



CIRUGÍA ESPAÑOLA

www.elsevier.es/cirugia



Original article

Laparoscopic adrenalectomy. Analysis of 100 cases^{☆,☆☆}

David Álvarez,^{*} Alegría Tuzón, Manuel Meseguer, Consuelo Sebastián, Jacinto Galeano, and José Luis Ponce

Unidad Endocrino-Metabólica, Cirugía General y del Aparato Digestivo, Hospital La Fe, Valencia, Spain

ARTICLE INFORMATION

Article history:

Received August 28, 2008

Accepted June 25, 2009

Online November 7, 2009

Keywords:

Adrenal tumours

Laparoscopic adrenalectomy

Laparoscopic surgery

A B S T R A C T

Background: Laparoscopic approach is widely used in our country. This technique has dramatically improved the outcome after surgery, reducing pain, morbidity, hospital stay, and promoting early patient mobilization.

Objective: This study presents 10 years experience and the first 100 adrenalectomies using laparoscopy performed between 1996 and 2007 in Hospital La Fe, Valencia, Spain.

Methods: A descriptive and prospective study was designed, 100 consecutive cases were included. Sixty-seven variables were analysed; these variables were influenced by factors depending on patient susceptibility, surgical technique, surgeon, as well as in-surgery and post-surgery complications.

Results: None of the patients in our series died. In the follow-up, only minor complications were reported: nosocomial pneumonia (1 patient), small eventration (2 patients), haematomas (2 patients), and infection at surgery site (2 patients). None of the complications required surgery.

Conclusions: We conclude that adrenalectomy by the laparoscopic approach could be the gold standard technique in a variety of patients with adrenal tumours. However, these should be performed within a specialised endocrinology surgery unit.

© 2008 AEC. Published by Elsevier España, S.L. All rights reserved.

[☆] 2007: communication for the Congress of the Spanish Society of Laparoscopic Surgery that took place in Granada under the following title: "First 100 adrenalectomies using laparoscopy performed in the Hospital La Fe of Valencia (1996–2007)." Authors: D. Álvarez Martínez, A. Tuzón Segarra, M. Díaz del Río, M. F. Meseguer Anastasio, C. Sebastián, and J. L. Ponce Marco.

^{☆☆} 2007: oral communication for the XVI National Meeting of Surgery taking place in San Sebastian: "First 100 adrenalectomies using laparoscopy performed in the Hospital La Fe of Valencia (1996–2007)." Authors: D. Álvarez Martínez, A. Tuzón Segarra, M. Díaz del Río, M. F. Meseguer Anastasio, C. Sebastián, and J. L. Ponce Marco.

^{*} Author for correspondence.

E-mail address: almarda70@hotmail.com; almarda@alumni.uv.es (D. Álvarez).

Adrenalectomía laparoscópica: análisis de una serie de 100 casos

R E S U M E N

Palabras clave:

Tumores suprarrenales

Suprarrenalectomía laparoscópica

Cirugía laparoscópica

Introducción: La cirugía laparoscópica es una vía de acceso cada vez más usada en nuestro país. La laparoscopia ha mejorado radicalmente el postoperatorio, pues han disminuido el dolor postoperatorio, la morbilidad y la estancia hospitalaria y ha favorecido la deambulación precoz.

Objetivos: Presentar la experiencia de más de 10 años de realizar esta intervención en el Hospital La Fe de Valencia. Presentamos los resultados de las 100 primeras suprarrenalectomías laparoscópicas realizadas entre los años 1996 y 2007.

Material y métodos: Estudio descriptivo prospectivo de 100 casos. Se han escogido 67 variables de interés, variables dependientes de la susceptibilidad del paciente, de los métodos diagnósticos, de la técnica quirúrgica, del cirujano, así como las complicaciones intraoperatorias y postoperatorias.

Resultados: No hubo mortalidad en el postoperatorio inmediato. La morbilidad incluyó una neumonía nosocomial, 2 pequeñas eventraciones, 2 hematomas, 2 infecciones de la herida y otras complicaciones menores que no precisaron reintervención en ningún caso.

Conclusiones: La suprarrenalectomía laparoscópica es la técnica de elección para un diverso grupo de tumoraciones suprarrenales. Sin embargo, pensamos que esta técnica no debe realizarse fuera de unidades especializadas en cirugía endocrina.

© 2008 AEC. Publicado por Elsevier España, S.L. Todos los derechos reservados.

Introduction

The laparoscopic approach has been the gold standard technique in adrenal disease surgery for over 10 years. Its advantages are well known: minimal incision, good control and access to vascular pedicles, reduction of hospitalisation time, significant reduction of post-surgery pain, and morbidity reduction.

