

Surgery Illustrated – Surgical Atlas

Hand-assisted radical laparoscopic nephrectomy

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ILLUSTRATIONS by STEPHAN SPITZER, www.spitzer-illustration.com

PLANNING AND PREPARATION

INDICATIONS

Radical nephrectomy (RN) has been the mainstay for treating localized RCC since first described by Robson in 1969 [1]. The laparoscopic RN (LRN) has introduced a new standard of care to urology, and is an advanced procedure requiring training in laparoscopic techniques. An intra-abdominal hand gives improved tactile feedback to the urologist, thereby making LRN less daunting. Hand-assisted laparoscopy (HAL) also provides yet another tool to help urologists perform more complex RNs. RN is the procedure of choice for localized RCC not amenable to partial nephrectomy. HALRN can be used for almost any patient who requires a RN and can also be used in patients with metastatic disease, either for palliating symptoms or for potential combination with adjuvant immunotherapy.

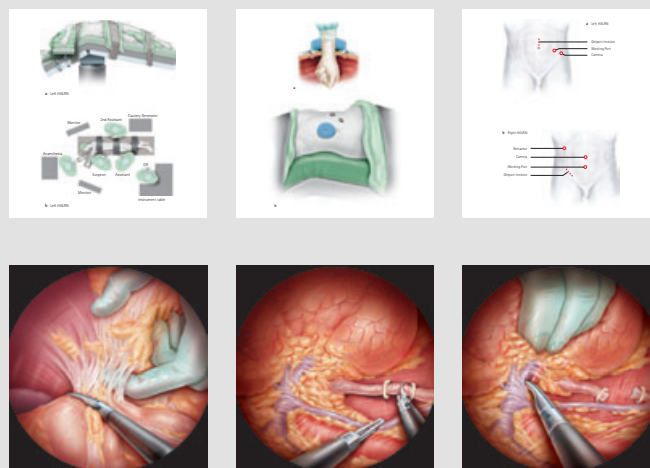
PATIENT SELECTION

There are no absolute contraindications to HALRN but there are many circumstances that increase the potential for morbidity, including bowel obstruction, peritonitis, abdominal wall infection, previous inflammation, previous surgery, and presence of inferior vena cava tumour thrombi [2]. Each surgeon must set limits according to his or her experience and confidence.

SPECIFIC EQUIPMENT/MATERIALS

Non-disposable:

- Two monitors, flat screen;
- 5-mm or 10-mm 30° laparoscope;
- 5-mm or 10-mm 0° laparoscope;
- High-flow insufflator;
- Three-chip laparoscopic camera;
- 5-mm Maryland dissector;
- 5-mm atraumatic grasper;



- 5-mm scissors, curved and straight blades;
- 5-mm suction/irrigation system (Nehzat);
- Carter-Thomason closure device (Inlet Medical, Eden Prairie, MN, USA);
- 5-mm curved harmonic scalpel (Ethicon Endo-Surgery, Cincinnati, OH, USA).

Disposable:

- Hand-access device (Gelport, Applied Medical, Rancho Santa Margarita, CA, USA);
- Non-bladed trocars, one 5-mm, two 10-mm (Visiport, Ethicon);
- Port reducers (Ethicon);
- LapSac (Cook Urological, Spencer, IN, USA);

- Endo-GIA stapler, vascular load (10 mm) (Ethicon);
- Sutures, 1 polydioxanone for fascial closure of hand port;
- 0 polyglactin for 10-mm ports;
- 4-0 polyglactin for skin closure.

SPECIFIC PATIENT PREPARATION

All patients should have a metastatic survey, including an anteroposterior and lateral chest X-ray or chest CT, serum calcium, serum alkaline phosphatase, and abdominal CT; the last is also useful to assist in surgical planning. A bone scan is advised for patients with elevated serum calcium levels, elevated alkaline phosphatase, or bone pain [3].

In addition, renal function should be evaluated by serum creatinine levels; if high, or if radiological imaging reveals an abnormal contralateral kidney, differential renography can be considered. Patients with renal insufficiency or compromised contralateral renal function might need further consideration for renal-sparing surgery.

All patients are instructed to discontinue anticoagulation medications ≥ 5 days before surgery. Bowel preparation comprises clear liquids and one bottle of magnesium citrate in the afternoon before surgery. The patient is instructed to take nothing by mouth after midnight. A first-generation cephalosporin is given before surgery.

SPECIFIC PATIENT POSITIONING

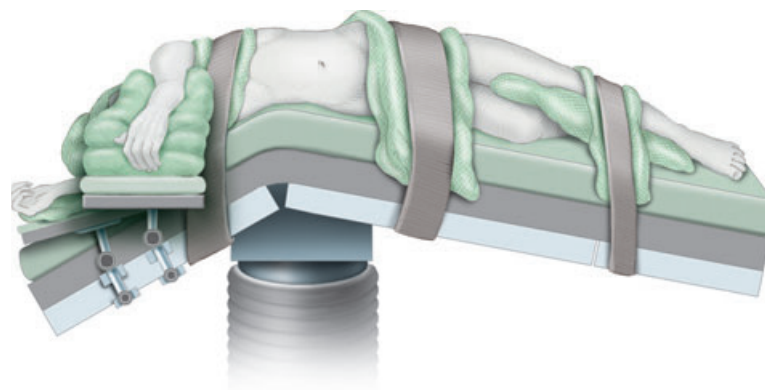
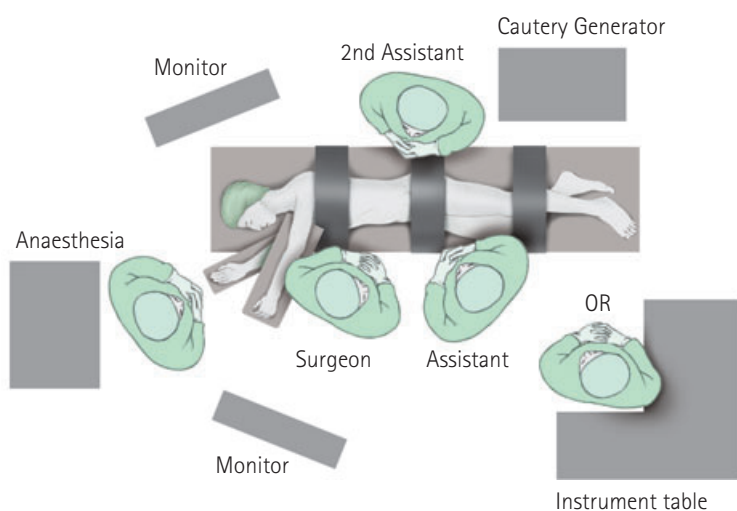
Figure 1a

