REVIEW ARTICLE

Open versus Laparoscopic Adrenalectomy for Multiple Adrenal Disorders

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Abstract

In this review article, twelve articles were reviewed from 1998-march 2009 and analyzed, treatment and management of different adrenal surgical problems were reviewed including pheochromocytoma, functional adenoma, adrenal cortical carcinoma, adrenal metastasis and primary adrenal malignancies. The studies were taken from Journal of clinical endocrinology and metabolism, annals of surgical oncology, Google, Springerlink, The Hongkong medical diary, ANZ journal of surgery. Evaluation of the safety of laparoscopic adrenalectomy in comparison open treatment was done.

Conclusion: Laparoscopic adrenalectomy should be the treatment of choice for all benign and certain malignant adrenal tumors. Laparoscopic resection of large adrenal tumors needs experienced surgeons in open and advanced laparoscopic surgery.

Keywords: Adrenalectomy, functional adenoma, adrenal cortical carcinoma, adrenal metastasis, pheochromacytoma, open *versus* laparoscopic surgery.

INTRODUCTION

Adrenal masses are one of the most prevalent of all human tumors. The prevalence of adrenal masses approaches 3% in middle age, and increases to as much as 7% in the elderly. [1] It is anticipated that the management of adrenal masses will be a growing clinical challenge in our aging society because of its high prevalence in the elderly and the increased use of abdominal imaging studies.

A. Functional Adenoma

If history or physical examination of a patient with a unilateral adrenal mass shows signs and symptoms suggestive of glucocorticoid, mineralocorticoid, adrenal sex hormone that is confirmed biochemically, adrenalectomy is often considered the treatment of choice. In the absence of clinical symptoms; treatment decisions for patients with biochemical evidence of cortisol hypersecretion present a vexing problem. While adrenalectomy has been demonstrated to correct biochemical abnormalities, its effect on long-term outcome and quality of life is unknown. Either adrenalectomy or careful observation has been suggested as a treatment option.

B. Pheochromocytoma

Pheochromocytoma is among the most life-threatening endocrine diseases, particularly if it remains undiagnosed. Patients even with "silent" pheochromocytomas are at risk for a hypertensive crisis and should undergo adrenalectomy.

C. Adrenocortical Carcinoma

In patients with nonfunctioning adrenal masses, distinguishing between malignant and benign primary adrenal tumors guides subsequent management. Variables to consider are the size of the lesion, its imaging characteristics, and its growth rate. Traditionally, the size of the lesion has been considered to be the major determinant of the presence of a malignant tumor. More than 60% of the adrenal masses less than 4 cm are benign adenomas, while less than 2% represent primary adrenocortical carcinomas. In contrast, the risk for carcinoma increases to 25% in lesions that are greater than 6 cm, while benignadenomas account for less than 15%. Therefore, the generally accepted recommendation is to excise lesions that are larger than 6 cm. Lesions that are less than 4 cm and are defined as low risk by imaging criteria are unlikely to have malignant potential and are generallynot resected. For lesions between 4 cm and 6 cm, either close follow-up or adrenalectomy is considered a reasonable approach. Adrenalectomy should be strongly considered if the imaging findings suggest that the lesion is not an adenoma.

D. Metastases

The adrenal glands are frequent sites for metastases from many cancers. Lymphoma and carcinoma of the lung and breast account for a large proportion of adrenal metastases. Other primary cancers include melanoma, leukemia, and kidney and ovarian carcinoma. In a review of 1000 consecutive autopsies of patients with carcinoma, the adrenal glands were involved in 27% of the cases.[4] The incidence of adrenal metastases in patients with breast and lung cancer is approximately 39 and 35%, respectively. [4,5] Among cancer patients, 50-75% of clinically in apparent adrenal masses are metastases.[6] There is no established clinical benefit to be derived form adrenalectomy in those patients who are diagnosed with a metastasis from a known primary neoplasm. Nevertheless; long-term survival has

been reported in selected patients, after resection of isolated adrenal metastases.[7] Since then, many series have confirmed that when metastasis is isolated to the adrenal gland, adrenalectomy by open or laparoscopic approach can achieve long-term survival.[8]

E. Others

Generally, myelolipoma and adrenal cyst are benign lesions that require no therapy. Larger, symptomatic or rapidly growing tumors are treated with adrenalectomy, which is usually curative. Infections, especially tuberculosis and histoplasmosis, can also manifest themselves as an adrenal mass. Surgery may be indicated if medical treatment is ineffective.

