

Laparoscopic transperitoneal anterior adrenalectomy



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AIM: Aim of this study was to report the authors' experience with the anterior transperitoneal approach, and with an anterior submesocolic approach in case of left sided lesions.

MATERIAL AND METHODS: From January 1994 to January 2011, 122 males and 170 females with a mean age of 50.7 years (range: 19-84) underwent laparoscopic adrenalectomy (LA) at 2 centers in Ancona and Rome (Italy) (that follow the same protocol). Fifteen patients underwent bilateral LA, the anterior transperitoneal approach was used in 233 cases (79.8%) and the anterior submesocolic in 59 (20.2%).

One hundred and two patients had Conn's syndrome, 51 miscellaneous lesions, 55 Cushing's syndrome, 47 incidentalomas, 46 pheochromocytoma, 2 metastatic masses, 2 myelolipomas and 2 adrenogenital syndromes. The lesions had a mean diameter of 3.24 cm (range: 0.5-10).

RESULTS: Mean operating time was 120 minutes (range: 30-390). Conversion to open surgery was required in 13 cases (4.45%). Blood pressure and heart rate were stable during the operation. There were 5 major complications. Mobilization and resumption of diet occurred on the first postoperative day. Mean hospital stay was 4.32 days (range: 2-30).

DISCUSSION: Early identification and ligation of the adrenal vein, with minimal gland manipulation, are the major advantages, especially in case of pheochromocytoma.

CONCLUSIONS: Adrenal masses can be successfully treated using a laparoscopic transperitoneal anterior approach, in presence of a suitable anesthesiological and surgical team's experience.

KEY WORDS: Adrenal tumors, Laparoscopic adrenalectomy, Pheochromocytoma.

Introduction

The adrenal gland is located deep in the retroperitoneum and in open surgery a large incision is required to reach it. The advent of minimally invasive tech-

niques has changed the surgical approach to the adrenal gland. Since Gagner's description in 1992, the use of LA has expanded greatly ^{1,2}. As reported in the literature, various minimally invasive techniques have been used documenting the feasibility, safety and efficacy of minimally invasive surgery ³. Postoperative pain, hospitalization, number and severity of complications improve with laparoscopy ⁴. The benefits of this technique have led many surgeons to extend the indication in order to include the majority of adrenal lesions. Therefore, all patients with an adrenal mass and benign character, or with tumor repetitive lesions are candidates for LA, except for patients with tumors larger than 15 cm. The approaches were usually lat-

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eral with the patient on the flank, posterior in the prone position and the anterior with the patient supine by transperitoneal approach. According to the literature the flank approach is mostly used, followed by the posterior and, finally, the anterior ones ⁵. In a previous work the authors reported reasons and results of their experience, which has favored the transperitoneal anterior approach, because in their opinion, it presents many advantages as compared to other techniques ⁶. Aim of this study was to report the authors' experience with the anterior transperitoneal and the submesocolic approach. A short description of the surgical technique is also provided and the results of the method are reported.

Materials and Methods

From January 1994 to January 2011, 122 males and 170 females with a mean age of 50.7 years (range: 19-84) underwent LA at 2 centers in Ancona and Rome (Italy) that follow the same protocol. Fifteen patients underwent bilateral LA, the anterior transperitoneal approach was used in 233 cases (79.8%) and the anterior submesocolic approach in 59 (20.2%). The indications were as follows: Conn's adenoma (102 cases), miscellaneous (51 cases including 46 non-secreting adenomas, 2 benign nodular hyperplasia, 3 adrenal cysts), Cushing's adenoma (55 cases), incidentaloma (47), pheochromocytoma (46), metastatic masses (2), myelolipoma (2), adreno-genital syndrome (2). In 233 patients (79.8%; 8 converted to open) the transperitoneal anterior approach and in 59 (20.2%; 5 converted to open) the front sub-mesocolic was used. Overall thirteen surgical procedures (4.45%) started by laparoscopy were converted to open. All patients have been previously studied by the Unit of Endocrinology. All patients have preoperatively done laboratory tests (measurement of blood levels of cortico-medullary hormones, urinary metabolites of the same values, etc.) and imaging studies (abdominal ultrasound, CT scan and / or MRI). The lesions had a mean diameter of 3.24 cm (range: 0.5-10). When the secretion of catecholamines was increased and confirmed the hypothesis of pheochromocytoma, patients began a preoperative preparation, at least 15 days before surgery, with alpha-blockers (doxazosin 20 mg / day). If patients reported episodes of tachycardia, beta-blockers have been added (atenolol 100-200 mg / day orally) from the first 2 days of surgery, following directions and in accordance with the endocrinologist and anesthesiologist. In 24 patients (8.21%) associated abdominal pathologies were found and cholecystectomies (18), ovariectomy (2), removal of ovarian cyst (1), echinococcus cysts of the left kidney (1), para-aortic neoformation (1) and pedunculated uterine fibroids (1) removal were performed during the same operation laparoscopically.

