

# The contribution of laparoscopic surgery in the treatment of adrenal gland diseases

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**Abstract.** Introduction. The indications for adrenalectomy have changed recently due to the availability of laparoscopic surgery and the increase in incident detection of tumors of the adrenal glands, the so called incidentalomas. Material and method. The present study is a preliminary one, performed on a consecutive series of patients hospitalized and laparoscopically adrenalectomized in the Surgery Clinic II Cluj-Napoca. Results. On the group studied, we did not have any case of conversion to classical surgery. The postoperative evolution was favorable, except for one case, which required reintervention for an intestinal-mesenteric infarction. The total duration of hospitalization, as well as the postoperative one, was obviously shortened by about half compared to the post-laparotomy. Conclusions. Laparoscopy for uni- or bilateral adrenalectomy could become the standard treatment, with good results in terms of morbidity and length of hospitalization in patients with: pheochromocytoma, aldosterone, Cushing’s adenoma, dysfunctional adenoma, metastases, myelolipoma or carcinoma.

**Key Words:** Adrenalectomy, laparoscopic surgery

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## Introduction

The history of adrenal surgery began in 1889 when J Knowsley Thornton performed the first adrenalectomy, removing a large tumor of the gland in the joint of the kidney in a young patient with hirsutism (Janetschek et al 1996).

The classic (open) surgical procedures addressed to the adrenal pathology - transabdominal, transthoracic or posterior retroperitoneal - involve wide incisions and extensive detachments to ensure a good control of the maneuvers of periglandular dissection and treatment of vascular pedicles. Consequently, increased postoperative morbidity is mainly determined by the pathway to the adrenal gland (Vargas 1997).

The introduction of minimally invasive surgery techniques has led to revolutionary changes for most surgical procedures. Adrenalectomy is a very good example of this. Patients with adrenal surgical pathology fully benefit from the advantages of laparoscopy, the procedure being used for a retroperitoneal organ, otherwise difficult to access (Vargas 1997; Hobart 2000). The indication for surgical treatment for the solution of adrenal pathology is in most cases established by or together with the endocrinologist. The exceptions are represented by the situations in which, intraoperatively, pathological changes of the gland are discovered that impose a surgical sanction. An example in this sense is the adrenal cystic degeneration, especially on the right side, preoperatively confused with a cyst of the upper renal pole - the reason and indication for laparoscopy. In this situation, the endocrinologist will take over the case after the removal of the respective gland (Miccoli 2004).

The preoperative investigative protocol must provide complete data on the morphology of the gland, on the neighborhood relations with important anatomical structures (inferior vena cava, liver, diaphragmatic pillars) and to highlight possible signs of malignancy (infiltration or embedding of neighboring structures, presence of regional lymph nodes). In this sense, apart from the ultrasound examination, often the first and most convenient imaging exploration, we consider it mandatory to perform a preoperative computed tomography (CT), in order to assess locoregionally development of the tumor, presence of positive lymph nodes and distant metastasis if present (Hobart 2000; Al-Sobhi 2000).

Laparoscopic adrenalectomy is considered the standard surgical procedure for most patients with benign, small or medium-sized adrenal lesions, hormonal active or inactive. The contraindications of this type of approach are precisely the indications for open adrenalectomy: large tumors, invasive adrenocortical carcinoma, metastatic pheochromocytoma of the periaortic ganglia, incorrigible coagulopathy or other particular contraindications for general anesthesia or laparoscopic technique (Miccoli 2004; Rubinstein 2005).

## Material and method

The present study is a preliminary one, performed on a consecutive series of patients hospitalized and laparoscopically adrenalectomized in the Surgery Clinic II Cluj-Napoca. From