OBJECTIVE

The aims of this study is evaluating the efficacy, safety and outcome of laparoscopic adrenalectomy for all adrenal benign and malignant tumors in comparison with open surgery, and also determine the risk factors which influence the outcome to identify those patients that are not good candidates for laparoscopic approach.

MATERIAL AND METHODS

A literature search was performed using search engine Google, High Wire Press, Springer Link and library facility available at laparoscopic hospital. Journal of clinical endocrinology and Metabolism. The Hongkong medical diary and ANZ journal of surgery.

TREATMENT

Surgical treatment is the only option. Preoperatively in all patients with preoperative signs and symptoms of catecholamine excess, alpha-adrenergic blockade was started 10 days to 2 weeks before surgery. For patients with tachycardia, beta-blockade was added. Patients with alpha blockade-induced orthostatic hypotension were treated with oral and/or intravenous volume loading during the 24 to 48 hours prior to surgery. Patients were infused with 1 to 2 L of crystalloid solution for intravascular volume expansion in the preoperative holding area. It is wise to have all patients an arterial line and 2 large-bore peripheral intravenous lines or a central venous line placed prior to the induction of general anesthesia.

SURGICAL TECHNIQUE

The adrenalectomies can be performed laparoscopically through a lateral decubitus or supine transperitoneal approach, or lateral retroperitoneal approach.[1,2] Briefly, a diagnostic laparoscopy was performed at the beginning of each procedure to rule out local tumor invasion or diffuse metastatic spread. The lateral decubitus transperitoneal approach; which is the most popular; starts with three subcostal ports (5-12 mm) allowed for the introduction of a 30° laparoscope and 2 working instruments. During right adrenalectomies, a fourth 5 mm port was placed in a subxyphoid position for liver retraction. Occasionally during left adrenalectomies, a fourth port was added below the tip of the left twelfth rib to provide blunt retraction of the kidney and/or adrenal gland. This technique was particularly useful for larger tumors, which often encroached upon the vascular hilum of the kidney, making exposure of the adrenal vein difficult. Early ligation and division of the adrenal vein was carried out prior to gland manipulation and dissection when possible.

For right adrenalectomies, the right hepatic lobe was completely mobilized to provide adequate visualization and safe access to the vena cava and adrenal vein. The triangular ligament was incised to the level of the diaphragm. The retroperitoneum was then opened longitudinally along the medial aspect of the adrenal gland, and immediately adjacent to the lateral edge of the liver, until the vena cava was clearly identified.

Development of the plane between the inferior vena cava and the medial margin of the gland was performed to expose the right adrenal vein. Early dissection and mobilization of the inferior retroperitoneal attachments to the tumor increased gland mobility and made venous control considerably safer.

On the left, the splenic flexure was mobilized to allow access to the splenorenal ligament. The retroperitoneal plane superficial to gerota fascia was developed to the level of the diaphragm, allowing for medial rotation of the spleen and the pancreatic tail. A complete medial rotation of adjacent structures was critical to provide adequate exposure of the adrenal gland and vein. Gerota fascia was incised medial to the superior pole of the kidney to provide access to the left adrenal vein and the adrenal gland. The vein was then ligated and divided at its confluence with the left renal vein.

On either side, the borders of the adrenal gland were first identified and then dissected away from the retroperitoneum, using periadrenal fat as a "handle". The larger glands, especially those greater than 5 cm, were most often resected with periadrenal fat, exposing the psoas muscle from the renal hilum cephalad to the diaphragm. The gland was never grasped to avoid hemodynamic liability, troublesome bleeding, or tumor disruption. Large adrenal veins, typically those greater than 7 mm in width, were divided with an endovascular stapler. Specimens were placed into an impervious extraction bag prior to morcellation (if necessary) and removal. The peritoneum and fascia at the trocar sites were closed endoscopically.

