

# Laparoscopic Adrenalectomy By The Transperitoneal Approach And Typical Complications: Own Experience And Review Of Current Literature

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## Citation

P Kornprat, C Langner, H Mischinger. *Laparoscopic Adrenalectomy By The Transperitoneal Approach And Typical Complications: Own Experience And Review Of Current Literature*. The Internet Journal of Surgery. 2005 Volume 7 Number 2.

## Abstract

Minimally invasive techniques play an increasingly important role in adrenal surgery. We report typical complications we have encountered. Between 1997 and 2003, 52 patients were referred to our centre for the surgical management of adrenal diseases. A laparoscopic approach was chosen for 25 patients. Indications for surgery were Conn's adenoma, pheochromocytoma, Cushing's-adenoma, virilizing tumour, incidentaloma and lung cancer metastasis. Conversion to laparotomy in 4 patients was due to morbid obesity, inhalatory problems with anaesthesia, anatomical difficulties in surveying the surgical field, and intraoperative bleeding. Eight patients underwent partial adrenalectomy. LA is the treatment of choice for small benign tumours with a low rate of mortality and acceptable risk of morbidity. Because of the rare incidence of adrenal tumours, it will never be a common procedure and will become established primarily in centres with appropriate expertise in laparoscopic and endocrine surgery.

## INTRODUCTION

The adrenal gland is a small organ with a low incidence of malignant tumours. As adrenal surgery does not require difficult reconstructive techniques, it is ideally suited for a laparoscopic approach. The first laparoscopic adrenalectomy (LA) was described 1992 by M. Gagner.<sup>1</sup> Since then, many institutions have used this technique successfully.

Experience shows that the laparoscopic approach is the therapy of choice for benign adrenal tumours as it avoids large incisions and provides excellent visualisation of an anatomical region that is difficult to expose in open surgery. The anterior transabdominal approach is most commonly used as it guarantees the best overall view, but the feasibility of total extraperitoneal approaches (retroperitoneal lateral and posterior) has also been demonstrated.<sup>2</sup> The literature<sup>2,3,4,5,6,7,8,9,10</sup> and our own experience show that LA can be associated with a high rate of complications, often corresponding to the experience of the surgical team. Complications can occur in many phases of the surgical procedure. We report typical complications we encountered.

## PATIENTS AND METHODS

Between 1997 and 2003, 52 patients were referred to our centre for the surgical management of adrenal diseases. The

laparoscopic approach was chosen for 25 of them (8 men, 17 women). Exclusion criteria for minimal invasive management were tumor size greater than 8 cm, suspicion of malignancy, and surgery due to additional diseases. Their median age was 45 years (range 21-79 years). Prior to surgery, they were all evaluated by an endocrinologist and underwent preoperative computed tomography (CT) (Fig.1 and 2). Table 1 shows detailed patient data. The indication for surgery in non-functioning adenoma was a tumour greater than 3 cm. All patients with pheochromocytoma received a preoperative  $\alpha$ -blockade with phenoxybenzamine, which was administered with increasing doses for 10-14 days. Patients with Conn's syndrome were given potassium, spironolactone and, if required, antihypertensive drugs. Postoperatively, patients with Cushing's syndrome received a short course of hydrocortisone.

