# *Transperitoneal laparoscopic radical nephrectomy for bulky renal tumors*

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*Laparoscopic management of kidney cancer is becoming accepted as an alternative to open radical nephrectomy. Technical considerations have limited the application of laparoscopic radical nephrectomy to relatively small, clinically localized tumors. At the National Cancer Institute, we have broadened the indications to include bulky tumors. Herein, we describe the operation with attention to the technical caveats that have been gained with experience.*

**Key Words:** kidney cancer, laparoscopy, nephrectomy

## Introduction

Laparoscopic radical nephrectomy (LRN) is a challenging operation requiring advanced laparoscopic experience. This operation is attractive with noted advantages of decreased post-operative morbidity, faster convalescence, and improved cosmesis.[1,2] One of the technical considerations that have limited the wide-spread acceptance of this procedure is the method of removal of the kidney. Options include intact specimen removal through a muscle-splitting incision or specimen morcellation. Morcellation has been associated with shorter hospital stays, less post-operative narcotic use, and does not compromise histological analysis in the majority of cases.[1-3] The need for accurate pathological staging is somewhat controversial, as currently no adjuvant therapies for renal cell carcinoma exist.

Current indications for LRN include clinically localized stage T1 or T2 tumors. At the National Cancer Institute (NCI), we have extended the indications for LRN to include bulky renal tumors (stage T3/T4). Many of these nephrectomies are performed in the cytoreductive setting for patients

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with metastatic disease prior to systemic immunotherapy Figure 1. Exclusion criteria for LRN include tumor thrombus involving the vena cava or extensive adjacent organ involvement preventing resection. Previous abdominal surgery has not excluded patients from a laparoscopic approach. Herein, we review the technique of transperitoneal LRN for large renal tumors including several operative perils we have gained during the initial experience with this procedure.

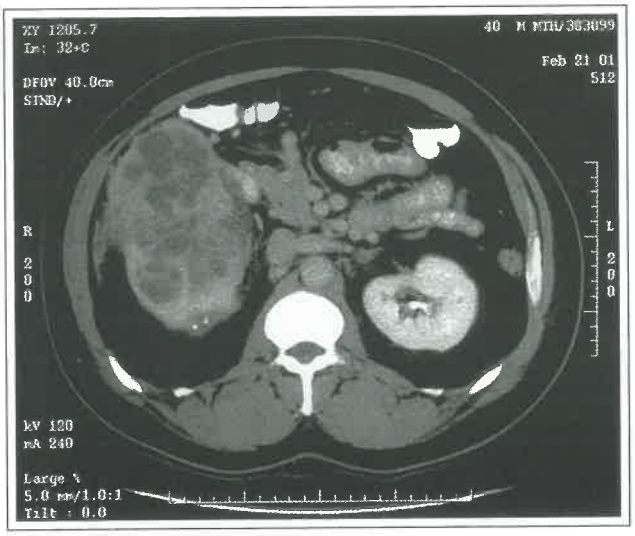


**Figure 1.** Contrast computed tomography image of a 15 cm right-sided renal tumor removed laparoscopically with intact extraction.

## Technique

Pre-operative management includes a mechanical bowel prep and placement of a large-bore intravenous access. Prior to positioning, patients receive a dose of intravenous antibiotic prophylaxis (generally a first-generation cephalosporin) and a urethral catheter is passed. To minimize bowel distension, an oral-gastric tube is placed and nitrous oxide anesthetic is not used. Pneumatic stockings and subcutaneous heparin are used for deep-venous thrombosis prophylaxis. Prior to breaking the table, a table clamp for the laparoscopic retractor holder[4] and the AESOP robot are attached to the table on the side contralateral to affected kidney. Patients are placed in a modified flank position with the affected side up and the table is flexed without the use of a beanbag or kidney rest to maximize the working distance between the lower costal margin and the anterior superior iliac spine. An axillary role is placed. The upper arm is suspended using a Kraske arm board while the lower arm is flexed and cushioned. The patient is secured to the table using wide tape over the upper back and arm and over the hip Figure 2.

