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Laparoscopic adrenalectomy: the new standard?

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Summary

Principles: Since 1994 we have been removing most non-malignant classified pathologies of the adrenal gland laparoscopically. Does this minimal invasive procedure involve advantages over the conventional approach?

Methods: Retrospective analysis of 22 all-consecutive laparoscopic adrenalectomies in 21 patients (10 women, 11 men, age 26–70 years, mean 43 years, 11 right, 9 left, one bilateral in MEN IIa syndrome). These procedures were performed between 1994 and 2001 transperitoneally in the lateral decubitus position, recently by use of the Ultracision device and once with a handport. These results are compared with 20 consecutive open transperitoneal unilateral adrenalectomies with similar pathologies (13 women, 7 men, age 28–77 years, median 51.5 years, 8 right, 12 left) carried out between 1988 and 1993.

Results: The mean operating times were 150 and 115 minutes with the laparoscopic and the open procedure respectively (p <0.011). On the other hand, mean hospital stay (6 versus 15 days, p <0.00001), intraoperative blood loss (200 versus 300 ml, p <0.04) and postoperative need for analgesics were significantly shorter or lower. Two out of the first five laparoscopic operations had to be converted into open adrenalectomy due to intraabdominal adhesions and a diaphragmatic injury with pneumothorax. In both groups three complications occurred (14% and 15%).

Conclusion: Laparoscopic adrenalectomy is a safe, effective and useful procedure involving a shorter hospital stay, lower intraoperative blood loss and a lower postoperative analgesics requirement compared with the open approach. The laparoscopic approach is the procedure of choice for all benign adrenal pathologies.

Key words: laparoscopy; adrenalectomy; adrenal surgery; hospital stay; operating time

Introduction

Since it was first described by Gagner in 1992 [1], laparoscopic adrenalectomy has grown within a few years into an established procedure. Case-controlled studies [2, 3] where laparoscopic procedures were compared with open technology show advantages as well as reduced mortality, shorter hospital stay, smaller wounds and an earlier return to normal activities. Other authors are talking about the new gold standard, based on their own results and a review of the literature [4]. The success of laparoscopic adrenalectomy is not surprising. An anatomic region requiring extensive transperitoneal exposure can be clearly represented and thus the access-related trauma to remove the adrenal glands is minimised. On the other hand, randomised trials comparing open with laparoscopic adrenalectomy are lacking and the success of this new procedure is based on case control studies and clinical experience.

Since 1994 we have regularly performed laparoscopic adrenalectomy [5] for benign pathologies of the adrenal gland. This paper reviews our early experience of this new operative procedure. Focused on length of hospital stay, operating time, intraoperative blood loss and postoperative analgesic use, we compared 22 consecutive laparoscopic adrenalectomies with 20 consecutively performed open ectomies over the previous six years. We also consider aspects such as learning curve and intraoperative complications at a single centre in Switzerland.

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Methods

22 laparoscopic adrenalectomies (11 right, 9 left, 1 bilateral) in 21 patients (11 women and 10 men, age 26–70 years, median 43 years, p = n.s.) performed between 1994 and 2001 in our clinic were analysed retrospectively (table 1). Preoperative investigations were performed on an outpatient basis by an endocrinologist of the internal medicine department. Briefly, hormones were detected in plasma and urinalysis on the basis of clinical suspicion or symptoms. Further investigations were clonidine tests for pheochromocytoma, dexamethasone tests for cortisol-secreting adenomas and furosemide stimulation tests for aldosterone-secreting adenomas. For preoperative imaging, every patient had either a CT or MRI scan of the abdominal part. Metaiodobenzylguanidine scintigraphy was done in one case of pheochromocytoma and selective adrenal gland angiography with synacthen stimulation was performed in one case of aldosterone-secreting adenoma. Patients with pheochromocytoma were treated preoperatively with an alpha-blocker (Dibenzyran®) and, if blood pressure was still elevated, in combination with a beta blocker. Patients with a cortisol-secreting adenoma were treated with cortisol i.v. during the day of operation and the first postoperative day. Further substitution was performed orally. Perioperative antibiotics were not routinely given.