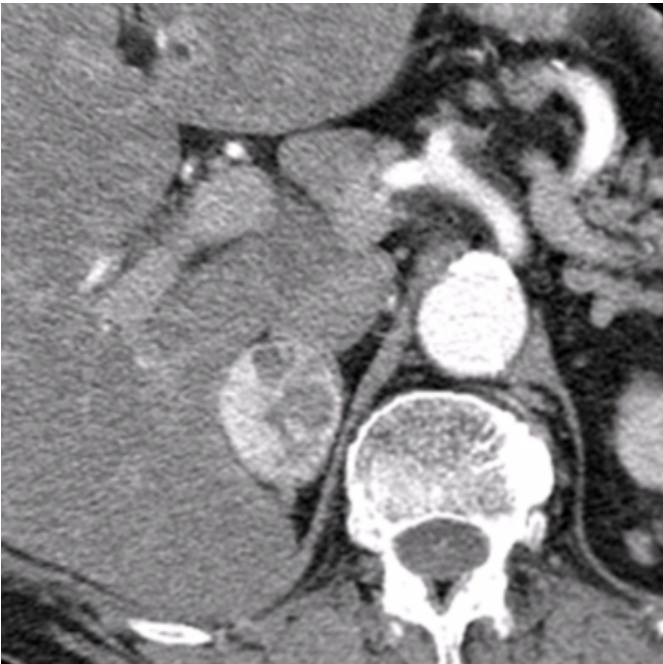
**Figure 1**

Table 1: Patient characteristics

Disease	Number	Mean diameter (cm)	Location		Gender	
			Right	Left	M	F
Conn's adenoma	9	1,7	3	6	3	6
Pheochromocytoma	4	7	2	2	2	2
Cushing's adenoma	6	3,75	3	3	1	5
Hyperandrogenism	1	3		1		1
Incidentaloma	4	6	1	3	1	3
Metastasis	1	2		1	1	

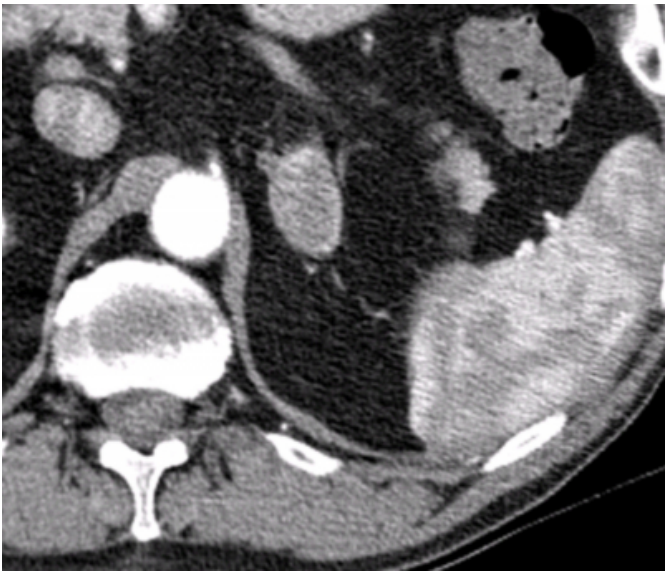
**Figure 2**

Figure 1: CT scan shows a phaeochromocytoma in the right adrenal gland



**Figure 3**

Figure 2: CT scan shows a lung cancer metastasis in the left adrenal gland



**SURGICAL TECHNIQUE**

The patient is placed in a lateral position on a balloon pillow. A series of 3 or 4 trocars of 5 to 10 mm are placed below the ribs between the posterior axillary line and the abdominal midline. The first trocar is placed using open technique. The optical device has a 30° angle. For right adrenalectomy, a liver retractor is used to elevate the right lobe of the liver. Then the right triangular ligament of the liver is dissected with laparoscopic scissors, forceps or the harmonic scalpel to expose the inferior vena cava. The perirenal fat is dissected superiorly and close to the vena cava to reveal the adrenal gland. Then the gland is dissected from the surrounding tissues. The major adrenal vein is controlled by clips and divided. All the other vessels are controlled using the harmonic scalpel or bipolar coagulation.

For left adrenalectomy, the lateral attachments to the spleen and the splenorenal ligament are divided, allowing the spleen and the pancreatic tail to fall medially. The adrenal gland is inspected and isolated according to the aforementioned procedure. In cases of partial adrenalectomy the tumor resection was carried out with bipolar coagulation or harmonic scalpel at a distance of 2 or 3 mm from the tumor. To avoid parenchymal bleeding after releasing the pneumoperitoneum, the resection margins are sealed with fibrin glue. On both sides, the gland is placed in a specimen bag for removal through a trocar and an aspiration drainage tube is set in place.

