into the IVC upstream of the tumor thrombus, the SVC, and the ileocolic vein for blood withdrawal. In addition, a catheter was inserted into the ascending aorta for blood return to prepare for cardiopulmonary bypass.

The upstream IVC was transected at the site of the thrombus formation (Fig. 7D). The tumor, right kidney, and IVC were dissected from the retroperitoneum, and several lumbar veins behind the IVC were dissected (Fig. 7E). The hepatoduodenal ligament was clamped to start extracorporeal circulation. The right atrium was opened, and the tip of the tumor thrombus was inverted outside of the IVC (Fig. 7F). The tricuspid valve was covered with gauze to prevent the tumor thrombus from moving toward the right ventricle. After transecting the IVC upstream of the hepatic vein confluence, the tumor thrombus was detached. Inflammatory adhesions caused the tumor thrombus to attach to the wall of the IVC; thus, removal of the tumor thrombus was difficult. The tip of the tumor thrombus was removed separately from the right atrium, and the resection was completed (Fig. 7G, H). The IVC was closed upstream of the hepatic vein confluence without reconstruction. The cardiopulmonary bypasses for cases 2 and 3 are shown in Fig. 8A and 8B, respectively.

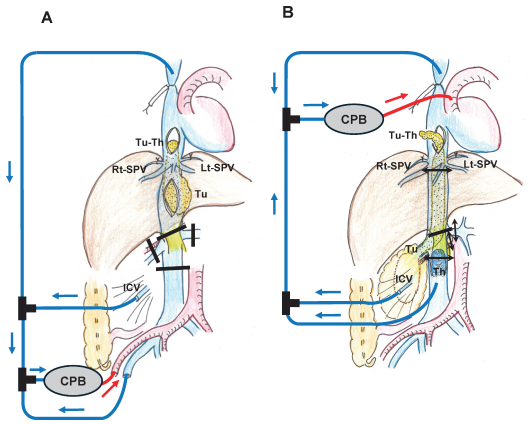

Fig. 8 Cardiopulmonary bypass schemes for cases 2 and 3
(A) Case 2. The inferior vena cava (IVC) was removed with the tumor and tumor thrombus and reconstructed with a prosthetic graft. (B) Case 3. The IVC was transected at the level of thrombus and upstream of the hepatic vein confluence and removed with the tumor and tumor thrombus without reconstruction. Bar, clamp. Arrows, dissection.
CPB: cardiopulmonary bypass
Tu: tumor
Th: thrombus
Tu-Th: tumor thrombus
Rt-SPV: right subphrenic vein
Lt-SPV: left subphrenic vein
ICV: ileocolic vein

Large RPSs involving the abdominal aorta

Extensive contact between the abdominal aorta and the tumor often occurs when a large RPS is located on the left side (Fig. 9A, B). Even when the border between the tumor and the abdominal aorta is unclear on preoperative CT scans, the tumor can usually be dissected during surgery. At the NURCC, resection of the abdominal aorta and reconstruction using a prosthetic graft were not required for any RPSs on the left side. However, the tumor and abdominal aorta may be firmly adhered to each other by inflammation and should be carefully separated to avoid damage to the vascular adventitia. We inserted an abdominal aortic stent graft before surgery to prepare for damage to the adventitia during tumor removal (Fig. 9C). The operation should be

