Performing Laparoscopic Adrenalectomy Safely

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As is the case with many minimally invasive surgical techniques, laparoscopic adrenalectomy has become the gold standard for the surgical treatment of most adrenal tumors. Several techniques are in use today. In this article we describe 1 such technique, highlight the common pitfalls encountered by the surgeon, and discuss how to avoid them.

Studies have shown a steady and significant decrease in the frequency and number of complications with the laparoscopic procedure when compared with the open technique. However, critical steps of the minimal-access operation may be accompanied by severe pitfalls for the unwary surgeon. This article highlights these complications and suggests ways to prevent them.

BACKGROUND

Gagner et al first described laparoscopic adrenalectomy in 1992. By 2000, more than 1000 cases involving this minimally invasive procedure had been reported in the literature. Two main techniques are used to perform the procedure: transperitoneal and retroperitoneal. The lateral transperitoneal route is the most popular one.

The most common indication for performing laparoscopic adrenalectomy is a unilateral benign adrenal tumor. Such tumors include incidentalomas, aldosteronomas, pheochromocytomas, and virilizing adrenal tumors. Among them, adrenal adenoma deserves special attention because of the newly recognized higher prevalence in patients with hypertension (5%-15%) and because the screening and diagnosis of the hypertensive population can lead to the detection of curable adenomas.

The cutoff for the size of the benign lesion that can safely be removed using minimally invasive techniques continues to be a point of discussion. When laparoscopic adrenalectomy was in its infancy, most surgeons recommended using laparoscopic methods only in tumors less than 6 cm, but the removal of tumors as large as 15 cm has been reported. However, surgeons should not attempt to remove large tumors until they have had adequate experience with the procedure. The laparoscopic technique has also been used effectively in bilateral adrenalectomy, especially for the treatment of adrenocorticotropic hormone–dependent Cushing syndrome.

The main contraindication for the use of the laparoscope in adrenalectomy is the presence of malignancy. Laparoscopic adrenalectomy has not proved safe or more effective than the open procedure in the treatment of adrenocortical carcinoma. Even though some researchers have described successful outcomes with laparoscopic adrenalectomy for cancer, most authors, including us, would caution against it at this time. Much of the debate about limiting the size of the tumor that can safely and effectively be removed using a laparoscope stems from the fact that adrenal masses larger than 6 cm are more likely to be malignant. Because these lesions are large and often invasive, they are difficult to remove, and a poor resection is obviously not in the patient’s best in-
terest. Therefore, excessive tumor size is a relative contraindication. Other factors that may discourage the use of laparoscopy include previous surgery and the patient’s physical characteristics; extensive scarring due to the former, as well as obesity in the case of the latter, may make the organs more difficult to identify and dissect safely. Cardiopulmonary disease preventing pneumoperitoneum and uncorrected coagulopathy prior to surgery may also be reasons to select an open technique. Finally, the surgeon must possess advanced laparoscopic skills.

PREOPERATIVE PREPARATION

Preoperative preparation varies depending on the type of tumor being treated and the choice of approach. For pheochromocytoma there is a risk of severe hypertension intraoperatively, even with minimal manipulation of the tumor. To avoid such a complication, the administration of an α-antagonist, such as prazosin hydrochloride or phenoxybenzamine hydrochloride, is necessary. In addition, β-blockers can be used to control intraoperative arrhythmia but only after α-blockade has been achieved. Combined α- and β-blockers, such as labetalol or carvedilol, are often useful in this situation. Patients with pheochromocytoma can have dangerous postoperative hypotension due to down-regulation of the adrenergic receptors and hypovolemia. All patients require careful monitoring after adrenalectomy and liberal use of saline infusion to prevent fluid depletion. For patients with aldosteronoma, potassium deficits should be corrected. A 6- to 8-week preoperative course of an aldosterone antagonist such as spironolactone is recommended to control hypertension, replenish potassium deficits, and restore aldosterone secretion from the suppressed contralateral gland to prevent addisonian syndrome leading to hypotension, azotemia, and hyperkalemic metabolic acidosis. Finally, the effects of excessive cortisol in patients with Cushing syndrome can be treated with metapyrone, ketoconazole, or mitotane. A team approach to the perioperative treatment of these patients is both desirable and strongly recommended. The roles of the endocrinologist and nephrologist cannot be over-emphasized. Routine bowel preparation and vaccination (triple vaccine against pneumococcus, meningococcus, and Haemophilus influenzae) are unnecessary given the low incidence of bowel and splenic injuries.