The patient is placed in a modified flank position. The kidney rest is raised minimally to avoid neuromuscular injuries, and the table is minimally flexed ($<20^\circ$). The downward leg is flexed, and the knee and ankle are well padded. The upward leg is straight and well supported with pillows. The lower arm is well padded at the elbow and wrist, and an axillary roll is placed. The upper arm can be suspended or placed on a padded Mayo stand. Wide cloth tape affixed to the bed and placed over the shoulder and greater trochanter increase stability. Tape blisters are avoided by placing towels or Tegaderm between the cloth tape and skin. The patient's entire abdomen and flank is then prepped and draped.

SPECIFIC ROOM POSITIONING

Figure 1b

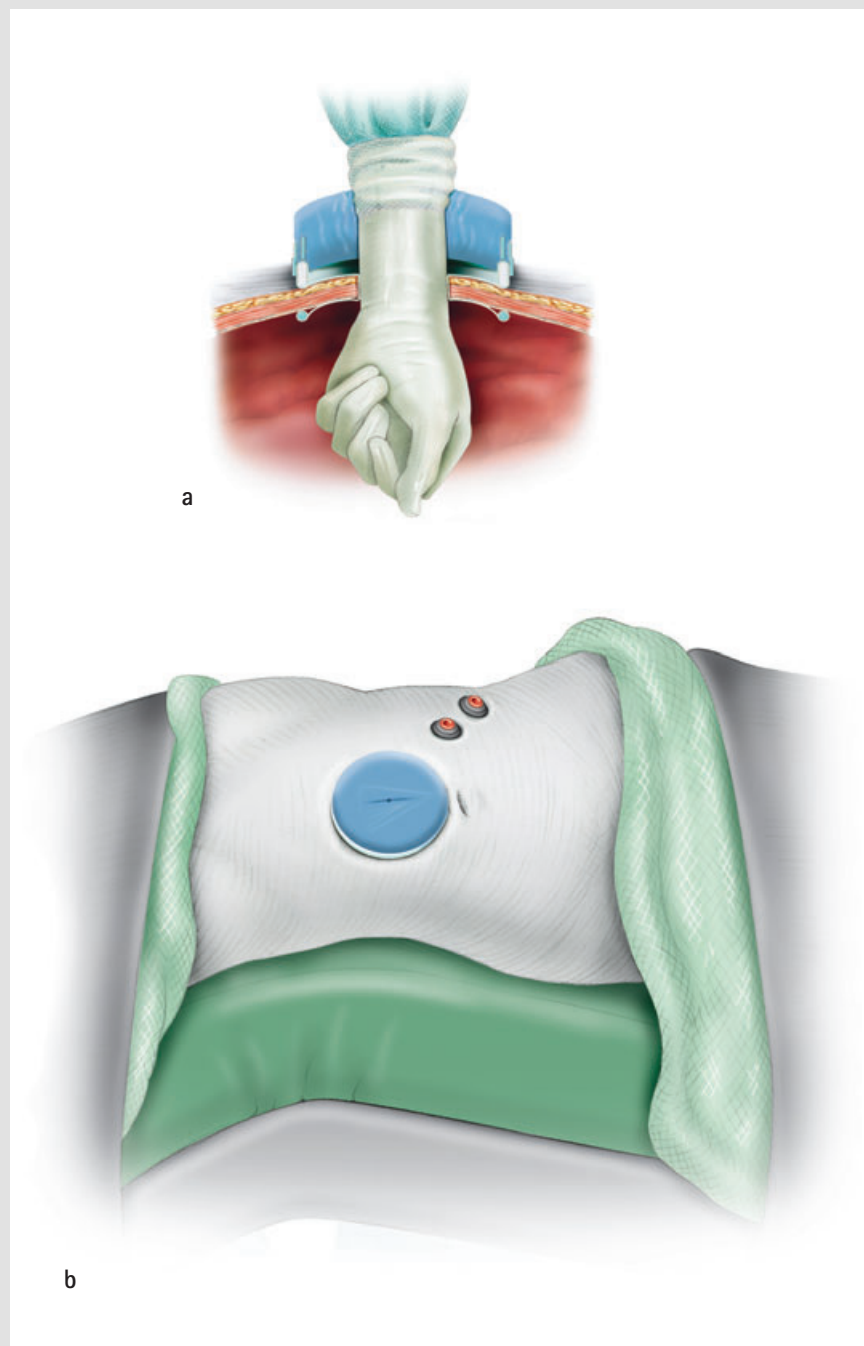
The surgeon and assistant stand together on the opposite side from the kidney to be removed. The surgeon is closest to the head of the patient, to facilitate hand-port and working-port access. The assistant stays closer to the feet to run the camera and, if necessary, an additional retractor. The surgical technician stays on the same side as the surgeons, closer toward the foot of the bed. The surgical instrument tables are on the side of the surgeon at the feet and behind the surgeons, and the power generators (i.e. cautery, harmonic scalpel) are across the table from the surgeons. Monitors are placed at the level of the patients' shoulders on both sides of the patient if a second assistant is present. An open instrument set should always be available should conversion to an open procedure be necessary.