A camera port (12 mm) is placed two finger breaths below the umbilicus at the lateral border of the ipsilateral rectus abdominus. We prefer a Hasson technique for initial transperitoneal port placement due to concerns of Veress needle injury resulting from the large tumor distorting the intra-abdominal anatomy. In our experience a transperitoneal approach is required as bulky tumors limit visualization and the working space during a retroperitoneal approach Figure 3. Two working ports (12 mm) are placed under endoscopic guidance using a triangle formation (lateral border of

**Figure 2.** Patient positioning for a laparoscopic left radical nephrectomy. The table is flexed without the use of a beanbag or kidney rest. The patient is secured to the table using tape. Note the adequate padding of all pressure points.

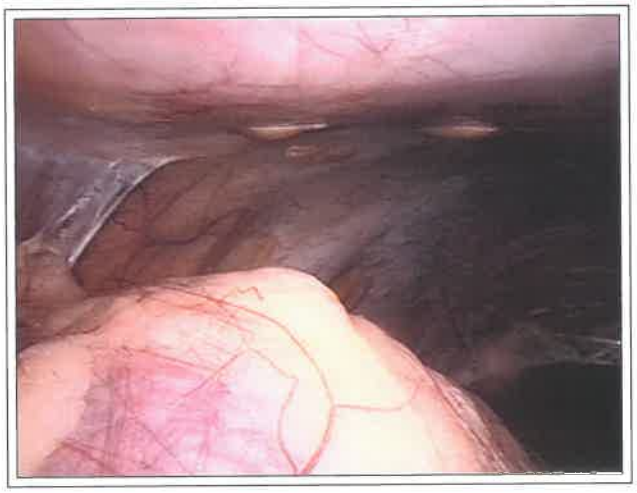

**Figure 3.** The initial transperitoneal laparoscopic view of a large (>10 cm) right renal cell carcinoma. The large tumor can fill the retroperitoneum making this approach untenable.

the rectus muscle and anterior axillary line). Prior to commencing dissection, the entire abdomen is inspected for evidence of metastases or adhesions. Any adhesions that may impair visualization or mobilization of the viscera are carefully taken down using sharp dissection. Use of a robotic system for camera control reduces fatigue of the surgical assistant and allows the majority of the dissection to be performed by a single surgeon.

On the right side, a fourth port (12 mm) is employed in a midline, sub-xiphoid location for placement of a liver retractor. Care must be used to avoid the falciform ligament during port placement. Elevation of the liver allows access to the subhepatic vena cava, right adrenal gland, and upper pole of the kidney. The fan retractor may also be employed on the left side for elevation of the spleen or pancreas in a similar fashion. The intracorporeal retractor is secured in position using an articulating arm retractor holder Figure 4 that is attached to the table[4].

