13 Posterior Retroperitoneoscopic Adrenalectomy

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13.1 Introduction

Minimally invasive adrenalectomy is the surgical standard for the removal of most adrenal tumors. Benign adrenal neoplasms, whether functioning or nonfunctioning, are amenable to removal by laparoscopic techniques with very minimal morbidity and excellent outcomes. The laparoendoscopic posterior approach for adrenalectomy has rapidly grown in popularity in the United States in the past decade, following the initial reports of the simplicity of this approach, as well as excellent outcomes in Europe [1]. More recently, modifications to established procedures have resulted in novel surgical techniques for adrenalectomy, including the application of robotic systems to this approach. Future advances in technology should result in the continued evolution of techniques and refinement of surgical capabilities, with the ultimate goals of enhanced surgeon proficiency and possibly improved patient outcomes.

Laparoscopic adrenalectomy was initially described in 1992 [2]. The first such operations were performed with a transperitoneal approach, using conventional laparoscopic techniques. Early reports confirmed excellent outcomes with laparoscopic/endoscopic removal of selected adrenal neoplasms. Subsequently, other groups reported the results of a lateral or posterior retroperitoneal approach to adrenalectomy. Compared with open adrenalectomy, laparoscopic adrenalectomy results in reduced postoperative pain, less blood loss, decreased wound complication rate, shorter hospital stay, and shortened patient convalescence.

Adrenalectomy through a posterior laparoendoscopic approach has been utilized with increasing frequency in the United States in recent years. Compared with transperitoneal laparoscopic adrenalectomy (TLA), the potential advantages of posterior retroperitoneoscopic adrenalectomy (PRA) include a more direct anatomic approach (obviating the need to mobilize overlying anatomic structures), shorter operative times, and reduced risk of sequelae from entering the peritoneal cavity, such as inadvertent bowel injury or postoperative formation of intra-abdominal adhesions. This approach has advantages for patients who have had multiple prior anterior peritoneal operations, as well as patients with bilateral adrenal pathology. Some potential disadvantages of the approach include surgeon unfamiliarity with a posterior anatomic view, and the risk of complications related to the use of increased insufflation pressures, including possible deleterious intraoperative cardiovascular effects, pneumothorax or pneumomediastinum, or extensive subcutaneous emphysema. Available reports confirm excellent and generally comparable outcomes with both TLA and PRA. Further studies may associate marginal or significant advantages with one of these approaches, but currently there are no evidence-based studies to support such advantages.

13.2 Surgical Technique

The sections below provide a stepwise description of a surgical technique for posterior endoscopic (retroperitoneoscopic) adrenalectomy.

13.2.1 Patient Positioning and Trocar Placement

After induction of general anesthesia and endotracheal intubation, a urinary catheter and appropriate hemodynamic monitoring are instituted. An arterial line and central venous catheter should be placed for patients with hormonally active tumors. A general overview of a suggested physical organization for the operating room equipment and personnel is depicted in Fig. 13.1. The patient is then rotated into the prone position with knees and hips flexed at 90° (Fig. 13.2). The positioning can be facilitated by the utilization of a

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specialized padded pillow for prone patient positioning, such as the Cloward surgical saddle (NL999, Cloward Instruments, Honolulu, HI). The iliac crests are optimally aligned on the lateral rises of the surgical cushion, allowing the patient's abdominal viscera to fall anteriorly and providing maximum reduction of the lumbar lordosis. This positioning optimizes exposure and facilitates access to the posterior subcostal space. With the patient prone, a brief preoperative ultrasound examination can be used to precisely localize the kidney and its upper pole, and thus the expected position of the surgical target, the adrenal gland. This maneuver can be helpful to optimize the placement of the trocar incisions and individualize access depending on variations in body habitus.

