

Laparoscopic Transabdominal Adrenalectomy for Pheochromocytoma Comparison with Conventional Open Adrenalectomy

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Abstract: The aim of this study, was to evaluate the results of Laparoscopic Transabdominal Adrenalectomy (LTA) with that Conventionally Open Adrenalectomy (COA) in the treatment of adrenal pheochromocytoma. The medical, operative and pathological records of 20 patients with pheochromocytoma were reviewed at Sina hospital, Tabriz medical university in north west of Iran from march of 2000 to December of 2006. Among the patients (11 male, 9 female) who underwent surgical removal, 10 patients underwent complete trans abdominal laparoscopic adrenalectomy and 10 patients operated unilateral transabdominal open adrenalectomy. Mean age of LTA and COA were 36.0 ± 13.7 and 42.3 ± 15.2 , respectively. Mean size of tumor in LA was 3.8 ± 0.77 cm and in COA was 5.8 ± 3.1 cm. In all cases there was a solid unilateral adrenal tumor, L/R localization of tumor in LTA was 5/5 and in COA was 4/6. No conversion occurred in LTA group. The two groups were comparable about age, sex, BMI. The size of the tumors in Laparoscopic groups was smaller than conventionally open group. The operative time in Laparoscopic group was longer than the open group (172.5 ± 19.18 vs 126.5 ± 27.8 , $p < 0.05$). Intraoperative cardiovascular instability was found in both groups of patients. Five patients (50%) in COA and four patients (40%) in LTA. The mean post operative length of hospital stay in LTA was seen 3.9 ± 1.2 (2-5) days significantly lesser than the COA which was 5.7 ± 1.7 (4-9) days ($p < 0.001$). Laparoscopic adrenalectomy is a safe, effective, useful and feasible procedure in most selected patients with pheochromocytoma providing the benefits of excellent results.

Key words: Adrenalectomy, pheochromocytoma, laparoscopy, LTA, COA

INTRODUCTION

With advances in video endoscopic technology have made it possible wide spread use of laparoscopy to remove solid organs such as adrenal gland. Laparoscopic Adrenalectomy (LA) was originally described by Gagner *et al.* (1992). Since then a plenty of adrenalectomies performed. Several studies have shown efficacy of laparoscopic approach in the surgical treatment of adrenal disorders, also found that the morbidity of laparoscopic adrenalectomy is lower than that of conventionally open adrenalectomy (Ichikawa *et al.*, 2000). Simforoosh *et al.* (2004) reported the first experiment of laparoscopic adrenalectomy in Iran. This study showed that transperitoneal adrenalectomy was an effective and safe approach in the treatment of adrenal masses with the least morbidity. Last decade the role of LA for pheochromocytoma become more important and sometimes it is the gold standard treatment (Gagner *et al.*, 1997). However, laparoscopic adrenalectomy has not been universally accepted as

appropriate for the resection of pheochromocytoma and it has been the subject of studies and controversies. One concern regarding a Laparoscopic approach for pheochromocytoma is anticipated technical difficulty. It has been speculated that increased pressure as the induction of pneumoperitoneum would accelerate release of catecholamines (Joris *et al.*, 1993). But on the other hand careful Laparoscopic manipulation of the tumor may reduce the release adrenergic substances achieving better cardiovascular stability.

The potential benefits of LA include shorter hospital stay with minimal morbidity, a more rapid post operative recovery and early return preoperative activities (Zeh and Udelsman, 2003). Laparoscopic and open surgical adrenalectomies have been compared in several reports (Sprung *et al.*, 2000; Inabnet *et al.*, 2000).

Since 2000, we have performed more than 10 laparoscopic adrenalectomies and 12 open adrenalectomy for pheochromocytoma at Sina hospital, Tabriz medical University. The aim of the present retrospective study was to evaluate the frequency of hemodynamic instability

during operation, post operative hospital stay and complications of Laparoscopic Transperitoneal Adrenalectomy (LTA) and Conventionally Open Adrenalectomy (COA) for pheochromocytoma.

MATERIALS AND METHODS

A total of 22 patients with pheochromocytoma referred to surgery department, Sina hospital of the medical university of Tabriz between march 2000 and December 2006 were considered for this study.