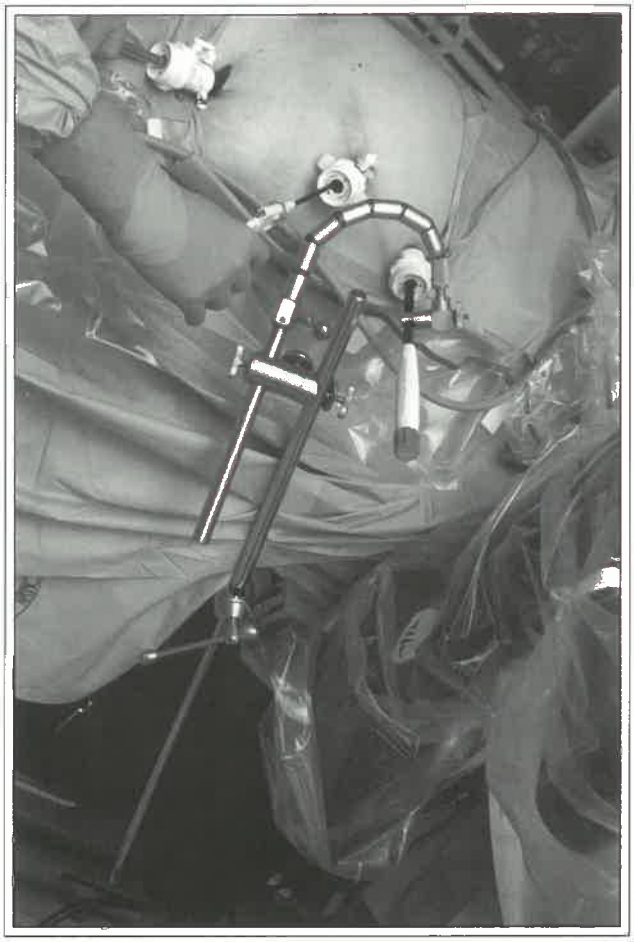

**Figure 4.** The articulating arm retractor holder allows stable retraction of the liver during right-sided dissections. During left-sided dissections, the spleen or pancreas may be retracted in a similar fashion.

*Right-sided dissection*

Once adequate exposure has been obtained, the vena cava is exposed in the subhepatic space Figure 5. Generally, the right renal vein becomes evident and dissection is commenced from the superior border of the vein. An avascular plane is developed above the renal vein and below the adrenal vein allowing access to the retroperitoneum. Lateral retraction allows sequential clipping and division of the many small vessels between the adrenal and posterior vena cava. This dissection is continued toward the liver until the right adrenal vein is identified at its confluence with the vena cava. Two clips on either side of the vein are used to secure hemostasis prior to division. The remainder of the peritoneum overlying the upper pole is scored using endoscopic scissors. The dissection is continued toward the liver and around the superior aspect of the adrenal gland where the superior adrenal artery is a constant finding if not clipped. A Harmonic Scalpel (Ethicon Endo-Surgery, Cincinnati, OH) is employed to dissect through the hepatorenal attachments. Any vessels of greater than 3 mm diameter are secured with clips.

Next, sharp dissection is used to score the peritoneum overlying Gerota's fascia allowing the colon to drop medially. After reflecting the hepatic flexure, the duodenum is bluntly deflected medially. Following the IVC inferiorly allows the duodenum and colon to be further mobilized. This maneuver allows identification and dissection of the lower pole of the kidney and ureter. Once the ureter is identified,

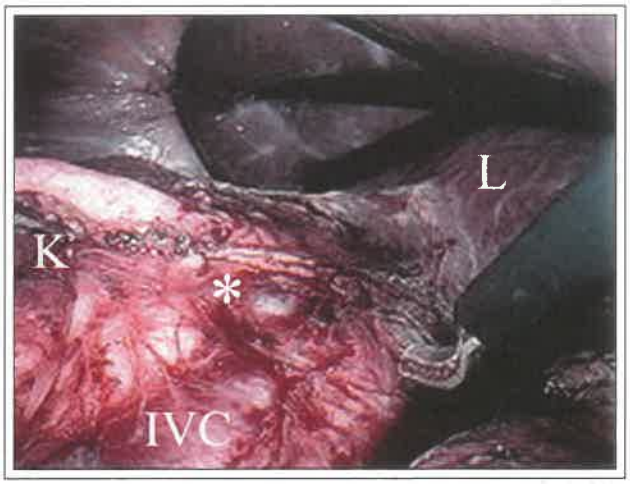


**Figure 5.** An intracorporeal image demonstrating retraction of the liver (L) cephalad exposing the subhepatic inferior vena cava (IVC) and the right kidney (K). The renal vein (*) becomes evident with initial dissection.

it may be retracted laterally using an instrument or alternatively, elevated towards the abdominal wall using a vessel loop placed with a Carter-Thomason trocar. The ureter is not divided until the hilar dissection is completed as it stabilizes the kidney and helps keep it from rotating with lateral retraction. The right gonadal vein is generally found entering the vena cava directly at the level of the lower pole and can be a source of bleeding.