SURGICAL TECHNIQUES

In both cases of right and left adrenalectomy, surgery is performed under general anesthesia. A naso-gastric tube and a urinary catheter are introduced. Patients with pheochromocytoma are monitored with intra-arterial catheter in the radial artery for blood pressure and central venous catheter (subclavian or internal jugular access) for a rapid introduction of liquids and to monitor changes in central venous pressure. Pneumoperitoneum is induced with a Veress needle at the umbilicus, or with open technique based on the preferences of the surgeon or the presence of previous surgery. The pneumoperitoneum is regulated at a pressure of 13 mmHg, with a carbon dioxide insufflator adjusted to 30 l/minute. 4 trocars and a 45° optic are used. This approach is performed with the patient supine, in steep anti-Trendelenburg position and the operating table rotated towards the opposite side of the lesion of about 30°, to facilitate exposure of the surgical field. The surgeon takes the side ipsilateral to the lesion. Following the surgical techniques used in this study are described.

RIGHT ADRENALECTOMY

A 12 mm trocar is inserted along the right para-rectal line, 2 - 4 cm above the transverse umbilical line. Another 12 mm trocar is added 2 centimeters the left of midline. The third and fourth trocars are inserted one at the right anterior axillary line and the other along the right midaxillary line (Fig. 1). We proceed to the dis-

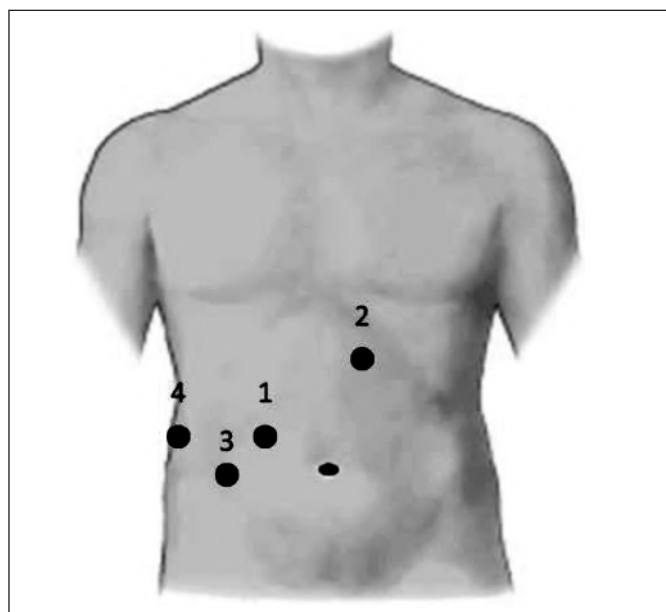


Fig. 1: Trocater position in transperitoneal right adrenalectomy. The operating surgeon and the first assistant are on the right of the patient, the second assistant on the left.

section of any adhesions between the gallbladder, omentum and transverse colon and the liver is raised with the retractor (Endo Retractor II TM, Covidien, Mansfield, Massachusetts, USA, or Endo Paddle Retractor TM, Covidien, Mansfield, Massachusetts, USA) introduced by the 2nd trocar, in order to expose Morrison's space. The optical trocar is introduced by the 3rd and the operative tools from the 1st and 4th trocar. The posterior parietal peritoneum is divided longitudinally along the right margin of the vena cava, extending the incision to the diaphragm where the adrenal gland is distinguishable from the sub-diaphragmatic retroperitoneal fat for its typical yellow ochre color. We then proceed to the dissection of all retrocaval arteries along the medial border of the adrenal gland. Then the right adrenal vein is identified by blunt dissection, avoiding excessive manipulation of the gland that could lead to an increase of circulating hormones and it is dissected between titanium clips (AcuClip, Tyco/Healtcare, Norwalk, Connecticut, USA). The gland is finally mobilized with a radio frequency scalpel (LigaSure TM tissue fusion, Covidien, Mansfield, Massachusetts, USA).