Initial trocar placement and access to the operative space is begun by making a transverse incision approximately 1.5 cm in length, below the tip of the 12th rib (Fig. 13.3). The retroperitoneal space is entered by sharp dissection through the thoracolumbar fascia and the erector spinae and quadratus lumborum

Figure 13.1

Organization of the operating room equipment and personnel for posterior retroperitoneoscopic adrenalectomy muscles. Gentle digital exploration confirms appropriate entry into the retroperitoneal fat, which readily yields way. The smooth inner surface of the posterior parietal wall can be felt with minimal blunt exploration of the finger in this potential space. In general, extensive finger dissection is not necessary to create the appropriate working space, which develops readily with the subsequent pressures following gas insufflation. It is important to avoid creating a false plane between the muscular layers or soft tissue of the posterior lumbar area, which can result in difficulty maintaining the appropriate pressures during the procedure, or the development of extensive subcutaneous emphysema. Next, two additional medial and lateral incisions are made, with a minimum optimal separation of 5 cm, and two 5-mm trocars are placed into the retroperitoneal working space with direct digital guidance (Fig. 13.4). A 12-mm blunt trocar (#OMS-T12BT, AutoSuture/Covidien, Mansfield, MA) with an anchoring inflatable balloon and adjustable sleeve is placed in the center port access site.

Figure 13.1

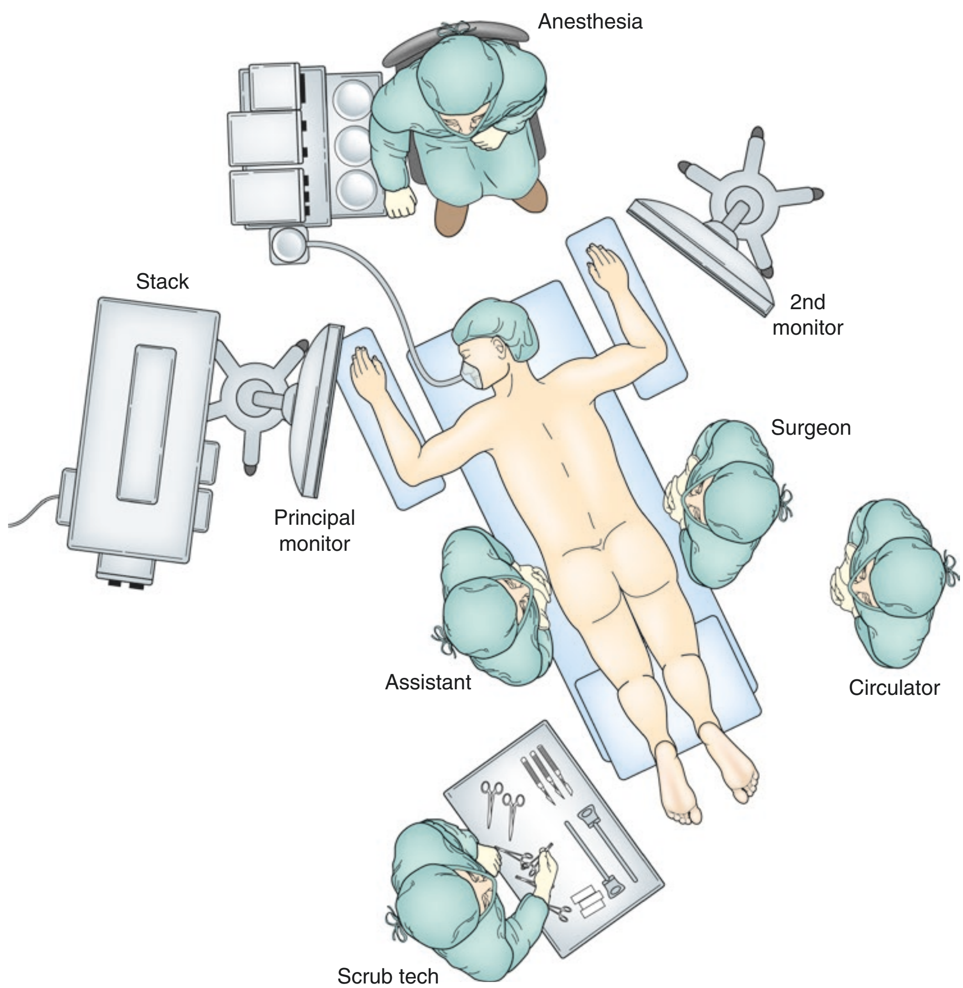


Figure 13.2

Positioning of the patient

Figure 13.3

The initial incision for 12 mm port (middle), with additional 5 mm port sites (medial and lateral)

