Laparoscopic Adrenalectomy

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The technique of laparoscopic adrenalectomy was first introduced in 1992 and has rapidly gained popularity, largely because of the many advantages of minimally invasive surgery. Diminished pain, rapid rehabilitation, and short hospitalization are all realized with endoscopic adrenalectomy.

There are three vital considerations in selecting patients for endoscopic adrenalectomy. First, malignant tumors or large pheochromocytomas are best treated by transabdominal or thoracoabdominal exposure. The potential reduction in operative trauma is insufficient justification for endoscopic access when radical resection is necessary. Second, the indications for surgery, perioperative biochemical testing, and pharmacologic coverage should be the same regardless of the method chosen for adrenal access. Third, only surgeons who have adequate experience in open adrenalectomy and have mastered the techniques of advanced laparoscopic surgery should perform the procedure endoscopically.

Although there are few absolute contraindications to laparoscopic adrenalectomy, tumors larger than 10 cm should not be approached laparoscopically, pri-
mainly because of the difficulty tumors of this size create in exposure and mobilization, rather than cancer risk. Other contraindications are those of any laparoscopic operations: uncorrectable coagulopathy, prior abdominal surgery preventing safe laparoscopic access or exposure, and cardiopulmonary disease preventing general anesthesia or pneumoperitoneum.

Two minimal access approaches to the adrenal gland are described: the lateral transperitoneal approach and the posterior retroperitoneal approach. The transabdominal lateral laparoscopic adrenalectomy, as described by Gagner, provides the best overall access to the adrenal gland and the area of adrenal exposure and dissection. This approach enables gravity retraction of the surrounding organs and simplifies exposure of the adrenal gland, and enables the surgeon to inspect the entire abdomen and use familiar anatomic landmarks. Although it is less popular, endoscopic retroperitoneal adrenalectomy may be ideal for most of these patients who have had previous abdominal surgery and for patients undergoing bilateral adrenalectomy. This discussion focuses on the lateral transperitoneal technique.

Endoscopic surgery is an access method therefore anatomic considerations and recognition of tissue planes, as well as the principles of careful dissection, are similar to those for open adrenalectomy.

In the transabdominal lateral approach to adrenalectomy the patient is placed in the lateral decubitus position (right or left, depending on the side to be operated on) with knees bent to enable gravity-facilitated exposure of the adrenal glands. In this position, tissue and organs overlying the adrenal glands do not need to be manipulated with laparoscopic instruments, but fall away from the retroperitoneum with the help of gravity. With this gravity-facilitated exposure, the complications and bleeding associated with such manipulation are avoided.
SURGICAL APPLICATIONS
Left Adrenalectomy

The operating room is set up. After induction of general, endotracheal anesthesia, a Foley catheter and an orogastric tube are placed and the patient is placed in the lateral decubitus position with the left side exposed. The patient is positioned with the iliac crest immediately over the table's kidney rest, and the kidney rest is elevated and the table extended. This maximizes the distance between the iliac crest and the costal margin in the midaxillary line for subsequent cannula insertion. Use of a beanbag on the operating table facilitates stabilization of the patient in this position. The left arm is positioned over the chest on a sling. All pressure points are adequately padded. The patient's skin is prepared and draped so that either laparoscopy or open surgery can be performed.
Ganuln sites and uses are illustrated. Preincisional local anesthesia is used. Moderate reverse Trendelenburg positioning is used. Carbon dioxide pneumoperitoneum to 15 mm Hg is initiated with a Veress needle inserted at the midclavicular line 2 cm below the left costal margin (ganula site for the camera).
This primary trocar may be placed with the Hasson technique if desired. A 30-degree angle scope is introduced, and a complete inspection of the abdomen is performed. Under direct vision, two additional 11 mm trocars are positioned about 2 cm below the costal margin near the epigastrium and at the anterior axillary line. Placement of the most lateral trocar requires sufficient mobilization of the hepatic flexure of the colon. A fourth trocar is placed in 50% of left-sided adrenalectomies and should be located in the posterior axillary line.

The first step of the operation is to establish the plane along the anterior surface of the left kidney just lateral and dorsal to the spleen and tail of the pancreas. This is accomplished by incising the splenorenal ligament and mobilizing the spleen laterally. Decubitus positioning facilitates this dissection and mobilization.
With gravity pulling the spleen medially and away from the anterior surface of the kidney, the spleen and tail of the pancreas are dissected away from the retroperitoneum and the superior pole of the kidney is exposed. The left adrenal gland, an orange-yellow gland nestled in the perirenal fat, often is visible at this point.

