Retroperitoneal versus Transperitoneal Laparoscopic Adrenalectomy: A Systematic Literature Review and Meta-Analysis

Mohamed S.S. Ramadan[1], Mahmoud S. Farahat[1], George M. Halim[1], Ahmed F. Abd Elhafez[2]

1. Department of General Surgery, Ain Shams University Hospital, Cairo, Egypt.
2. Department of General Surgery, MTI University, Egypt.

Correspondence to Mohamed S.S. Ramadan
Tel: +201020357975
e-mail: mohamadsaber164018@gmail.com

Abstract:
Introduction: The most common option for surgical management of the majority of adrenal illnesses is laparoscopic adrenalectomy. TLA substituted open adrenalectomy through laparotomy and is currently the favored operating treatment for the management of small benign adrenal cancers. Retroperitoneal laparoscopic adrenalectomy (RLA) has additionally been defined as an alternative laparoscopic approach. **Aim**: This research aimed to compare retroperitoneal and transperitoneal laparoscopic adrenalectomy within a non-randomised comparative (NRT) trials and updated meta-analysis of randomized controlled (RCT). **Methods**: A total of 11 studies have been chosen for the present analysis, involving a total of 3454 cases undergoing a total of 3474 laparoscopic adrenalectomies. A total of 2128 patients underwent TLA, whereas 1329 cases underwent retroperitoneal laparoscopic adrenalectomy (RLA). **Results**: Regarding studies reported on the difference in operating time and bleeding with cases within TLA group and RLA group; significant heterogeneity was determined. Consequently, a random effect model was applied for analysis. The combined MD and 95% confidence intervals results demonstrated statistically insignificant variance among groups. AS according to studies reported on the difference in time to ambulation, intraoperative complications, postoperative complications and mortality rate with cases within TLA group and RLA group; insignificant heterogeneity identified. Consequently, a fixed effect model has been used for analysis. The combined MD and 95% confidence intervals results demonstrated statistically insignificant variance among groups. **Conclusion:** The two standard minimal access adrenalectomy techniques (TLA and RLA) may be securely performed on cases who are chosen properly. TLA is favored for large tumors, bilateral tumors, less frequent intraoperative blood pressure peaks and for the learning process. RLA may be favored for cardiac and previous abdominal surgery patients.
Keywords: adrenal gland, adrenal gland disease, adrenalectomy, laparoscopic adrenalectomy, Retroperitoneal, transperitoneal.

Introduction:

Laparoscopic adrenalectomy (LA) is becoming a more frequent and widely acknowledged therapy choice for adrenal gland illnesses. It provides numerous benefits in comparison with traditional open operations, such as a faster recovery period, reduced pain and scarring, and smaller incisions. In the future, laparoscopic adrenalectomy will become an increasingly refined and efficient therapy choice as technology and surgical techniques remain advancing. LA comprises four main types: hand-assisted, transperitoneal, posterior retroperitoneoscopic, and robot-assisted **[1]**.

Martin Walz established the retroperitoneoscopic method as the more favored method for adrenal tumors in the mid-1990s. Since its introduction, the advantage of bilateral adrenalectomy in the same position and less extensive dissection has increased popularity. A successful laparoscopic adrenalectomy necessitates a comprehensive understanding of retroperitoneal anatomy, as well as an accurate hemostatic procedure and gentle tissue manipulation **[2]**.

At present, the lateral transabdominal procedure to the adrenals is one of the most frequently utilized techniques. It offers sufficient working space and an optimal comprehensive view of the adrenal region and adjacent structures. The endoscope's magnification is especially beneficial during the dissection process in this region **[3]**.

Prudhomme *et al.* [4] compared 2 laparoscopic adrenalectomy procedures (RLA and TLA) and concluded that the transperitoneal and retroperitoneal procedures to laparoscopic adrenalectomy are both safe, with a similar rate of severe complications and death. However, the surgical conversion rate was greater with transperitoneal laparoscopy. The retroperitoneal procedure must be used for small adrenal lesions.

The aim of this work is to compare RLA and TLA within an updated meta-analysis of RCTs and NRTs.

Methods

To conduct a systematic review of management software and manually assess for eligibility to be involved, search outcomes for studies published following 2000 were performed. The PRISMA flowchart was produced in accordance with the search outcomes and the inclusion/exclusion criteria.

Inclusion criteria

- Randomized control trials.
- Controlled clinical trials.

Included in this study were RCTs and NRTs that evaluated RLA in comparison to TLA. to be considered for inclusion, studies needed to explicitly define their procedures for example posterior retroperitoneoscopic, or transperitoneal laparoscopic for reporting signs for operations, as well as for comparing a minimum of one outcome of interest. The most current publication was chosen if multiple studies from the same institution were found.

Exclusion criteria

- Case reports.
- Case series studies.
- Cross sectional studies.
- Non-English studies.

Case series and editorials lacking original data, as well as those that failed to report a minimum of one result measure of interest, were excluded from the comparative analysis. Robotic adrenalectomy has been excepted.

An adrenalectomy performed for diagnosed adrenocortical cancer or metastases, kids' adrenalectomy, robotic adrenalectomy, and lateral retroperitoneal adrenalectomy were removed.

Type of interventions

Transperitoneal and retroperitoneal laparoscopic adrenalectomy.

Search strategy for identification of studies

We searched the MED-LINE database, PubMed, Cochrane Register of Controlled Trials (The Cochrane Library) and Google Scholar utilizing the following keywords correlated with: retroperitoneal; retroperitoneoscopic; transperitoneal; posterior; lateral adrenalectomy.

Methods of the review

Locating and selecting studies

Search has been performed utilizing the following databases: MEDLINE database, PubMed, The Cochrane Library, and Google Scholar.

Data extraction

Data were extracted using the following keywords: retroperitoneal; retroperitoneoscopic; transperitoneal; posterior; lateral adrenalectomy.

Demographic data, surgical information, and results for cases were independently extracted from the involved studies by two reviewers. Age, body mass index (BMI), and sex comprised the demographic details that were documented. The surgical data that was collected included the laterality of the adrenal tumor, the size of the tumor (which is typically indicated on preoperative imaging), and any prior abdominal operations.

Outcomes

Surgical time, estimated blood loss (EBL), conversion to open operations, time to oral intake, time to ambulation, time to return to normal activities, early morbidity and death were the key results that were analyzed. Bilateral adrenalectomies were analyzed on a per case basis.

