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Complications of Laparoscopic Adrenalectomy: Results of 169 Consecutive Procedures

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Abstract. Laparoscopic adrenalectomy (LA) has become the gold standard for adrenalectomy. Review of the literature indicates that the rate of intra- and postoperative complications is not negligible. The aim of this study was to evaluate the complications observed in a series of 169 consecutive LAs performed at a same center for a variety of endocrine disorders. Between June 1994 and December 1998 a series of 169 LAs were performed in 159 patients: 149 unilateral LAs and 10 bilateral LAs. There were 98 women and 61 men with a mean age of 49.7 years (range 22–76 years). There were patients with 61 Conn syndrome, 41 with Cushing syndrome, 1 androgen-producing tumor, 29 pheochromocytomas, and 37 nonfunctioning tumors. Mean tumor size was 32 mm (range 7–110 mm). LA was performed by a transperitoneal flank approach in the lateral decubitus position. Mean operating time was 129 minutes (range 48–300 minutes) for unilateral LA and 228 minutes (range 175–275 minutes) for bilateral LA. There was no mortality. Twelve patients had a significant complication (7.5%): three peritoneal hematomas requiring (in two cases) laparotomy and (in one case) transfusion; one parietal hematoma; three intraoperative bleeding episodes without need for transfusion; one partial infarction of the spleen; one pneumothorax; one capsular effraction of the tumor; and two deep venous thromboses. Eight tumors were malignant at final histology (4.7%), of which four were completely removed laparoscopically. Conversion to open surgery was required in eight cases (5%): for malignancy in four cases, difficulty of dissection in three cases, and pneumothorax in one case. With a mean follow-up of 26.58 months (range 6–60 months) all patients are disease-free. We conclude that LA is a safe procedure. With increasing experience the morbidity becomes minor. To avoid complications LA should be converted to open surgery if local invasion is suspected or if there is difficulty with the dissection.

During the last few years laparoscopic adrenalectomy (LA) has become the gold standard for adrenalectomy. Several retrospective studies have compared LA with open anterior or posterior adrenalectomy and have suggested that LA is associated with less postoperative discomfort, decreased hospital stay, decreased postoperative disability, and decreased rate of complications [1–11]. There are few prospective randomized trials comparing open adrenalectomy and LA [12]. The enthusiasm for minimally invasive adrenal surgery leads one to think that these case-control studies may not be forthcoming.

Review of series in the literature indicates that intra- and postoperative complications of LA are not negligible. The aim of this study was to evaluate the complications observed in a large series of 169 consecutive LAs performed at a same center for a variety of endocrine disorders.

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Materials and Methods

In our department between June 1994 and December 1998 a total of 169 LAs were performed in 159 patients: 149 unilateral and 10 bilateral. There were 98 women and 61 men with a mean age of 49.7 years (range 22–76 years). Classification of the physical status of patients according to the American Association of Anesthesiology (ASA) score was ASA 1, 9.8%; ASA 2, 60.1%; ASA 3, 28.7%; and ASA 4, 1.4%. There were 61 with Conn syndrome, 41 with Cushing syndrome, 1 androgen-producing tumor, 29 pheochromocytomas, and 37 nonfunctioning tumors (Table 1). The mean tumor size was 32 mm (range 7–110 mm). The bilateral LAs were performed for seven Cushing syndromes, two familial pheochromocytomas, and one Conn syndrome.

The LAs were performed by a transperitoneal flank approach in the lateral decubitus position as first described by Gagner et al. [1, 2]. The dissection was achieved using hook cautery, coagulating scissors, or harmonic scalpel if it was available. The adrenal arteries and the main adrenal vein were clipped.

The gland was extracted in total after being placed in a plastic bag. If the tumor was larger than 6 cm it was cut up into small pieces in the bag before extraction. Drainage was optional. All patients received prophylaxis for deep vein thrombosis. Nasogastric suction was not used postoperatively. Oral fluids were given on the next day. All patients stood and walked on average at postoperative day 1.5 (range postoperative days 1–3). The mean operating time was 129 minutes (range 48–300 minutes) for unilateral LA and 228 minutes (range 175–275 minutes) for bilateral LA. For bilateral LAs patients were first placed in the right lateral decubitus position and then repositioned to expose the second side. Preoperative preparation with nicardipine and intraoperative nicardipine infusion were used to help control the blood pressure in patients with pheochromocytoma.

Table 1. Indications for 169 laparoscopic adrenalectomies.

