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Indications

Primary tumors of the adrenal gland

Adenoma – usually those less than 5 cm, where the risk of adrenocortical cancer is low, although this point is controversial

Pheochromocytoma

Aldosteronoma

Metastatic tumors of the adrenal gland

Adrenal hyperplasia

Preoperative Preparation

Preoperative laboratory studies:

Type and crossmatch blood

Evaluation for functional tumors:

Plasma metanephrines, normetanephrines, fractionated catecholamines

Plasma aldosterone and renin

Plasma cortisol and ACTH

Plasma electrolytes

24-h urine VMA, metanephrines, fractionated catecholamines

Preoperative diagnostic imaging studies:

Computed tomography (CT) of the abdomen/pelvis and/or abdominal magnetic resonance imaging (MRI) of the adrenals

Metaiodobenzylguanidine (MIBG) scanning for pheochromocytoma (rarely)

Preoperative preparation for suspected pheochromocytoma: Initiate alpha-blockade prior to the initiation of beta-blockade. Phenoxybenzamine is the preferred alpha-blocker

and is dosed as follows: 10 mg orally twice daily for 3 days, then 10 mg orally three times daily for 3 days, then 20 mg orally twice daily for 3 days, and then 20 mg in am/10 mg at noon/20 mg in pm for 3 days; the last dose is given the night before surgery (none the morning of surgery). Three days prior to operative intervention, start beta-blockade, such as propranolol 10 mg orally three times daily for 3 days (the last dose given the morning of surgery). During alpha-blockade, patients are urged to drink freely to replete plasma volume and to check and record their pulse and blood pressure daily. A physician or nurse should check in with patients to make sure their blood pressure is not too low.

Intravenous fluids

Preoperative antibiotics

Orogastric tube

Foley catheter

Pneumatic compression stockings

Pitfalls and Danger Points

Hypertensive crisis (in patients with pheochromocytomas not adequately blocked)

Hypotension (after removal of pheochromocytoma)

Adrenal insufficiency (after removing a gland for Cushing's syndrome, or if there has been previous contralateral adrenalectomy or possibly nephrectomy)

Need for conversion to open adrenalectomy

Inadvertent injury to adjacent organs, including colon, spleen, pancreas on the left; colon, duodenum, and liver on the right

Devascularization of the upper pole of the kidney

Injury of the left renal vein or IVC

Operative Strategy

This chapter describes the transabdominal approach to laparoscopic adrenalectomy. References at the end describe alternative retroperitoneal approaches.

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Left adrenalectomy requires mobilization of overlying colon, spleen, and tail of pancreas to expose the adrenal gland. It is important to ensure adequate mobilization of the splenic flexure and to limit the medial aspect of the superior dissection to avoid injury to the colon and stomach. Resection of the left adrenal requires control of the left adrenal vein and branches of the adrenal artery, originating from the inferior phrenic artery, aorta, and renal artery. It is possible the blood supply may also originate from the intercostal and gonadal vessels. These arteries branch into an extensive plexus in the capsule and require careful dissection. Attempts should be made to minimize tumor manipulation as well as to avoid rupture of the tumor capsule if present.

On the right, the hepatic flexure of the colon must be retracted down and the right lobe of liver retracted cephalad. The right adrenal vein is short and fat; this fragile vessel drains directly into the inferior vena cava. Adequate exposure of this vessel is facilitated by developing the areolar plane over the anterior and right lateral aspect of the inferior vena cava, after obtaining adequate exposure of the adrenal gland. The right adrenal vein is generally secured and divided with a vascular stapler or clips. The stump of the vein which remains attached to the adrenal can be used as a convenient handle for manipulating the gland.

Operative Technique

Patient Positioning

Position the patient on a beanbag, in the lateral decubitus position. Place the kidney rest between the 11th rib and the iliac crest, raise it to its highest position, and then flex the table.

Pad and support the ipsilateral arm on a moveable upper arm rest (such as a Ming Sling), and place a roll in the dependent axilla. Lean the patient back approximately 15° to increase the anterior exposure, and then inflate the beanbag. Place two pillows between the patient's legs, and secure the hips and shoulders by tape (over a folded towel) extending from one edge of the table to the other (Fig. 123.1a).