Statistical analysis

Review Manager version 5.4.1 was applied for conducting all data analyses. (The Cochrane Collaboration, 2014, Copenhagen: The Nordic Cochrane Centre). The odds ratio for binary outcomes has been detected utilizing a 95% confidence interval (CI). For continuous results, we determined the mean difference with a 95% confidence interval. If there is no indication of heterogeneity among studies, we utilized a fixed-effect model utilizing the Mantel-Haenszel method for calculating the total impact estimation with a 95% confidence interval. Otherwise, the random-effects model applying technique of DerSiomonian and Laird was chosen. Q statistic and I^2 test have been applied for evaluating the heterogeneity between studies, that indicates the percentage of variability in the impact estimations. A P value of less than 0.05 was represented statistically significant.

Results

The electronic search revealed a total of 719 references from the four databases, including 185 references from PubMed, 249 from Scopus, 43 from Embase, and 242 from Web of Science.

Following the removal of 453 duplicates, 266 documents remained for abstract and title screening. Forty relevant papers were eligible for full-text screening. 29 articles

have been eliminated in accordance with the exclusion criteria. No additional articles were imported during the manual search of references.

Ultimately, 11 articles met the predetermined inclusion criteria and were then included into the quantitative and qualitative analyses. The flow diagram of the research selection process is shown in Figure 1.

The present analysis chose a total of 11 studies, which included 3454 cases who underwent a total of 3474 laparoscopic adrenalectomies. Transperitoneal laparoscopic adrenalectomy was performed on 2128 cases, while retroperitoneal laparoscopic adrenalectomy (RLA) was performed on 1329 cases. Table 1 demonstrates demographic data of studied have been included.

General characteristic of included patients are demonstrated in table 2. Participants' age varied between 42 and 57 years in the TLA group and from 40 to 58 years in RLA group. The majority of participants were females, ranging from 47% to 92% in the TLAgroup, and ranging from 52% to 87% in the RLA group.

The majority of patients underwent unilateral adrenalectomy, ranging from 75% to 100% in the TLA group and from 90% to 100% in the RLA group. The average size of adrenal tumor varied between 1.9 and 7.5 centimeters within the TLA group, and from 2.5 to 7.2 cm in the RLA group. The underlying adrenal pathology (table 3) in the TLA group was benign (PHEO, adenoma, hyperplasia) in 73% to 100%, malignant (carcinoma, sarcoma, Mets) in 0% to 12%, and unspecified in 0% to 24% patients. In the RLA group, benign causes were reported in 71% to 100%, malignant causes were reported in 0% to 19%, and other causes were reported in 0% to 27% patients.

As shown in Figure s 2 and 3, the Cochrane Collaboration's quality evaluation tool was utilized to evaluate RCTs according to allocation concealment, random sequence generation, blinding of outcome evaluation, blinding of personnel and participants, incomplete outcome data, selective reporting, and other biased factors.

Perhaps demonstrated in table (4), observational retrospective and prospective studies were evaluated by the modified Newcastle-Ottawa Scale(NOS). A maximum of 7 stars could be assigned to each study. The average quality score was 6.1, ranging from 5 to 7, indicating high methodological quality.

All studies reported on the difference in duration of operation, with 432 cases in TLA group and 365 cases in RLA group. A significant heterogeneity has been determined. Consequently, a random-effect model was applied for analysis (I^2-value = eighty-seven percent, P-value < 0.001). The combined MD and 95% confidence intervals were 5.24 (-5.47 to 15.95). The combined result demonstartes statistically insignificant variance among groups according to the operating time (Z = 0.96, P= 0.34) (Figure 4).

Eight studies reported on the variance in bleeding, with 394 cases within TLA group and 327 cases within RLA group. A significant heterogeneity has been determined. Consequently, a random-effect model has been applied for analysis (I^2 = 77%, P-value < 0.001). The combined MD and 95% confidence intervals were 18.98 (2.47 to35.5). The combined result demonstrates an insignificant variance among groups according to incidence of bleeding (Z = 2.25, P = 0.02) (Figure 5).

In all, three studies reported on the variance in time to ambulation, with 102 cases within TLA group and 125 cases within RLA group. Insignificant hetergeneity has been determined. Consequently, a fixed-effect model has been applied for analysis (I^2 = 57%, P = 0.10). The combined MD and 95% confidence intervals were 0.17 (-0.01

to 0.34). The combined result demonstartes no statistically significant variance regarding time to ambulation (Z = 1.83, P= 0.07) (Figure 6).

Five studiesreported on the intraoperative complication rate (table 5), with 201 cases within TLA group and 91 patients within RLA group. Insignificant heterogeneity has been determined. Consequently, a fixed-effect model has been applied for analysis (I^2 = 0%, P-value = 0.86). The combined OR and 95% confidence intervals was 1.71 (0.32 to9.15). The combined result demonstartes insignificant variance among groups according to intraoperative complication rate (Z = 0.62, P= 0.53).

All studies reported on the postoperative complication rate (table 6), with 2128 cases within TLA group and 1329 cases within RLA group. Insignificant heterogeneity has been identified. Consequently, a fixed-effect model has been applied for analysis (I^2 = 0%, P= 0.89). The combined OR and 95% confidence intervals was 1.37 (0.97 to 1.92). The combined outcome demonstartes statistically insignificant variance among groups according to postoperative complications (Z-value = 1.81, P-value = 0.07).

In all, seven studies reported on mortality rate, with 1890 cases within TLA group and 1179 cases within RLA group. Insignificant hetergeneity has been determined. Consequently, a fixed-effect model has been applied for analysis (I^2 = 29%, P = 0.24). The combined OR and 95% confidence intervals was 1.18 (0.36 to3.86). The combined result demonstartes statistically insignificant variance among groups according to death rate (Z-value = 0.27, P-value = 0.79) (Figure 7).

Five studiesreported on the intraoperative complication rate (table 5), with 201 cases within TLA group and 91 cases within RLA group. Insignficant hetergeneity has been determined. Therefore, a fixed-effect model has been utlized for analysis (I^2-value = 0%, *P-value* = 0.86). The combined OR and neintyfive percent confidence intervals was 1.71 (0.32 to9.15). The combined result demonstartes insignificant variance among groups according to intraoperative complication rate (Z = 0.62, P= 0.53) (Figure 8).

Ten studiesreported onconversion rate, with 2090 cases within TLA group and 1291 cases within RLA group. Insignficant hetergeneity has been determined. Therefore, a fixed-effect model has been utlized for analysis (I^2 = 0%, *P-value*= 0.55). The combined OR and neintyfive percent confidence intervals was 1.03 (0.64 to1.67). The combined result demonstartes statistically insignificant variance among groups according to conversion rate(Z-value = 0.14, *P-value* = 0.89) (Figure 9).

