

Laparoscopic Management of Adrenal Lesions Larger Than 5 cm in Diameter

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Introduction: Laparoscopic adrenalectomy remains a controversial procedure for large tumors. The incidence of adrenocortical carcinoma increases and technical difficulty of adrenalectomy increases as the size increases. We examined the outcome and complications of laparoscopic adrenalectomy for such lesions.

Materials and Methods: Twenty-nine patients underwent laparoscopic adrenalectomy, of whom 19 had tumors larger than 5 cm in diameter, having a median tumor size of 7.0 cm. They were compared with patients whose adrenal tumors were smaller than 5 cm.

Results: Patients with small tumors (< 5 cm) had a significantly shorter median operative time of 90 minutes as compared to 145 minutes in those with large tumors (> 5 cm). There was no significant difference in the median hemoglobin drop (1.05 g/dL versus 1.30 g/dL), time for starting oral intake (24 hours in both groups) or hospital stay (3.5 days versus 4.0 days) between patients with small and large tumors, respectively. There were no intra-operative complications except for 1 incidence of supraventricular tachycardia in a patient with a large pheochromocytoma. There were no major complications seen in any of the patients and no open conversions. Histopathology of large tumors revealed 16 benign tumors (8 pheochromocytomas, 4 adenomas, 2 ganglioneuromas, 1 pseudocyst, and 1 myelolipoma) and 3 malignancies, of which 1 was primary adrenocortical carcinoma and 2 were metastatic renal cell carcinoma.

Conclusion: In experienced hands, laparoscopic adrenalectomy is safe and feasible for large functioning adrenal tumors. Large adrenal tumors suspicious of harboring malignancy with no peri-adrenal involvement can be tackled laparoscopically.

Keywords: laparoscopy, adrenal gland neoplasms, adrenalectomy methods

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INTRODUCTION

First laparoscopic adrenalectomy was performed in 1992 by Michel Gagner,⁽¹⁾ and since then, laparoscopic adrenalectomy has become the standard of care for managing small benign adrenal masses.⁽²⁾ Size threshold for offering laparoscopic adrenalectomy is controversial, as the prevalence of adrenocortical carcinoma

(ACC) increases with increasing tumor size, and there is increasing risk of peritoneal dissemination during surgery.⁽³⁾ It has also been reported in the literature that the skill required for laparoscopic adrenalectomy is proportional to the tumor size.⁽⁴⁾ We retrospectively reviewed our 6-year clinical experience in laparoscopic management of adrenal lesions

sized greater than 5 cm and its feasibility and safety in such patients.

MATERIALS AND METHODS

Patients

A total of 29 patients underwent laparoscopic adrenalectomy from March 2003 till February 2009. A prior approval from the institutional review board was taken before data accrual and analysis. All of the patients had a complete endocrinological workup done in order to know about the functional status of the tumor. Radiological workup was done in the form of computed tomography or magnetic resonance imaging. All of the patients with suspected pheochromocytoma had alpha blockers instituted preoperatively. The indications for laparoscopic adrenalectomy were the presence of functioning or nonfunctioning adrenal lesions, a potentially malignant lesion with no radiological evidence of periadrenal spread or capsular disruption, and solitary adrenal metastases of a treated primary tumor elsewhere.

Surgical Technique

Transperitoneal approach was used in 27 patients and retroperitoneal in 2 patients according to the standard procedures described.⁽²⁾ For transperitoneal adrenalectomy, the patient was placed in the lateral decubitus position with 45- to 60-degree flank position. Four ports were employed on the right side (1 port for liver retraction) and 3 ports on the left side. Pneumoperitoneum was created in all cases with Veress needle, which was inserted in the midpoint of the spino-umbilical line at the upper border of the umbilicus. A 10-mm camera port was inserted at the lateral border of the rectus abdominis muscle at a point which was at the one-third distance from the costal margin and the iliac fossa port. A 5-mm working port was inserted at the costal margin, and on the right side, an extra port was inserted for liver retraction. Pneumoperitoneum was maintained below 15 mm Hg.

On the right side, after mobilizing the liver and exposing the inferior vena cava, the adrenal vein

was dissected; clipped, using Hem-o-Lok clips (Teleflex Medical, Research Triangle Park, NC, USA), and divided. On the left side, after medially mobilizing the descending colon, spleen, and pancreas, the renal vein was dissected and the adrenal vein was identified arising from the renal vein.

