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Laparoscopic management of adrenal tumors: a four-year experience in a single center

G. ROMANO, A. AGRUSA, D. CHIANETTA, G. FRAZZETTA
V. SORCE, G. DI BUONO G. GULOTTA

Aim. Today laparoscopy is considered the first choice treatment of many adrenal tumors, although its use is still controversial for large adrenal masses and incidentally found adrenal cortical carcinoma.

Methods. From January 2009 to February 2014 we performed 42 lateral transperitoneal laparoscopic adrenalectomies. The indications for surgery were non-functioning adenoma larger than 4 cm or rapid growth and hormone-secreting tumor. The diagnosis was confirmed in all cases with computed tomography and magnetic resonance imaging and also metaiodobenzylguanidine scintigraphy if pheochromocytoma was suspected. In all cases we realized a complete preoperative hormonal study. We describe and analyzed retrospectively: age, side, indication for surgery, tumor size, length of hospital stay, complication and conversion rate.

Results. Twenty-two patients with functional tumors and 20 with non functional tumor were subjected to laparoscopic adrenalectomy. There was no conversion to open surgery. Mean operative time was 120 min and estimated blood loss was 80 mL (range 50-350). There was no mortality or major complications. The average length of hospital stay was 3.5 day. During pheochromocytoma removal hypertension occurred in 2 cases. Patient with aldosteroma became normotensive and no required postoperative antihypertensive therapy.

Conclusion. Laparoscopic adrenalectomy is a standard safe procedure for adrenal surgery.

*Department of General Surgery
Urgency and Organ Transplantation
University of Palermo, Palermo, Italy*

The risk of encountering incidental adrenal cortical cancer increases for large lesions and additional attention is required in these cases to observe oncologic surgical principles. Pre-operative work -up has a primary role in adrenal surgery. An accurate management of adrenal tumors requires an agreement among radiologist, endocrinologist, oncologist and surgeon. Previous abdominal surgery does not constitute a contraindication to laparoscopic transperitoneal adrenalectomy.

KEY WORDS: Adrenalectomy – Laparoscopy - Adrenal surgery.

Laparoscopic adrenalectomy was first described in 1992.¹ Since then, laparoscopy has developed dynamically, becoming a gold standard in the management of functional and non functional adrenal tumor <6 cm diameter.² In the hands of an experienced surgeon, laparoscopic adrenalectomy has many advantages that classical surgery lacks. Established advantages of laparoscopic approach include lower blood loss, shorter hospitalization, quicker return to normal activity and better cosmetic result.^{3, 4} Currently indication to laparoscopy for tumors >6 cm is still a matter of debate and surgeons are divided between supporters

Corresponding author: G. Romano, MD, PhD, Department of General Surgery, Urgency and Organ Transplantation, University of Palermo, via L. Giuffrè 5, 90127 Palermo, Italy. E-mail: giorgio.romano@unipa.it

and detractor. Accumulated experiences of mini-invasive surgery, thanks to the advent of better instrumentation for dissection and hemostasis, improved video imaging, better familiarity with endoscopic equipment by the operating room staff have made the indication expand to large tumors, pheochromocytomas and localized malignant tumors.^{5, 6} Workup including radiographic localization of the pathology and confirmation of the diagnosis by an inclusive endocrine evaluation, is also mandatory.

Materials and methods

Forty-two patients, 22 male and 20 female, with a mean age of 51 years were operated between 2009 and 2014: 26 left-sided lesions and 16 right-sided lesions. The indications for surgery were cortisol-producing adenomas (N.=8), pheochromocytomas (N.=2) aldosterone producing adenomas (N.=12), non-functioning adenoma (N.=16), myelolipoma (N.=4). Mean tumor size was 5.5 cm. Aldosteronomas were associated with the smallest size (1.5 cm) while myelolipoma was the largest observed mass (14 cm). The diagnosis was confirmed in all the cases with computed tomography and/or magnetic resonance imaging and also metaiodobenzylguanidine scintigraphy if pheochromocytoma was suspected. In all cases we realized a complete preoperative hormonal study.