This dissection plane is relatively avascular if excessive bleeding is encountered, the wrong plane of dissection is being developed. It is important to continue the mobilization up to the diaphragm and close to the greater curve of the stomach and short gastric vessels. The dissection along the anterior surface of the kidney and adrenal gland continues until the inferior pole and medial border of the adrenal gland are exposed.

The exposure is analogous to opening a book, with the pages of the book being the spleen—pancreatic tail and the anterior surface of the kidney—adrenal gland, and the spine of the book being a line just beyond the medial edge of the adrenal gland. Depending on the adrenal pathology and amount of retroperitoneal body fat, the lateral and anterior surfaces of the adrenal gland will become visible during this dissection. It is important not to mobilize the adrenal gland along its lateral edge too early in the exposure. If this mistake is made, gravity will allow the mobilized adrenal gland to fall medially, preventing visualization and access to the medial and inferior edges of the gland where the left adrenal vein is most likely encountered.
When the recirculation of fat prevents clear visualization of the gland, its medial and inferior edges can be localized by balloonization of the retroperitoneal tissue along the anterior surface of the kidney. In even the most obese patients or those with Cushing's syndrome, both situations where localization can be difficult, this technique has enabled identification of the dissection plane between the anterior surface of the kidney and the inferior border of the adrenal gland. Once this cleavage plane is estimated, careful dissection with a hook cautery eventually exposes the inferior and medial edge of the gland. In these difficult situations, some have advocated the routine use of intraoperative laparoscopic ultrasonography to localize the gland. While we have been prepared to apply this, with the techniques described above, we have never needed to rely on ultrasound for gland localization.

The next step is isolation of the left adrenal vein, typically located at the inferior pole of the adrenal gland and draining into the left renal vein. With small tumors (<5 cm), this is most easily accomplished by first dissecting the inferior and medial aspects of the adrenal gland, staying close to the gland until the vein is isolated and clipped. A right-angle dissector greatly facilitates this exposure and isolation. By staying close to the gland, risk to the left renal vein is minimized. The vein is then clipped with a medium to large ligature clip. We have found a 5-mm clip applied adequate for this ligation. Once the vein is transected, dissection continues from inferior and medial to superior and lateral following the anterior surface of the kidney. For large tumors, early identification of the adrenal vein may be difficult. In these cases, we mobilize the gland laterally and inferiorly to find the inferior border of the gland and the adrenal vein.
Final dissection and gland excision progresses from medial to lateral and inferior to superior. While some have advocated use of an ultrasonic dissector to dissect the soft tissues surrounding the adrenal gland, we have found monopolar electrocautery with a hook dissector the most effective method in the confined space and relatively avascular planes of dissection. The inferior phrenic artery is frequently encountered along the superior edge of the adrenal gland and should be sought and ligated with clips. Alternatively, the numerous left adrenal arteries can be individually secured with bipolar electrocautery, an ultrasonic dissector, or vascular clips. Dissection continues until the adrenal gland is completely free.

Before specimen extraction, the operative field is carefully inspected for hemostasis. The area is irrigated and suctioned dry. Points of bleeding from retroperitoneal fat are coagulated with electrocautery. Areas of bleeding from visible vessels are clipped.

When hemostasis is ensured, the adrenal gland is placed in a specimen retrieval sac inserted through the medial 10 mm cannula. Sac size will depend on the specimen to be removed. The sac must be stout enough so as not to rupture during extraction.
The sac is removed through one of the 10 mm cannula sites. The fascia of the cannula site of extraction may need to be stretched with a Kelly clamp to facilitate removal. For large tumors, the entire incision may need to be extended. The adrenal gland should not be morcellated, because histologic architecture must be preserved for pathologic analysis.

The operation is completed by closing the fascia of the 10 mm incisions with absorbable suture. If a significant amount of irrigation was used during the procedure, it will tend to disperse to the lower and right abdomen, out of the reach of suction. It may be difficult to aspirate all of this irrigant and, when the patient is again supine, it will tend to drain from the lateral cannula site. In these cases, a soft Silastic drainage catheter positioned in the left upper quadrant and exiting the lateral-most cannula site may help control and evacuate this fluid during the first 12 hours postoperatively. This drain is removed on the first postoperative morning. If irrigation is minimal (<500 ml) no drain is necessary.

Right Adrenalectomy

The patient is placed in the lateral decubitus position, with the right side up. Pneumoperitoneum to 15 mm Hg is initiated with a Veress needle inserted at the midclavicular line below the right costal margin (cannula site for the camera). After establishing pneumoperitoneum, the remaining cannula sites are marked. A fourth cannula in the epigastrium is necessary for a retractor to el-