Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

AN INTEGRATED STRATEGY FOR OPTIMIZING SURGICAL MANAGEMENT OF ADRENAL TUMORS THROUGH NOVEL SURGICAL INNOVATIONS

Khalimova Zamira Yusufovna [1,3], Omonov Oybek Avazkhanovich[1], Muzaffarov Farrukh Umarovich[1], Mirzakarimova Zumrad Sanjarovna [1], Mardonov Jamshid Normurotovich[2,3]

1- Republican Specialized Scientific and Practical Medical Center of Endocrinology named after Academician Y.K. Turakulov, Tashkent, Uzbekistan
2- State Institution "Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov", Tashkent, Uzbekistan
3- Tashkent State Medical University, Tashkent, Uzbekistan
Corresponding author: *Jamshid N. Mardonov*
E-mail: md.jamshidbek@gmail.com

Abstract. Laparoscopic adrenalectomy is the standard treatment for most adrenal tumors due to its lower invasiveness, reduced complication rate, and shorter hospital stay [1,2]. However, large, hormonally active, hypervascularized, and technically complex tumors are associated with an increased risk of bleeding, hemodynamic instability, and access conversion [3,4]. *Study Objective:* To improve the efficacy and safety of surgical treatment of adrenal tumors by implementing improved laparoscopic techniques developed by the authors. *Materials and Methods:* A retrospective analysis of treatment outcomes was conducted for 90 patients with adrenal tumors operated on in 2024-2026. Clinical, hormonal, radiation, and surgical outcomes were assessed. *Results:* Hormonally active tumors were detected in 91.1% of patients. Standard laparoscopic adrenalectomy was performed in 66.6%, modified techniques in 22.2%, and hand-assisted laparoscopic surgery for tumors larger than 7 cm in 11.2%. The proposed methods reduced blood loss, expanded the indications for minimally invasive surgery, and decreased the conversion rate. *Conclusion:* The developed integrated approach improves surgical safety and expands the capabilities of laparoscopic adrenalectomy for complex adrenal tumors.

Keywords: laparoscopic adrenalectomy, pheochromocytoma, Cushing's syndrome, aldosterone, hormonally active tumors, minimally invasive surgery, adrenalectomy complications, endocrine surgery, intraoperative bleeding, large adrenal tumors, minimally invasive treatment.

Introduction

Adrenal diseases affect approximately 5% of the population, with their prevalence increasing with age [1,4-6]. Although most patients do not require surgical treatment, adrenal pathology can be accompanied by severe, and sometimes life-threatening, clinical conditions. In recent decades, due to the widespread introduction of modern imaging techniques and improved diagnostics, the number of adrenalectomies performed has increased by approximately 65%[2]. The development and standardization of adrenal surgery played a significant role in this.

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

It should be noted that just a few decades ago, postoperative morbidity and mortality rates after adrenalectomy reached 30% and 4%, respectively [3]. In modern observational series, the complication rate has decreased to 6-18%, and mortality is less than 1% [2,4]. Despite significant improvement in outcomes, the risk of complications remains clinically significant, especially in patients with large, hormonally active, or technically complex tumors. The main causes of postoperative morbidity are intraoperative damage to adjacent anatomical structures, infectious complications, thromboembolic events, and the development of adrenal insufficiency. This emphasizes the need for further improvements in surgical techniques and perioperative patient management.

Despite the high efficacy of laparoscopic adrenalectomy, for adrenal masses, especially those with pronounced vascularization, the standard dissection technique may be associated with an increased risk of intraoperative bleeding and trauma to surrounding tissues. Particular technical difficulties arise with pheochromocytomas, tumors with tight attachment to surrounding structures, obscured anatomical landmarks, and repeated interventions. Traditional dissection methods, including electrocoagulation and ultrasonic scalpel, do not always provide sufficient selectivity and safety, necessitating the search for new surgical solutions. Adrenal tumors larger than 7 cm in diameter are traditionally associated with an increased risk of conversion and complications during laparoscopic removal. The main challenges are related to the lack of tactile feedback, limited ability to reliably stabilize the tumor, and technical difficulties in mobilizing large tumors.

Therefore, the development of improved laparoscopic adrenalectomy techniques aimed at improving the manageability of the procedure, reducing the risk of complications, and expanding the indications for minimally invasive treatment of large and complex tumors is of significant practical interest.

Materials and Methods

This study is based on an analysis of clinical data from patients with adrenal tumors examined and treated at the Academician Y.Kh. Turakulov Republican Specialized Scientific and Practical Medical Center of Endocrinology from 2024 to 2026. The study was conducted using our own clinical data. An analysis of the surgical treatment outcomes for 90 patients with adrenal masses was conducted. The diagnosis was established using a combination of clinical, laboratory, and instrumental diagnostic methods.

