

Original Article

Laparoscopic Adrenalectomy is Feasible for Large Adrenal Masses > 6 cm

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OBJECTIVE: Laparoscopic adrenalectomy (LA) has become the established procedure for adrenal masses less than 6 cm. The role of LA for large adrenal masses is well defined to a lesser extent.

METHODS: Thirty-six LAs were performed in 32 patients (including four patients with single stage bilateral adrenalectomies) over a period of 3 years, from May 2002 to 2005. Patients were divided into two groups based on the tumour size, i.e. masses less than 6 cm (group I) and masses 6 cm or more (group II). The results with respect to mean (95% confidence interval) operative time, blood loss, postoperative course and complications were compared.

RESULTS: Group II included 11 LAs performed in 10 patients including one bilateral LA for bilateral pheochromocytomas in multiple endocrine neoplasia 2A. The mean size (\pm standard deviation) of masses was 8 cm (\pm 1.47). In comparison, 22 patients in group I underwent 25 adrenalectomies (including three bilateral single stage procedures for Cushing's syndrome). The mean size of masses was 4.1 cm (\pm 1.27). There were eight and six pheochromocytomas in groups I and II, respectively. By comparing groups I and II, only minimal increase in blood loss and operating time was noted with no significant difference in hospital stay and morbidity. Two cases required conversion to hand assistance towards the end of the procedure in view of their large size.

CONCLUSION: LA is the procedure of choice for small adrenal masses but is also feasible for large functioning and nonfunctioning adrenal masses with equally good results. Even bilateral large functioning tumours can be treated safely by LA in a single stage when sufficient experience with the procedure is attained. [*Asian J Surg* 2007;30(1):52-6]

Key Words: adrenal gland neoplasm, adrenalectomy, laparoscopy, pheochromocytoma

Introduction

Laparoscopic adrenalectomy (LA) is the established gold standard procedure for adrenal masses with all the inherent advantages of minimally invasive surgery.^{1,2} There is no recommended consensus on the maximum tumour size that can safely be removed laparoscopically. The aim of our study was to assess the feasibility of LA for adrenal masses \geq 6 cm in size and whether the larger size causes

any significant increase in morbidity, technical difficulty and complications.

Patients and methods

Data were entered prospectively for 32 patients who underwent 36 LAs between May 2002 and 2005 at our department. Of the 32 patients, 10 patients had masses \geq 6 cm (group II) and 22 patients had masses < 6 cm (group I).

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All patients underwent preoperative biochemical evaluation including 24-hour urinary vanillylmandelic acid (VMA), metanephrines and cortisol. Imaging was done with contrast-enhanced computed tomography (CT). Magnetic resonance imaging, meta-iodobenzylguanidine and iodonorcholesterol scanning were performed in selected patients. In cases where biochemical investigations indicated the mass to be pheochromocytoma, adequate alpha blockade and volume replenishment were performed preoperatively.

A single surgeon performed all the laparoscopic adrenalectomies using the anterolateral transperitoneal approach. Three ports were used on the left and four on the right side with the patient in lateral kidney position. A 10 mm camera port was inserted by an open technique at a site 2 cm above the umbilicus at the lateral border of rectus sheath. Two working ports were employed. One 10 mm port was placed in the iliac area 2 inches above and medial to the anterior superior iliac spine and one 5 mm port was placed subcostally in the midclavicular line. An additional 5 mm liver retraction port was used for the right side in the epigastrium. Carbon dioxide was used for insufflation and pneumoperitoneum was maintained keeping a pressure of 12–14 mmHg.

On the left side, early control of the adrenal vein was attained after medial mobilization of the colon, spleen and pancreas. On the right side, the right lobe of the liver was mobilized and inferior vena cava exposed to approach the adrenal vein. After control of the adrenal vein, the gland was dissected free using the Harmonic scalpel™ (Ethicon, Johnson and Johnson, Cincinnati, OH, USA). Specimens were retrieved after extending the iliac port incisions. In two left-sided masses, a terminal hand assist was employed (no special hand port device was necessary) through a midline supraumbilical 7 cm incision. This same incision was used to extract the specimen. In one woman who underwent single stage bilateral LA for large bilateral pheochromocytomas, a lower midline incision through her previous tubectomy scar was used to extract the specimens. The simultaneous bilateral LA in both groups I and II was performed by the anterolateral transperitoneal approach with the patient in the lateral decubitus position. The patient was repositioned and draped in the opposite lateral decubitus position after completing one side. All specimens were removed intact without morcellation in an endo-catch bag. The mean (95% confidence interval [CI]) operating time, mean blood

loss and postoperative course in the two groups were assessed. Intraoperative haemodynamic alteration was defined as a rise in systolic blood pressure by 30% and/or diastolic blood pressure by 10% of the baseline at any time from positioning, induction, creating pneumoperitoneum and handling the tumour. A fall in blood pressure by the same margins after removal of the tumour was also considered as haemodynamic alteration.

Results

A total of 32 patients underwent 36 LAs during the study period. This included four cases of single stage bilateral LA. None of the LA was converted to open surgery.