Following the ureter superiorly facilitates identification of the renal hilum. A laparoscopic grasper or suction-irrigator device placed between the ureter and the vena cava may be used to retract the lower pole laterally, exposing the renal hilum Figures 6, 7. We have had some difficulties with retracting large tumors using light flexible instruments. We use a large laparoscopic gynecologic biopsy forceps (also known as Spoon/Stone forceps) that is a more rigid instrument for retraction Figure 8. As suggested by Clayman's group,[5] we isolate the vein and artery separately using a right-angled dissector Figure 9. The artery is ligated just after it crosses the vena cava. In patients where tumor or bulky lymph nodes obscure the hilar dissection, the kidney may be mobilized to allow a posterior dissection and approach the renal hilum from behind. The renal vein is carefully inspected for tumor thrombus. Intraoperative ultrasound may be employed if there is any question of vein involvement. The renal vein is secured using an EndoGIA stapling device Figure 10. If a tumor thrombus that extends to the vena cava is found, then conversion to open should be performed. Recently,

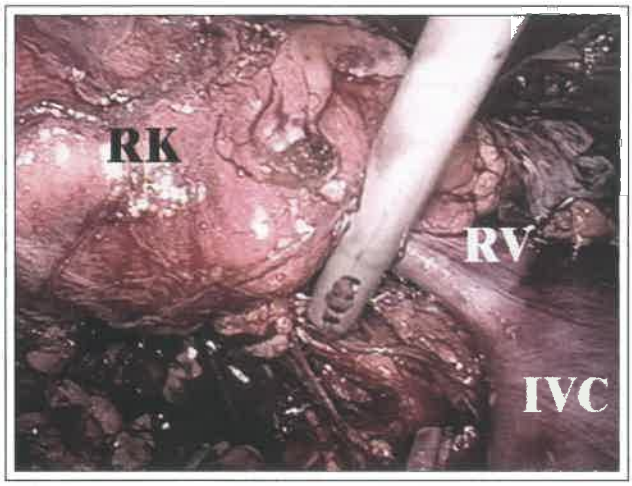


**Figure 6.** Lateral retraction of the lower pole of the right kidney allows the hilar structures to be placed on tension. RV: renal vein; IVC: inferior vena cava; RK: right kidney


**Figure 7.** The right renal hilum with the ureter (U) and lower pole elevated by a laparoscopic instrument. The tension facilitates safe dissection of the renal artery (A) and vein (V).

Chan et al. described a rapid ligation technique for securing the renal vessels.[6] In this technique, blunt dissection is used to create a space between the vein and posterior tissue followed by ligation of the posterior tissue including the renal artery using an endovascular stapler. Following this the vein is inspected to ensure no secondary blood supply is present and then secured.

After inspection for hemostasis, the ureter is divided between clips Figure 11. To complete the dissection, posterior and lateral attachments are taken down using the harmonic scalpel. Preserving these attachments until the end of the operation prevents the kidney from falling medially and obscuring

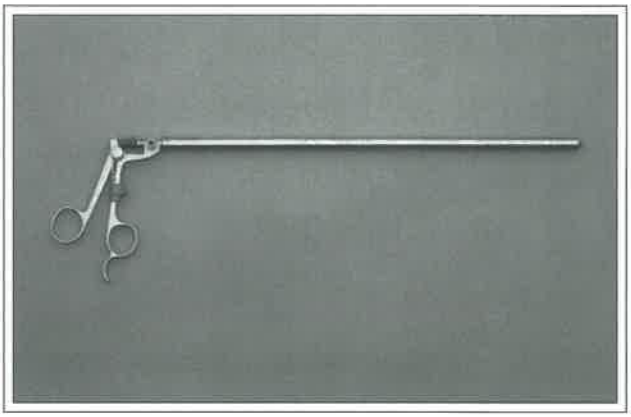

**Figure 8.** The Spoon/Stone forceps instrument is rigid enough to retract large tumors without compromising the instrument.

