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RESEARCH ARTICLE OPEN ACCESS

Comparative Analysis of Laparoscopic and Open Adrenalectomy Outcomes in Wasit Province, Iraq

Adrenalectomy Outcomes in Wasit Province, Iraq

Al Maliki NKJ[1]

[1]*Dean of Wasit Medical College, General Surgeon, Surgical Department, Wasit Medical College*

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Abstract

Objective: To compare perioperative outcomes of laparoscopic adrenalectomy (LA) and open adrenalectomy (OA) in managing adrenal tumours at Al-Karami Teaching Hospital, Wasit Province, Iraq.

Method: This retrospective study reviewed 80 patients who underwent adrenalectomy between January 2015 and December 2023. Data on demographics, tumour characteristics, operative details, and postoperative outcomes were collected. Statistical analysis included t-tests, Chi-square, and Mann–Whitney U tests, with significance set at $p<0.05$.

Results: Of 80 patients (mean age 37.4 years; M: F ratio 1:5.8), 70 underwent LA and 10 OA. Pheochromocytoma was the most common indication (82.5%). Compared to OA, LA had significantly lower blood loss (90 vs. 180mL, $p<0.001$), shorter operative time (135 vs. 158 min, $p=0.008$), and reduced hospital stay (1.9 vs. 3.3 days, $p<0.001$). No conversions from LA to OA occurred. All malignant tumours (5%) were treated with OA. Postoperative complications were minor (7.5%) and did not differ significantly between groups.

Conclusion: LA is a safe and effective alternative to OA for adrenal tumours <6cm, offering shorter operative time, less blood loss, and faster recovery, even in resource-limited settings. Adoption of laparoscopic techniques and structured surgical training could improve adrenal surgery outcomes in similar regions.

Keywords: Adrenalectomy, Laparoscopy, Open surgery, Pheochromocytoma, Iraq

Plain English Summary

This study compared two surgical techniques used to remove adrenal gland tumours, laparoscopic (minimally invasive) and open surgery, in a cohort of 80 patients treated at Al-Karami Teaching Hospital in Wasit Province, Iraq, between 2015 and 2023. The aim was to evaluate differences in outcomes such as blood loss, operation time, hospital stay, and complications. Most patients underwent laparoscopic adrenalectomy, which involved smaller incisions and specialised instruments guided by a camera. Most tumours were hormonally active, with pheochromocytoma being the most common diagnosis. Results showed that laparoscopic adrenalectomy was associated with significantly less blood loss, shorter hospital

Correspondence:
Naseer Kadhim Jawad Al Maliki
Surgical Department
Wasit Medical College
Iraq
09647811964069, nalmaliki@uowasit.edu.iq

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stays, and faster recovery times compared to open surgery. No procedures had to be switched from laparoscopic to open, indicating careful patient selection and surgical expertise. Nearly all tumours were found to be benign upon pathological examination, and postoperative complications were minor and manageable. These findings support the safety and effectiveness of laparoscopic adrenalectomy for adrenal tumours smaller than six centimetres, even in resource-limited settings. The results suggest that expanding training in minimally invasive techniques could improve surgical care in similar regions across Iraq and the broader Middle East.

Introduction

The incidence of adrenal tumours has increased significantly over the past two decades, largely due to the widespread use of high-resolution imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI) in routine clinical practice (1). While many of these lesions are non-functional and incidentally discovered, a significant proportion represent hormonally active tumours that necessitate surgical intervention. Adrenalectomy remains the definitive treatment for most functional adrenal neoplasms, including pheochromocytoma, Cushing's syndrome, and primary hyperaldosteronism, as well as for large or suspicious non-functional tumours (2).

Historically, open adrenalectomy (OA) was the standard approach for adrenal gland removal. However, since its introduction in the early 1990s, laparoscopic adrenalectomy (LA) has rapidly gained acceptance as the preferred technique for managing benign adrenal tumours, particularly those less than 6cm in diameter (3). The laparoscopic approach offers several advantages over the open method, including reduced intraoperative blood loss, shorter hospital stays, faster recovery times, and improved cosmetic outcomes (1).

