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Original Research

Laparoscopic Approach to the Adrenal Masses: Single-Center Experience of Five Years

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Abstract

Objectives: Currently, laparoscopic adrenalectomy is the gold standard technique for suitable patients with adrenal masses. In this study, we aimed to assess the postoperative results of patients who underwent laparoscopic adrenalectomy.

Methods: Between January 2014 and October 2019, 76 cases were operated and retrospectively evaluated. Laparoscopic transabdominal adrenalectomy was applied to the patients. Demographic profiles, preoperative indications, intraoperative and postoperative complications, mortality and length of hospital stay were evaluated.

Results: Seventy-six patients (30 male, 46 female) with a mean age of 47.2±11.7 (range 22-71) years underwent laparoscopic adrenalectomy. Thirty-nine of the patients had right; 33 of the patients had left adrenal masses. Three patients had bilateral adrenal cortical hyperplasia. One patient was operated for paraganglioma. Conversion to open adrenalectomy was observed in four patients (5.26%). Nine patients (11.8%) experienced intraoperative and postoperative complications. Intraoperative and postoperative complications were bleeding from spleen (2 cases) and upper pole of kidney (1 case), renal artery injury (1 case), bleeding from liver parenchyma (2 cases), ischemia of spleen and pancreas (1 case), small intestinal injury (1 case) and incisional hernia (1 case). The complication rate is acceptable and comparable with other studies in the literature.

Conclusion: Laparoscopic adrenalectomy can be safely applied in suitable patients with acceptable complications and low conversion rates.

Keywords: Adrenalectomy; laparoscopy; Cushing's syndrome; pheochromocytoma; incidentaloma.

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Surgical approach to the adrenal masses is an important challenge for surgeons and decision making for operative strategy is critical for patient safety and prognosis. A surgeon should decide how to manage an adrenal mass considering the patient's general performance, size of the adrenal mass, presence of malignancy, previous operation history of the patient and his own surgical skills.[1]

Although open adrenalectomy is a standard procedure, minimally invasive techniques become increasingly widespread, such as laparoscopic adrenalectomy, which has become a gold standard technique since its definition in 1992 by Gagner et al.[2-4] Robotic or laparoscopic techniques and transabdominal or posterior retroperitoneal approach can be applied to the patient considering the surgeon's experience and characteristics of adrenal masses.[5]

Malignant adrenocortical tumors are the main cases for open surgery to avoid the dissemination of cancer.[1,6] Tumor size is important for decision making, but there is no consensus for open surgery indication. Laparoscopic adrenalectomy has superiority over open adrenalectomy con-

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cerning pain control, length of hospital stay, morbidity and cosmetic results.[5,7]

In this study, we aimed to assess the postoperative results of the patients who underwent laparoscopic adrenalectomy in our center.

Methods

The data of 76 patients with adrenal masses who were operated in our surgery clinic, between January 2014-October 2019, were evaluated retrospectively. In general, laparoscopic adrenalectomy was applied to patients with small or middle-sized benign masses. Patients with adrenal masses which were suspected to be malignant or patients with extensive sized masses were operated using an open approach. Patients with indications for laparoscopic adrenalectomy and the operations which started laparoscopically have been included in this study. Seven patients who were decided to have open surgery preoperatively were excluded from this study. Indications for open adrenalectomy was suspicion for malignancy (n=3), extensive sized pheochromocytoma (10 cm) (n=1), recurrent adrenocortical tumor (n=1), and paraganglioma (n=2).

All cases were operated by a single experienced endocrine and laparoscopic surgeon (MU). Demographic profiles, preoperative diagnoses, intraoperative and postoperative complications, pathological results and length of hospital stay of the patients were collected retrospectively.