## RESULTS

LA was successfully completed in 21 patients. Conversion to laparotomy in 4 patients was due to morbid obesity, inhalatory problems with anaesthesia, anatomical difficulties in surveying the surgical field, and intraoperative bleeding. The latter obese patient had a Cushing's adenoma on the right gland, and the liver retractor caused an intraoperative liver injury. Postoperative complications occurred in two patients. One had a left-sided Conn's adenoma and developed pancreatitis, which was managed conservatively, and one patient with Cushing's adenoma developed a diabetic crisis, which ultimately required hospitalization for 41 days. Eight patients underwent partial adrenalectomy (5 Conn's adenoma, 3 Cushing's adenoma).

The mean operative time was 90 minutes (range, 65-150). Considering the operative time for the whole study, there was a trend toward reduction in operating time. The mean blood loss was 90 mL (range, 60-350). The mean length of hospital stay was 10 days (range, 6-41) and is longer than in American studies, for reasons that have to do with the Austrian health system, in which there is little pressure to reduce hospitalisation time, and patient expectations.

All patients were checked postoperative by an endocrinologist. There has been no recurrence during a mean follow-up time of 24 months (range 6-56).

## DISCUSSION

LA has become the standard approach in most institutions. The low prevalence of adrenal tumors makes this one of the least commonly performed laparoscopic procedures. This fact implies that the incidence of intra- and postoperative complications is higher than in procedures that are performed more often. This procedure involves a number of critical steps where complications can occur.

The first such critical juncture is the beginning of the laparoscopy with the establishment of the pneumoperitoneum. As vascular and hollow or solid organs may be injured by trocar or Veress needle<sup>11</sup>, at our centre we only use the open approach for the first trocar. The next critical moment is the exposure of the surgical field as there are great differences in the anatomy of the left and right sides. On the right side, the liver has to be mobilized with a smooth retractor; this has to be done very gently to avoid tearing the capsule. One patient in our study sustained a capsule tear and bleeding, requiring conversion to laparotomy. On the left side, the lateral attachments to the

spleen and the splenorenal ligament have to be separated with coagulating scissors or the harmonic scalpel. At this point, injuries to the spleen or bleeding from small vessels may occur.<sup>12,13</sup> The division of the splenic ligaments under magnified laparoscopic vision and the use of gravity rather than manual retraction are important for reducing the rate of splenic injuries.<sup>6</sup>

The use of monopolar coagulation must be kept to a minimum. When it is used, it is important that the current for coagulation is minimal. The insulation of all the coagulation instruments must also be checked before the procedure. Otherwise, severe burns or coagulation damage may appear along the surgical path of the instruments.<sup>8</sup> The surgeon must keep a close eye on the coagulation site. We mainly use bipolar coagulation and the harmonic scalpel. The harmonic scalpel has made an important contribution to laparoscopic surgery as it permits faster and easier preparation.<sup>14</sup>

The next important step is to identify the tail of the pancreas. This can be difficult if the patient is obese or the tail is large and located below the spleen.<sup>3,8,15</sup> The damage to the pancreas can cause acute postoperative pancreatitis. One of our patients had this complication; it could be handled conservatively, but caused a prolonged hospital stay. When previous surgery, especially hepatobiliary, pancreatic or renal surgery, has caused adhesions and it is difficult to expose the surgical field, conversion to laparotomy is an option.