POSTOPERATIVE CARE

Crystalloid fluid challenge to treat postoperative hypotension. NG-tubes as indicated. Clear liquids can be given on the same night after surgery. Patients were discharged 3-5 days. Follow-up in OPD at 7 to 10 days and another at 3 to 4 weeks postoperatively, and subsequently as needed. Long-term follow-up included frequent blood pressure monitoring for the first year, then yearly thereafter. Urinary metanephrine levels are followed annually for a period of 5 years.

COMPLICATIONS

The advent of laparoscopy for advanced surgical procedures has given rise to specific risks of intraoperative complications. Complications being reported in the literature included tissue injury (liver, spleen, pancreas, kidney, duodenum and colon), vascular injury (hepatic artery, splenic artery, venal cava and adrenal veins), and major hemorrhage. Postoperative complications such as hematoma, infection and port-site herniation have also been reported. The overall complication rates reported in various literatures, including the local one, were around 4%, and the mortality was less than 1%.[2,11-13] The conversion rate was around 4-5% for various approaches of laparoscopic adrenalectomy. In most cases, the reason for conversion was bleeding, difficult dissection, or intraoperatively suspected malignancy.

OUTCOME AND ANALYSIS

Compared with those who underwent a standard open approach, patients undergoing a laparoscopic adrenalectomy have demonstrated decreased perioperative morbidity, shorter hospitalization, and faster functional recovery.[3-4]

DISCUSSION

Surgical treatment offers the cure for all adrenal tumors (benign or malignant). Despite the improvements in perioperative medical management, anesthesia, and surgical techniques, adrenalectomy for adrenal tumors carries morbidity rates as high as 40% and perioperative mortality rates of 2 to 4%.[5] Fears of cardiovascular instability due of excessive catecholamine release caused by the pneumoperitoneum and/or laparoscopic dissection have urged concerns over the role of laparoscopy in adrenalectomy. Continuous invasive monitoring and pharmacologic intervention by an experienced anesthesia team are necessary to avoid substantial cardiovascular instability. The surgeon must avoid excessive tumor manipulation, which can result in catecholamine release. Tumor manipulation has been shown to be the most important intraoperative factor for catecholamine release during both open and laparoscopic adrenal resections.[6-8] Fernandez-Cruz et al[9] demonstrated that mean plasma norepinephrine and epinephrine increased 13.7 and 34.2-fold during open tumor manipulation.

Thompson and associates[25] performed a matched case-control study comparing 50 patients having open adrenalectomy to 56 patients having adrenalectomy through a posterior approach. They found that LA, compared to OA, was significantly associated with shorter hospital stay, less postoperative narcotic use, more rapid return to normal activity, increased patient satisfaction, and less late morbidity. However, the laparoscopic procedure was associated, with longer operating room time and higher cost. Similar results have been reported by Prinz[26] and by Brunt et al,[27] who found that LA had distinct advantages compared to OA. Laparoscopic tumor manipulation was associated with a significantly diminished increase in plasma catecholamine levels (norepinephrine, 8.6-fold; epinephrine, 17.4-fold).[24] Rocha et al[6] also reported that such hormonal release occurs despite an early adrenal vein ligation, likely due to the extensive vascularity of pheochromocytomas. Careful adrenal dissection, using periadrenal fat as a handle, with minimization of direct manipulation or compression of the gland itself, is critical to avoid catecholamine release. Intra-abdominal insufflation during laparoscopic pheochromocytoma excision may alone cause an increase in serum catecholamines.[6-10]

