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Robot-Assisted Laparoscopic Adrenalectomy for Adrenocortical Carcinoma: Initial Report and Review of the Literature

SALEEM S. ZAFAR, M.D. and RONNEY ABAZA, M.D.

ABSTRACT

We report the first robot-assisted laparoscopic adrenalectomy for adrenocortical carcinoma. This patient was referred to our center for extirpation of an incidentally discovered 8-cm adrenal mass. The patient underwent robot-assisted laparoscopic adrenalectomy. Surgical margins were negative for malignancy, and the patient was discharged home on the first postoperative day. We review the literature regarding robot-assisted laparoscopic adrenalectomy and discuss the potential benefits of this technique as compared with standard laparoscopy in the management of adrenocortical carcinoma.

INTRODUCTION

THE SURGICAL MANAGEMENT OF ADRENAL MASSES has evolved from the traditional open adrenalectomy to the less invasive laparoscopic approach. The first laparoscopic adrenalectomy was performed in 1992.1 A more recent development in the treatment of adrenal masses has been the use of the da Vinci surgical robot (Intuitive Surgical, Mountain View, CA). Horgan and Vanuno reported the first da Vinci robot-assisted laparoscopic adrenalectomy in 2001,[2] and since then several others have reported their experience with this procedure as well.[3–12] We report the first robot-assisted laparoscopic adrenalectomy for the treatment of adrenocortical carcinoma, review the current literature, and discuss the potential benefits of robotic technology in minimally-invasive treatment of adrenal pathology.

CASE REPORT

Brief history

A 49-year-old male was incidentally found to have an 8-cm mass in the left adrenal gland. Metabolic evaluation, including 24-hour urine catecholamines and vanillylmandelic acid, serum and 24-hour urinary cortisol, and serum electrolytes, was normal. The patient subsequently underwent a percutaneous computed tomography–guided biopsy prior to referral to our center, which demonstrated features consistent with an oncocytoma. The patient was referred for discussion of minimally-invasive options for extirpation.

Review of a preoperative magnetic resonance imaging scan revealed a left adrenal tumor and suspicion that it might alternatively represent an unusually exophytic upper pole renal mass rather than a primary adrenal process (Fig. 1), particularly given the results of the biopsy and rarity of adrenal oncocytoma.[13] The patient was counseled on the possible benignity of the mass and offered observation but elected to proceed with adrenalectomy or partial nephrectomy, depending on intraoperative findings, due to the size of the mass and uncertainty regarding its possible adrenal origin. A robot-assisted approach was chosen in the event that partial nephrectomy might be necessary, or in the event dissection of the large mass might benefit from the robotic instruments, although a standard laparoscopic approach was also offered and felt to be equally reasonable.

Operative technique

The patient was placed in an oblique supine position with the left side raised to approximately 30° with a roll. A Veress needle was used to insufflate the abdomen through a 10-mm paramedian vertical incision midway between the xiphoid process and the umbilicus, and an optical 10-mm port was placed. Two 8-mm robotic ports were placed, one port a fingerbreadth

Robotic & Minimally-Invasive Urologic Surgery (RoMIUS) Institute of Northwest Ohio, Toledo, Laparoscopy, Simulation & Robotics (LaSR) Training Center, St. Vincent Mercy Medical Center, Toledo, and Department of Urology, University of Toledo College of Medicine, Toledo, Ohio.

