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A comparison of open vs laparoscopic adrenalectomy

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Abstract

Background: To compare the outcome of patients who underwent laparoscopic transabdominal adrenalectomy (LA) with those who had open adrenalectomy (OA).

Methods: A retrospective review of consecutive adrenalectomies performed by a single surgical team at a university hospital. Outcome measurements were operative time, operative blood loss, procedure-related complications, postoperative stay, and return to regular activity.

Results: Twenty-nine adrenalectomies were done in 23 patients during a 54-month period. There were 12 OAs performed in nine patients and 17 LAs were done in 14 patients. Both groups were similar in their demographics and their indications for operation. All attempted LAs were successfully completed. The mean operative time was longer for LA than for OA (289 vs 201 min; $p = 0.042$). Resumption of oral intake (1.0 vs 3.0 days; $p = 0.002$), postoperative hospital stay (3.0 vs 7.9 days; $p = 0.002$), and return to regular activity (8.9 vs 14.6 days; $p = 0.002$) were significantly shorter after LA than after OA. There were no postoperative deaths and there was no difference in operative blood loss between the two groups. Procedure-related complications occurred in three patients having LA and in five patients having OA.

Conclusions: Patients having LA had longer operative procedures but shorter hospital stays and faster return to normal activity than patients having OA. Procedure-related complications for LA were due to bleeding into the retroperitoneum or abdominal wall. Significant postoperative cardiac and respiratory complications occurred only in the OA group.

Key words: Adrenal gland — Adrenalectomy — Laparoscopy

The technologic improvements in laparoscopic equipment coupled with the improved skills of laparoscopic surgeons and the desire of patients to have less traumatic and disfiguring operations have extended the applications of minimally invasive operative techniques. Gagner et al. [3] demonstrated that laparoscopic resection of the adrenal gland was feasible. Subsequently, other investigators [1, 2, 4–8, 10, 11, 13–15] have confirmed that laparoscopic adrenalectomy can be performed reliably and safely. However, laparoscopic adrenalectomy, as with other advanced minimally invasive procedures, has been advocated and adopted prior to confirmation, in clinical trials, of its proposed advantages over traditional open procedures. Before laparoscopic adrenalectomy can be accepted as a standard procedure, the outcome of the laparoscopic approach must be examined by comparison to open adrenalectomy. Ideally, a comparison of laparoscopic to open adrenalectomy should be done in a prospective randomized trial. However, few centers have a sufficient number of patients requiring adrenalectomy to make such a study practical. Herein we present our results examining the outcome, in a consecutive series of patients, of laparoscopic vs open adrenalectomy.

Materials and methods

Twenty-nine adrenalectomies were performed in 23 consecutive patients over a 54-month period. From June 1991 to July 1993, 12 open adrenalectomies (OAs) were performed in nine patients. Beginning in September 1993 all patients referred for adrenalectomy were offered the option of open or laparoscopic adrenalectomy (LA). All patients chose the laparoscopic approach and 17 LAs were performed in 14 patients. All OAs were done by the same surgeon and all LAs were performed by a single surgical team. Preoperative endocrine evaluations were performed or reviewed by the same endocrinologist.

The patient characteristics (Table 1) and indications for operation (Table 2) were similar in both groups. In the OA group an anterior approach was used in five patients (three patients unilateral and two patients bilateral adrenalectomy), and a posterior approach was used in four patients (three patients unilateral and one patient bilateral adrenalectomy). The anterior approach was used in three patients who were judged to have contraindications for posterior adrenalectomy. These patients had a pheochromocytoma, prior nephrectomy on the side requiring adrenalectomy, and multiple back operations with chronic back pain. In addition, two patients had open anterior approaches so that concomitant procedures

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Table 1. Characteristics of patients who had adrenalectomy

	Open	Laparoscopic
Number of patients	9	14
Number of adrenalectomies	12	17
left	5	7
right	1	4
bilateral	3	3
Mean age, years (range)	56 (34–73)	57 (45–75)
Male/female	3/6	5/9
Prior abdominal surgery	5	8

