

Bilateral Laparoscopic Adrenalectomy

OCTAVIO A. CASTILLO, M.D.,^{1,2} GONZALO VITAGLIANO, M.D.,¹ OSCAR CORTES, M.D.,¹
MARCELO KERKEBE, M.D.,¹ IVAN PINTO, M.D.,¹ and LEONARDO ARELLANO, M.D.³

ABSTRACT

Background and Purpose: Laparoscopic adrenalectomy has become the gold standard in the surgical management of adrenal pathology. Bilateral adrenalectomy is indicated in patients with Cushing's disease secondary to macroadenoma or hypophysial hyperplasia in whom medical treatment and transsphenoid surgery have failed. Also, it is the first choice for bilateral benign tumors and metastatic neoplasia. We present our experience with bilateral laparoscopic adrenalectomy, analyzing its indications, feasibility, results, and complications.

Patients and Methods: Between November 1999 and December 2005, 221 laparoscopic adrenalectomies were performed by the same surgeon (OAC) at our institution. Of the 221 adrenalectomies, 44 were bilateral. A total of 20 patients underwent bilateral synchronic laparoscopic adrenalectomy (91%); the remaining 2 had two-stage procedures. There were 6 cases of bilateral pheochromocytoma, 6 patients with Cushing's disease, 3 cases of metastasis, 3 congenital adrenal hyperplasias, 2 hyperaldosteronisms, and a single case each of adrenal adenoma and myelolipoma. The average patient age was 41.6 years (range 17–72 years), and the male-to-female ratio was 1:2.6.

Results: Total laparoscopic adrenalectomy and partial adrenalectomy were performed on 37 and 7 occasions (84% and 16%), respectively. The mean tumor size was 4.15 cm (range 1–11 cm). The mean operative time for each adrenalectomy was 79.2 minutes (range 25–210 minutes). The estimated intraoperative blood loss was on average 65.4 mL (range 0–500 mL). Only one patient required a blood transfusion. There was only one intraoperative complication (2.2%), a renal-vein injury that was controlled with intracorporeal suturing. There were no open conversions. The mean hospital stay was 3.19 days (range 2–5 days).

Conclusions: Bilateral laparoscopic adrenalectomy is technically feasible and can be performed with minimal bleeding in a reasonable surgical time.

INTRODUCTION

SINCE IT WAS FIRST DESCRIBED by Gagner and associates in 1992,¹ laparoscopic adrenalectomy has become the gold standard in the surgical management of adrenal pathology. Present indications for laparoscopic adrenalectomy include aldosteronoma, pheochromocytoma, Cushing's disease, nonfunctioning adenomas, and rare entities such as adrenal cysts, myelolipomas, and adrenal metastases.^{2,3}

Bilateral adrenalectomy is indicated in patients with Cushing's disease secondary to macroadenoma or hypophysial hyperplasia in whom medical treatment and transsphenoid surgery have failed. Also, it is the first choice for bilateral benign tu-

mors and metastatic neoplasms.⁴ We present our experience with bilateral laparoscopic adrenalectomy, analyzing its indications, feasibility, results, and complications.

PATIENTS AND METHODS

Patients

Between November 1999 and December 2005, 221 laparoscopic adrenalectomies were performed by the same surgeon (OAC) at our institution. Of them, 44 were bilateral (Table 1). Of these 22 patients, 20 (91%) had synchronous bilateral

¹Section of Endourology and Laparoscopic Urology, Department of Urology, and ²Department of Pathology, Clínica Santa María, Santiago de Chile, Chile.

³Department of Urology, School of Medicine, Universidad de Chile, Santiago de Chile, Chile.

