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## *Laparoscopic Lateral Transabdominal Adrenalectomy for Small and Medium Sized Benign Functioning Adrenal Diseases*

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### **Abstract**

From October 1944 to December 2000, fifteen cases of benign functioning adrenal tumors successfully underwent laparoscopic lateral transabdominal adrenalectomies at Bangkok Metropolitan Administration (BMA) Medical College and Vajira Hospital. There were 10 women and 5 men. Their ages ranged from 30-52 years (mean  $38.5 \pm 5.42$  years). The mean size of tumors was  $2.8 \pm 1.45$  cm (range 1.3-6 cm), the mean weight of tumors was  $14.88 \pm 10.06$  gm (range 60 - 225 gm). Operative time in pheochromocytoma was not significantly longer than in aldosteronoma (147.5 vs 114.4 min,  $p > 0.05$ ); removal of left-sided adrenals, on average, was longer but not significantly (right : left = 126:131.5 min  $p > 0.05$ ). Mean estimate blood loss in pheochromocytoma was significantly more than in aldosteronoma (128.3 vs 73.3 ml  $p = 0.028$ ). There was no mortality, morbidity was encountered in only one case from specimen removal site hematoma and there was no conversion. The mean hospital stay was  $3.3 \pm 0.42$  days (range 2 - 5 days), time to return to work was  $8.3 \pm 1.6$  days (range 5 - 12 days). Laparoscopic lateral transabdominal adrenalectomy is safe and effective. It reduces both hospital stay and intraoperative blood loss and promotes earlier return to work. These factors suggest that this operation should become a standard procedure for small-sized and medium-sized benign adrenal diseases in the future.

The introduction of laparoscopic cholecystectomy in 1988 ushered in a new endoscopic surgical era of many other areas of abdominal surgery. The minimally invasive techniques has been worldwide accepted due to the advent of better instrumentation for dissection and hemostasis, improved video imaging, better

familiarity with endoscopic equipment, increasing patient awareness and demand for these procedures.<sup>1,10,11,13,14</sup> Since the first laparoscopic lateral transabdominal adrenalectomy was described by Gagner et al<sup>2,3,4,5,9,13,14</sup> and laparoscopic anterior transabdominal adrenalectomy by Petelin et al<sup>1</sup> in 1992,

Gagner's procedure has quickly been adopted and increasing numbers of these operations have been reported.<sup>9,13</sup> The difficulty in reaching the organ via open means makes resection of this gland particularly amenable to the laparoscopic approach.<sup>7,11,15</sup>

The reported benefits of laparoscopic adrenalectomy include decreased blood loss and less analgesic requirements, shorter hospital stay and recovery time. Yet, it is unlikely that prospective randomized controlled trials will ever be conducted, due to such prospective studies would be very prolonged, owing to the small number of patients with adrenal diseases.<sup>13</sup> The purpose of this study is to discuss our operative experience and outcomes with laparoscopic lateral transabdominal adrenalectomy.

## MATERIALS AND METHODS

From October 1994 to December 2000, fifteen consecutive patients, 5 men and 10 women, underwent laparoscopic lateral transabdominal adrenalectomy at BMA Medical College and Vajira Hospital. Their ages ranged from 30-52 years (mean  $38.5 \pm 5.42$ ). Five operations were carried out on the right adrenal gland and 10 on the left side. Complete endocrinological evaluations by biochemical hormonal studies and tumor localization by CT scan or MRI were performed preoperatively. Six patients with pheochromocytoma and hypertension were treated with alpha-adrenergic blockade (Prazocine 2-5 mg/d), calcium channel blocker (Nifedine 30-60 mg/d) and beta-adrenergic blockade in case of arrhythmia (10-120 mg/d). Eight patients with primary aldosteronism received aldosterone antagonist (Spironolactone 50-100 mg/d) for correction of hypokalemia.

No special consent form for the operation was used because this operation was considered to be the same as an open procedure but with a different approach. However patients were all informed of the possibility of a conversion to a laparotomy if necessary. Demographic data, preoperative pharmacologic blockade, type of tumor, size of tumor, operative time, blood loss, hospital stay, requirement of analgesics, intra- and post-operative complications, and time returning to work, were recorded.