Table 2. Indications for adrenalectomy

Diagnosis	Open	Laparoscopic
Aldosteronoma	3	7
Cushing's syndrome	4	4
Nonfunctional adenoma	1	2
Pheochromocytoma	1	1

could be done at the time of adrenalectomy. One patient had symptomatic cholelithiasis and had simultaneous right adrenalectomy and cholecystectomy. Another patient had Cushing's syndrome due to metastatic gastrinoma producing adrenocorticotropic hormone (ACTH), had a parietal cell vagectomy to help control Zollinger-Ellison syndrome, and had bilateral adrenalectomies. In the two patients having multiple operative procedures the time required to complete the adrenalectomies was recorded separately from the total operative time.

All LAs were performed using a transperitoneal approach in the lateral decubitus position. For most patients, initial peritoneal access was gained using a supraumbilical incision with the patient in the supine position. After completing a laparoscopic survey of the abdominal cavity the scope was removed and the supraumbilical port was covered with a sterile occlusive dressing. The patients were then placed in the lateral decubitus position, the operating table was flexed, and the patient's flank and back were prepped and draped. Pneumoperitoneum was reestablished and four or five 11-mm trocars were placed along the costal margin and flank. In last two patients, pneumoperitoneum was achieved using a Veress needle with the patients in the lateral decubitus position.

For right LA the right lobe of the liver, the hepatic flexure of the colon, and the duodenum were reflected medially and the inferior vena cava was identified. Dissection proceeded cephalad along the vena cava until the right adrenal vein was identified. The right adrenal vein was then dissected and double clipped proximally and distally before being divided. The medial and superior margins of the right adrenal gland were then carefully dissected with electrocautery. Vessels that were encountered were clipped before being divided. The lateral and inferior attachments of the adrenal gland were the last to be divided.

For left LA the splenic flexure of the colon was reflected medially. The lateral attachments of the spleen were then divided and the spleen and pancreatic tail were reflected medially. The left renal hilum was located and the left adrenal vein was dissected and double clipped proximally and distally before being divided. Circumferential dissection of the left adrenal gland was the done in a manner similar to that described for right LA. Both 0° and 30° laparoscopes were used as needed. The adrenal glands were placed in a sterile plastic bag and extracted through the flank trocar incision. Extraction of the adrenal glands usually required a slight extension of the skin incision and gentle finger dissection to split the flank muscles. The fascia of all trocar sites was closed with absorbable sutures. Drains were not used and patients were allowed to resume oral intake and to ambulate when they felt they were ready.

A retrospective review was done comparing the outcome of patients who had LA compared to those who had OA. The study was approved by the Institutional Review Board at The University of Connecticut Health Center. Data collection was obtained by reviewing hospital and office records and by personal and telephone interviews. Outcome measurements examined were operative times, operative blood loss, procedure complications, resumption of oral intake, postoperative hospital stay, and return to regular activity. Statistical analysis was performed using the Student's *t*-test for unpaired data, and a p value of less than 0.05 was considered to represent a significant difference in outcome measurements.

Results

All adrenalectomies were successfully completed. None of the laparoscopic approaches required conversion to an open procedure and all adrenal glands removed were intact. The patient characteristics (Table 1) and indications for adrenalectomy (Table 2) were similar in the open and laparoscopic groups. Table 3 shows the outcome measurements observed in both groups. For the entire study group, including unilateral and bilateral procedures, patients who underwent LAs had longer operative times than those who had OAs (289 vs 201 min; $p = 0.042$). However, the laparoscopic group had a faster postoperative recovery than the open group, as measured by a resumption of oral intake (1.0 vs 3.0 days; $p = 0.002$), postoperative hospital stay (3.0 vs 7.9 days; $p = 0.002$), and return to regular activity (8.9 vs 14.6 days; $p = 0.002$). Operative blood loss was similar in both groups.