Port Placement

For transperitoneal laparoscopic adrenalectomy, four ports are used. In order to ensure appropriate space for the instruments, place each 8–10 cm apart. Place the lateral-most port through the flank between the iliac crest and 11th rib. Prior to insufflation, mark the location of the ports, two fingerbreadths below the costal margin. The most medial port is located in the epigastrium or subxiphoid region, in the midline. The lateral port is marked between the iliac crest and 11th rib in the midaxillary line, and the other two are

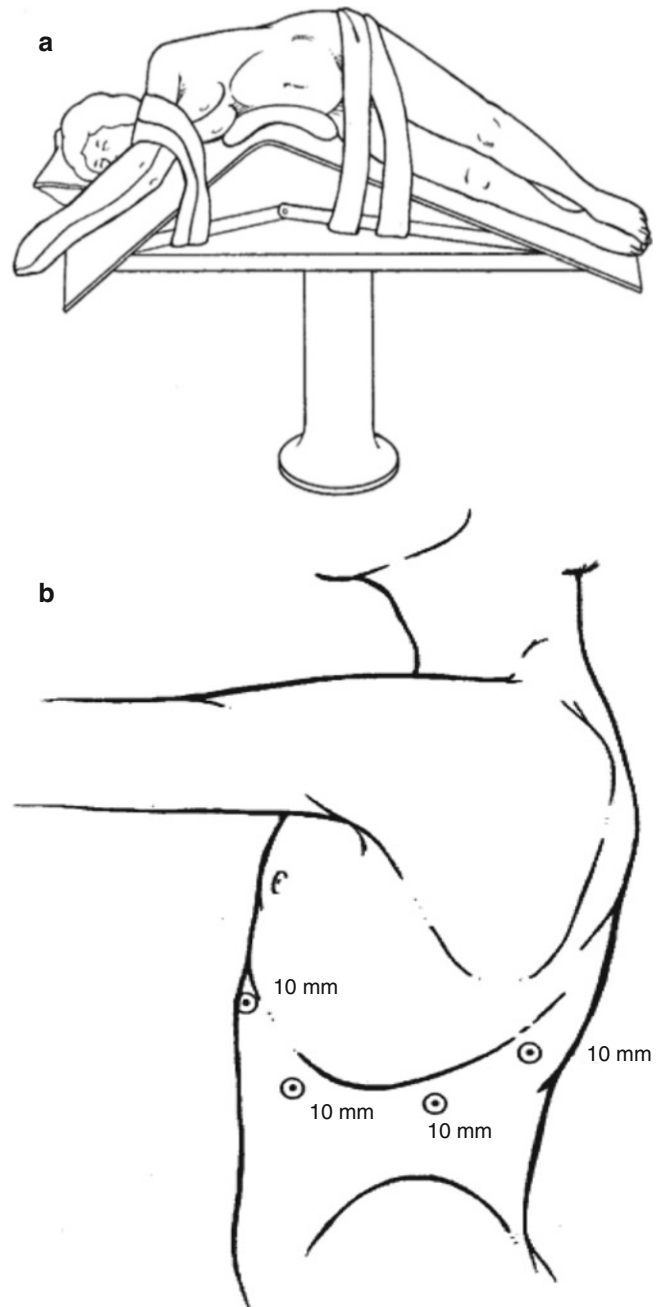


Fig. 123.1 (From Scott-Conner CEH, editor. Retroperitoneal approach. The SAGES manual: fundamentals of laparoscopy, thoracoscopy, and GI endoscopy. New York: Springer; 2006, with permission)

distributed between these two with 8–10 cm between each port (Fig. 123.1b). The first port is placed via an open approach, at the site of the second most medial position.