In all, four studiesreported on the time to oral intake, with 225 cases within TLA group and 144 cases within RLA group. A signficant hetergeneity has been determined. Therefore, a random-effect model was utlized for analysis (I^2 = 92%, *P-value*< 0.001). The combined MD and neintyfive percent confidence intervals was 0.21 (-0.39 to0.80). The combined result demonstartes statistically insignificant variance among groups according to time to oral intake(Z-value = 0.68, P-value = 0.50) (Figure 10).

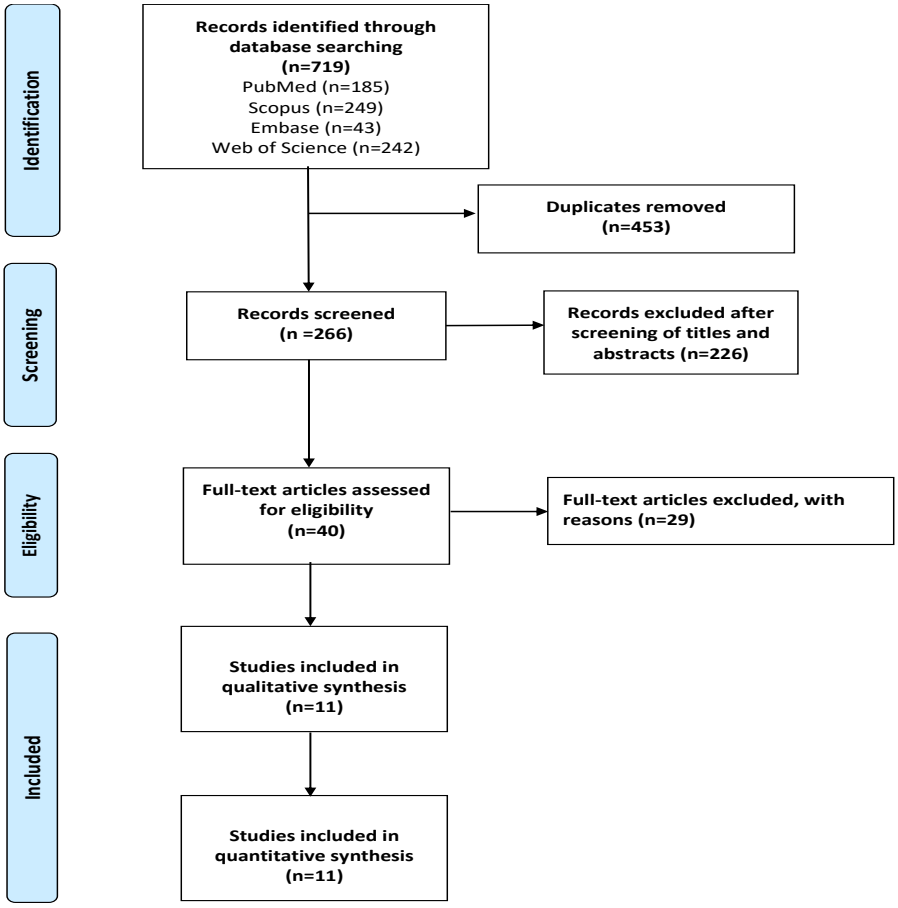

Fig. (1): PRISMA Flow Diagram of the Research Selection Process

Table (1): Study characteristics (N = 2128 patients)

First Author	Year	Country	Design	Study Period		Sample Size	
				From	To	TLA	RLA
Giger	2004	Switzerland	Retrospective	1997	2002	12	11
Rubinstein	2005	USA	RCT	1997	1999	25	32
Gockel	2005	Germany	Retrospective	1994	2004	23	18
Tai	2006	China	Retrospective	1995	2004	20	20
Lombardi	2008	Italy	Prospective	2003	2007	38	38
Berber	2009	USA	Retrospective	1994	2008	69	90
Dickson	2011	USA	Retrospective	2000	2009	23	23
Chai	2017	Korea	RCT	2012	2016	42	41
Lei	2023	China	Retrospective	2012	2022	57	73
Van Den Heede	2023	Multi	Retrospective	2015	2020	1696	964
Zhang	2023	China	Retrospective	2011	2021	123	19

RCT, randomized controlled trial; RLA, retroperitoneal laparoscopic adrenalectomy; TLA, transperitoneal laparoscopic adrenalectomy

Table (2): Patient characteristics (N = 2128 patients)

First Author	Age, yrs.		Female Gender, %		Tumour Size, mm		Unilateral, %		Bilateral, %	
	TLA	RLA	TLA	RLA	TLA	RLA	TLA	RLA	TLA	RLA
Giger	57		65		4.9	4.5	75	100	25	0
Rubinstein	57	58	48	63	2.7	2.6	100	100	0	0
Gockel	45		46		3.6		85		15	
Tai	54.3	42.1	45	75	1.9	2.6	100	100	0	0
Lombardi	49	46.3	92	87	3.7	3.6	100	100	0	0
Berber	52	51	64	52	4.4	2.8	81	90	19	10
Dickson	42	47.3	70	52	4	3.3	96	100	4	0
Chai	48	46.4	67	63	2.9	3	100	100	0	0
Lei	45.6	49.1	47	59	7.5	7.2	100	100	0	0
Van Den Heede	55	54	56	62	3.3	3.5	100	100	0	0
Zhang	49	40	56	58	5	2.5	100	100	0	0

Table (3): Adrenal pathology (N = 2128 patients)

First Author	PHEO		Adenoma		HypeRLAsia		Malignancy		Others	
	TLA	RLA	TLA	RLA	TLA	RLA	TLA	RLA	TLA	RLA
Giger	48		17		13		0		22	
Rubinstein	24	3	44	16	20	5	12	6	0	2
Gockel	100	18	0	0	0	0	0	0	0	0
Tai	10	2	65	16	10	1	0	0	15	1
Lombardi	18	6	82	32	0	0	0	0	0	0
Berber	33	12	30	51	13	15	10	10	13	2
Dickson	100	23	0	0	0	0	0	0	0	0
Chai	19	7	48	16	17	10	0	0	17	8
Lei	100	73	0	0	0	0	0	0	0	0
Van Den Heede	21	192	53	491	0	0	2	21	24	260
Zhang	100	19	0	0	0	0	0	0	0	0