It is of utmost importance the selection of subsidiary patients to laparoscopic intervention. Laparoscopic surgery has been indicated for aldosterone-producing adenoma, cortisol-producing adenoma, pheochromocytoma, incidentalomas >4 cm, and adrenal metastasis. Malignant adrenal tumour is strongly contraindicated.

This technique requires a learning curve. Dissection of arterial and venous vessels prior to gland removal is a must; on the left side, the left adrenal vein stemming from the renal vein or the diaphragmatic-adrenal venous trunk, which is used as a guide for gland dissection, and on the right side, the main adrenal vein, branching out from cava vein. Small-calibre arterial vessels branch directly from aorta, from renal and from diaphragmatic arteries. In-surgery haemorrhage is the most feared complication.

Our aim is to evaluate results to the short and long term for the first 100 adrenalectomies using laparoscopy performed in a single centre during 10 years.

Material and methods

Observational descriptive study of 100 cases. All patients that underwent laparoscopic adrenalectomy during 10 years were included. No age limit was set. Indications accepted for this intervention using laparoscopy exclusively were respected.

The endocrinology surgery team of Hospital La Fe of Valencia performed all laparoscopies.

Inclusion criteria:

1. Laparoscopic adrenalectomy for aldosterone-producing adenoma, cortisol-producing adenoma, pheochromocytoma, incidentalomas >4 cm, and adrenal metastasis, occurring between the years 1997–2007, and performed at the endocrine-metabolic surgery unit of the general and digestive surgery service of Hospital La Fe of Valencia.

Outcomes were data-based complying with protocol.

Variables introduced in the study are shown in Table 1.

Pre-surgery characteristics of the group of individuals in the series can be observed in Table 2.

Medical background of each one of the patients surgically treated was analysed: the presence of 41 patients with arterial hypertension is noticeable, 10 patients with multiple endocrine neoplasia 2A (MEN2A), 5 patients with headache,

Table 1 – Variables subject to study

<i>Variables derived from patient</i>	<i>Variables derived from disease</i>
Name	Diagnosis
Surname	Side
Case history number	Size
Age Finding	Pre-surgery treatment
Weight	Imaging techniques
Size Laboratory test	
Allergies	
Patient's history	
Surgical history	
<i>Variables derived from the intervention</i>	<i>Variables derived from post-surgery</i>
Date	Number of drains and withdrawal
Re-intervention	Days in reanimation
Surgeon	Re-intervention
First assistant	Post-surgery complications
Anaesthetist	Treatment at discharge
Procedure duration	Hospital stay
Thromboembolic and antibiotic prophylaxis	Evolution
Access to cavity	Pathology
Findings	
Blood loss-transfusions	
In-surgery complications	
Conversion	

Table 2 – Pre-surgery characteristics of patients

Patients	95
Sex: male/female	38/62
Age, mean, y	48.55
BMI, mean	28.96
Tumour size mean, cm	3.47 (range, 0.80–11)
Side	
Right	43
Left	47
Bilateral	5
BMI indicates body mass index.	

Table 3 – Complete hormonal laboratory test

<ul style="list-style-type: none"> • Free catecholamine in urine of 24 h • Metanephrine in urine of 24 h • Serum potassium • Plasma renin • Plasma aldosterone • Free urinary cortisol in 24 h
--

5 diabetic patients, 4 patients with lung cancer, 3 patients with ischemic heart disease, 1 patient with colon cancer with hepatic metastasis, and 1 patient with renal cancer (Table 3).

Hormonal analysis assessment was decisive for diagnosis. A complete hormonal laboratory test was requested for all cases (Table 3).

No catecholamine and plasma metanephrine study was used.¹

Outcomes depending on type of tumour are detailed right below.

For pheochromocytoma, the analytic data which alteration was most frequently observed was the increment of metanephrine in urine, increasing in 100% of the cases.

Patients with Cushing syndrome were studied by the following analytical parameters: Free urinary cortisol in 24 h urine and test of 1mg of dexamethasone, which negative result confirmed the presence of Cushing's syndrome in 100% of the cases. Free urinary cortisol was high in all patients.

For patients suspected of hyperaldosteronism, the analytic values studied were reduction of plasma renin activity and increase of aldosterone in blood, and an increment of aldosterone was observed in the 24 patients (100% of the cases).

Eventually, patients with non-functioning tumours or metastasis, as well as patients with other diagnosis, were practiced a complete series of hormonal analyses (Table 3). Pheochromocytoma has been the disease that caused the largest number of interventions. The second largest, and by the same proportion, are hyperaldosteronism (Conn's syndrome) and Cushing's syndrome, as shown in Table 5 and in Figure 1.