Indication	No.
Conn syndrome	61
Cushing syndrome	41
Androgen–producing tumor	1
Pheochromocytoma	29
Nonfunctional tumor	37
Total	169

Results

There was no mortality. Twelve patients (7.5%) had significant complications (Table 2): three peritoneal hematomas (requiring in two cases a laparotomy and in one case a transfusion), one parietal hematoma, three intraoperative bleeding episodes without need for transfusion, one partial infarction of the spleen that regressed spontaneously, one pneumothorax, two deep venous thromboses, and one capsular effraction of the tumor. The average length of hospital stay was 5.4 days (range 3–15 days). The endocrinopathy was successfully cured in all patients with functioning tumors. During the mean follow-up of 26.58 months (range 6–60 months), none of the patients had recurrence of hormonal excess.

Eight tumors were malignant (4.7%). Four of the eight malignant tumors were completely removed laparoscopically: two metastases, one leiomyosarcoma (40 mm), and one androgen-producing tumor (35 mm). In the latter case malignancy was demonstrated on the specimen by vascular invasion of the proximal portion of the left adrenal vein. Conversion to open surgery was required in the four other patients. In six cases malignancy was suspected or confirmed at the start of the procedure: four metastases (two conversions) and two adrenocortical carcinomas (two conversions). In these cases suspicion of malignancy was based on the difficulty of dissection, dense adhesions, consistency of the tumor, or unusual and numerous retroperitoneal feeding vessels. With a follow-ups of, respectively, 4, 4, 1, and 1 years patients with the leiomyosarcoma and the three adrenocortical carcinomas are disease-free: Tumor markers are negative, and there is no evidence of local recurrence. The four patients in whom LA was attempted to cure a solitary adrenal metastasis had a known primary cancer (two in the lung, one in the colon, one melanoma) that had been completely resected previously. The mean follow-up is 1 year. The operation was converted to an open procedure in eight patients (5%), for malignancy in four cases, difficulty of dissection in three cases, and pneumothorax in one case.

Discussion

The rate of complication in this series is comparable to those of other laparoscopic series [1, 5, 10–12]. Until now the open posterior approach was the procedure of choice for small and benign adrenal tumors. It has been well established that the open posterior approach is safe and allows early postoperative discharge [13]. Today, LA has completely replaced the open posterior approach, although it has been suggested that the laparoscopic approach offers no advantages over the open posterior technique. Conversely, in a retrospective study Brunt and colleagues [6] demonstrated that patients undergoing LA experienced significantly fewer overall complications than those who undergo the open posterior technique. In a prospective case-control study comparing LA to conventional open posterior adrenalectomy, Thompson and colleagues [12] demonstrated that early and (even more so) late morbidity were significantly decreased in the laparoscopic group. In addition, in all series the data are distorted by the fact that there is a learning curve for LA.

In our series the two main causes of complications were bleeding and the lack of experience in our first cases. The most common intraoperative and early postoperative complication is bleeding. In our hands hemorrhage was responsible for two-thirds of the complications and half of the conversions. Severe bleeding that required conversion to open surgery or a laparoscopic or an open reoperation with the need for transfusion have been also reported in other series [10, 14–16].

In our series, inexperience was responsible for four complications: one pneumothorax during dissection of the right triangular ligament of the liver, one peritoneal hematoma from the trocar orifice requiring reoperation and transfusion, and two peroperative bleeding episodes related in one case with effraction of the lower pole of a left adrenal and in the other case with dissection of the tail of the pancreas, which was mistaken for the adrenal. In the latter case the patient presented postoperatively with partial infarction of the spleen, which regressed spontaneously.

Laparoscopic adrenalectomy does not modify the risk of thromboembolism. Two of our patients had deep venous thrombosis with one pulmonary embolus. Venous thrombosis prophylaxis is mandatory, and we routinely used heparin therapy. Intermittent compression devices during surgery are also a recommended precaution [10].

We encountered one capsular effraction during dissection of a 75 mm left pheochromocytoma. We did not convert to open surgery because the capsular effraction was minimal, but this is questionable. As with open surgery, large tumors should be excised en bloc. One should be aware that during the laparoscopic dissection there is a major risk of capsular effraction as the surgeon cannot mobilize the tumor with his or her hands but only with instruments. We think that tumors larger than 6 cm in diameter can only be removed laparoscopically only by surgeons who are experienced with this technique.

Malignancy was observed in eight cases (4.7%). Concerning the four primary malignant tumors, in two cases malignancy was not suspected during surgery and the tumors were completely removed laparoscopically without difficulty. Retrospectively, we believe that we would not have performed more extensive surgery by the open approach. In the two other cases, an adrenocortical carcinoma was strongly suspected at the start of the procedure because of the macroscopic features of the tumor. We immediately converted to an open, extensive procedure. In our opinion, LA can be proposed for large tumors or tumors at risk of malignancy [17]. The risk of malignancy should be evaluated at the start of the laparoscopic procedure. If local invasion is observed or if there is a strong suspicion of malignancy, the operation should be immediately converted to open surgery. In the four other cases, a diagnosis of adrenal metastasis was strongly suspected preoperatively; and malignancy was confirmed at the beginning of the procedure. In two cases the operation was converted to the open technique because of difficulty of dissection and bleeding, but in two other cases the tumor was completely and easily removed laparoscopically. In these last two cases we would not have per-

Table 2. Complications in 169 laparoscopic adrenalectomies.