TABLE 1. PATIENT CHARACTERISTICS AND OPERATIVE DATA

No. of patients	22
Mean age (years)	41.6
Sex (M:F)	6:16
Surgery	
Adrenalectomy	37
Tumorectomy	7
Simultaneous procedures	20
Mean operative time (min)	79.2
Mean estimated blood loss (mL)	65.4
Mean tumor size (cm)	4.15
Mean hospital stay (days)	3.19

adrenalectomy, and two had two-stage surgery. The average patient age was 41.6 years (range 17–72 years), and the male-to-female ratio was 1:2.6. In all patients, endocrine evaluation was performed. A database was kept prospectively. Preoperative diagnosis, lesion size evaluated by CT scan or MRI, surgical technique, operative time, intraoperative bleeding, histopathologic diagnosis, complications, conversion to open surgery, and hospital stay were reviewed.

Surgical technique

All procedures were carried out transperitoneally. The patient was placed in either the left or the right lateral decubitus position for the first adrenalectomy and then changed to the contralateral decubitus position for the second procedure (Fig. 1). When a left-sided adrenalectomy is performed, three trocars are placed 3 cm below the costal rim: a 10-mm trocar in the medial axillary line for the camera and a second 10-mm trocar in the posterior axillary line and a 5-mm trocar in the median clavicular line as working ports (Fig. 2A). In these cases, it is necessary to divide the splenicocolic ligament and reflect the splenic angle of the colon. The spleen and the tail of the pancreas are mobilized medially to reveal the adrenal gland. Because of the transperitoneal approach, there is no way to expose the adrenal tumor adequately without completely reflecting the spleen. Gerota's fascia is opened between the medial portion of the kidney and the adrenal mass, allowing the mass to fall medially and facilitating identification of the renal and adrenal veins.

For the right-sided procedures, a fourth 5-mm trocar is added in the epigastrium, through which forceps are placed to keep the liver from obstructing the field (Fig. 2B). In these cases, the triangular hepatic ligament is sectioned, allowing the liver to move forward and out of the way. Then the posterior peritoneum is incised transversally, immediately caudal along the length of the liver. We find it valuable to dissect the avascular plane between the upper pole of the kidney and the adrenal gland. This dissection is deepened until the posterior muscular structures are clearly visible. After that, the dissection is extended laterally along Toldt's line and medially over the inferior vena cava. This maneuver allows the mass to be reflected cephalad, facilitating the exposure of the inferior vena cava and the right adrenal vein. In both the right- and the left-sided procedure, the main suprarenal vein is dissected, clipped, and divided. This step usually is performed after all of the adrenal gland has been freed. However, in the setting of pheochromocytomas, we believe that prompt control of the adrenal vein is crucial if a catecholamine surge is to be avoided.

For partial adrenalectomy, we do not routinely clip the adrenal vein; instead, we prefer to section the normal parenchyma surrounding the nodule carefully. For this step, we have found no difference between monopolar electrocautery, the Ligasure device, and the Harmonic Scalpel. However, we routinely use the Harmonic Scalpel because of its proved versatility.

RESULTS

The average size of the adrenal gland or tumor was 4.15 cm (range 1–11 cm). The most common clinical entity was pheochromocytoma, followed by Cushing's disease, metastatic cancer, hyperaldosteronism, congenital adrenal hyperplasia, and single cases each of myelolipoma and adrenal adenoma. Total laparoscopic adrenalectomy and partial adrenalectomy were performed on 37 and 7 occasions (84% and 16%), respectively. Partial adrenalectomy was carried out in two pheochromocytomas, two adrenal adenomas, and three cases of hyperaldosteronism with a single small node previously documented with CT scan. The mean tumor size in the tumorectomies was 3.3 cm (range 2–6 cm).

The mean operative time for each adrenalectomy was 79.2 minutes (range 25–210 minutes), being 79.4 and 78.9 minutes for right and left adrenalectomies, respectively. The operative time was measured from the time the first trocar was placed until the last trocar was withdrawn. However, to calculate total anesthetic time, the additional 50 minutes needed to induce general anesthesia and change patient position should be added. Nevertheless, the longer anesthetic time needed for bilateral adrenalectomy did not impact postoperative recovery. The estimated intraoperative blood loss was on average 65.4 mL (range 0–500 mL), as estimated by the anesthesiologist. The loss was considered to be 0 mL when there was no measurable blood in the suction/irrigation device. Only one patient required a blood transfusion. There was only one intraoperative complication (2.2%): a renal-vein injury that was controlled with intracorporeal suturing. However, conversion to open surgery was not required in this or any other case.