Surgical technique

Operative time was considered as the period from skin incision to wound dressing. An antibiotic and antithrombotic prophylactic therapy was administered in all cases. All operations were performed using a lateral trans-peritoneal laparoscopic approach. The patients were placed on operating table in the supine position until general anesthesia was induced. The patient was then turned to the lateral decubitus position on the side opposite to the adrenal lesion. The goal is to expand the distance between the costal margin and the iliac crest.⁶ The surgeon and

the first assistant stand facing the abdominal wall of the patient. Pneumoperitoneum was obtained by Veress needle technique and was maintained at 12-14 mmHg with CO₂.^{7, 8} The first trocar was placed at the anterior axillary line, 2 cm below the costal margin. The next ports were placed on either side of the first port with at least 6 cm of distance between them to allow freedom of movement of the instruments. For a right adrenalectomy a fourth port was necessary for placement of liver retractor.⁹ In the right adrenalectomy, the right lobe of liver was elevated with a fan retractor and mobilized completely dividing the right triangular ligament. Once mobilized, dissection began of the medial border of the adrenal gland. A plane was developed between the lateral margin of the IVC and the medial border of the adrenal gland. The adrenal vein was identified, exposed and divided by double clipping on either side. Once the adrenal vein was divided, the dissection proceeds superiorly and inferiorly with the ultrasonic dissector. The specimen should then be mobilized posteriorly of the psoas muscle. Once the specimen has been mobilized, the specimen should be placed in an impermeable endobag and removed from the abdomen. Hemostasis was assured and the fascia was closed with absorbable suture. The skin was closed with monocryl. In the left adrenalectomy the dissection began with the mobilization of the splenic flexure. The splenorenal ligament was then completely divided from the inferior pole of the spleen to the level of the diaphragm using the ultrasonic dissector. This allowed complete mobilization of the spleen medially. The border of the adrenal gland should be mobilized from the left kidney until the adrenal vein was identified emptying into the left renal vein. The adrenal vein should be identified and exposed and could then be doubly clipped and divided. Once the adrenal vein was controlled, the gland should be mobilized taking all the periadrenal tissue in block with the gland. Care should be taken to avoid the tail of the pancreas during this dissection. A bipolar coagulation was routinely preferred for hemostasis whenever necessary.¹⁰

Results

From January 2009 to February 2014 we performed a total of 42 lateral transperitoneal laparoscopic adrenalectomies. We used exclusively a lateral laparoscopic transperitoneal approach. There were no conversion to open surgery. The mean operating time was 120 minute and ranged from 100 to 240 minutes. In our initial experience a right-sided procedure required an average of 140 minutes compared to 100 minutes for left side adrenalectomy. The indications for surgery were cortisol-producing adenomas (N.=8), pheochromocytomas (N.=2) aldosterone producing adenomas (N.=12), non-functioning adenoma (N.=16), myelolipoma (N.=4). In patients with functioning adenomas surgery determined a normalization of pathological hormonal serum levels. In a case of preoperative cortisol-producing adenoma definitive histological analysis showed an adrenal cortical carcinoma with no capsular invasion; in another case histological analysis revealed a malignant pheochromocytoma. There is no evidence of local recurrence respectively after 36 and 15 months of follow-up. Mean tumor size was 5.5 cm. Aldosteronoma was associated with the smallest size (1.5 cm) while myelolipoma was the largest observed mass (14 cm). Mean estimated blood loss was 80 ml (range 50-350). During pheocromocytomas removal intraoperative hypertension occurred in 2 cases without particular complications. There was no mortality nor major complications. The average length of hospital stay was 3.5 day.

Discussion

Since its initial description in 1992, laparoscopic adrenalectomy steadily gained favor among surgeons as the procedure of choice for most small and benign adrenal pathologies. Prior comparisons of laparoscopic and open adrenalectomies showed that laparoscopic adrenalectomy provides patients benefit, including the decreased

