
Laparoscopic versus open adrenalectomy for surgical adrenal disease

Niels-Erik B. Jacobsen, MD, Jeffrey B. Campbell, MD, Michael G. Hobart, MD

Division of Urology, Royal Alexandra Hospital, University of Alberta, Edmonton, Alberta, Canada

JACOBSEN NEB, CAMPBELL JB, HOBART MG. Laparoscopic versus open adrenalectomy for surgical adrenal disease. *The Canadian Journal of Urology*. 2003;10(5):1995-1999.

Objective: To compare the intraoperative and postoperative outcomes of laparoscopic versus open adrenalectomy for surgical adrenal disease.

Materials and methods: Prospectively collected data from 22 consecutive laparoscopic adrenalectomies, performed by one surgeon (MGH) over a period of 18 months at the Royal Alexandra Hospital, Edmonton, Alberta, were reviewed. Laparoscopic adrenalectomy was performed by both the transperitoneal and retroperitoneal approaches. In addition, a retrospective chart review was performed for all open adrenalectomies, performed at the same institution, over a 6 year period. Exclusion criteria were locally invasive lesions and masses greater than 8 cm in diameter. Adrenal pheochromocytomas were included in both groups. The two groups were evaluated with respect to intraoperative and postoperative outcomes.

Results: Twenty-two laparoscopic and 19 open adrenalectomies were reviewed. Both groups were similar

with regard to gender, age, body mass index, and ASA class. Two laparoscopic cases, both with a history of prior ipsilateral adrenal surgery, were converted to the open approach. The laparoscopic group had a longer mean operative time (171 minutes versus 104 minutes), yet had a lower estimated blood loss (146 cc versus 455 cc), blood transfusion rate (0% versus 16%), and intraoperative complication rate (5% versus 16%). Both groups were similar with regard to specimen size and pathology. The laparoscopic group required less post-operative analgesia (44 mg morphine versus 478 mg morphine), resumed a regular diet sooner (1.1 days versus 3.7 days), and had a shorter hospital stay (2.2 days versus 5.4 days).

Conclusions: In our experience, prior ipsilateral adrenal surgery greatly increases the risk of open conversion. This study is consistent with the findings of a number of previously reported studies, supporting the emergence of laparoscopic adrenalectomy as the standard of care for surgical management of benign adrenal disease.

Key Words: laparoscopic adrenalectomy, intraoperative outcome, postoperative outcome

Introduction

Laparoscopic adrenalectomy has gained in popularity for the management of benign adrenal disease since

its first description in 1992 by Gagner et al.¹ By reason of its small size, low incidence of malignant tumors and the relatively high morbidity of the traditional open approach, the adrenal gland seems ideally suited for laparoscopy.² With reports of minimal morbidity, shorter hospital stay, rapid convalescence and comparable short-term efficacy, it is fast becoming the procedure of choice for benign adrenal disease.³ The purpose of this study was to examine our initial experience with laparoscopic adrenalectomy (transperitoneal and retroperitoneal) by comparing

Accepted for publication September 2003

Address correspondence to Michael G. Hobart, MD, Division of Urology, University of Alberta, Royal Alexandra Hospital, Hys Centre, Suite 400, 11010 101 Street, Edmonton, Alberta T5H 4B9 Canada

the intraoperative and postoperative results to that of open adrenalectomy in a retrospective manner.

Materials and methods

A retrospective review was performed on 22 consecutive patients who underwent laparoscopic adrenalectomy performed by one surgeon (MGH) at the Royal Alexandra Hospital in Edmonton from February 2000 to July 2001, and the past 19 open adrenalectomies performed at the same institution by General Surgery and Urology from October 1995 to May 2000. Indications for surgery in the laparoscopic group included four aldosteronomas, three cortisol-secreting adenomas, seven pheochromocytomas, four isolated adrenal metastases, three adrenal incidentalomas larger than 4 cm, and one virilizing adenoma Table 1. Likewise, indications in the open group included six aldosteronomas, two cortisol-secreting adenomas, six pheochromocytomas, one isolated adrenal metastasis, and four adrenal incidentalomas larger than 4 cm Table 1. Exclusion criteria for laparoscopic adrenalectomy were CT or MRI characteristics suspicious for primary adrenal malignancy and masses larger than 8 cm.