All the operations were performed under general anaesthesia with use of a muscle relaxant and controlled ventilation. Transperitoneal access in the lateral decubitus position, as described elsewhere [4, 7], was selected. Briefly, the patient is positioned in a 90-degree flank position with the bed flexed to increase the space between ribs and iliac crest. For right adrenalectomy four, and for left adrenalectomy three, cannulas (with an optional fourth) are used. Pneumoperitoneum is currently established up to 14 mm Hg pneumoperitoneal pressure with a Veress needle unless there has been prior surgery in the upper abdominal part. In such cases open positioning of the first trocar is indicated. A 30-degree angle laparoscope is used. On the right side, after liver retraction and lifting, the posterior peritoneum is incised to expose the lateral aspect of the inferior vena cava, renal and adrenal veins. Tissue dissection along the lateral aspect of the inferior vena cava permits identification of the transversely oriented short adrenal vein directly entering the inferior vena cava. The main adrenal vein is dissected, clip-ligated and divided. The adrenal gland is lifted and the space between the adrenal gland and the psoas muscle is enlarged. Grasping of the adrenal tissue must be avoided since it may cause troublesome bleeding with subsequent reduced vision of the operative field. Dissection of the upper adrenal margin, separating it from the liver, requires particular attention to the small inferior phrenic vessels, which are clipped, not coagulated, owing to their tendency to retract once sectioned.

On left side, after medialisation of the left colon flexure, incision of the phrenocolic and lienorenal ligaments is necessary to mobilize the spleen medially. Gerota's fascia is then incised to expose the left renal and adrenal veins. The first crucial step is identification of the adrenal vein, whereupon it is dissected, clipped and divided. The venous stump is used to gently lift the adrenal gland, and the posterior aspect of the adrenal gland is freed from its lateral and medial attachments. If sizable vessels are found, they must be clipped and divided. Particular attention is called for during the adrenal isolation, involving dissection of the upper margin, often located deep down under the inferior splenic border with a venous branch of the inferior phrenic vein which may be difficult to secure. Once freed, the adrenal gland is extracted intact in an Endobag. The adrenal fossa is inspected carefully for bleeding under reduced pneumoperitoneal pressure.

During the last seven operations the Ultracision (Ethicon/Johnson & Johnsons®) was used. In a very obese patient we used Handport once. All 22 laparoscopic adrenalectomies were performed by four surgeons.

The postoperative regimen with respect to mobilisation and nutrition depended on general condition, pain and intestinal activity respectively.

The outcome in laparoscopically treated patients was compared with that in 20 open, transperitoneal, unilateral adrenalectomies (13 women, 7 men, age 28–77 years, median age 51.5, p = n.s.) with similar, non-malignant pathologies, performed between 1988 and 1993 (table 1). Preoperatively a single i.v. dose of second-generation cephalosporin was given to these patients Postoperatively, low-molecular heparin was dispensed in prophylactic dosage according to body weight. Continuous variables were compared with the Mann-Whitney U test. P-values of <0.05 were taken as significant.

Table 1

Indication, age and gender.

	laparoscopic	open	p
	n = 22	**n = 20**	
Pheochromocytoma	11	10	
Aldosterone-secreting adenoma	6	6	
Cortisol-secreting adenoma	2	3	
Non-functional adenoma	3	1	
Age median	43 (26–70, ± 14.2)	51.5 (28–77, ± 12.1)	ns
Sex	11 f / 10 m	13 f / 7 m	ns

f: female, m: male, ns: non significant

Table 2

Operating time, hospital stay, blood loss and analgesic use.