LATERAL TRANSPERITONEAL APPROACH

The lateral transperitoneal approach is the one favored by our team. Every patient needs excellent intravenous access, a urinary catheter, and an orogastric tube. We discourage the routine use of the nasogastric tube postoperatively. Additional use of more invasive cardiac monitoring intraoperatively may be necessary at the discretion of the anesthesiologist.

POSITIONING

After the induction of anesthesia and intubation are complete, the patient is placed in a full flank position with the affected side up. At this point, the operative side may be hyperextended by flexing the operating table. This step increases the working area between the ipsilateral inferior costal margin and the iliac crest. This in turn facilitates the placement of ports and minimizes the annoying restriction of movement that one commonly encounters in this region.

PITFALLS

Aggressive flexing of the table can increase the risk of neuromuscular injury and may be unnecessary; pneumoperitoneum should provide adequate working space. These patients may complain of significant back and flank pain for extended periods.

The patient should be secured to the table, which can be rotated to provide comfortable operating conditions for the surgeon. Finally, the patient should be positioned on the table in a manner that facilitates a rapid transition to an open procedure, should it become necessary. Until the surgeon becomes extremely facile with this procedure, full contingency plans must be in place for possible rapid open intervention.

LEFT ADRENALECTOMY

Most procedures require the use of only 3 ports; we prefer 10-mm ports. The first port is inserted into the midline about midway between the umbilicus and the xiphoid process and is mainly used for positioning the camera. In obese patients, we have found it helpful to move the camera port closer to the costal margin and left midclavicular line. Either the open Hasson technique or the Veress needle may be used. The former is our choice and is strongly recommended in the event of prior abdominal surgery. The use of the 30° laparoscope is logical and recommended. Carbon dioxide is insufflated to a preset pressure of about 15 mm Hg.

Left adrenalectomy requires mobilization of the splenic flexure of the colon and the spleen (Figure 1 and Figure 2). The descending colon is mobilized by incising along the white line of Toldt. The splenic flexure is mobilized by transecting the splenocolic ligaments and...
incising the posterior peritoneum below the edge of the spleen. The colon should “fall away” and out of the field of vision after this mobilization is completed. The spleen is fully mobilized from its lateral, posterior, and superior attachments and displaced medially. If the adrenal gland is not readily identifiable, the left renal vein is located, followed by the left adrenal vein, which drains into the superior aspect of the renal vein. The adrenal gland can then be found by tracing the left adrenal vein superiorly to the gland (Figure 3). To achieve this, the Gerota fascia must be opened to identify the gland and its vascular supply. This approach is essential during surgery for pheochromocytoma, in which early control of the renal vein is crucial. Alternatively, dissection of the superior, lateral, and medial aspects of the gland may be carried out first with the adrenal vein dealt with last. The Harmonic Scalpel (Ethicon Endo-Surgery, Cincinnati, Ohio) is a useful instrument for a safe and expeditious dissection. The adrenal vein is controlled with surgical clips and divided (Figure 4). Use of the Harmonic Scalpel to control the adrenal vein is imprudent and inadvisable. Multiple small vessels at the superior and medial aspects of the gland can be easily dealt with using electrocautery or the Harmonic Scalpel, ensuring hemostasis. Finally, the free adrenal gland is placed in a retrieval bag and removed via the first port site.

PITFALLS

Placement of the first port too close to the umbilicus may result in an insufficient length of the camera available to visualize the entire operative field. Similarly, placement of this port too high may result in interference by the falciform ligament.

The second and the third ports are placed just below the costal margin in the midclavicular and midaxillary lines, respectively. In obese patients, these ports may have to be moved to the midaxillary and posterior axillary lines. All ports must be placed so that they naturally adopt a position pointing toward the operative field. Lack of attention to this step may result in a struggle to orient the working ports and instruments throughout the procedure, especially in overweight patients. We have never found it necessary to use a fourth port, but this is sometimes needed to retract the spleen or kidney.

The second and third ports (working ports) must be placed at least 8 cm apart whenever possible. Placement of these ports too close can significantly hamper the operation by restricting the working space and freedom of movement.