Data were collected in a retrospective manner in all patients by review of medical records, including the anaesthesia records, pathology reports operative notes. 10 patients underwent complete transabdominal laparoscopic adrenalectomy and 10 patients operated unilateral trans abdominal open adrenalectomy. Two patient with adrenal mass greater than 12 centimetre suspected for carcinoma excluded this study. Exclusion criteria for LTA group were: adrenal gland mass with a diameter >6 cm²) high risk patients who, due to their poor general condition, would not tolerate the pneumopritoneum. The following data were analyzed: demographics, including age and gender; tumor characteristics, size and site; operative factors, surgical time and cardiovascular instability; outcome, complications and hospital stay. The LTA group consisted of 5 male and female patients with a mean age of 36.0±13.7 years (range 14-55). The COA group consisted of 6 male and 4 female patients whose mean age was 42.3±15.2 years (23-75). The mean BMI in LTA group was 24.7±2.3 and 26.2±1.7 in COA group as shown in Table 1.

The patients were informed of technical aspects of the Laparoscopic access, the potential complications and the possible need for conversion to open surgery.

All patients in both groups were comprehensively examined by endocrinologists. They had a complete preoperative endocrinologic work up and biochemical screening, including measurement of catecholamine metabolite concentration in plasma and imaging study with CT Scan. They received preoperative α-adrenergic blockade (phenoxybenzamine) at least for ten days before operation. Beta-adrenergic blockade with propranolol for tachydysrhythmia was administered to one patient in LTA and two patients in COA group.

The Laparoscopic adrenalectomy was performed by trans abdominal approach with the patients placed in lateral decubitus position. Three Trocars were used for left sided resections and 4 Trocars for right sided ones. Access to peritoneal cavity was obtained initially through a one centimetre transverse incision placed in mid

Table 1: Patients' characteristics

	Laparoscopic group (LTA) (N = 10)	Open group (COA) (N = 10)	P value
Sex F/M	5/5	4/6	0.500
Age (Mean±SD years)	36.0±13.7	42.3±15.2	0.343
(range)	(14-55)	(23-75)	(0.492)*
Localization L/R	5/5	4/6	0.500
Mass size (mean±SD)	3.8±0.77	5.8±3.1	0.077**
(Range)	(2.8-4.8)	(3-12)	(0.064)*
Body mass index(kg m ⁻²)	24.7±2.3	26.2±1.7	0.124
(Range)	(21.1-28.4)	(22.3-28.3)	(0.143)*

*Numbers in parenthesis was calculated using Mann-Whitney non-parametric test. **Equal variances not assumed

Clavicular line slightly above umbilicus, with using open technique a 10-12. Trocar is placed into abdominal cavity the abdomen is insufflated with carbon dioxide to a pressure between 8-10 mmHg and camera inserted. Two 10-12 additional. Trocar in left side, are placed one each in 5 to 10 centimetre distance of camera Trocar approximately two finger breaths below the costal margin. On the right side a 4th Trocar was inserted just below the costal margin lateral or medial to the rectus abdominis muscle.

The major adrenal vein was localized and secured first before mobilizing the tumor. Dissection was performed by using electrocautery or harmonic scalpel and tumor was removed in the endoscopic bag through one of the port sites. The retroperitoneal space was examined for any evidence of bleeding.

Open surgery was performed through transabdominal approach with using of transverse incision just below costal margin or midline incision. Patients were placed in supine position. In most cases adrenal vein was localized and secured before mobilizing tumor.

The following pre-operative parameters were compared in the two groups: cardiovascular instability, operative time. To evaluate cardiovascular instability during operation, an increase in systolic blood pressure more than 200 mmHg and decrease in systolic blood pressure less than 80 mmHg considered cardiovascular instability and a heart rate of more than 100 per minutes was defined as tachyarrhythmia episode. The surgical time was defined as the time of the initial skin incision to complete of skin closure. Length of hospital stay was considered as the number of days in hospital after the operative procedure. Data are expressed as mean plus or minus standard deviation. Statistical analysis were performed. In order to compare groups, the chi-square or Fisher exact test and the independent sample t-test were used for Categorical and numerical variables, respectively. In all cases of using t-test, Levene's Test for Equality of Variances was done. All of the numerical variables comparisons repeated with Mann-Whitney test as a non-parametric test in assumption that the variables' distribution is not normal because of low number of the

cases All statistical tests are two-tailed and were performed by SPSS® (version 13.5) statistical software.

RESULTS

In Laparoscopic patients all tumors were successfully removed. No Laparoscopic adrenalectomies were converted to open procedure.

Although conventionally open group of patients were slightly older than the patients underwent Laparoscopic adrenalectomy, the two groups were comparable about age, sex, BMI. The size of the tumors in Laparoscopic groups was smaller than conventionally open group.