Figure 13.2

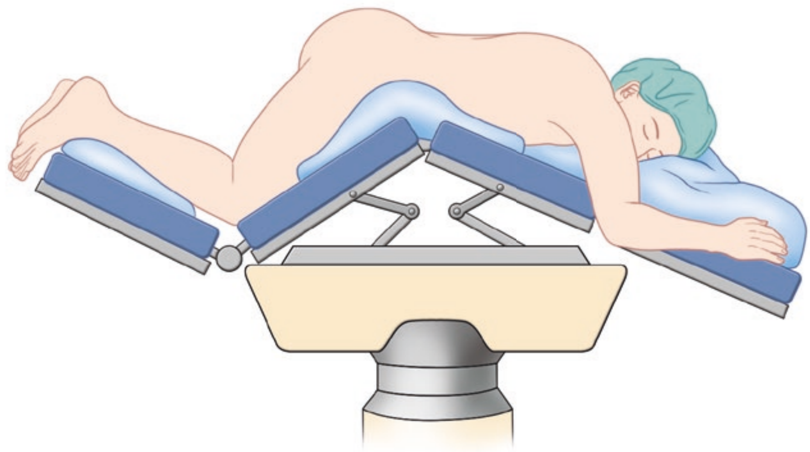


Figure 13.3

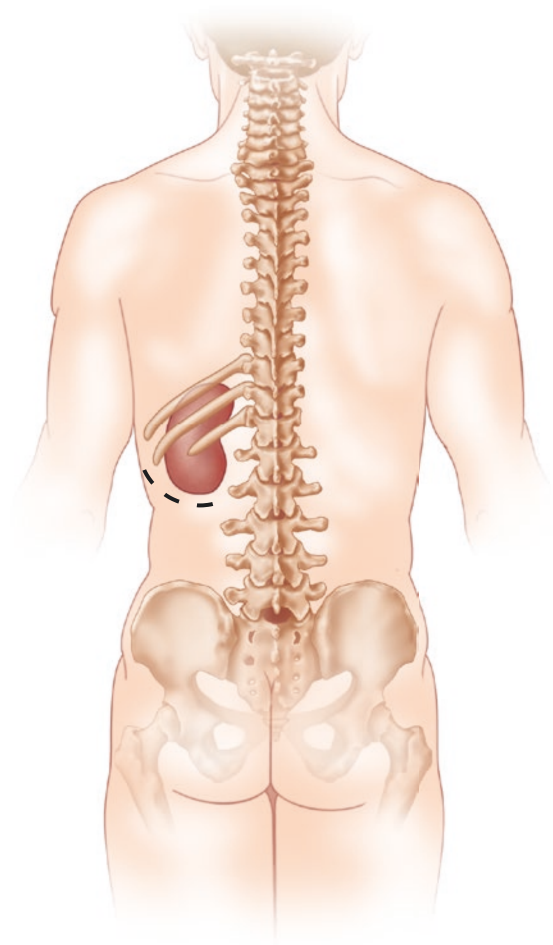
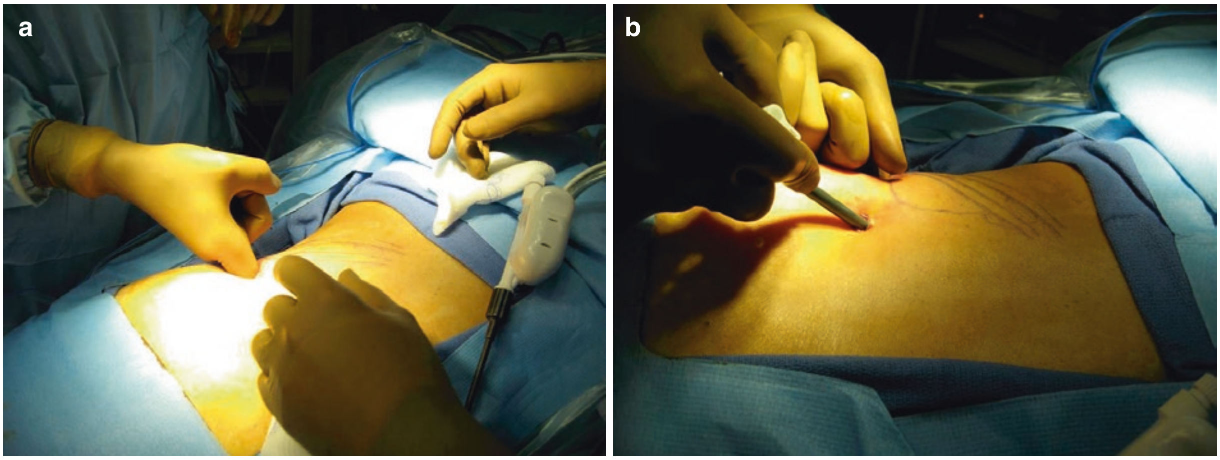