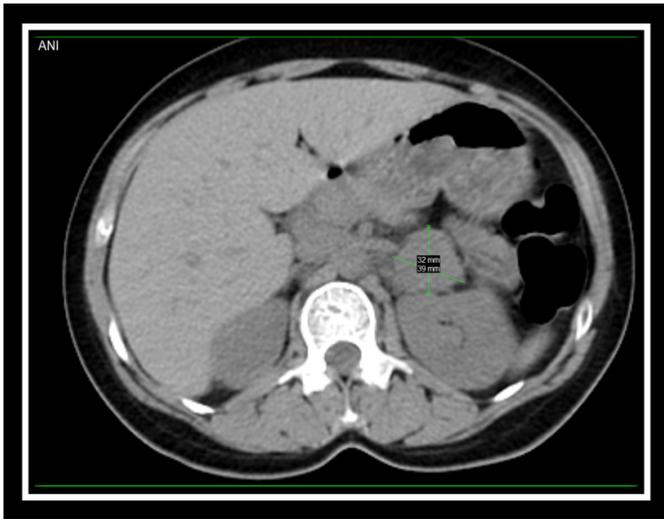


Fig. 1. Abdominal CT. ell-defined nodular formation, with homogeneous structure

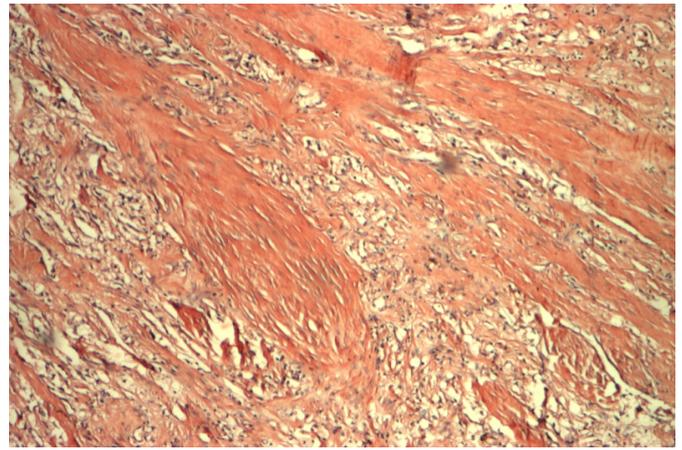


Fig. 5. Optical microscopy; Red-Congo staining



Fig. 2. Macroscopic appearance of the postoperative part ; Fig. 3. the adrenal gland has an eccentric nodular formation

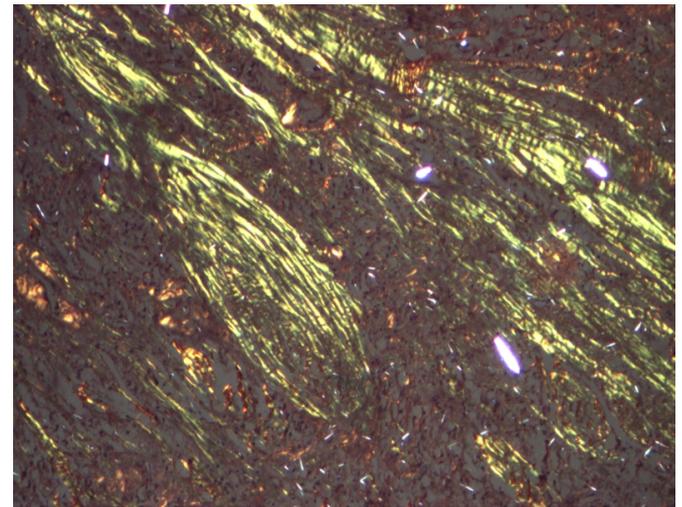


Fig. 6. Examination in polarized light amyloid deposits

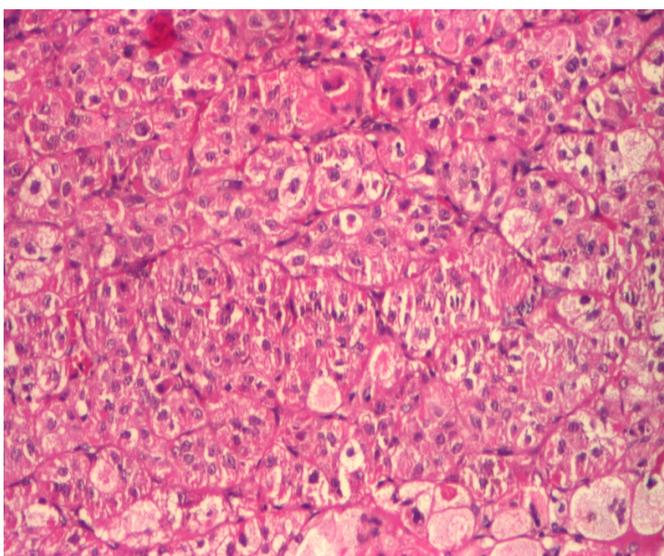


Fig. 4. Optical microscopy; Hematoxylin-eosin staining fine network of fibrovascular tissue areas of the hyalin making an alveolar appearance of the tumor

these, we selected for example two cases of adrenalectomy by laparoscopic approach.