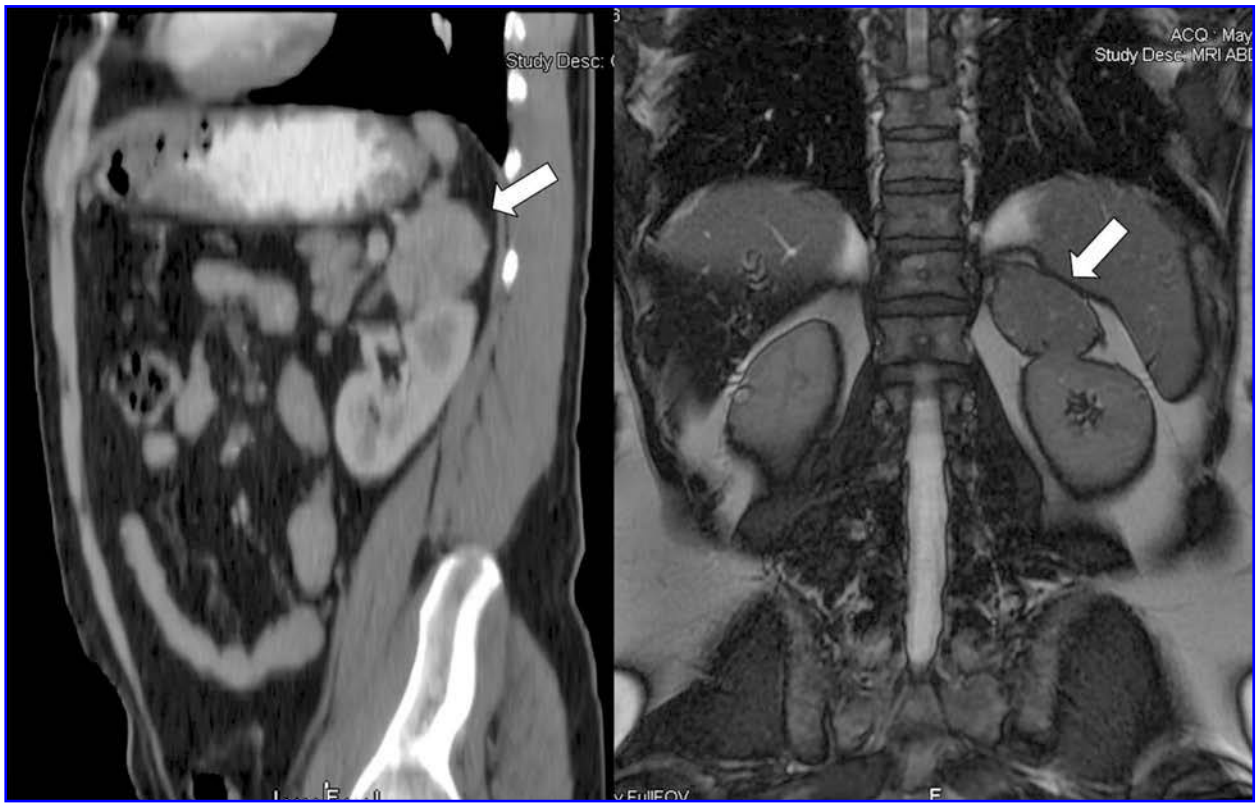

FIG. 1. Preoperative images revealing adrenal tumor (arrows) closely abutting the upper pole of the kidney.

below the left costal margin in line with the optical port, and another three fingerbreadths below the optical port in the midclavicular line. Two additional 5-mm ports were placed for bedside laparoscopic assistance.

The left colon and spleen were mobilized medially. Once the spleen was reflected away from the anterior surface of the tumor, the presence of islands of normal adrenal tissue appearing stretched over the surface of the mass was felt to be consistent with a primary adrenal process. The upper pole of the kidney was identified and cleared, confirming the origin of the mass to be unrelated to the kidney. All fatty tissue superior to the upper pole of the kidney was maintained on the adrenal mass with a similar wide margin of fatty tissue taken laterally, medially, and inferior to the spleen (Fig. 2). Finally, medial dissection and posterior dissection was performed using the robotic instruments to individually dissect and ligate adrenal arteries and the adrenal vein (Fig. 3).

The adrenal gland was placed in a specimen retrieval bag and removed from the optical port site by slightly extending the incision (Fig. 4). Once all of the incisions were closed, the patient was admitted for overnight observation and discharged on the first postoperative day. The total length of the procedure was 138 minutes, and the estimated blood loss was 20 mL. Pathology demonstrated predominantly grade I adrenocortical carcinoma, but also oncocytic foci as had been seen on the biopsy. All margins were negative for malignancy. The patient has been followed now for 3 months without any postoperative complications, and follow-up imaging is planned but yet to be performed. He was allowed to return to work in an automotive factory 1 month after surgery.

DISCUSSION

Standard laparoscopic adrenalectomy has widely become a standard method of extirpative management of adrenal masses. The hand-assisted laparoscopic technique has also been described but with the disadvantage of a larger wound for hand access than that needed for specimen retrieval.[14] Horgan and Vanuno reported the first robot-assisted laparoscopic adrenal-

FIG. 2. Intraoperative images showing wide resection of the adrenal tumor, including (**A**) anterior surface of the tumor with attenuated overlying islands of normal adrenal tissue, (**B**) inferior aspect of dissection against the surface of the kidney (right), (**C**) lateral dissection leaving fat with tumor, and (**D**) superior aspect of dissection against the surface of the spleen (left).

FIG. 3. Posterior and medial aspect of dissection with control of adrenal vessels, including (**A**) retraction of the tumor (left) superiorly away from the upper pole of the kidney (right) for wide posterior dissection, (**B**) a representative adrenal artery being individually ligated and divided, (**C**) identification and dissection of the adrenal vein, and (**D**) the adrenal vein controlled and circumferentially dissected with a clip.

