



## Surgery in Motion

# En Bloc Mobilization of the Pancreas and Spleen to Facilitate Resection of Large Tumors, Primarily Renal and Adrenal, in the Left Upper Quadrant of the Abdomen: Techniques Derived from Multivisceral Transplantation

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### Abstract

**Background:** The left upper quadrant of the abdomen may be occupied by a wide range of urologic pathology. When these lesions are large, safely resecting them often presents a significant technical challenge, with the possibility of resultant morbidity and mortality.

**Objective:** We describe a technique derived from our experience with multivisceral transplant and organ procurement, which provides excellent exposure of this anatomic region.

**Design, setting, and participants:** From May 1999 to April 2006, 70 patients underwent en bloc mobilization of the spleen and the pancreas and, as necessary, the stomach for masses in the left upper retroperitoneum. Pathology included malignant and benign lesions, including renal cell carcinoma (RCC) with or without inferior vena cava (IVC) involvement, adrenal tumors, retrocrural lymphadenopathy from testicular cancer, and transitional cell carcinoma of the renal pelvis.

**Surgical procedure:** An extended subcostal transabdominal approach was used to resect large tumors in the left upper abdomen. This approach offers significant advantages over conventional approaches, including a flank, thoracoabdominal, or midline transabdominal incision with reflection of the descending colon.

**Measurements:** Intraoperative variables, including operative time, blood loss, transfusion rate, and extent of mobilization were recorded. Postoperative complications, including prolonged intubation, ileus, and deep venous thrombosis were also noted.

**Results and limitations:** Mean estimated blood loss during surgery was 973 ml. There were no perioperative deaths. No patients had pancreatitis or acute renal failure. Deep venous thrombosis was not seen. Cardiopulmonary bypass was used in one patient with an atrial thrombus. At a median follow-up of 42 mo, two patients died due to metastasis.

**Conclusions:** Techniques acquired from organ harvesting as well as our experience at multivisceral transplant, such as en bloc mobilization of the spleen, pancreas, and stomach, can be utilized safely and effectively to gain excellent exposure to the left upper retroperitoneum via an extended subcostal incision with no additional morbidity for the patient.

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## 1. Introduction

The urologist has historically approached most open surgical cases in a very traditional manner. Conventionally, the kidney has been approached either through flank or midline incisions, the bladder through a midline incision, and the prostate through a smaller minilaparotomy incision. Only relatively recently, within the last few years, have significant changes been made in the approach taken by urologic surgeons. Recent strides have allowed less painful results with improved cosmesis, such as laparoscopic and minimally invasive surgery. Many of these advances are made as a result of factors related to patient comfort and appearance. However, these recent enhancements belie little change in surgical techniques, many of which have been honed over decades of modification and evolution [1].

Certain situations exist where current surgical approaches are suboptimal. One example is a large tumor in the left upper quadrant of the abdomen. Surgeons use a variety of techniques to access pathology in these anatomic regions [2,3]. However, the urologist often deals with situations that are not well suited to these approaches, including a large renal cell carcinoma (RCC) with involvement of the inferior vena cava (IVC), adrenal tumors, extensive teratoma from a testicular tumor subsequent to chemotherapy, and, rarely, an extensive transitional cell carcinoma invading the renal cortex.

The standard surgical approaches for removal of tumors in the left upper quadrant are flank, transabdominal through a subcostal or midline incision, or thoracoabdominal. While these approaches are appropriate in many instances, they may be disappointing for large tumors that can extend to the diaphragmatic crus and may increase the complexity while decreasing the safety of the operation.

In our experience, the flank approach does not provide sufficient exposure for very large tumors. A transabdominal midline incision may provide reasonable exposure but suffers from a telescopic effect. A telescopic effect is encountered when the limits of the surgical field become narrower as the surgeon proceeds deeper into the dissection. This can be a disadvantage, especially if the adjacent organs such as the spleen, pancreas, and, occasionally, the stomach are not fully mobilized and may lead to injury of local structures. A thoracoabdominal incision provides excellent exposure but, we believe, has more morbidity because of the need for a chest tube and greater postoperative analgesia [4].