**a** Left HALRN**b** Left HALRN

HAND-ACCESS DEVICES

Figure 2

Although several devices are available, each access device maintains the pneumoperitoneum while allowing the hand to stay in the abdomen. We currently use the GelPort, which uses a soft gel-type cap with a small slit through which the surgeon places a hand. The GelPort allows transfer of the hand in and out of the port without loss of pneumoperitoneum.



SURGICAL STEPS

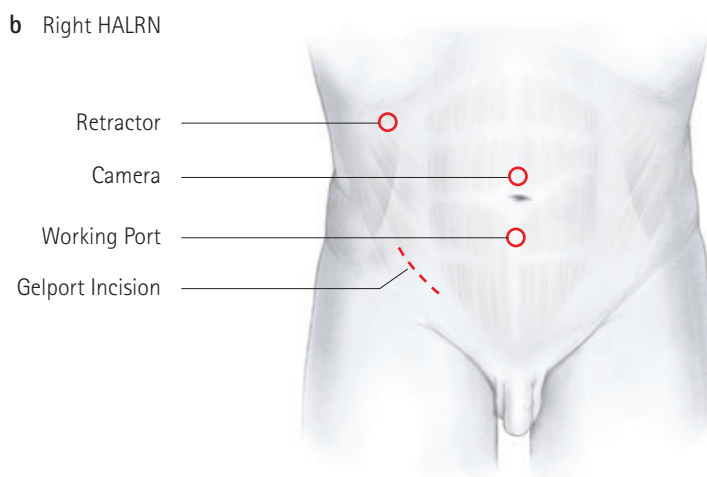
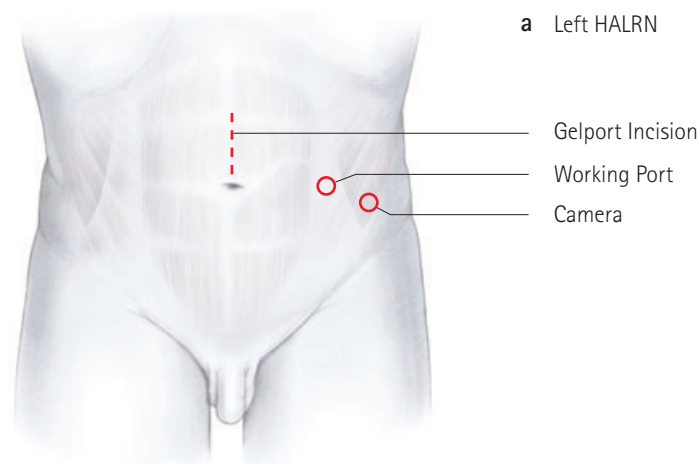
STEP 1. PLACING THE HAND PORT AND TROCARS

To obtain pneumoperitoneum, a Veress needle is inserted into the ipsilateral lower quadrant along the midclavicular line lateral to the rectus muscle. The abdomen is insufflated to 15 mmHg using carbon dioxide. We introduce a 0° laparoscope through a 5- or 10-mm Visiport under direct vision. This feature allows us to carefully identify each layer of anterior abdominal wall and ensure correct entry into the pneumoperitoneum. The abdomen is then surveyed to evaluate for metastatic disease and adhesions. The hand device and remaining ports are then typically placed under direct vision.

Figure 3

For a right-handed surgeon performing a left HALRN, we recommend the hand port be placed in a midline incision just above the umbilicus (Fig. 3a). For a right-handed surgeon performing a right HALRN, we recommend the hand port be placed in a Gibson incision in the right lower quadrant (Fig. 3b). Alternatively, for a right HALRN a right-handed surgeon could use the mirror image set-up as on the left side, and work with his or her dominant hand in the abdomen. In addition to the hand port, two or three trocars are typically required; one 5-mm or 10-mm camera, one 10-mm working port, and sometimes an additional 5-mm working port for additional retraction, particularly on the liver for right sided tumours. When performing a HALRN through a midline Gelport incision, the 10-mm working port should be placed in the mid axillary line in a position more cranial than the camera port. If needed for retraction, an additional 5-mm working port can be placed laterally in the subcostal region, somewhere between the mid-axillary line and the mid-clavicular line, or wherever the surgeon considers it to be of the best use.

For obese patients, placing the hand-access device in the usual location might put the hand port at an uncomfortable distance from the kidney, making dissection difficult. We recommend placing the hand-access device lateral to the midline, to stay closer to the kidney. Trocar positioning should also be adjusted to allow for the more lateral location of the hand access device.