Figure 13.4

(**a**) The 12 mm trocar site incision is made in the left flank, and blunt dissection performed with a finger to enter the retroperitoneal space. (**b**) The medial 5 mm trocar is placed into the retroperitoneal working space with digital guidance

Figure 13.4



13.2.2 Creation of Working Space and Identification of Critical Landmarks

Insufflation pressures of 18–24 mmHg are utilized in the retroperitoneum to create an adequate working space. Opening of this potential space requires only the institution of positive gas insufflation and some gentle spreading with blunt-tipped instruments. A gentle, opposing, spreading motion of two instruments is used to open Gerota's fascia (Fig. 13.5), exposing the perirenal and periadrenal fat. The upper pole of the kidney should be identified as a critical starting landmark for the dissection. The adrenal gland is found superomedial

Figure 13.5

The opening of Gerota's fascia, exposing the perirenal and periadrenal fat

Figure 13.6

The surgical anatomy of the adrenal glands from the posterior view to the upper renal pole, and is generally situated very medially against the paraspinous muscles. The inferior portion of the gland occasionally extends in part somewhat anterior to the kidney (behind the kidney as viewed from the posterior approach). The surgical anatomy of the adrenal glands from the posterior view is shown in Fig. 13.6. The amount of retroperitoneal fat depends on the patient's body habitus, and initial identification of the superior pole of the kidney is the key to establishing the surgical anatomy required to continue the dissection.