Transplant techniques are often used in urologic oncologic surgery, and, in this paper, we present a description of a novel surgical approach. Initially, an

extended subcostal incision provides excellent visualization of the structures in the left upper abdomen. Subsequently, when the spleen and pancreas and, as necessary, the stomach are mobilized, a telescopic phenomenon is avoided and a large mass can be safely removed. Mobilization of these structures toward the midline is helpful for two reasons: It exposes the left hemidiaphragm and crura, enabling the surgeon to work in an expanded surgical field, and allows visualization of the upper abdominal aorta and vena cava for excellent vascular control.

## 2. Methods and patients

From May 1999 to April 2006, 70 patients underwent resection of tumors in the left upper abdomen. In every case, the surgical exposure was initiated through a subcostal transabdominal approach. The spleen, pancreas, and stomach were mobilized to varying degrees depending upon the site and extent of the tumor. Operative time, estimated blood loss, use of bypass techniques, and amount of blood transfusions were recorded. Postoperative complications such as prolonged intubation, renal failure, pancreatitis, ileus, splenic injury, etc. were recorded.

### 2.1. Surgical technique: *En bloc mobilization of the spleen, pancreas, and stomach*

#### 2.1.1. Patient position, incision, and retractor system

The patient is prepped and draped in the supine position. If there is a level 3 thrombus in the IVC, the axilla and groin are incorporated in the sterile field [5]. A left subcostal incision three fingers' breadth below the costal margin is made and extended to the midline. Once the extent of the neoplasm is evaluated, the incision is extended to the right side with a xiphisternal extension. The xiphisternal extension helps in the placement of the Rochard retractor system (Fig. 1). The Rochard retractor is critical, as it retracts the costal margin and flattens the diaphragm [6]. The traction required on the left costal margin is usually more than that required for the right to optimize exposure of the left upper abdomen. Should further access to the right upper quadrant structures be

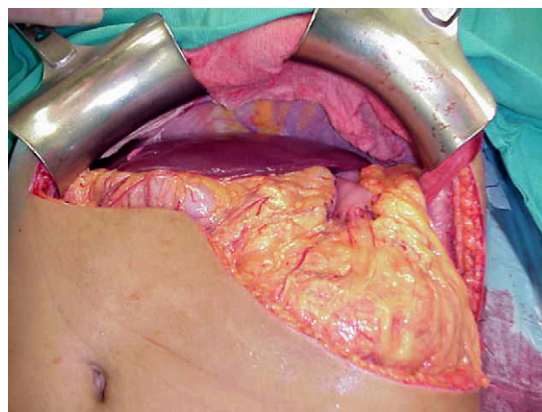
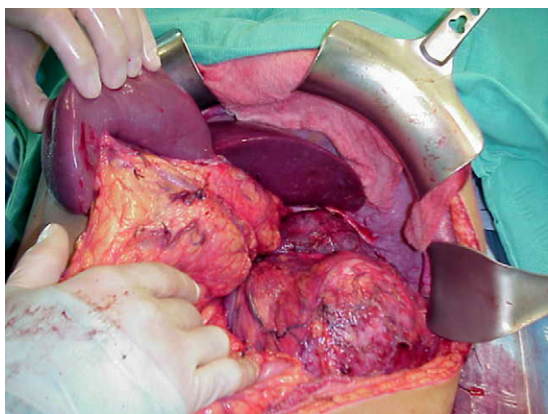


Fig. 1 – Incision and the Rochard retractor system.

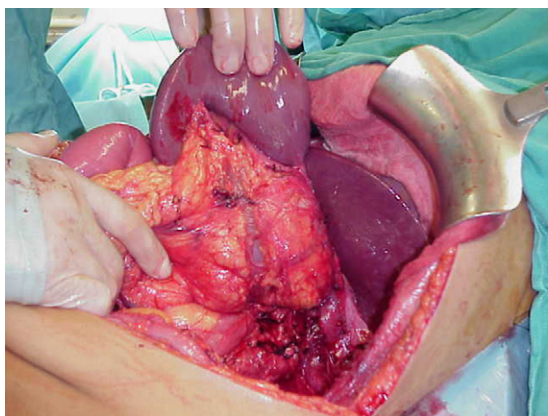


**Fig. 2 – Spleen being used as a handle for dissection.**

desired, the incision may be extended to the contralateral side, effectively creating a chevron incision.