Complication and patient no.	Adrenal disease	ASA score	Tumor size (mm)	Side	Treatment
Peritoneal hematoma					
1	Pheo	3	40	Right trocar orifice	Reop—laparotomy, blood transfusion
2	Cushing's bilat. hyperplasia	1	—	Left	—
3	Cushing's adenoma	1	26	Left	Reop—laparotomy
Parietal hematoma					
4	Conn	3	8	Right conversion subcostal	—
Perioperative bleeding					
5	Cushing's bilat. hyperplasia	2	—	Left	Conversion
6	Metastasis	3	41	Right	Conversion
7	Metastasis	4	60	Right	Conversion
Spleen infarction					
8	Conn	2	10	Left	Conversion
Pneumothorax					
9	Conn	2	25	Right	Conversion
Tumor effraction					
10	Pheo	3	75	Left	—
Deep venous thrombosis					
11	Conn	2	30	Right	Heparin
12	Pheo	3	20	Right	Heparin

Conn: Conn's adenoma; Pheo: pheochromocytoma; bilat.: bilateral; ASA: American Association of Anesthesiology; Reop: reoperation.

formed a different operation by the open approach. Although most patients with adrenal metastases are not candidates for surgery, LA can be proposed to remove a solitary adrenal metastasis in the few patients in whom a primary carcinoma was completely resected during a previous operation.

Theoretically, many pathophysiologic changes increase the risk of hemodynamic instability during LA for pheochromocytoma. Our 29 patients with pheochromocytoma were prepared with nicardipine and had a nicardipine infusion intraoperatively. Despite this precaution, fluctuations in blood pressure occurred in half of them. These results were comparable to those of open procedures in our experience. As with open surgery, the wide fluctuations in plasma catecholamines were essentially related to tumor mobilization. It has been demonstrated that acute hypercapnia increases plasma catecholamines in experimental animals [18]. Therefore helium pneumoperitoneum has been proposed because it minimizes the risk of respiratory acidosis and hypercapnia frequently associated with CO_2 insufflation [19]. Currently the experience of other groups confirms the safety of LA for pheochromocytoma [19–22].

During the postoperative course the main advantages of LA are the reduced rate of respiratory complications and the dramatic decrease in wound complications [5, 10, 12, 16]. We observed one wound complication in our series: a parietal hematoma after conversion to a subcostal incision. Patients requiring adrenalectomy for Cushing syndrome benefit particularly from the laparoscopic approach. Infections, hematomas, dehiscence, and slow healing are frequently observed in cushingoid patients, particularly in those who require large incisions for bilateral adrenalectomy. An experimental animal study has clearly demonstrated a potentially measurable benefit of the laparoscopic approach in the cushingoid model in terms of wound healing [23].

There is still some debate about the respective advantages and drawbacks of the transperitoneal and retroperitoneal approaches [24, 25]. One disadvantage of transperitoneal access on the left side is the need for extensive dissection of the spleen and the tail of the pancreas to visualize the adrenal gland. Therefore there is a potential risk of injury of the spleen and of postoperative pancreatitis. The main advantage of the transabdominal flank approach is that it allows gravity-facilitated exposure of the adrenals. Once the spleen and the tail of the pancreas have been completely mobilized, they spontaneously fall medially. They do not need any further medial retraction. Therefore complications and bleeding associated with such manipulations are avoided. In our series there were no clinical or biochemical signs of pancreatitis and no spleen injuries.

In our opinion the low rate of complications is also associated with correct indications for LA. There are few absolute contraindications. Some of the contraindications are not specific to adrenal surgery, such as major coagulation disorders and previous surgery. Invasive adrenal carcinoma is certainly an absolute contraindication for a laparoscopic approach. A 12 cm or larger tumor, even a benign lesion such as myelolipoma, is also a contraindication. The available working space is limited, particularly on the right side. The dissection is time-consuming. Whether LA should be proposed for other adrenal tumors and particularly for potentially malignant tumors remains questionable. In these cases laparoscopy should be considered first as an additional procedure of investigation to assess the possible malignancy of a tumor. The decision to remove the tumor laparoscopically or to convert to open surgery can be based on this final peroperative evaluation. Conversion should not be considered a failure of LA. Open adrenalectomy and LA are sometimes complementary. To avoid complications the surgeon must not hesitate to convert to an open procedure, bearing in mind that a safe open adrenalectomy is a perfectly acceptable solution to finish a long and difficult LA.

