

Perioperative results of 214 laparoscopic adrenalectomies by anterior transperitoneal approach

Emanuele Lezoche · Mario Guerrieri · Francesca Crosta · Alessandro Paganini · Giancarlo D'Ambrosio · Giovanni Lezoche · Roberto Campagnacci

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Abstract

Background The present study attempts to evaluate the perioperative results of the anterior approached laparoscopic adrenalectomy (LA) in a large cohort of patients, and report the advantages and disadvantages of this route. **Methods** 204 patients, 125 female and 79 male with a mean age 52.8 years (range, 19–75 years), underwent LA by the anterior transperitoneal approach from 1994 to 2005 in our institution. There were 100 right and 114 left LAs. Ten patients underwent bilateral LA. Associated surgical procedures were performed in 17 cases. During the same period 47 LAs had been performed by different approaches (flank and submesocolic).

Results Mean operative time was 80 minutes for right (40–150), 109 minutes for left (64–300) and 194 minutes for bilateral adrenalectomy. Intraoperative major complications were observed in six patients. Mortality occurred in one diabetic patient who was converted to open surgery because of a colonic perforation and subsequently developed a Candida sepsis in the postoperative course. The mean size of lesion removed was 6.2 cm (1.5–12 cm). Oral intake started within 24 hours and the mean hospital stay was 2.5 days (1–8 days). Histology results were as follows: nonsecreting adenoma 65, Cushing's adenoma 58, Conn's

adenoma 53, pheochromocytoma 24, metastases 9, myelolipoma 3, adrenogenital syndrome 1, carcinoma 1.

Conclusions LA by anterior transperitoneal approach is safe and effective in our experience, despite the inherent limitation that this was not a prospective randomized study. The main advantage of this route is early ligation of the adrenal vein on both sides, enabling the performance of associated surgical procedures and bilateral adrenalectomy.

Keywords Minimally invasive surgery · Laparoscopic adrenalectomy · Adrenal tumours

Laparoscopic removal of the adrenal gland was first reported in 1992 [5–15]. Since its introduction, the technique has rapidly gained popularity among surgeons dealing with adrenal disease. LA is currently considered the gold standard in the treatment of patients with benign functioning and relatively small benign nonfunctioning adrenal lesions, while the reliability of laparoscopy with malignancy is still debated [13–15]. There are a significant number of studies in which LA is reported to be associated with decreased morbidity and postoperative hospital stay, and improved cosmetic results when compared with open procedure [12]. These encouraging results have led many surgeons to liberalize somewhat their criteria for elective adrenal resection, expanding the indications for laparoscopic adrenalectomy to large, nonfunctioning tumours with potential malignancy and to metastatic lesions [3]. Various laparoscopic approaches to the adrenal gland have been described. The most accepted route to the adrenal gland is the flank transperitoneal, with the patient in the lateral decubitus position. The anterior transperitoneal access in a supine patient is less frequently performed. In fact, this route is technically very demanding, requiring skill in laparoscopic colonic surgery. For instance, during

E. Lezoche · M. Guerrieri · F. Crosta · A. Paganini · G. D'Ambrosio · G. Lezoche · R. Campagnacci
Clinica di Chirurgia Generale e Metodologia Chirurgica,
Università Politecnica delle Marche, Azienda Ospedaliera
Umberto I, Ancona, Italy

F. Crosta (✉)
Clinica di Chirurgia Generale e Metodologia Chirurgica,
Università Politecnica delle Marche, Azienda Ospedaliera
Umberto, Ancona, Italy
e-mail: francescacrosta74@hotmail.com

left adrenalectomy by this approach, the splenic colonic flexure must be widely mobilized to reach the left adrenal region [9–16]. Despite the abundant literature, the best laparoscopic approach to adrenals is still a controversial issue, as each of these approaches has specific advantages and disadvantages [9–16]. The aim of the present study was to report the perioperative results of a large series of patients who underwent LA by the transperitoneal anterior approach, in order to investigate the related advantages and disadvantages.