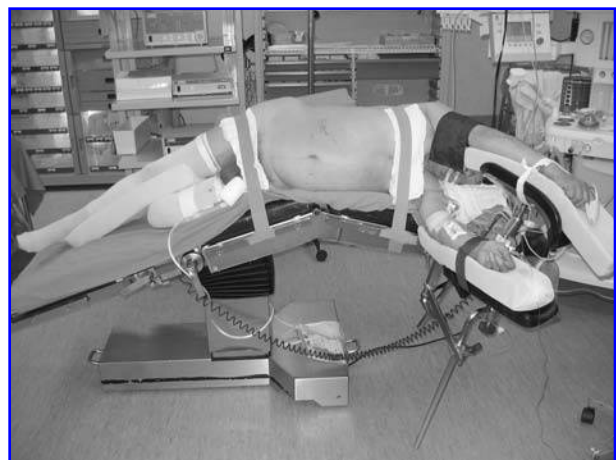
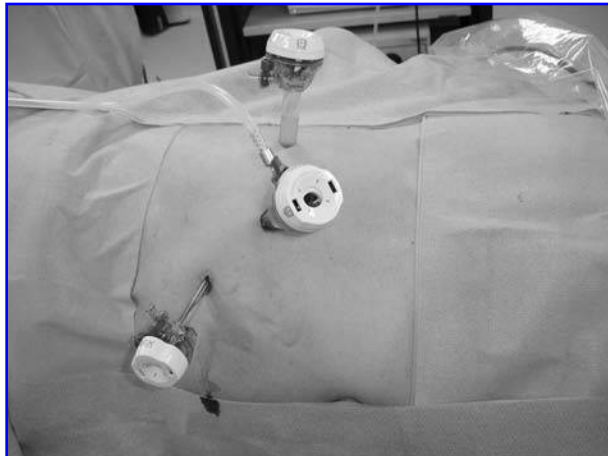


FIG. 1. Patient positioned for right adrenalectomy.

A



B

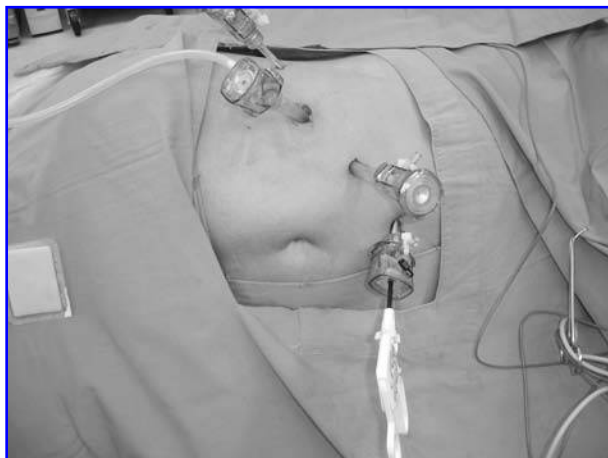


FIG. 2. Trocar placement for left (A) and right (B) adrenalectomy.

All patients were started on an oral diet 6 hours after surgery. The mean hospital stay was 3.19 days (range 2–5 days). It is noteworthy that our sociocultural situation delays hospital discharge. Table 2 shows the operative data and outcomes.

DISCUSSION

In their series of 100 laparoscopic adrenalectomies carried out between 1992 and 1996 Gagner and collaborators⁵ reported 10 patients who underwent bilateral adrenalectomy: 3 cases of malignant pheochromocytoma, 2 of benign pheochromocytoma, 3 of Cushing's disease, and 1 each of bilateral adenoma and bilateral macronodular hyperplasia. Hasan and associates⁴ published on seven patients who underwent bilateral laparoscopic adrenalectomy for bilateral pheochromocytoma, Cushing's disease, or metastatic cancer.