After placing the first port, confirm intra-abdominal positioning, and insufflate to 15 mmHg. Place the remaining ports under direct visualization. Place the next more lateral port, followed by the most lateral. Place these after assessing whether the right or left colon needs to be mobilized, which is unusual on the right, but common on the left. Finally, place

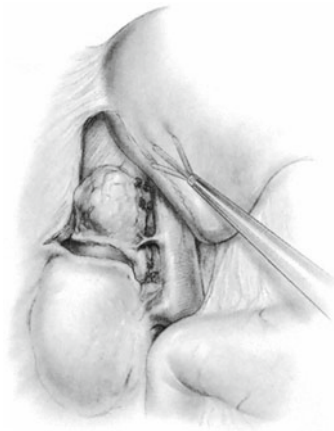


Fig. 123.2 (From Brunt LM. Laparoscopic adrenalectomy. *Lap Surg Abdom.* 2004;213–37, with permission)

the most medial port. This port often traverses the falciform ligament – and this is facilitated by pushing the liver down with an instrument at the time of this insertion.

Right Adrenalectomy

Place ports as noted above and insufflate to 15 mmHg with carbon dioxide. Before placing the lateral port, visualize the hepatic flexure of colon. If there is adequate space, place the port under direct visualization. However, if more space is necessary, the hepatic flexure may need to be mobilized.

Use the midclavicular port for the camera, preferably a 30° scope. Place a fan retractor through the subxiphoid port, and use it to retract the liver medially. Elevate the lateral peritoneum with an atraumatic grasping clamp, and divide the right triangular ligament at the peritoneal reflection using a harmonic scalpel. Carry this as far superiorly as technically feasible, making sure not to go as high as the right hepatic vein. Use the fan retractor to gently lift and retract the lateral edge of the liver.

Open Gerota's fascia over the middle of the kidney in a vertical fashion, extending this incision cephalad to where the lateral edge of the liver meets the diaphragm. Beginning at the superior pole of the kidney, divide the perinephric fat along this line back to the diaphragm, leaving some fatty tissue attached to the adrenal. Push the lateral fat away. Next, open the peritoneum 1 cm lateral to the liver, extending up to the diaphragm, and inferiorly to the upper third of the kidney.

Medially, identify the vena cava just below the liver edge and gently dissect the space between it and the superior pole of the kidney (Fig. 123.2). This concludes the medial most extent of the dissection. As dissection continues, gentle retraction of the inferior vena cava in a medial fashion as well as elevation of the liver will help expose the adrenal gland.

As the adrenal gland comes into view, liberate it from the perinephric fat with the harmonic scalpel, beginning at the

superior and lateral aspects. The harmonic scalpel is preferred, as the arterial supply to the adrenal is not often visualized. If the adrenal is not encountered in this manner, continue dissection through the perinephric fat, superomedially from the point of earlier fat bisection. Again, if the lateral edge is still not located, continue dissection in the plane between the superior pole of the kidney and the vena cava until it is visualized.

After dissecting free the superior and lateral aspects of the adrenal, clear the area between the adrenal and kidney. Take care with this dissection, as the blood supply to the superior pole of the kidney is found inferomedially in this space.

Then retract the adrenal laterally, and use the harmonic scalpel to clear the areolar tissue between the vena cava and the inferior aspect of the gland. Carefully dissect with the harmonic scalpel superior and medial to the adrenal, hugging the top of the adrenal gland, to avoid injury to the adrenal vein.

The right adrenal vein is shorter in length than on the left and drains directly into the vena cava. Careful dissection is necessary to avoid conversion to an open procedure secondary to vascular injury in this area. Use gentle blunt dissection to open the space between the lateral wall of the vena cava and the adrenal gland. Then use a dissector to open up the posterior plane, joining the openings created superiorly and inferiorly.

Position an Endo GIA stapler with a 2.5 mm vascular load, with one fork posterior and one anterior to the adrenal vein. Fire it to secure and divide the adrenal vein (Fig. 123.3). Take down any additional attachments with the harmonic scalpel until the gland is free.

Place the adrenal gland in an endoscopic bag, and remove it through the midclavicular port site. Check the resection area for adequate hemostasis along the vena cava and the adrenal bed and for adequate blood flow to the superior pole of the kidney.

Check the surrounding area for extra-adrenal or residual tissue.

Irrigate the field and close the fascia with 0 Vicryl sutures. Close the skin incisions with 4-0 Monocryl subcuticular sutures.

Left Adrenalectomy

Port placement is the same as with a right adrenalectomy but on the left side of the patient. Use a 30° scope passed through the subxiphoid site. Grasp the splenic flexure with an atraumatic grasping clamp. Divide peritoneal attachments near the splenic flexure, using the harmonic scalpel along the lateral aspect for about 15 cm and in the direction of the transverse colon for about 10 cm. This frees up the lower aspect of the kidney.