### 2.1.2. Dissection

The dissection is started by incising the posterior peritoneal attachment of the spleen. The spleen is mobilized and used as a handle to elevate the tail of the pancreas (Fig. 2). Extreme care must be taken not to place undue traction on the spleen. It should be retracted in a medial direction, which subsequently exposes both the splenic-diaphragmatic and splenorenal ligaments. These should be divided with electrocautery prior to continuing the dissection. The spleen should be bluntly dissected off Gerota's fascia and the diaphragm early to prevent a pneumothorax. The incision on the peritoneal lining is continued down over the line of Toldt to reflect the descending colon medially. Similarly the peritoneal incision is extended superiorly toward the crus of the diaphragm. The surgeon reflects the spleen and left colon toward the midline and, at the same time, incises the avascular fibrofatty plane about 1 cm from the posterior aspect of the pancreatic capsule. This helps in peeling the pancreas off the mass (Fig. 3). At that time, the pancreatic tail and body may be elevated anteriorly and toward the midline, allowing further dissection away from the mass. The following points are important: Visualize and preserve the



**Fig. 3 – View of the left upper retroperitoneum after mobilization of the spleen, pancreas, stomach, and colon.**

splenic artery and vein using the spleen as a handle. Avoid unnecessary traction on the spleen, which can cause a tear in the capsule and bleeding. Avoid dissection into the body of the pancreas. Avoid injury to the gastric serosa while mobilizing the posterior aspect of the stomach. Identify and preserve the inferior mesenteric vein at the lower border of the pancreas. Adhere to the principle of en bloc mobilization rather than individual organ dissection. To that end, the spleen may remain attached to the greater curvature of the stomach by the left gastroepiploic and short gastric vessels.

The limit of this dissection is the left border of the aorta, where one appreciates the origin of the celiac and superior mesenteric trunks. The small bowel mesentery is then incised to expose the lower aorta and the confluence of the IVC. The left renal vein is visualized crossing the aorta just below the superior mesenteric artery. Often, in the presence of a large renal mass with or without a vena caval tumor thrombus, a large number of vascular collaterals will be present. These should be meticulously ligated to prevent significant hemorrhage at this step.

Thus, the entire retroperitoneum is visualized by incising the peritoneal attachment of the spleen and descending colon as well as a fibrofatty layer on the posterior aspect of the pancreas (Fig. 3). Injury to these vital organs is minimized by a no-touch technique.

Depending on the extent of the tumor and associated lymph node and vascular involvement, the aorta and vena cava are identified.

This technique of mobilization is derived from the rapid-devascularization principle that is employed during explantation of the recipient's abdominal viscera for multivisceral transplant. In the presence of dense adhesions and collaterals, the diseased organs need to be devascularized rapidly to decrease the amount of bleeding. This requires rapid access to the celiac and superior mesenteric arterial pedicles [7].

The mobilized spleen, pancreas, stomach, and, sometimes, the small bowel are wrapped in moist towels and tucked under the right hemidiaphragm to expose the aorta and entire left retroperitoneum from the crus of the diaphragm to the pelvis and aortic bifurcation.

## 3. Results

From May 1999 to April 2006, 70 patients underwent resection of tumors in the left upper abdomen using the en bloc technique.

### 3.1. Patient factors

The demographics of these patients are illustrated in Table 1. There were 46 men and 24 women. Ages ranged from 26–83 yr (mean: 48).