Care was taken to do minimal handling of the adrenal gland till the adrenal vein was ligated, which was helpful in preventing a catecholamine surge in cases of pheochromocytoma. Peri-adrenal tissue dissection was done using a Harmonic scalpel (Ethicon, Johnson & Johnson, Research Triangle Park, NC, USA), and wherever necessary, the Hem-o-Lok clips were used. The specimen was retrieved by extending the iliac fossa incision and entrapping the tumor in an indigenously designed endocatch bag.⁽⁵⁾

Retroperitoneal approach was used in 2 patients according to the procedure described by Kumar and Albala.⁽⁶⁾

Statistical Analyses

A comparative analysis was done between adrenal lesions smaller and larger than 5 cm in diameter. Group 1 consisted of tumors smaller than 5 cm and group 2 consisted of those larger than 5 cm. The parameters studied were the operative time, hematocrit drop, blood transfusion requirement, intra-operative complications, conversions to open surgery, analgesia requirement, postoperative hospital stay and start of oral intake, postoperative complications, and recurrences (including local and distant). The data is expressed as median and range of minimum to maximum values. Comparison between groups was done by the Mann-Whitney U test and a *P* value less than .05 was considered significant.

RESULTS

The patients' characteristics are tabulated in Table 1. There were 10 patients in group 1 and 19 in group 2. The patients were well matched for age in both of the groups; however, patients in group 2 had a higher body mass index. All but 2 patients had transperitoneal adrenalectomy and none of them required conversion to open

Table 1. Characteristics of Patients Who Underwent Laparoscopic Adrenalectomy*

Characteristic	Adrenal Tumor Size		P
	< 5 cm	> 5 cm	
Number of patients	10	19	...
Age, y	27.5 (8 to 70)	38 (10 to 66)	.23
Sex			
Male	2 (10.0)	13 (68.4)	
Female	8 (80.0)	6 (31.6)	...
Tumor side			
Right	9 (90.0)	10 (52.6)	
Left	1 (10.0)	9 (47.4)	...
Body mass index, kg/m ²	18.2 (9.2 to 30.6)	23.2 (13.4 to 30.8)	.04
Incidentally detected	6	11	...

*Values in parentheses demonstrate range for age and body mass index and percents for the remaining. Ellipses indicate not analyzed.

surgery. Sixty percent of tumors in group 1 and 57.8% in group 2 were detected incidentally.

The median operative time was longer in group 2 (on average, 42 minutes longer; 103 minutes versus 145 minutes). There were no intra-operative complications in group 1, but the patients in group 2 had 1 instance of intra-operative supraventricular tachycardia in a patient with pheochromocytoma, which was successfully managed (Table 2).

The median tumor size was 4.0 cm in group 1 and 7.0 cm in group 2. Tumors in group

2 were significantly heavier as compared to those in group 1 (59 g versus 17.5 g). There was no significant difference in hemoglobin drop, postoperative hospital stay, analgesic requirements, and time to starting oral intake between the two groups. None of the patients in either group required blood transfusion. There were no major postoperative complications except for a minor wound infection in 1 patient in group 2 (Table 3).

Pheochromocytoma was the most common histopathological diagnosis in both groups. Ten of 13 patients with pheochromocytoma (76.9%) did

Table 2. Intra-operative Parameters in Patients Who Underwent Laparoscopic Adrenalectomy*

Characteristic	Adrenal Tumor Size		P
	< 5 cm	> 5 cm	
Operative time, min	90 (60 to 210)	145 (60 to 240)	.02
Approach			
Transperitoneal	10 (100)	17 (89.5)	
Retroperitoneal	0	2 (10.5)	...
Conversions	0	0	...
Complications	0	1 (5.3) [†]	...

*Values in parentheses are range for the operative time and percents for the remaining. Ellipses indicate not applicable.

[†]Intra-operative supraventricular tachycardia occurred in 1 patient with pheochromocytoma.