After mobilisation of the liver or the spleen, the dissection of the gland is begun; here it is very important to first identify the vascular landmarks. These are the vena cava with the adrenal vein and adrenal arteries. Vessels can be misidentified and if the hepatic or renal artery is injured, severe hemorrhage will ensue. As it is very difficult to control an arterial hemorrhage, it is very important to identify the source of bleeding and not to set clips blindly. Liver or spleen necroses are described in the literature.<sup>16,17</sup>

The adrenal vein must be prepared very gently as tears in the vena cava have been described.<sup>18,19</sup> If such a complication occurs, the hemorrhaging area must be compressed and aspirated immediately to control bleeding. If this is not possible or the team is not skilled in laparoscopic suturing, conversion to open procedure should be undertaken. The conversion rate ranges from 0 to 11% in the literature.<sup>3,4,5,6,7,8,9,10,13,15,16</sup> Gas embolism can also occur in these cases, and when it does, it is important to increase the

positive-end-expiration pressure (PEEP).

Adrenal arteries originate immediately from the aorta and can cause postoperative haematoma, if uncontrolled.

It is important to know that on the right side, an accessory adrenal vein is present in about 10% and drains into a hepatic vein.<sup>13</sup> This vein can tear during the mobilisation of the liver and the bleeding is very difficult to control. On the left side, the accessory adrenal vein is always present and joins the diaphragmatic vein. It is easier to identify and when it is injured, the bleeding is easier to control.

When the vessels are controlled, the gland itself represents a risk for complications. Tears and ruptures are possible.<sup>16,20</sup> Parenchymal bleeding and bleeding out of the medulla are much-feared complications and difficult to handle. This can be a problem in cases of partial adrenalectomy, because the pressure of the pneumoperitoneum largely prevents parenchymal bleeding and bleeding out of the medulla.<sup>21,22</sup> As postoperative bleeding or hematoma can develop, a nearly dry resection line on the remaining healthy gland should be reserved; the resection line can be easily sealed with fibrin glue. The glue is fixed within a few minutes and prevents bleeding after the pneumoperitoneum is released.

Other complications include bowel injuries such as duodenal lesions related to a right adrenal dissection, or colonic tears related to trocar access or electrosurgical devices.<sup>8,23</sup> If these lesions are not immediately diagnosed and treated, major postoperative complications can lead to peritonitis and re-operation.

The major impact of laparoscopic surgery is the reduction of wound infections and wound healing problems; late wound problems such as chronic pain and hernia are also very uncommon, there are fewer cardiac and pulmonary problems, the frequency of pneumothorax and pleural tears is reduced, and there is less postoperative pain.<sup>3,4,5,6,7,8,12,13,14,15,16,24</sup>

The intraoperative complication rate ranges from 0-11% with a mortality rate of 0-2% in the literature.<sup>3,5,6,7,8,13,14,15,16,21,24</sup>

The laparoscopic approach to adrenal surgery requires a surgical team skilled in adrenal surgery and laparoscopic techniques; the best indications are Conn's adenoma (Fig.3A), benign Cushing's tumours and virilizing tumours, because they are usually small and easy to dissect.

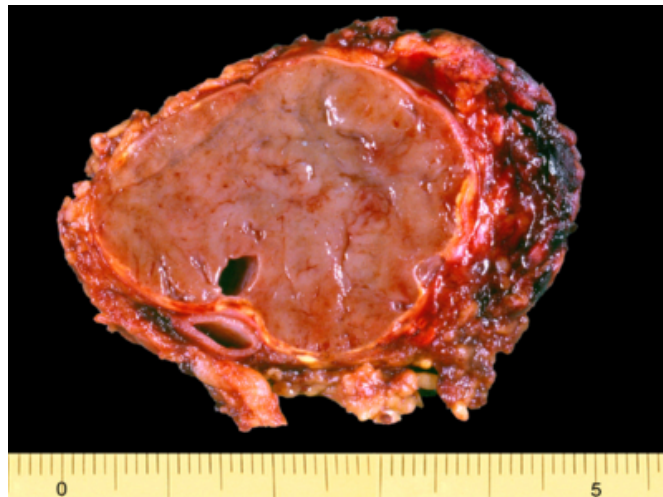
Pheochromocytomas can be managed laparoscopically, but they have a greater potential for intraoperative complications. Pheochromocytomas (Fig.3B) are associated with hypervascularisation, which can lead to bleeding when they are mobilised.