Patients and methods

From 1994 to 2005, 261 consecutive laparoscopic adrenalectomies were performed at Clinica di Chirurgia Generale e Metodologia Chirurgica, Ospedali Riuniti, University of Ancona and at the Paride Stefanini Department of Surgery, II Clinica Chirurgica, University of Rome La Sapienza, Italy. Both the clinical protocol and surgical procedures were adopted by the two institutions under the consecutive direction of a single main investigator (EL). Moreover, the majority of cases (>150) were carried out in a single institution (University of Ancona). The present study analyzes the 214 adrenalectomies performed by the anterior transperitoneal route, not reporting the procedures fulfilled with different laparoscopic approaches. During the same time period, among the patients eligible for surgical therapy for adrenal mass, open surgery was scheduled for only two cases because of suspected invasive malignancy at preoperative imaging assessment. Exclusion criteria were evidence of tumor invasion into surrounding tissues and/or lymph node involvement. In the laparoscopically anterior approached cohort 204 patients (125 females, 79 males, mean age 52.8 years, range 19–75 years) underwent 214 LAs, 114 left and 100 right. Ten patients underwent bilateral adrenalectomy, of which nine were treated for bilateral cortisol-producing hyperplasia, while one, affected by multiple endocrine neoplasia (MEN 2A) and having previously undergone open left adrenalectomy, was treated for bilateral pheochromocytoma, recurring at the left side. All patients were studied with a computed tomography (CT) scan and abdominal ultrasonography (US) before surgery. Magnetic resonance imaging (MRI) was executed in selected cases, due to unclear CT scan findings or the lack of CT due to iodate contrast allergy. In patients with suspected pheochromocytoma ^{75}Se -cholesterol or ^{131}I metaiodobenzylguanidine, scintigraphy was performed. All patients received a complete endocrine evaluation, including measurement of serum cortisol at 08:00 and 00:00; measurement of plasma adrenocorticotrophic hormone, serum dehydroepiandrosterone sulphate, and testosterone at 08:00; an overnight dexamethasone

suppression test (1 mg orally at 23:00 and measurement of serum cortisol at 08:00 the following morning); upright plasma aldosterone and plasmatic renin activity (PRA) tests, and measurement of the 24-hour excretion of urinary free cortisol, vanillylmandelic acid and catecholamines. The serum electrolyte levels were also evaluated. Patients with pheochromocytomas received appropriate preoperative blockade with phenoxybenzamine and a beta-blocker (doxazosin 20 mg/day orally). Patients with Conn's syndrome-related potassium deficiency received spironolactone and preoperative potassium counterbalance. Clinically based indications for surgery were: incidentaloma ($n = 65$), Cushing's syndrome ($n = 59$), Conn's syndrome ($n = 53$), pheochromocytoma ($n = 24$), metastatic mass ($n = 9$), myelolipoma ($n = 3$), and adrenogenital syndrome ($n = 1$) (Table 1). Detailed informed consent, including the procedure-related risks, the possibility to switch to open surgery, and to eventually treat preoperatively undiagnosed associate diseases, was obtained in all cases.

Surgical technique

Technical details of the surgical procedure were previously reported [9, 10, 13].

Results

The mean operative time for right and left LA was 80 (40–150) and 109 minutes (64–300), respectively, and 194 (170–280) minutes for bilateral adrenalectomy. Seventeen patients (8.3%) with preoperatively known associated

Table 1 Clinical characteristics of patients

Sex	
Male	79
Female	125
Mean age, yr (range)	52.8 (19–75)
Size of tumor, cm (range)	6.2 (1.5–12)
Tumor side	
Right, n (%)	100 (49)
Left, n (%)	114 (55.8)
Indication	
Incidentaloma (n)	65
Conn's syndrome (n)	53
Cushing's syndrome (n)	59
Pheochromocytoma (n)	24
Virilizing adrenogenital syndrome (n)	1
Myelolipoma (n)	3
Metastases (n)	9

