

Laparoscopic Adrenalectomy in the Treatment of Pheochromocytoma: Comparison with Open Approach

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ABSTRACT

Purpose: To compare operative and postoperative parameters after laparoscopic and open surgery in the treatment of adrenal pheochromocytoma. Methods: Electronic and paper charts of 173 patients who underwent surgery for adrenal pheochromocytoma at our institution over a period of 17 years (Jan 1990 - May 2007) were reviewed. Perioperative parameters were compared in the two groups. Subgroup analyses were performed for 96 patients identified with lesions > 5 cm. Results: The two groups were similar in terms of age, sex, body mass index (BMI), and American Society of Anesthesiology (ASA) score. The tumors treated by open surgery (6.8 ± 3.9 cm) were larger than those treated by laparoscopy (4.5 ± 1.95 cm). Mean estimated blood loss (EBL) (801 vs. 140 ml), operating (OR) time (262 vs. 158.5 minutes), length of stay (LOS) in PACU (624 vs. 311 minutes), total hospital stay (184 vs. 67.5 hours), morphine requirement (488 vs. 53.5 mg), and time for complete convalescence (109 vs. 23 days) were significantly greater with open surgery. Post-operative complications were seen more often in the open group (25 vs. 20). In the subgroup with lesions > 5 cm, the two groups were similar in terms of age, sex, BMI, and ASA. Mean Blood loss (600 vs. 100 ml), OR time (277 vs. 172 minutes), LOS in PACU (10.9 vs. 6.3 hours), total hospital stay (7.6 vs. 2.9 days), morphine requirement (551 vs. 54 mg), and time for complete convalescence (94 vs. 14 days) were significantly greater with open surgery. Conclusions: Despite the tumor size, laparoscopic surgery is safe and effective in the treatment of adrenal pheochromocytoma due to the advantages of the minimal invasive surgery.

Key words: Adrenalectomy; Laparoscopy; Pheochromocytoma.

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INTRODUCTION

Since laparoscopic adrenalectomy (LA) was first described in 1992¹, several studies have been published depicting low morbidity in relation to it²⁻⁴. An important limitation to LA is associated to large tumors high risk of malignancy. However, numerous studies have supported that with necessary experience and knowledge LA may be an effective approach to treat large-volume adrenal masses⁵⁻⁶.

Pheochromocytomas are uncommon tumors that predominantly develop in the adrenal gland (90%). Most of them are benign (90%) and the standard treatment is surgical resection after patient's clinical control. Perioperative management of these tumors may

be complex due to arterial blood pressure fluctuation and cardiac arrhythmias. It was thought that high abdominal pressure caused by CO₂ insufflation during LA, as well as laparoscopic manipulation would be factors that would worsen these fluctuations. This was considered more pertinent to large tumors (> 5-6cm) as more complex dissection is necessary. However, several studies have suggested that this concern remains theoretical and that LA is safe and effective for the treatment of pheochromocytomas⁷⁻⁸.

A 17 years experience using surgical treatment for adrenal pheochromocytoma was demonstrated and intraoperative and follow-up parameters were compared between LA patients and open Adrenalectomy (OA) patients in our institution.

PATIENTS AND METHODS

Medical charts of 173 patients who underwent surgery for adrenal pheochromocytoma were reviewed at our institution over a period of 17 years (from January 1990 until May 2007). Laparoscopic Adrenalectomy was performed in 112 patients and open adrenalectomy in 61 patients.

Open adrenalectomy was performed by a variety of standard approaches, where five different surgeons used thoracoabdominal, chevron, subcostal or flank incision. The size of the incisions was not recorded. Transperitoneal⁹ or lateral retroperitoneal¹⁰ laparoscopic adrenalectomy was performed under the head surgeon supervision. After access was obtained, carbon dioxide insufflation pressure was maintained at 15mmHg. All efforts were accomplished to ligate early the main adrenal vein during LA and before adrenal gland manipulation.

Perioperative data recorded were age, sex, BMI, ASA, tumor size on computed tomography, perioperative systolic and diastolic blood pressure (mmHg) and perioperative medications. Intraoperative data include operative time, estimated blood loss, intraoperative hemodynamic and cardiac details, choice of surgical technique, resection of contiguous organs, intra and postoperative complications, postanesthesia care unit (PACU) length of stay, total length of hospital stay, anesthetic requirements and catecholamine levels in different intervals.

Follow-up data include final histopathology, length of convalescence, necessity of antihypertensive drugs, late complications and biochemical recurrence. Follow-up information was obtained either by telephone or medical charts. Perioperative and follow-up parameters were compared between the two groups. Subgroup analysis was done to patients with lesions ≥ 5 cm, so groups become similar in regard to tumor size.

Data are expressed as mean $\pm$ standard deviation (SD) or as median and variance. Comparison between the two groups and inside the groups was analyzed using Student's t-test, Mann-Whitney's U-test or ANOVA. P-value of $< 0,05$ was considered significant.