Hormonal profiles of the patients were evaluated preoperatively. In hormone active patients, diagnoses were made based on biochemical test results. Patients underwent imaging studies of either computed tomography or magnetic resonance imaging. Selective adrenal vein sampling was applied to patients who had Conn's Syndrome and small masses that could not be visualized via magnetic resonance imaging and computed tomography. Patients with pheochromocytoma were treated with alfa and beta blockers, preoperatively. Preoperative steroid replacement treatment was applied to patients with Cushing's disease. Serum potassium levels were checked and corrected in patients with Conn's Syndrome, preoperatively.

Operative Technique

Antibiotic prophylaxis was applied to all patients during the induction of anesthesia. To apply right or left lateral transabdominal laparoscopic adrenalectomy, patients were positioned to lateral decubitus. To extend the range between the 12th rib and the iliac crest, the operation table was bent 50-60 degree angle. The first port was placed using an open technique. Other ports were placed under direct vision. Periadrenal dissection was applied using Harmonic scalpel® (Ethicon Endo-Surgery INC- Johnson & Johnson Medical SPA, NJ, USA) or LigaSure™device (Medtronic, Minneapolis, MN, USA). After the adrenal vein was disclosed, the distal side of the vein (Vena cava at the right, left renal vein at the left side) was closed with two metallic or polymer clips and divided. Drains were not used routinely, but a Jackson-Pratt drain was placed in the surgical area in case of need. Adrenal mass was removed from the first port site using a laparoscopic specimen retrieval bag. The port site was extended when needed. The abdominal fascia was closed with polypropylene suture material at the first port site.

Results

Indications and Operative Techniques

Seventy-six patients (30 M, 46 F) with an indication for laparoscopic adrenalectomy were operated between January 2014 and October 2019. The mean age was 47.2±11.7 (range 22-71) years. Thirty-nine cases had right adrenal masses, while 33 cases had left adrenal masses. Three of the patients had Cushing's disease and bilateral adrenal cortical hyperplasia. One patient was operated for abdominal paraganglioma and this mass was localized at the anterior side of the aortic bifurcation.

The preoperative and postoperative findings of the patients were summarized in Table 1.

Table 1. Preoperative and postoperative findings of the laparoscopic adrenalectomy cases

Age (Mean+SD) (Min-Max) year	47.2±11.7 (range 22-71)
Gender (M/F)	30/46
Operation site*	
Right (n)	39
Left (n)	33
Bilateral (n)	3
Tumor Size Mean+SD cm	4.06±2.08
Tumor Diameter >6 cm n (%)	10 (13.2)
Clinical Diagnosis n (%)	
Cushing's syndrome due to adrenal adenoma	19 (25)
Pituitary Cushing's syndrome	3 (3.9)
Conn's syndrome	12 (15.8)
Pheochromocytoma	27 (35.5)
Paraganglioma	1 (1.3)
Non-functioning tumor	14 (18.4)
Conversion to open surgery n (%)	4 (5.3)
Complications n (%)	9 (11.8)
Hospital stay (day)	7.10±7.07
Mortality n (%)	1 (1.3)

*One patient was operated for intraabdominal paraganglioma.

Four out of 76 (5.3%) patients have undergone previous abdominal operations. Two out of four patients had a previous laparoscopic cholecystectomy, one patient had previous open hysterectomy and one patient had open surgery for duodenal ulcer bleeding. One of the patients with laparoscopic cholecystectomy underwent laparoscopic right, and the other patient underwent laparoscopic left adrenalectomy. None of these patients experienced conversion during adrenalectomy.

Ten out of 72 (13.9%) patients with adrenal masses greater than 6 cm in size were applied laparoscopic surgery. Their preoperative diagnoses were as follows: nonfunctional adenoma (4), pheochromocytoma (5), Pituitary Cushing's syndrome (1). None of these patients experienced a conversion to open surgery.