The study included female and male patients aged 10 to 75 years, including children, working-age individuals, and the elderly, allowing for an assessment of the disease's progression across different age groups.

The age distribution of patients was as follows: 3 (3.3%) under 18, 48 (53.3%) between 18 and 45 years, 32 (35.5%) between 45 and 65 years, and 7 (7.8%) over 65 years.

The gender distribution in the study group was significantly different: 63 (70%) female patients and 27 (30%) male patients. Study inclusion criteria:

1. The presence of a space-occupying adrenal lesion confirmed by MSCT data - 87 cases (96.7%) and/or MRI - 3 cases (3.3%).

2. Patients who presented with an adrenal mass were required to undergo an examination to determine their hormonal activity.

The hormonal activity of adrenal masses in 90 (100%) operated patients varied: increased hormonal activity was detected in 82 patients (91.1%), normal hormonal activity - in 5 patients (5.6%), and low hormonal activity - in 3 patients (3.3%).

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

The distribution of patients with adrenal masses by hormonal activity of a particular hormone was as follows: ACTH-independent Cushing's syndrome - in 21 patients (23.3%); aldosterone - in 21 patients (23.3%); pheochromocytoma - in 36 (40%) patients; adrenocortical adenoma (corticosteroma, androsteroma) - in 12 (13.3%) patients.

Table 1.
Distribution of patients with adrenal gland formations by type of hormonal activity:

Adrenal Tumor by Type of Hormonal Activity	Absolute Number (Total = 90)	%
ACTH-independent Cushing's syndrome	21	23.3%
Aldosteroma	21	23.3%
Pheochromocytoma	36	40.0%
Adrenocortical adenoma	12	13.3%
Total	90	100%

Patients were distributed according to the size of the adrenal tumor as follows: the size of the formation was 1.0-1.5 cm in 21 (23.3%) patients, 2.0-3.0 cm in 12 (13.3%) patients, 4.0-5.0 cm in 28 (31.1%) patients, 5-7 cm in 14 (15.6%) patients, and more than 7 cm in 15 (16.7%) patients.

Table 2.
Distribution of Patients According to Adrenal Tumor Size

No.	Tumor Size, cm	Number of Patients, n	Percentage, %
1	1.0-1.5	21	23.3%
2	2.0-3.0	12	13.3%
3	4.0-5.0	28	31.1%
4	5-7	14	15.6%
5	More than 7	15	16.7%
	Total	90	100%

The clinical picture of hormonally active tumors was dominated by symptoms caused by excessive secretion of adrenal hormones. Regardless of the type of hormonal activity, persistent high blood pressure was the first symptom of the disease in all cases. In patients with catecholamine-secreting tumors, arterial hypertension and autonomic crises were predominant. In patients with cortisol-producing tumors, signs of metabolic disorders, obesity, and

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

osteoporosis were observed, while in aldosterone-producing tumors, high blood pressure was accompanied by changes in water and electrolyte balance and cardiac arrhythmia.

Depending on the increased hormonal activity, secondary diseases developed in operated patients, and other comorbidities were also diagnosed: Symptomatic arterial hypertension grade 3 (SAH) - in 82 (91%); Steroid diabetes mellitus (DM) type 2 - 38 (42%); osteoporosis - 21 (26.5%); obesity grades 2-3 - 72 (80%); coronary heart disease (CHD), chronic heart failure (CHF) - 35 (39%); duodenal ulcer (DU) - 14 (15.5%); vitamin D deficiency - 49 (54.4%); nodular goiter grades 1-2, euthyroidism, TIRADS-II - 28 (31%); fatty hepatosis - 73 (81%); severe anemia - 11 (12%); cholelithiasis (GSD) - 9 (10%); right ovarian cystoma - 3 (8.6%); A history of acute cerebrovascular accident (ACVA) was present in 8 patients (8.9%), and other unspecified conditions were present in 77 patients (85.5%).

According to the location of the adrenal masses, 44 patients (48.9%) were right-sided, 41 patients (45.6%) were left-sided, and 5 patients (5.5%) were bilateral. In the majority of cases, 94.5% of the tumors were unilateral. The size of the masses varied widely-from 1.0 cm to 7.0 cm, with larger tumors exceeding 6-7 cm in diameter.

Depending on their hormonal activity, patients were divided into groups, which allowed for a comparative analysis of the clinical course, laboratory parameters, and surgical outcomes. Dynamic monitoring of the growth rate of small adrenal tumors was not always possible, as the patients were from different regions of the Republic, and some were lost during observation for unknown reasons. Therefore, a reliable analytical conclusion is not available.