requirements for analgesics, operative time, morbidity and mortality and shorter hospital stay and recovery time.¹¹ More than 75% of laparoscopic adrenalectomy are performed for endocrine causes of hypertension such as aldosteronoma, Cushing's syndrome and Cushing's disease, and pheochromocytoma without preoperative evidence of local invasion or metastasis. Other indications include non functioning adenoma, adrenal cysts, metastases, myelolipoma, primary adrenal cortical neoplasm.¹³ Recovery from clinical syndromes associated with excessive hormonal secretion, is the major objective of surgery, but the large acceptance of the mini-invasive approach extend the indications to the treatment of adrenal incidentaloma >6 cm. We chose this cut-off because of the increased risk of incidentally found adrenal cortical carcinoma and because of technical limitations (longer operative time, increased blood loss).¹⁴ In our experience, thanks to the improvement of the surgical skills, the technology assistance and new dissection instrumentations, laparoscopic adrenalectomy is performed successfully also for adrenal masses of 14 cm. In these cases additional attention is required to observe oncological principle. Laparoscopic approach allows us to reduce manipulation of the adrenal glands, displacing the surrounding structures without "handling" the tumor, primary vascular control whenever possible, and sparing of the adrenal capsule, avoiding its rupture and tumor spillage. These surgical approach is effective, safe and well tolerated in most cases, with a very low morbidity rate. The majority of studies demonstrated laparoscopic adrenalectomy is associated with fewer complications than open adrenalectomy.¹⁴ This is mainly due to a reduction in pulmonary and wound complications. The most common significant complication associated with laparoscopic adrenalectomy is bleeding which may lead to blood transfusion or conversion to open procedure. This is usually due to tearing of the adrenal vein. Other rare complications that have been reported with laparoscopic adrenalectomy

include injury to the renal vessels, spleen, pancreatic tail or colon. The complication rate ranges from 3% to 20%¹⁵ and is similar to that reported in the management of other endocrine diseases.^{15, 16} Previous laparotomic surgery may be not considered as contraindication. Diaphragmatic injury is another complication that may require placement of a thoracic drain or conversion to an open procedure for repair lesion.^{17, 18} Complications specific to endocrine hypertension include intra-operative hypertensive crisis in patients with pheochromocytoma, and occur in slightly more than 1% of patients.² Conversion to an open procedure occur in approximately 2% of cases, with a range of 0% e 13%, and is reported in all but one large series. The main indication for conversion is uncontrollable bleeding that mainly occurs from smaller vessels, but can include injury to the inferior vena cava or renal vessels, mainly the left renal vein. The next most common reason for conversion to the open technique is malignancy with local and vascular invasion detected upon laparoscopic exploration.¹⁹ Various laparoscopic approaches to the adrenal gland have been described. The most accepted route to the adrenal gland are posterior retroperitoneoscopic adrenalectomy and lateral transperitoneal approach.¹¹ The lateral transperitoneal approach seems to be associated with many advantages such as a clear evidence of anatomical landmarks. In fact during right adrenalectomy, identification of the lateral margin of the inferior cava vein and peritoneum opening at this level is straightforward, rapidly leading to both identification of the medial margin of the adrenal gland and visualization of the adrenal vein. During left adrenalectomy, the identification of the left renal vein is generally easy even in an obese patient. Following this landmark the visualization of the left adrenal vein is rapidly obtained.²⁰ The early ligation of the main adrenal vein before gland manipulation is always possible utilizing this approach. In fact, early ligation of the main vein reduces the risk of catecholamine release in the

bloodstream. If vein ligation is performed as the first step, one may be able to reduce the risk of cell dissemination in the case of suspected malignant lesions or when treating masses greater than 5-6 cm.^{21, 22} In our experience two adrenal tumors of 12 cm in diameter were treated successfully and in both cases the masses were benign. Early identification and ligation of the adrenal vein, with minimal gland manipulation are the major advantages, especially in case of pheochromocytoma.^{2, 20} Immediate conversion to open surgery may be required in the case of major bleeding. In lateral laparoscopic approach, a short time is required to change the patient position and the anatomical site of bleeding is more readily identified after opening the abdomen with a medial incision.²⁰

Conclusions

Laparoscopic adrenalectomy is a safe and effective treatment for non-functioning adenoma larger than 4 cm or rapid growth and hormone-secreting tumor. The large acceptance of the mini-invasive approach extended the indications to the treatment of adrenal incidentaloma >6 cm. In our experience, thanks to the improvement of the surgical skills, technology assistance and new dissection instrumentations, laparoscopic adrenalectomy was record report series of case of large lesion of up 14 cm that have been successfully with laparoscopy. In these cases additional attention is required to observe oncological principle.

In lateral trans-peritoneal laparoscopic adrenalectomy early identification and ligation of adrenal vein, with minimal gland manipulation, reduces the risk of cell dissemination when treating masses greater than 6 cm. An accurate management of adrenal tumors requires an agreement among radiologist, endocrinologist, oncologist and surgeon. Previous abdominal surgery does not constitute a contraindication to laparoscopic trans-peritoneal adrenalectomy.

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Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.