This stimulus may be via either a direct tumor compression or a change in tumor perfusion. The pneumoperitoneum with CO_2 may lead to hypercapnia and acidosis, which, in turn, are known stimuli of catecholamine secretion and hypertension.[6-11] Rocha et al found a more than 10-fold elevation in catecholamines during abdominal insufflation to 12 mm Hg with CO_2, with about 50% of patients experiencing hypertensive episodes.[6] As a result, helium has been suggested as an alternate insufflation agent to eliminate the deleterious effects of CO_2 during laparoscopic adrenalectomies for adrenal tumors. In a prospective evaluation of 11 patients undergoing helium insufflation during laparoscopic pheochromocytoma resection, the authors demonstrated that its use avoided significant intraoperative hypercarbia or acidosis and provided greater intraoperative hemodynamic stability.[7] Interestingly, though, there were no differences between the CO_2 and the helium insufflation groups in either serum catecholamine surges or overall surgical outcomes.[7] When compared with other indications for adrenalectomy, laparoscopic resection of adrenal tumors, results in longer operative times, higher complication rates, and longer hospitalization. With growing experience using advanced laparoscopic techniques, conversion rates have decreased from 22 to 0-4%.[12-14] The "learning curve" may play a significant role in improving the efficiency and safety of advanced laparoscopic procedures. Extreme care must be exercised to avoid intraoperative capsular disruptions and possible iatrogenic pheochromocytomatosis. Li et al[15] reported 3 cases of pheochromocytoma recurrence 3 to 4 years after initial laparoscopic resection and possible tumor spillage. As a result, many investigators have suggested that laparoscopy be avoided for pheochromocytomas larger that 7 to 8 cm.[12-17] Conversion to an open procedure is warranted, however, when laparoscopic dissection cannot be performed safely or a complete resection cannot be performed without undue trauma to the gland.

It has been agreed by several authors that a posterior retroperitoneal LA is preferable to an anterior LA, especially inpatients who have either bilateral adrenal tumors, prior toextensive abdominal procedures with resultant adhesions and scar tissue formation, or pre-existing cardiopulmonary disease.[18,19] Posterior LA is not indicated in patients with large adrenal tumors. The absolute contraindications for laparoscopic adrenalectomy include primary or metastatic invasive adrenal malignancies because extensive *en bloc* surgery and node dissection will be necessary. As well as coagulopathy, which can't be controlled preoperatively. Size of the tumor correlates with malignant potential. Weight greater than 100 gm or size

equal to 6 cm is highly suggestive of malignancy[20,21] Laparoscopy is a limited approach to the adrenal, requiring manipulation of the gland to remove it. In patients with cancer,wide resection of the gland with contiguous structures provides the best chance for cure.[22]

The lateral transperitoneal approach is preferred over the retroperitoneal approach because of improved working space and gland visualization.[23] The resected gland is removed from the port site in an occlusive bag to decrease peritoneal implantation and port site recurrence.

The question is not weather laparoscopic adrenalectomy foradrenal tumors should be done or not, but by whom should it be performed. A surgeon who is very proficient laparoscopically and significantly knowledgeable about adrenal anatomy may be able to perform this operation in a hospital that offers an appropriate level of anesthesia and ICU care.

CONCLUSION

laparoscopic resection of bening adrenal tumors can be performed safely with a short hospital stay and few complications; minimally invasive adrenalectomy for large tumors has historically been controversial. Lesions larger than 6 cm are associated with longer operative times than smaller lesions, but they are not associated with greater blood loss, higher rates of intraoperative hemodynamic instability, or longer hospital stay.

