Robot-Assisted Adrenalectomy (Total, Partial, & Metastasectomy)

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KEYWORDS

• Adrenalectomy • Robotic surgery • Partial adrenalectomy • Metastasectomy

KEY POINTS

- Robotic adrenalectomy has been shown to be feasible and safe for resection multiple types of adrenal tumors.
- Compared with traditional laparoscopic adrenalectomy, robotic adrenalectomy is associated with lower blood loss and length of stay but at an increased cost per surgery.
- The role of partial adrenalectomy is currently limited to patients with familial syndromes but may be facilitated by a robotic approach.
- Resection of metastases to the adrenal gland seems safe and feasible using a robotic approach.
- Large prospective studies comparing laparoscopic and robotic adrenalectomy are still needed to define the benefit of robotics.

INTRODUCTION

Minimally invasive adrenalectomy became the gold standard treatment of benign adrenal neoplasms after the initial report of laparoscopic adrenalectomy was described by Gagner and colleagues[1] in 1992. Multiple series have demonstrated decreased pain, lower blood loss, faster convalescence, less ileus, and shorter hospital stays compared with open surgery.[2–10] More recently, robotic surgery has been increasingly used as an alternative to laparoscopic surgery. Multiple feasibility studies have demonstrated the safety and feasibility of robotic adrenalectomy.[11–17] The perceived advantages of robotic over traditional laparoscopy include stereoscopic vision, improved magnification, and greater range of motion.[18] As experience with robotic adrenalectomy has increased, robotic adrenalectomy has been used for progressively more difficult operations, including resection of large tumors,[16] pheochromocytomas,[19] and adrenocortical carcinomas (ACC).[20] Additionally, recent studies also support the role of a robotic-assisted approach during partial adrenalectomy[21] and adrenal metastasectomy.[22]

In this article, the authors review the evolution of robotic adrenal surgery, discuss the evaluation of adrenal lesions, indications for robotic adrenalectomy, and describe the surgical technique. Indications for robotic partial adrenalectomy and metastasectomy are also reviewed along with early outcomes for these procedures.

EVALUATION

Radiographic Evaluation

Adrenal tumors are frequently diagnosed, with incidental adrenal tumors found in 3.4% to 7.0%

Conflicts of Interest: None.

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of patients on imaging studies.[23] Although adrenal masses were historically diagnosed based on sequelae from hormone-secreting tumors, most masses are now found based on imaging alone. Meaningful clinical information may be gleaned from the imaging evaluation. Besides size, which can drive surgical management, enhancement characteristics can help differentiate adenomas from other lesions. Hamrahian and colleagues,[24] from the Cleveland Clinic, evaluated 290 patients and found that adrenal adenomas had significantly lower mean Hounsfield unit (HU) attenuation (16.2) than ACC (36.9), adrenal metastases (39.2), or pheochromocytoma (38.6). The high intracytoplasmic fat content of adenomas causes this difference in attenuation. Furthermore, a cutoff of 10 HU was associated with a 100% specificity to differentiate adenomas from nonadenomas, though the sensitivity was only 40%. Therefore, although lesions with 10 HU or less are almost universally adenomas, lesions with greater than 10 HU attenuation may require further evaluation, as 30% of adrenal adenomas are fat poor.[25] In these cases, the pattern of intravenous contrast washout can be helpful. Adenomas have faster washout of enhancement than other lesions like metastases or pheochromocytomas, which retain contract for longer periods. A washout of 40% to 60% at 10 min is typical of adenomas, with specificity approaching 100%.[26]

Although computed tomography (CT) studies can identify most adrenal adenomas, magnetic resonance imaging (MRI) can also be a useful adjunct. In opposed-phase MRI, lesions with intracellular lipid may be identified by loss of signal intensity on out-of-phase images.[27]

ENDOCRINE EVALUATION

A full hormonal evaluation is necessary in all patients with adrenal lesions to determine if the mass is functionally active. This evaluation is particularly important in preoperative planning, as blood pressure control, electrolyte status, and volume resuscitation should be tailored in patients with functionally active lesions. The American Association of Clinical Endocrinologists (AACE) and the American Association of Endocrine Surgeons (AAES) recently released a comprehensive review of the management of adrenal incidentalomas, including hormonal workup.[28] The guidelines recommend all patients with an adrenal incidentaloma to undergo clinical, biochemical, and radiographic evaluation for signs and symptoms of hypercortisolism, aldosteronism, pheochromocytoma, or a malignant tumor. The recommend screening results are described later and summarized in Table 1.

Hypercortisolism

Hypercortisolism, or Cushing syndrome, is characterized by excess circulating glucocorticoid. The signs and symptoms of hypercortisolism include hypertension, truncal obesity, moon facies, hirsutism, mood disturbance, osteopenia, diabetes mellitus, and easy bruising.[29] Although there are multiple causes of Cushing syndrome, including exogenous steroid use and corticotropin-secreting pituitary tumors, the cause germane to this review is a cortisol-secreting adrenal tumor. The simplest screening test recommended by the AACE/AAES is the 1-mg overnight dexamethasone suppression test.[28] In patients with clinical suspicion because of

Table 1
Endocrine workup of an incidentally discovered adrenal mass

Lesion/Syndrome to Rule Out	Screening Test	Confirmatory Tests
Hypercortisolism	Overnight 1 mg dexamethasone suppression Urine-Free Cortisol	Late-night salivary cortisol, 24-h urine-free cortisol
Primary aldosteronism	Morning plasma aldosterone and renin to calculate an aldosterone-to-renin ratio	Aldosterone suppression test with salt loading Adrenal vein sampling used to distinguish an adrenal mass from bilateral adrenal hyperplasia when unclear radiographically and in patients >40 y
Pheochromocytoma	Plasma fractionated metanephrines/normetanephrines or 24-h total urinary metanephrines	Routine confirmation unnecessary with an abnormal screening test Iodine-123 metaiodobenzylguanidine used to rule out extra-adrenal pheochromocytoma