Group II included 10 patients (11 LAs) with masses ≥ 6 cm (one patient underwent bilateral LA for large bilateral pheochromocytomas in multiple endocrine neoplasia [MEN] 2A syndrome). This group comprised five males and five females, with a mean age (\pm standard deviation) of 42.8 years (± 10.65). Five tumours were left-sided, four right-sided and one bilateral. The mean size of the masses in group II was 8 cm (± 1.47). The indications for surgery in group II were pain abdomen, large incidentaloma and preoperative diagnosis of pheochromocytoma (Table 1). Postoperative histopathology of the 11 tumours revealed six pheochromocytomas (one bilateral), two ganglioneuromas and one each of soft tissue tumour (leiomyoma), tuberculosis and myelolipoma. Twenty-two patients (25 LAs) in group I had a mean age of 33.6 years (± 15.02). This group was composed of 16 females and six males, with 10 tumours on the right, nine on the left and three bilateral. The mean size of the tumours in this group was 4.1 cm (± 1.27). Histopathology of the 25 specimens showed eight pheochromocytoma, six Cushing's, six Conn's, two adenomata, one each with hyperplasia, ganglioneuroma and a normal adrenal. All except one were benign. The large pheochromocytoma of 11 cm was reported as malignant, in view of the size and vascular invasion. The normal gland was removed in a teenaged boy with uncontrolled hypertension needing three drugs. His urinary VMA was elevated and CT scan was misinterpreted as a left adrenal mass, which in retrospect was probably just a very prominent splenic notch.

The mean (95% CI—lower and upper values) operative time, blood loss and hospital stay for group II was 142.7 minutes (103, 182), 105.9 mL (34.4, 177.4) and 4.1 days (3.12, 5.08), respectively. Group I had a mean (95% CI)

Table 1A. Demographics of 10 patients with adrenal mass ≥ 6 cm

S. no.	Age (yr)	Sex	Side	Size (cm)	Indication for surgery
1	48	F	Right	6	Incidentaloma
2	28	M	Left	6.7	Pain abdomen
3	64	M	Right	8	Evaluation of hypertension
4	32	M	Left	11	Phaeochromocytoma
5	47	M	Left	7	Incidentaloma
6	37	F	Bilateral	9	Phaeochromocytoma
7	40	F	Left	8	Phaeochromocytoma
8	49	F	Left	9	Pain abdomen
9	34	F	Right	6.5	Phaeochromocytoma
10	49	M	Right	9	Large myelolipoma

Table 1B. Operative details of 10 patients with adrenal mass ≥ 6 cm

S. no.	Histopathology	Operating time (min)	Blood loss (mL)	Hospital stay (d)	Complications
1	Phaeo	240	300	4	Blood transfusion
2	Ganglioneuroma	90	50	2	None
3	Leiomyoma	240	20	5	None
4	Phaeo	210	250	8	Pulmonary oedema
5	Ganglioneuroma	120	50	4	None
6	Phaeo	220	100	3	None
7	Phaeo	90	25	4	None
8	Tuberculosis	180	300	4	None
9	Phaeo	120	50	4	None
10	Myelolipoma	60	20	3	Minor wound infection

operating time, blood loss and hospital stay of 113.9 minutes (85.25, 142.55), 40 mL (29.04, 50.96) and 3.8 days (3.37, 4.23), respectively.

Two of the larger left-sided masses that were greater than 8 cm were converted to hand assistance towards the end of the procedure to facilitate dissection and retrieval. One was a large vascular phaeochromocytoma (11 cm) and the second was a large tuberculous adrenal with enlarged nodes. A 7 cm midline incision was made in the epigastrium towards the end of the procedure. The left hand of the operating surgeon was then inserted to snugly fit the incision at the wrist. The specimen was retrieved through the same incision. No special hand port device was employed as this part of the operation lasted for less than 10 minutes and the minimal gas leak was reduced by manually compressing around the incision. One woman with MEN 2A syndrome underwent single stage bilateral LA for phaeochromocytomas measuring more than 8.5 cm on each side. In her case, the specimens were retrieved through an infraumbilical

midline incision through the scar of previous tubectomy. In one of the patients with an 8 cm right-sided mass, a simultaneous laparoscopic cholecystectomy for calculus cholecystitis was performed. Eighty-three percent (5/6) of group II and 50% (4/8) of group I patients with phaeochromocytoma had intraoperative rise in blood pressure. Irrespective of their size, these could be managed easily. All the phaeochromocytomas had a fall in blood pressure irrespective of group or size following the removal of the tumour; this was managed by volume expansion. The overall complication rate in group II was 30% (3/10). This included intraoperative blood loss needing transfusion ($n = 1$), minor wound infection ($n = 1$) and pulmonary oedema ($n = 1$). Blood loss occurred in one patient with a tuberculous adrenal adherent to surrounding structures. One patient with phaeochromocytoma developed pulmonary oedema and needed postoperative ventilation for 8 hours. One patient with a large myelolipoma had a minor infection of the incision site through which the specimen

was retrieved. In group I, only two patients had minor complications of shoulder tip pain and subhepatic collection that resolved spontaneously.