There is no question regarding the distinct advantages offered by laparoscopic adrenalectomy over the classic open approach. A shorter hospital stay, reduced analgesic requirements,

and faster convalescence with greater patient satisfaction favor the laparoscopic approach.⁵

Catecholamine overproduction is responsible for the clinical manifestations of pheochromocytoma. Surgery differs from all other treatments in the inherent risks this specific tumor poses. Several series of laparoscopic adrenalectomy for pheochromocytoma have been reported. However, there are no randomized studies comparing laparoscopic adrenalectomy with open surgery. It has been suggested^{2,6} that catecholamine liberation would be less during laparoscopic surgery than open surgery. In our series of six cases of bilateral adrenalectomy for pheochromocytoma, the mean tumor size was 6.6 cm (range 2–11 cm). In this subgroup, there were no intraoperative complications attributable to either the surgical technique or the acute flow of catecholamines. On histopathologic analysis, one patient was found to have malignant pheochromocytoma. Surgical margins were negative, and a 15-month follow-up has shown no recurrence. Two patients had von Hippel-Lindau disease, and one patient presented bilateral pheochromocytomas in the setting of a MEN II syndrome. Familial pheochromocytoma was detected in one patient; tumorectomy was not feasible because of the sizes of the tumors (4 and 7 cm). A case of partial bilateral laparoscopic adrenalectomy for pheochromocytoma in a man with lesions of 2.5 and 4 cm was reported by Kaouk et al,⁷ with excellent results. However, because of the considerable size of the pheochromocytomas in our series, partial adrenalectomy was not feasible.

Transsphenoidal surgery is the preferred treatment for patients with Cushing's disease. Success rates are close to 90% in the setting of pituitary microadenomas but drop to 65% for macroadenomas and to 38% for recurrent or persistent disease.^{8,9} The treatment of patients with Cushing's disease who have relapsed after transsphenoid microsurgery remains controversial. Treatment options include medical adrenalectomy, repeated transsphenoidal surgery, radiation with a gamma knife, and bilateral adrenalectomy.¹⁰ Medical therapy frequently is poorly tolerated because of its long-term secondary effects. Pituitary radiation with a gamma knife is effective in only 63% of patients; nevertheless, the incidence of global pituitary deficiency after radiation can reach 50%.¹⁰ On the other hand, bilateral adrenalectomy has been shown to be effective in reversing the signs and symptoms of Cushing's disease.^{10–14} Laparoscopy has significantly reduced the morbidity classically associated with open adrenalectomy. Various reports confirm its feasibility in patients with Cushing's disease.^{13,14} In the series of Hawn and coworkers,¹⁰ 18 patients underwent bilateral laparoscopic adrenalectomy for Cushing's syndrome between 1994 and 2000. The quality of life was improved in 81% of the patients. However, despite the improvement, patients do not reach the quality-of-life standards of the general population. In 2000, Gill² reviewed six laparoscopy studies specifically for Cushing's disease, in which he found a total of 46 patients submitted to bilateral adrenalectomy. In our series, simultaneous and two-stage bilateral laparoscopic adrenalectomy for Cushing's disease was carried out on five patients and one patient, respectively. The mean surgical time was 81.2 minutes (range 35–210 minutes). The average intraoperative blood loss was 50.8 mL (range 0–300 mL). In one patient, the renal vein was injured during dissection. Bleeding was controlled and the lesion repaired laparoscopically. The mean follow-up was 29