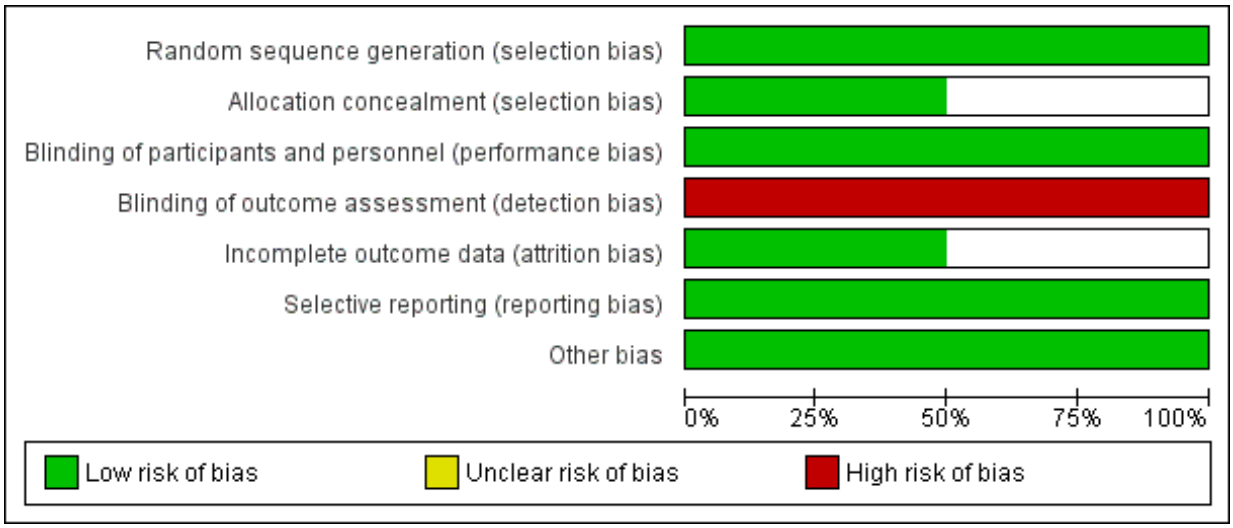

Fig. (2): Risk of bias graph for RCTs

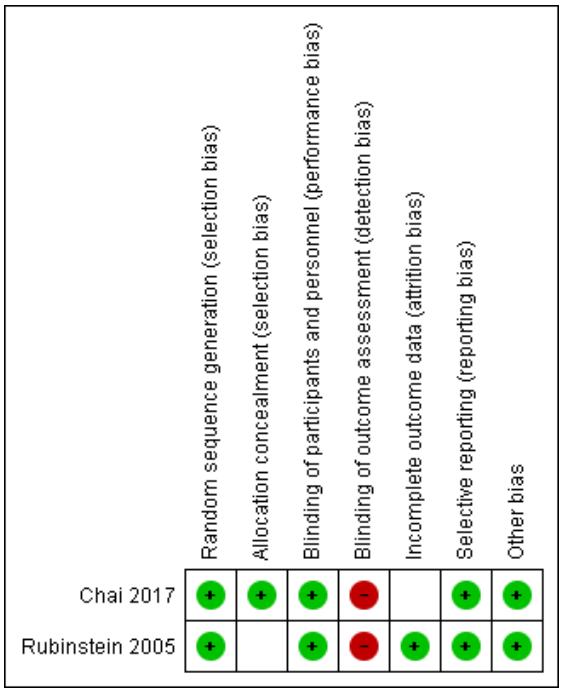

Fig. (3): Risk of bias summary for RCTs

Table (4): Newcastle-Ottawa scale quality evaluation of oservational studies

	Selection Parameter	Comparability Parameter	Outcome Parameter	Total Score	Quality
Giger	✶✶✶	✶✶	✶✶	7	High
Gockel	✶✶✶	✶✶	✶✶	7	High
Tai	✶✶	✶✶	✶	5	Moderate
Lombardi	✶✶✶	✶✶	✶✶	7	High
Berber	✶✶	✶✶	✶✶	6	High
Dickson	✶✶✶	✶✶	✶	6	High
Lei	✶✶✶	✶	✶	5	Moderate
Van Den Heede	✶✶✶	✶	✶✶	6	High
Zhang	✶✶	✶✶	✶✶	6	High

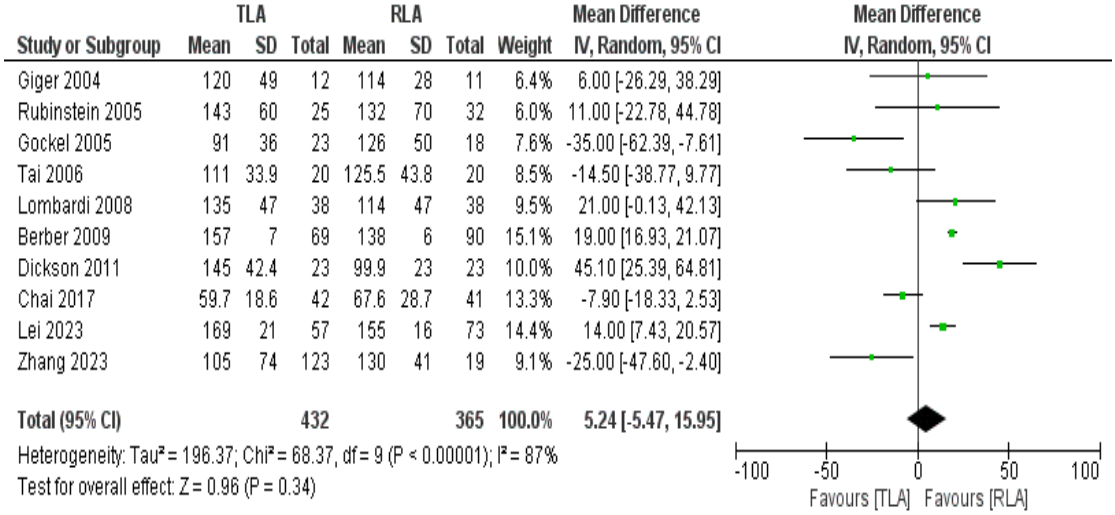

Figure (4): Forest plot of operating time demonstrates statistically insignificant variance among groups