### Case 1

The 27-year-old patient is hospitalized for precordial pain with irradiation in the left arm, occipital headache, high blood pressure, asthenia. Apart from the personal surgical pathological antecedents represented by appendicectomy for acute appendicitis and the surgical treatment of right inguinal hernia, the only significant element in the personal antecedents is represented by the multiple episodes of hypertension during the 4 pregnancies. Physiological parameters at admission were within normal limits, except for blood pressure which is stabilized at 120/80 mm HG following prompt administration of Metoprolol 25 mg. Following the collection of biological samples, a hyper eosinophilic inflammatory syndrome is detected. An abdominal ultrasonography identifies a left paraaortic formation of 4/2 cm, which is in contact with the left kidney (medial face) and an adrenal tumor cannot be excluded at this moment. The abdominal CT examination reveals at the level of the adrenal gland a well delimited nodular formation, with homogeneous structure, having the dimensions of 4 / 3.2 / 5 cm (Fig. 1). Following the anamnesis, the clinical and paraclinical examinations, the diagnosis of the adrenal tumor is established. After a preliminary preoperative preparation, surgery is performed, laparoscopic left adrenalectomy. The excised piece (Fig. 2,3) is sent



Fig. 7. Macroscopic appearance in postoperative part yellow-gray of the adrenal gland of 33/22/17 mm

to the Pathological Anatomy Laboratory of S.C.J.U Cluj for histopathological examination, which certifies the diagnosis of pheochromocytoma.

#### Anatomopathological result:

**Macroscopic:** The piece of 6.5 / 3 / 3.3 cm represented by the adrenal gland presents an eccentric nodular formation, well delimited by 4/3/3 cm, which has on the section the aspect of adrenal parenchyma (fig. 2,3).

**Microscopic:** Adrenal fragment with the presence of a tumor formation composed of medium and large cells, with fine granular cytoplasm, euchroma nuclei, nucleolates, with reduced pleomorphism. Between the groups of cells, a fine network of fibrovascular tissue is observed, achieving an alveolar aspect of the tumor (fig. 4). The structure of the cortex is disorganized by tumor compression and by hyal areas in which Congo red staining (Fig. 5) and examination in polarized light suggest amyloid deposits (Fig. 6).

#### Case 2

The 49-year-old patient was already diagnosed at the time of hospitalization with Conn's Disease. With a rich associated pathology (obesity grade II, mixed hyperlipemia, anemic syndrome), the patient complains - in addition to hypertensive outbreaks - headache, balance disorders, tinnitus, diplopia, paresthesias, tremor. The CT examination identifies at the level of the right adrenal a hypodense formation with the dimensions of 28/24/20 mm. The surgery is performed, performing a laparoscopic right adrenalectomy. Histopathological examination of the excised piece (Fig. 7) confirms the diagnosis of Conn.

#### Anatomopathological result

**Macroscopic:** on the section, the piece of 45/26/17 mm represented by the adrenal gland shows on the section a yellow-gray nodular formation of 33/22/17 mm (fig. 7).

**Microscopic:** adrenal gland with disorganized architecture (fig. 8). Histological aspect that may fit in a clinical context with a Conn Disease.

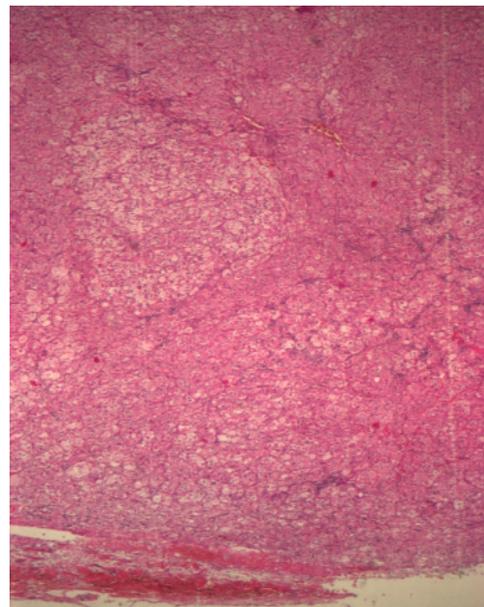


Fig. 8. Optical microscopy; Hematoxylin-eosin staining nodular formation disorganized architecture

#### Surgical technique

Video-assisted techniques recognize 3 variants dictated by the patient's position, the access path in the retroperitoneal space being, as the case may be, direct or through the peritoneal cavity:

- anterior approach (transperitoneal),
- lateral approach (transperitoneal or retroperitoneal),
- posterior approach (retroperitoneal).