RESULTS

The two groups were similar in terms of age, sex, BMI and ASA (Table 1). Bilateral cases were

excluded from the statistical analysis of each group. Tumors treated by open surgery were larger than the ones treated by laparoscopy ($6,8 \pm 3,9$ vs. $4,5 \pm 1,95$ cm; $p=0,001$). The average EBL (801 vs. 140 ml; $p=0,0001$), operative time (262 vs 158,5 minutes; $p=0,0003$), PACU length of stay (10,4 vs. 5,18 hours; $p=0,001$), total length of hospital stay (7,6 vs 2,8 days; $p=0,001$), morphine requirement (488 vs. 53,5 mg; $p=0,01$) and total length of convalescence (109 vs 23 days; $p=0,001$) were significantly greater in the open surgery. Postoperative complications were more frequent for the open adrenalectomy group (17,8% vs. 32,8%; $p=0,003$).

In the subgroup with lesions > 5 cm (Table 2), the two groups were similar in terms of age, sex, BMI and ASA. Average EBL (600 vs. 100 ml; $p=0,0003$), Operative time (277 vs 158,5 minutes; $p=0,0001$), PACU length of stay (10,9 vs 6,3 hours; $p=0,006$), total length of hospital stay (7,6 vs. 2,9 days; $p=0,0003$), morphine requirement (551 vs. 54 mg; $p=0,00001$) and total length of convalescence (94 vs 14 days; $p=0,001$) were significantly greater in the open surgery. As well as in the general group, postoperative complications were more common for the open adrenalectomy group (47% vs 20%; $p=0,0008$).

The laparoscopic group complications were less serious, with adverse cardiac events without relevant sequelae in only four patients of the total series. At the beginning of our experience three conversions occurred (a large mass encroaching to the inferior vena cava, a firm mass with no distinct margins and one case associated to serious hypertension by pneumoperitoneum induction).

DISCUSSION

Currently, pheochromocytoma has been considered a contraindication to laparoscopic adrenalectomy, as well as malignant and bilateral tumors or lesions larger than 6 cm. However, recent data have depicted that, on the contrary, LA is a safe minimally invasive choice for the surgical treatment of pheochromocytoma.

The greatest open adrenalectomy morbidity is imputed to the necessity of a large incision to access the retroperitoneum and dissect the tumor with a minimal manipulation in order to avoid great fluctuations of the catecholamine levels. Laparoscopic Adrenalectomy has the advantage of minimal incision in addition to optical

Table 1 - Comparison between laparoscopic and open adrenalectomy for pheochromocytoma.

	Laparoscopic (n=112)	Open (n=61)	P value
Time interval	Feb 1996-May 2007	Jan 1990-Feb 2005	
Mean age (anos)	58,1 ± 12,5	49,9 ± 15,3	0,36
Man: Woman	57:55	23:38	0,14
Right: Left	59:53	34:27	0,18
Tumor size (cm)	4,5 (1,2-12) ± 1,95	6,8 (2-22) ± 3,9	0,001
Bilateral Adrenalectomy	3	3	0,44
Mean number of perioperative anti-hypertensive	1,0 ± 1,2 (0-4)	1,3 ± 0,9 (0-3)	0,17
Mean number of postoperative anti-hypertensive	0,3 ± 0,7 (0-3)	0,3 ± 0,7 (0-3)	1,0
Approach	- Retroperitoneal 45 - Transperitoneal 67	- Chevron 23 - Thoracoabdominal 11 - Subcostal 22 - Flank 5	N/A
Mean BMI	25,5 ± 5,8	30 ± 11,5	0,34
Mean ASA	3 ± 0,56	3 ± 0,5	0,71
Mean Blood loss (ml)	140 ± 173	801 ± 1004	0,0001
Mean Operative Time (min)	158,5 ± 55	262 ± 92	0,0003
Intraoperative Median of the number of vasodilators	1,0 (0-5)	1,0 (0-2)	0,61
Mean preoperative systolic arterial pressure			
Maximum	209 ± 45	181 ± 36	0,039
Minimum	83 ± 16	88 ± 15	0,03
Mean preoperative diastolic arterial pressure			
Maximum	105,5 ± 22	100 ± 23	0,64
Minimum	52,9 ± 11,3	47 ± 10,1	0,009
Mean intraoperative IV vol (cc)	3931,7 ± 1621,5	7114,5 ± 3802,5	0,04
Mean PACU time (min)	311 ± 188,5	624 ± 369	0,001
Mean hospital stay (hours)	67,5 ± 55	184 ± 62	0,001
Mean morphine requirement (mg)	53,5 ± 65	488 ± 607	0,001
Complications			
- Intraoperative	3 (0,27%)	2 (3,3%)	0,19
- Postoperative	20 (17,8%)	25 (41%)	0,003
- Late	1 (0,01%)	2 (3,3%)	0,16
Mean convalescence time	23 ± 25	109 ± 132	0,001
Nº.Recurrence	2	3	0,24
Nº.Malignant pheochromocytomas	2	3	0,24
Associated Syndromes	4	4	0,37
-MEN2a	1 (unilat)	2 (1 bilat, 1 unilat)	
-VHL	3 (unilat)	2 (1 bilat, 1 unilat)	

magnification and direct illumination of the operative field which is excellent for organs located in deep cavities such as the adrenal gland.