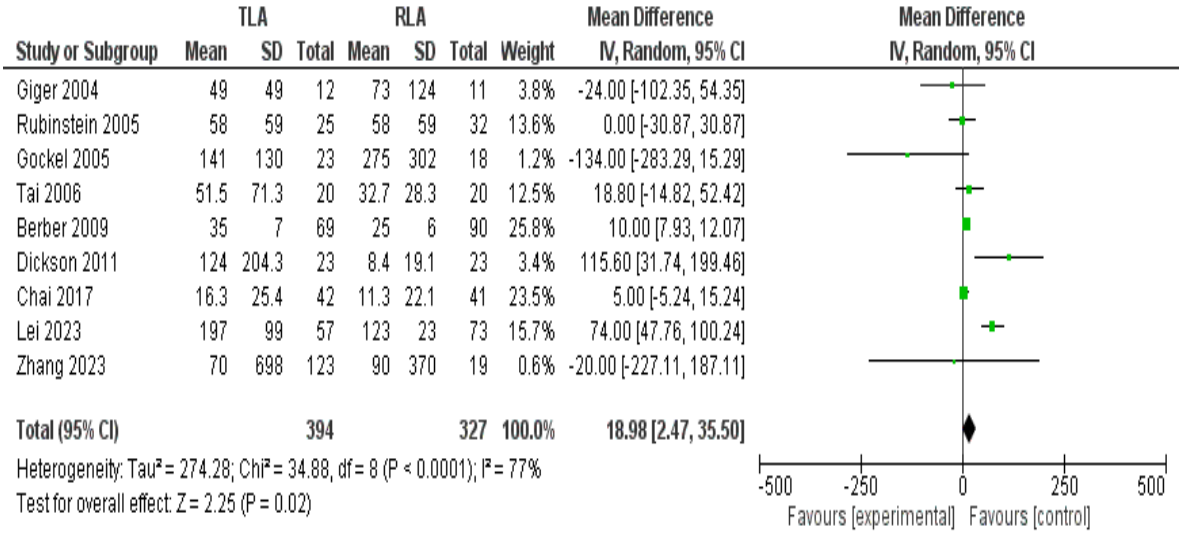

Figure (5): Forest plot of blood loss reveals statistically insignificant variance among groups

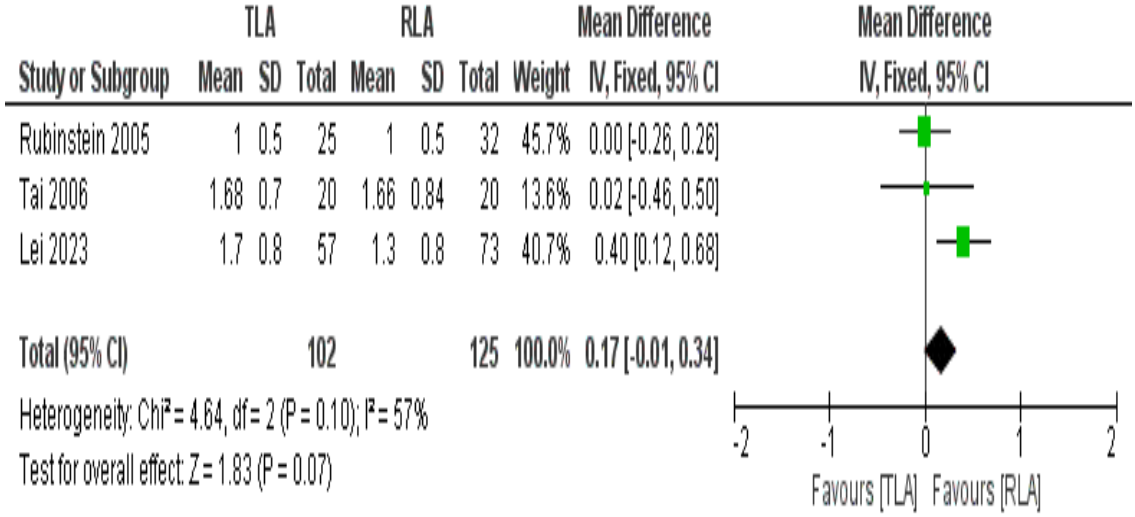

Figure (6): Forest plot of ambulation time demonstrates statistically insignificant variance among groups

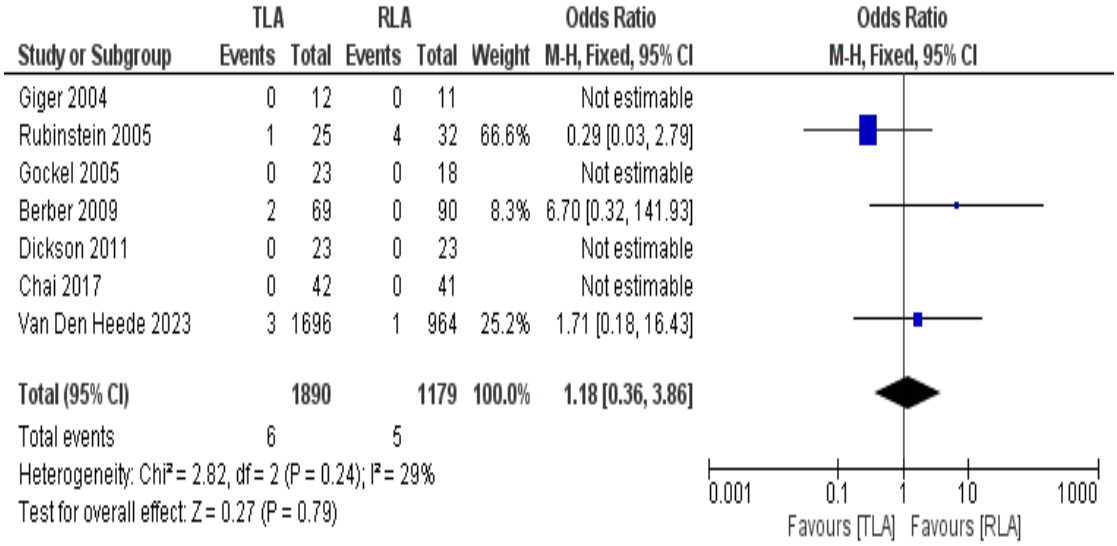

Figure (7): Forest plot of mortality probability demonstrates statistically insignificant variance among groups

Table (5): Intraoperative complications

First Author	TLA	RLA
Giger	None	None
Gockel	1 Pneumothorax	None
Tai	1 Pneumothorax 1 Bleeding	1 Bleeding
Dickson	None	None
Zhang	1 Hypotension following adrenal vein ligation 1 Bleeding following short hepatic vein injury	None

Table (6): Postoperative complications

First Author	TLA	RLA
Giger	1 Infection	1 Infection
Rubinstein	1 Infection 1 Hematoma 2 Port hernia	1 Urinary retention
Gockel	1 Polyuria	1 Arrhythmia
Tai	1 Atelectasis	None
Lombardi	1 Bleeding	1 Thrombophlebitis 1 Abdominal hypothesia
Berber	None	2 Neuralgia
Dickson	1 Bleeding 1 Haemothorax	1 Pneumothorax 1 Urinary retention 1 Pleural effusion
Chai	Ileus	None
Lei	27 Not specified	28 Not specified
Van Den Heede	69 Not specified	28 Not specified
Zhang	2 Hypotension	None

