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Early Experience with Transperitoneal Laparoscopic Adrenalectomy: Retrospective Analysis of the First 100 Cases

Transperitoneal Laparoskopik Adrenalektomi ile İlgili Erken Deneyimler: İlk 100 Olgunun Retrospektif Analizi

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ABSTRACT Objective: To evaluate the clinical, surgical, and pathological outcomes of patients who underwent transperitoneal laparoscopic adrenalectomy (LA) for adrenal masses in our department over the past 5 years. **Material and Methods:** We retrospectively reviewed 100 patients who underwent LA between December 2017-May 2024. Demographic data, perioperative parameters, complication rates, and pathological findings were analysed. Preoperative endocrine evaluation and radiological imaging were performed in all patients. Statistical analysis was conducted using SPSS v25.0, and significance was set at $p<0.05$. **Results:** The cohort included 65 females and 35 males, with a mean age of 54.1±13.5 years. Right-sided LA was more frequent (58%). The mean mass size was 43.7±23.6 mm, and the average operative time was 103.9±27.8 minutes. Conversion to open surgery occurred in 4 (4%) patients. Seven patients experienced Clavien-Dindo grade II complications requiring transfusion; no grade III-V complications or mortality were observed. Histopathology revealed 62 adenomas, 29 benign non-adenomatous lesions, and 9 malignancies, including 3 renal cell carcinoma metastases and 2 adrenocortical carcinomas. Functional adrenal masses were present in 61% of patients, with clinical improvement observed postoperatively. **Conclusion:** LA is a safe and effective minimally invasive approach for adrenal masses, offering favorable perioperative outcomes and low complication rates. Even in complex cases, including large tumors and pheochromocytomas, LA can be performed safely with appropriate patient selection and surgical expertise.

Keywords: Adrenalectomy; adrenal gland neoplasms; minimally invasive surgical procedures; treatment outcome

ÖZET Amaç: Bu çalışmanın amacı, son 5 yıl içinde bölümümüzde adrenal kitleler nedeniyle transperitoneal laparoskopik adrenalektomi (LA) operasyonu yapılan hastaların klinik, cerrahi ve patolojik sonuçlarını değerlendirmektir. **Gereç ve Yöntemler:** Aralık 2017-Mayıs 2024 tarihleri arasında LA uygulanan 100 hastayı retrospektif olarak inceledik. Demografik veriler, perioperatif parametreler, komplikasyon oranları ve patolojik bulgular analiz edildi. Tüm hastalarda preoperatif endokrin değerlendirme ve radyolojik görüntüleme yapıldı. İstatistiksel analiz, SPSS v25.0 kullanılarak yapıldı ve anlamlılık düzeyi $p<0,05$ olarak belirlendi. **Bulgular:** Kohortta, 65 kadın ve 35 erkek yer almakta olup, ortalama yaş 54,1±13,5 yıl idi. Sağ taraflı LA daha sık yapıldı (%58). Ortalama kitle boyutu 43,7±23,6 mm ve ortalama ameliyat süresi 103,9±27,8 dk idi. Hastaların 4'ünde (%4) açık cerrahiye geçildi. Yedi hasta, transfüzyon gerektiren Clavien-Dindo derece II komplikasyonlar yaşadı; derece III-V komplikasyonlar veya mortalite gözlenmedi. Histopatolojik inceleme sonucu, 62 adenom, 29 benign nonadenomatöz lezyon ve 3 renal hücreli karsinom metastazı ve 2 adrenokortikal karsinom dâhil 9 malignite saptandı. Hastaların %61'inde fonksiyonel adrenal kitleler mevcuttu ve ameliyat sonrası klinik iyileşme gözlendi. **Sonuç:** LA, adrenal kitleler için güvenli ve etkili bir minimal invaziv yaklaşımdır ve uygun perioperatif sonuçlar ve düşük komplikasyon oranları sunar. Büyük tümörler ve feokromositomalar dâhil olmak üzere karmaşık olgularda bile uygun hasta seçimi ve cerrahi uzmanlık ile LA güvenli bir şekilde gerçekleştirilebilir.