LEFT ADRENALECTOMY

Anterior Approach

The first 12 mm trocar is inserted on the midline above the umbilicus. A second trocar is inserted on the right midclavicular line two fingers below the costal arch. A third trocar on the left midclavicular line along the transverse umbilical line and the fourth trocar at the level of the anterior axillary line (Fig. 2). The procedure begins with the section of the peritoneum along the left parietocolic border, extending the incision to the sigmoid colon. After having dissected the splenocolic ligament, the left colon is mobilized medially with blunt dissection. Once the lower edge of the pancreas tail is identified we proceed with opening of Gerota's fascia to expose the left adrenal gland. Then by blunt dissection the left adrenal vein is identified until its confluence with the left renal vein. The vein is closed with titanium clips (AcuClip, Tyco/Healtcare, Norwalk, Connecticut, USA), placing two clips on the side of the renal vein and one on the side of the gland, and then it is divided.

Transperitoneal anterior submesocolic approach

A variant of the left adrenalectomy by transperitoneal approach is the Anterior Submesocolic approach. The trocars are placed in the same way as in the anterior approach. The first 12 mm trocar is inserted in the midline above the umbilicus. A second 12 mm trocar is inserted on the right midclavicular line two fingers below the costal arch. A third 12 mm trocar on the left midclavicular line along the transverse umbilical

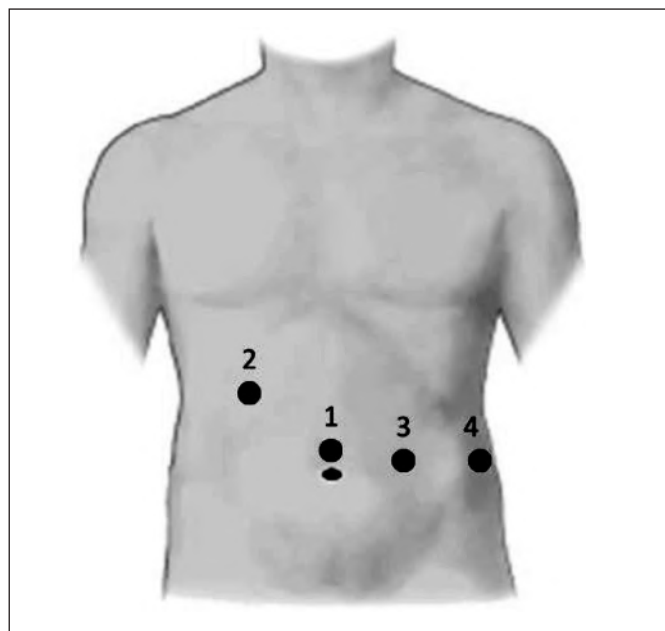


Fig. 2: Placement of the trocar in the left transperitoneal adrenalectomy. The operating surgeon and the first assistant are on the left of the patient, the second assistant to the right.

line and the fourth 12 mm trocar at the level of the anterior axillary line (Fig. 2). In this case, the transverse mesocolon is lifted with a clamp introduced from the 2nd trocar to expose the Treitz ligament and to identify the lower mesenteric vein. The peritoneum is opened at the insertion of the posterior transverse mesocolon level on the lower edge of the pancreas, between the first jejunal loop and the mesenteric vein or immediately laterally to this. The dissection proceeds along the retro-pancreatic plane, after lifting the pancreas-mesocolon transversum. Then Gerota's fascia is incised to search for the top edge of the left renal vein. This structure is prepared in a latero-medial up to identify the adrenal vein, which is prepared and divided between clips (AcuClip, Tyco/Healtcare, Norwalk, Connecticut, USA) before entering the adrenal lodge. At this point we divide thin medial sub-diaphragmatic arterial branches and ligaments that connect the gland to the surrounding anatomical structures.

In all cases the dissection is performed with radiofrequency tools (LigaSure TM tissue fusion, Covidien, Mansfield, Massachusetts, USA) or ultrasound (ultracision, Harmonic Scalpel, Ethicon Endo Surgery, Cincinnati, Ohio, USA) depending on the surgery preference. Monopolar electrocoagulation is used selectively to control hemostasis. Once released, the gland is removed in an extraction bag. Hemostasis is controlled also with hemostatic material (FloSeal, Baxter Healthcare Corporation, Deerfield, Illinois, USA), and a drainage is left into the adrenal lodge.