Laparoscopic adrenalectomy was planned for 76 patients preoperatively. However, 72 of them had surgery laparoscopically, and the remaining four patients had a conversion to open surgery. Laparoscopic right adrenalectomy was applied to a patient with situs inversus totalis, and no complication was observed intra- and postoperatively.[8]

The mean size of the masses was 4.06±2.08 cm (range 0.8-12.2 cm). The mean diameter of adrenal masses was 4.08±2.09 cm in laparoscopically completed cases and 3.75±1.79 cm in cases with conversion to open adrenalectomy. No statistical difference was found between the two groups ($p>0.05$). The mean length of hospital stay was 6.14±2.62 (range 2-17) days in patients whose operations were completed laparoscopically. The mean length of hospital stay was 24±22.7 days (range 7-63) in patients with conversion to open surgery. There is a significant statistical difference between the two groups ($p<0.0001$).

Reason for Open Surgery

Conversion to open adrenalectomy was observed in four patients (5.26%). Conversion to open adrenalectomy was observed in one case of right adrenalectomy (renal artery injury), one case of left adrenalectomy (bleeding from the upper pole of the left kidney) and two cases of bilateral adrenalectomy. Reasons for conversion to open adrenalectomy in bilateral adrenalectomy were bleeding from liver parenchyma and inadequacy of pneumoperitoneum in a morbidly obese patient during the entrance of the first laparoscopic port and ischemia of spleen and pancreas in another patient.

Complications, Morbidity and Mortality

Nine patients (11.8%) experienced intraoperative and postoperative complications. Complications during operations were bleeding from spleen (2 cases), bleeding from the upper pole of the kidney, renal artery injury, bleeding from liver parenchyma (2 cases), ischemia of spleen and pancreas (pancreatic fistula developed), small intestinal injury and incisional hernia. Renal artery injury was repaired with polypropylene suture. Bleeding except renal artery injury was controlled using electrocautery and applying Surgicel (Ethicon, Inc. Somerville, NJ, USA) to the bleeding site.

During bilateral laparoscopic adrenalectomy, ischemia of spleen was observed, and the tail of the pancreas was dissected together with the adrenal gland. Thus, we converted to open surgery. Distal pancreatectomy via linear stapler and splenectomy was applied. A drain was placed in the surgical area. Postoperatively, the patient had a pancreatic fistula with 60 ml drainage per day and amylase levels with threefold of normal serum amylase level. The patient was followed more than four weeks because of an intraabdominal abscess formation. A percutaneous drain was placed through the abscess in the 4th week. After the removal of the drain, the patient was discharged on the 63rd postoperative day.

In a case of laparoscopic left adrenalectomy, unrealized small bowel injury occurred probably during the entrance of the second laparoscopic port. The patient was re-operated via laparotomy on the postoperative second day, and the injury was repaired primarily. Toxic ischemic hepatitis was observed due to anesthesia in 1 case. This patient was treated with IV hydration and N-acetylcysteine infusion. During the hospital stay, liver function tests got normalized, and the patient was discharged on the 14th day postoperatively.

One patient with a previous history of Chronic Obstructive Pulmonary Disease (COPD) died due to Acute Respiratory Distress Syndrome (ARDS). This patient was admitted to the internal medicine ward for pheochromocytoma, and was transferred to the intensive care unit during his stay because of severe COPD and stayed there for 28 days. After the operation, the patient could not be extubated, and he died on the fourth postoperative day.

Hernia at the incision site was observed in one patient and hernia was originated from the port site at which the adrenal gland removed. This port site entrance was extended during the removal of the specimen retrieval bag.

Discussion

Clinical evaluation of adrenal masses and choosing the right surgical strategy are strong challenges, even for experienced surgeons. In this study, we wanted to share our experiences and discuss our results, considering the literature on laparoscopic surgery. The majority of the patients had indications for laparoscopic adrenalectomy. Most of the operations were completed laparoscopically, and conversion to open surgery was limited.

