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Mohit Butaney

Alison Levy

Craig G. Rogers

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Robotic total and partial adrenalectomy: A step by step approach

Mohit Butaney *, Alison C Levy, Craig G Rogers

Henry Ford Health System, Vattikuti Urology Institute, 2799 W. Grand Boulevard, Detroit, MI 48202, USA

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ABSTRACT

Objective: While open adrenalectomy was performed for many years, minimally invasive adrenalectomy has become the gold-standard for surgical resection of adrenal masses owing to superior perioperative outcomes. The objective of this video is to describe our technique of performing robot-assisted total and partial adrenalectomy.
Patients and surgical procedure: In this video, we use the case of a left-sided aldosteronoma to demonstrate our technique of a left robot-assisted total adrenalectomy and a large right-sided tumor with solid enhancing component and mass effect compressing the IVC to demonstrate a right robot-assisted total adrenalectomy. Additionally, we briefly highlight nuances of performing a partial adrenalectomy and the utility of ultrasound in this setting.
Results: There were no intraoperative or postoperative complications. All patients were discharged per our routine pathway on post-operative day one. Through our step-by-step video, we demonstrate our technical approach and tips to successfully perform a robotic total and partial adrenalectomy.
Conclusion: Robot-assisted adrenalectomy is an effective and well-established option for the management of adrenal masses. The added dexterity and improved visualization provided by the robotic approach allows surgeons to provide patients with an effective, efficient, and oncologically appropriate operation with rapid convalescence.

Introduction

Incidental adrenal lesions are being detected with increasing frequency due to the greater use and improved quality of cross-sectional abdominal imaging. [1] While open adrenalectomy was once the standard of care, minimally invasive adrenalectomy has become the gold-standard starting with the laparoscopic approach in the 1990s owing to improved perioperative outcomes and rapid convalescence. [2–5] The increased number of skilled robotic surgeons and adoption of robotic surgery has paved the way for robotic surgery to facilitate high-quality minimally invasive surgery for the surgical management of adrenal masses [6].

In the associated video, we highlight our technique to perform robot-assisted total and partial adrenalectomy.

Patients and surgical procedure

Preoperative evaluation and preparation

Pathology of adrenal masses ranges from benign to aggressive malignant lesions. Benign lesions can be further subcategorized into functioning and non-functioning adenomas. Pre-operative functional evaluation, often performed in concert with the endocrinology team, is important as hormonally active tumors may require extirpative treatment, careful perioperative management and often management of post-operative symptoms. Removal of non-functional tumors is typically based on size and any associated symptomatology. Additionally, partial adrenalectomy has been established as an acceptable option in patients with bilateral adrenal tumors, solitary adrenal glands, or tumors in patients with hereditary syndromes.

Appropriate abdominal imaging with a CT or MRI is necessary for diagnosis and surgical planning. In case of a pheochromocytoma, special care to ensure good operative hydration and blockade is necessary. Several weeks of alpha blockade, followed by beta blockade prior to surgery is recommended. Preoperative steroids are given to patients with cortisol-producing masses and hormone replacement is continued for a few weeks postoperatively. Patients with aldosterone-secreting tumors might require blood pressure and electrolyte management. Additionally, adrenal vein sampling is an important adjunct to confirm the diagnosis. Other typical surgical considerations for routine pre-

* Corresponding author.
E-mail address: mbutane1@hfhs.org (M. Butaney).

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operative blood work, anti-coagulation, medication management, and antibiotic prophylaxis also apply.

Operative setup, patient positioning, and port placement

The patient is placed in a full flank position with an axillary roll and the arm secured at the patient's side, behind the hip to avoid robotic arm collisions. The table is flexed at approximately 15° and all pressure points are protected. After abdominal access and insufflation is achieved, ports are placed in a similar fashion to most upper tract surgery in a linear fashion along the ipsilateral rectus abdominis border from cephalad to caudal starting about one centimeter below the costal margin and approximately 7–8 cm caudally for additional ports. A 12 mm assistant port is placed midline above the umbilicus and additionally, a sub xiphoid 5 mm port with a locking grasper is used for a right sided adrenalectomy to retract the liver.

Surgical technique

Our typical setup for instruments is a monopolar hook in the right arm, 0° camera, and robotic vessel sealer on the left. An optional fourth arm using a prograsp can be used based on surgeon preference. A suction-irrigator, blunt-tip grasper, and a specimen bag are typically used through the assistant port.

Left total adrenalectomy

After takedown of any adhesions, the bowel is reflected medially by incising along the white line of Toldt and then proceeding cephalad towards the spleen. Lienophrenic, leirorenal and lienocolic ligaments may be taken down to improve exposure to the left adrenal gland. The plane between the pancreas and anterior kidney is then developed. Gerota's fascia is incised at the level of the renal hilum and the left renal vein is identified. The 4th arm can be used to provide lateral and inferior retraction of the kidney to aid in dissection. Dissection proceeds carefully along the medial aspect of the adrenal gland. The adrenal vein and the arterial inflow to the adrenal gland are then ligated using the vessel sealer at the takeoff from the renal vein. A stapler or hem-o-lok clips can also be used. The surface of the kidney is then located and the adrenal gland is dissected along the contour of the kidney while avoiding grasping the gland directly. After freeing all remaining attachments, the specimen is placed in a 10 mm specimen entrapment bag and removed through the assistant port.