Intraoperative bleeding in Laparoscopic group was not significant and non of patients needed intraoperative blood transfusions, but in open group, two patients required a transfusion of four units of packed red blood cells and in one patient because of bleeding nephrectomy was done. The operative time in Laparoscopic group was longer than the open group. The Laparoscopic procedures required surgical time between 140 and 195 min with mean time 172±19.8, it was significantly longer than the time needed to performed the conventional adrenalectomies. The time of operation in open group lasted between 115 and 160 min and mean time 140±14. There was observed significant difference in operative time between two groups. There was no correlation between operative time and tumor size in two groups.

For Laparoscopic adrenalectomy operative time had a relation with learning curve. Last two operation times were considerably shorter (145, 140 min) than the first one (195 min). There was no significant difference in surgical time of Laparoscopic adrenalectomy between the tumors on the right side in compare with the tumors located on the left side as shown in Table 2.

Intraoperative cardiovascular instability was found in both groups of patients. In 5 patients (50%) in conventional open group and in four patients (40%) in LG.

The mean of instability of cardiovascular in LTA was 1.2±1.55 and in COA was 2.3±2.8 no significant difference was found as shown in Table 2. In almost all patients, hypertension was controlled with Nitro-glycerine drip and β blockade administration.

Most hypertension episodes were of short duration, only one patient with a large mass had longer lasting episodes of hypertension (>3-5 min) preoperatively. We couldn't find any relation between size of tumor and preoperative hypertension crisis.

The mean post operative length of hospital stay in LTA was seen 3.9±1.2 (2-5) days significantly lesser than the COA which was 5.7±1.7 (4-9) days (p<0.001) Table 2.

Post operative complication was seen in only one patient underwent Laparoscopic procedure, this was one case of pneumothorax after operation who recovered after insertion of chest tube. In COA one wound infection and one case of pneumonia were found.

DISCUSSION

In 1992, laparoscopic adrenalectomy was first described by Gagner *et al.* (1993) in three patients. A larger series validated the application of minimally invasive surgical techniques for the removal adrenal glands (Assalia and Gagner, 2004).

Pheochromocytoma has also been approached Laparoscopic ally since 1992 (Assalia and Gagner, 2004), but there were doubts concerning the safety of the procedure in light of alterations observed the CO₂ insufflation.

However, with increasing experience, it has been verified that the metabolic and homodynamic alterations (hypercapnia, respiratory acidosis, decreased cardiac index) observed are of small importance and do not augment the risk in Laparoscopic surgery. These problems can be reduced if managed by careful anesthetic maintenance including increased minute ventilation, low pressure pneumopritoneum 8-10 mmHg. Laparoscopic surgery can be safer than conventionally open adrenalectomy, meaning avoiding the main risk factors of procedure by controlling the adrenal vein at the beginning and doing minimal manipulation of tumor. In our opinion dissection and occlusion of the adrenal vein should be performed before the manipulation of the gland. Pre-operative preparation with α blocker, in our preference phenoxybenzamin, pre-operative hyperhydration and rigorous hemodynamic control in surgery room are the main factors determining the success of the procedure, open or Laparoscopic.

One of important characteristic of pheochromocytoma is that they may be multifocal and even

Table 2: Pre- and postoperative data

	Laparoscopic (N = 10)	Open (N = 10)	P value
Operative time (min)			
Total	172.5±19.18	155.50±17.23	0.052(0.001)*
Left adrenalectomy	166.00±22.75	166.25±20.16	0.987(0.444)*
Right adrenalectomy	179.00±14.32	148.33±11.70	0.005(0.004)*
No of intraoperative instability	1.2±1.55	2.3±2.8	0.294(0.147)*
Blood loss			
Non-significant	10	8	0.237
Needs transfusion	0	2	
Total no of complications	1	2	0.152
Hospital stay(day)	3.9±1.3	5.7±1.7	0.016(0.001)*

*Numbers in parenthesis was calculated using Mann-Whitney non-parametric test

bilaterally positioned. In Laparoscopic approach, only unilaterally examination can be possible and due to this all patients in our report were preoperatively examined for synchronous tumors by CT scan. These examinations will, in most cases, reveal the occurrence of any bilateral pheochromocytoma.