Data are expressed as mean  $\pm$  SD for the continuous variables and 2-tailed student t-test is applied in comparison between the two groups.

## OPERATIVE TECHNIQUE

### *Laparoscopic right adrenalectomy (4 trocars)*

The patient is placed in the left lateral decubitus position with the right side up. The surgeon and assistant stand facing the anterior surface of the abdomen. The table is flexed and a rolled sheet is positioned under the axilla and the umbilicus. The right side should be hyperextended so that the space between the costal margin and the iliac crest is maximally exposed. The right arm is extended and suspended. The body area from umbilicus to the vertebral column and from the nipple to mid iliac crest should be prepped and draped. A 1 cm skin incision is made at 2 cm below and parallel to the costal margin and medial to the right anterior axillary line. A 10-mm Hasson trocar is inserted as an open technique and pneumoperitoneum is created with CO<sub>2</sub> insufflation to the pressure not more than 15 mmHg throughout the procedure. After inspection of the abdomen through a 30° laparoscope, three additional 10-mm trocars are required to perform the operation. The second trocar is inserted under direct vision via the right flank at the point inferior and slightly posterior to the tip of the 11th rib. The third and fourth trocars are placed more anteriorly with the most medial port being at the lateral border of rectus abdominis muscle. The fan-type liver retractor is inserted in the most anterior trocar to gently reflect the right hepatic lobe medially. The procedure begins with the laparoscope in the second trocar and the surgeon working through the two most lateral ports. The triangular ligament and the right lateral hepatic attachments are transected with ultrasonic scissors. If the adrenal mass is < 5 cm in diameter, early control of the right adrenal vein is feasible. The inferior adrenal portion is first mobilized using an ultrasonic scalpel. The dissection is continued medially and superiorly along the lateral edge of inferior vena cava (IVC). Careful dissection along the vena cava, the right adrenal vein will be encountered and can be clipped with medium-large titanium clips at least two on the vena cava side. As the dissection moves over the superior portion of the adrenal, small branches from the inferior phrenic vessels usually can be controlled with the ultrasonic scalpel. If the mass is > 5 cm in diameter, we prefer to dissect laterally and superiorly first and then continue caudally along the vana cava to reach the adrenal vein.

Once the mass is completely mobilized, the adrenal is placed into an endopouch and removed through the first trocar site by spreading the abdominal muscle with a Kelly clamp. The incision may need to be enlarged to facilitate removal of the lesion if it is > 4 cm. All incisions are closed with polyglycolic absorbable suture, size 2-0 for the fascia and 4-0 Nylon for the skin.

#### *Laparoscopic left adrenalectomy (3 trocars)*

For a laparoscopic left adrenalectomy, the patient is placed in the right lateral decubitus position (left side up) with the surgeon facing the patient's abdomen. Pneumoperitoneum is established in the same manner as described above. The initial incision is made for 1 cm long, at 2 cm below left costal margin and in the left anterior axillary line. After inspection of the abdomen through a 30° laparoscope, two additional 10-mm trocars are required to perform the operation. One is inserted at the point inferior and medial to the tip of the 11th rib. The other is at more anterior and medial to the initial trocar. The laparoscope is placed through the most anterior trocar. The working channels are the two lateral ports. Mobilization of the splenic flexure and spleen inferiorly and medially is required until it is close to the greater curvature of the stomach to expose the left kidney.

When the short gastric vessels are identified posteriorly, the dissection should be stopped. Once the spleen is fully mobilized, it will fall medially by gravity. The "golden yellow" adrenal gland in the dense perinephric fat will become visible in the superomedial aspect of the left kidney. The ultrasonic scalpel is used to dissect the adrenal gland from surrounding tissue. If tumor is < 5 cm in diameter, early attack and dividing the adrenal vein first is feasible. Left adrenal vein is dissected from the perinephric fat with a right angled instrument for a distance 1.5 to 2 cm and clipped with medium large titanium clips in the same manner as described for right adrenalectomy. After division of the vein, adrenal mobilization becomes much easier by grasping at the adherent perinephric fat, not at the capsule of the adrenal gland that will tear and bleed. The branches of left inferior phrenic vessels often are quite large and should be clipped when approaching the superomedial pole of the adrenal gland.<sup>11</sup> The left adrenal gland is removed from the peritoneal cavity in the same manner as

described above for right adrenalectomy.