The transperitoneal approach offers the advantages of a large workspace, easy identification of anatomical structures, wide exposure of the gland, allowing the removal of larger lesions compared to retroperitoneal techniques. Also, this access path does not require special laparoscopic instruments.

The trocars are positioned at the level of the costal rim, in the subxiphoid region and the right flank.

The right adrenal gland is located at the upper pole of the kidney, postero-inferior to the right hepatic lobe, lying on the diaphragm, in contact with the inferior vena cava. Three arterial sources approach the gland with rich anastomosis between each other: the central artery (from the aorta), the superior arterial group (from the right inferior diaphragmatic artery), the inferior group from the right renal artery. Venous blood is collected by satellite veins, best represented by the central vein that flows directly into the inferior vena cava.

Exposure to the dissecting area requires adequate mobilization of the liver. The way in which the right hepatic lobe is displaced depends a lot on obtaining a comfortable access in the dissection space of the adrenal gland. Its lifting is done with the help of an atraumatic divider, of "snake" type or in fans, inserted through the subxiphoid trocar.

Under proper conditions, the crimson-yellow color of the gland is difficult to confuse and the dissection plan is comfortably achieved.

Access to the adrenal lodge is possible after sectioning the posterior parietal peritoneum, an operative gesture that will be initiated at a distance of 1.5-2 cm from its glissonian insertion and at least 2 cm laterally from the inferior vena cava (IVC). From this level, the sharpe sectioning of the peritoneum extends laterally

to the triangular ligament and is performed with the help of a hook, monopolar scissors or other electric dissection devices. Exposure of the anterior face of the gland is performed by blunt dissection maneuvers or using electrosurgery devices, performed in an extracapsular anatomical plane, through loose avascular tissue.

The enlargement to the left of the parietohepatic peritoneum is necessary for the good highlighting of the venous plane. IVC should be well released before any attempt to approach the adrenal vessels. Hemorrhagic incidents can only be resolved by IVC clamping if it is well exposed.

Complete highlighting of the entire medial and superior contour of the gland is mandatory in order to allow the safe treatment of vascular pedicles and to achieve a complete removal of the gland.

After preparation, the central vein will be clipped twice towards the inferior vena cava and one clip to the gland or vascular stapler can be used. In 20% of cases there is an accessory central vein that must be searched carefully, sometimes being a cause of massive hemorrhage, difficult to control.

Due to the lateral decubitus position, after sectioning the central vein, the IVC runs to the medial and the retrocavity extension of the gland can be easily dissected.

The central artery can sometimes be sectioned at its branches by electrocoagulation, other times it requires clipping and sectioning. It is then continued with the release of the upper edge of the gland from the medial. The vascular elements of the upper and lower pedicles can be sectioned by monopolar or bipolar coagulation.

On the left side, the adrenal gland covers the upper renal pole and plunges medially on the renal pedicle. Access to the left adrenal lodge is possible after extensive mobilization of the spleno-pancreatic block. Due to the patient's lateral position, the spleen, pancreas and stomach will move to the medial, without the need for additional retraction. For this reason, on the left side laparoscopic adrenalectomy requires, in most cases, the use of only 3 access points: 2 trocars of 10 mm and 1 of 5 mm, placed parallel to the left costal rim.

The first gesture is represented by the incision of the laterosplenic peritoneum, at a distance from its spinal insertion, a maneuver extended up to the level of the left diaphragmatic pillar. The dissection will be conducted in a relatively avascular plane, located retropancreatic and anterior to the adrenal-renal capsule. Through the transparency of this conjunctive structure, the specific aspect of the adrenal tissue is easily distinguished. The important vascular elements to be approached in left adrenalectomy are the central pedicle and the upper pedicle, the latter representing branches of the diaphragmatic vessels.