	laparoscopic	open	p
Mean OP-time (min)	150 (75–270, ± 48)	115 (70–240, ± 37)	<0.011
Mean hospital stay (d)	6 (4–10, ± 1.9)	15 (9–40, ± 6)	<0.00001
Mean blood loss (ml)	200 (50–400, ± 158)	300 (200–500, ± 105)	<0.04
Mean analgesics (d)			
– Opiates	2 (1–4, ± 0.8)	3 (1–8, ± 1.2)	<0.04
– NSAID	6 (4–10, ± 1.7)	11 (9–23, ± 2.4)	<0.03

Abb: NSAID: Non-steroidal anti-inflammatory drugs

Results

The indication for the adrenalectomies was afforded by four different adrenal pathologies (21 pheochromocytoma, 12 cortisol-secreting adenoma, 5 aldosterone-secreting adenoma and 4 non-functional adenoma) (table 1). Bilateral laparoscopic adrenalectomy, based on a MEN IIa syndrome (bilateral phaeochromocytoma), took 210 minutes. The median operating time with the laparoscopic method was significantly longer than with the open method (150 *vs* 115 minutes, p <0.011). On the other hand, mean hospital stay (6 *vs* 15 days, p <0.00001), intraoperative blood loss (200 *vs* 300 ml, p <0.04) and need for postoperative analgesics (2 *vs* 3 days for opiates, p <0.04 and 6 *vs* 11 days for NSAID, p <0.03) were significantly shorter/lower with the laparoscopic than with the open method. Operating time, hospital stay, blood loss, analgesic use and the corresponding significance are summarised in table 2. The operating times for all laparoscopic procedures are given in chronological order in figure 1.

The third and the fifth laparoscopic operations had to be converted to open adrenalectomy, the former due to extensive adhesions in the upper abdominal part after laparotomy for perforated appendix seven years before, and the latter due to a too deep-lying diaphragm which was accidentally injured. This led to subsequent loss of the pneumoperitoneum. Even by closing the diaphragm with sutures and insertion of a thoracic drain, the overview in the abdominal cavity was not satisfactory and we therefore converted to the open method. The longest laparoscopic adrenalectomy lasted 270 minutes. This case was an obese patient (BMI 32) whose adrenal gland artery consisted of many small arterioles which rendered dissection more difficult.

The laparoscopically removed specimens had diameters between 3.5 and 8 cm. Four glands were removed through a non-expanded instrumental cannula, eight through an instrumental cannula expanded by incision, seven through an umbilical incision and three through an inguinal incision.

Complications occurred during hospitalisation in both groups. Atelectasis and in one case lung embolism occurred in two patients after laparoscopic procedures. The latter required a prolonged hospital stay (10 days). Atelectasis, superficial wound infection and deep venous thrombosis, involving a 40-day hospital stay, occurred after open adrenalectomy. Intra- and postoperative complications are summarised in table 3. All complications healed fully with appropriate treatment.

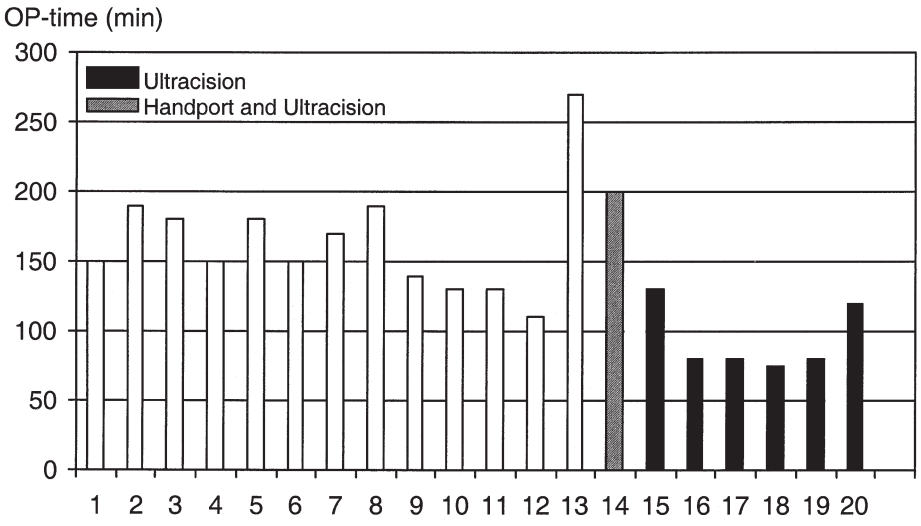

Figure 1
Operating times for unilateral laparoscopic adrenalectomies (n = 20) in chronological sequence.