Use of irrigation must be kept to a minimum. Any bleeding should be addressed primarily with suction and temporary pressure. The use of a small piece of oxycelulose (Surgicel; Johnson & Johnson, Somerville, NJ) helps. Irrigation often turns the entire operative field red and makes the distinction of fine anatomy challenging. Of course, careful dissection in the first place should obviate this dilemma.

The adrenal gland is sometimes difficult to visualize owing to a preponderance of perinephric fat. This situation is more common in men and in those with small tumors. If the previously described measures fail to localize the adrenal gland, intraoperative ultrasound can be used to determine its location.

The gland should always be dissected with a rim of fatty tissue attached to its surface. This allows manipu-
lation of the gland without grasping it, which may tear the gland and cause troublesome bleeding.

RIGHT ADRENALECTOMY

Four ports are usually required on the right side. The additional port is placed in the left upper quadrant in the subcostal position and accommodates the liver retractor. The other 2 ports are placed subcostally in the anterior and posterior axillary lines. The most posterior trocar is placed last, near the costovertebral angle.

The first step in right-sided adrenalectomy is mobilization of the right lobe of the liver by incising the lateral and posterior attachments (Figure 5). The liver is then retracted superiorly and medially, and the inferior vena cava is identified (Figure 6).

Unlike the left side, the right side of the colon rarely presents an impediment to accessing the adrenal gland. Dissection of the adrenal gland may be safely begun at its superior pole just beneath the diaphragm. The adrenal vein may be sought early in the dissection, especially in small glands. This makes the rest of the dissection easier; otherwise, the gland is dissected laterally and inferiorly with the medial surface and adrenal vein dealt with last. This medial dissection necessarily runs along the wall of the inferior vena cava and must be performed deliberately and with great care. The adrenal vein is short and broad. It is clipped at least twice on the side of the inferior vena cava and then divided (Figure 7). Alternatively, a vascular stapler may be used. We have never encountered the need to use a vascular stapler to divide the right adrenal vein. Whereas much of this dissection may be undertaken using electrocautery, for the less experienced surgeon, the Harmonic Scalpel is a safer tool. Once the adrenal gland is completely mobilized, it can be removed in a retrieval bag through a 10-mm port. The fascia at the 10-mm port sites are usually closed with 0 Vicryl (polyglactin 910) (Ethicon, Somerville, NJ).

PITFALLS

Liver injury can easily occur during retraction and must be avoided. Large hematomas form rapidly. Bleeding can be persistent and difficult to control completely when injuries are deep. Continued bleeding makes it nearly impossible to proceed laparoscopically. The choice of liver retractors is a personal one, although we have observed a slightly higher incidence of liver injuries with bladed-fan liver retractors. The 2 posterior working ports must be placed at least 10 cm apart to facilitate trouble-free dissection.

Vena cava injuries and other vascular injuries are responsible for up to 7% of the complications of laparoscopic adrenalectomy and are an important cause of conversion to the open procedure. Careful dissection of the adrenal gland with the Harmonic Scalpel instead of electrocautery or scissors may prevent or lessen these injuries.

The inferior dissection should be performed with great care. The renal vein must be identified. One must always be on guard for the possibility of an aberrant adrenal vein, which drains into the right renal vein. An aberrant upper pole branch of the renal artery may be accidentally damaged during this portion of the dissection.

CONCLUSIONS

The use of laparoscopic techniques has quickly become the gold standard for the surgical treatment of most be-
nign adrenal tumors. Laparoscopic adrenalectomy for cancer is debatable and should be undertaken only by experienced surgeons willing to enforce stringent cancer criteria in their operative procedures. Laparoscopic adrenalectomy provides the same benefits as other minimally invasive techniques: reduced hospitalization, reduced pain and discomfort, fewer complications, and a faster recovery time. Although laparoscopic procedures may require extended operating time when compared with conventional open techniques, this difference quickly diminishes with further experience, making laparoscopic techniques as safe and efficacious as the time-honored traditional approaches.

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REFERENCES


Correction

Errors in Photograph Caption and Text. In the article titled “Department of Surgery, Duke University Medical Center, Durham, NC,” published in the July issue of the ARCHIVES (2004;139:706-708), the photograph caption should have listed Dr Sabiston’s name as follows: David C. Sabiston, Jr, MD. Also, the correct name of the addition to the Duke University Health System is Duke Health Raleigh Hospital, not Raleigh Community Hospital.