## RESULTS

The demographic features of 15 patients who underwent laparoscopic lateral transabdominal adrenalectomy are shown in Table 1.

The overall mean operative time was  $127.7 \pm 49.24$  min (60-225 min). Mean operative time in pheochromocytoma was not significantly longer than in aldosteronoma and Cushing's adenoma (147.5 vs 114.4,  $p > 0.05$ ). Left adrenalectomy took longer time than right adrenalectomy but also not statistically significant (126 : 131.5,  $p > 0.05$ ). The overall mean blood loss was  $90 \pm 39.85$  ml (50 - 200 ml). Blood loss in pheochromocytoma was significantly more than in aldosteronoma and Cushing's adenoma (128.3 ml vs 73.3 ml,  $p = 0.028$ ) (Table 2).

Mean hospital stay was  $3.3 \pm 0.42$  days (2 - 5 days). All patients were able to take liquid diet in the evening of the same day of operation. Nine patients needed only 2-3 doses of oral analgesics (2 tablets of Paracetamol 500 mg/dose) on the first postoperative day. Two patients required two doses of 50 mg of Pethidine intramuscular injection on the first postoperative day. Four patients needed one dose of 50 mg of Pethidine intramuscular injection on the first postoperative day and two doses of oral analgesics on the second postoperative days. Mean time to return to work was

**Table 1** Demography of patients

Age (yr.)	$38.5 \pm 5.4$
range	30-52
Gender	
male	5
female	10
Body weight (Kg)	$58.6 \pm 10.6$
range	45-78
Site of adrenal	
right	5
left	10
Pathology	
Aldosteronoma	8
Pheochromocytoma	6
Cushing's adenoma	1
Size of tumor (cm)	$2.8 \pm 1.45$
range	1.3-6.0
Weight of tumor (gm)	$14.88 \pm 10.06$
range	5.0-40.0

**Table 2** Pathological details compare to operative time and blood loss.

	Patients (n)	Size (cm)	Weight (gm)	Operative time (min)	Blood loss (ml)
Pheochromocytoma	6	3	20	147.5**	128.3*
Aldosteronoma	8	2	11.3	106.3**	53.5*
Cushing's adenoma	1	1.8	8		

\* = statistically significant \*\* = statistically not significant

8.3 ± 1.6 days (5 - 12 days). There was no mortality and only one case of pheochromocytoma developed hematoma at the tumor removal site. There was no conversion to open surgery in this study. Significant improvement or cure of hypertension was seen in all 15 adrenalectomized patients at 1-2 months follow up.

## DISCUSSION

Our initial experience indicates that laparoscopic lateral transabdominal adrenalectomy is a safe and well-tolerated procedure for benign endocrine disorder affecting the adrenal gland. This concept and approach by allowing gravity to help with medial visceral rotation of the liver or the spleen<sup>11,15</sup> is now widely advocated.<sup>10,11,13,14</sup> In right adrenalectomy we still used four-port technique because it is necessary to use a 10 mm fan type retractor inserted in the most anterior trocar to reflect the right hepatic lobe of liver more medially for gaining exposure of the vena cava and the medial border of the right adrenal gland. In left adrenalectomy we use only three ports since it is not necessary to insert retractor to reflect the spleen medially because once the spleen is fully mobilized, it will fall medially by gravity and open the space leading toward the left adrenal gland. Debates exist on the limits of the size of adrenal tumor suitable for laparoscopic removal. Highly suspicious malignant adrenal tumor should not be considered for laparoscopic removal because the role of endoscopic approach of malignant adrenal tumor remains controversial.<sup>17</sup> Preoperative differentiation between benign and malignant adreno-cortical tumors does not appear relevant by high technological imaging because malignancy in Conn's syndrome is extremely rare. The cortisol-producing adrenal tumor of less than 6 cm in diameter is one in 10,000.<sup>18</sup> Preoperative CT scan, MRI and nuclear imaging with <sup>131</sup>I metaiodobenzyl-guanidine (MIBG) are unable to differentiate benign and malignant pheochromocytoma