Table 3
Intra- and postoperative complications.

Complications	laparoscopic		open	
Intraoperative	2	1 adhesion 1 diaphragm injury	0	
Postoperative	3	1 lung embolism 2 alelectasis	3	1 atelectasis 1 wound infection 1 deep venous thrombosis

Discussion

The conventional transabdominal approach to the adrenal glands renders a large incision and thorough preparation necessary. Minimally invasive methods such as the laparoscopic technique reduce operative trauma, and this means shorter hospitalisation, lower blood loss and less need for analgesics [3, 8–10]. The cosmetic advantage is not inconsiderable [10, 11].

Potentially malignant adrenal lesions must be treated as contraindications for the laparoscopic approach in order not to jeopardie wide en bloc resection. One should convert to the open technique when a malignant tumour is found intraoperatively [4, 12]. In case of doubt, we do not recommend frozen sections and favour open resection. Except for a few case reports [13] there are to our knowledge no investigations into frozen section of adrenal glands and the danger of tumour dissemination. The effect of pneumoperitoneal pressure on tumour dissemination and tumour recurrence at port site remains unclear. In animal models increased pneumoperitoneal pressure significantly increased instrument contamination and tumour recurrence at port-site incisions [14]; on the other hand, authors report no increase in circulating tumour DNA due to pneumoperitoneum [15]. In a review of the literature Schaeff et al. conclude that there is clinical evidence that laparoscopy with CO_2 pneumoperitoneum may enhance tumour dissemination [16], but randomised trials are lacking.

The diameter is a relative contraindication. Although masses of up to 10–15 cm are resectable laparoscopically [4, 17], the dissection may be difficult and time-consuming and exposure may be not optimal due to limited space. For a larger mass not suspect for cancer the surgeon's experience may prompt the decision in favour of the laparoscopic approach. But as long as malignancy is not excluded, tumours with a diameter of more than 6–8 cm should be considered possibly malignant [4]. We therefore recommend open resection for lesions larger than 8 cm without clarified dignity. Management decisions on an incidental mass are based on its biochemical activity, the radiological characteristics and the patient's age and preference. Biochemical evaluation has been described previously [18]. Regarding imaging, a small homogeneous mass with smooth margins points to a benign mass. Radiological techniques may allow accurate non-invasive differentiation of benign from malignant adrenal masses with a specificity of up to 96% for incidental adrenal masses [19, 20]. Image-guided fine needle aspiration cytology of a suspected adrenal mass has even higher specificity but also a morbidity rate of 4.3% [20]. Accordingly, we do not currently perform this procedure as a diagnostic approach to adrenal masses.

Various laparoscopic techniques have been reported [4, 21–24]. The main difference between individual techniques is between the transperitoneal [21, 22] and retroperitoneal [23, 24] approach. We use only the most common transperitoneal approach in the lateral decubitus position [10, 17]. This allows the viscera to gravitate away from the area of dissection and the respective adrenal gland becomes visible after dissection in a largely avascular area. Another advantage of this approach is the relatively large intraabdominal working space, which is usually not available with the retroperitoneal approach. The latter approach carries an elevated risk of hypercapnia and subcutaneous emphysema [10]. However, in the event of extended intraabdominal adhesions the retroperitoneal approach may be beneficial. Hence prior abdominal surgery is not a contraindication for the laparoscopic approach. The decision to use a transperitoneal or retroperitoneal access usually depends on the surgeon's preference.