The left central vein flows into the left renal vein most commonly into the common trunk with the lower left diaphragmatic vein, from which it must be isolated before clipping.

The left central vein will be double-clipped proximal to the renal vein and then sectioned with scissors. The left middle adrenal artery comes from the aorta and will be discussed later. It can be treated with titanium clips or bipolar electrocoagulation. Following the upper edge of the gland, the branches of the upper adrenal pedicle will be isolated and ligated using an electrocoagulation procedure.

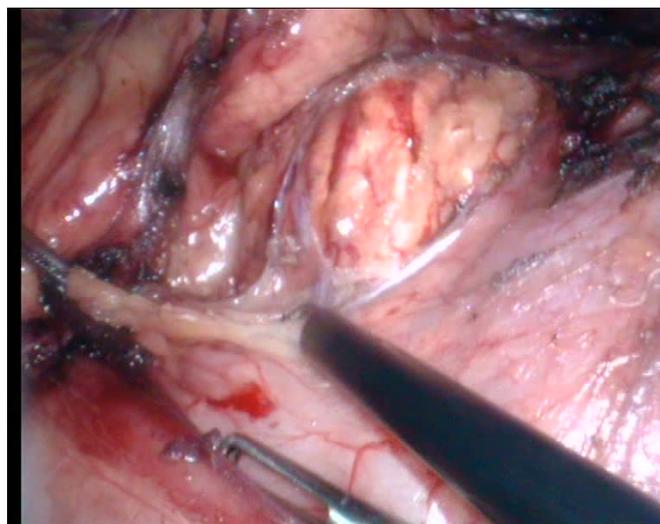


Fig. 9. In situ adrenal tumor

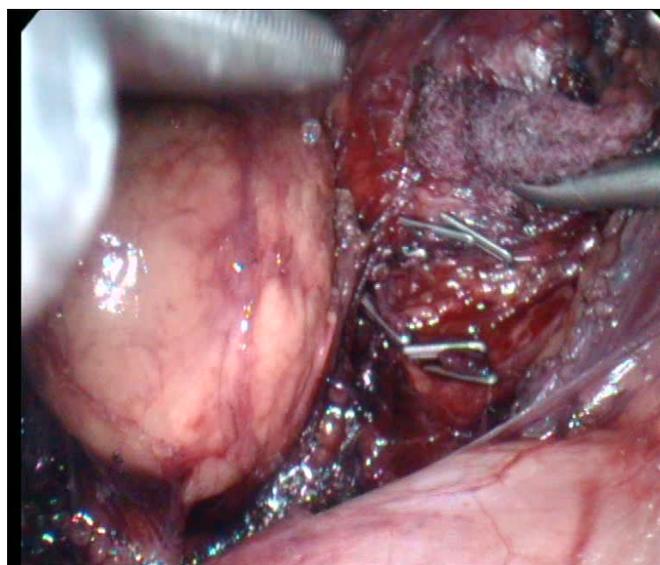


Fig. 10. Adrenal vein – clipping, hemostasis

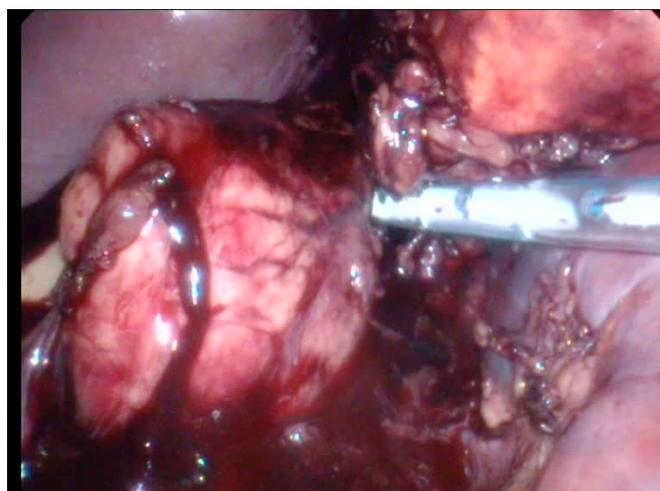


Fig. 11. Fixing the drain tube in the adrenal lodge

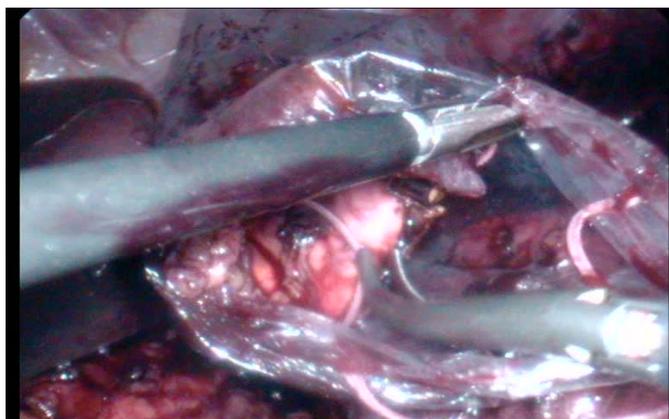


Fig. 12. Using the extraction bag



Fig. 13. Removal of tumor from the abdominal cavity

The complete mobilization of the gland is performed by posterior dissection, in a loose, avascular space that separates it from the upper renal pole and the muscular wall. Operating room extraction, hemostasis control and lodge drainage are the final times of laparoscopic adrenalectomy.

## Results

All patients were treated in the Surgery II Clinic by the same surgeon. The main symptom that brought the patients to the doctor was the oscillation of the blood pressure and one patient accused marked asthenia, fatigue, where the routine investigations detected incidental adrenal tumor.

Patients ranged from 27 to 65 years of age, most of them admitted with comorbidities such as obesity, dyslipidemia, but no significant surgical history.

The patients admitted were diagnosed adrenal pheochromocytoma tumors, adrenal adenomas and Conn disease.

The tumors were located mainly on the left kidney.

On the first day of hospitalization, routine preoperative investigations were performed and patients signed an informed consent for surgery and participation in this study. The majority of the patients underwent surgery in the second day of hospitalization and for those who needed additional paraclinical investigations, the surgical intervention took place in day 3 of hospitalization. The surgery was performed under general anesthesia, with the patient in a left and right lateral decubitus position, depending on the location of the lesion.