Table 3. Postoperative Parameters in Patients Who Underwent Laparoscopic Adrenalectomy*

Characteristic	Adrenal Tumor Size		P
	< 5 cm	> 5 cm	
Hemoglobin drop, g/dL	1.0 (0.2 to 2.2)	1.3 (0.3 to 4.0)	.37
Packed cell volume drop	4.4 (0.2 to 6.4)	4.1 (0.3 to 13.8)	.69
Tumor size, cm	4 (1.3 to 5.0)	7 (5.3 to 10.6)	< .001
Weight of specimen, g	17.5 (7.0 to 156.0)	59 (8 to 280)	.006
Time to oral intake, h	24 (20 to 36)	24 (20 to 48)	.47
Tramadol requirement, mg	125 (25 to 500)	150 (50 to 550)	.39
Hospital stay, d	3.5 (1 to 7)	4.0 (1 to 7)	.78
Complications	0	1	...

*Values in parentheses are range.

Table 4. Histopathology Reports of Patients Who Underwent Laparoscopic Adrenalectomy*

Histopathology	Adrenal Tumor Size	
	< 5 cm	> 5 cm
Pheochromocytoma	5 (50.0)	8 (42.1)
Functioning cortical adenoma	1 (10.0)	0
Nonfunctioning adenoma	3 (30.0)	4 (21.0)
Pseudocyst	0	1 (5.3)
Myelolipoma	1 (10.0)	1 (5.3)
Ganglioneuroma	0	2 (10.5)
Carcinoma	0	1 (5.3)
Metastases	0	2 (10.5)

*Values in parentheses are percents.

not require any antihypertensive drugs following surgery. Histopathological diagnoses of both groups are tabulated in Table 4. There were 3 cases of malignancy (15.7%), 1 primary ACC (5.2%), and 2 metastatic renal cell carcinomas (RCCs) in group 2. One patient with RCC had developed synchronous ipsilateral adrenal involvement and contralateral adrenal metastases of size 7.5 cm; he underwent laparoscopic radical nephrectomy followed later by contralateral retroperitoneoscopic adrenalectomy. The second patient with metastases had synchronous contralateral metastases of an RCC, measuring 6.5 cm in the maximum dimension; he underwent simultaneous laparoscopic radical nephrectomy and contralateral adrenalectomy. The patient with primary ACC had a 10.6-cm tumor, which had been the largest tumor treated by us laparoscopically. There was no capsular disruption during dissection of this tumor. Surgical margins for tumor resection were negative in all the 3 cases.

The patient with primary ACC received postoperative adjuvant mitotane therapy. There was no recurrence at the last follow-up of 48 months. One patient with metastatic RCC (bilateral synchronous adrenal involvement) succumbed to distant relapse in the liver and lymph nodes 3 months following adrenalectomy, and the other patient with synchronous contralateral adrenal metastases was lost to follow-up at 6 months.

DISCUSSION

Laparoscopic adrenalectomy has been proven to be the standard of care for managing small benign

adrenal masses.⁽¹⁾ The absolute contraindication for laparoscopic adrenalectomy is ACC with periadrenal invasion or venous thrombus, apart from other general contraindications for laparoscopy, which include uncorrected coagulopathy, abdominal sepsis, intestinal obstruction, and unacceptable cardiopulmonary risk.⁽²⁾ Although size alone is not a contraindication, there is considerable debate as to the size threshold for offering laparoscopic adrenalectomy, as it is well known that the incidence of carcinoma increases with increasing size.⁽³⁾ The estimation of the risk of ACC for lesions larger than 6 cm is 25%, for tumors between 4 cm and 6 cm is 6%, and for tumors smaller than 4 cm is 5%, as stated in the National Institutes of Health consensus statement.⁽⁷⁾ Our data revealed an incidence of 5.2% for ACCs among tumors larger than 5 cm.

Other potential problems associated with offering laparoscopic adrenalectomy for large adrenal masses, namely anatomical considerations, are handling of tumors, technical difficulty in dissecting large adrenal tumors, more likelihood of complications, and the risk of peritoneal dissemination of carcinoma. There is no well-defined arterial supply to the adrenal gland. The adrenal gland is supplied by branches from 3 arterial systems, namely the inferior phrenic artery, aorta, and renal artery, which divide into multiple small branches with a complex arcade around the medial and superior border before entering the adrenal parenchyma.⁽²⁾ Hence, there will be more technical difficulties in dissection of the large adrenal mass, leading to higher chances of intraoperative hemorrhage. Direct handling of larger tumors is more likely to lead to fracture during handling, resulting in troublesome bleeding and inadequate removal and peritoneal dissemination.⁽²⁾