TABLE 2. OPERATIVE DATA AND OUTCOMES ACCORDING TO PATHOLOGIC NATURE OF LESION

<i>Clinical entity</i>	<i>Mean age</i>	<i>M:F</i>	<i>Surgery type</i>	<i>Synchronous?</i>	<i>Mean operative time (min)</i>	<i>EBL (mL)</i>	<i>Complications</i>	<i>Tumor size (cm)</i>	<i>Surgical margins</i>	<i>Follow-up (months)</i>	<i>Results</i>
Pheochromocytoma (<i>N</i> = 6)	33.6	1:2	2 tumorectomies; 10 adrenalectomies	Yes	97.1	106.6	No	6.6	Neg	44	Asymptomatic
Cushing's disease (<i>N</i> = 6)	42.8	F	Adrenalectomies	5 yes; 1 no	81.2	51	Renal vein injury	3.6	Neg	29	Asymptomatic
Cancer metastasis (<i>N</i> = 3)	63	2:1	6 adrenalectomies	2 yes; 1 no	70.8	145	No	6.3	4 neg; 2 pos	6	2 asymptomatic; 1 tumor progression
Congenital adrenal hyperplasia (<i>N</i> = 3)	17.6	F	Adrenalectomies	Yes	67.5	50	No	7.5	Neg	25	Asymptomatic
Hyperaldosteronism (<i>N</i> = 21)	61	1:1	3 tumorectomies; 1 adrenalectomies	Yes	57.5	17.5	No	4.1	Neg	46	Asymptomatic
Adrenal adenoma (<i>N</i> = 1)	44	F	2 tumorectomies	Yes	55	20	No	3.5	Neg	24	Asymptomatic
Myelolipoma (<i>N</i> = 1)	49	F	Adrenalectomies	Yes	82.5	0	No	8	Neg	34	Asymptomatic

months (range 3–75 months). All patients reported significant quality-of-life improvement after surgery.

With the widespread use of laparoscopy, some centers have extended the indications for laparoscopic adrenalectomy to include large primary, potentially malignant, and metastatic tumors.¹⁵ Authors who advocate this technique argue that the laparoscopic approach offers significantly less morbidity while preserving the principles of oncologic surgery.^{16,17} Nevertheless, laparoscopic adrenalectomy for potentially malignant tumors or adrenal metastases remains controversial.^{2,16,17} Adrenal metastases usually occur in patients with primary cancer of the lung, kidney, gastrointestinal tract, or breast or melanoma.¹⁸ Many reports confirm that the resection of adrenal metastases in patients with a single excisable primary tumor can result in prolonged survival, especially in patients with non-small-cell lung cancer and those with renal-cell carcinoma.¹⁸ Laparoscopic adrenalectomy for suspected adrenal metastasis is acceptable when: (1) there is a curative intention for a solitary adrenal metastasis; (2) as a palliative procedure for large, symptomatic, and synchronous adrenal metastases; and (3) there is a diagnostic suspicion of adrenal metastasis.¹⁷ In the experience of Kebebew and colleagues¹⁷ with laparoscopic adrenal metastasectomy in 17 patients, the surgical margins were negative in all cases, and there was no local failure with a mean follow-up of 3.3 years. In that series, there was only one case of bilateral adrenal metastasis resulting from a primary colon cancer. We performed bilateral adrenalectomy in the setting of adrenal metastasis in three occasions. One patient was a 47-year-old woman with a history of lung cancer and suspicion of metastasis of 5 and 3.2 cm in the right and left adrenal gland, respectively. The patient underwent bilateral laparoscopic radical adrenalectomy with surgical times of 60 and 45 minutes and blood loss of 50 and 20 mL for the right and left adrenalectomies, respectively. In both specimens, microscopic evaluation revealed an adenocarcinoma with negative surgical margins. A 13-month follow-up showed absence of recurrence. Another patient was a 70-year-old man with melanoma who underwent bilateral adrenalectomy in two stages for a 9- and 3-cm left and right adrenal mass, respectively. The surgical time and operative blood loss were 97 and 98 minutes and 300 and 0 mL for the left and right adrenalectomies, respectively. The surgical margins were negative, and a 41-month follow-up was uneventful. The last patient of this group was a 72-year-old man with history of non-Hodgkin's lymphoma and bilateral adrenal metastases. Synchronous bilateral adrenalectomy was performed with a total operative time of 125 minutes. Operative blood loss was 500 mL, and the tumor size was 8 and 9.5 cm for the left and right adrenalectomies, respectively. Surgical margins were positive, and the patient passed away 6 months after surgery.