After the first description of laparoscopic adrenalectomy by Gagner and friends in 1992, this technique has become an essential approach for endocrine surgeons.[1,2] In our clinic, we routinely apply lateral transabdominal laparoscopic adrenalectomy for appropriate patients. Safety and feasibility of laparoscopic adrenalectomy have been approved by many studies in the literature, and our experience also affirms its superiority in selected patients.[3,5,9] Laparoscopic adrenalectomy were planned for most of the patients except for patients with suspicion for malignancy, pheochromocytoma with extensive size and recurrent adrenocortical tumor. These patients were eligible for open adrenalectomy. Laparoscopic adrenalectomy can be applied through retroperitoneal or transperitoneal techniques. The transabdominal technique was preferred considering the surgeon's experience. However, in selected cases, single incision laparoscopic adrenalectomy can be applied safely with less postoperative pain and better cosmesis as it has been mentioned in the literature.[10]

Literature suggests open surgery for the possibility of malignancy, recurrent cases and masses with larger sizes.[1,7,9] In former studies, laparoscopic surgery has been accepted as a contraindicated procedure for masses greater than 6 cm. However, today, tumor size is not a definitive contraindication for laparoscopic surgery.[12]

Recently, adrenal masses with greater diameter have been operated successfully with the laparoscopic technique. In their study, Conzo et al.[1] included patients with ASA score less than 3, age less than 80 years, adrenal benign tumors less than 8 cm, non-functioning tumors less than 12 cm, and adrenal metastases less than 6 cm, for laparoscopic adrenalectomy. In our study, 10 (13.8%) out of 72 patients who underwent laparoscopic adrenalectomy had adrenal masses greater than 6 cm. The laparoscopic technique was applied successfully to all of these patients, and tumor size was not a reason for conversion. Comparable with current literature, our study supports that laparoscopic adrenalectomy can be safely performed in adrenal masses greater than 6 cm with no suspicion of malignancy.

Pheochromocytoma has a good blood supply, and greater sizes of these tumours can be dangerous because of the high risk of bleeding and unstable preoperative course. Therefore, open surgery is a choice for extensive sized pheochromocytoma masses.[13] In addition to open surgery, in current literature, it has been reported that transperitoneal and retroperitoneal laparoscopic adrenalectomy can be applied for pheochromocytomas greater than 5 cm.[14]

In our study, laparoscopic adrenalectomy was applied to 27 out of 28 pheochromocytoma patients (96.4%) except one patient who had an adrenal mass with a diameter of 10 cm. The mean tumor size was 4.41±1.70 cm. The greatest diameter of laparoscopically operated pheochromocytoma was 7.5 cm. Renal artery injury occurred in one patient with a tumor adjacent to the renal artery. Laparoscopic surgery was converted to open surgery and the renal artery was repaired. In this patient, due to malignant pheochromocytoma, recurrence was observed at the postoperative 10th month. The patient was re-operated and paraaortic lymph node excision was applied.

To take advantage of the benefits of laparoscopic adrenalectomy, even in sizes of >10cm, non-functional adenomas were operated with the laparoscopic method. A patient with non-functional adenoma with a size of 11 cm was found eligible for laparoscopic adrenalectomy and no complication was observed intraoperatively.

Although we applied prophylactic antibiotics to all of our patients, it has still been on a debate in the literature. The use of prophylactic antibiotics is practice dependent. There are several studies in the literature which are against prophylactic antibiotic use[15] and support the use of prophylactic antibiotics in patients with Cushing's syndrome and individual clinical factors,[16] approves routine use of prophylactic antibiotics.[17]