In both groups, patients were ambulant, tube free and able to tolerate a fluid diet on the 1st postoperative day.

Discussion

Since the first description of the technique by Gagner et al³ in 1992, LA has become the gold standard procedure for all types of adrenal pathologies. The indications for adrenalectomy broadly include all functioning masses irrespective of size and nonfunctioning adrenal masses > 4 cm. The absolute contraindications for LA are large adrenocortical carcinomas with tumour invasion of adjacent structure, metastatic phaeochromocytomas to para-aortic lymph nodes, phaeochromocytomas during pregnancy, unacceptable cardiopulmonary disease and untreated bleeding diathesis.^{2,4} However, large size alone is not an absolute contraindication.²

Although a variety of laparoscopic approaches have been described, our experience has been exclusively with the anterolateral transperitoneal approach. This is also the most commonly practiced approach in most published series.⁵⁻⁷ We have found this approach advantageous because of the wide exposure obtained, especially for large lesions. Gravity also aids to keep mobilized viscera away from the field. In two cases, we were able to do additional intra-abdominal procedures (cholecystectomy and deroofting of renal cyst) at the same time. Although proponents of the retroperitoneal endoscopic adrenalectomy also claim advantages, the approach is not useful for large adrenal masses.⁷⁻⁹

To date, no consensus has been reached on the maximum lesion size that can be removed laparoscopically. Gagner⁴ reported removal of a 15 cm adrenal mass by LA. Adrenal masses > 6 cm are considered potentially malignant and in general have not been considered suitable for LA. Recent large series have reported successful outcomes with LA for large masses. Except anecdotally the upper limit for size has been 12 cm (Table 2).

The concerns with regard to LA for large lesions (> 6 cm) are the likelihood of lesions being malignant and the possibility of inadequate removal and inability to remove adjacent organs. An increased risk of local and distant recurrence has been described.¹⁰⁻¹² Analysis of results by various authors performing LA for known and suspected malignant adrenal masses has shown that local and systemic recurrences do occur, although no port site recurrence has been reported.^{13,14} Interestingly, with regard to the recurrence rate, laparoscopic resection offers short-term oncological results comparable to open surgery.¹⁴

Technically, LA for large masses needs adequate experience. In our series, we noted that with increasing experience, operating times continue to decrease. The mean operating time for the initial 20 adrenal units was 141.7 minutes as compared to the mean operating time of 98.9 minutes for the next 16 units (data not shown). In subsequent cases performed at our centre that are not included in this study, the operating time has further shortened, indicating that there is a definite learning curve for LA. Our series correlates with other series of LA for large masses which have reported a mean operating period of 129-205 minutes, blood loss of 100-400 mL and conversion rate of 0-11% mainly due to malignant invasion. The overall complication

Table 2. Laparoscopic adrenalectomy in large tumours

Study	n	Approach	Mean size (cm)	Operating time (min)	Blood loss (mL)	Conversions (%)	Complications (%)	Hospital stay (d)
Henry et al ⁹	19	LTA	7 (6-9)	N/A	N/A	11	0	N/A
Kazaryan et al ¹⁸	12	LTA	5.8 (3.5-11)	165	125	0	0	3
Valeri et al ¹³	6	LTA	2.5-6	160	260	0	0	4
Kebebew et al ¹⁴	23	LTA, REA	5.1 (1.5-12)	166	N/A	4	13	2.75
MacGillivray et al ¹⁵	12	LTA	8.2 (6-12)	190	100	0	42	2
Hobart et al ¹⁶	14	LTA, REA	8	205	400	14	21	2.4
Heinford et al ¹⁷	11	LTA, REA	5.9 (1.8-12)	181	138	9	9	2.3
This study	11	LTA	8 (6-11)	142.7	105.9	2 THA	30*	4.1

*One haemorrhage, pulmonary oedema and wound infection each. n = total number of patients; LTA = lateral transperitoneal approach; REA = retroperitoneal endoscopic adrenalectomy; N/A = data not available; THA = terminal hand assist. Note: Values in parentheses are the range.

rate was 0–42%.^{9,13–18} Although we had an overall complication rate of 30% in group II, it was only 9% in group I. This was not statistically significant using Fisher's exact test. Bleeding requiring transfusion occurred in a patient who had adhesions to surrounding structures. Terminal hand assist is an option to be kept in mind while performing LA for larger masses and was required in two patients in our series. There were no conversions to open surgery or mortality.

LA for large adrenal masses is safe and feasible. The lateral transperitoneal approach in such cases offers the advantage of wide exposure and large working space. This approach can be used to offer LA in a single stage to patients with large bilateral functioning masses; with increased experience, the mass size alone does not become the limiting factor. The maximum accepted size continues to be debated, although it seems prudent not to advocate LA for masses > 12 cm in view of the technical difficulty, longer operating time, increased blood loss, more complications and potential for malignancy with adjacent organ involvement. The employment of terminal hand assist as an option increases the effectiveness of LA for large and adherent adrenal masses.

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