Primary hyperaldosteronism is a rare cause of hypertension. Adrenalectomy usually is required in the setting of an adrenal adenoma and when medical treatment has been ineffective.¹⁹ The laparoscopic approach has been used widely in the management of this entity, with excellent results in more than 90% of cases.² It has been well established that in cases of aldosterone-producing adenomas, conservative surgery is as effective as total adrenalectomy.^{20,21} Meria and coworkers²² published one of the largest series of laparoscopic adrenalectomies for the management of primary hyperaldosteronism. In their ex-

perience with 212 consecutive patients with primary hyperaldosteronism, a total of 213 transperitoneal operations were performed: 193 adrenalectomies and 20 adrenal tumorectomies, with only 1 case of bilateral adrenalectomy.

In our series, hyperaldosteronism had been diagnosed in two patients and congenital adrenal hyperplasia in three. In the group with hyperaldosteronism, one patient underwent simultaneous bilateral adrenal tumorectomy, and in the other patient, a simultaneous right adrenalectomy and left tumorectomy was performed. The other three patients underwent simultaneous bilateral adrenalectomy. All patients are currently taking no medication and asymptomatic. We believe that conservative adrenal surgery is technically feasible and has the advantage of avoiding corticosteroid-replacement therapy in cases of bilateral pathology. Of the 221 adrenalectomies performed at our institution, conservative adrenal surgery for Conn's disease was performed in 18 patients. All but one patient were asymptomatic after surgery. In this sole patient, two-stage total laparoscopic adrenalectomy was required. From our limited experience, we believe that partial adrenalectomy in the setting of Conn's disease should be reserved for cases where a single small node can be differentiated easily from normal parenchyma.

Discriminating adenoma from carcinoma remains a significant problem for pathologists. Size has been considered to be the single best predictor of malignancy in adrenal neoplasms that have been diagnosed incidentally. In a series reported by Hara and associates,²³ 12 nonfunctioning adenomas were diagnosed after 63 laparoscopic adrenalectomies. In our series, only one patient presented with bilateral nonfunctioning adrenal adenomas. The patient underwent laparoscopic bilateral tumorectomy. The total operative time and blood loss were 110 minutes and 40 mL, respectively. The tumors measured 3 and 4 cm for the left and right adrenalectomies, respectively.

Myelolipoma is a benign tumor that usually appears in the adrenal gland, although myelolipomatous foci also can be found associated with other adrenal pathologies or in extra-adrenal locations.²⁴ No malignant potential has been proved for adrenal myelolipoma. Although many lesions discovered incidentally are small and asymptomatic, reports of voluminous symptomatic lesions or lesions generating complications such as bleeding with secondary shock are not infrequent.^{25–28} Symptomatic lesions usually require surgical management, and open surgery has classically been advocated.^{24,26–28} However, laparoscopic adrenalectomy has produced a considerable decrease in morbidity, hospital stay, and convalescence. In our series, a 49-year-old woman underwent laparoscopic bilateral adrenalectomy for a 10-cm right and a 6-cm left adrenal myelolipoma. Bleeding was minimal, and the surgical time was very satisfactory: 120 mL and 45 minutes, respectively. A 34-month follow-up has been uneventful. Adrenal myelolipoma has typical tomographic characteristics that make it identifiable in the majority of cases, such as the presence of a pseudocapsule between the mass and the surrounding retroperitoneal fat.^{24,29} The pseudocapsule, which is made up of a few cellular layers of adrenal cortex compressed by the myelolipoma, facilitates dissection of the mass and vascular control, thus reducing the technical complexity of laparoscopic surgery on these tumors and allowing laparoscopic management of lesions >5 cm. To our knowledge, there is no other case of bilateral laparoscopic adrenalectomy for adrenal myelolipoma reported in the literature.³⁰

CONCLUSIONS

We consider bilateral laparoscopic adrenalectomy a feasible technique. In this series, bilateral adrenalectomy was performed for metastatic cancer, pheochromocytoma, hyperaldosteronism, myelolipoma, and Cushing's disease, with excellent surgical times with minimal bleeding. We had no major intraoperative or early postoperative complications or conversions to open surgery. We believe the laparoscopic approach is the optimum choice when bilateral adrenalectomy is warranted.