For patients who had unilateral adrenalectomies, the laparoscopic group had longer operative procedures (258 vs 166 min; $p = 0.006$), but they were able to tolerate oral intake sooner (1.0 vs 2.8 days; $p = 0.013$) and had shorter postoperative hospital stays (2.4 vs 5.7 days; $p = 0.001$) than did patients having open procedures. Patients having unilateral LAs were also able to resume regular activities sooner than those who had unilateral OAs (7.6 vs 11.6 days; $p = 0.017$).

Bilateral adrenalectomies were performed in three patients in each group. Again, patients having laparoscopic procedures had longer operations (402 vs 270 min; $p = 0.289$) and a trend toward faster recovery compared to the open group: They more quickly resumed oral intake (1.0 vs 3.3 days; $p = 0.155$) and normal activity (13.7 vs 19.3 days; $p = 0.004$) and had a shorter postoperative hospital stay (5.3 vs 12.0 days; $p = 0.134$). However, because of the small number of patients having bilateral procedures, significant differences were not reached on statistical analysis.

Procedure-related complications occurred in five patients (56%) who had OAs (Table 4). Two patients had significant atelectasis, with elevated temperatures, and required intensive respiratory therapy. One patient required prolonged intubation, necessitating admission to the intensive care unit. One patient developed postoperative congestive heart failure, and another patient had an episode of postoperative hypotension that required transfer to the intensive care unit to rule out myocardial infarction. In the LA group, procedure-related complications occurred in three patients (21%). One patient developed a retroperitoneal hematoma (documented by computed tomography), which caused flank and back pain and prolonged return to normal activity but did not require a blood transfusion. Another patient had an abdominal wall hematoma and received a transfusion of two units of autologous blood. The third patient developed cellulitis at one of the trocar sites that resolved with oral antibiotics. None of the patients in the laparoscopic group had postoperative pulmonary or cardiac complications. There were no perioperative deaths in either the laparoscopic or open adrenalectomy groups.

Table 3. Comparison of outcome measurements: open vs laparoscopic adrenalectomy

	Open mean (±SD)	Laparoscopic mean (±SD)	*p* value
Operative time (min)	201 (108)	289 (86)	0.042
First oral intake (days)	3.0 (2.1)	1.0 (0.4)	0.002
Hospital stay (days)	7.9 (4.9)	3.0 (1.6)	0.002
Return to regular activity (days)	14.6 (4.9)	8.9 (3.7)	0.002
Blood loss (ml)	500 (574)	198 (144)	0.072

Discussion

A variety of operative approaches can be used for resection of the adrenal glands. The open approaches most often used for adrenalectomy utilize an anterior abdominal incision, a flank or posterior incision with resection of a rib, or a thoracoabdominal incision. The choice of operative approach is determined by a combination of the adrenal pathology, the patient's condition, and the surgeon's experience. Regardless of the method chosen for open adrenalectomy, the deep location of the adrenal glands, their fragile capsule, and their proximity to surrounding viscera and vessels require that a long incision be used to obtain adequate exposure for safe removal of the glands.

Gagner et al. [3] introduced the laparoscopic approach as another method for adrenal resection. Other investigators [1, 2, 4–8, 10, 11, 13–15] have confirmed the feasibility and safety of laparoscopic adrenalectomy. There have been other reports [1, 8, 10, 11, 15] comparing the results of laparoscopic with open adrenalectomy. The findings of these studies are similar to our results demonstrating longer operative times but a faster postoperative recovery and no increase in complication rates for patients having LA compared to OA. In our study the advantage of LA over OA was demonstrated by an earlier resumption of oral intake, a shorter postoperative hospital stay, and a faster return to regular activity. Others have also shown that patients undergoing LA require less postoperative pain medication and ambulate sooner than patients having OA [8, 10, 11, 15].