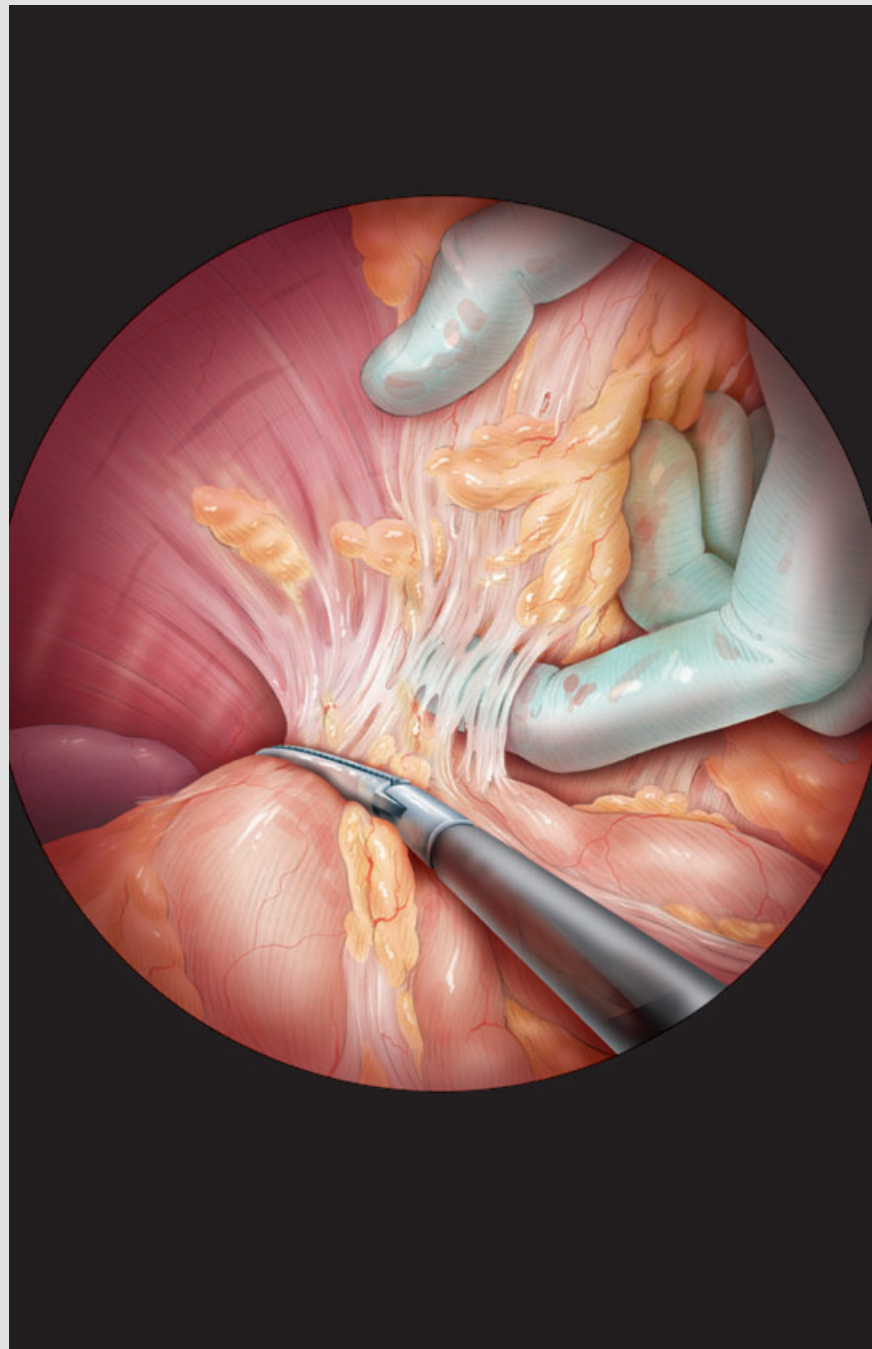
STEP 2. INCISE THE WHITE LINE OF TOLDT AND MOBILIZE THE COLON

Figure 4

The intra-abdominal hand should be used to place medial traction on the colon to clearly delineate the line of Toldt. After an incision is made on this fascial plane, a finger can be inserted in the plane behind the fascia to push the colon away and expose a bloodless plane through the peritoneal attachments. These attachments are then incised from the iliac vessels to the hepatic or splenic flexure, to free the colon from the lateral abdominal wall. For a right nephrectomy, the liver is released from the side-wall by incising the triangular ligament, to allow it to be retracted superiorly. Once the duodenum is identified, the Kocher manoeuvre should be performed to reflect the duodenum medially and expose the inferior vena cava. For a left nephrectomy, the splenic flexure between the colon and spleen is left intact so that after the spleen is released, the plane between the spleen and upper pole of the kidney can be developed to allow both the spleen and colon to fall away medially. The dissection should be close to the spleen to avoid perforating the diaphragm. One should also keep in mind that the stomach can come around the lateral aspect of the spleen, thus creating the potential for injury.