REFERENCES

- Gagner M, Lacroix A, Bolte E. Laparoscopic adrenalectomy in Cushing's syndrome and pheochromocytoma. *N Engl J Med* 1992;327:1033-1036.
- Gill IS. The case for laparoscopic adrenalectomy. *J Urol* 2001;166:429-436.
- Hobart MG, Gill IS, Schweizer D, Sung GT, Bravo EL. Laparoscopic adrenalectomy for large-volume (≥ 5 cm) adrenal masses. *J Endourol* 2000;14:149-154.
- Hasan R, Harold KL, Matthews BD, Kercher KW, Sing RF, Heniford BT. Outcomes for laparoscopic bilateral adrenalectomy. *J Laparoendosc Adv Surg Tech A* 2002;12:233-236.
- Gagner M, Pomp A, Heniford BT, Pharand D, Lacroix A. Laparoscopic adrenalectomy: Lessons learned from 100 consecutive procedures. *Ann Surg* 1997;226:238-247.
- Fernández-Cruz L, Taura P, Saenz A. Laparoscopic approach to pheochromocytoma: Hemodynamic changes and catecholamine secretion. *World J Surg* 1996;20:762-765.
- Kaouk JH, Matin S, Bravo EL, Gill I. Laparoscopic bilateral partial adrenalectomy for pheochromocytoma. *Urology* 2002;60:1100-1103.
- Mampalam TJ, Tyrrell JB, Wilson CB. Transsphenoidal microsurgery for Cushing's disease: A report of 216 cases. *Ann Intern Med* 1988;109:497-493.
- Chee GH, Mathias DB, James RA, Kendall-Taylor P. Transsphenoidal pituitary surgery in Cushing's disease: Can we predict outcome? *Clin Endocrinol (Oxf)* 2001;54:617-626.
- Hawn MT, Cook D, Deveney C, Sheppard BC. Quality of life after laparoscopic bilateral adrenalectomy for Cushing's disease. *Surgery* 2002;132:1064-1069.
- Zeiger MA, Fraker DL, Pass HI, Nieman LK, Cutler GB, Chrousos GP. Effective reversibility of the signs and symptoms of hypercortisolism by bilateral adrenalectomy. *Surgery* 1993;114:1138-1143.
- Nagesser SK, vanSeters AP, Kievit J, Hermans J. Long-term results of total adrenalectomy for Cushing's disease. *World J Surg* 2000;24:108-113.
- Vella A, Thompson GB, Grant CS, Young WF Jr. Laparoscopic adrenalectomy for adreno-corticotropin-dependent Cushing's syndrome. *J Clin Endocrinol Metab* 2001;86:1596-1599.
- Acosta E, Pantoja JP, Famino R, Rull JA, Herrera MF. Laparoscopic versus open adrenalectomy in Cushing's syndrome and disease. *Surgery* 1999;126:1111-1116.
- Heniford BT, Arca MJ, Walsh RM, Gill IS. Laparoscopic adrenalectomy for cancer. *Semin Surg Oncol* 1999;16:293-306.
- Valeri A, Borrelli A, Presenti L. Adrenal masses in neoplastic patients: The role of laparoscopic procedure. *Surg Endosc* 2001;15:90-93.
- Kebebew E, Siperstein AE, Clark OH, Duh Q-Y. Results of laparoscopic adrenalectomy for suspected and unsuspected malignant adrenal neoplasms. *Arch Surg* 2002;137:948-953.
- Kim SH, Brennan MF, Russo P, Burt ME, Coit DG. The role of surgery in the treatment of clinically isolated adrenal metastasis. *Cancer* 1998;82:389-394.
- Plouin PF, Fiquet-Kempf B, Fakhoudi F, Rezolle JP, Guerry B. Hypertension and primary hyperaldosteronism. *Arch Mal Coeur Vaiss* 2000;93:1469-1473.
- Al-Sobhi S, Peschel R, Bartsch G, Janetschek G. Partial laparoscopic adrenalectomy for aldosterone-producing adenoma: Short- and long term-results. *J Endourol* 2000;14:497-499.
- Nakada T, Kubota Y, Sasagawa I, Yagisawa T, Watanabe M, Ishigooka M. Therapeutic outcome of primary aldosteronism: Adrenalectomy versus enucleation of aldosterone-producing adenoma. *J Urol* 1995;153:1775-1778.
- Meria P, Fiquet-Kempf B, Hermieu JF, Plouin PF, Duclos JM. Laparoscopic management of primary hyperaldosteronism: Clinical experience with 212 cases. *J Urol* 2003;169:23-35.
- Hara I, Kawabata G, Hara S. Clinical outcomes of laparoscopic adrenalectomy according to tumor size. *Inter J. Urol* 2005;12:1022-1027.
- Kenney PJ, Wagner BJ, Rao P, Heffess CS. Myelolipoma: CT and pathologic features. *Radiology* 1998;208:87-95.
- Wrightson WR, Hahm TX, Hutchinson JR, Cheadle W. Bilateral giant adrenal myelolipomas: A case report. *Am Surgeon* 2002;68:588-589.
- Lamont JP, Lieberman ZH, Stephens JS. Giant adrenal myelolipoma. *Am Surgeon* 2002;68:392-394.
- Lawler LP, Pickhardt PJ. Giant adrenal myelolipoma presenting with spontaneous hemorrhage. CT, MR and pathology correlation. *Irish Med J* 2001;94:231-233.
- Répássy DL, Csata S, Sterlik G, Iványi A. Giant adrenal myelolipoma. *Pathol Oncol Res* 2001;7:72-73.
- El-Mekresh MM, Abdel-Gawad M, El-Diasty T, El-Baz M, Ghoneim MA. Clinical, radiological and histological features of adrenal myelolipoma: Review and experience with a further eight cases. *Br J Urol* 1996;78:345-350.
- Castillo O, Cortés O, Vitagliano G. Laparoscopic adrenalectomy for suprarenal myelolipoma. [journal name] (in press).

