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Review Article

Minimally Invasive Surgical Approach: Laparoscopic Adrenalectomy

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Abstract

Adrenalectomy is performed to adrenal tumors that secret excess hormone and for those that are concerning for malignancy. There are many approached to adrenalectomy, including minimally invasive and open approaches. LA is considered an advanced procedure with a potential risk of serious complications requiring a high skill level. Surgical residents today face the challenge of learning complex skills in a limited time, growing expectations regarding efficiency, quality, and financial viability of health care delivery. Minimally invasive techniques became more popular and available and were therefore included in surgery residents' training program. However, it remains unclear whether advanced procedures like LA can be performed as safely by residents as by attending surgeons. Previous studies have addressed the interaction between residents' participation in surgical procedures and outcomes such as morbidity and mortality with conflicting results.

Introduction

The right and left adrenal glands are located within Gerota fascia adjacent to the kidneys. The arterial supply of the adrenal glands consists of small arterial branches arising from the inferior phrenic artery, the aorta, and the renal arteries. Venous drainage of the left adrenal gland is to the left renal vein through the left adrenal vein, while the right adrenal vein drains directly into the inferior vena cava.The adrenal gland is comprised of two distinct layers, the outer adrenal cortex, and the inner adrenal medulla, which have distinct hormonal production.

The adrenal medulla is made up of ectodermal cells of neural crest origin and is the site of catecholamine production, which includes dopamine, norepinephrine, and epinephrine.

The adrenal cortex is divided into three zones, from superficial to deep being the zona glomerulosa, zona fasiculata, and the zona reticularis.

Transperitoneal Surgical Approach

Transperitoneal approach offers the greatest visualization of the operative field, reducing intraoperative injuries and ensuring minimal morbidity. In addition to a monitor tower and gas insufflator set at intra-abdominal pressure of 15 mm Hg, we use 0° and 30° 10-mm laparoscopes. One 12-mm and three 5-mm trocars are generally used. Our surgical instruments include suction aspirator, curved ultrasonic shears, right-angle forceps, bipolar forceps, monopolar Endoshears, 5-mm Hem-o-Lok (Weck) clip-applier, Endopouch specimen bag, and PEER retractor. Pneumoperitoneum is established using a Veress needle technique.

Left adrenalectomy

We generally use three 5-mm working ports and one 12-mm camera port for left-sided procedures. The first 12-mm port is inserted in the umbilicus or at the lateral border of the rectus abdominis muscle just above the level of the umbilicus to accommodate the camera. Two subcostal 5-mm ports are placed; one in the midclavicular line and the other in the lateral border of the rectus abdominis muscle. The third 5-mm subcostal trocar is inserted in the anterior axillary line. Avoid placing these ports too closely together. Doing so can severely restrict freedom of movement and operating space; 8-10 cm apart should be the goal.

Right adrenalectomy

Five ports are used for right-sided procedures. The trocars are placed in a mirror image to the left side with the addition of a 5mm in the epigastrium for liver

retraction. The epigastric trocar is inserted just to the left of the midline in relation to the lower edge of the liver, so that it does not interfere with the right-handed instrument and trocar. Occasionally, the liver is enlarged and floppy and the grasper may not be adequate for optimal retraction. The Diamond-Flex triangular retractor (Snowden-Pencer, Tucker, GA) inserted through the medial or lateral trocars may then be used for liver retraction. The first step is division of the triangular ligament and careful cephalad retraction of the liver using a locking grasper that is inserted through the epigastric trocar. The grasper holds a fold of the peritoneum or the diaphragm on the lateral abdominal wall, and retracts the liver. Unlike the left side, the colon rarely requires significant mobilization.

Lateral Retroperitoneal Surgical Approach

The retroperitoneal approach has the advantage of avoiding the intra-abdominal organs and allowing direct access to the adrenal. This technique does not provide the same operative exposure as transperitoneal attempts and tumors larger than 7 cm may not be amenable to this technique. Additionally, there is a general lack of anatomical landmarks, making dissection more challenging. The major indication for the retroperitoneal approach is previous intra-abdominal surgery with the presence of adhesions.

Retroperitoneal access

Most surgeons use the open Hasson technique to gain access to the retroperitoneum. The 2 cm skin incision is made approximately 2 cm below the inferior edge of the 12th rib. The underlying muscle layers are bluntly separated and the retroperitoneum entered by dividing the thoracolumbar fascial layer with a hemostat. With careful finger dissection, a potential space is created below the fascia to allow placement of the balloon dilator (Origin Medsystems, Menlo Park, CA). Care should be taken to avoid puncturing Gerota's fascia during this step. Approximately 800 mL of air is inflated into the balloon to create the working space.

Left adrenalectomy

After port placement and balloon creation of the operating space, we incise Gerota's fascia posterior to the upper renal pole with the Harmonic Scalpel. By extending this dissection around the superior aspect of the kidney, the unmobilized adrenal will remain stationary, allowing the kidney to fall away from the gland. The use of a 30° laparoscope greatly aids this maneuver. The surgeon must be aware at this juncture of accessory renal vessels which can be injured during this step. Next, isolation of the main renal vessels is performed. Care must be taken to avoid dissecting too far caudally into the renal hilum.

Right adrenalectomy

Ports are placed in a similar mirror image fashion to the left. Again the investing fascial layer around the right kidney is opened transversely along the upper renal pole and circumferential dissection continued, creating a potential space between the adrenal and the kidney. At this point the IVC is identified and dissection is extended superiorly along the lateral edge of the cava. The right adrenal vein is likely encountered at this point, branching off the medial aspect of the gland. This vessel is again divided between clips.

Transthoracic Surgical Approach

For a very select group of patients where prior surgical attempts in the transabdominal and retroperitoneal cavities precludes a laparoscopic approach, a minimally invasive approach to the adrenal gland has been suggested. Gill *et al.*, first introduced the technique of the thoracoscopic transdiaphragmatic adrenalectomy.

Laparoscopic Bilateral Adrenalectomy

Bilateral adrenalectomy is performed for bilateral adrenal hyperplasia associated with Cushing's syndrome that is refractory to medical management. The surgery may also be required for bilateral adrenal neoplasms. Patients demonstrating an excess of cortisol have increased adipose tissue and some have argued that a laparoscopic approach in these patients is most appropriate. In addition, patients with Cushing's syndrome have an increased rate of morbidity due to poor wound healing and increased risk of thromboembolic events.

Surgical Complications

Small liver injuries can occur during retraction or adrenal dissection on the right. Bipolar coagulation, Endo-peanut compression, or placement of Surgicel generally leads to hemostasis. Additionally, the argon beam can be useful for troublesome bleeding. Rarely do injuries lead to open conversion.

Conclusion

Adrenalectomy has been shown to have a relatively low risk of postoperative complications, with an overall rate of 3.6%. Improved patient outcomes and decreased hospital costs have been demonstrated when adrenalectomy is performed by a high-volume adrenal surgeon (>/=6 adrenalectomies/year). An interprofessional approach to adrenalectomy aids in the prevention and avoidance of intraoperative and postoperative complications, and in some cases, allows for same-day discharge.

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