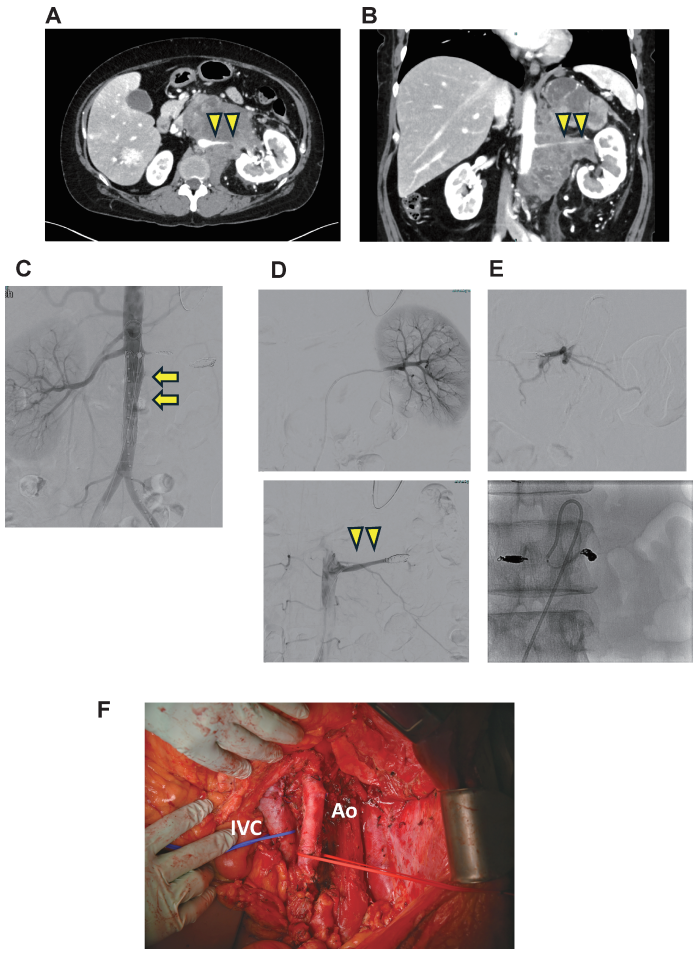

Fig. 9 A left-sided leiomyosarcoma involving the abdominal aorta
The computed tomography images from the axial (A) and coronal (B) scans indicate a tumor involving the abdominal aorta (arrowheads, left renal artery). An abdominal aortic stent graft (arrows) was inserted two days before surgery to prepare for damage to the adventitia during tumor removal (C). Embolization of the left renal artery (upper panel, before embolization; lower panel, after embolization; D). Embolization of the lumbar artery (upper panel, before embolization; lower panel, after embolization; E). After tumor removal (F).
IVC: inferior vena cava
Ao: aorta

performed with support from vascular surgeons when there is a possibility that the tumor cannot be removed from the abdominal aorta and the prosthetic arterial graft is necessary.

In most cases of tumors extensively in contact with the abdominal aorta on the left side, left nephrectomy is necessary. The left renal artery is often the feeding vessel for these tumors and the left kidney. Therefore, this vessel should be dissected early during the surgery. However, if the left renal artery is covered by a large tumor, this procedure can only be performed at the final stage of tumor resection. If the left nephrectomy will be performed with the tumor resection and the left renal arterial flow will be difficult to control during surgery, radiologists should embolize the left renal artery before surgery (Fig. 9D). Similarly, the lumbar artery, which branches off from the abdominal aorta on the dorsal side, often feeds the tumor. In such cases, the lumbar arteries also should be embolized by a radiologist in advance (Fig. 9E, F). These procedures are typically performed one or two days before surgery.

DISCUSSION

The pathogenesis of retroperitoneal tumors is very diverse. These tumors are rarely symptomatic due to their location and are often diagnosed when they are already large. Most large RPSs are in close contact with large blood vessels located in the retroperitoneal cavity. CT images often show that these large tumors are close to the abdominal aorta or IVC, which may lead to the conclusion that the tumor is unresectable. However, in a large percentage of cases, the tumor can be detached from these blood vessels. With the appropriate approach, as described in this article, even tumors involving major blood vessels can be safely resected. Resecting these tumors requires collaboration among multiple departments.

Surgeons involved in retroperitoneal tumor resections should be skilled at dissecting large blood vessels in the retroperitoneal space. Tumors with extensive attachments to large blood vessels should not be declared as unresectable because the number of “RPS refugees” who cannot undergo surgery will increase throughout the world. Conversely, retroperitoneal tumor surgery requires specific skills acquired through experience at high-volume centers. In addition, these complicated tumor resections require collaboration among multiple departments. Thus, establishing a system within the hospital to safely perform RPS surgery is essential.

CONFLICT OF INTEREST DISCLOSURE

None reported.

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