Anahtar Kelimeler: Adrenalektomi; adrenal bez neoplazileri; minimal invaziv cerrahi işlemler; tedavi sonucu

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With the increasing advancement and widespread adoption of laparoscopic procedures over time, the applicability of laparoscopic surgery has been considered and discussed in various surgical fields. The adrenal gland is deemed suitable for laparoscopic techniques due to its small size, low incidence of malignancy, and higher morbidity associated with open surgical techniques. This minimally invasive approach was first described by Gagner et al. in 1992. Since then, it has gained widespread acceptance and has become the gold standard method for the removal of adrenal gland lesions.[1] Among the available laparoscopic techniques, the lateral transperitoneal approach remains the most commonly preferred due to the wider operative field and familiar anatomical landmarks. High-volume centres have reported significantly lower rates of complications and conversion to open surgery with increasing surgical experience.[2] The advantages of minimally invasive surgery include shorter hospital stays, faster postoperative recovery, and earlier return to daily activities.[3,4] Today, laparoscopic interventions are the preferred method for adrenalectomy in many centres.

In this study, we aimed to evaluate, in light of the literature, the outcomes of patients diagnosed with adrenal masses who underwent transperitoneal laparoscopic adrenalectomy (LA) in our department over the past 5 years.

MATERIAL AND METHODS

Following the approval of the ethics committee of our hospital (Bursa Faculty of Medicine Ethics Committee; date: March 20, 2024; no: 2024 TEBK 2024/03-10), data from 100 patients who underwent data from 100 patients who underwent transperitoneal LA for adrenal masses in Bursa Yüksek İhtisas Training and Research Hospital between December 2017-May 2024 were retrospectively analysed. Patients under 18 years of age were excluded from the study. The study complied with the Declaration of Helsinki, legal regulations, good clinical practices and ethical principles.

The demographic characteristics of the patients, including age and gender, as well as the size of the adrenal mass, operation time, amount of bleeding, preoperative and postoperative haemoglobin levels, duration of hospital stay, and intraoperative and postoperative complications, were evaluated. Pathology reports were also reviewed and recorded. Operation time was defined as the period from the placement of the camera and working ports to the closure of the skin. Pathology reports were reviewed to record mass size, with the mass size defined as the measurement reported in the pathology examination.

All patients received preoperative endocrinology consultations. Tests for cortisol, aldosterone, adrenocorticotropic hormone, dehydroepiandrosterone sulfate, metanephrine, normetanephrine, noradrenaline, and adrenaline levels were carried out to assess the function of the adrenal mass. A 1 mg dexamethasone suppression test was conducted for all cases. In suspected Cushing's disease, 24-hour urinary cortisol levels were also measured. Patients with high and irregular blood pressure levels underwent 24-hour blood pressure Holter monitoring. Plasma metanephrine levels were determined in patients with elevated catecholamine breakdown products in 24-hour urine samples.

All adrenal masses were preoperatively imaged using triphasic abdominal computed tomography or abdominal magnetic resonance imaging. For cases with a high risk of malignancy, positron emission tomography imaging was utilised to better differentiate between benign and malignant lesions.

Adrenal lesions were assessed by a multidisciplinary council consisting of urology and endocrinology specialists. Adrenalectomy is recommended for patients with functional adrenal masses, symptomatic non-functional adrenal lesions larger than 6 cm, or adrenal lesions that show growth during follow-up, raising concerns about malignancy.

STATISTICAL ANALYSES

All data were analysed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean±standard deviation or median with range, depending on the distribution. Categorical variables were presented as frequencies. Comparisons between groups were conducted using the Student's t-test or the Mann-Whitney U test for continuous variables.

The normality of data distribution was assessed using the Kolmogorov-Smirnov test. Statistical significance was defined as a p value <0.05.