STEP 3. FREE THE LATERAL AND SUPERIOR ATTACHMENTS TO THE KIDNEY

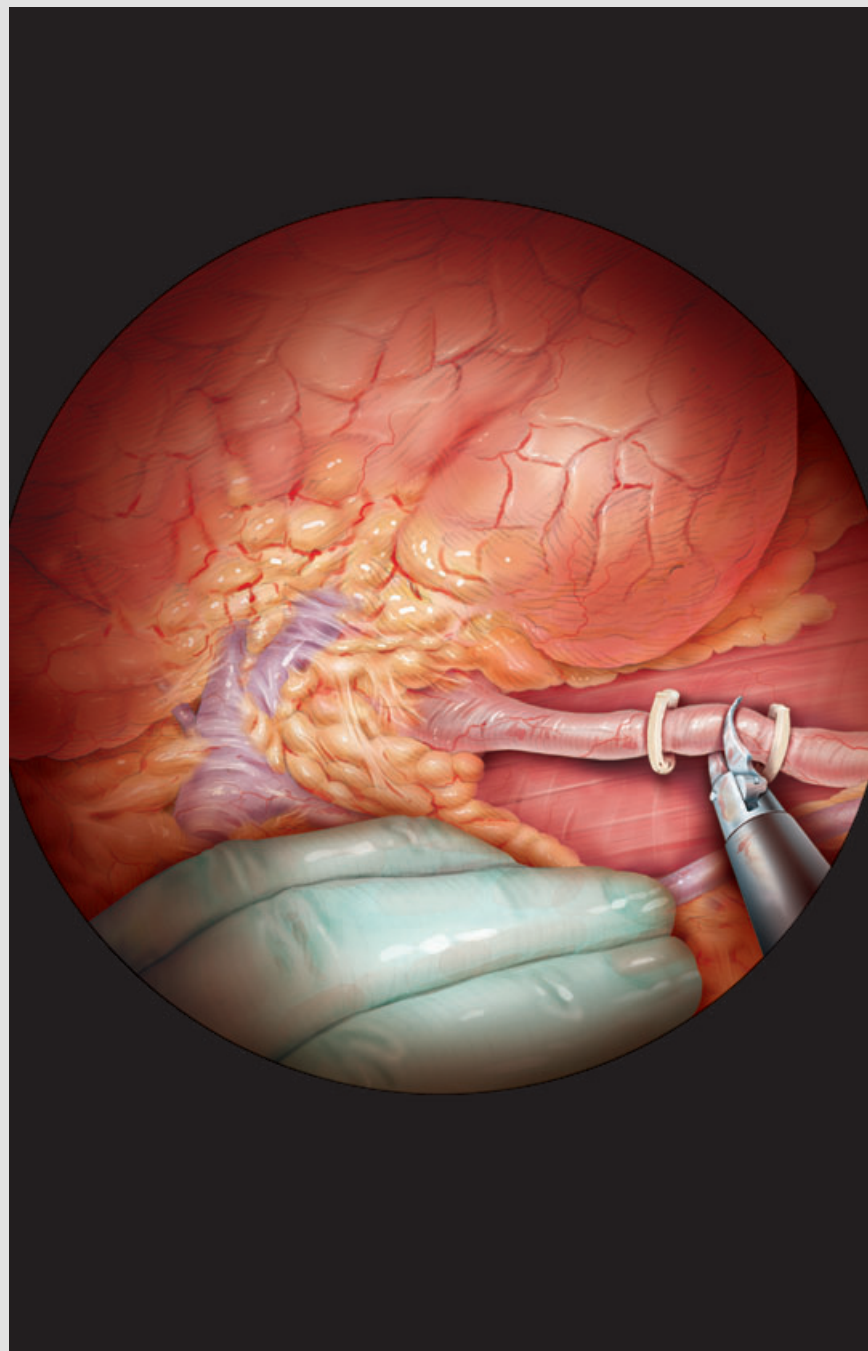
With the anterior surface of Gerota's fascia visible after medial reflection of the colon, attention is turned to mobilizing the lateral and superior attachments of the kidney. The lateral aspect is freed from the lower pole toward the upper pole. The upper-pole attachments are liberated medially to the adrenal. The 30° lens facilitates dissection of the upper and lateral pole attachments. The posterior attachments should be left intact at the point in the case.



STEP 4. LOCATE AND CONTROL THE URETER, AND MANAGE THE GONADAL VEIN

Figure 5

The ureter should be identified early and divided between clips, or with the vascular stapler. The ureter typically lies medial to the psoas, alongside the gonadal vein. During dissection of the ureter, care should be taken to avoid damaging the gonadal vein, to avoid troublesome bleeding. During the left nephrectomy, the gonadal vein can be followed cranially to the renal vein. On the right side the surgeon should be careful not to avulse the gonadal vein off the vena cava. Rather, the gonadal vein should be released away from the ureter and allowed to return medially. Even slight traction on the gonadal vein can cause the gonadal vein to tear. After division, the proximal ureteric stump can be used to assist with retraction of the kidney. The lower pole of the kidney can now be freed in a lateral to medial direction, with care taken medially to avoid inadvertent injury to unrecognized lower pole vessels.