**Figure 4**

Figure 3a,b,c: (Macro) Conn's adenoma, pheochromocytoma, lung cancer metastasis

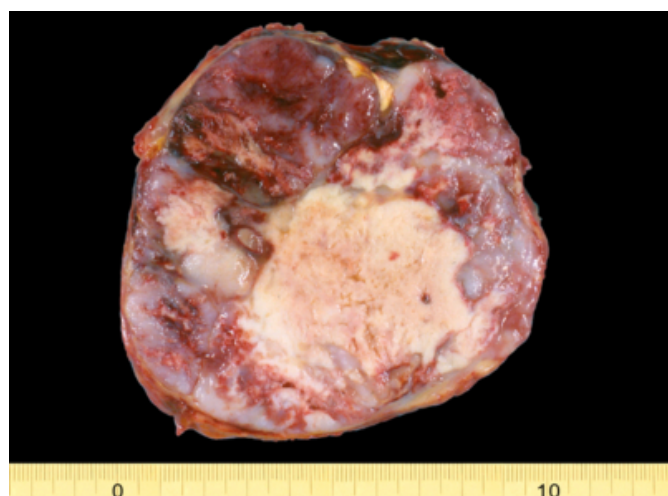


**Figure 5**





**Figure 6**



It is important that the adrenal vein is to be clipped early in the operation and without major manipulation of the tumour itself. There were no problems with blood pressure or heart rate after appropriate preoperative treatment with phenoxybenzamine.<sup>24</sup> Incidentalomas are diagnosed by exclusion and surgery is necessary if they are larger than 3 cm, or if increasing size is demonstrated upon follow-up scan.<sup>4</sup> In cases of metastasis to the adrenal gland (Fig.3C), it is important to retrieve the specimen in a bag. Rassweiler et al. reported a port site metastasis after adrenalectomy of a lung metastasis.<sup>25</sup> The causes of port site metastasis are multifactorial. The most prominent factor is the aggressiveness of the tumor. Other authors<sup>26</sup> noted that poor surgical technique increases the risk of port site metastasis and with improving surgical skills the incidence decreases.

Partial adrenalectomy has usually been recommended for bilateral hereditary pheochromocytomas to maintain cortical function of the adrenal gland and to avoid lifelong mineral corticoid replacement therapy. Current indications for partial adrenalectomy are patients with small, potentially benign, tumors of the adrenal gland.<sup>21,22,27</sup> The tumor should involve only a certain part of the gland. The advantage is the retaining functional tissue on the side of the affected gland in case of a subsequent adrenalectomy on the contralateral side for other reasons. Unclear histology features of the tumor are an argument against partial resection. On the other side the adrenal gland is a small organ, so adrenal sparing surgery is more difficult, therefore laparoscopic procedures give an excellent view of the adrenal gland and its surroundings, allowing clear differentiation of tumor and normal tissue, thereby making precise dissection possible. When a normal limb of an adrenal gland adheres to the liver, making

complete resection risky, partial adrenalectomy is safer than total adrenalectomy. Therefore, this procedure can reduce intraoperative blood loss and operation time.<sup>27</sup>

Contraindications for laparoscopic approach are tumour size greater than 8-10 cm or preoperative suspicion of malignancy.<sup>4,6,7,13,21,24</sup>

The results strongly argue that LA has a positive impact on the outcome of adrenal surgery beyond the traditional laparoscopic benefits of reduced pain and faster recovery. The procedure has a learning curve and is technically challenging; early conversion is indicated when problems develop. With its low mortality rate and acceptable risk of morbidity, the laparoscopic approach is the treatment of choice for small benign adrenal tumours. It will never be a common operation because of the rare incidence of adrenal tumours, but it can be expected to become established in centers with appropriate expertise in laparoscopic and endocrine surgery.

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