All patients with adrenal tumors were examined with native MSCT or MRI. If adrenal tumors 5 cm or larger were detected, MSCT angiography of the kidneys and adrenal glands was mandatory. Based on the results of the MSCT angiography, the characteristics of the adrenal tumors were studied and the likelihood of malignancy was assessed.

The MSCT technique with washout calculation was performed in 57 (63%) of the patients examined and subsequently operated on.

This method is based on determining the rate of tumor density reduction after intravenous bolus administration of a contrast agent. To do this, the X-ray density (in HU) of the pathological lesion is measured:

• during a native examination,
• in the early arterial-venous phase (after 60-80 seconds),
• in the delayed phase (after 10-15 minutes).

Two quantitative criteria are used: absolute and relative "washout" of the contrast agent.

Absolute Washout (AW) is calculated using the formula:

AW (%) = (HU_(early)-HU_(delayed))/(HU_(early)-HU_(native)) \times 100

Criterion values:

1) 60% (when measured after 60 sec and 15 min) or > 50% (when measured after 80 sec and 10 min) - typical of benign adenomas;

2) ≤ 60% (or ≤ 50%) - suspicious for malignancy or pheochromocytoma.

Relative washout (RW) is calculated using the formula:

RW (%) = (HU_(early)-HU_(delayed))/HU_(early) \times 100

Criterion values:

1) 40% - sign of a benign process;

2) ≤ 40% - typical of malignant tumors and pheochromocytomas.

Thus, rapid washout of the contrast agent is a reliable quantitative marker of the benignity of adrenal masses in 98% of examined patients.

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

Native CT and MSCT angiography did not allow us to determine the malignancy of the tumor with 100% accuracy; however, they did allow us to predict oncologic risk and justify the choice of surgical approach.

All patients were examined using a uniform diagnostic algorithm, including clinical assessment, laboratory testing of hormonal profiles, and a combination of imaging techniques. This ensured the comparability of the obtained data and the objectivity of subsequent analysis.

Laboratory diagnostics of adrenal masses in this study were aimed at identifying the hormonal activity of the tumors, clarifying their functional nature, and differentiating between hormonally active and hormonally inactive neoplasms. The combination of laboratory methods was selected based on the clinical presentation, imaging data, and the expected hormonal profile of the tumor.

All patients with identified adrenal masses underwent laboratory examination in a stepwise manner. The first stage assessed the presence or absence of tumor hormonal activity, and the second stage clarified the nature of the specific hormone hypersecretion.

To diagnose autonomous cortisol production, an overnight suppression test with 1 mg dexamethasone was used.

To detect primary hyperaldosteronism, basal aldosterone and renin levels were determined, followed by calculation of the aldosterone-renin ratio (ARR). An elevated ARR was considered a screening indicator of autonomous aldosterone production.

If pheochromocytoma or paraganglioma was suspected, plasma and/or 24-hour urine metanephrine and normetanephrine levels were measured. These parameters were considered the most sensitive and specific markers of catecholamine-secreting tumors. In the presence of clinical signs of virilization or feminization, dehydroepiandrosterone sulfate (DHEAS), androstenedione, and 17-hydroxyprogesterone levels were measured.

All patients additionally underwent blood electrolyte analysis, glucose levels, lipid profile, and acid-base balance. These parameters were used for a comprehensive assessment of metabolic disorders associated with hormonally active tumors, as well as to prepare patients for surgical intervention.

Results

The clinical sample included patients with 82 (91.1%) hormonally active and 8 (8.8%) hormonally inactive adrenal tumors. Adrenalectomy was performed on the right (48.9%) or left (45.6%) side in 87 cases (96.7%), and bilateral adrenalectomy was performed in 3 (5.5%) patients.

In 3 (60%) patients out of 5 (100%) with bilateral adrenal lesions, a single-stage, staged, organ-preserving partial adrenalectomy was performed laparoscopically.

When choosing a surgical method, absolute preference was given to standard laparoscopic adrenalectomy; this method was used in 60 (66.6%) patients operated on by us.

We have developed an improved method of laparoscopic adrenalectomy by preliminary extraction of surrounding fatty tissue around the adrenal gland and tumor using a cavitation ultrasonic aspirator, followed by adrenalectomy. This method was used in 20 (22.2%) patients. The effectiveness of the improved method was 98%, which allowed for organ-preserving surgery in 15 (75%) patients and safe removal of the entire gland transformed into a tumor in 5 (25%).