All patients underwent laparoscopic surgery. The instruments used consisted of the usual laparoscopy kit containing the camera, gripping forceps, dissecting forceps, monopolar electrocautery and scissors. In addition, 5 mm Ligasure forceps were used. The operative steps were performed without major complications in all five patients, one patient showed minimal bleeding from the central artery, hemostasis was performed safely with the placement of a titanium clip. No patient needed conversion to conventional surgery.

The average time of surgery was 140 minutes and all operations were performed by the same operating team.

Postoperatively, the patients were supervised for 24 hours in the Intensive Care Unit, and, except for one, all the patients were transferred to the surgery department on day 1 postoperatively with a favorable evolution. One patient showed an unavoidable postoperative course with postoperative pain initially moderate then progressively increasing and lack of transit for feces and gases. On day 4 postoperatively the patient presents intense abdominal pain, weathered abdomen, not participating in respiratory movements, absence of intestinal transit and absence of hydroaerial noises. Emergency abdominal CT is performed, which detects an entero-mesenteric infarction for which emergency surgery is performed and a jejunal enterectomy of approximately 40 cm is performed. The patient is again taken to the Intensive Care Unit with a favorable postoperative evolution. Resumption of intestinal transit is achieved on day 5 postoperatively, oral hydration and progressive oral feeding were initiated. On day 7 postoperatively, the patient is transferred to the surgery department.

During the hospitalisation in the surgery department all patients had a favorable evolution with good general condition, hemodynamic stability, blood pressure values within normal limits, low intensity pain with the need for minor analgesic medication, intestinal transit present, good food tolerance, surgical wounds without inflammation, in the process of healing.

All the patients with the exception of the one with the entero-mesenteric infarction could be discharged safely on day 4 postoperatively. The patient who presented the postoperative complication and who required surgical reoperation was discharged in good general condition on day 14 postoperatively.

## Discussion

This study aimed to highlight the importance of laparoscopic surgery in the treatment of pheochromocytoma and Conn's disease in a number of patients admitted for surgical treatment for adrenal pathologies.