Adrenalectomy may be required for many different pathologic conditions affecting the adrenal glands. Our experience demonstrates that the laparoscopic approach is applicable to the wide variety of benign adrenal diseases. The laparoscopic approach is particularly well suited for patients with small unilateral adrenal adenomas producing aldosterone or cortisol. In these cases the adrenal tumor is reliably benign, localized, and does not invade surrounding structures. In addition, the small size of the adrenal lesion does not distort anatomic landmarks and allows for easy extraction of the adrenal gland through a trocar-port incision. The optical magnification provided by laparoscopy allows for meticulous dissection and control of the adrenal vessels with minimal trauma to the surrounding tissues.

Bilateral LA utilizing the flank approach is a more cumbersome and time-consuming endeavor than unilateral LA because repositioning and repreping of the patient is required. Although the published experience for bilateral LA is limited [2, 4], our experience indicates that bilateral LA is feasible and well tolerated in patients with ACTH-dependent Cushing's syndrome. Our patients undergoing bilateral LAs showed a trend toward a faster postoperative recovery, for all outcome parameters, than did patients who had open bilateral adrenal resections.

The appropriateness of LA in patients with pheochromocytoma is more controversial than for other adrenal lesions. Anterior transabdominal exploration has been the traditional approach used in patients with pheochromocytoma because it allows for the evaluation and management of potentially bilateral, extra-adrenal, and malignant disease. The accuracy of imaging studies such as computed tomography, magnetic resonance imaging, and metaiodobenzylguanidine scintigraphy in identifying patients with bilateral, ectopic, or multifocal disease has allowed for a focused unilateral approach in selected patients with non-familial pheochromocytoma [9]. Despite the numerous small venous tributaries draining the adrenal gland, early ligation of the main adrenal vein has been considered an important technical aspect of adrenalectomy for pheochromocytoma. We have found that the laparoscopic approach allows for easy identification and early ligation of the main adrenal veins, on both the right and left sides, before manipulation of the adrenal glands. In addition, the laparoscopic approach facilitates the ''dissection of the patient away from the tumor'' and minimizes manipulation of the adrenal lesion, reducing the risk of excessive catecholamine release.

The size limitation of adrenal tumors for which LA is appropriate has not been determined. The largest adrenal tumor that we removed laparoscopically was a 5.8-cm adenoma. Laparoscopic resection of this gland was not technically difficult and the specimen was easily extracted by extending a trocar-site skin incision and gently splitting the flank muscles. Adrenal tumors larger than 6 cm have an increased risk of being malignant and may be best managed by an open approach.

It is an appropriate criticism of this procedure that long operative times are required for LA. Although a learning curve for this procedure has not yet been defined, a significant improvement in the time required for LA has been demonstrated as operator experience increases [8, 11], and operative times as short as 90 min have been reported [11]. As surgeons gain more experience with the laparoscopic approach operative times should continue to improve and may approach those reported for OA.

Progress in the evolution and refinement of operative techniques is stimulated by the desire to adequately and safely treat the underlying disease while minimizing the operative complications and postoperative sequelae of the procedure. For many surgeons the open posterior approach has become the preferred method for resecting benign adrenal lesions because it provides easy access to adrenal glands

Table 4. Complications: open vs laparoscopic adrenalectomy

	Open ($n = 9$)	Laparoscopic ($n = 14$)
Cardiac	2	0
Pulmonary	3	0
Wound infection	0	1
Hematoma	0	2
Total complications (%)	5 (56%)	3 (21%)

and results in fewer complications and a faster recovery compared to the anterior or thoracoabdominal approaches [12, 16]. The application of minimally invasive techniques to adrenal surgery offers the potential for further reductions in the operative trauma and postoperative recovery associated with adrenal operations. Our study has demonstrated that LA is feasible for a variety of benign conditions affecting the adrenal gland. Despite longer operative times, patients having LA had a faster postoperative recovery and fewer cardiac and pulmonary complications than did patients having OA. Our results show that the outcome of patients undergoing LA compares favorably to those who had OA, and this justifies this approach as an appropriate and viable option for patients requiring adrenalectomy for benign adrenal conditions.

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