### 3.2. Tumors

Fifty-seven of the 70 patients had a large left RCC. Two patients had a left adrenal tumor with a concurrent right renal mass. One patient had a

**Table 1 – Patient demographics and tumor factors**

Patient demographics	
Number of patients	70
Male/female	46/24
Ages (mean), yr	26–83 (48)
Tumor factors	
Left-sided RCC	57
Subgroups	
RCC with lymphadenopathy	4
RCC with left adrenal tumor	3
RCC with IVC involvement	7
RCC with renal vein involvement	5
Left adrenal mass with right RCC	2
Left recurrent adrenal tumor	1
CT scan–diagnosed mass	6
Subgroups	
Recurrent RCC involving spleen	1
Sarcoma	2
Undifferentiated tumor involving the kidney	1
Recurrent RCC involving the diaphragm	1
Recurrent TCC involving the diaphragm	1
Angiomyolipoma of the kidney	1
Testicular retrocrural lymphadenopathy	2
Recurrent teratoma	1
RCC = renal cell carcinoma; IVC = inferior vena cava; CT = computed tomography; TCC = transitional cell carcinoma.	

recurrent left adrenal tumor. Six patients had retroperitoneal masses diagnosed on computed tomography (CT) scan. One patient had a large angiomyolipoma of the kidney. Two patients had retroperitoneal lymphadenopathy from testicular cancer (post chemotherapy). One patient presented with a recurrent teratoma. Of the 70 patients, 2 had involvement of the left hemidiaphragm from an RCC and a transitional cell carcinoma (TCC), respectively. IVC involvement was noted in seven patients with a left-sided RCC. Two involved the suprahepatic and three the infrahepatic IVC. Five patients had renal vein invasion. Two patients had an atrial tumor thrombus.

### 3.3. Intraoperative factors

Cardiopulmonary bypass was used in one patient with an RCC and thrombus extending to the right atrium. Four patients required additional mobilization of the liver off the IVC in the piggyback manner. The remaining patients underwent en bloc mobilization of the spleen, pancreas, and stomach and descending colon, as described. Four patients had a splenic tear that was repaired by mesh splenorrhaphy. Two patients had injury to the tail of the pancreas. One had a distal pancreatic resection, and one had the tear repaired. Two patients with involvement of the diaphragm had a resection of the diaphragm with Gore-Tex replacement. Another patient required wide resection of the tumor,

including a part of the diaphragm. This patient also received a Gore-Tex replacement of the diaphragm. One patient had a tear of the stomach serosa that was repaired. Two patients required placement of a chest tube.

Mean estimated blood loss during surgery was 973 ml (range: 100–16 000). The patient with 16 000-cm<sup>3</sup> blood loss required cardiopulmonary bypass (CPB) for a renal tumor with IVC thrombus extending to the right atrium. No patient required a splenectomy. There were no intraoperative or perioperative deaths.

### 3.4. Postoperative factors

All patients were transferred to intensive care after surgery. All were extubated within 24 h. There were no rib fractures due to traction from the Rochard retractor. Pain control was with a patient-controlled analgesia (PCA) pump that was usually discontinued 24–48 h after extubation. Patients with renal vein and IVC involvement were given low molecular weight dextran in the immediate postoperative period and placed on low-dose aspirin when able to tolerate a diet. None of the patients had clinical pancreatitis or renal failure. None had deep vein thrombosis. At a median follow-up of 42 mo, three patients are dead, two from metastasis and one from a pulmonary embolus following a hip replacement.

## 4. Discussion

Resection of large tumors in the left upper retroperitoneum is challenging due to their relative inaccessibility, the high incidence of multiple pathologic findings, and complex vascular anatomy. Traditional approaches have used either flank or thoracoabdominal incisions [8]. Both of these approaches have significant drawbacks in complex cases where excellent exposure and control of the field is mandatory. At our institution, these methods are commonly utilized in cases of local disease that is not felt to require extensive mobilization. This decision is often made based on preoperative radiographic imaging, pathology (if available), laboratory values when applicable, and other pertinent studies to form a cohesive clinical evaluation of tumor burden. The level of IVC thrombus, lymph node status, and extension into local structures is also ascertained. For extensive tumors and advanced cases, we advocate the use of a transabdominal, subcostal incision with a midline xiphisternal extension (if the subcostal incision is extended bilaterally).