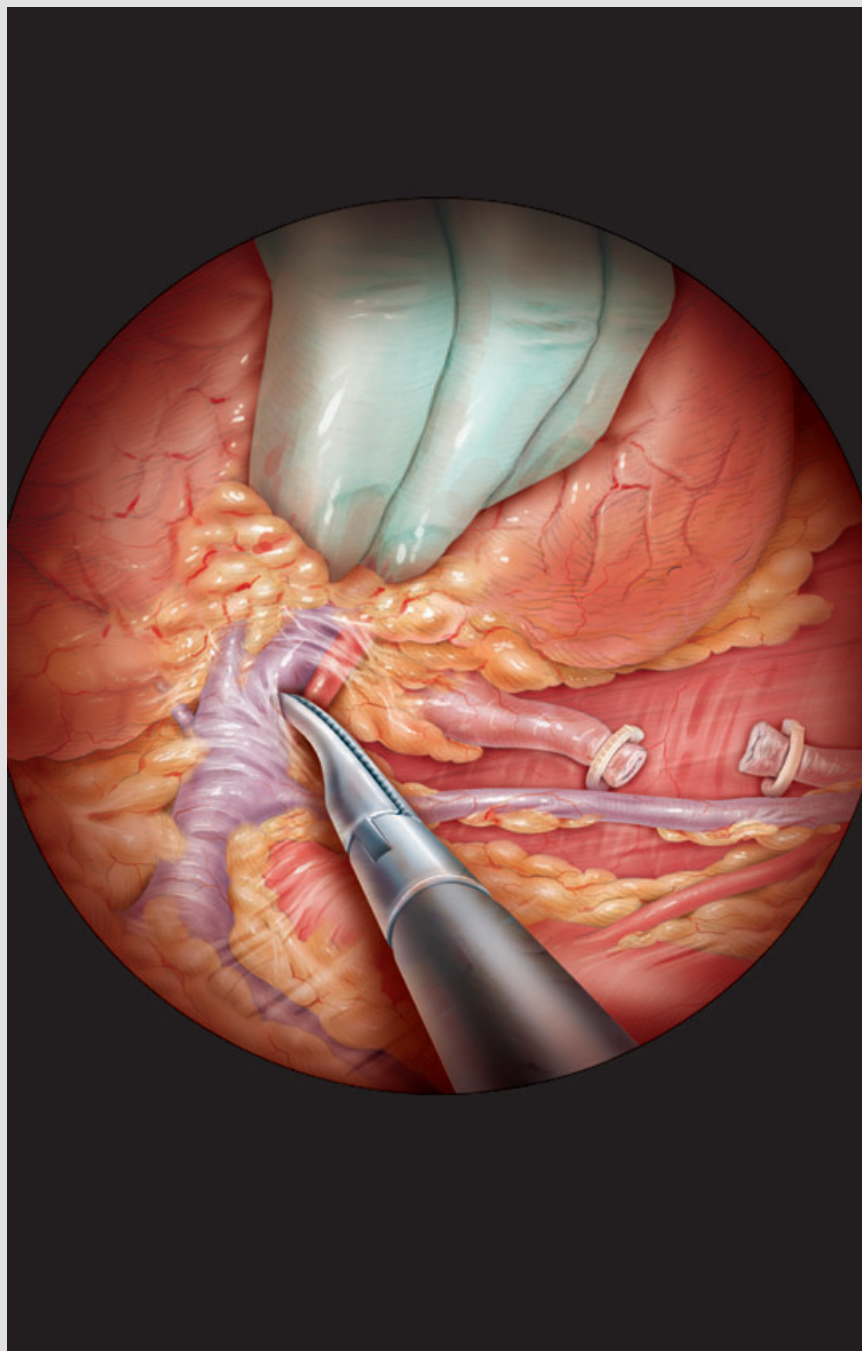


STEP 5. IDENTIFY AND MOBILIZE THE RENAL VEIN AND ARTERY**Figure 6**

The anterior surface of the vein should be identified and carefully cleaned. On the left side, the adrenal and gonadal vein branches should be located. The artery should be located by palpation. The renal vein and artery should be dissected free. This dissection is facilitated by freeing the posterior attachments to the kidney and flipping the kidney anteriorly for a posterior approach to the renal artery.

STEP 6. FREE THE POSTERIOR ATTACHMENTS TO THE KIDNEY

After the renal vein and artery have been identified, the posterior attachments to the kidney should be freed. The only remaining attachments are at the hilum and superiorly at the adrenal gland.



STEP 7. DIVIDE THE RENAL ARTERY AND VEIN

Figures 7 and 8

The renal artery is divided with a vascular stapler using posterior artery control [4,5]. This involves flipping the kidney medially to expose the renal artery. The renal vein can then be stapled with a vascular stapler. It is imperative to confirm that the stapler extends across the entire renal vein. Always pause after deploying the stapler, to allow adequate 'seating' of the staple rows. Stapling over clips can cause staple misfire, often resulting in unnecessary haemorrhage.

STEP 8. FREE THE REMAINING MEDIAL ATTACHMENTS

After dividing the renal artery and vein, medial lymphatics and adipose tissue might remain. These can be taken down with the harmonic scalpel or cautery, keeping in mind that an aberrant vessel can be hidden in this tissue.