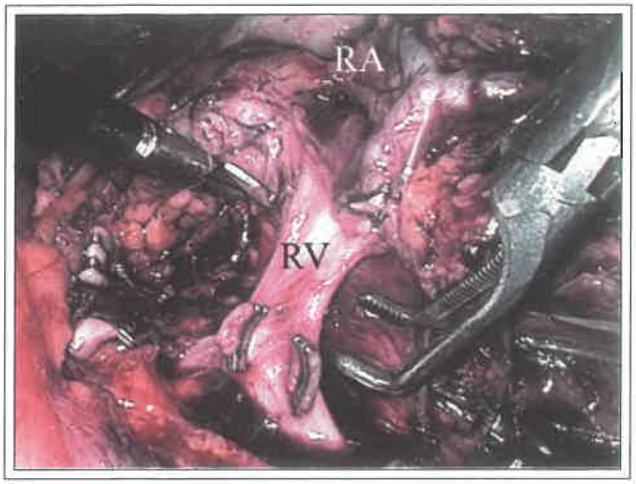


**Figure 9.** Dissection of the left renal hilum using a right angle dissector. The renal vein (RV) and renal artery (RA) are isolated and individually ligated.

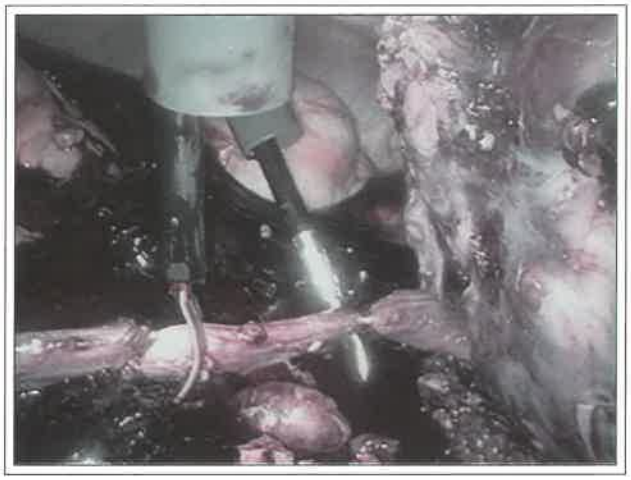

**Figure 11.** Division of the right ureter prior to removal of the specimen. The ureter is controlled with clips then sharply divided.

visualization of the hilum. At this point, a lymph node sampling or formal dissection may be performed if indicated.

### *Left-sided dissection*

Dissection of left-sided tumors is similar to the above description with the following important differences. Initial dissection is performed to reflect the colon medially to allow identification of the kidney. The harmonic scalpel is useful during mobilization of the upper pole attachments where the vascular gastro-colic and gastro-splenic omentum is located. After completely mobilizing the upper pole attachments and the lower pole, attention is turned toward the hilum, where the renal vein is usually evident crossing the aorta, and gonadal vein may be identified inserting inferiorly Figure 9. The adrenal vein may be evident and either left intact or alternatively ligated Figure 12. Incision of the peritoneum lateral to the spleen will allow the medial reflection of the spleen, pancreas and splenic flexure of the colon with blunt dissection Figure 13, exposing the upper pole of the kidney and adrenal gland.[7] The hilar dissection is performed with close observation for lumbar veins. After the renal artery is controlled, the vein is stapled proximal to the adrenal vein origin. If present, lumbar veins are individually ligated with clips. The only remaining attachments are lateral and posterior.

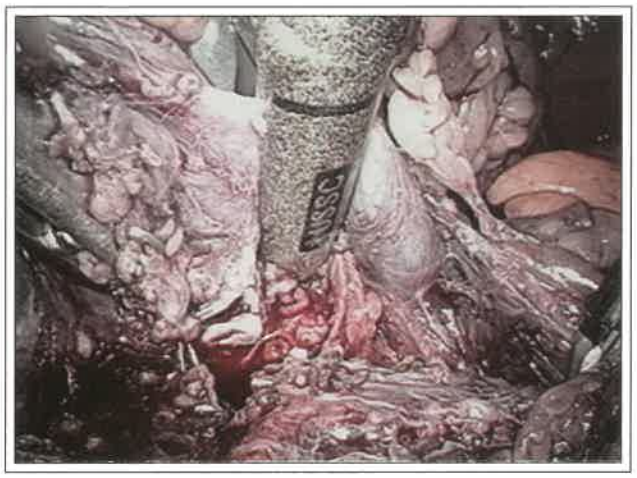


**Figure 10.** The right renal vein is ligated using a vascular stapling device. Prior to placement of the stapler, the vein is inspected to ensure patency and the absence of a renal vein thrombus.