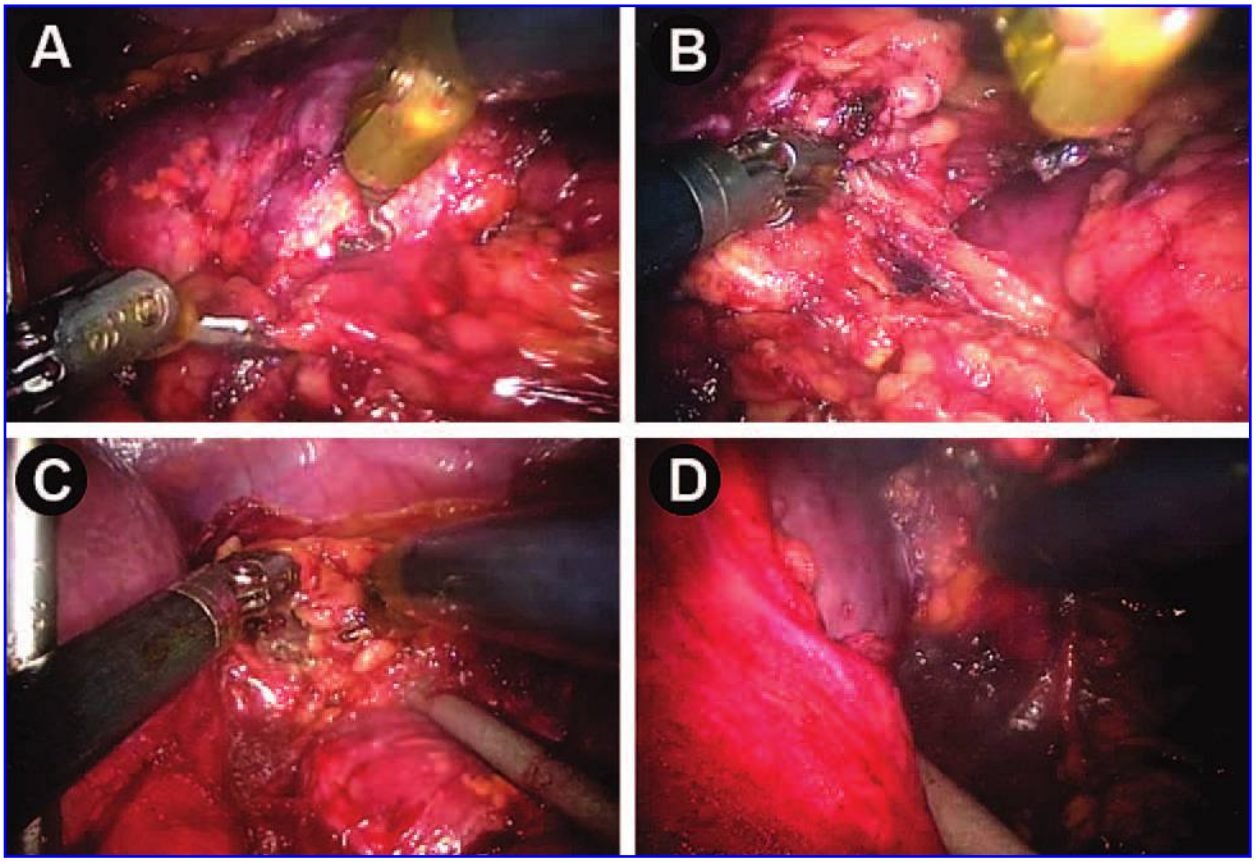

FIG. 2.