Pheochromocytoma, a catecholamine-secreting tumour, poses unique challenges during surgical resection due to the risk of life-threatening hemodynamic instability. Laparoscopic resection has been shown to provide better control of intraoperative blood pressure fluctuations compared to open surgery, especially when performed with meticulous preoperative preparation and careful intraoperative technique (5).

Despite the growing body of evidence supporting LA as the gold standard for adrenal surgery, access to this minimally invasive technique remains limited in many low- and middle-income countries, including parts of Iraq. In Wasit Province, few studies have evaluated the feasibility and outcomes of laparoscopic versus open approaches in adrenal surgery.

This study aims to assess the safety, efficacy, and short-term outcomes of both laparoscopic and open adrenalectomy techniques among 80 patients who underwent adrenal gland removal at Al-Karami Teaching Hospital between January 2015 and December 2023. We also compare operative time, estimated blood loss, length of hospital stay, postoperative complications, and histopathological findings between the two surgical approaches

Materials and Methods

Patient Selection

All patients aged between 18 and 65 years with confirmed adrenal tumours undergoing elective adrenalectomy were included. Functional tumours were diagnosed based on clinical features and biochemical testing, including plasma and urinary catecholamines, cortisol levels, and aldosterone-renin ratio. Non-functional tumours were identified incidentally during abdominal imaging for unrelated conditions.

Exclusion Criteria

Patients were excluded if:

Medical records were incomplete.

Surgery was performed as an emergency without a clear preoperative diagnosis.

Tumours larger than 6cm with suspicion of malignancy were resected using a non-standardised approach.

Follow-up data were unavailable.

Data Collection

Data were extracted from both archived paper records and electronic health systems by two independent researchers using a standardised form. Information collected included:

Demographics: age, gender

Clinical data: symptoms, hormonal status, preoperative preparation

Imaging findings: tumour size, laterality, CT/MRI appearance

Surgical details: approach, operative time (skin incision to closure), estimated blood loss (EBL), intraoperative events

Postoperative outcomes: hospital stay, complications (e.g., infection, adrenal insufficiency)

Histopathology: tumour type and malignancy

Follow-up: recurrence, need for additional treatment

Surgical Techniques

Laparoscopic Adrenalectomy

Performed using the transperitoneal lateral approach (3). Patients were placed in the lateral decubitus position. Three or four trocars were used. Preoperative alpha- and beta-blockade was administered for pheochromocytoma.

Open Adrenalectomy

Performed via posterior or transabdominal approach. Used for tumours>6cm or with suspicion of malignancy to ensure complete resection.

Definitions

Operative time: from skin incision to closure

Estimated blood loss (EBL): calculated from suction volume and gauze weight

Hospital stay: Time from surgery day to discharge

Complications: graded using Clavier-Dindo classification (6)

Tumour size: measured on preoperative CT and confirmed pathologically

Functional tumour: confirmed by biochemical testing

Statistical Analysis

Data were analysed using SPSS v26. Continuous variables were expressed as mean ± SD or median (IQR) based on normality (Shapiro-Wilk test). Between-group comparisons used an independent t-test or a Mann-Whitney U test. Categorical variables were analysed using Chi-square or Fisher's exact test. $p < 0.05$ was considered significant.

Subgroup analysis was performed for pheochromocytoma cases (n=66), showing LA associated with lower EBL (95 vs. 175mL, p=0.003) and shorter stay (2.0 vs. 3.2 days, p=0.011).

Results

A total of 80 patients who underwent adrenalectomy at Al-Karami Teaching Hospital and affiliated centres between January 2015 and December 2023. The results are presented across several domains, including demographic characteristics, surgical approaches, tumour pathology, perioperative outcomes, and complications.

Demographic Characteristics

Demographic characteristics are summarised in Table 1 and illustrated in Figure 1. The mean age was 37.4 years (range: 19–62), with a male-to-female ratio of 1:5.8. Female predominance reflects a higher incidence of functional tumours.