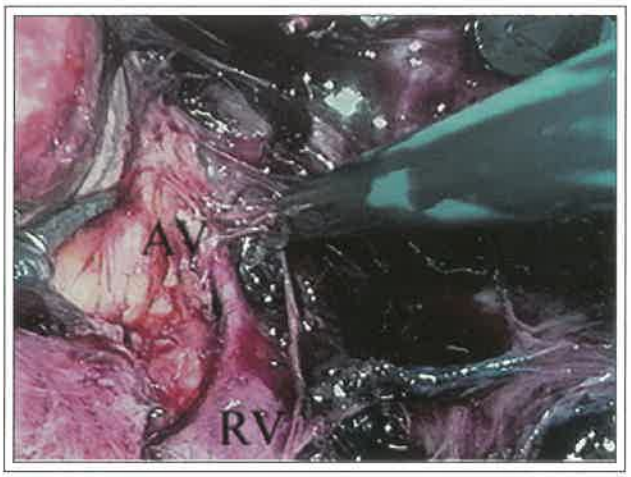


**Figure 12.** Dissection of the left renal vein (RV) revealing the junction of the adrenal vein (AV).

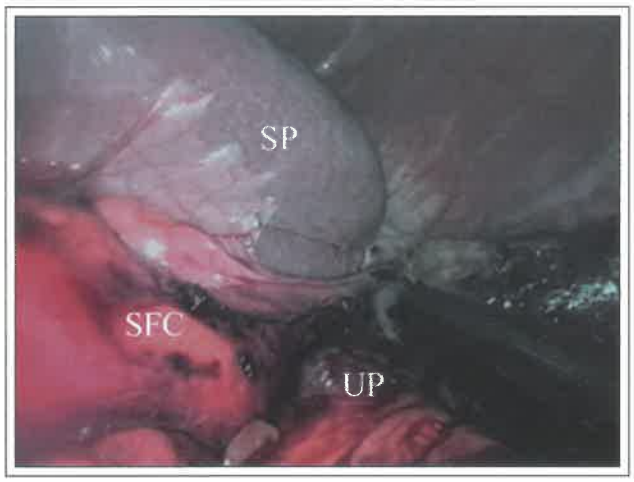


**Figure 13.** The lateral attachments for the spleen (SP) are released to allow the spleen and splenic flexure of the colon (SFC) to fall medially exposing the upper pole of the kidney (UP).

*Specimen removal*

To ensure the kidney is free, a spin test is performed. During this maneuver, the specimen is rotated 360 degrees using graspers ensuring that all attachments have been divided. As mentioned earlier, the specimen may be removed by morcellation or via a small muscle-splitting incision. Due to concerns of intra-abdominal tumor spillage, we have reserved morcellation for patients with documented metastatic disease. A morcellation sac (Lapsac™, Cook Urologic, Spencer, IN) is loaded into one of the working ports. Placement of the specimen into the Lapsac™ requires a total of five ports. Three locking graspers are used to hold the sac open and a grasper is used to push the specimen into the sac through a fourth port. Once the specimen is engaged in the sac, the mouth of the sac is brought to the body surface through any convenient port. The surgical field is covered with a disposable Steri-Drape barrier (3M, St. Paul, MN) and new surgical drapes. The specimen is morcellated both manually and mechanically with the mouth of the sac being held taught by the surgeon and assistant. Morcellation is completed by alternating an automated morcellator (Cook Urological, Spencer, IN) attached to suction with manual disruption using sponge-holding forceps. Several points merit attention. Firstly, the diameter of the Lapsac™ limits morcellation to specimens 15 cm or smaller. Secondly, the sac should be inspected for structural integrity prior to commencing the morcellation process. The surgeon must be cautious with the amount of force exerted on the mechanical morcellator, as perforation of the Lapsac™ is possible. For this reason, intracorporeal monitoring of the morcellation process using the camera is mandatory. After removal of the Lapsac™, the barriers are removed and the surgical team must change gloves and gowns.