Single-handed laparoscopic adrenalectomy for patients with tumors larger than 7 cm was performed in 10 (11.2%) patients, eliminating the need for a forced wide thoraco-phrenic laparotomy, thereby reducing the risk of intraoperative complications and bleeding.

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

In all 90 (100%) patients undergoing surgery, we used our own developed intraoperative stabilization model to prevent intraoperative hemodynamic instability.

Own developments and results:

The proposed improved laparoscopic adrenalectomy method, for which a patent application has been filed, includes standard laparoscopic procedures: creation of a pneumoperitoneum, trocar placement, adrenal mobilization, and isolation of the central adrenal vein. A distinctive feature of this technique is the dissection of the neuroendocrine mass using a cavitation ultrasonic aspirator in combination with the assistance of the surgeon's single hand, inserted into the abdominal cavity through a mini-incision.

The assisting hand is used for adrenal traction, tactile control of the intervention site, mechanical protection of vascular and adjacent anatomical structures, and temporary compression of bleeding sources. This combination of techniques ensures high controllability of the dissection and increases the safety of the procedure.

This technique is particularly effective for adrenal masses larger than 7 cm in diameter, allowing for en bloc removal of the tumor without compromising its integrity. The fundamental distinguishing feature of this method is that: tissue destruction is selective; vascular and fibrous structures are preserved; and dissection is performed under visual control, without harsh tissue tension.

This allows for the formation of a clear boundary between the tumor and surrounding structures even before the final mobilization of the adrenal gland.

The technical result is achieved by dissecting the adrenal mass using a cavitation ultrasonic aspirator, and performing the surgical procedure with the assistance of one hand, inserted through a mini-incision.

The cavitation ultrasonic aspirator enables selective dissection of the adrenal mass with simultaneous aspiration of fatty tissue fragments. One-handed surgical assistance is used for adrenal traction, tactile control of the surgical site, mechanical protection of vascular structures, and temporary compression of bleeding sources.

An improved method of laparoscopic adrenalectomy of adrenal masses using a cavitation ultrasonic aspirator and one-handed surgical assistance. The essence of the improved method is as follows:

- establishing pneumoperitoneum through a Veres needle with CO2 injection up to 14 atm. pressure.
- through a 5 mm and 10 mm skin incision, 2 10 mm trocars and 2 5 mm trocars are inserted at standard points.
- the right lobe of the liver is retracted upward and backward using a leaflet retractor. If a left adrenal mass is present, the splenic angle of the transverse colon is brought down.
- A cavitation ultrasonic aspirator is used to destroy adipose tissue cells and simultaneously perform aspiration. Between 100 and 300 ml of adipose tissue is extracted from the capillaries over 30 minutes with minimal blood loss.
- The adrenal gland, including the mass and major blood vessels, is visually examined.
- The final stage of the surgical intervention is selected:

a) complete laparoscopic adrenalectomy - when complete transformation of the adrenal tissue into a tumor is detected;

b) removal of the adrenal tumor while preserving the intact glandular tissue.

- The surgery is completed by removing the macroscopic specimen.
- if the tumor size is greater than 7 cm, the surgeon assists with one hand.

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

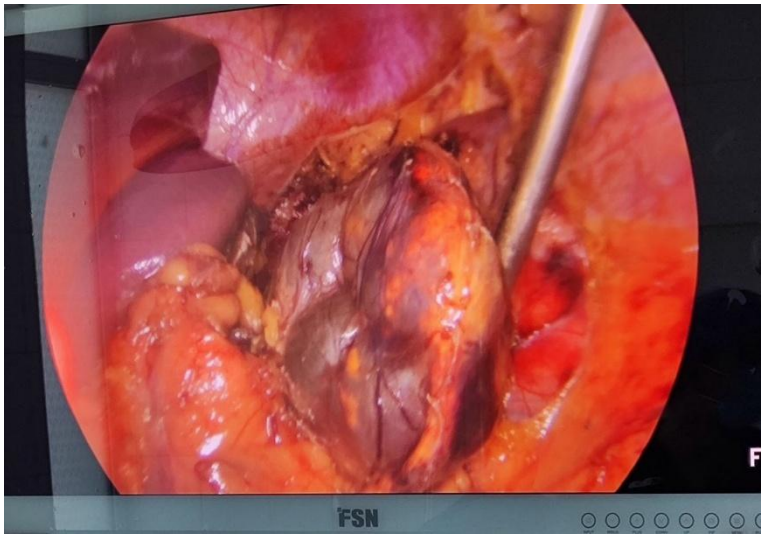

Fig1. Illustration of the technical execution of dissection of a left adrenal corticosteroma using a cavitation ultrasonic aspirator.