RESULTS

A total of 100 LA cases, including 65 females and 35 males, were retrospectively analysed in this study. Right LA was performed in 58 patients, while left LA was performed in 42 patients. The mean age of the patients was 54.1±13.49 years, and the mean size of the adrenal masses was 43.7±23.6 millimetres. The mean lesion size was 35.2±1.3 millimetres in adenomas, 58.0±2.3 millimetres in non-adenomatous benign masses, and 48.1±2.9 millimetres in malignant lesions. The difference between the groups was statistically significant (p<0.001). The mean operation time was 103.9±27.8 minutes. The mean length of hospital stay was 4.9±1.1 days.

The demographic characteristics, clinical, and perioperative variables of the patients are summarised in Table 1.

Conversion to open surgery was required in 4 patients: in two due to liver injury secondary to adhesions to the liver, in one due to bleeding, and in one due to uncontrolled hypertension. The average blood loss during the procedures was recorded at 50.8±44.1 mL. In the postoperative period, Clavien-Dindo Class 2 complications occurred in 7 patients, all of whom required blood transfusions. No patients experienced class 3 or 4 complications, and there were no instances of mortality.

TABLE 1: Demographic characteristics, intraoperative results, and complications of the patients

	Minimum	Maximum	X̄±SD
Age (year)	19	84	54.1±13.49
Weight (kg)	55	128	83.7±12.8
Height (cm)	147	187	166.2±6.7
BMI (kg/m^2)	18.1	52.2	30.1±5.1
Preop Hgb (g/dL)	9.8	17.8	13.2±1.4
Postop Hgb (g/dL)	8.5	14.6	11.3±1.3
Operation time (minutes)	65	260	103.9±27.8
Blood loss (mL)	10	650	50.8±44.1
Hospital stay (day)	3	8	4.9±1.1
Pathological specimen size (mm)	13	170	43.7±23.6

SD: Standard deviation; BMI: Body mass index; Hgb: Hemoglobin

Preoperatively, 61 patients had functional adrenal masses, while 39 had non-functional adrenal masses. Of those with functional adrenal masses, 26 were diagnosed with Cushing's syndrome, 20 with Conn's syndrome, 12 with phaeochromocytoma, 2 with subclinical Cushing's syndrome, and 1 with both Cushing's and Conn's syndromes.

Postoperative pathological findings were reported as follows: 62 adenomas, 29 patients with non-adenoma benign masses distributed as follows: 12 pheochromocytomas, 9 myelolipomas, 3 endothelial cysts, 1 adrenal cortical hyperplasia, 1 ganglioneuroma, 1 lymphangiectasia, 1 cavernous hemangioma, and 1 benign cystic formation. The pathology of 9 patients was reported as malignant, including: 3 metachronous clear cell renal cell carcinoma metastases, 2 adrenocortical carcinomas (ACC), 1 high-risk gastrointestinal stromal tumour (GIST), 1 adenocarcinoma metastasis, 1 B-cell non-Hodgkin lymphoma, and 1 non-small cell lung carcinoma metastasis.

DISCUSSION

LA has become the gold standard treatment for adrenal masses.[5] The absence of large skin incisions and minimal bowel manipulation in laparoscopic surgery has led to reduced postoperative morbidity, shorter hospital stays, and superior cosmetic results.[6] Numerous studies have reported that LA offers shorter hospitalisation periods, faster recovery, improved patient satisfaction, and lower morbidity compared to open adrenalectomy.[7-9] However, the role of laparoscopic surgery for large adrenal masses with high malignant potential remains a subject of debate.

LA can be performed using either a retroperitoneal or transperitoneal approach.[10] Both approaches have unique advantages and disadvantages. The retroperitoneal approach avoids intra-abdominal adhesions, making it advantageous for patients with a history of prior abdominal surgeries. However, its narrower working space can make the dissection of large adrenal masses challenging.[11] On the other hand, the transperitoneal approach provides a larger operative field, facilitating the management of larger adrenal masses. In our clinic, due to extensive experience with transperitoneal laparoscopic kidney surg-

eries, the lateral transperitoneal approach has been routinely performed.