Right total adrenalectomy

After takedown of adhesions, the liver is retracted superiorly using a locking grasper onto the diaphragm through an additional 5 mm subxiphoid port. Just as an on the left side we do a "top-down" approach mobilizing the cephalad aspect of the adrenal gland from the liver down to the psoas muscle. Getting lateral exposure above the adrenal gland helps define the musculature underneath the adrenal gland. Mobilization of the hepatic flexure and kocherization of the duodenum aid in exposure of the inferior vena cava. Dissection proceeds along the lateral border of the IVC from the inferior aspect of the liver to the takeoff of the renal vein. Ligation of short hepatic veins may be helpful to improve exposure to the adrenal vein. The adrenal vein is carefully isolated and ligated with the robotic vessel sealer. Gerota's fascia is incised and the plane between the upper pole of the kidney and adrenal gland is developed. Arterial supply to the adrenal gland is similarly identified and ligated with the vessel sealer medially. The 4th arm is helpful to elevate the adrenal gland, often with a small amount of fat left on it as a handle, in order to take down the remaining attachments of the adrenal gland to the kidney. Once the adrenal gland is completely released, the specimen is removed in similar fashion as described above.

Partial adrenalectomy

Initial dissection for a partial adrenalectomy is similar to a total adrenalectomy. The adrenal gland is mobilized completely to allow it all a face-on view so that it can be manipulated to "flip like a page of a book" on its arterial supply. This is crucial to be able to accurately dissect out the affected limb. At this point we employ intraoperative ultrasound to mark the borders of resection. The TilePro feature (Intuitive Surgical Inc., Sunnyvale, CA) displays live intra-operative ultrasound images simultaneously with the operative view on the surgeon console. A plane between the tumor and normal adrenal is developed with a small rim of normal tissue. Once dissected, the use of clips and cautery along the resection line is important to reduce bleeding. Hemostatic agents such may be used to assist hemostasis. Once resected, the specimen is eventually removed in a similar fashion.

Post-operative care

Postoperatively a clear liquid diet is started, and a complete blood count and serum chemistries are ordered at 12 h post-op. Intravenous fluids, analgesia as required, DVT prophylaxis, and antibiotic prophylaxis are used as per hospital protocol. Vital signs and fluid balances are closely monitored during the first 24 hours. Urethral catheter is removed on the morning of post-operative day 1. Partnering with endocrinologists in evaluating these lesions is an important aspect of pre- and post-operative management. Apart from preservation of hormonal function, there is a risk of recurrence associated with partial adrenalectomy which requires careful monitoring post-operatively.

Results

In our video, we demonstrated our technique for a robot-assisted adrenalectomy for both left and right sided adrenal masses, and technical considerations in a partial adrenalectomy. No complications were encountered in these cases. All patients were discharged post-operative day one after their pain was well controlled, they were able to ambulate, and tolerate a diet.

Surgical tips and tricks

Through our video we hope we were able to highlight some of the following surgical tips and tricks in performing an adrenalectomy:

- Wide mobilization of the spleen and liver is crucial for left and right adrenalectomy respectively to avoid working in a deep space and for adequate exposure of the upper pole.
- A "top-down" approach where dissection of the upper adrenal gland is done before releasing lower kidney attachments is helpful in proceeding efficiently and safely.
- Cottonoids or surgical sponges are often helpful to aid atraumatic dissection such as retracting the pancreas on the left and dissecting away the IVC on the right.
- A "no-touch technique" often described as "dissecting the patient away from the tumor" where minimal pressure is applied to the gland is helpful particularly for functional tumors but is good practice for all cases.
- Early ligation of the adrenal vein prior to manipulation of the adrenal gland, particularly in cases of pheochromocytoma, is recommended.
- Dissection of vessels should be performed on stretch. The vessel sealer is a great instrument for adrenal surgery but Maryland bipolars, monopolar scissors, clips, hem-o-lok clips are all reasonable substitutes depending on surgeon preference and availability.
- The use of ultrasound can be helpful in a partial adrenalectomy for delineation of the tumor. Judicious use of clips, staples, and hemostatic agents can be helpful for hemostasis while avoiding excessive thermal injury.

Conclusion

Minimally-invasive adrenalectomy is well established with improved convalescence compared to the open approach. The robotic system provides increased wristed dexterity and improved visualization which facilitates the precise dissection of vessels and tumors during total and partial adrenalectomy and consequently improves surgical efficiency and technique. This described technique is a safe, reproducible, and efficient approach for the surgical treatment of adrenal masses.

The video related to this article can be found online at: doi:10.1016/j.urolvj.2022.100138.

Declaration of Competing Interest

The authors have no conflicts of interest.

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Informed consent

The authors certify that informed consent was obtained from the patients for this work.

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