A mini-access for one-handed assistance is created as follows: Access for the surgeon's hand is created by a 5-6 cm skin and subcutaneous tissue incision on the anterolateral abdominal wall, in the projection of the midaxillary line, along the anterior border of the transverse abdominis muscle. The muscles are dissected along the direction of the muscle fibers, thereby preserving the integrity of the muscle fibers. The abdominal wall muscles, by squeezing the surgeon's hand, help prevent CO2 leakage, and the peritoneum is dissected up to 3 cm.

During the operation, the movements of one hand of the operating surgeon with the laparoscopic manipulator are easily synchronized, creating conditions for manual contact with the tissue and structures. All convenient access is achieved with minimal trauma to soft tissues. Upon completion of the surgery, the macroscopic specimen is removed through the same access used by the surgeon's hand. The integrity of the abdominal wall is easily restored by suturing with atraumatic suture material.

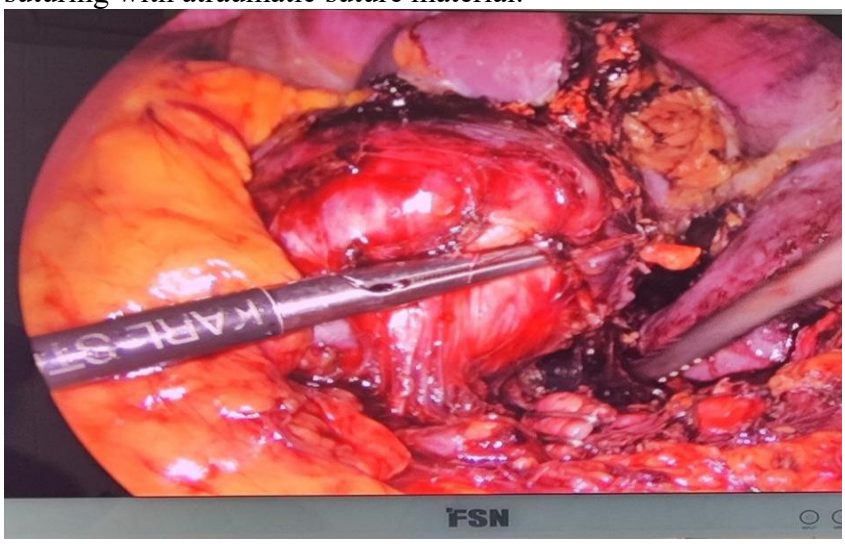

Fig 2. Illustration of laparoscopic adrenalectomy for a right adrenal pheochromocytoma larger than 7 cm, performed with one-handed assistance.

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

To prevent intraoperative hemodynamic instability, a patent-pending utility model for intraoperative stabilization developed by the authors was used. The method is based on preliminary (24-48 hours prior to surgery) collection of 200-400 ml of autologous blood followed by its jet reinfusion, initiated synchronously with the central adrenal vein control and continued for 3-10 minutes. The pathophysiological rationale for this method is to prevent a sharp decrease in systemic vascular resistance and venous return due to the sudden cessation of catecholamine flow into the systemic circulation after vein ligation. The use of synchronized autoreinfusion ensures the replenishment of circulating blood volume, maintenance of cardiac output, and a reduction in the need for vasopressor and glucocorticoid support. In all cases of surgical intervention, the method was fully implemented; critical fluctuations in blood pressure and significant hemodynamic instability were not observed during surgery.

Postoperatively, patients remained in the intensive care unit for the first 24 hours under continuous cardiac monitoring. Hydrocortisone replacement therapy was administered, followed by a gradual dose reduction. Subsequently, oral hydrocortisone therapy was prescribed, also using a different regimen, with a gradual dose reduction of 5 mg every 3 days, under clinical monitoring. Patients were scheduled for a follow-up examination one month after discharge. Other results:

Hypox returned to normal after HRT within 14-30 days in 44 patients (48.9%), hypox returned after HRT within 3-5 days in 43 patients (47.8%), and lifelong hormone replacement therapy was prescribed to 3 patients (3.3%).

Table 3.