It is known that over the last 20 years, the wide dispersion of imaging stimulated an expansion of indications for adrenalectomies and nephrectomies (Brunt 2001). Fewer complications and death rates, diminished postoperative pain, ileus and costs, shorter hospitalisation periods, fast recovery, patients being able to resume their life by returning quickly to work than those who undergo open, classical procedure are the main pros for laparoscopic adrenalectomy (Brunt 2001). The complexity rate ranges from 3 to 20%. Recovery from clinical disorders related to imbalanced hormonal secretion is the most important target of the surgical procedure. Moreover, oncological results of laparoscopic treatment of adrenal metastases were similar to those following conventional open procedure (Brunt 2001; Harris 2003).

As far as we can tell, due to the improvement of the electrosurgery devices and innovation in surgical instruments, for example the laparoscopic ultrasound probe, valuable during a saving adrenalectomy, laparoscopic adrenalectomy was considered the best quality level of the treatment in this pathology (Rossi 2002; Jeschke 2003).

The first patient presented in the study was diagnosed with pheochromocytoma. It is known that pheochromocytoma is a neuroendocrine tumor that secretes catecholamines in higher doses than the normal range, causing hypertension, tachycardia, hypovolemia, adrenergic cardiomyopathy and extreme vasoconstriction. Among patients with pheochromocytoma, 10% have various endocrine neoplasia, MEN type 2A or 2B, with consecutive adrenal tumors. Medical procedure for pheochromocytoma is prone to hazard because of the hemodynamic and cardiovascular complications that can appear both intra- and postoperatively. The use of laparoscopy in the surgical treatment of pheochromocytoma has long been disputed due to the pneumoperitoneum, which causes changes in hemodynamics and may increase the release of catecholamines. Laparoscopy has evolved and beside the easy approach, it has also led to the reduction of the operating time in the case of this intervention. In the case of our patient, the surgery lasted about two and a half hours. Studies have shown that, on average, a laparoscopic intervention for adrenalectomy in a patient with pheochromocytoma lasts for approximately three hours (Ishidoya 2005). This emphasizes the fact that it is very important to shorten the operating time, for this one should have a specialized team in this technique. It has also been shown that during a laparoscopic intervention for pheochromocytoma, the level of catecholamines is lower than in the case of a classic one (Kalady 2004). This fact can be explained by the more refined gestures, smoother manipulation of tissues and less pain (Brunt 2001, Kalady 2004, Kazaryan 2004).

The second case was about a patient who had primary hyperaldosteronism. As in the previous case, the patient had uncontrollable hypertension. The surgery resulted in the normalization of blood pressure values. In the case of our intervention we chose the transperitoneal approach. This approach is also used by many authors due to the fact that it offers better exposure for maneuvers. Studies show that the retroperitoneal approach is often used in pregnant patients due to the fact that pregnancy can lead to changes in the abdominal cavity anatomy (Kosaka 2006). The recovery after laparoscopic adrenalectomy is faster than in the case of classic approach. Most patients are discharged on day three or four postoperatively, which is also the case in our study. Moreover, patients can return to the daily routine and resume work faster. From the complications point of view, we can say that it is a lower risk. Some studies have shown that the risk of infection decreases by up to 60% in laparoscopic procedures and the risk of bleeding by up to 30% (Kim 2004; Bentrem 2002; Thomson 2004).

The size of the tumors removed laparoscopically was <8 cm in the operated cases. Studies show that the time of intervention does not differ in the case of tumors below 8 cm, a fact that has been confirmed by our case study (Castillo 2008). Some authors have pointed out that tumors larger than 8 cm should be operated in the classical way (Shen 2007). Also the contraindication of laparoscopic surgery in adrenal tumors may be primary

adrenocortical carcinoma, where there is an increased risk of positive margins (Miller 2010).

Increased attention should be paid to adrenal tumors with local invasion, because they may bleed during dissection and hemostasis can be sometimes difficult to achieve. It is important to choose the correct surgical technique depending on the type and size of the tumor, keeping in mind that every patient is different and the approaches chosen are only the means to an end, not a purpose itself. (Hsu 2002; Gill 2001).

## Conclusions

Laparoscopic adrenalectomy is a safe and effective technique for the surgical removal of adrenal tumors. This minimally invasive approach provides clear advantages over open resection. With careful patient selection and adequate surgical technique, successful outcomes should be expected.

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