After laparotomy for a perforated appendix one patient, no. 3 in the series, needed to be converted to open adrenalectomy due to extensive adhesions. Because of prior abdominal surgery this patient would have been a candidate for the retroperitoneal approach. In patient no. 5 conversion was rendered necessary by a very low-lying left diaphragm due to a preexisting phrenicus lesion after mitral valve replacement four years earlier. In all the subsequent cases no conversion was necessary, also implying a learning curve with laparoscopic adrenalectomy in our series. In other studies [17, 25] conversion to open surgery has been reported in 3–6%. The reasons for conversion were usually uncontrollable intraoperative bleeding, malignancy or widespread adhesions after prior abdominal surgery.

Although mean operating time for laparoscopic adrenalectomy (150 min) is significantly longer than for the open procedure, the advantages of the former are obvious: shorter hospital stay, less postoperative pain [8–10] and better cosmetic results. Moreover, a learning curve is observable (figure 1). Currently it takes 75–90 min to resect an adenoma in our surgery department. Two out of the four surgeons performed only one operation. For the other two surgeons, increased experience and new instruments (Ultracision) have resulted in a shorter operating time. Others have published mean operating times ranging between 123 and 202 minutes [17, 25]. In all studies comparing laparoscopic with open adrenalectomy, the mean operating time was longer for the minimally invasive technique [3, 8–10].

A mean hospital stay of less than three days is reported by several authors [17, 22, 24]. The hospital stay could be shortened, on the one hand, by hospitalisation on the day of the operation and not the day before, and, on the other hand, by better outpatient support from family doctors, relatives or home support institutions.

Our complication rate was 14% in the laparoscopic and 15% in the open group. Other series

[3, 9, 10] report higher postoperative complication rates: up to 40% after open surgery and between 0.2% [4] and 16% [13] after laparoscopic adrenalectomy. Atelectasis and pneumonia were the most common causes after the open procedure. Deep venous thrombosis, haematoma (which required laparotomy or transfusion in several cases) [26] and pneumothorax [17, 26] are the most frequently reported after laparoscopic adrenalectomy.

Based on our own experience with a relatively small number of cases in a single centre in Switzerland, we have observed that laparoscopic adrenalectomy is a safe, effective and useful procedure with decreasing hospital stay, less intraoperative blood loss and less postoperative need for analgesics. Reviewing the literature, where series of more than a hundred cases are reported [17, 21–24, 26], we find our results confirmed. We therefore conclude that laparoscopic adrenalectomy is the procedure of choice for most benign adrenal pathologies.

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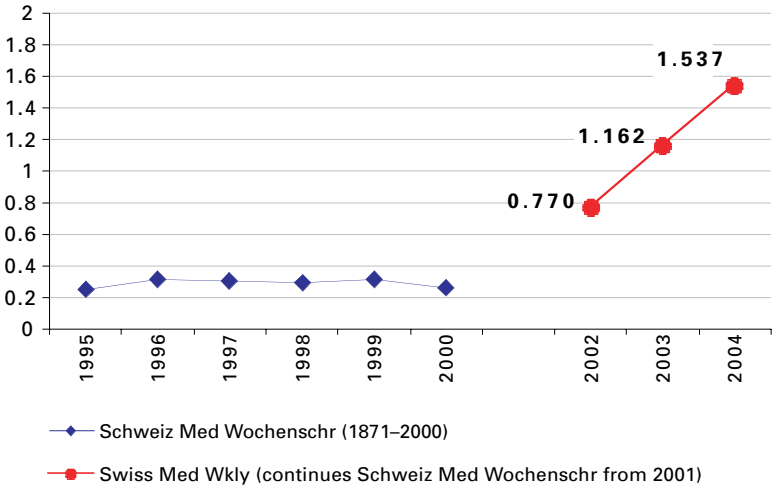

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