Conversion rates to open surgery in LA vary between 0.2% and 6.2% in the literature.[12] Thompson et al. reported a 5.6% conversion rate in a study involving 659 patients, attributing conversions to factors such as large mass size and malignancy.[13] In our series, the conversion rate was 4%, with reasons including liver injury, bleeding and aggressive hypertension.

The size of the adrenal mass is a critical factor in adrenal surgery, both due to the difficulty of surgical dissection and the increased risk of malignancy associated with larger masses. Sada et al. reported that the risk of malignancy is below 2% for adrenal masses smaller than 4 cm but increases to 25% for masses larger than 6 cm.[14] Despite the challenges posed by larger masses, recent publications have suggested that LA can be safely performed even in such cases.[15] In our study, the average tumour size was 43.7±23.6 mm, which is consistent with similar series in the literature.

Adrenal metastases are uncommon, with primary tumours such as lung, kidney, colon, and breast cancers, as well as malignant melanomas, being the most frequent sources. Metastases are bilateral in approximately half of the cases.[16] Adrenalectomy for selected patients with adrenal metastases can positively impact life expectancy.[17] In our series, there were three cases of clear cell renal cell carcinoma metastases, one adenocarcinoma metastasis, one lung non-small cell carcinoma metastasis, and one high-risk GIST. On the other hand, the pathology of two patients was reported as ACC. European guidelines recommend open surgery as the standard technique for ACC. Nevertheless, some experts and studies suggest that LA, when performed by experienced teams, may represent a viable alternative to open resection.[18,19]

The average operative time for LA in the literature ranges from 70 to 360 minutes, depending on the technique.[20,21] In our series, the mean operative time was 103.8±27.8 minutes, which is consistent with the literature. Numerous factors influence hospital stay duration, but laparoscopic surgery is generally associated with shorter hospitalisation. In our study, the mean hospital stay was 4.9±1.1 days. Although slightly longer than some reports, our results align with specific studies.[22] This extended stay may be attributed to factors such as high American Society of Anesthesiologists scores, comorbidities, larger mass sizes, operations involving multiple surgeons, and the educational nature of our centre. Importantly, there was no mortality in our series, demonstrating the safety of the laparoscopic approach.

LA is also feasible for pheochromocytoma cases. Bai et al. reported less intraoperative hemodynamic instability in LA compared to open adrenalectomy in a study of 182 patients with pheochromocytoma.[23] In our series, conversion to open surgery was necessary for two pheochromocytoma patients due to hypertension and bleeding. These findings highlight that pheochromocytoma remains a significant factor in conversion rates.

The most common indication for adrenalectomy in our series was functional adrenal masses. Most patients achieved normalised blood pressure and glucose levels postoperatively, eliminating the need for antihypertensive and antidiabetic medications. The marked improvement in these patients' quality of life underscores the importance of accurate diagnosis and timely surgical intervention.

CONCLUSION

LA is a minimally invasive and effective surgical method with low morbidity in treating adrenal masses. Its advantages include shorter recovery times, reduced hospital stays, and favourable cosmetic outcomes. Moreover, urologists experienced in laparoscopic nephrectomy can quickly adapt to LA, even with a limited number of cases. However, further studies with larger patient cohorts and long-term follow-up are needed to provide more definitive conclusions.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Soner Çoban, Anıl Erkan, Tarık Gufran Aliefendioğlu;* ***Design:*** *Soner Çoban, Ersoy Uysal, Anıl Erkan;* ***Control/Supervision:*** *Soner Çoban, Muhammet Güzelsoy;* ***Data Collection and/or Processing:*** *Tarık Gufran Aliefendioğlu, Ali Rıza Türkoğlu, Ahmet Mermertaş, Oğuzhan Akpınar, Mutlu Güneş;* ***Analysis and/or Interpretation:*** *Anıl Erkan, Muhammet Güzelsoy;* ***Literature Review:*** *Soner Çoban, Ersoy Uysal, Anıl Erkan;* ***Writing the Article:*** *Soner Çoban, Ersoy Uysal, Anıl Erkan, Tarık Gufran Aliefendioğlu;* ***Critical Review:*** *Tarık Gufran Aliefendioğlu, Mutlu Güneş.*

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