LAPAROSCOPIC ADRENAL RESECTION: CHANGING TECHNIQUES FOR ESTABLISHED INDICATIONS

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Introduction

The operative approach to adrenal cortical tumors must be individualized according to the size and expected nature of the mass. For many years, there have been four distinct surgical approaches from which the surgeon could choose to gain access to the adrenal: anterior/transperitoneal, thoracoabdominal, flank/retroperitoneal, and posterior (Fig 1). The recent development of advanced laparoscopic instruments and techniques, however, has made laparoscopic adrenalectomy the preferred method for resection of most adrenal cortical and medullary tumors. Each of these diverse operative techniques continues to have a place in the surgical management of these masses. The Table demonstrates how the situation at hand usually plays a dominant role in dictating the appropriate surgical approach. Other factors that may dictate the preferred technique to be used include associated diseases, the overall health of the patient, bilaterality and, of course, the surgeon’s familiarity with each procedure.

It has long been recognized that patients typically experience a more uneventful hospital stay following the posterior and flank approaches to the adrenal gland. This benefit has been attributed to the avoidance of entry into the peritoneal cavity and less tissue manipulation through the smaller, more localized operative field. This more directed approach results in less postoperative pain, ileus, and respiratory compromise as well as a hastened recovery compared to patients undergoing a more formal anterior/transabdominal approach. The avoidance of potential pancreatic injury and postoperative adhesion formation is also attractive for these two techniques.

Nearly all of the benefits attributed to the retroperitoneal and posterior approach to the adrenal can be expected to an even greater degree following laparoscopic adrenalectomy. A number of studies have made this comparison and demonstrated that removal of the adrenal by laparoscopy is well tolerated, is associated with little postoperative pain, and typically results in a remarkably quick return to normal function. These three routes are best suited for small- to moderate-sized masses and are usually not appropriate for malignant lesions or large masses that would require a large operative field for adequate exposure.

Anterior/Transabdominal Approach

The anterior/transabdominal approach remains the preferred method for resection of large or malignant adrenal tumors. Through the subcostal incision employed by most surgeons, excellent exposure can be gained to the adrenal and its adjacent organs. The pancreas, spleen, stomach, colon, kidney, and major visceral vascular structures can often be involved within a malignant left adrenal mass, all of which can be accessed through this approach. Similarly, the vena cava, duodenum, colon, and kidney can be encroached upon by a right adrenal cancer necessitating adequate anterior exposure. This approach also provides the exposure needed to assess resectability in those patients with extremely large tumors or in those in which preoperative imaging studies suggest the involvement of contiguous structures.

Most surgeons prefer to reflect the spleen and body/tail of the pancreas as well as the splenic flexure of the colon to the patient’s right to gain direct access to the left adrenal gland.
Adequate exposure is equally necessary for large or malignant lesions of the right adrenal. Upward retraction of the liver following complete mobilization of the right lobe is essential. Larger lesions may require reflection of the duodenum and downward mobilization of the hepatic flexure of the colon. These techniques are designed to allow sufficient exposure of the adrenal arteries and the short right adrenal vein. Care should be exercised with the right adrenal vein and the surgeon should expect a number of large veins emptying directly into the vena cava from large malignant lesions. A mechanical retractor greatly simplifies the effort needed to gain exposure on the right or left, and of course, wide exposure is the primary reason the transabdominal approach is selected.

**Thoracoabdominal Approach**

When extensive exposure is needed, as in the case of giant malignant lesions, the thoracoabdominal approach will often provide the only option for safe resection. All incisions undertaken for large tumors should be planned so that conversion to the thoracoabdominal technique can be made. This method has all the drawbacks of both abdominal and thoracic incisions, yet the exposure gained can be lifesaving. This approach should not be undertaken lightly because of its high potential for morbidity, yet when wide visualization of surrounding structures such as the vena cava becomes necessary, there is no substitute.

**Flank/Retroperitoneal Approach**

The flank approach to the adrenal gland is a compromise between minimal surgery through a limited incision and the wide exposure gained through the transabdominal approach. Positioning is key to the successful exposure of the retroperitoneal space and necessitates that the patient is placed in a semidecubitus position. By flexing the operating table, the costal margin and the iliac crest can be separated, thereby distracting the organs within the operative field. This allows excellent visualization of the adrenal gland and its anatomic neighbors on the operative side; however, visualization of the contralateral gland is impossible. Therefore, the flank approach is not appropriate for those patients who harbor bilateral tumors. Similarly, the advantages gained by remaining in the retroperitoneal space are probably lost if the greater peritoneal cavity is entered, necessitating excessive manipulation of bowel. Since exposure of the kidney and its vascular pedicle is excellent, this approach is ideally suited for medium-sized tumors and those that may involve the kidney. If the necessity arises, conversion to the transabdominal procedure can be made without much difficulty if the incision is planned well.

**Posterior Approach**

For a number of years, the posterior or lumbar approach to the adrenal gland has been the favorite of many surgeons for the removal of small- to medium-sized benign tumors. This technique is so well tolerated that it is often used in a bilateral fashion utilizing two incisions when the situation necessitates bilateral adrenalectomy. The 12th rib is typically resected; however, care should be exercised to preserve the accompanying neurovascular bundle since weakness of the lateral abdominal musculature may result, necessitating excessive manipulation of bowel.