We chose transperitoneal anterior access for Laparoscopic approach. The choice we made for transperitoneal approach, instead of the extra peritoneal access, is due to two facts: first, our greater familiarity with the transperitoneal approach, second, the greater ease of obtaining control over the adrenal vein in the beginning of the procedure, a task that is more troublesome in extra peritoneal approach (Lezoche *et al.*, 2000, 2002; Gasman *et al.*, 1998). To ligate the adrenal vein early in the Laparoscopic procedure and to minimize manipulation of tumor, a transperitoneal approach is recommended (Janetsche and Neumann, 2001). Sprung *et al.* (2000) compared the outcomes of Laparoscopic adrenalectomies to open ones and he found Laparoscopy was superior in surgical time; blood loss and hospital stay. Inabnet *et al.* (2000) compared 11 Laparoscopic adrenalectomies to 11 transperitoneal open adrenalectomies, and showed that both procedures resulted in similar incidence of hypertensive crisis (>200 mmHg), although a greater increase in the mean arterial pressure, central venous pressure and pulmonary capillary wedge pressure were found in the laparoscopic group. On the other hand, Edwin *et al.* (2001) reported a lower incidence of the greater one third increase in systolic blood pressure during Laparoscopic adrenalectomies as compared to open surgery for pheochromocytoma. In our experience lower incidence of hypertension and tachycardia were found as compared to open surgery. Sprung *et al.* (2000) reported that laparoscopic patients experienced less severe hypotension than open surgical patients, although the highest Intraoperative blood pressures and the number of hypertensive episodes were similar for both groups. It is likely that Laparoscopic adrenalectomies result in similar or milder hemodynamic changes as compared to open surgical procedures for pheochromocytoma.

In comparing the outcomes of our Laparoscopic adrenalectomies on 10 patients to those of 10 open adrenalectomies performed for pheochromocytomas Laparoscopy was superior but not significant differences statistically with regard to cardiovascular instability, blood loss, but surgical time in Laparoscopy is longer than open adrenalectomies (172.5±19.18 vs 126.5±27.8). Surgical time had no relation with tumor size, positional side of tumor. After performing more Laparoscopic adrenalectomy the operation time and complication

rate in Laparoscopy reduced (based on learning curve) (Eto *et al.*, 2006; Goitein *et al.*, 2004). We considered that the operation time in LTA for pheochromocytomas seem to be more dependent upon to learning curve of operators but Masatoshi *et al.* (2006) reported deferent idea and he showed operation time in laparoscopic adrenalectomy was more dependent on the feature of tumor than learning curve.

The complication rates of Laparoscopic adrenalectomies for pheochromocytomas range from 0-20 % in the literatures. Gagner *et al.* (1997) reported that 60% of the complications experienced in 100 consecutive Laparoscopic adrenalectomies occurred in 25 pheochromocytoma patients.

No major complications due to catecholamine releases during operations have been occurred between two groups of our patients.

In our experience, after operation we had only one complication in LTA and two non major complications in open group.

We didn't have conversion of Laparoscopy to open surgery. In Laparoscopic adrenalectomies the incidence of conversion to open surgery in a large series of patients after review of articles by Mastuda *et al.* (2002) was 4% among 227 patients for pheochromocytoma. In reports of over 100 Laparoscopic adrenalectomies conversion to open surgery was necessary not only for pheochromocytomas but also for other adrenal tumors and the conversion rate range from 1-5% (Gagner *et al.*, 1997). These results support the idea that the technical demand of a Laparoscopic adrenalectomy for pheochromocytomas is similar or slightly higher than that for other adrenal tumors.

Average length of hospital stay for laparoscopic adrenalectomy is significantly lesser than conventionally open adrenalectomy reported by several authors (Gagner *et al.*, 1997; Bonjer *et al.*, 2000; Toniato *et al.*, 2007). We found a significant difference in hospital stay after operation between the laparoscopic and conventional open groups, the mean hospital stay of LTA significantly is shorter than conventionally open group (3.9±1.3 vs 5.7±1.9, p<0.001).

CONCLUSION

Laparoscopic approaches for pheochromocytoma provide more hemodynamic stability than open surgery. With preoperative use of Modern imaging modalities, extensive abdominal exploration in these patients is obsolete. It should be emphasized that the prerequisite for an uncomplicated intra-and postoperative course is an experienced team, because pheochromocytomas are

relatively rare tumors, Laparoscopic adrenalectomy should remain an operation that is performed in centers with endocrine specialists and expert Laparoscopic team. Finally we have observed that Laparoscopic adrenalectomy is a safe, effective and useful procedure in most selected patients with pheochromocytoma providing the benefits, less morbidity, shorter hospital stay.

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