Table 1: Demographic Characteristics of Patients Undergoing Adrenalectomy in Al-Karami Province, Iraq (2015–2023)

Parameter	Value
Total number of patients	80
Mean age	37.4 years
Age range	19–62 years
Gender ratio (M: F)	1:5.8

Figure 1 shows the age distribution of patients who underwent adrenalectomy. Female patients predominated (M: F ratio 1:5.8), consistent with the higher prevalence of functional adrenal tumours, particularly pheochromocytoma and hypercortisolism, in women. presents a histogram showing the frequency distribution of patient ages, highlighting that most patients were in the third to fifth decades of life.

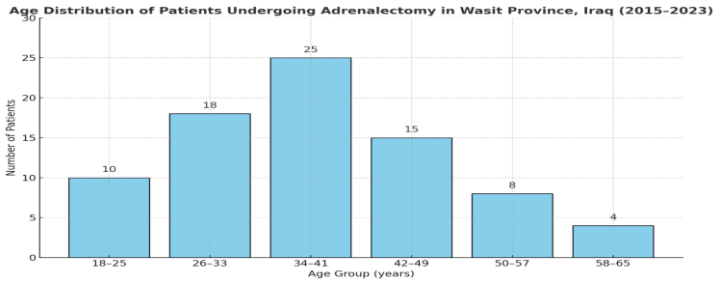


Figure 1: Histogram of Patient Age Distribution Among Adrenalectomy Cases

Surgical Approaches

As shown in Table 2, the distribution of surgical approaches is presented.

Table 2: Distribution of Surgical Approaches in Adrenalectomy Procedures (n=80)

Procedure	Number of Cases	Percentage (%)
Laparoscopic Adrenalectomy (LA)	70	87.5
Open Adrenalectomy (OA)	10	12.5

Out of the 80 procedures performed, 70 (87.5%) were conducted using a laparoscopic approach, while 10 (12.5%) utilised an open technique. Figure 2 shows the percentage distribution of the surgical techniques used.

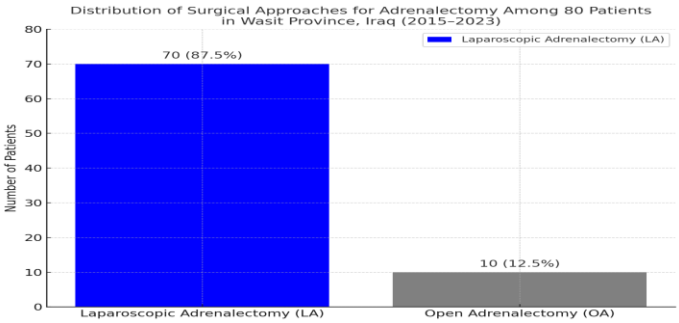


Figure 2: Bar Chart Showing Distribution of Surgical Approaches (Laparoscopic vs. Open Adrenalectomy)

Notably, there were no conversions from laparoscopic to open surgery, indicating appropriate preoperative selection of cases and adequate surgical expertise. Laparoscopic adrenalectomy has become the preferred method for managing benign adrenal tumours, particularly those less than 6cm in diameter

As shown in Table 3, the tumour laterality is summarised. Among all cases, 39 tumours (48.8%) were located on the right adrenal gland, 37 (46.2%) on the left, and 4 (5.0%) were bilateral lesions.

Table 3: Tumour Laterality and Anatomical Location in Patients with Adrenal Tumours

SIDE	Number of Cases
Right adrenal gland	39
Left adrenal gland	37
Bilateral tumours	4

Figure 3 compares operative times by tumour laterality. Right-sided adrenalectomies were associated with shorter operative times compared to left-sided ones (125 vs. 150 minutes), likely due to anatomical differences and easier access to the right adrenal vein during dissection. As shown in Table 4, operative time, blood loss, and hospital stay are compared between right and left adrenalectomy.