In our study, the mean length of hospital stay (7.10±7.07 day) was found to be longer than the time described in the literature.[11,14] Indeed, length of hospital stay was 6.14±2.62 days in laparoscopically completed cases, and it was shorter than cases with conversion to open surgery (24±22.7 days in cases with conversion, $p<0.0001$). The main reason for this finding was the longer stay in complicated cases. Especially, Cushing's disease patients with laparoscopic bilateral adrenalectomy had a long hospital stay. During the surgery, ischemia of spleen was observed, and the tail of the pancreas was dissected together with the adrenal gland. Thus, we converted to open surgery. Distal pancreatectomy via linear stapler and splenectomy was applied. A drain was placed in the surgical area. During follow up, pancreatic fistula developed, and the patient stayed at the hospital for 63 days. When compared with literature, mean hospital stay was observed to increase in complicated cases. Chen and colleagues defined age >65 and American Society of Anesthesiology (ASA) physical status classification system 3 or 4 as patient factors that independently influenced the prolonged length of stay on multivariate analysis.[18]

Conversion to open adrenalectomy was observed only in four (5.2%) patients, and this percentage is compatible with the rates of the literature. Thompson et al.[9] operated 659 patients, and their conversion rate was 5.6%. Bittner et al.[12] operated 402 patients and their conversion rate was 6.2% (22 patients). Both of these studies showed that there

was no correlation with tumor site (right or left) for conversion. In our study, one right, one left and two bilateral laparoscopic adrenalectomy patients experienced a conversion to open surgery. In this study, the main reason for conversion was bleeding. Shen et al.[13] analyzed 456 cases retrospectively, and their study had a conversion rate of 5.5%. They found that tumor size of >5 cm, pheochromocytoma and obesity were risk factors increasing the rate of conversion and tumor size was the most important predictor factor. There should be no hesitation for conversion to open surgery when patient safety is at risk.

Bleeding is one of the most common complications during laparoscopic adrenalectomy.[19,20] In our study, we had bleeding from the liver in two cases, bleeding from spleen in two cases, renal artery injury in one case and upper pole bleeding of kidney in one case. One case of bleeding from the liver developed in a morbidly obese patient during the entrance of the first laparoscopic port. In addition to liver damage, pneumoperitoneum was inadequate, and we converted to open surgery to control the bleeding. There is no clinical correlation between cases, but mostly, the reason for bleeding is the proximity of the adrenal gland to the major vessel and organs and difficulty in retraction of liver and spleen from the operation area in obese patients. Other more common complications in the literature are reoperation, vasoactive agent support, pneumonia and pulmonary embolism.[18]

Toxic ischemic hepatitis is observed in one of the patients with subclinical Cushing syndrome with a mass in the left adrenal gland. It has been reported that volatile anesthetics could cause liver toxicity.[21] The diameter of the mass was 3 cm, and laparoscopic left adrenalectomy was applied. Toxic ischemic hepatitis developed at postoperative 2nd day and the patient was discharged at the postoperative 14th day after the normalization of liver function tests.

One pheochromocytoma patient died after laparoscopic left adrenalectomy due to ARDS. The diameter of the mass was 5.6 cm and the patient had a known history of COPD. After surgery, the patient had difficulty breathing and the patient was transferred to the intensive care unit. The patient died due to severe ARDS on the 4th day postoperatively.

In one study, the database of American College of Surgery National Surgical Quality Improvement Program was evaluated for the laparoscopic cholecystectomy and laparoscopic adrenalectomy applied between 2012 and 2015, and the operative risks were found same for both procedures.[22] Also, in patients with a history of previous abdominal surgery, laparoscopic adrenalectomy can be safely applied when compared to patients with no history of previous abdominal surgery.[23]

Moreover, for successful laparoscopic adrenal surgery, surgical experience, number of patients operated in a hospital per year and multidisciplinary approach of the surgeon, endocrinologist and anesthesiologist for patient selection are crucial.[11]

Conclusion

Adrenalectomy is a serious operation, and surgical strategy is important, specifically in complicated cases. The laparoscopic techniques can be applied safely for selected patients. Patient safety should be first priority, and conversion to open surgery should be applied when needed.

Disclosures

Ethics Committee Approval: This study was approved by Sisli Hamidiye Etfal Hospital Local Ethics Committee (1422-28.01.2020).

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Conflict of Interest: None declared.

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