TABLE 1. Indications for surgery

	Laparoscopic	Open
Aldosteronoma	4	6
Cushing's	3	2
Pheochromocytoma	7	6
Virilizing	1	0
Metastases	4	1
Incidentaloma > 4 cm	3	4

Laparoscopic adrenalectomy was performed by both the transperitoneal and retroperitoneal approaches in 15 and 7 patients respectively. A 4 port transperitoneal approach was utilized as described by Gagner et al with the modification of a 5 mm port inferior to the Xiphoid process to aid in liver retraction and spleen and pancreas retraction.⁴ The retroperitoneal approach has been previously described in detail by Suzuki and included a 3 port technique with the camera port placed off the tip of the 12th rib and sequential retroperitoneal balloon dilations performed using the OriginTM retroperitoneal balloon dilator (Auto SutureTM, Fort Worth, Texas).⁵ Open adrenalectomy was performed by the subcostal (n = 7), posterior (n = 5), flank (n = 4) and thoracoabdominal approaches (n = 3).

Hospital and office records were reviewed in a retrospective manner for demographics, operative indications, imaging characteristics, operative time, estimated blood loss, intraoperative complications, pathology, analgesic requirements, resumption of normal diet, length of hospital stay and postoperative complications. The Mann-Whitney U independent-samples test was used for statistical analysis using SPSS version 9.0.

Results

Twenty-two laparoscopic and 19 open adrenalectomies were reviewed. Both groups were similar with regard to gender, age, body mass index (BMI) and American Society of Anaesthesiology (ASA) classification Table 2. Two patients in the laparoscopic group, both with multiple endocrine neoplasia type 2A and a history of prior ipsilateral adrenal surgery, required conversion to open adrenalectomy. In one patient, bleeding from the adrenal vein could not be controlled laparoscopically, while in the other severe intraoperative hypotension developed soon after a recognized small bowel enterotomy occurred during port placement. The etiology for the hypotension was not immediately apparent, and conversion was deemed the appropriate course of action. Post-operatively, this patient was found to have a hemothorax due to improper central line placement.

The laparoscopic group had a longer mean operative time (171 minutes versus 104 minutes), yet a lower estimated blood loss (146 ml versus 455 ml) both of which were statistically significant ($p < 0.05$) Table 3. Intraoperative complications were similar, developing in one (5%) laparoscopic patient and 3 (16%) open patients Table 4. A recognized small bowel enterotomy occurred in one laparoscopic patient during port placement. In the open group a splenic laceration in one patient was repaired primarily while a splenic laceration in another patient required splenectomy. A third open patient developed severe hypotension requiring ICU admission

TABLE 2. Baseline patient characteristics

	Laparoscopic	Open
Male	10	9
Female	12	10
Age (years)	55 (22-82)	50 (32-78)
BMI (kg/m ²)	28.3 (18.5-39.2)	28.2 (17.3-36.3)
ASA class	2.7	2.8

TABLE 3. Intraoperative and post-operative results

	Laparoscopic (all)	Laparoscopic (-conversions)	Open
Operative time (min)	177*	171*	104
Blood loss (mL)	196*	146*	455
Morphine eq. (mg)	69*	44*	478
Time to normal diet	1.8*	1.1*	3.7
Hospital stay (days)	3.0*	2.2*	5.4

*p<0.05

TABLE 4. Complications

	Laparoscopic	Open
Intra-operative	one small bowel enterotomy	one splenic laceration one splenectomy
Post-operative	one transfusion one wound cellulitis	one severe hypotension (ICU) one atrial fibrillation one <i>clostridium difficile</i> colitis

postoperatively. Both groups were similar with respect to specimen size and pathologic diagnosis Table 5. There were no unrecognized primary adrenal malignancies in either group.

Postoperatively the laparoscopic group demonstrated less analgesic requirements (44 mg morphine equivalents versus 478 mg), more rapid resumption of normal diet (1.1 days versus 3.7 days) and shorter duration of hospitalization (2.2 days versus 5.4 days) all of which were statistically significant ($p < 0.05$) Table 3. Complications in the postoperative period were similar Table 4. One patient in the laparoscopic group developed a small postoperative bleed which was managed conservatively with transfusion of two units of packed red blood cells while another patient required a short course of antibiotics for wound cellulitis. In the open

group, one patient developed new onset atrial fibrillation and another patient required antibiotics for *clostridium difficile* colitis.