Address reprint requests to:
Octavio Castillo, M.D.

*Section of Endourology and Laparoscopic Urology
Department of Urology
Clínica Santa María
Avenida Santa María 0500
7530234 Providencia
Santiago de Chile, Chile*

E-mail: octaviocastillo@vtr.net

ABBREVIATIONS USED

CT = computed tomography; MEN = multiple endocrine neoplasia; MRI = magnetic resonance imaging.

This article has been cited by:

1. Chun-Hou Liao, Shiu-Dong Chung, Ming-Kuen Lai, Hong-Jeng Yu, Shih-Chieh Chueh. 2009. Laparoscopic simultaneous bilateral partial and total adrenalectomy: a longer follow-up. *BJU International* . [[CrossRef](#)]
2. Airazat M. Kazaryan , Irina Pavlik Marangos , Arne R. Rosseland , Bård I. Røsok , Olaug Villanger , Emir Pinjo , Per F. Pfeffer , Bjørn Edwin . 2009. Laparoscopic Adrenalectomy: Norwegian Single-Center Experience of 242 ProceduresLaparoscopic Adrenalectomy: Norwegian Single-Center Experience of 242 Procedures. *Journal of Laparoendoscopic & Advanced Surgical Techniques* **19**:2, 181-189. [[Abstract](#)] [[PDF](#)] [[PDF Plus](#)]