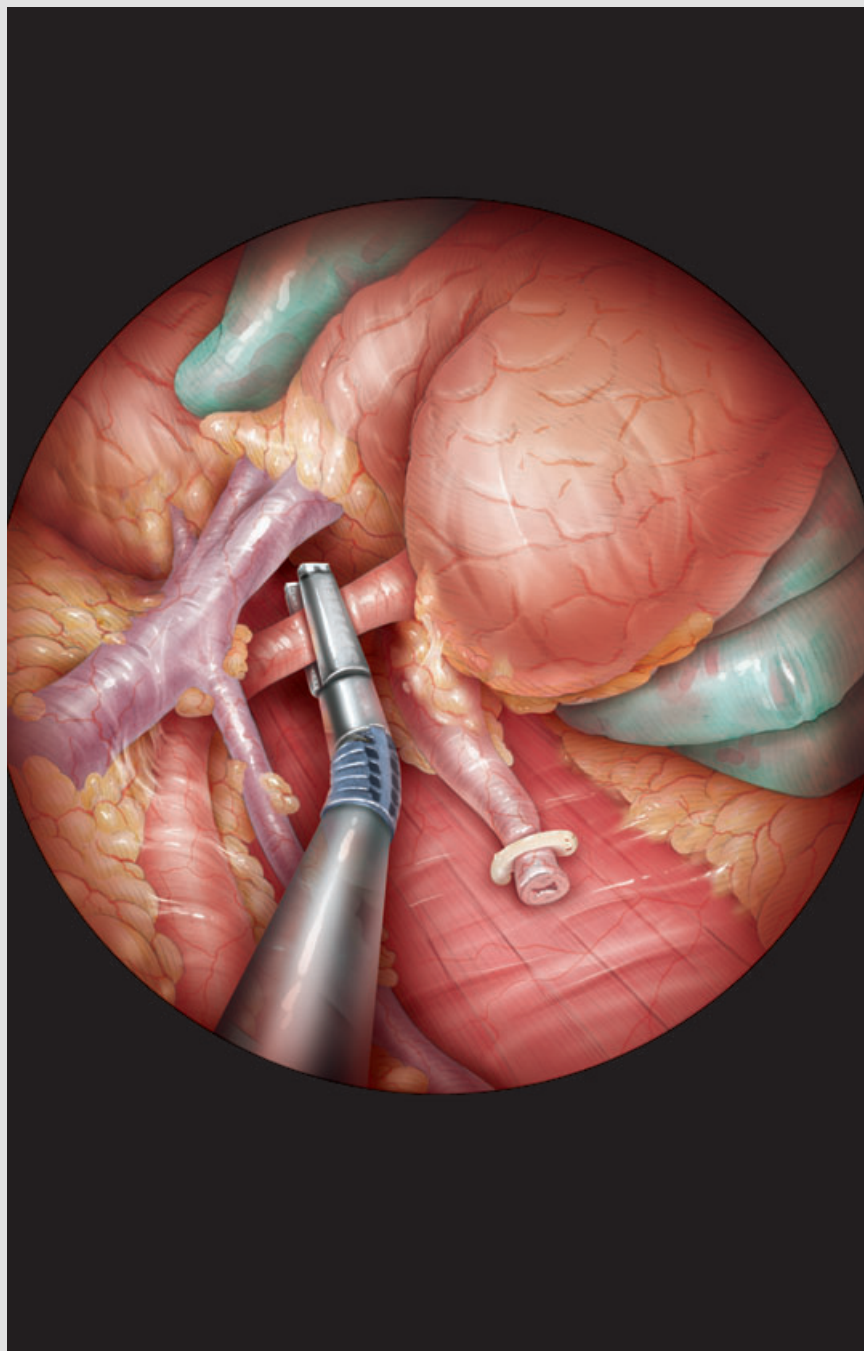
STEP 9. SPARE OR REMOVE THE ADRENAL

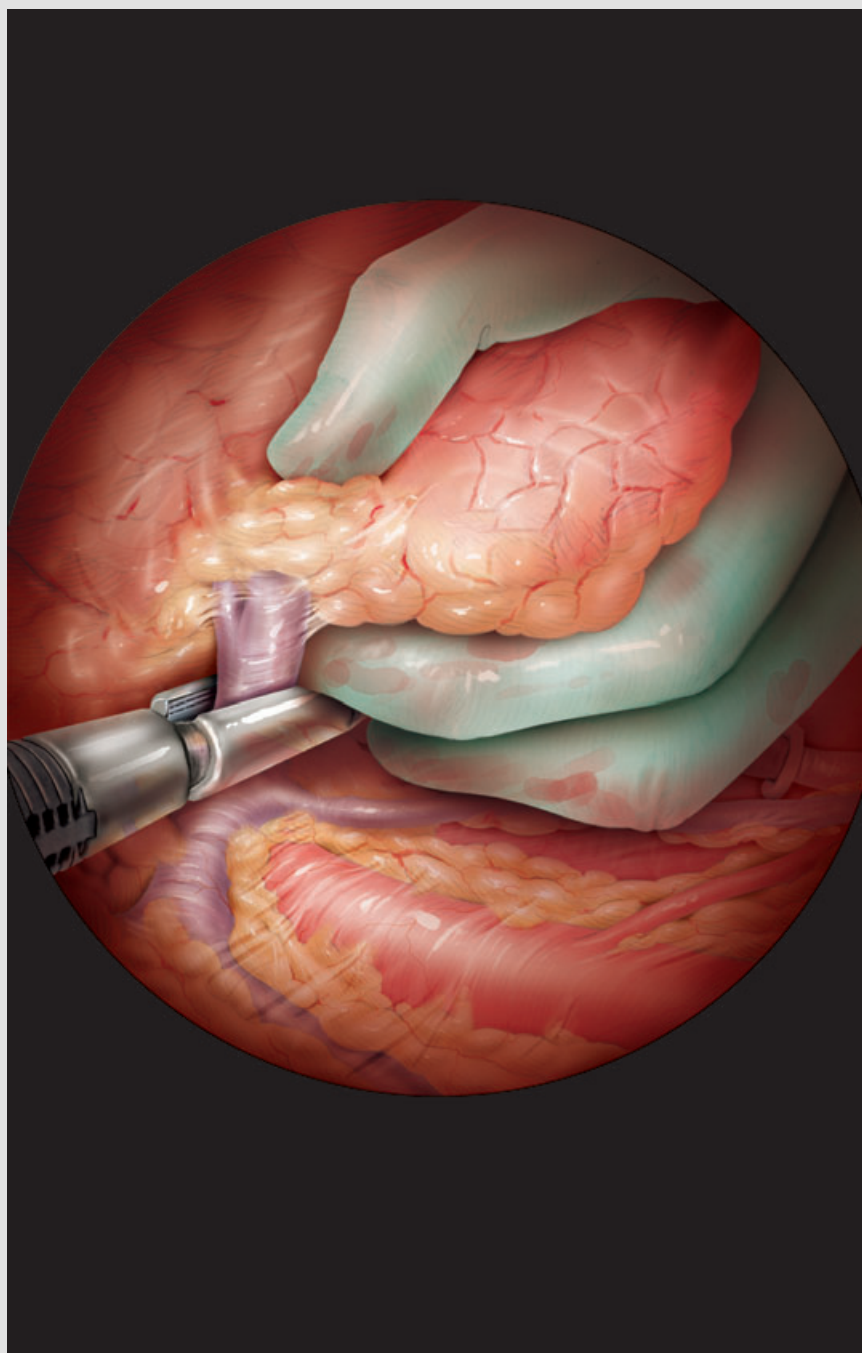
If the adrenal is to be spared, the plane between the upper pole of the kidney and adrenal should be developed. Care should be taken to stay lateral and inferior to the adrenal to avoid most of the vessels supplying and draining the adrenal. We prefer to spare the adrenal for ipsilateral upper pole tumours, as long as a distinct plane is evident; aggressive dissection is key.

If the adrenal is not to be spared, it should be removed en bloc. The adrenal vein on the respective side should first be identified and divided between clips. One must take care when clipping either adrenal vein, as the right vein is typically quite short and the left vein clips can interfere with the stapler due to its origin off the renal vein.

STEP 10. LOWER THE PNEUMOPERITONEUM AND ASSESS FOR BLEEDING

Working insufflation pressures (15 mmHg) can tamponade venous bleeding. We routinely lower the insufflation pressure to 5 mmHg and survey the hilar area, upper pole, and lower pole areas to assess for bleeding before or after specimen removal.