Table 4: Comparison of Operative Time, Blood Loss, and Hospital Stay Between Right and Left Adrenalectomy

SIDE	Operative Time (min)	Blood Losses	Hospital Stay
Right	125	90	2
Left	150	105	2

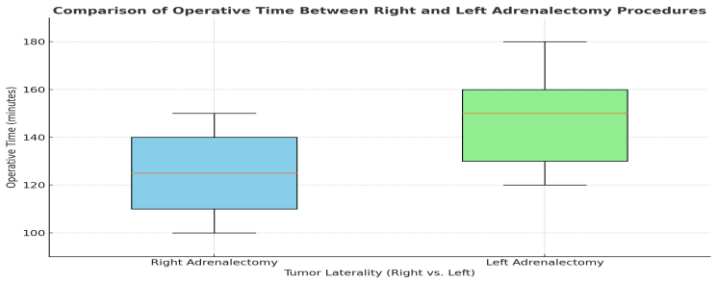


Figure 3: Box Plot Comparing Operative Times by Tumour Laterality (Right vs. Left Adrenalectomy)

Indications for Surgery

As shown in Table 5, the indications for adrenalectomy according to hormonal activity and pathology are listed. The most common reason for performing adrenalectomy in this cohort was the presence of pheochromocytoma, which accounted for 66 out of 80 cases, or 82.5% of all procedures. This reflects a high prevalence of catecholamine-secreting tumours in the region and underscores the importance of managing significant hemodynamic risks during surgery. Other functional tumours included five cases of hypercortisolism due to adrenal adenomas causing Cushing's syndrome, representing 6.2% of cases. Primary hyperaldosteronism caused by aldosterone-producing adenomas was identified in three patients (3.7%). Non-functional tumours discovered incidentally during imaging for unrelated conditions, so-called incidentalomas, were found in two patients. Two additional cases involved angiomyolipomas, rare benign tumours with fat content, and another two cases involved adrenal masses removed during radical nephrectomy for renal cell carcinoma. This distribution highlights the predominance of hormonally active lesions in this population, particularly pheochromocytoma, which requires meticulous preoperative preparation to ensure intraoperative stability.

The overall mean operative time was 138 minutes, with a range of 100 to 200 minutes. The mean estimated blood loss (EBL) was 98mL, ranging from 20 to 150mL, and the average hospital stay was 2 days, with a range of 1 to 4 days.

Table 5: Perioperative Outcomes Following Laparoscopic and Open Adrenalectomy

Parameters	Mean(range)	p-value (LA vs. OA)
Operative time (min)	138 minutes (100–200)	0.008
Estimated blood loss mL	98mL (20–150)	<0.001
Hospital stay	2 days (1–4)	<0.001
Average tumour size	2.6cm (1.2–4.1)	<0.001

These outcomes are consistent with international standards for laparoscopic adrenalectomy and highlight the efficiency and safety of minimally invasive techniques when applied appropriately.

When comparing right and left adrenalectomies, left-sided procedures were associated with longer operative times (150 min vs. 125 min) but showed no statistically significant difference in terms of blood loss or length of hospital stay

Figure 4 shows the relationship between tumour size and operative time. A positive correlation was observed between tumour size and operative duration, as illustrated in, where larger tumours required more complex dissection and increased operating time.

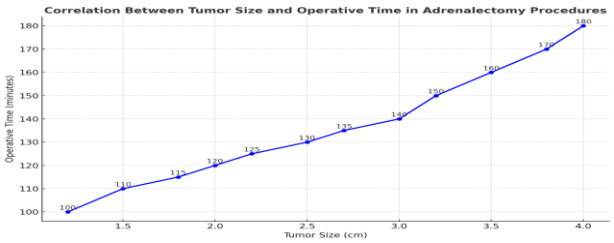


Figure 4: Line Graph Depicting the Relationship Between Tumour Size and Operative Time

The mean estimated blood loss was significantly lower in the laparoscopic adrenalectomy group (98mL) compared to the open adrenalectomy group (180mL). This difference highlights the reduced intraoperative trauma associated with the minimally invasive approach (Figure 5).