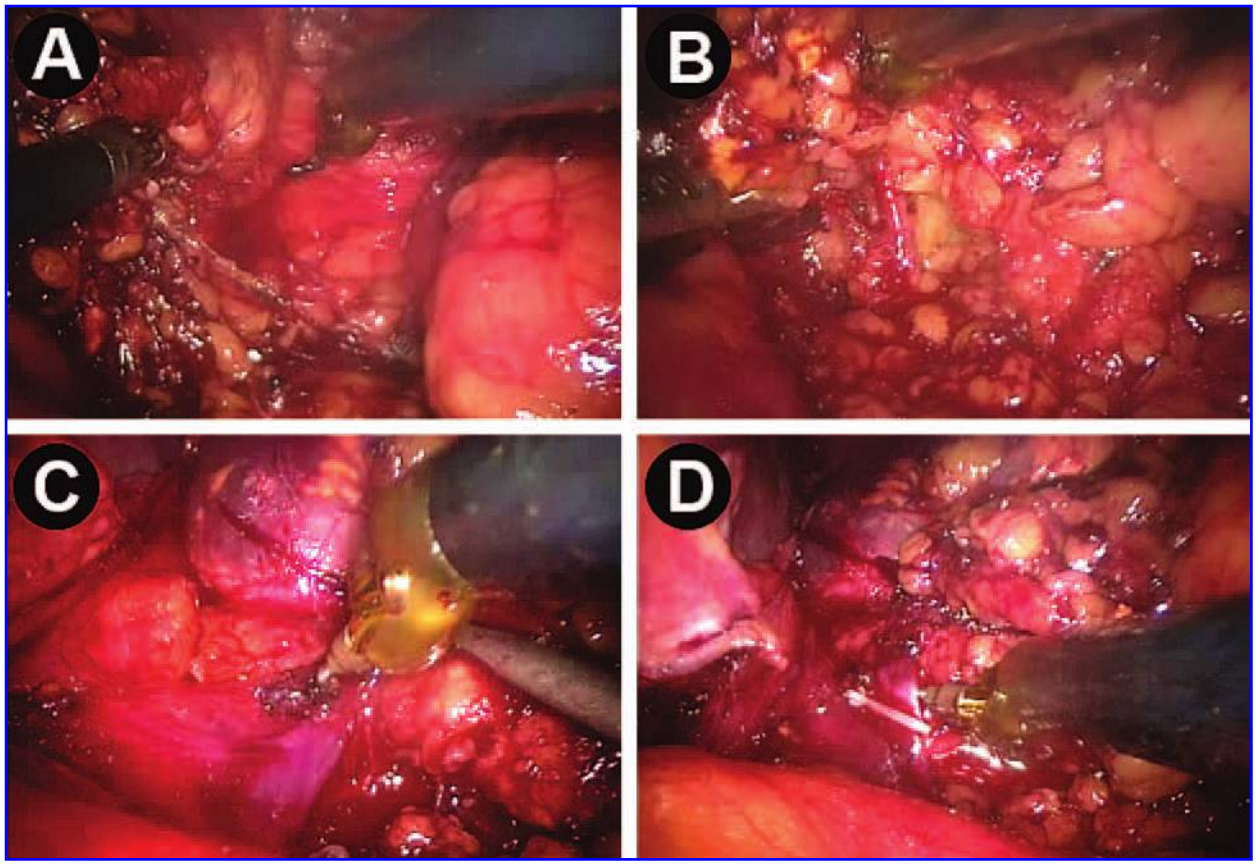

FIG. 3.

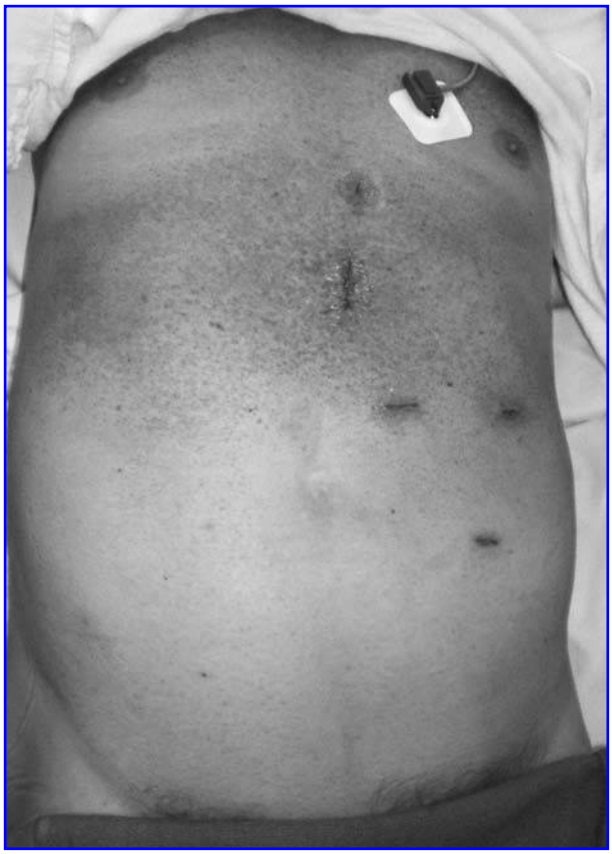

FIG. 4. Postoperative view of port sites including extraction site (second wound from top).

ectomy in 2001.[2] Several groups have since reported their robotic adrenalectomy series, ranging from 1 to 30 cases (Table 1).[3–12]

Pathologic findings in these series have included non-functioning adenoma, pheochromocytoma, aldosteronoma, glucocorticoid-secreting adenoma, angiomyolipoma, cortisol-secreting adenoma, macronodular hyperplasia, and metastatic carcinoma.[12] Our case represents the first report in the literature of robot-assisted laparoscopic adrenalectomy for adrenocortical carcinoma.