Discussion

Our initial results with laparoscopic adrenalectomy are consistent with that of other published studies.^{6,7,19,20} Indications for surgery included pheochromocytoma, aldosteronoma, cortisol-producing adenoma, incidentaloma and solitary adrenal metastases all of which are recognized indications for laparoscopic adrenalectomy.⁶ Whereas operative time was slightly longer in the laparoscopic group, estimated blood loss was lower. Of more importance to the patient, laparoscopic adrenalectomy was superior to the open procedure in terms of

TABLE 5. Pathology

	Laparoscopic	Open
Specimen size (cm)	4.0 (1.5-7.3)	4.0 (1.0-7.5)
Adenoma	12	12
Pheochromocytoma	6	6
Other	one adrenal cyst one nodular hyperplasia two metastases	one myelolipoma

analgesic requirements, return to normal diet, and duration of hospitalization. While the mean hospital stay in this series was 2.2 days, outpatient same day laparoscopic adrenalectomy has been described for highly select patients with small tumors.⁷ Although a formal financial analysis was beyond the scope of this study, other groups have found the laparoscopic technique provides up to a 17.9% decrease in total hospital costs compared to open adrenalectomy.^{8,9} With a growing body of evidence in the literature attesting to the safety, efficacy and potential advantages of laparoscopic adrenalectomy it is difficult to argue with those who consider it to be the procedure of choice for benign surgical adrenal disease.^{10,11}

The maximum size of adrenal tumor amenable to laparoscopic adrenalectomy remains a controversial issue. Recognizing the poor specificity of tumor size in detecting adrenocortical carcinoma many centres have successfully applied laparoscopic adrenalectomy to the resection of large tumors greater than 6 cm in size providing they lack evidence of local invasion or venous thromboses on preoperative imaging.¹²⁻¹⁴ Hobart et al compared laparoscopic to open adrenalectomy for large-volume tumors and found the laparoscopic specimen weight of en bloc adrenal gland and periadrenal fat to be greater than that of the open specimen.¹⁵ In their opinion, the laparoscopic procedure replicated the open surgical oncologic principle of wide-margin, en bloc resection. Similarly, Heniford et al and Henry et al performed laparoscopic adrenalectomy on a total of 30 patients with large potentially malignant adrenal lesions up to 12 cm in size.^{12,13} Three patients required conversion due to local invasion but all completed laparoscopic procedures demonstrated negative surgical margins including six patients who had adrenocortical carcinoma on pathologic diagnosis. At a follow-up of 8 to 83 months, five of these six patients remained disease-free. It is the collective thought of these authors that the size of the adrenal tumor should not be the primary deterrent from proceeding with

laparoscopic adrenalectomy, but rather the presence of local invasion and poorly defined tissue planes. Open adrenalectomy with wide en bloc resection remains the procedure of choice for adrenocortical carcinoma and laparoscopic surgeons should have a low threshold for open conversion when primary adrenal malignancy is suspected.

Although our numbers are relatively small, we found no statistical difference between transperitoneal and retroperitoneal laparoscopic adrenalectomy with regard to operative time, blood loss, intraoperative and postoperative complications, postoperative pain, time to oral intake and length of hospital stay Table 6. Several larger studies including a retrospective comparison at the Cleveland Clinic have likewise found no difference between the two approaches.¹⁶ Some feel that the transperitoneal approach may be technically simpler for right adrenalectomy because of familiar anatomy and because virtually no colonic mobilization is necessary, while the retroperitoneal approach is advantageous in patients with extensive intraabdominal adhesions or morbid obesity or for left adrenalectomy thereby eliminating the need for extensive colonic and splenic mobilization.¹⁷ Two patients in our laparoscopic series, both of which had undergone previous ipsilateral adrenal surgery, required open conversion. This 9% conversion rate is comparable to that reported in the literature (0% – 14%).¹⁸⁻²¹ Owing to potential difficulties with both access and dissection, we feel that prior ipsilateral adrenal or renal surgery may represent a relative contraindication to laparoscopic adrenalectomy by standard techniques. Interestingly, Gill et al have demonstrated that thoracoscopic transdiaphragmatic adrenalectomy can be safely performed and represents a valid surgical alternative in these select patients.²²

Conclusion

The results of our study compare favorably with other published series, lending support to the emergence of laparoscopic adrenalectomy as the standard of care

TABLE 6. Transperitoneal versus retroperitoneal

	Transperitoneal	Retroperitoneal	
Operative time (min)	168	198	p 0.11
Blood loss (mL)	123	352	p 0.07
Morphine eq. (mg)	29	155	p 0.26
Time to normal diet	1.1	3.1	p 0.14
Hospital stay (days)	2.1	5.0	p 0.29

for the management of benign surgical adrenal disease. Adrenocortical carcinoma with evidence of local invasion remains a contraindication to laparoscopic adrenalectomy, and in our experience, the patient with a history of prior ipsilateral adrenal surgery should be counselled as to the increased risk of conversion to the open procedure. □