Figure 13.5

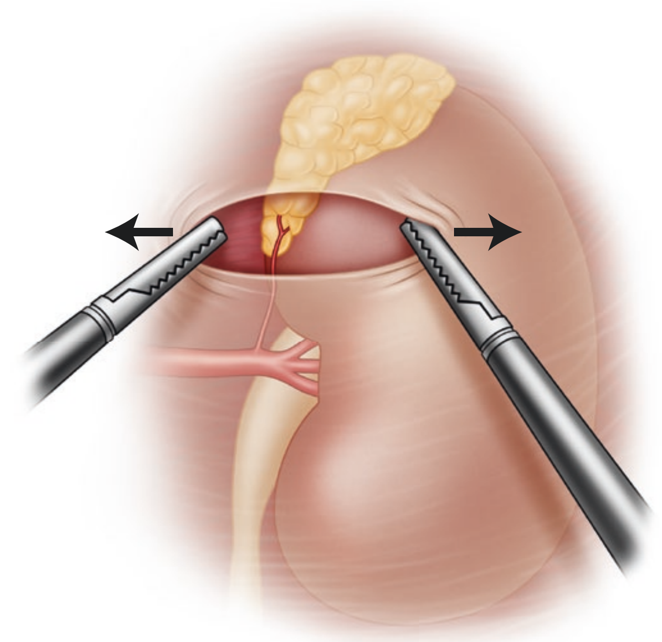
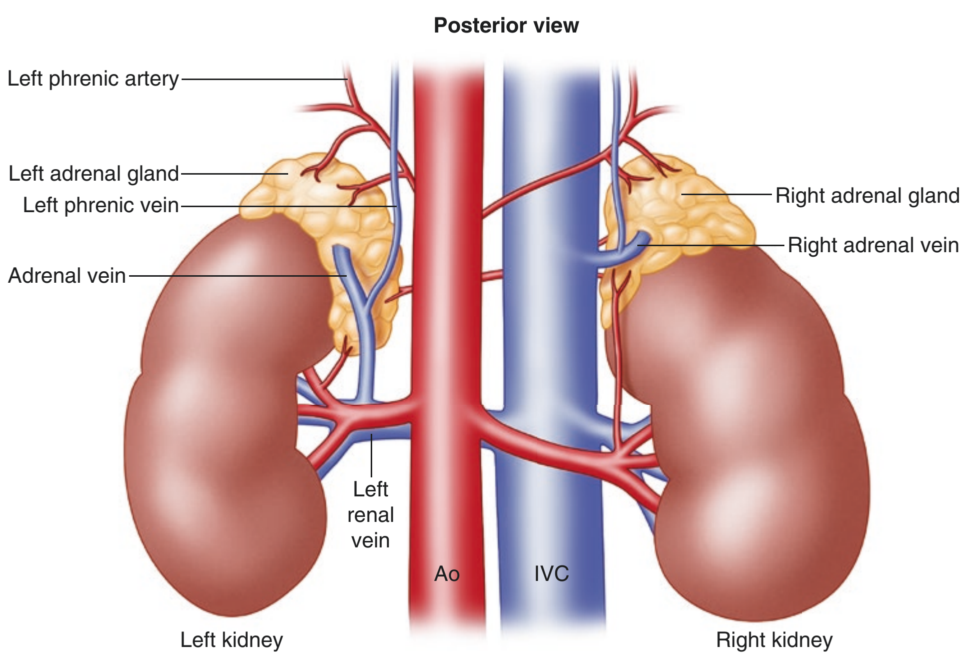


Figure 13.6



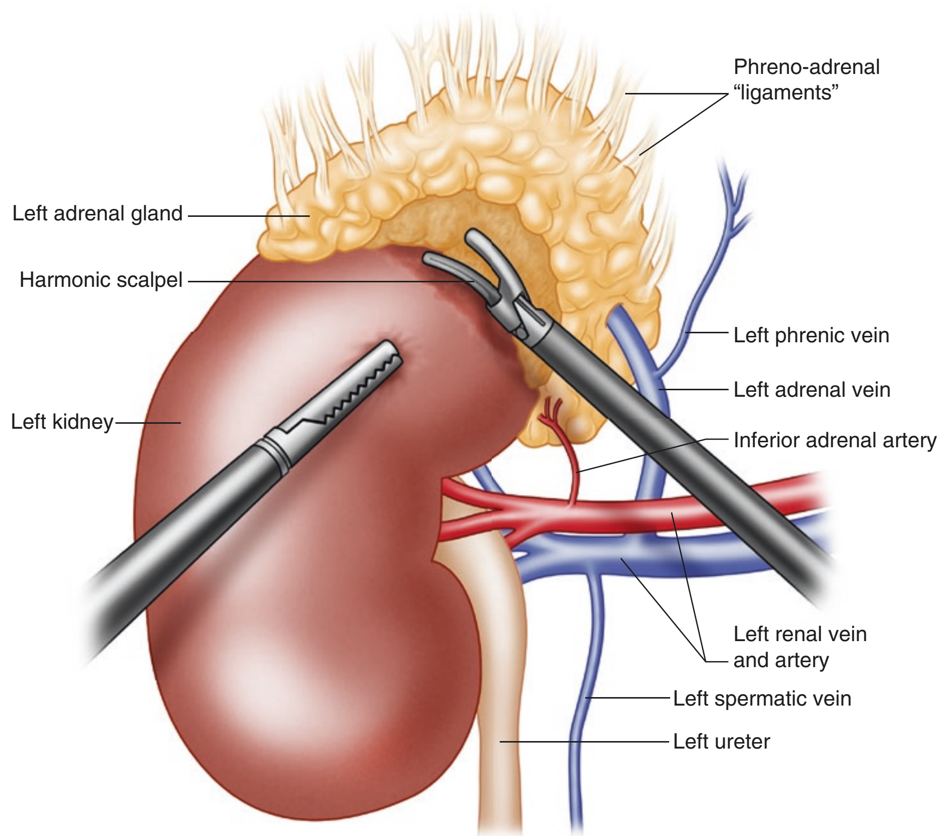
13.2.3 Adrenal Gland Dissection: Operative Strategy