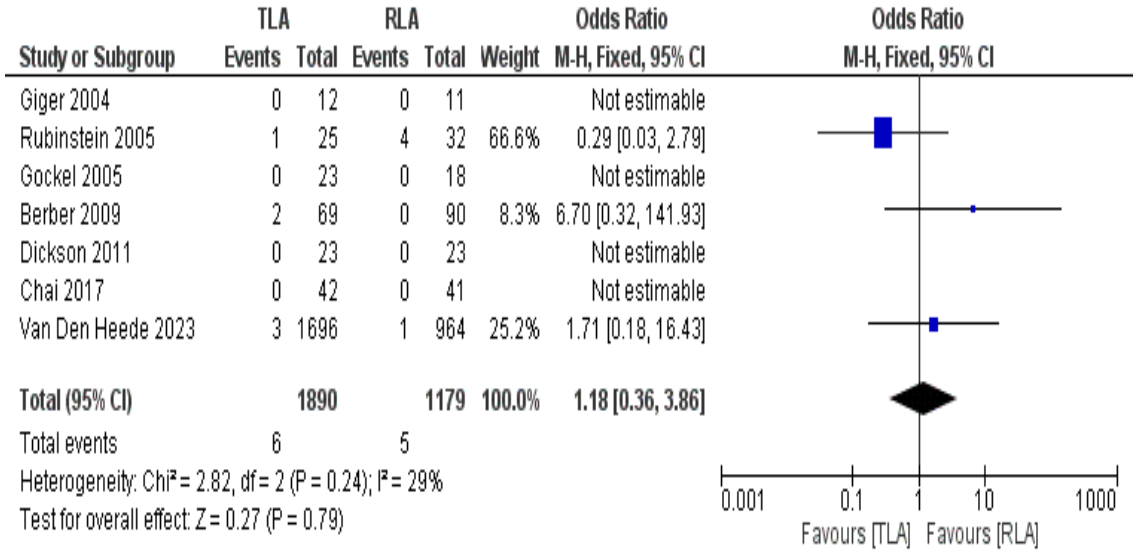

Figure (8): Forest plot of intraoperative complications demonstrates statistically insignificant variance among groups

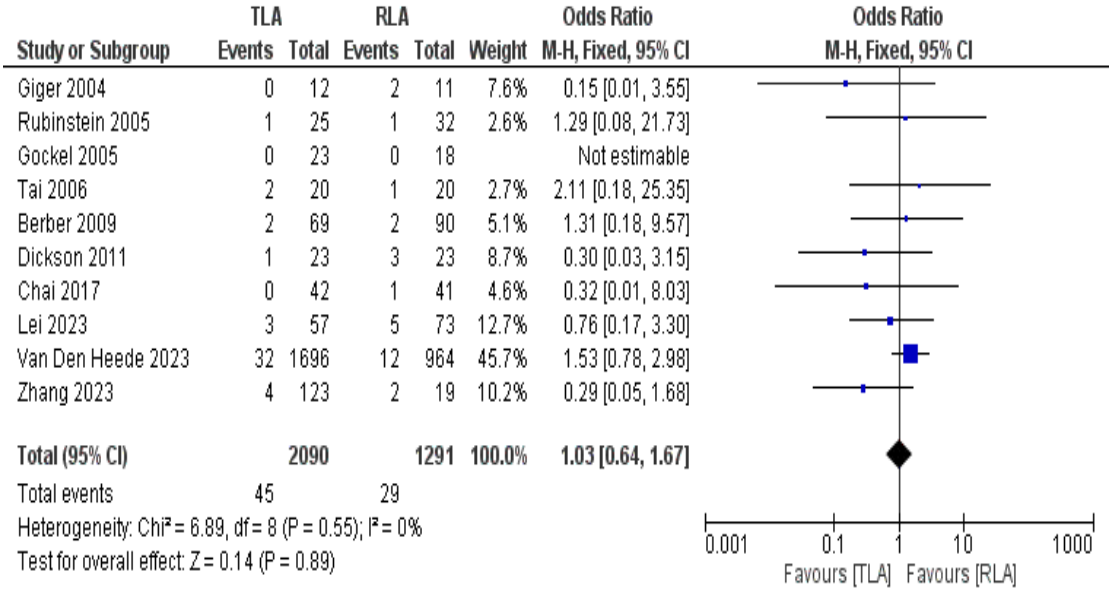

Figure (9): Forest plot of conversion to open operation rate demonstrates statistically insignificant variance among groups

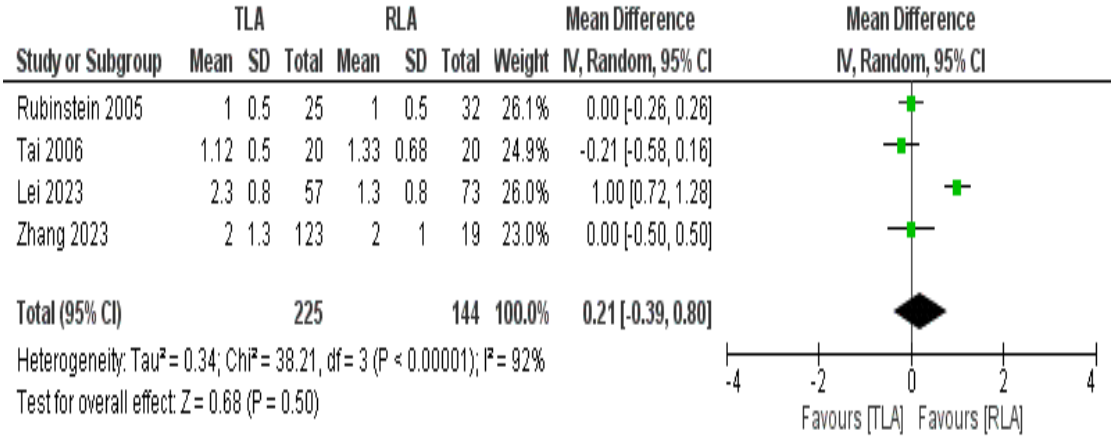

Figure (10): Forest plot of time to oral intake demonstrates statistically insignificant variance among groups

Discussion

Gagner et al. [5] were the first to explain laparoscopic adrenalectomy. The lateral transperitoneal procedure was shown to be effective in the removal of all adrenal tumors except for the largest ones by **Gagner et al. [6].** The procedure resulted in a shorter duration of stay and a decrease in pain, without affecting the duration of surgery or morbidity.

Until **Walz et al. [7]** popularized the alternative posterior retroperitoneoscopic approach (RLA) with the cases in a modified prone position, the extraperitoneal approach didn't succeed to gain traction. The RLA utilizes the same tools as a TLA.