diseases (11 symptomatic gallstones, four ovarian cysts, one symptom-recurrent chronic appendicitis and one left kidney cyst) were simultaneously treated for both diseases. Cholecystectomy (six), left and right ovariectomy (two and one, respectively), appendectomy (one), and left kidney cyst fenestration (one) were performed among 11 right LA, while five cholecystectomy and one right ovariectomy were performed in patients undergoing left adrenalectomy. Upper abdominal associated procedures were performed without positioning additional trocars, beyond the standard four trocars for LA, whereas lower abdominal and pelvic procedures allowed one or two supplementary trocars and an operative table position change. There were six (2.9%) intra-operative complications that required conversion to open surgery: four for bleeding, only one of which required postoperative blood transfusions; one arrhythmia during right adrenalectomy for pheochromocytoma due to repeated arterial blood pressure peaks, and one colonic tear during a bilateral adrenalectomy for Cushing's hyperplasia. The latter patient, who had previously undergone sigmoid resection with temporary colostomy for peritonitis, died from Candida sepsis 60 days after the re-operation. There was only one case with a major postoperative complication, a hemoperitoneum due to a laceration of Glissonian liver capsule, that required a reoperation on the first postoperative day via laparoscopic access. A minor complication, an abdominal abscess, was treated by ultrasound-guided drainage and medical therapy (Table 2). Uncomplicated patients were ambulating freely and tolerating a light diet within 24 hours of operation. Concerning postoperative pain, 15% of patients required administration of a single dose of analgesic (Ketorolac 30 mg). The mean hospital stay was 2.5 days (range, 1–8). The mean diameter of removed adrenal was 6.2 cm (1.5–12 cm). Definitive histology resulted as follows: non-secreting adenoma 65, Cushing's adenoma 58, Conn's adenoma 53, pheochromocytoma 24, metastases 9, myelolipoma 3, adrenogenital syndrome 1, carcinoma 1 (Table 3). Adrenocortical carcinoma was found in a patient who received indication to LA as a clinical case of Cushing's syndrome with a left adrenal mass that measured 3.5 cm. Patients treated for metastasis (three from gastric cancer, one from lung cancer, two from renal cancer, one from melanoma and two from breast cancer) underwent postoperative chemotherapy.

Discussion

Since its first description [4], the use of laparoscopic adrenalectomy has expanded significantly [5] and today the laparoscopic approach is considered the gold standard for benign masses not greater than 5–6 cm in diameter [3]. The most frequently performed technique is the flank approach

Table 2 Morbidity and hospital stay

Bleeding (<i>n</i>) (%)	4 (1.9)
Conversion (<i>n</i>) (%)	6 (2.9)
Major complication (hemoperitoneum) (%)	1 (0.5)
Intra-abdominal collection (<i>n</i>) (%)	1 (0.5)
Wound infection (<i>n</i>) (%)	0
Mean hospital stay, days (range)	2.5 (1–8)

Table 3 Definitive histology

Incidentaloma (<i>n</i>) (%)	65 (31.8)
Cushing's adenoma (<i>n</i>) (%)	58 (28.4)
Conn's adenoma (<i>n</i>) (%)	53 (25.9)
Pheochromocytoma (<i>n</i>) (%)	24 (11.7)
Metastases (<i>n</i>) (%)	9 (4.4)
Adrenocortical carcinoma (<i>n</i>) (%)	1 (0.5)
Adrenogenital syndrome adenoma (<i>n</i>) (%)	1 (0.5)
Myelolipoma (<i>n</i>) (%)	3 (1.4)

with the patient in the lateral decubitus position [2, 9, 12, 17]. The anterior transperitoneal approach is considered by most surgeons to take longer and to be more complex, and is therefore rarely performed. The authors partly disagree with this opinion, believing that the perioperative results of present experience may suggest an alternative view. In fact the conversion rate (2.8%) is quite low compared to data from the literature, and the operative times for left and right adrenalectomy are no longer than those reported for other approaches [1]. The mean operative time for left adrenalectomy was longer than for the right side because access to the left adrenal region required a wide mobilization of the colonic splenic flexure and transverse colon. At any rate, examining our LAs performed by means of flank approach, the main operative parameters (operation time, complications) did not seem to differ significantly, taking into account the smaller number of LAs that we carried out by this technique. Furthermore, when indicated, it was possible to perform bilateral laparoscopic adrenalectomy. In the present series 10 patients were operated on (nine Cushing's syndrome and one pheochromocytoma) for a bilateral localization of the adrenal mass. Moreover, associated procedures were performed in all cases without changing the patient's position. On the basis of the present experience the anterior approach seems to be associated with the following advantages:

- (1) Easy, rapid positioning of the patient on the operative table. With this approach the patient is placed on the operative table in the supine position and the table is rotated on the left or on the right by 15° and in a moderate anti-Trendelenburg position.