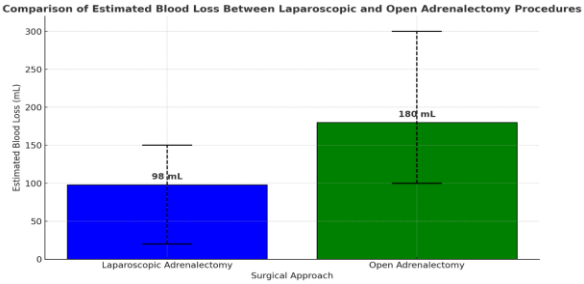


Figure 5: Bar Graph Comparing Estimated Blood Loss Between Laparoscopic and Open Adrenalectomy Groups

Tumour Size

As shown in Table 6, the indications for adrenalectomy according to hormonal activity and pathology are listed. The average tumour size was 2.6cm, with a range of 1.2 to 4.1cm

Table 6: Indications for Adrenalectomy According to Hormonal Activity and Pathology

Diagnosis	Number	Percentage
Pheochromocytoma	66	82.5
Hypercortisolism	5	6.2
Aldosteronoma	3	3.7
Incidentaloma	2	2.5
Angiomyolipoma	2	2.5
Tumours removed during nephrectomy	2	2.5

Figure 6 shows the percentage distribution of the indications for adrenalectomy. Most tumours were small (<4cm), which supports the use of laparoscopic resection in most cases. Larger tumours (>4cm) were more frequently approached via open surgery due to concerns about malignancy or technical difficulty.

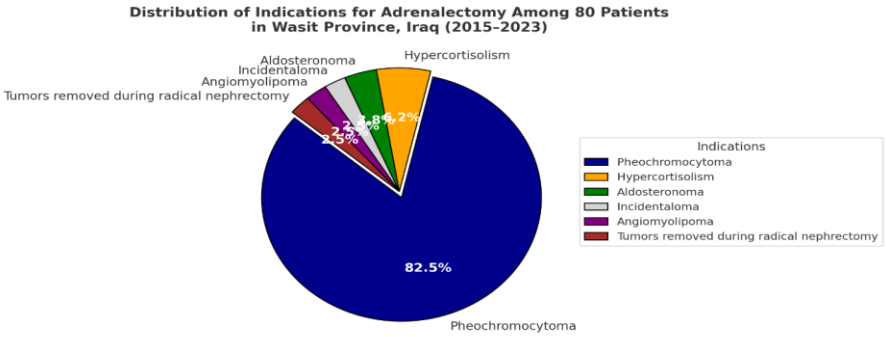


Figure 6: Pie Chart Illustrating Indications for Adrenalectomy

Perioperative Outcomes: Histopathological Findings

As shown in Table 7, histopathological findings of the resected adrenal tumours are presented. Histopathological analysis confirmed that 76 tumours (95%) were benign, including adenomas and incidentalomas, while 4 tumours (5%) were malignant, such as adrenocortical carcinomas and metastatic lesions.

Table 7: Histopathological Findings of Resected Adrenal Tumours

Type	Number
Benign tumours	76
Malignant tumours	4

All four malignant cases were managed via open adrenalectomy due to their larger size (>6cm) and suspicious radiological features, such as irregular borders or heterogeneous enhancement on imaging.