The team that performed all the laparoscopic adrenalectomies is formed by 4 surgeons with experience in laparoscopic surgery, who are experts in this type of interventions.

Cholecystectomy stands out with relation to the number of interventions associated with laparoscopic adrenalectomy in the same surgical act (Table 4).

Adrenal tumour findings are shown in Table 5.

During localisation diagnostic process, CT was the most frequently used examination, performed in 61 cases. The

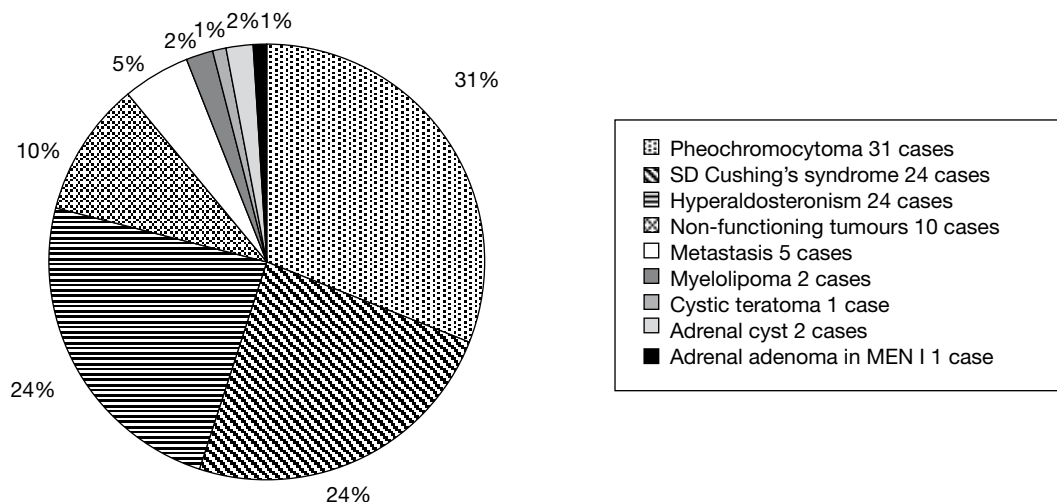


Figure 1 – Case distribution.

Table 4 – Associated interventions

Associated intervention	Number of cases
Cholecystectomy	3
Cyst nephrectomy	1
Cholecystectomy and umbilical hernia	1
Thyroidectomy	1
Thyroidectomy and parathyroidectomy	1
Thyroidectomy and central neck resection	1
Parathyroidectomy and auto-transplantation	1

Table 5 – Finding paths to adrenal tumours

Finding path	Number of cases
Study by HT	25
Casual finding	23
Manifestations study for Cushing's syndrome	14
MEN follow-up	10
Cancer follow-up	6
AHT, headache and palpitations	3
Early puberty	1

AHT indicates arterial hypertension; MEN, multiple endocrine neoplasia.

second most frequent was NMR for 49 cases. Both were useful in 100% of the cases. Diagnosis was given by abdominal ecography in 7 out of 10 times. Scintigraphy showed uptake in 33 out of 42 cases. Among other tests, 5 PET and 1 renal magnetic resonance angiography were requested. In all those patients with pheochromocytoma, an isotopic study with MIBG (meta-iodine-benzylguanidine) was performed, given its high specificity.² In all metastasis cases a PET was performed, which always turned out positive and identified

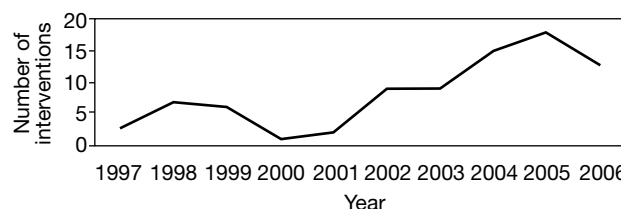


Figure 2 – Number of interventions per year.

the adrenal metastasis as the only manifestation of the malignant process.

Pre-surgery treatment was individualised for each patient:

- Pheochromocytoma: phenoxybenzamine was always given (doses between 20 to 100 mg) and, when tachycardia occurred, propranolol was added (40 mg).
- Cushing's syndrome: ketoconazol was added only in those cases with specific clinic (the dose used in patients over 30 kg was 200 mg/day in 2 oral doses).
- Hyperaldosteronism: spironolactone was administered (100–400 mg daily doses in adults).