- (2) Clear evidence of anatomical landmarks. 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.
- (3) Wider exposure of the adrenal gland [5]. The vision of the left and right adrenal glands following the anterior approach is wide; it is also facilitated by the use of a 45° angled laparoscope.
- (4) Early ligation of the main adrenal vein before gland manipulation is always possible utilizing this approach. A no-squeeze technique and no direct manipulation of the gland before the complete adrenal vascular pattern exclusion from the main circulation is strongly recommended in the case of suspected malignancy and pheochromocytoma [7]. In fact, early ligation of the main vein reduces the risk of catecholamine release in the bloodstream [8]. 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, even if many large adrenal tumors are benign [3–6]. In addition, the risk of malignancy for smaller adrenal tumors may be greater than was previously appreciated [11]. Technically, Gagner does not consider size as an absolute contraindication, because he has performed laparoscopic adrenalectomy for lesions of up to 13 cm in diameter, demonstrating the feasibility of this kind of surgery [14]. In our experience two adrenal tumors of 12 cm in diameter were treated successfully and in both cases the masses were benign.
- (5) The possibility to perform a bilateral LA is another advantage of the anterior approach and does not require changing the patient's position on the operative table. By allowing one to explore the entire abdomen and all areas of possible localization of extra-adrenal tumours by means of intraoperative ultrasound and direct vision, the anterior approach reduces the risk of misdiagnosis of ectopic tissue, for instance, in the case of pheochromocytoma. Moreover, the supine patient position allows the surgeon to perform associated surgical procedures, as reported in over 17 patients the present series.
- (6) Immediate conversion to open surgery may be required in the case of major bleeding. In this case, no extra time is required to change the patient position and the anatomical site of bleeding is more readily identified after opening the abdomen [9] with a medial incision. This leads to a complete view of the intraperitoneal organs and structures and the ability to investigate these retroperitoneally. As the surgeon becomes more confident with laparoscopic adrenalectomy, lesions larger than 5 cm in diameter can increasingly be approached. This increases the risk of traction on the main right adrenal vein, particularly during the flank approach for right-sided lesions, causing a life-threatening lesion of the inferior vena cava. According to Gagner and Assalia, bleeding is the most prevalent reason for conversion during the operation (40% of overall complications) and the main cause of reoperation, followed by organ injuries (3.1%) [1]. Indeed, every surgeon confident with adrenal gland surgery knows that generally the length of the main vein becomes shorter as the size of the gland increases. This anatomical condition may render the flank approach unfavorable. On the contrary, in the present experience, the risk of traction on the main right adrenal vein with the anterior approach was minimized proceeding cephalad the dissection of the medial margin of the adrenal mass. By dividing the small adrenal arteries arising from the aorta and located behind the inferior cava vein, the adrenal mass progressively shifts laterally. As a consequence, the space between the medial margin of the adrenal gland and the lateral margin of the inferior vena cava becomes wider, allowing easier control of the adrenal vein.
- (7) There is general agreement that the flank position has the advantage of fluids collecting out of the operative field by gravity, due to the position of the patient. On the other hand this situation may in fact turn into a risk for the patient, for example during a left LA, in the case of an accidental and unnoticed tear of the spleen due to dislocation of this organ outside the visualized operative field, particularly when using a 0° laparoscope. Otherwise, when adopting, the anterior approach fluids are collected close to the operative field and are therefore more easily checked by the surgeon.

LAs performed by the anterior approach lead us to collect some impressions about this laparoscopic route, gathering the related advantages and disadvantages on the basis of the abovementioned considerations and to justify these both theoretically and, having performed LAs by other approaches as well, in practice. On one hand, despite the nonrandomized nature of this study, biases originated from the nonrandomized selection and the significant difference between the number of procedures (anterior flank, sub-mesocolic) should not completely obscure the resulting technique-related advantages. On the other hand we are

conscious of the disadvantages of the anterior approach, such as the wider extension of dissection for left LA, compared to the flank technique (but lower if we compare the supine submesocolic with the flank technique) [13]. Therefore, we do not assert the advantages of our method, but instead suggest that the anterior transperitoneal approach should gain greater attention from the surgical community and eventually be employed more frequently during LA in an attempt to selectively improve its outcome.

Conclusions

Laparoscopic adrenalectomy by the anterior transperitoneal approach is safe and effective in a significant cohort of patients, allowing us to underline the related advantages, without neglecting its inherent disadvantages. It is our belief that further prospective, randomized studies will confirm the present data.

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