REFERENCES

1. Heniford BT, Arca MJ, Walsh RM, Gill IS. Laparoscopic adrenalectomy for cancer. Semin Surg Oncol 1999;16:293-06.
2. Gagner M, Pomp A, Heniford BT, et al. Laparoscopic adrenalectomy: Lessons learned from 100 consecutive procedures. Ann Surg 1997;226:238-46; discussion 246-47.
3. Brunt LM. The positive impact of laparoscopic adrenalectomy on complications of adrenal surgery. Surg Endosc 2002;16:252-57.
4. Jacobs JK, Goldstein RE, Geer RJ. Laparoscopic adrenalectomy: A new standard of care. Ann Surg 1997;225:495-01; discussion 501-02.
5. Werbel SS, Ober KP. Pheochromocytoma: Update on diagnosis, localization, and management. Med Clin North Am 1995;79:131-53.
6. Flavio Rocha M, Faramarzi-Roques R, Tauzin-Fin P, et al. Laparoscopic surgery for pheochromocytoma. Eur Urol 2004;45:226-32.
7. Fernandez-Cruz L, Saenz A, Taura P, et al. Helium and carbon dioxide pneumoperitoneum in patients with pheochromocytoma undergoing laparoscopic adrenalectomy. World J Surg 1998;22:1250-55.
8. Marty J, Desmonts JM, Chalaux G, et al. Hypertensive responses during operation for phaeochromocytoma: A study of plasma catecholamine and haemodynamic changes. Eur J Anaesthesiol 1985;2:257-64.
9. Fernandez-Cruz L, Taura P, Saenz A, et al. Laparoscopic approach to pheochromocytoma: Hemodynamic changes and catecholamine secretion. World J Surg 1996;20:762-68; discussion 768.
10. de La Chapelle A, Deghmani M, Dureuil B. Peritoneal insufflation can be a critical moment in the laparoscopic surgery of pheochromocytoma. Ann Fr Anesth Reanim. 1998;17:1184-85.
11. Rose CE Jr, Althaus JA, Kaiser DL, et al. Acute hypoxemia and hypercapnia: Increase in plasma catecholamines in conscious dogs. Am J Physiol 1983;245:H924-29.
12. Cheah WK, Clark OH, Horn JK, et al. Laparoscopic adrenalectomy for pheochromocytoma. World J Surg 2002;26:1048-51.
13. Kercher KW, Park A, Matthews BD, et al. Laparoscopic adrenalectomy for pheochromocytoma. Surg Endosc. 2002;16:100-02.
14. Kim AW, Quiros RM, Maxhimer JB, et al. Outcome of laparoscopic adrenalectomy for pheochromocytomas vs aldosteronomas. Arch Surg 2004;139:526-29; discussion 529-31.
15. Li ML, Fitzgerald PA, Price DC, et al. Iatrogenic pheochromocytomatosis: A previously unreported result of laparoscopic adrenalectomy. Surgery 2001;130:1072-77.
16. Inabnet WB, Pitre J, Bernard D, et al. Comparison of the hemodynamic parameters of open and laparoscopic adrenalectomy for pheochromocytoma. World J Surg 2000;24:574-78.
17. Staren ED, Prinz RA. Adrenalectomy in the era of laparoscopy. Surgery 1996;120:706-709; discussion 710-11.
18. Walz MK, Peitgen K, Hoermann R, Giebler RM, Mann K, Eigler FW. Posterior regroperitoneoscopy as a new minimally invasive approach for adrenalectomy: Results of 30 adrenalectomies in 27 patients. Word J Surg 1996;20:769-74.
19. Bonjer HJ, Lange JF, Kazemier G, deHerder WW, Steyerberg EW, Bruining HA. Comparison of three techniques for adrenalectomy. Br J Surg 1997;84:679-83.
20. Ross NS, Aron DC. Hormonal evaluation of a patient with an incidentally discovered adrenal mass. N Engl J Med 1990;323:1401-07.
21. Page DL, DeLellis RA, Hough AJ. Tumors of the adrenal. In: HartmannWH, Cowan WR (Eds). Atlas of Tumor Pathology. Washington Armed Forces Institute of Pathology 1986;1-06.
22. Soper NJ, Brunt LM, Kerbl K. Laparoscopic general surgery, 1994.
23. Duh QY, Siperstein AE, Clark OH, et al. Laparoscopic adrenalectomy:Comparison of the lateral and posterior approaches. Arch Surg 1996;131:870-76.
24. Gagner M, Lacroix A, Bolte E. Laparoscopic adrenalectomy in Cushing's syndrome and pheochromocytoma. N Engl J Med 1992;327:1033.
25. Thompson GB, Grant CS, van Heerden J, et al. Laparoscopic versus open posterior adrenalectomy: A case-control study of 100 patients. Surg 1997;6:132-36.
26. Prinz RA. A comparison of laparoscopic and open adrenalectomies. Arch Surg 1995;130:489-94.
27. Brunt LM, Doherty GM, Norton JA, Soper NJ, Quasebarth MA, et al. Laparoscopic adrenalectomy compared to open adrenalectomy for benignadrenal neoplasms. J Am Coll Surg 1996;183:1-10.