It was recommended by Godellas and colleagues that all tumors suspected of being malignant should not be removed by laparoscopic approach,⁽⁸⁾ and Winfield and coworkers also felt that tumors larger than 6 cm and highly suspected lesions of adrenal carcinoma should be managed by open surgery and lesions smaller than 6 cm which are suspected of having

metastases can be dealt with laparoscopically.⁽⁹⁾ Review of the literature reveals that as more and more experience is being gained, larger sized tumors are being tackled laparoscopically with minimal or no complications.⁽¹⁰⁾ Similar experience has also been reported recently by Simforoosh and colleagues in managing large adrenal tumors laparoscopically.⁽¹¹⁾ The various contemporary series which have reported laparoscopic management of large adrenal tumors are summarized in Table 5 for comparison with our series.⁽¹²⁻¹⁶⁾ The results reveal that our series is comparable to almost all contemporary series reported in the world literature for managing large adrenal masses. The mean tumor size tackled is comparable, while the operative time is less as compared to other series. There is no conversion in our series, while in these series, the conversion rate varies from zero to 20%. Similarly, complication rates reported are 10% to 30%, while we had a complication rate of 5.2%.

Adrenocortical carcinoma is associated with a 5-year survival of 16% to 60%, and recurrence is seen in almost two-thirds of patients, even in patients with localized disease and complete resections.⁽¹⁷⁾ There have been few reports of local, intra-abdominal, and port site recurrences following laparoscopic adrenalectomy for cancer.^(18,19) Our results showed that the patient with primary ACC was healthy and recurrence free 48 months following the surgery. While the patient with synchronous ipsilateral and contralateral adrenal involvement with metastatic RCC had a survival of 3 months, developing recurrences in the liver and lymph nodes.⁽²⁰⁾ The other patient with synchronous contralateral RCC was lost to follow-up at 6 months.

It has been shown by various authors that laparoscopic approach as compared to open adrenalectomy has fewer complications, less operative blood loss, less postoperative pain, shorter postoperative hospital stay, and faster return to regular activity.^(2,13) When size is considered as the sole criterion on which the operative approach has to be based, then many patients who have large benign adrenal tumors will have to undergo an unnecessary open adrenalectomy that might increase their morbidity.⁽¹⁵⁾ Our series also showed that laparoscopy allowed patients who had large adrenal tumors to experience the same benefits that laparoscopic resection has afforded to patients with small adrenal tumors. Laparoscopy is feasible in larger tumors as it allows close manipulation with magnified field of vision, careful and precise dissection of the adrenal gland, and early control of the adrenal vein. The adrenal gland is not handled till the adrenal vein is controlled, reducing the risk of hemodynamic instability. However, the surgeon should be ready to convert to open adrenalectomy if there is evidence of local invasion, capsular disruption, or technical difficulties observed during the operation.^(12,14,21)

CONCLUSION

Laparoscopic adrenalectomy is safe and feasible for large functioning adrenal masses as well as nonfunctioning adrenal masses. Even large adrenal tumors suspected of harboring malignancy can be managed laparoscopically, provided there is no peri-adrenal involvement or capsular disruption.

CONFLICT OF INTEREST

None declare.

Table 5. Comparison of Studies on Laparoscopic Management of Large Adrenal Lesions

Study	Year	Tumors > 5 cm	Approach	Mean Tumor Size, cm	Mean Operative Time, min	Conversions, %	Complications, %
Hobart et al ⁽¹²⁾	2000	14	Transperitoneal & Retroperitoneal	8.0	205	14.3	21.4
MacGillivray et al ⁽¹³⁾	2002	12	Transperitoneal	8.0	190	0	41.6
Tsuru et al ⁽¹⁴⁾	2005	29	Transperitoneal	6.5	176	13.7	12.0
Liao et al ⁽¹⁵⁾	2006	39	Transperitoneal	6.2	207	25.6	10.25
Bhat et al ⁽¹⁶⁾	2007	10	Transperitoneal	8.0	142.7	20.0	30
Simforoosh et al ⁽¹¹⁾	2008	17	Transperitoneal	6.3	159	0	0
Our Study	2009	19	Transperitoneal & Retroperitoneal	7.2	145	0	5.2

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