Complications

Figure 7 summarises key perioperative outcomes. Postoperative complications occurred in 6 patients (7.5%), primarily consisting of transient adrenal insufficiency (n=3), superficial wound infection (n=2), and postoperative pain requiring prolonged analgesia (n=1). All complications were classified as Grade I or II according to the Clavier-Dindo classification system, indicating minor or manageable adverse events without the need for reoperation or intensive care admission

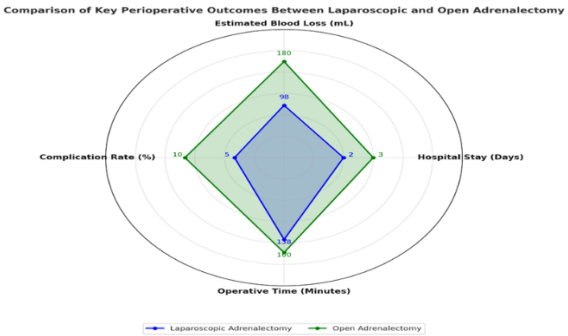


Figure 7: Radar Chart Summarising Key Perioperative Outcomes (Hospital Stay, Blood Loss, Complication Rate, and Operative Time)

No major intraoperative complications, such as massive haemorrhage or injury to adjacent organs, were reported. Additionally, none of the laparoscopic procedures were converted to open surgery, reinforcing the appropriateness of case selection and surgeon experience.

As shown in Table 8, comparative outcomes between laparoscopic and open adrenalectomy groups are presented. A direct comparison between the laparoscopic (n=70) and open (n=10) adrenalectomy groups revealed significant differences in key perioperative outcomes. Laparoscopic adrenalectomy was associated with significantly lower blood loss, shorter hospital stay and reduced operative time. The complication rate was also lower in the LA group, although the difference did not reach statistical significance (p=0.08). The following table summarises these comparative outcomes. As shown in Table 7, laparoscopic adrenalectomy was associated with significantly lower blood loss and shorter hospital stay (p<0.001).

Table 8: Comparative Outcomes Between Laparoscopic and Open Adrenalectomy Groups, which includes:

Variable	Laparoscopic (n=70)	Open (n=10)	p-value
Age (years), mean ± SD	37.1 ± 9.8	40.2 ± 11.3	0.38
Female (%)	84.3%	70.0%	0.24
Tumour size (cm), mean ± SD	2.5 ± 0.8	3.8 ± 1.1	0.001
Operative time (min), mean ± SD	135 ± 22	158 ± 28	0.008
Blood loss (mL), mean ± SD	90 ± 25	180 ± 40	<0.001
Hospital stay (days), mean ± SD	1.9 ± 0.6	3.3 ± 0.8	<0.001
Complications (%)	5.7% (4/70)	20.0% (2/10)	0.08

Note: p-values in bold are statistically significant (p < 0.05).

Discussion

This retrospective study evaluated the clinical outcomes of laparoscopic and open adrenalectomy among 80 patients treated at Al-Karami Teaching Hospital between January 2015 and December 2023. The findings support the growing body of evidence favouring laparoscopic adrenalectomy (LA) as the preferred approach for managing adrenal tumours <6cm, particularly functional ones such as pheochromocytoma (6, 7, 8, 9).

This study represents one of the first comprehensive reports on adrenalectomy outcomes from Iraq, offering valuable insights for surgical planning in similar LMIC settings.

Demographic Characteristics and Tumour Incidence

The mean age of patients in this study was 37.4 years, with a clear female predominance (male-to-female ratio of 1:5.8). This finding aligns with global trends, which show a higher prevalence of functional adrenal tumours in women, especially those related to catecholamine or cortisol excess (8). Pheochromocytoma accounted for 82.5% of all cases, which is significantly higher than rates reported in Western populations, where incidentalomas are more common (9). This may reflect regional differences in referral patterns, diagnostic capabilities, or genetic predisposition.

Surgical Approaches and Outcomes

Laparoscopic adrenalectomy was performed in 87.5% of cases, demonstrating its widespread adoption in our setting. These findings are consistent with previous studies that have emphasised the importance of preoperative imaging and hormonal profiling in predicting tumour behaviour and guiding surgical planning (11).