Results

In 13 cases (4.45%) conversion to open surgery was required. The causes of conversion were: adhesion of the adrenal lesion to the inferior vena cava (1), right adrenal gland embedded in the liver (1), hemorrhage (3), adhesion to the left diaphragmatic crus (1), adhesion to the tail of the pancreas (1), instability pressure (1) and difficult identification of anatomical structures (5). Mean operating time was 120 minutes (range: 30-390). Postoperative complications were observed in 13 cases, five of which were Grade III or higher according to the classification of Clavien ⁷: hemoperitoneum (2), colonic fistula in the first part of the experience (1), chylous ascites (1) and pneumothorax (1). Grade I or II complications were sub-occlusion (2), pleural effusion (3), hematoma at trocar insertion (2), infrahepatic abscess (1). In 12 patients blood transfusions during postoperative period has been required. Patient mobilization and resumption of diet occurred on the first post-operative day. The mean hospital stay was 4.32 days (range 2-30).

Discussion

Nowadays LA is considered the gold standard treatment of adrenal lesions and particularly in case of Conn's syndrome, Cushing's disease, incidentalomas, and adrenal metastases ^{2,4,6,8}. In the literature several studies on the lateral transperitoneal approach are reported, described for the first time by Gagner¹. The reasons are the large working space (which remains free from blood during surgery, because the blood collected during dissection flows in the sloping seat) and the shorter duration of the learning curve ⁹. In this study the authors evaluate the results of the anterior approach for lesions located on the right and on the left. The main disadvantage of the traditional anterior or left transperitoneal LA is that the splenic flexure of the colon must be mobilized and widely moved medially to access to the adrenal gland after opening Gerota's fascia. This results in a prolongation of the operative time. On the other hand, even the lateral approach requires extensive dissection and mobilization of the spleno-pancreatic complex ^{1,3}. For this reason the authors have introduced laparoscopic sub-mesocolic left adrenalectomy. Its main advantages are the smaller dissection and reduction in operating time, because access to the adrenal vein is more direct, and the early identification, ligation and section of the left adrenal vein is performed without manipulation of the adrenal gland. This aspect is particularly important especially in secreting lesions. However, a peculiarity of this access is to operate in a restricted working space and in an area characterized by major vascular structures, such as the left renal vein and aorta ⁵. Even on the right primary advantage of the anterior approach is the research, identification, ligation and division of the adrenal vein as the first step of surgery, before

any manipulation of the gland. This reduces the incidence of hemodynamic instability in case of secreting lesions. In addition there is also a technical reason for preferring the prior division of the right adrenal vein, due to the shortness of the adrenal vein itself. If you first perform the mobilization of the gland, the subsequent vascular control is more difficult because the gland is to be drawn medially and behind the inferior vena cava by the same right adrenal vein. Whereas, the priority ligation and section of the right adrenal vein, followed by the preparation of the medial edge of the gland, achieves the effect of removing the gland from the inferior vena cava in such a way that the subsequent mobilization, performed with the radiofrequency or ultrasound instrument, can take place safer and faster, since there are no other major vascular structures to control.

In case of pheochromocytoma, the blood pressure's increase and heart arrhythmias, that may occur during surgery, have led many surgeons to consider open adrenalectomy more secure than the laparoscopic approach ¹⁰. The authors of this study disagree. Regarding the medical preparation to the surgical treatment an effective reduction of peri-operative complications is obtained with the administration of alpha and beta-blockers, starting the administration few weeks prior to surgery, and with the infusion of crystalloid solutions and plasma expanders before induction of anesthesia, avoiding to give an overdose of antihypertensive drugs due to the risk of a sudden fall in blood pressure after ligation of the adrenal vein ¹¹. Thus the careful preparation of the patient, the gradual acquisition of experience by the surgeons and anesthesiologists, the accurate intraoperative vital signs monitoring, the use of appropriate equipment allow to reduce the complications rate significantly ¹². Colic fistula, described by the authors among major complications was observed in the first part of the authors' experience when radio frequency and ultrasonic instruments were not yet available.