Example of intraoperative hemodynamic dynamics by stages of bilateral laparoscopic partial adrenalectomy using jet autoreinfusion synchronized with clamping of the central adrenal vein/main venous collectors

Stage / Event	Time	SBP/DBP (mmHg)	MAP	HR (bpm)	Infusion / Medications	Comment
Admission to OR (before induction)	T0	125/80	95	82	Crystalloids 300 mL	Normotensive baseline status
Anesthesia induction and intubation	T+10 min	130/82	98	88	Propofol, fentanyl, rocuronium (standard protocol)	Transient response without hypertensive crisis
Creation of pneumoperitoneum (CO_2 14 mmHg)	T+20 min	135/85	102	90	Crystalloids 250 mL	Mild increase in MAP related to pneumoperitoneum
Manipulation of right adrenal tumor (medial limb)	T+50 min	138/89	115	105	Urapidil 20 mg IV bolus (if required), esmolol 20 mg	Transient sympathetic response
Autologous reinfusion 250	T+60 min	135/85	102	90	Rapid reinfusion of	No critical hypotension due

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

mL+ without c lamping of right adrenal central vein					250 mL autologous blood over 5 min	to autologous reinfusion
Completion of right-sided resection, hemostasis	T+70 min	130/80	97	86	Crystalloids 200 mL	Hemodynamicall y stable, no vasopressors required
Repositioning to right lateral position	T+90 min	125/78	93	84	-	Stable parameters
Manipulation of left adrenal tumors (multiple nodules)	T+12 5 min	1/100	120	110	Urapidil 20 mg IV bolus (if indicated)	Transient blood pressure elevation during tumor traction
Autologous reinfusion 150 mL+ without clamping of left venous collectors	T+13 5 min	130/82	98	90	Rapid reinfusion of 150 mL autologous blood over 3-5 min	Hemodynamic stabilization without vasopressor support
Completion of surgery, CO_2 evacuation	T+16 5 min	120/78	92	80	-	Stable hemodynamics
0-6 hours postoperatively (ICU)	Post-op	120/80	93	78	Hydrocortiso ne 100 mg IV ×2, crystalloids 500 mL	Stable blood pressure without vasopressors
Postoperative day 1	POD 1	120/80	93	76	Hydrocortiso ne dose reduced to 50 mg	Hemodynamicall y stable

SBP/DBP - systolic/diastolic blood pressure (mmHg), MAP - mean blood pressure (mmHg), HR - heart rate (beats/min).

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

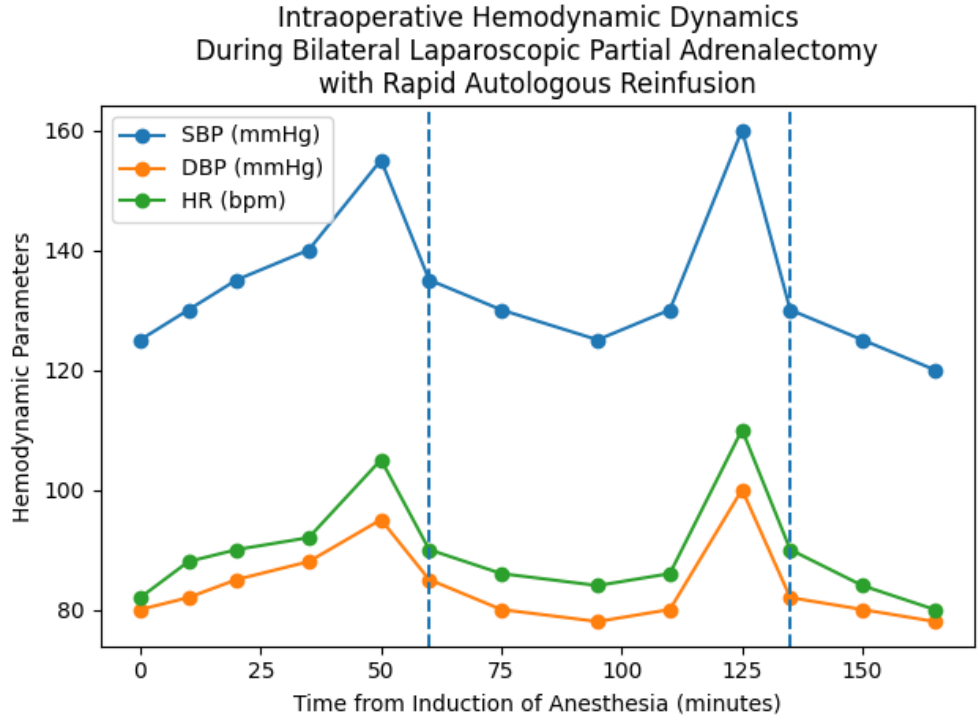

Fig 3. Example of intraoperative hemodynamic parameters during bilateral laparascopic partial adrenalectomy with rapid autologous reinfusion.

Discussion

Modern advances in endocrine surgery are characterized by the widespread adoption of high-tech imaging techniques and minimally invasive surgical procedures, which have significantly improved the safety and effectiveness of treatment for patients with hormonally active adrenal tumors. Laparoscopic adrenalectomy is currently considered the standard surgical treatment for most adrenal tumors due to its reduced morbidity, reduced complication rate, and shorter hospital stay.