The initial localization of the adrenal gland within the retroperitoneal fat may be elusive at first, but with experience, the bright yellow appearance of the adrenal cortex is readily identified. Ultrasound may facilitate the expedient localization of the gland and may be performed in the operating room after patient positioning and prior to the incision, or with a laparoendoscopic ultrasound transducer. A suggested strategy for adrenal

Figure 13.7

The upper pole of the kidney is gently retracted laterally and inferiorly, and the inferior and medial border of the left adrenal gland is dissected gland dissection is to initially develop the plane between the upper border of the kidney and the inferior edge of the adrenal gland. After defining the adrenal gland border, this dissection is continued around the inferior and medial aspects of the gland until the adrenal vein is identified. The upper pole of the kidney is gently retracted laterally and inferiorly, and the inferior and medial border of the adrenal gland is dissected (Fig. 13.7). The superolateral (diaphragmatic) and anterior (peritoneal) attachments of the adrenal gland are left intact until later, leaving the gland anchored for optimal dissection.

Figure 13.7



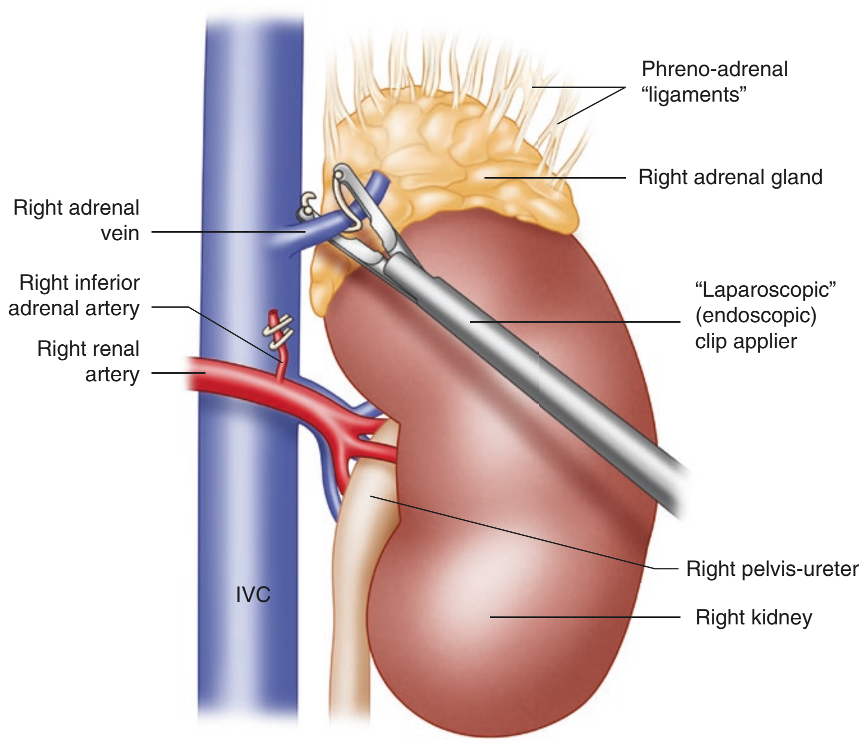
13.2.4 Identification and Division of the Adrenal Vein

The adrenal vein is identified early and divided. The adrenal vein anatomy can vary, especially on the right. The left adrenal vein arises from the renal vein, and a smaller phrenic vein branch coursing superiorly and medially is very constant. On the right, the adrenal vein arises directly from the inferior vena cava; it generally originates somewhat posteriorly on the vein and takes a more horizontal course. Anatomic variations in the venous drainage can occur on the left and are somewhat more frequent on the right. An ultrasonic energy device (harmonic scalpel) can be helpful in dividing small arterial branches when dissecting the periadrenal fat. A