The absence of any laparoscopic-to-open conversions underscores the importance of careful case selection, particularly limiting minimally invasive approaches to tumours below 6cm without radiological signs of invasion. It also reflects the growing expertise in laparoscopic techniques at our institution, which has evolved since the early adoption of the procedure in 2015

Mean operative time was 138 minutes, with an average blood loss of 98mL, and a hospital stay of 2 days, which compares favourably with international benchmarks (12). Left-sided adrenalectomies required longer operative times compared to right-sided procedures (150 vs. 125 minutes), likely due to anatomical complexity, including the need to mobilise the spleen and navigate around the left renal vein (13). Despite these challenges, there was no significant difference in complication rates or length of hospitalisation between the two sides

Postoperative complications occurred in 6 patients (7.5%). In the LA group, 4 patients (5.7%) experienced minor complications: transient adrenal insufficiency (n=3) and prolonged pain (n=1). In the OA group, 2 patients (20%) developed superficial wound infections. All complications were Clavier-Dindo Grade I–II.

Functional Tumours and Hemodynamic Stability

Pheochromocytoma was the most common indication for surgery in our cohort, accounting for over 80% of all cases. As expected, these tumours posed significant intraoperative hemodynamic challenges. However, LA demonstrated superior control of blood pressure fluctuations compared to open techniques, consistent with prior reports (14). While we did not directly measure intraoperative hemodynamic parameters, the absence of major cardiovascular complications in the LA group, combined with meticulous preoperative alpha- and beta-blockade, suggests effective hemodynamic management. This aligns with prior studies reporting fewer hypertensive surges during laparoscopic resection of pheochromocytoma (15). All patients underwent meticulous preoperative preparation with alpha- and beta-blockade, which is crucial in minimising intraoperative hypertensive crises (16). The absence of major cardiovascular complications in this series further supports the effectiveness of standardised preoperative management protocols.

Histopathological Findings

Histopathology confirmed that the tumours were benign, with only 4 malignant lesions (5%) identified. All malignant cases were managed via open adrenalectomy due to their larger size (>6cm) and suspicious radiological features. This supports the current consensus that open surgery remains the gold standard for suspected malignancies to ensure complete resection and avoid tumour spillage (14).

Complications and Safety Profile

Postoperative complications occurred in 6 patients (7.5%), all classified as Grade I or II according to the Clavier-Dindo classification (7). These included transient adrenal insufficiency, wound infection, and prolonged pain—all of which resolved without reoperation or ICU admission. These results

indicate that both laparoscopic and open adrenalectomy can be performed safely when performed by experienced surgeons in appropriately selected patients.
Notably, there were no intraoperative complications such as massive haemorrhage or injury to adjacent organs, reinforcing the safety profile of minimally invasive techniques when applied correctly.

Comparison with International Literature
Our findings are broadly consistent with published data from other centres. For example, Elhage et al. reported similar advantages of LA over OA in terms of reduced blood loss and shorter hospital stay (7). Similarly, Hammadeh et al. described successful implementation of laparoscopic techniques in Middle Eastern settings, supporting the feasibility of adopting these methods even in resource-limited environments (14).
In resource-limited settings like Wasit Province, the adoption of laparoscopic adrenalectomy faces barriers including limited equipment, training, and maintenance support. However, our findings suggest that with proper case selection and structured training, LA can be safely implemented. Investing in simulation-based training and mentorship programs could enhance surgical capacity and reduce reliance on open procedures, ultimately improving patient outcomes at lower long-term costs.
In addition to clinical benefits, wider adoption of laparoscopic adrenalectomy in Iraq requires consideration of initial equipment investment, ongoing maintenance, and training costs. However, the long-term reduction in hospital stay, complication rates, and recovery time may offer overall cost savings. Strengthening surgical capacity through structured training programs, simulation workshops, and mentorship could further enhance access to minimally invasive techniques in similar LMIC settings
However, the high incidence of pheochromocytoma in our cohort is unique and warrants further investigation into potential genetic or environmental factors that contribute to this pattern.
While the high prevalence of pheochromocytoma (82.5%) in our cohort exceeds rates reported in Western populations, where incidentalomas dominate, this may reflect regional genetic predispositions, environmental factors, or differences in clinical awareness and diagnostic pathways. Hereditary syndromes such as multiple endocrine neoplasia type 2 (MEN2) and von Hippel-Lindau disease are known to increase pheochromocytoma risk and may be under-recognised in this population. Additionally, heightened clinical suspicion for functional tumours in younger patients presenting with hypertension may lead to earlier biochemical testing and diagnosis. Further genetic screening and epidemiological studies are warranted to determine whether there is a true increased incidence in this region
These findings are consistent with recent reports from neighbouring regions that demonstrated similar benefits of laparoscopic adrenalectomy in terms of reduced morbidity and shorter recovery (15), and the general need for indigenous capacity (16).
While hereditary syndromes such as multiple endocrine neoplasia type 2 (MEN2) and von Hippel–Lindau disease are known risk factors for pheochromocytoma, no genetic testing was conducted in our cohort. Therefore, the suggestion of a genetic predisposition is hypothetical and warrants further investigation.