The advantages of standard laparoscopic adrenalectomy over traditional open adrenalectomy are consistent with other minimally-invasive procedures as described by Guazzoni and associates in a review of the English literature regarding laparoscopic and open adrenalectomy outcomes. Mean blood loss, hospital stay, and complication rates were all significantly lower for the laparoscopic groups.[15]

In comparing standard laparoscopy with robot-assisted adrenal surgery, several authors have studied whether any benefit exists for one procedure over the other. Brunaud and colleagues found no difference in perioperative quality-of-life outcomes between laparoscopic and robotic adrenalectomy.[16] Morino and co-workers found a higher complication rate and higher cost with robot-assisted adrenalectomy as compared with standard laparoscopy.[17] Complications in the robotic group included hypertensive episodes in two patients with pheochromocytomas, but no patient required conversion to open adrenalectomy.

The da Vinci robot offers several potential advantages over standard laparoscopic instrumentation, including three additional degrees of freedom, elimination of tremor, scaling of instrument movements, and surgeon control of the laparoscope. Disadvantages include, among others, the lack of tactile sensation (unlike the limited extent in standard laparoscopy as compared with open surgery) and reliance on a skilled bedside assistant. Whether robot assistance adds any benefit to laparoscopic adrenalectomy is uncertain.

Certainly, it is possible that robot assistance may make minimally-invasive adrenalectomy possible for those not skilled in standard laparoscopy, as robotic technology has been suggested by some to be enabling by shortening the learning curve for laparoscopic procedures.[12] On the contrary, for a skilled laparoscopic surgeon, the robot may be a hindrance and add unnecessary time and cost to the procedure, particularly for those not as experienced with robotics as with standard laparoscopy.[17] Therefore, any analysis comparing the two techniques cannot

TABLE 1. PUBLISHED REPORTS OF ROBOTIC ADRENALECTOMY AND ASSOCIATED ADRENAL PATHOLOGIES

Report	*Year*	*No. of cases*	*Pathology*
Horgan and Vanuno[2]	2001	1	NR
Bentas et al[4]	2002	4	Pheochromcytoma, adenoma, metastasis
Desai et al[7]	2002	2	Pheochromcytoma, adenoma
Young et al[11]	2002	1	Adrenal oncocytoma
Beninca et al[3]	2003	9	Pheochromcytoma, adenoma
Brunaud et al[5]	2003	14	Pheochromcytoma, adenoma
Giulianotti et al[8]	2003	3	Adenoma
Talamini et al[9]	2003	6	NR
D'Annibale et al[6]	2004	1	Myelolipoma
Undre et al[10]	2004	2	Adenoma
Winter et al[12]	2006	30	Pheochromcytoma, adenoma, AML, adrenal hyperplasia, metastasis
Present case	2007	1	Adrenocortical carcinoma

AML = angiomyolipoma; NR = not reported.

be generalized to all surgeons and institutions. We believe that individual surgeons will need to decide whether there is benefit based on their own skill level and experience.

In the case described here, we are confident that the favorable outcome of the procedure could have been achieved with standard laparoscopy in our hands as well as in those of any other experienced laparoscopist. Nevertheless, we subjectively did appreciate the additional ease afforded by the articulating instruments that allowed for more nimble navigation of the various planes around the adrenal mass. For example, the angle of approach while dissecting the upper pole of the kidney as close to the kidney as possible and then below the adrenal mass was easily handled by the articulating robotic wrists. This was equally beneficial, again subjectively, while dissecting the mass and surrounding fat away from the underside of the spleen, leaving as little tissue on the spleen as possible.

Whether our sense of the benefit of robotic assistance would have been as favorable for a mass of more typical size is uncertain. In this case we used the robot anticipating a possible need for partial nephrectomy, which we also perform laparoscopically, and have yet to decide whether we will use it for all or any future adrenalectomy procedures. As with our early experience with robotics in multiple urologic procedures, we have yet to determine the exact role of the robot given our comfort with standard laparoscopy, and will continue to evolve our discrimination regarding its use with time and further experience.

CONCLUSION

The feasibility of robotic adrenalectomy has been well described. Our case represents the first reported application of this technique to primary adrenocortical carcinoma with potential benefit gained by the use of robot assistance rather than standard laparoscopy.

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Address reprint requests to:
Saleem S. Zafar, M.D.
3065 Arlington Ave
Toledo, Ohio 43614

E-mail: Saleem.Zafar@utoledo.edu

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