After mobilizing the splenic flexure, place the lateral port under direct visualization. Move the camera to this lateral-most port, and pass a fan retractor in the most medial port. Use this to gently elevate the lateral aspect of the spleen.

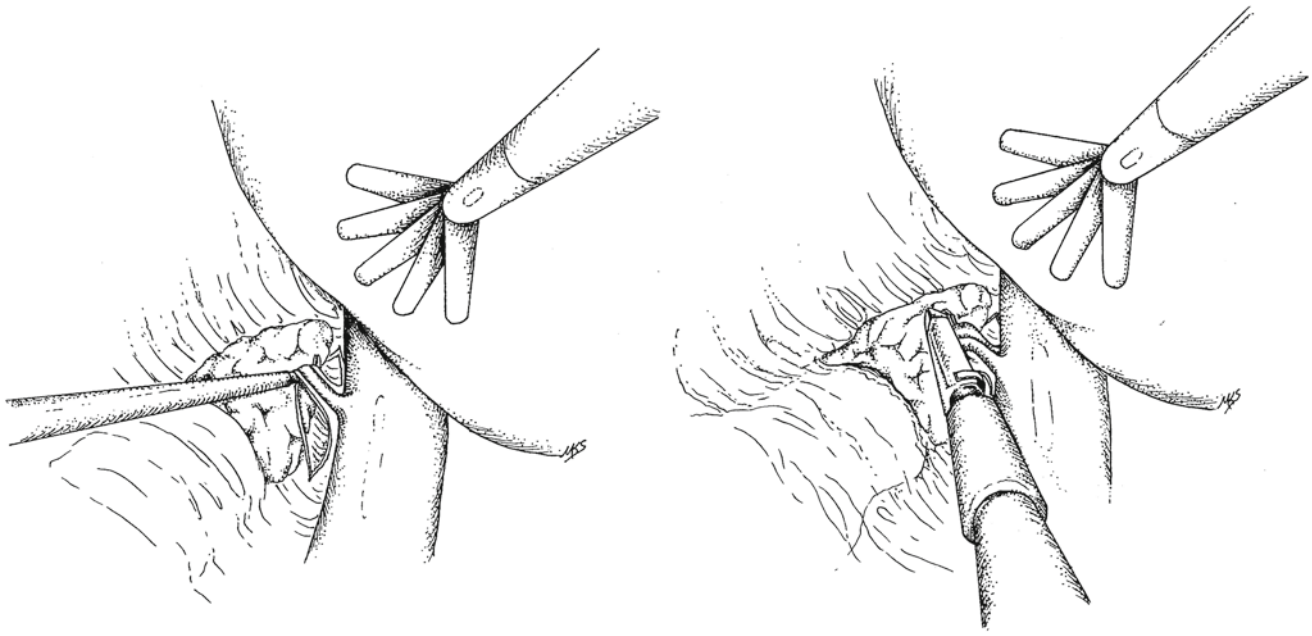


Fig. 123.3 (From Scott-Conner CEH, editor. Retroperitoneal approach. The SAGES manual: fundamentals of laparoscopy, thoracoscopy, and GI endoscopy. New York: Springer; 2006, with permission)

Working with harmonic scalpel and graspers placed through the two middle ports, take down the peritoneal attachments of the spleen are taken down. As the spleen is rotated medially and cephalad, the perinephric fat over the kidney should come into view.

Open Gerota's fascia as described for right adrenalectomy. Divide the perinephric fat with the harmonic scalpel just cranial to the superior pole of the kidney, continuing straight vertically, then deeper posteriorly toward the diaphragm, and at the upper aspect, medially toward the stomach and aorta. As dissection continues in this superomedial trajectory, the adrenal should come into view (Fig. 123.4). This is facilitated by gently retracting the spleen and lateral peritoneum medially with the fan retractor. If necessary, during this dissection, change the position of the scope and instruments for improved traction and visualization.