**Laparoscopic Adrenalectomy**

Since 1993, several manuscripts have been published touting the advantages of laparoscopic adrenalectomy. As experience has been gained in this technique, surgeons have been applying it to larger and larger cortical tumors and even pheochromocytomas (Fig 2). From the more limited case reports to some of the more recent larger studies, one thing is certain: this procedure is well tolerated by patients and results in a dramatic recovery not seen following any other approach to this organ. Nearly all studies report expected postoperative hospital stays of two or three days, decreased blood loss compared to the open procedure, and little if any need for narcotics beyond the first postoperative day.

Several distinct laparoscopic techniques have been proposed to gain access to the retroperitoneal adrenal glands. Although many authors have suggested an approach that starts and remains retroperitoneal, our preference -- as well as that of the vast majority of authors reporting on the subject -- is for standard transperitoneal laparoscopy with a directed retroperitoneal dissection as discussed here. Regardless of the laparoscopic approach, the patient must be put into a semilateral or lateral decubitus position with the table broken to widen the space between the iliac crest and the costal margin. Some surgeons are using a lateral incision for large tumors because of the limited operative field and the inability to assess or resect adjacent structures. Laparoscopic surgery has recently supplanted the posterior approach as the preferred method for removal of adrenal masses dictating minimal surgery for benign disease.
By downward traction on the peritoneum overlying the kidney, the adrenal gland is easily visualized. The removal of this gland is straightforward, but the right adrenal vein is short and can make ligation difficult. We prefer to use an Endo-GIA (United Stated Surgical Corp, Norwalk, Conn) type of vascular stapling device on the right adrenal vein to provide a more secure ligation, while others use clips.

Access to the left adrenal can be achieved in two ways. The first requires the splenic flexure of the colon to be mobilized so it can be reflected medially and inferiorly. The descending colon does not need to be fully mobilized, since the aim is to uncover the inferior edge of the pancreas where the kidney and adrenal will be found. Another option is to proceed directly through the peritoneum overlying the distal transverse mesocolon. Either way, the inferior boarder of the pancreas must be seen. The vein on the left is considerably longer and easily lends itself to safe transection between clips. We have found that the actual dissection of the adrenal from surrounding structures is made considerably easier with significantly less blood loss with the use of a harmonic scalpel. Once free, removal of the mass from the abdominal cavity is facilitated by placement into a specimen bag and enlargement of one of the flank port sites using muscle-splitting techniques.

**Learning Laparoscopic Adrenalectomy**

Laparoscopic adrenalectomy is an advanced laparoscopic technique. The use of angled cameras and multiple instruments simultaneously can be challenging. Fig 3 shows the time required by the authors to laparoscopically resect left and right adrenal glands. A significant learning curve is apparent in that an improvement is seen for the first 10 cases on each side after which no further improvement is seen. This learning curve has been described previously, but others have suggested further improvement through a surgeon’s first 15 cases on each side. Also note that the left side requires significantly more dissection of adjacent organs, thereby increasing the total operative time over laparoscopic right adrenalectomy.

![Graph showing learning curve for laparoscopic adrenalectomy](Image)

**Indications**

With the vast number of adrenal lesions found in asymptomatic patients, the consideration is always one of diagnosis and resection vs repeated follow-up examination. The ability to remove small lesions with little morbidity may have an impact on the management of these potentially malignant lesions. Since the laparoscopic approach is typically tolerated so well, it may be suited for many patients as the cutoff for resection rather than long-term follow-up for these incidentalomas decreases from 6 to 4 or even 3 cm. Small- to moderate-sized functional tumors in symptomatic patients also provide excellent candidates for laparoscopic resection. One must also consider that an incidental, nonfunctional lesion seen on magnetic resonance imaging may cause emotional stress for the patient, and this stress may be relieved only by resection. Laparoscopic adrenalectomy is an excellent solution for this unique situation.

The reported conversion rate from laparoscopic adrenalectomy to open is 6.4%, which has been seen in our hands as well. The most common reasons that the laparoscopic procedure cannot be carried out to completion are the presence of intra-abdominal adhesions and a difficult dissection, whereby the surgeon feels an open procedure will provide a safer and more complete resection. The latter is more common in morbidly obese patients. It has also been shown that a more experienced surgical team decreases the amount of complications.

Although advances in laparoscopic techniques have provided a new approach to an old problem, its use should be applied appropriately. The lack of wide exposure and tactile sensation leaves this method prone to incomplete removal of malignant tumors. Because of these limitations, we agree with the vast majority of authors who suggest that this method of adrenalectomy be reserved for lesions with a small probability of malignancy. This would typically mean that patients with lesions larger than 8 to 10 cm are not good candidates for a laparoscopic approach. Similarly, masses that have radiographic signs of malignancy such as irregular boarders may be better approached through one of the more conventional methods. Through the use of an individual approach for each patient and each adrenal mass, the most appropriate operative technique, whether minimally invasive or not, can be chosen to minimize morbidity while maximizing curative potential.

**References**


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