The number of interventions performed yearly has varied: it has progressively increased since 2000 (Figure 2).

The usual approach was lateral transperitoneal in lateral recumbent position. Four 10 mm-subcostal trocars were usually used. Optiview (Ethicon EndoSurgery®, Cincinnati, OH) or Hasson trocar (M. H. Hasson in 1971) were indistinctly used to introduce the camera. Ten mm trocars were used because they allow introducing swabs useful for dissection. These swabs cannot be introduced using 5 mm trocars. Thirteen patients were operated with 3 trocars, usually through the left side. Five trocars were used in 1 case.

For gland dissection, clips and electric scalpel were initially used. Following that, Ligasure Valleylab® (Vessel Sealing System) and Endo Clip® (Tyco Healthcare).

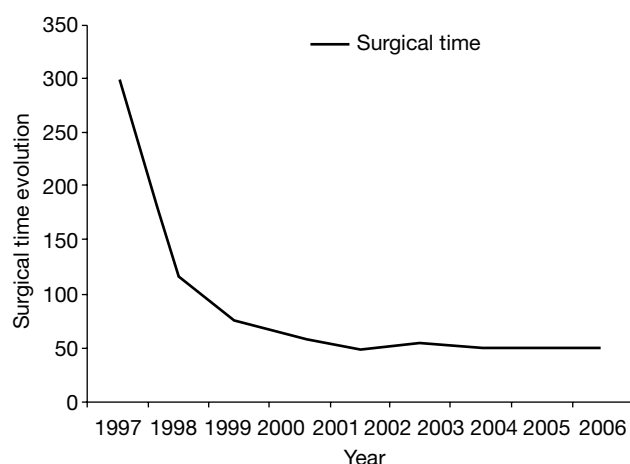


Figure 3 – Surgical time.

Table 6 – In-surgery complications

	Number of cases
Spleen tear	2
Pneumothorax	2
Haemorrhage of a diaphragmatic artery	1
Haemodynamic instability	1

Table 7 –Post-surgery complications

	Number of cases
Haematoma on the abdominal wall	3
Infection at surgery site	2
Eventration	2
Respiratory insufficiency (PTE)	1
Intra-abdominal collection and pneumonia	1
PTE indicates pulmonary thromboembolism.	

Results

Patients with surgical history were operated on: three patients with previous cholecystectomy (2 of them underwent right adrenalectomy), 19 patients with gynaecologic/urologic surgery, 2 patients with contralateral adrenalectomy, and 1 patient with total colectomy associated with resection of hepatic metastasis.

Average time of unilateral adrenalectomy from anaesthesia induction until the patient left the operating room was 120 min (range, 45–180; SD, 33.091). Approximately 240 min for bilateral adrenalectomies (range, 130–300; SD, 70.498). Right side mean was 117.62 min and left side mean was 125.52 min. In the case of associated interventions, duration varied depending on the type of intervention (Figure 3).

Mean hospital stay was 7.1 days. Mean was 6 days and mode was 5 days (range, 3–26; SD, 4.319). Post-surgery stay

was 5.2 days. Some patients were admitted 2 days before the intervention to complete their pre-surgery treatment. Patients with pheochromocytoma stayed 24 h at the intensive care unit after surgery.

Thromboembolic prophylaxis was low-molecular weight heparin for all the cases: enoxaparin (40 mg subcutaneously during 10 days).

Mortality was 0%.

In-surgery complications are shown in Table 6.

The 2 small tears of the spleen capsule did not require splenectomy.

The 2 pneumothorax were drained in the same surgical act.

A small haemorrhage of a diaphragmatic artery did not force to open surgery.

Haemodynamic instability occurring in one pheochromocytoma forced to open surgery.

No differences were found between the numbers of complications in the right side against the left side.

Associated post-surgery complications are described in Table 7.

The average size of adrenal tumours ablated was 3.47 cm, minimum size was 0.80 cm (one case of pheochromocytoma in a patient with MEN2A syndrome), and maximum size was 13 cm (myelolipoma). The following were removed: one 7 cm-adrenal cyst, one 8 cm metastasis, two 9 cm and 10 cm myelolipomas, and one 11 cm cystic teratoma.

Two units of red blood cell concentrates had to be transfused after surgery in 2 cases. The first one due to haematoma on the abdominal wall and the second for chronic anaemia prior to intervention.

Rate of conversion to open surgery was 3%.

The first case that had to be converted to open surgery was on January 1997. Surgery was opened due to intra-abdominal haemorrhage and did not require transfusion afterwards.

The second case was lung metastasis and occurred on March 2004. After initial assessment, tumoural infiltration of kidney and adrenal vein was observed.