Dissect along the superolateral aspect of the gland with the harmonic scalpel. Grasp the superior adrenal fat and use this to rotate the gland anteriorly for optimal exposure and takedown of the superomedial attachments. Dissect the lateral edge of the gland off the medial edge of the kidney in an avascular plane.

Next, pull the gland laterally, and continue the dissection between the fat/edge of the adrenal and aorta, in the areolar plane which presents itself when there is adequate traction.

Carefully dissect the inferior edge of the adrenal from the surrounding fat. At the medial aspect, dissect posteriorly, taking care not to injure the renal or adrenal vein. Develop the space between the kidney and inferior aspect of the adrenal, and then connect this posteriorly to the opening made in the medial inferior aspect. Place an Endo GIA 45 stapler with a 2.5 mm load across the space and fire

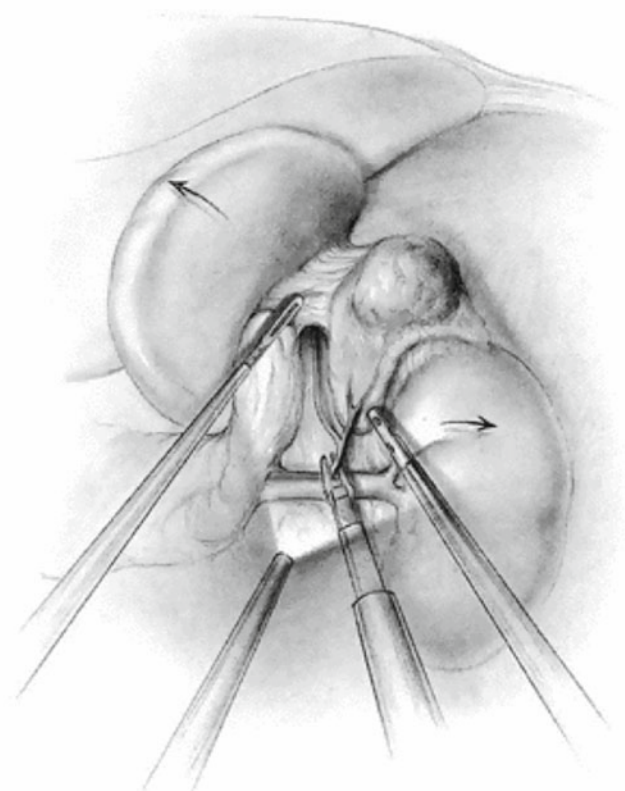


Fig. 123.4 (From Brunt LM. Laparoscopic adrenalectomy. *Lap Surg Abdom.* 2004;213–37, with permission)

it to divide the adrenal vein within. Alternatively, as the vein is longer on the left, it may be dissected free (Fig. 123.5) and clipped.

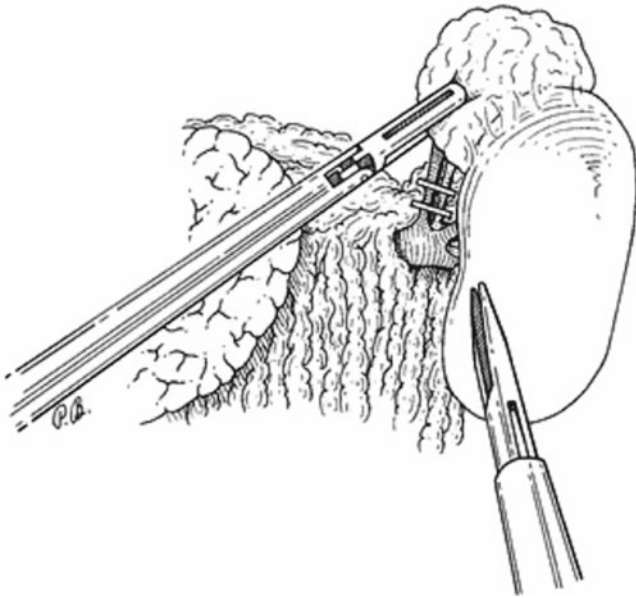


Fig. 123.5 (From Smith CD, Weber CJ, Amerson R. Laparoscopic adrenalectomy: new gold standard. *World J Surg.* 1999;389–96, with permission)