Even with a very careful preoperative management, there is a risk of secondary of obit which

may not be predicted due to hemodynamic changes and arrhythmia during pheochromocytoma surgery. Besides, pneumoperitoneum may induce hypertensive crises because of the abdominal pressure or hypercapnia. This is one of the greatest concerns

Table 2 - Comparison between laparoscopic and open adrenalectomy for pheochromocytoma = 5 cm.

	Laparoscopic (n=51)	Open (n=45)	P value
Length of time	Feb 1996-May 2007	Jan 1990-Feb 2005	-
Mean Age (year)	50,3 ± 13,9	49,8 ± 16,4	0,87
Mean tumor size	7 (5-12) ± 1,7	8,5 (5-22) ± 3,4	0,01
Median perioperative anti-hypertensive	1 (0-3)	1 (0-3)	0,89
Median postoperative anti-hypertensive	0,3 (0-2)	0,15 (0-2)	0,52
Mean BMI	29 ± 7,3	29,5 ± 11	0,74
Median blood loss (ml)	100 (10-1400)	600 (100-4500)	0,0003
Mean operative time (min)	172 ± 70	277 ± 91	0,0001
Median intraoperative vasodilators	1 (0-5)	1 (0-2)	0,64
Mean intraoperative systolic arterial pressure			
Maximum	194 ± 46	187 ± 39	0,48
Minimum	98 ± 14	88 ± 17	0,003
Mean intraoperative diastolic arterial pressure			
Maximum	102 ± 25	104 ± 26	0,75
Minimum	55 ± 10	45 ± 10	0,48
Men IV vol	3801,1 ± 1503,9	7908,6 ± 3913,4	0,04
Mean PACU time (hours)	6,3 ± 3,5	10,9 ± 6,4	0,006
Mean hospital stay (days)	2,9 ± 2,4	7,6 ± 2,7	0,0003
Mean morphine requirement (mg)	54 ± 47	551 ± 657	0,00001
Complications (%)			
- Intraoperative	2 (4%)	2 (4%)	0,89
- Postoperative	10 (20%)	21 (47%)	0,0008
- Late	1 (2%)	2 (4%)	0,49
Mean convalescence time	14,6 ± 11,8	94 ± 128	0,0001
Nº.Recurrence(%)	-	1	0,28
Nº.Malignant pheochromocytomas	2	3	0,54

during AL. However, recent studies have demonstrated that there are no significant hemodynamic differences between LA and OA¹¹. Toniato e cols.¹² evaluated the short-term and long-term outcomes of laparoscopic (n=40) versus open adrenalectomy (n=24) for pheochromocytomas. Advantages of the laparoscopic approach in regard to operating time, hospital stay, need for intensive care, intraoperative blood loss, intraoperative hypertension, postoperative analgesia, and return to oral nutrition were observed. The analysis of tumor size (=6 vs >6 cm) showed that none of the variables differed significantly, except for intraoperative blood loss, which was greater for the larger neoplasms. Our results also suggest that the size of the tumor does not affect the surgical outcome, as the subgroup analysis of tumor larger than 5 cm showed significant advantages of the laparoscopic approach.

Despite increased systolic and diastolic arterial pressure in the laparoscopic group (Table 1), only one patient developed cardiovascular complications in this group.

Partial bilateral adrenalectomy data were excluded from this analysis to avoid confusion; however, it should be emphasized that it is a feasible technique through laparoscopic approach.

LA for malignant tumors remains controversial. In our study, there were two malignant pheochromocytoma in the LA group and three in the OA group, which demonstrate the feasibility of both approaches. The number of patients, however, is small.

There are contraindications for laparoscopic adrenalectomy; therefore the open technique is recommended for pheochromocytomas encroached to the great vessels and larger than 12cm. Thus, we emphasize LA importance and feasibility to the

majority of our patients due to several advantages demonstrated in this series, such as less operative time, less blood loss, shorter PACU length of stay, less anesthetic requirements, shorter hospital stay, less postoperative complications and faster convalescence.

This study limitation is inherent to its retrospective comparison; however, it demonstrates based on a great number of patients the safety and advantage of the laparoscopic approach for pheochromocytoma.

CONCLUSION

Laparoscopic surgery is safe and efficacious for adrenal pheochromocytoma larger than 12cm, it has been considered as a therapeutic choice for these tumors.

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