Figure 13.8

After dissection, the right adrenal vein is divided between surgical clips. *IVC* Inferior vena cava curved or right-angled dissecting instrument can be used to completely define the adrenal vein and separate it from the loose investing connective tissue. The adrenal vein represents the single important vascular structure to be controlled during adrenalectomy, and it is recommended that this critical structure be identified and addressed early in the operative procedure. After it is safely dissected, the adrenal vein is divided between surgical clips (Fig. 13.8). Using gentle blunt retraction of the adrenal gland, the remaining periadrenal fat and soft tissue attachments are divided using an advanced laparoendoscopic energy device to complete the dissection. The adrenal gland is removed in a specimen bag.

Figure 13.8



13.3 Robot-Assisted Retroperitoneoscopic Adrenalectomy (RAPRA)

The challenges of the posterior endoscopic approach include a smaller working space, limitations related to the rigid design of conventional instruments, and the need to position port sites close together, resulting in the potential for instrument conflicts and difficult operating angles. The application of robotic techniques to laparoendoscopic adrenalectomy follows the logical progression of laparoscopic technology and novel instrumentation.

Robotic surgical systems provide several advantages:

- Improved three-dimensional visualization and magnification of the operative field
- Articulating instrumentation with improved ability to work within a smaller physical space
- Optimized surgeon ergonomics
- Tremor filtering
- Motion scaling

Robotic surgery also has some potential disadvantages:

- Markedly more complex instrumentation and setup requirements
- The need for a specialized operative support team
- Increased costs
- Increased total operative time
- A lack of evidence-based data for equivalent or superior patient outcomes and patient acceptance

Initial reports of robot-assisted techniques have confirmed the feasibility and safety of this modification of laparoscopic adrenalectomy and have demonstrated expected excellent surgical outcomes, comparable to outcomes for conventional laparoscopic adrenalectomy [3–5]. It is also important to consider costs and investment in setup time, as well as the need for a specialized surgical suite and team. The fixed costs of initial capital expense and of disposable equipment and the need for a specialized surgical suite and team may be justified if operative times are significantly decreased with further experience. Further analysis of surgical results and patient outcomes will be necessary to define the role of robot-assisted adrenalectomy.

13.4 Results and Conclusions

A minimally invasive operation is the preferred surgical technique for removal of small, functioning or nonfunctioning adrenal neoplasms. The adrenal gland may be accessed anatomically from an anterior transperitoneal approach (TLA) or from a posterior retroperitoneal approach directly through the back. Minimally invasive PRA involves a more direct anatomic approach and generally fewer port sites. It offers operative simplicity in patients with bilateral tumors or multiple previous anterior operations. In general, PRA does not require advanced suturing techniques; the single major vascular structure to be identified and divided is the adrenal vein. A few important challenges associated with the posterior approach include the small working space and limited operative angles for dissection or application of surgical clips when working with rigid laparoendoscopic instruments, but the addition of robotic articulating instrumentation may provide significant ergonomic advantages in the very small working space. Another potential advantage of robotic surgery is its enhanced precision in identifying and dividing the adrenal vein and dissecting the adrenal gland, as a result of magnification and improved three-dimensional visualization.

The stepwise technique for posterior endoscopic removal of the adrenal gland described in this chapter is associated with expected excellent outcomes and very low morbidity. The application of robotic systems technology is a further modification that may provide advantages over this approach and further refinement of the technique [3–5]. Additional advances such as robotic adaptations of single incision laparoscopic surgery (SILS) represent future areas for study. Currently, there is no evidenced-based confirmation of improved results or outcomes in patients undergoing minimally invasive adrenalectomy via the posterior endoscopic approach, when compared with conventional transperitoneal laparoscopic adrenalectomy. Continued refinements in minimally invasive technology are almost certain to occur, however. Technologic advances in minimally invasive techniques will continue to result in modifications to minimally invasive adrenalectomy and expanded surgical experience and indications.

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