However some authors described a significant rate of intra-operative blood pressure instability during laparoscopic adrenalectomy for pheochromocytoma ^{3,13,14}. In 1996 Gagner ³ reported elevated intra-operative blood pressure (maximum systolic pressure > 200 mmHg) in 58% of cases. In 2002 Kercher ¹³ found values above 170 mmHg in 67% of cases. In the series of Thomson¹⁴ intraoperative tachyarrhythmias with paroxysms are reported during manipulation of the tumor. In fact, intraoperative squeezing of the gland, may cause hemodynamic changes despite a right alpha and beta receptors block. Therefore, the authors recommend a careful mobilization of the gland, without compression or traction in order to avoid significant amines increase. Other authors ^{15,16,17} recommend preventive ligation of the adrenal vein to prevent hypertensive attacks before the manipulation of the gland. However the question is still debated. Gagner ¹ and Vargas ¹⁸ do not consider the prior ligation of the vein necessary, as they believe that a delicate

manipulation of the gland is always possible. In our series the procedure was converted for pressure instability just in 1 case of right adrenalectomy for pheochromocytoma. In this case, despite the temporary interruption of the laparoscopic maneuvers and the reduction of the pneumoperitoneum, the systolic blood pressure remained above 200 mmHg. Kalady et al.¹⁹ suggest a transperitoneal anterior procedure with the patient in supine position, which offers a large work space and easier conversion in case of necessity, as the authors of this study. Others prefer the retroperitoneal posterior approach²⁰. We believe the anterior approach, and in particular submesocolic access to the left adrenalectomy, represents an available alternative to the more common lateral access. The main advantage is the early closure of the adrenal vein as first step of the operation which reduces the risk of adverse effects caused by the manipulation of the gland in secreting tumors and in particular in pheochromocytoma. Furthermore, the prior closure of the adrenal vein is an oncologically correct operation in adrenalectomies performed for metastatic tumors. Finally, this approach allows the removal of the adrenal gland with minimum dissection, in particular to the left adrenalectomy, and thus with reduced operative time and local complications, such as bleeding or iatrogenic injuries to the surrounding organs.

Conclusions

Adrenal masses can be successfully treated using a laparoscopic transperitoneal anterior approach. LA is a safe and effective procedure, which allows the removal of the gland with minimal manipulation. Therefore, it has been quickly established as the gold standard approach compared to the open one. To date, the lateral transperitoneal and retroperitoneal approaches are most as used compared to the transperitoneal anterior approach with the patient supine. The authors' preference goes to this latter approach because it allows easy identification of anatomical landmarks, early ligation of the adrenal vein, and when necessary, easier and more rapid conversion to open surgery. However this access requires a considerable experience by the surgical team.

Riassunto

SCOPO DELLO STUDIO: Scopo dello studio è illustrare l'esperienza degli autori con l'accesso anteriore transperitoneale, e nei casi di lesioni surrenaliche sinistre, l'approccio anteriore submesocolico.

MATERIALI E METODI: Dal gennaio 1994 al gennaio 2011, 122 uomini e 170 donne con un'età media di 50,76 anni (range: 19-84) sono stati sottoposti a surrenalectomia laparoscopica nei due centri di Roma e Ancona che seguono lo stesso protocollo. Quindici pazienti sono sta-

ti sottoposti a surrenalectomia laparoscopica bilaterale, in 233 casi (79,8%) è stato impiegato l'approccio anteriore transperitoneale ed in 59 (20,2%) quello anteriore sotto-mesocolico.

Tra i pazienti sottoposti a surrenalectomia laparoscopica, 102 erano affetti da sindrome di Conn, 51 miscellanea, 55 da malattia di Cushing, 47 da incidentaloma, 46 da feocromocitoma, 2 da ripetizioni metastatiche, 2 da mielolipoma e 2 da sindrome adreno-genitale, il diametro medio delle lesioni è stato di 3,24 cm (range: 0.5 - 10).
RISULTATI: Il tempo medio dell'intervento è stato di 120 minuti (range: 30-390), in 13 casi (4,45%) si è resa necessaria la conversione in chirurgia a cielo aperto. La pressione arteriosa e la frequenza cardiaca sono rimaste stabili. Sono state osservate 5 complicanze maggiori. Mobilizzazione ed alimentazione sono state riprese in 1 giornata post-operatoria e la degenza media è stata di 4,32 giorni (range: 2-30).

DISCUSSIONE: L'identificazione e la legatura precoce della vena surrenalica, con minima manipolazione della ghiandola sono il punto qualificante di questo accesso ed il maggior vantaggio della tecnica, soprattutto in caso di feocromocitoma.

CONCLUSIONI: Le lesioni surrenaliche possono essere trattate con successo per via laparoscopica transperitoneale anteriore, in presenza di adeguata esperienza da parte dell'equipe anestesilogica e chirurgica.

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