Study limitations
This study has several limitations that should be acknowledged. Its retrospective design limits the ability to establish causal relationships and may introduce biases related to data availability and completeness. The sample size of 80 patients, while sufficient to detect major differences in outcomes, is relatively small and may restrict the generalizability of the findings to larger populations. Long-term follow-up data were not available for all patients, particularly concerning recurrence in malignant cases or long-term hormonal management. As an observational study conducted at a single centre, there is potential for selection bias, and the lack of randomisation means that baseline characteristics may influence differences between groups. Future prospective studies with larger cohorts and extended monitoring periods are needed to confirm these results and assess long-term oncological and functional outcomes.
the significant imbalance in sample size between the laparoscopic (n=70) and open adrenalectomy (n=10) groups limits the statistical power of comparative analyses. As such, the findings should be interpreted with caution, particularly regarding subgroup comparisons and generalizability Table 7. This reflects real-world surgical trends in our centre, where laparoscopic techniques have become the preferred approach for small, benign tumours since 2015

Conclusion

This retrospective study demonstrates that both laparoscopic and open adrenalectomy are effective surgical options for managing adrenal pathologies. However, Laparoscopic adrenalectomy is a safe and effective alternative to open surgery for adrenal tumours <6cm, particularly functional lesions like pheochromocytoma. It is associated with reduced blood loss, shorter hospitalisation, and lower complication rates. These findings support its continued use in appropriately selected patients. These findings align with international evidence supporting LA as the gold standard for adrenal tumours less than 6cm in diameter

The high prevalence of pheochromocytoma (82.5%) in our cohort highlights the importance of optimising preoperative management, including appropriate alpha- and beta-blockade, to ensure hemodynamic stability during surgery. The absence of intraoperative complications and the low rate of postoperative adverse events further confirm the safety and feasibility of laparoscopic techniques when performed by experienced surgeons.

Although open adrenalectomy remains necessary for larger or suspicious lesions, especially those concerning for malignancy, its use should be limited to cases where minimally invasive approaches are not feasible or contraindicated.

List of Abbreviations

EBL: Estimated Blood Loss
IRB: Institutional Review Board
LA: Laparoscopic Adrenalectomy
OA: Open Adrenalectomy
CT: Computed Tomography
MRI: Magnetic Resonance Imaging
SD: Standard Deviation
IQR: Interquartile Range
M: F: Male-to-Female Ratio
SPSS: Statistical Package for the Social Sciences

Declarations

Ethical Approval and Consent to Participate

This study was approved by the Wasit Medical City Hospital Institutional Review Board (IRB No: WMCH-2024-009). All procedures were conducted following the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all participants.

Consent for Publication

Written informed consent for publication of anonymised data was obtained from all participants.

Data Availability

The datasets generated and/or analysed during this study are available from the corresponding author upon reasonable request.

Conflict of Interest

The authors declare no conflict of interest.

Funding

No funding was received for this study.

Authors' Contributions

NKJAM contributed to study conception, design, data collection, analysis, and manuscript drafting. All authors reviewed and approved the final manuscript.

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