The third case took place on April 2005. It was a pheochromocytoma in a MEN2A patient. Surgery was opened due to haemodynamic instability.

No patient was surgically treated again.

Discussion

We agree with most authors consulted³⁻⁵ on that laparoscopic adrenalectomy is a safe and efficient procedure to treat benign tumours of the adrenal gland. From its beginnings in Spain, in 1993, with publications of authors such as Fernández Cruz, this technique has been strengthening itself for diseases particular to the adrenal gland.

We also agree with other authors such as Strong et al⁶ on that it is a safe procedure for resection of adrenal metastasis, with similar results regarding resection margins and local recurrence.

Discussion stands as to maximum size of tumours to be treated laparoscopically. Some authors suggest a maximum of 15 cm. We consider size not to be a limitation at present, since in our series tumours of up to 13 cm have been resected (Toniato et al⁷).

There are a number of factors that must be taken into account to obtain a satisfactory result: both a correct selection of patients and a complete pre-surgery update are necessary. A complete hormonal laboratory test should always be made. No patient should be operated on if pre-surgery is not complete, no matter how evident the tumour image is.⁸

On the other hand, a reduction of surgery time has been observed in the number of operations performed by each surgeon; from 150 min initially in 1997 to approximately 50 min in interventions performed last year.

We agree with Gagner et al,⁹ Plaggemars et al,¹⁰ and Smith et al¹¹ regarding the access path. The lateral transperitoneal path was chosen at our centre. This latter does not imply an increase in surgical time against open adrenalectomy used by surgeons familiarised with such technique. It results in a complete vision of the abdominal cavity and convenient access to vascular structures.

Together with Wu et al,¹² our opinion is that experienced surgeons in laparoscopic surgery should perform laparoscopic adrenalectomy.

In conclusion, we consider laparoscopic adrenalectomy to be a safe procedure for any type of tumour, independently of its hormonal production, except for malignant tumours. Its gradually progressive generalisation proves it right.

REFERENCES

1. Lenders JW, Keiser HR, Goldstein DS, Willemsen JJ, Friberg P, Jacobs MC, et al. Plasma metanephrines in the diagnosis of pheochromocytoma. *Ann Intern Med.* 1995;123:101-9.
2. Oleaga A, Goñi F. Feocromocitoma: actualización diagnóstica y terapéutica. *Endocrinol Nutr.* 2008;55:202-16.
3. Fernández-Cruz L, Benarroch G, Torres E, Astudillo E, Saenz A, Taura P. Laparoscopic approach to the adrenal tumors. *J Laparoendosc Surg.* 1993;3:541-6.
4. Jacobs JK, Goldstein RE, Geer RJ. Laparoscopic adrenalectomy. A new standard of care. *Ann Surg.* 225, 495-502.
5. Tim Lok Kwan N. Adrenalectomy in Hong Kong: A critical review of adoption of laparoscopic approach. *Am J Surg.* 2007;194:153-8.
6. Strong VE, Angelica MD, Tang L, Prete F, Gönen M, Coit D, Touijer KA, Fong Y, Brennan MF. Laparoscopic adrenalectomy for isolated adrenal metastasis. *Ann Surg Oncol.* 2007;14: 3288-9.
7. Toniato A, Boschin IM, Opocher G, Guolo A, Pelizzo M, Mantero F. Is the laparoscopic adrenalectomy for pheochromocytoma the best treatment?. *Surgery.* 2007;141:723-7.
8. de la Cruz Vigo JL, Sanz de la Morena MP. Cirugía laparoscópica adrenal. In: Targarona EM, editor. *Guía clínica de la asociación española de cirujanos: cirugía endoscópica.* Editorial Arán; 2003. p. 496-507.
9. Gagner M, Pomp A, Heniford BT, Pharand D, Lacroix A. Laparoscopic adrenalectomy: Lessons learned from 100 consecutive procedures. *Ann Surg.* 1997;226:238-46.
10. Plaggemars JH, Targarona ME, van Couwelaar G, D'Ambra M, García A, Rebasa P. ¿Qué ha cambiado en la adrenalectomía? De la cirugía abierta a la laparoscópica. *Surgery.* 2005;77: 132-8.
11. Smith CD, Weber CJ, Amerson JR. Laparoscopic adrenalectomy: New gold standard. *World J Surg.* 1999;23:389-96.
12. Wu CT, Chiang YJ, Chou CC, Liu KL, Lee SH, Chang, YH, et al. Comparative study of laparoscopic and open adrenalectomy. *Chang Gung Med J.* 2006;29:468-73.