This allows adequate retraction of the costal margins using a Rochard retractor and obviates the need for a thoracoabdominal incision [9]. At our institution, given the referral patterns of advanced retroperitoneal cancers, approximately 80% of all resections of open, significantly locally advanced, left upper quadrant tumors are performed using this technique. This clearly does not include localized lesions or tumors amenable to minimal-mobilization, laparoscopic, or hand-assisted techniques.

In addition, to avoid the previously highlighted telescopic phenomenon, this approach allows for an expanded surgical field that is further exposed by en bloc mobilization of the spleen, pancreas, and stomach. Additionally, this maneuver helps to delineate the vasculature of the area by exposing the upper abdominal aorta as well as the IVC when required. Thus, safe resection of these tumors is possible with excellent vascular control.

As stated above, a number of additional techniques are available and should be utilized to assist in the safe completion of this operation. Initially, using the spleen as a handle to gain early vascular control over the local structures is very important. The en bloc mobilization of the stomach with spleen attached via the left gastroepiploics and short gastric arteries allows significantly improved exposure, with the additional benefit of forgoing the vascular manipulation of these arteries to achieve the same goal.

Given the lack of extensive training with pancreatic manipulation and the obvious risks to the patient of pancreatic injuries, the urologist often approaches this organ with significant apprehension. However, utilizing the above techniques with gentle traction will usually result in minimal local trauma. Pancreatic bleeding is often easily controlled with fine suture ligation with an atraumatic needle, as the pancreatic vessels frequently retract into the tissue. All of these techniques combine to allow for a safe, effective operation that does not compromise oncologic control and results in decreased morbidity for the patient compared to traditional approaches.

## 5. Conclusions

This technique was derived from our experience in multivisceral transplantation and organ procurement. It is simple to apply and can be reproduced without morbidity. Transplant techniques have been utilized in urologic surgery in the past, and there have been reports of the use of organ procurement techniques in the exposure of the left upper abdomen

[10]. This technique of exposing the left upper retroperitoneum is used in multivisceral transplantation, where the recipient's residual abdominal organs are required to be explanted rapidly, as well as during a multivisceral graft harvest, where the surgeon procures the organ en bloc. Our experience is consistent with other reports for similar pathology, and this technique does not contribute to additional peri- or postoperative morbidity or mortality.

**Author contributions:** Gaetano Ciancio had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

*Study concept and design:* Ciancio, Soloway, Manoharan.

*Acquisition of data:* Ciancio, Soloway, Vaidya.

*Analysis and interpretation of data:* Shirodkar, Ciancio.

*Drafting of the manuscript:* Shirodkar, Ciancio, Hakky, Vaidya.

*Critical revision of the manuscript for important intellectual content:* Shirodkar, Ciancio, Soloway.

*Statistical analysis:* Shirodkar, Ciancio, Soloway.

*Obtaining funding:* Ciancio, Soloway.

*Administrative, technical, or material support:* Shirodkar, Ciancio, Hakky, Vaidya, Manoharan.

*Supervision:* Ciancio, Soloway.

*Other (specify):* None.

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## Appendix A. Supplementary data

The Surgery in Motion video accompanying this article can be found in the online version at [doi:10.1016/j.eururo.2008.12.038](https://doi.org/10.1016/j.eururo.2008.12.038) and via [www.europeanurology.com](http://www.europeanurology.com). Subscribers to the printed journal will find the Surgery in Motion DVD enclosed.

## References

- [1] Walsh PC. The discovery of the cavernous nerves and development of nerve sparing radical retropubic prostatectomy. *J Urol* 2007;177:1632–5.
- [2] Kaban GK, Czerniach DR, Litwin DE. Hand-assisted laparoscopic surgery. *Surg Technol Int* 2003;11:63–70.
- [3] Uranues S, Alimoglu O. Laparoscopic surgery of the spleen. *Surg Clin North Am* 2005;85:75–90.