The posterior retroperitoneoscopic approach has been significantly more developed and learning curve problems were resolved, resulting in the addition of more studies comparing posterior retroperitoneoscopic approach to laparoscopic transperitoneal adrenalectomy to scientific literature. These studies include randomized control trials and a Cochrane review of the earlier studies [**8]**.

Although minimally invasive adrenalectomy was stated to yield favorable outcomes when performed via the transperitoneal or retroperitoneal route, a limited number of studies have conducted a comprehensive comparison of the two techniques, demonstrating that neither method is better. Nevertheless, the majority of these studies were constrained by a small sample size and a single-institution design. The objective of this research was to conduct an updated meta-analysis of non-randomized comparative (NRT) trials and randomized controlled (RCT) to compare retroperitoneal and transperitoneal laparoscopic adrenalectomy to address these limitations.

The electronic search produced 249 from Scopus, 185 references from PubMed, 242 from Web of Science, and 43 from Embase, resulting in a cumulative total of 719 references across all 4 databases.

The current analysis selected a total of 11 studies , which included 3454 cases who underwent a total of 3474 laparoscopic adrenalectomies. In total, 2128 cases underwent transperitoneal laparoscopic adrenalectomy (TLA), while 1329 cases underwent retroperitoneal laparoscopic adrenalectomy (RLA).

The publication year varied between 2004 and 2023. The country of origin was carried across the studies. 3 studies have been carried out in the united states of America, 3 studies have been carried out in Europe (Germany, Switzerland, and Italy), three studies were carried out in China, one study was carried out in Korea, and one study was multicentric.

Giger *et al.* [9] reported The outcomes of TLA and ERA for various benign adrenal gland illnesses. The authors indicated that the retroperitoneoscopic method is equally successful as the transperitoneal route, providing the same advantages of minimally invasive procedures for case comfort, reduced hospitalization, and recovery time. They preferred a primary transperitoneal laparoscopic technique for bilateral and left-sided lesions because it facilitates easier dissection and allows for rapid identification of critical anatomical landmarks, resulting in decreased duration of operation relative to the retroperitoneoscopic method. Unilateral right-sided cancers of as much as eight centimeters are excised by ERA, but bigger lesions are more effectively resected laparoscopically.

Gockel *et al.* [10] evaluated the importance of endoscopic adrenalectomy for management of pheochromocytoma and sought to determine the most effective operating procedure by observing the during surgery and following surgery. phases. They demonstrated that endoscopic adrenalectomy can be carried out on cases with

pheochromocytoma through both transperitoneal and retroperitoneal routes following a sufficient amount of preparation. The transperitoneal method with the case situated in a lateral position is the preferred operative method due to the reduced duration of operation, improved overview of the operating field, and fewer common intraoperative blood pressure peaks. Retroperitoneal adrenalectomy cases demonstrated a trend toward a shorter postoperative in-hospital stay, although this was statistically insignificant.

Rubinstein et al. [11] conducted a comparison of transperitoneal and retroperitoneal laparoscopic adrenalectomy in fifty-seven consecutive cases with intermediate-term monitoring. They concluded that the transperitoneal and retroperitoneal approaches are both safe and effective for the majority of benign adrenal lesions that necessitate operations.

In a retrospective review of forty cases, **Tai *et al.* [12]** compared and examined the outcomes of two different laparoscopic adrenalectomy methods. Twenty lateral retroperitoneal and twenty lateral transperitoneal laparoscopic adrenalectomies were carried out during the study duration from 1995 and 2004. Demographic variables did not show any obvious variation among the two groups. There was insignificant variance among the two procedures in terms of operational time, days to diet and ambulation, hospitalization, rate of conversion, and complication. After a mean monitoring duration of 15.9 months, no recurrence was identified. The learning curves demonstrate a progressive reduction in operation time for both approaches, which is indicative of the methods' maturation. In summary, laparoscopic adrenalectomy is both safe and efficacious, whether performed transperitoneally or retroperitoneally. The two techniques yield identical results.

to identify if there is an optimal and preferred method for the removal of small- to medium-sized benign adrenal cancers, **Lombardi et al. [13]** conducted a comparison of the outcomes of TLA and posterior retroperitoneoscopic approach according to intraoperative variables and postoperative results. They were unable to identify any conclusive data that would suggest a clearcut advantage of posterior retroperitoneoscopic approach over TLA for the removal of benign small- to medium-sized adrenal lesions, which account for the majority of operative adrenal illnesses. It continues appropriate for the surgeon's experience and preference to continue to be the primary factors in determining the option among both surgeries.

Berber et al. [14] discovered that two laparoscopic adrenalectomy methods have allowed us to manage a significant number of cases with a variety of adrenal conditions, resulting in high levels of satisfaction for both the case and the surgeon. While the present opinion is that the LT and PR approaches are competitive, they are actually complementary if specific case selection standards are met.

Dickson et al. [15] assessed the safety and perioperative results of RLA in cases with PHEO in comparison to LA. LA and RLA were determined to be both safe and efficacious for cases with PHEO. RLA necessitates a cognitive "reorientation" for the surgeon, as the anatomy is initially unfamiliar from this perspective. Nevertheless, surgeons who possess the laparoscopic skill set needed for transabdominal operations may become efficient in the posterior approach once they have become facile with the critical landmarks required for the procedure. In comparison to LA, RLA leads to a reduction in surgical durations, bleeding, and following surgery LOS. RLA is our favored method for treatment of PHEO, as it eliminates the necessity for visceral mobilization and is particularly well-suited for cases who have undergone previous abdominal surgeries.

In a study conducted by **Chai et al. [16],** the operating result of TLA and RLA in cases with adrenal gland adenomas were compared. The results indicated that there was insignificant variance in operative results between the two procedures, involving operative time, bleeding, discomfort following the surgery, duration of hospital stay, and complication rate. Both TLA and RLA are safe for benign adrenal cancers, and the surgeon can decide on either method based on their preference and experience.

In the management of large pheochromocytoma, **Lei et al. [17]** conducted a comparison of the perioperative and monitoring results for TLA and RLA. They showed that both transperitoneal laparoscopic adrenalectomy, retroperitoneal laparoscopic adrenalectomy are efficient management procedures for large pheochromocytoma; however, the perioperative result of retroperitoneal laparoscopic adrenalectomy is superior to transperitoneal laparoscopic adrenalectomy. Independent risk factors for HI include increased levels of hormones and larger tumor size.

Van Den Heede *et al.* [18] analyzed PRLA versus TLA in adults and confirmed the reduced duration of hospitalization following retroperitoneal laparoscopic adrenalectomy. Both procedures are safe resulting in comparable morbidity and conversion rates.