Bilateral hormonally active tumors present a particular clinical challenge, as they traditionally carry a risk of developing chronic adrenal insufficiency after total adrenalectomy. This clinical case demonstrates that, with timely diagnosis, thorough preoperative preparation, and a multidisciplinary approach, it is possible to safely perform single-stage bilateral laparoscopic partial adrenalectomy while preserving functionally significant cortical tissue. An organ-preserving approach minimizes the risk of complete loss of adrenal function and the need for lifelong glucocorticoid replacement therapy. At the same time, radical removal of hormonally active tumor nodes leads to the elimination of catecholamine hypersecretion and the regression of secondary clinical manifestations, including symptomatic hypertension, which significantly reduces cardiovascular risks and improves the patient's prognosis.

One of the key challenges in the surgical treatment of pheochromocytomas remains severe intraoperative hemodynamic instability, particularly during central adrenal vein control. The authors developed a method of intraoperative stabilization based on synchronized jet reinfusion of autologous blood, aimed at maintaining preload and cardiac output during the most critical stage of the surgery. In the presented case, the use of this technique allowed us to avoid severe hypotension and reduce the need for pharmacological vasopressor support.

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

However, further clinical observations and extensive studies are needed to definitively evaluate the effectiveness of this method.

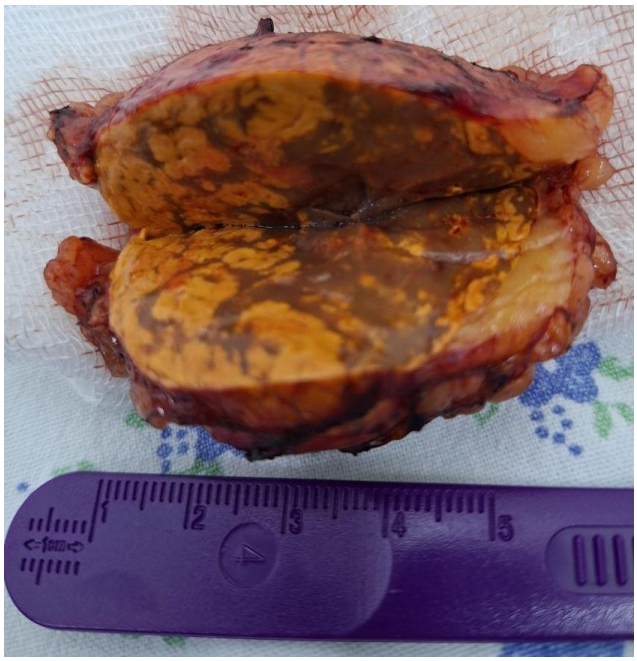

Fig 4. Macroscopic appearance of pheochromocytoma >5cm.

The use of a cavitation ultrasonic aspirator has enabled the following: decreased intraoperative blood loss; reduced the incidence of coagulation lesions; shortened the time of the complex dissection stage; increased manageability of the surgical process; and improved safety of interventions for hormonally active tumors.

The surgeon's hand performs the following functions: tumor stabilization; gentle traction; tactile assessment of density and mobility; and emergency hemostasis, if necessary.

Creation of a mini-access for manual assistance, tactile tumor stabilization, laparoscopic dissection under combined vision and palpation control, adrenal gland removal, and completion of the surgery with specimen extraction in a container.

This method has enabled the following: expanded indications for laparoscopic adrenalectomy; reduced conversion rates; increased safety; and preservation of all the advantages of a minimally invasive approach.

The technical result of the invention is to increase the safety and manageability of laparoscopic adrenalectomy, reduce the risk of intraoperative bleeding and damage to vascular structures, and expand the indications for laparoscopic treatment of large adrenal formations.

Claims of the invention:

1. An improved method for laparoscopic adrenalectomy of adrenal neuroendocrine lesions using a cavitation ultrasonic aspirator and single-handed surgical assistance. This method includes creating a pneumoperitoneum, installing laparoscopic ports, mobilizing the adrenal gland, isolating and clipping the central adrenal vein, and removing the lesion. Dissection of the neuroendocrine lesion and adjacent tissues is performed using a cavitation ultrasonic aspirator. The surgical intervention is performed with single-handed surgical assistance, inserted into the abdominal cavity through a mini-incision. The surgeon uses one hand to apply traction to the adrenal gland and mechanically protect the vessels and adjacent anatomical structures during dissection. 2. Cavitation ultrasound dissection is performed in the

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

capsule of the adrenal mass from the surrounding adipose tissue with simultaneous aspiration of adipose tissue fragments.