since benign pheochromocytoma may also invade the adrenal capsule and veins. The size of pheochromocytoma is important and reliable in predicting the chance of malignancy. The smaller the tumor, the lower the risk of malignancy is. To date, many authorities have concluded that pheochromocytomas are not a contraindication for laparoscopic adrenalectomy especially the small (< 6 cm) and medium-sized (6-10 cm) tumors. Even if the pathological reports confirm of malignancy or raise the possibility of malignancy but histologically the tumor is confined to the gland, a laparoscopic removal that had not violated the principles of surgical oncology should be considered adequate.

In our series, we found that 14 cases of small-sized tumors (5 cases of pheochromocytomas, 8 cases of aldosteronomas and one Cushing's adenoma) and medium-sized pheochromocytoma (6-10 cm in diameter) all successfully underwent laparoscopic lateral transabdominal adrenalectomy. Their pathological reports were all benign. Thus, our experiences indicate that the benign small-sized (<6 cm in diameter)<sup>12</sup> and medium-sized tumours (6-10 cm in diameter)<sup>15</sup> are the indication for this approach. Although Gagner et al had reported resection of a 14 cm benign adrenal mass by this technique in his series, such a huge mass makes dissection difficult and time consuming due to the space available in this area is limited. Large masses always have unusually numerous retroperitoneal feeding vessels that require tedious dissection but the currently available new ultrasonic scalpel enables dissection more convenient and less intraoperative blood loss. Invasive adrenal carcinoma should be considered an absolute contraindication for laparoscopic approach<sup>11</sup> since more extensive en bloc resection of the adjacent organs may be required. Open approach is more appropriate for this condition.

When comparing the results of pheochromocytoma to cortical adenoma, we found that only

**Table 3** Comparing our series to published series dealing with laparoscopic adrenalectomy.

	Patients (n)	Operative (min)	Blood loss (ml)	Hospital stay (days)	Return to work (days)	Post op. complication (%)	Conversion rate (%)	Number of analgesic injection
Stoker et al. (Surg Endosc, 1995)	6	152 ± 26	82 ± 30	2.0 ± 0.6	-	0.17	0	-
Rotherford et al. (World J Surg, 1996)	67	123.9 ± 5.7	-	5.1 ± 0.2	-	0.10	-	-
Gagner et al (Ann Surg, 1997)	100	123	70	2.4	-	12	3	5.5
Thompson et al (Surg, 1997)	50	167	-	3.1	3.8	0	0	28
Jacobs et al (Ann Surg, 1997)	19	164 ± 107	109 ± 75	2.3 ± 0.9	-	0.05	0	-
Ting et al (Am of Surg, 1998)	12	160 (145-300)	50 (5-200)	3 (2-5)	11 (4-28)	0	0	0 (0-2)
Imai et al (Am of Surg, 1999)	40	147	40	12	-	-	-	3
*Our study	15	127.7 ± 49.24 (60-225)	90 ± 39.85 (50-200)	3.3 ± 0.42 (2-5)	8.3 ± 1.6 (5-12)	0.07	0	8

intraoperative blood loss in pheochromocytoma was significantly more than in both aldosteronoma and Cushing's adenoma ( $p = 0.028$ ). This is because not only the mean tumor size and weight in the former are greater but also the nature of pheochromocytoma itself is a highly vascular tumor (Table 2). Our results are comparable to the series reported in world literature (Table 3).

### CONCLUSION

Laparoscopic lateral transabdominal adrenalectomy is a safe and effective procedure that can reduce hospital stay, operative time, blood loss, pain, postoperative complications and promote earlier return to work. This approach, if increasingly popularized, should become a standard procedure for adrenalectomy in small-sized and medium-sized benign functioning adrenal tumors in the future. However, it is an absolute contraindication in invasive adrenal carcinoma.

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