Résumé

En quelques années, la voie d'abord laparoscopique s'est imposée dans la chirurgie surrénalienne. Néanmoins, le taux de complications per et post-opératoires ne doit pas être négligé. Le but de ce travail est d'évaluer les complications observées dans une série homogène de 169 surrrénalectomies laparoscopiques

(SL) pratiquées par la même équipe. De Juin 94 à Décembre 98, 169 SL par voie trans-péritonéale latérale furent pratiquées chez 159 patients: 149 SL unilatérales et 10 SL bilatérales. Il y avait 98 femmes et 61 hommes d'un âge moyen de 49.7 ans (22–76). Les lésions correspondaient à: 61 syndromes de Conn, 41 syndromes de Cushing, 29 phéochromocytomes, une tumeur virilisante et 37 tumeurs non sécrétantes. La taille moyenne des tumeurs était de 32 mm (7–110). La durée opératoire moyenne fut de 126 minutes (48–300) pour les SL unilatérales et 228 minutes (175–275) pour les SL bilatérales. La mortalité est nulle. Douze patients ont présenté une complication (7.5%): 3 hémopéritoines nécessitant 2 laparotomies et une transfusion sanguine, un hématome pariétal, 3 hémorragies peropératoires sans nécessité de transfusion, un infarctus splénique partiel, un pneumothorax, une effraction tumorale et 2 phlébites des membres inférieurs. Parmi les 8 tumeurs malignes (4.7%), 4 furent entièrement enlevées par voie laparoscopique. Une conversion fut pratiquée dans 8 cas (5%): pour malignité dans 4 cas, pour difficulté de dissection dans 3 cas et pour un pneumothorax. Avec un recul moyen de 26.58 mois (6–60), tous les patients présentant des tumeurs sécrétantes sont guéris de leur syndrome endocrinien et aucune récidive locale n'a été observée. En conclusion, la SL est une intervention sûre et fiable. Avec l'expérience et à condition de convertir en chirurgie ouverte en cas de suspicion de malignité ou de difficultés de dissection le taux de complication devient très faible.

Resumen

En un corto periodo de tiempo, la adrenalectomía laparoscópica se ha convertido en la técnica de elección para la extirpación de las glándulas suprarrenales. Sin embargo, una somera revisión bibliográfica demuestra que con esta técnica, la tasa de complicaciones intra y postoperatorias no es nada despreciable. El objetivo de estudio es evaluar las complicaciones producidas en una serie consecutiva de 169 adrenalectomías, realizadas por vía laparoscópica en nuestro Centro, por diversas afecciones endocrinas. Entre junio de 1994 y diciembre del 98 se realizaron en 159 pacientes, 169 adrenalectomías laparoscópicas (LA), de las 149 fueron unilaterales y 10 bilaterales. La serie comprende 98 mujeres y 61 hombres, cuya edad media era de 49.7 años (rango 22–76). Los pacientes fueron intervenidos por: síndrome de Conn 61 casos; síndrome de Cushing 41; tumor productor de andrógenos 1 caso; feocromocitomas 29 y tumores no funcionantes (incidentalomas) 37. El diámetro medio de la tumoración fue de 32 mm (rango 7–110 mm). La LA se realizó mediante abordaje transperitoneal con el paciente en decúbito lateral. La duración media de la intervención para las LA unilaterales fue de 129 minutos (rango 48–300) y para las bilaterales de 228 minutos (rango 175–275). No se registró mortalidad alguna. 12 pacientes (7.5%) presentaron complicaciones graves: en 3 casos se produjeron hematomas peritoneales que requirieron en dos, una laparotomía y en el otro, transfusión de sangre; se constató un caso de hematoma parietal y 3 de hemorragia intraoperatoria, que no requirieron transfusión sanguínea; se observó un infarto esplénico parcial y un neumotórax; en un caso se produjo ruptura de la cápsula tumoral y dos pacientes desarrollaron una trombosis venosa profunda. El estudio microscópico definitivo reveló que 8 (4.75%) tumores eran malignos, de los que 4 fueron totalmente extirpados por vía laparoscópica. En 8 pacientes (5%) fue imprescindible la reconversión a cirugía abierta: en 4 casos por tumores malignos, en 3 por dificultades invencibles en la disección de la suprarrenal y en uno por neumotórax. El seguimiento medio de 26.58 meses (rango 6–60) permitió constatar que todos los pacientes estaban curados. Concluimos señalando que la LA es un procedimiento seguro. A mayor experiencia menor número de complicaciones; para evitar éstas, la LA ha de reconvertirse a cirugía abierta siempre y cuando se sospeche infiltración tumoral local o cuando surjan dificultades en la disección de la glándula suprarrenal.

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