- [4] Morrissey NJ, Hollier LH. Anatomic exposures in thoracoabdominal aortic surgery. *Semin Vasc Surg* 2000;13:283–9.
- [5] Ciancio G, Vaidya A, Savoie M, Soloway MS. Management of renal cell carcinoma with level III thrombus in the inferior vena cava. *J Urol* 2002;168:1374–7.
- [6] Ciancio G, Hawke C, Soloway MS. The use of liver transplant techniques to aid in the surgical management of urological tumors. *J Urol* 2000;164:665–72.
- [7] Kato T, Ruiz P, Thompson JF, et al. Intestinal and multi-visceral transplantation. *World J Surg* 2002;26:226–37.
- [8] Vaidya A, Ciancio G, Soloway MS. Surgical techniques employed for the resection of renal cell carcinomas with inferior vena cava thrombus. *J Urol* 2003;169:435–44.
- [9] Ciancio G, Livingstone AS, Soloway M. Surgical management of renal cell carcinoma with tumor thrombus in the renal and inferior vena cava: the University of Miami experience in using liver transplantation techniques. *Eur Urol* 2007;51:988–95.
- [10] Marsh CL, Lange PH. Application of liver transplant and organ procurement techniques to difficult upper abdominal urological cases. *J Urol* 1994;151:1652–6.

**Editorial Comment on: En Bloc Mobilization of the Pancreas and Spleen to Facilitate Resection of Large Tumors, Primarily Renal and Adrenal, in the Left Upper Quadrant of the Abdomen: Techniques Derived from Multivisceral Transplantation**

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Even though there is a certain degree of uncertainty about the usefulness of front-line radical nephrectomy in the era of targeted therapies for the treatment of metastatic renal cell carcinoma (RCC), complete resection of all visible tumours with negative margins remains the key for long-term survival in locally advanced renal tumours [1]. The irruption of antiangiogenic drugs has enabled tremendous progress in the management of metastatic RCC, and there is great hope that adjuvant and neoadjuvant strategies will also contribute to improving outcomes of patients with high-risk localised disease [2].

It is likely that both the timing and the profile of RCC surgery will change in the era of targeted therapies. Very challenging surgery in the era of immunotherapy was probably not useful when median life expectancy of patients was <1 yr. In the context of metastatic RCC, which is increasingly looking like a chronic disease, the interest in extensive surgery is renewed. Additionally, there are suggestions that antiangiogenic drugs could render primarily unresectable tumours suitable for complete resection [3].

Consequently, we found great interest to the surgical approach which is described in the current issue of *European Urology* by Ciancio et al [4]. Of course, en bloc mobilisation of the spleen and the

pancreas, and, as necessary, the stomach, should be recommended only when it is felt that a conventional approach may allow inadequate quality of resection. Finally, it is also now well established that the quality of surgical resection is crucial for oncologic outcome after postchemotherapy retroperitoneal lymph node dissection [5]. Therefore, uro-oncologist surgeons should be aware of this technique, which allows radical resection with good security and reproducibility of both large renal tumours and left-sided enlarged lymph nodes.

## References

- [1] Ljungberg B, Hanbury DC, Kuczyk MA, et al. Renal cell carcinoma guideline. *Eur Urol* 2007;51:1502–10.
- [2] Ravaud A, Wallerand H, Culine S, et al. Update on the medical treatment of metastatic renal cell carcinoma. *Eur Urol* 2008;54:315–25.
- [3] Patard J-J, Thuret R, Raffi A, Laguerre B, Bensalah K, Culine S. Treatment with sunitinib enabled complete resection of massive lymphadenopathy not previously amenable to excision in a patient with renal cell carcinoma. *Eur Urol* 2009;55:237–9.
- [4] Ciancio G, Vaidya A, Shirodkar S, Manoharan M, Hakky T, Soloway M. En bloc mobilization of the pancreas and spleen to facilitate resection of large tumors, primarily renal and adrenal, in the left upper quadrant of the abdomen: techniques derived from multivisceral transplantation. *Eur Urol* 2009;55:1106–11.
- [5] Heidenreich A, Thüer D, Polyakov S. Postchemotherapy retroperitoneal lymph node dissection in advanced germ cell tumours of the testis. *Eur Urol* 2008;53:260–74.

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