20. Takeda M. Laparoscopic adrenalectomy: transperitoneal vs retroperitoneal approaches. *Biomed Pharmacother* 2000;54(Suppl 1):207-210.
21. Yoshida O, Terachia T, Matsuda T. Complications in 369 laparoscopic adrenalectomies: a multi-institutional study in Japan. *J Urol* 1997;157(Suppl):282, Abstract 1098.
22. Gill IS, Meraney AM, Thomas JC, Sung GT, Novick AC, Lieberman I. Thoracoscopic transdiaphragmatic adrenalectomy: the initial experience. *J Urol* 2001;165(6):1875-1881.

References

1. Gagner M, Lacroix A, Bolte E. Laparoscopic adrenalectomy in Cushing's syndrome and pheochromocytoma. *N Engl J Med* 1992;327(14):1033.
2. Jacobs JK, Goldstein RE, Geer RJ. Laparoscopic adrenalectomy. A new standard of care. *Ann Surg* 1997;225(5):495-501.
3. Gill IS. The case for laparoscopic adrenalectomy. *J Urol* 2001;166(2):429-436.
4. Gagner M. Laparoscopic Adrenalectomy. *Surg Clin North Am* 1996;76(3):523-537.
5. Suzuki K. Laparoscopic adrenalectomy: retroperitoneal approach. *Urol Clin North Am* 2001;28(1):85-95.
6. Gagner M, Pomp A, Heniford BT, Pharand D, Lacroix A. Laparoscopic adrenalectomy: lessons learned from 100 consecutive procedures. *Ann Surg* 1997;226(3):238-246.
7. Gill IS, Hobart MG, Schweizer D, Bravo EL. Outpatient adrenalectomy. *J Urol* 2000;163(3):717-720.
8. Hobart MG, Gill IS, Schweizer D, Bravo EL. Financial analysis of needlescopic versus open adrenalectomy. *J Urol* 1999;162(4):1264-1267.
9. Ortega J, Sala C, Garcia S, Lledo S. Cost-effectiveness of laparoscopic vs open adrenalectomy: small savings in an expensive process. *J Laparoendosc Adv Surg Tech A* 2002;12(1):1-5.
10. Guazzoni G, Cestari A, Montorsi F, Lanzi R, Rigatti P, Kaouk JH, Gill IS. Current role of laparoscopic adrenalectomy. *Eur Urol* 2001;40(1):8-16.
11. Sung GT, Gill IS. Laparoscopic adrenalectomy. *Semin Laparosc Surg* 2000;7(3):211-222.
12. Heniford BT, Arca MJ, Walsh RM, Gill IS. Laparoscopic adrenalectomy for cancer. *Semin Surg Oncol* 1999;16(4):293-306.
13. Henry JF, Sebag F, Iacobone M, Mirallie E. Results of laparoscopic adrenalectomy for large and potentially malignant tumors. *World J Surg* 2002;26(8):1043-1047.
14. MacGillivray DC, Whalen GF, Malchoff CD, Oppenheim DS, Shichman SJ. Laparoscopic resection of large adrenal tumors. *Ann Surg Oncol* 2002;9(5):480-485.
15. Hobart MG, Gill IS, Schweizer D, Sung GT, Bravo EL. Laparoscopic adrenalectomy for large-volume (> or = 5 cm) adrenal masses. *J Endourol* 2000;14(2):149-154.
16. Sung GT, Gill IS, Soble JJ, Bravo EL. Laparoscopic adrenalectomy: Comparison of transperitoneal needlescopic versus retroperitoneoscopic approaches. *J Endourology* 1998;12(Suppl 1):205, Abstract P18-3.
17. Sung GT, Hsu TH, Gill IS. Retroperitoneoscopic adrenalectomy: lateral approach. *J Endourol* 2001;15(5):505-511.
18. Dudley NE, Harrison BJ. Comparison of open posterior versus transperitoneal laparoscopic adrenalectomy. *Br J Surg* 1999;86(5):656-660.
19. Winfield HN, Hamilton BD, Bravo EL, Novick AC. Laparoscopic adrenalectomy: the preferred choice? A comparison to open adrenalectomy. *J Urol* 1998;160(2):325-329.