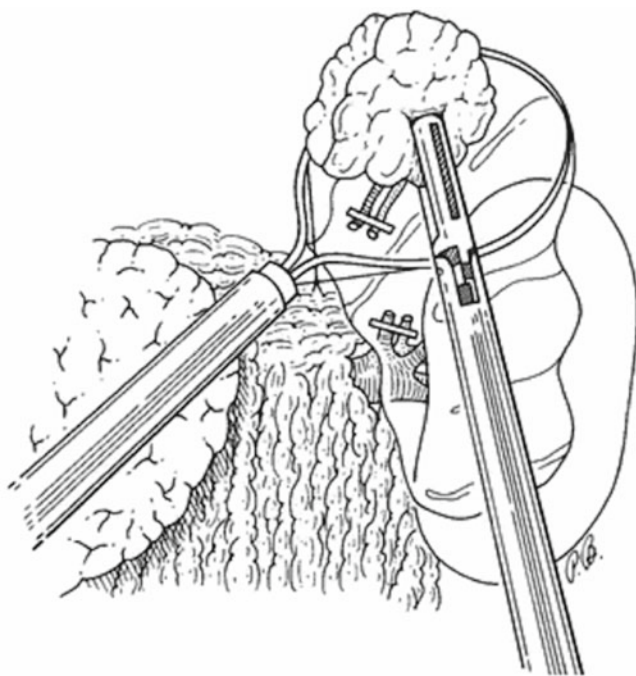


Fig. 123.6 (From Smith CD, Weber CJ, Amerson R. Laparoscopic adrenalectomy: new gold standard. *World J Surg.* 1999;389–96, with permission)

Remove the adrenal gland via an endoscopic retrieval bag (Fig. 123.6), via the midclavicular port site. Inspect the resection area for adequate hemostasis and adequate blood flow to the superior pole of the kidney. At this time, also search the area for extra-adrenal or residual tissue. Irrigate the field and then close the fascia with 0 Vicryl

suture. Close the skin with 4-0 Monocryl in a running subcuticular fashion.

Postoperative Care

In the absence of complications, such as bleeding or internal organ injury, patients are admitted to a general surgical floor postoperatively. Patients with pheochromocytomas are observed overnight in the ICU for hypotension and are transferred to floor on postoperative day 1; beta-blockade is weaned postoperatively. Postoperative antibiotics are not administered. The diet is advanced as tolerated, and patients are ambulated early. Most patients are discharged 2–3 days postoperatively.

Complications

Bleeding from retraction of the liver or spleen is usually controllable with use of the argon beam coagulator. Bleeding from the right hepatic vein, IVC, or renal vein/artery on the right side is an indication for immediate conversion to an open procedure; on the left, the splenic artery and vein can be injured as the spleen is retracted if the dissection is carried out too medially, and inferiorly the renal vein and artery, all of which should lead to open conversion.

Visceral injury may occur if the splenic flexure of the colon is not adequately and carefully mobilized; if the superior dissection is taken too medially, the stomach may be encountered on the other side of the spleen.

Obese patients may occasionally develop *rhabdomyolysis* from prolonged positioning on one side, which is identifiable by its characteristic dark urine in the Foley bag. Adequate hydration (with or without alkalinization) is important for management.

Hypotension is typical after adrenalectomy for pheochromocytoma, even with adequate alpha-blockade. This may require pressors in the early postoperative period, and therefore pheochromocytoma patients should be observed in the ICU overnight.

Sometimes it can be *difficult to locate the adrenal*, especially in large patients with small glands (such as in aldosteronoma). Some advocate using laparoscopic ultrasound to help find the gland. If one continues to struggle, consider opening the medial port site enough to accommodate a hand port; in these difficult situations, one can often palpate the relatively firmer adrenal tissue within the softer perinephric fat, which can help getting the procedure back on track.

Wound infection following a laparoscopic adrenalectomy is rare, but should this be suspected (erythema, purulence at port sites, fever), the incision should be opened for drainage, packed, and allowed to close via secondary intention.

Intestinal obstruction due to adhesions occasionally occurs but is a rare complication with the use of laparoscopy.

Port-site *hernia* is possible but again is a rare complication. Should a hernia be identified, discussion with the patient should be had regarding elective repair.

Further Reading

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