3. One-handed surgical assistance is used for adrenal neuroendocrine masses greater than 7 cm in diameter, with cavitation ultrasound aspiration performed under direct surgical control.

4. One-handed surgical assistance is used for temporary compression of bleeding sources in the area of the adrenal mass.

5. Removal of the mass is performed without damaging the capsule.

6. Removal of the mass is performed through a mini-incision, using one-handed surgical assistance.

Utility Model Formula:

1. A method for intraoperative hemodynamic stabilization during adrenalectomy in patients with hormonally active adrenal tumors, including anesthetic management and infusion-transfusion support. 24-48 hours prior to surgery, 300-400 ml of the patient's autologous blood is collected and preserved in a sterile container with an anticoagulant. During laparoscopic adrenalectomy, jet reinfusion of the prepared autologous blood is initiated synchronously with clamping of the central adrenal vein and continued for 3-10 minutes.

2. Jet reinfusion of autologous blood is performed in a volume of 300-400 ml, and the rate of reinfusion of autologous blood is regulated depending on the degree of critical decrease in systemic arterial pressure after clamping of the central adrenal vein.

3. Preliminary collection of autologous blood 24-48 hours before surgery helps reduce initially elevated blood pressure in patients with hypertension to approximately 130/90 mmHg.

4. When autologous blood reinfusion is performed simultaneously with central adrenal vein clamping, a stable blood pressure of at least 100/60-110/70 mmHg is maintained.

5. Autologous blood reinfusion is used during laparoscopic adrenalectomy in patients with hormonally active adrenal tumors associated with a high risk of intraoperative hemodynamic instability.

Conclusion

The developed method expands the indications for laparoscopic adrenalectomy for adrenal masses, including tumors greater than 7 cm in diameter, improves surgical safety, and reduces the incidence of intraoperative complications. The method can be implemented in specialized surgical hospitals without changing standard laparoscopic equipment.

The developed method expands the indications for laparoscopic adrenalectomy for adrenal masses, including tumors larger than 7 cm in diameter, increases surgical safety, and reduces the incidence of intraoperative complications. The method can be implemented in specialized surgical hospitals without changing standard laparoscopic equipment.

An improved method of laparoscopic adrenalectomy of adrenal masses using a cavitation ultrasonic aspirator and single-handed surgeon assistance improves the safety and manageability of surgery and expands the possibilities of minimally invasive treatment of large tumors.

The use of the proposed method for preventing intraoperative hemodynamic instability ensures: prevention of a significant drop in blood pressure during clamping of the central adrenal vein; reducing the need for vasopressor support; reducing the dose of glucocorticoids during the intraoperative period; reducing the risk of acute cardiovascular complications; increasing the overall safety of adrenalectomy in patients with hormonally active adrenal tumors.

Western European Journal of Medicine and Medical Science
Volume 4, Issue 05, May 2026
https://westerneuropeanstudies.com/index.php/3
ISSN (E): 2942-1918 Open Access| Peer Reviewed

References:

1. Lenders J. W. M. et al. Pheochromocytoma and paraganglioma: an endocrine society clinical practice guideline //The Journal of Clinical Endocrinology & Metabolism. – 2014. – T. 99. – №. 6. – C. 1915-1942.
2. Berends A. M. A. et al. Incidence of pheochromocytoma and sympathetic paraganglioma in the Netherlands: a nationwide study and systematic review //European journal of internal medicine. – 2018. – T. 51. – C. 68-73.
3. Fassnacht M. et al. Management of adrenal incidentalomas: European society of endocrinology clinical practice guideline in collaboration with the European network for the study of adrenal tumors //European journal of endocrinology. – 2016. – T. 175. – №. 2. – C. G1-G34.
4. Fishbein L. Pheochromocytoma and paraganglioma: genetics, diagnosis, and treatment //Hematology/Oncology Clinics. – 2016. – T. 30. – №. 1. – C. 135-150.
5. Khalimova Z.Y. et al. Application of A Novel Intraoperative Hemodynamic Stabilization Technique During One-Stage Bilateral Partial Adrenalectomy for Multiple Bilateral Pheochromocytomas: A Clinical Case Report // International Journal of Medical Sciences And Clinical Research, 6(04), 32–39. https://doi.org/10.37547/ijmscr/Volume06Issue04-05
6. Omonov O.A. et al. “Laparoscopic Adrenalectomy In The Management Of Adrenal Neoplasms: Clinical Outcomes And Diagnostic Considerations”. The American Journal of Medical Sciences and Pharmaceutical Research, vol. 8, no. 2, Feb. 2026, pp. 93-99, doi:10.37547/tajmspr/Volume08Issue02-14.