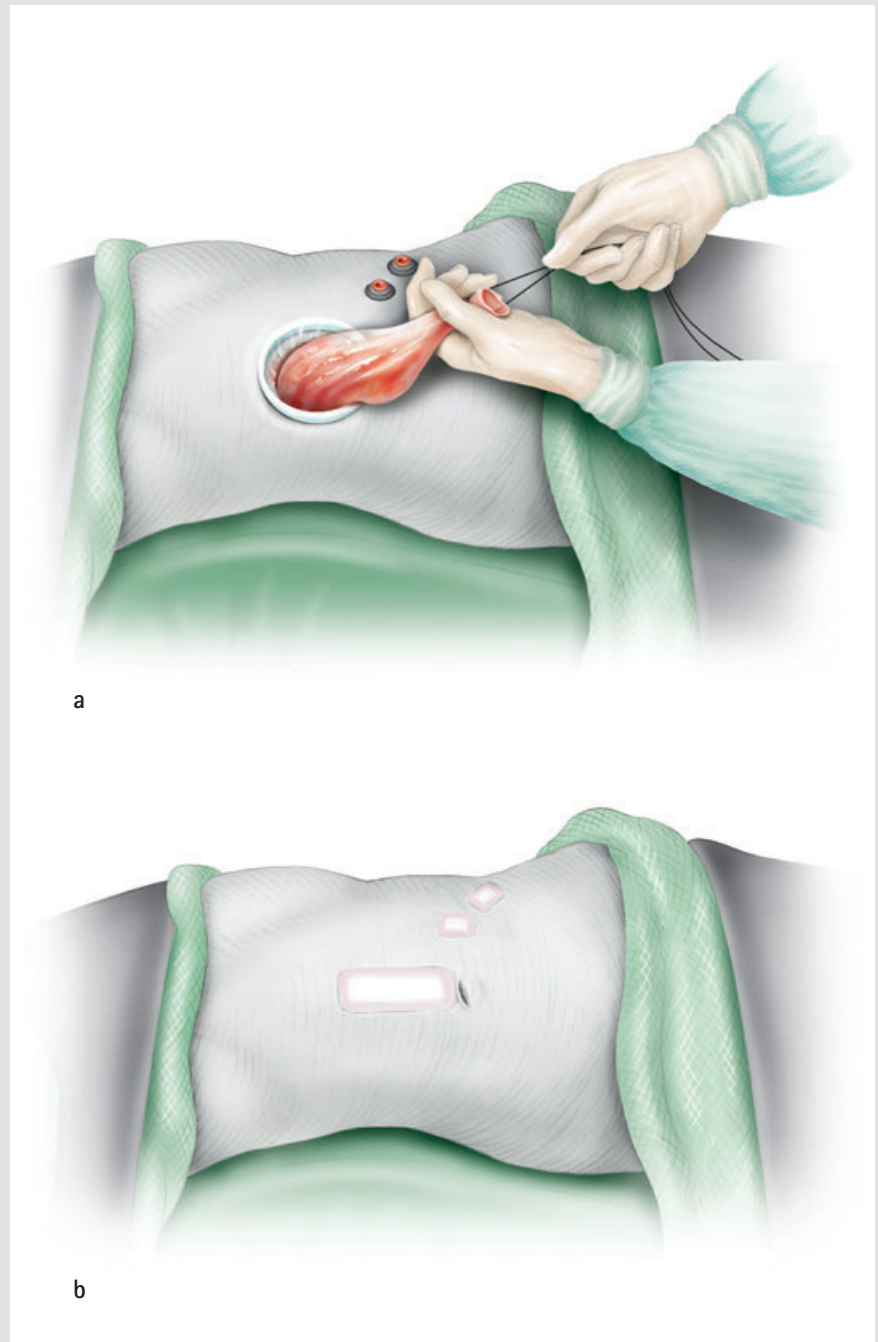




STEP 11. REMOVING THE SPECIMEN

Figure 9

Before removal the specimen must be placed into a bag to prevent potential tumour seeding of the wound. We use the LapSac (Cook Urological) which is currently the only extraction bag that is impenetrable to tumour cells. To facilitate placing the specimen into the bag, one side of the open end should be grasped with an instrument, and the other held open with a finger. After the specimen is carefully placed into the opening, the drawstring is pulled to close the bag, which can be extracted through the hand-port site. Occasionally, large tumours might necessitate extension of the hand-access incision to extract the specimen.



STEP 12. CLOSE THE PORT SITES AND HAND-ACCESS SITE

We routinely close all 10-mm port sites in adults and all 5- and 10-mm port sites in children, to prevent herniation of omentum or bowel. We use the Carter Thomasen device (Inlet Medical, Eden Prairie, MN, USA) to place our suture under direct vision. After all sutures are placed, the laparoscope is used to visualize the removal of all ports, and the sutures are tied.

POSTOPERATIVE CARE

All incisions are closed with a subcuticular suture and dressed with liquid adhesive (Mastisol, Ferndale Labs, Inc. Ferndale, MI, USA) and sterile strips. A small non-occlusive dressing is placed over the hand-access incision and band aids are placed over the port incisions. A first-generation cephalosporin is given for the first 24 h after surgery. Patients wear sequential compression devices on the lower extremities until ambulating well. Ambulation is begun on the night of surgery. Patients are offered clear

liquids the morning of the first day after surgery. Diet is advanced as tolerated. Patients are typically discharged on the second or third day after surgery.

FROM SURGEON TO SURGEON

LRN remains the modern standard of care for treating localized renal cancer. HAL surgery represents a pragmatic development in urological laparoscopy. For many urologists, HAL surgery is the only approach they will have the time and resources to learn. HALRN hastens learning for the surgeon gaining experience in laparoscopy, due to the familiarity and confidence gained with the advantages of tactile sensation. When performing any RN, hand assistance with intact removal has confirmed benefits for the patient and surgeon.

REFERENCES

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- 4 **Nakada SY.** Techniques in endourology: hand-assisted laparoscopic nephrectomy. *J Endourol* 1999; **13**: 9–15
- 5 **Nakada SY, Fadden P, Jarrard DF et al.** Hand-assisted laparoscopic radical nephrectomy: comparison to open radical nephrectomy. *Urology* 2001; **58**: 517–20

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Abbreviation: HAL(RN), hand-assisted laparoscopic (radical nephrectomy).