The results of cases with pheochromocytoma who underwent surgery using retroperitoneal and lateral transperitoneal approaches were assessed by **Zhang et al. [19].** The clinical parameters at presentation were similar among both groups, with the exception of the tumor size, which was larger in the transperitoneal group. Operation time, calculated bleeding, frequency of complications, intraoperative transfusion rate, analgesic requirement following surgery, conversion to open operations, time to 1st oral intake, and average hospitalization didn't show insignificant variances among both groups. Both groups demonstrated comparable intraoperative hemodynamic variables. Both hemodynamic parameters and perioperative results remained comparable following normalizing for tumor size utilizing propensity score matching. In general, the perioperative and intraoperative hemodynamic variables for LTLA and LRLA were comparable if utilized to treat pheochromocytoma. Cases with pheochromocytoma may undergo endoscopic adrenalectomy through either the transperitoneal or retroperitoneal method following sufficient preparation.

We can say that the time to oral ingestion was reduced in cases who underwent RLA; nonetheless, the variance may not be clinically significant due to the significant heterogeneity that was observed.

Regarding time to ambulation, three studies reported on the variance in time to ambulation, with 102 cases within TLA group and 125 cases within RLA group. Insignificant hetergeneity has been noticed. Consequently, a fixed-effect model has been applied for analysis (I^2 = 57%, *P*- = 0.10). The combined MD and 95% confidence intervals were 0.17 (-0.01 to 0.34). The combined result demonstartes no statistically significant variance regarding time to ambulation (Z = 1.83, *P* = 0.07).

In conclusion, the current study illustrates that both TLA and RLA mainstream minimum access adrenalectomy techniques may be successfully carried out in well-chosen cases. TLA is favored for large tumors, bilateral tumors and for the learning process as it applies reduced operational durations, improved overview of the operating field from the anatomical point of view and less frequent intraoperative blood pressure peaks. RLA may be favored for cardiac and previous abdominal surgery patients.

Financial support and sponsorship

Nil.

Conflict of interest

None.

References

1- Kim K. Various methods for laparoscopic adrenalectomy. J Endrocr Surg 2023; 23(1): 1-6.

2- Maccora D, Walls GV, et al. Bilateral adrenalectomy: a review of 10 years' experience. Ann R Coll Surg Engl 2017; 99(2).

3- Raffaelli M, De Crea C, Bellantone R. Laparoscopic adrenalectomy. Gland Surg 2019; 8: S41-52.

4- Prudhomme T, Roumiguie M, Gas J, Soulie M, Thoulouzan M and Huyghe E. Comparison between retroperitoneal and transperitoneal laparoscopic adrenalectomy: Are they both equally safe? 2020. J of Visceral Surgery, 158(3), 204-210.

5- Gagner M, Lacroix A, Bolte E. Laparoscopic adrenalectomy in cushing's syndrome and pheochromocytoma. N Engl J Med 1992; 327: 1033.

6- Gagner M, Pomp A, Heniford BT. Laparoscopic adrenalectomy: lessons learned from 100 consecutive procedures. Ann Surg 1997; 226: 238–246

7- Walz MK, Peitgen K, Hoermann R. Posterior retroperitoneoscopy as a new minimally invasive approach for adrenalectomy: results of 30 adrenalectomies in 27 patients. World J Surg 1996; 20: 769–774.

8- Arezzo A, Bullano A, Cochetti G, Cirocchi R, Randolph J, Mearini E. Transperitoneal versus retroperitoneal laparoscopic adrenalectomy for adrenal tumours in adults. Cochrane Database Syst Rev 2018; 12: Art No: CD011668.

9- Giger U, Vonlanthen R, Michel JM and Krahenbuhl ML. Trans- and retro-peritoneal endoscopic adrenalectomy: Experience in 26 consecutive adrenalectomies. Dig Surg 2004; 21: 28-32.

10- Gockel I, Vetter G, Heintz A and Junginger Th. Endoscopic adrenalectomy for pheochromocytoma: Difference between the transperitoneal and retroperitoneal approaches in terms of the operative course. Surg Endosc 2005; 19: 1086-1092.

11- Rubinstein M, Gill IS, Aron M, Kilciler M, Meraney AM, Finelli A. Prospective, randomized comparison of transperitoneal versus retroperitoneal laparoscopic adrenalectomy. J Urol 2005; 174: 442-5.

12- Tai CK, Li SK, Hou SM, Fan CW, Fung TC and Wah MK. Laparoscopic adrenalectomy: Comparison of lateral transperitoneal and lateral retroperitoneal approaches. Surg Laparosc Endosc Percutan Tech 2006; 16: 141-145.

13- Lombardi CP, Raffaelli M, De Crea C, Sollazzi L, Perilli V, Cazzato MT. Endoscopic adrenalectomy: Is there an optimal operative approach? Results of a single-center case-control study. Surgery 2008; 144: 1008-15.

14- Berber E, Tellioglu G, Harvey A, Mitchell J, Milas M, Siperstein A. Comparison of laparoscopic transabdominal lateral versus posterior retroperitoneal adrenalectomy. Surgery 2009; 146: 621–5.

15- Dickson PV, Alex GC, Grubbs EG, Ayala-Ramirez M, Jimenez C, Evans DB. Posterior retroperitoneoscopic adrenalectomy is a safe and effective alternative to transabdominal laparoscopic adrenalectomy for pheochromocytoma. Surgery 2011; 150: 452–458.

16- **Chai YJ, Yu HW, Song RY, Kim SJ, Choi JY, Lee KE.** Lateral transperitoneal adrenalectomy versus posterior retroperitoneoscopic adrenalectomy for benign adrenal gland disease: randomized controlled trial at a single tertiary medical center. Ann. Surg, 2017.

17- **Lei K, Wang X, Yang Z, Liu Y, Sun T, Xie W.** Comparison of the retroperitoneal laparoscopic adrenalectomy versus transperitoneal laparoscopic adrenalectomy for large (≥6cm) pheochromocytomas: A single-centre retrospective study. Front. Oncol. 2023; 13: 1043753.

18- **Van Den Heede K, Vatansever S, Girgin T, Van Slycke S and Makay Z.** Posterior retroperitoneal versus transperitoneal laparoscopic adrenalectomy in adults: Results from the EUROCRINE® surgical registry. Langenbeck's Archives of Surgery 2023; 408: 241.

19- **Zhang Q, Huang Y, Yan L, Liu Z, Xu Z and Gu G.** Comparison of lateral transperitoneal versus retroperitoneal laparoscopic adrenalectomy for pheochromocytoma: A single-centre retrospective study. Updates in Surgery 2023; 75: 1259-1266.