If an open incision is used for specimen removal, we prefer a lower midline location due to the reduced post-operative morbidity associated with the muscle-splitting incision. The size of the incision required depends on specimen size. If possible, the specimen is placed within an impermeable sac prior to removal. A standard single-layer closure is performed of the incision. Closure of port sites is performed with absorbable sutures introduced using a Carter-Thomason trocar system (Inlet Medical, Eden Prairie, MN) with laparoscopic guidance.

Hand assistance during dissection is occasionally helpful and some authors prefer this approach.[8] If the kidney begins to fall medially during the initial dissection or if bleeding occurs, the hilar dissection may become very difficult. A hand port placed in an infra-umbilical mid-line location will allow an assistant to retract the kidney laterally yielding better visualization. Blunt dissection may be performed using the hand port for upper and lower pole attachments once the major blood supply has been secured. Two advantages of hand-assisted nephrectomy include reduced operative time and the specimen may be removed directly through the hand port.[8]

## Discussion

Several advantages exist for LRN over conventional open radical nephrectomy. In patients with localized renal cancer, other authors found a statistically significant decrease in blood loss, pain medication requirements, and shorter convalescence in comparison with open radical nephrectomy patients with localized tumors up to 10 cm in diameter.[1] Limited experience exists in patients with metastatic disease. Previously, a pilot study comparing laparoscopic cytoreductive nephrectomy with and without morcellation to open nephrectomy was completed at the NCI.[2] The laparoscopic group with morcellation required less parenteral narcotics, had a shorter hospital stay, and had a shorter time to initiation of systemic Interleukin-2.

One disadvantage of LRN found in several series is the prolonged operative times.[1-3,8,9]. In a comparison of hand-assisted and pure laparoscopic nephrectomy, average operative time was reduced by 85 minutes in the hand-assisted group.[8] These investigators also

encountered fewer major complications in the hand-assisted group. Cost appears to be significantly higher for LRN with both longer operative times and disposable instruments contributing to increased total costs. The Washington University group found higher costs associated with LRN in comparison to open radical nephrectomy. Although most analyses do not factor in the shorter convalescence of LRN and earlier return to work, the estimated benefit of the faster recovery may eliminate any cost benefit for open radical nephrectomy.[1] Indeed, when the savings of performing a LRN on an employed patient may exceed $1000 U.S. dollars.[10]

Large renal tumors can provide unique challenges during laparoscopic dissection necessitating patience and meticulous technique. We agree with Barrett and Fentie's opinion that persistence in the more difficult cases is required due to the overall benefit realized by the patient of a fully laparoscopic procedure.[11] Several other points should be stressed. Firstly, blood loss during LRN for bulky tumors may be increased relative to previously published series.[1,3,9,12] The surgeon must be vigilant for parasitic tumor vessels requiring ligation. Lymphadenopathy, particularly in the renal hilum can lead to increased blood loss and longer dissection times. Some difficulties with vascular stapling devices have been reported[11,13] and early recognition of device malfunction can allow the surgeon to take the necessary steps to minimize or prevent hemorrhage. In the NCI pilot study of cytoreductive LRN, there was no advantage for the laparoscopic approach with respect to blood loss.[2] Additionally, conversion to open is required more often during cytoreductive LRN than for localized kidney cancer and likely represents the advanced nature of the disease.

LRN for large renal tumors is a challenging operation requiring a broad array of ablative laparoscopic techniques. With increasing laparoscopic experience and training in our educational programs, more urologists will become comfortable with the procedure and more patients will likely benefit. Bulky renal tumors should not be a contraindication to LRN. Currently, LRN for locally advanced kidney cancer remains developmental. In our experience, cytoreductive LRN is a feasible but often difficult operation and we believe it should be performed in the context of a prospective study of new treatment options for metastatic renal cell carcinoma. □

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