

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

185,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Laparoscopic Left Adrenalectomy with Submesocolic and Retropancreatic Approach

Andrea Balla, Silvia Quaresima, Ardit Seitaj,

Andrea M. Isidori, Franco lafrate and

Alessandro M. Paganini

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/66457>

Abstract

Introduction: The safety and efficacy of laparoscopic transperitoneal lateral adrenalectomy and retroperitoneoscopic adrenalectomy have been reported. The aim is to report the authors' experience in laparoscopic left adrenalectomy with an alternative transperitoneal submesocolic and retropancreatic approach with patient supine.

Research methods: The authors have performed laparoscopic transperitoneal submesocolic, retropancreatic adrenalectomy for both benign and malignant, functioning lesions >4cm in diameter or with smaller lesions but having an imaging pattern suspicious of malignancy or of sub-clinically secreting tumors. After opening the posterior peritoneum at the root of the transverse mesocolon and Gerota's fascia, the junction of the inferior adrenal vein with the left renal vein is identified. The adrenal vein is then prepared and divided, followed by mobilization and removal of the left adrenal gland.

Conclusion: Early ligation of the adrenal vein is the most relevant technical feature of this procedure to avoid the release of catecholamines, hormones or neoplastic cells which could occur during manipulation of the gland prior to ligation of the main adrenal vein. Moreover, this approach makes it possible to perform associated procedures, including a bilateral adrenalectomy, without the need to reposition the patient on the operative table, but simply by positioning additional trocars.

Keywords: adrenal tumors, laparoscopic adrenalectomy, pheochromocytoma, transperitoneal anterior approach, submesocolic retropancreatic approach

1. Introduction

The surgical approach to the adrenal gland has raised debate among surgeons due to its retroperitoneal location and for the complexity in the management of secreting tumors, particularly in case of pheochromocytoma (PHE) [1–3]. Traditionally, open adrenalectomy is made difficult due to its deep anatomical location, and it is associated with up to 39% morbidity rate and prolonged hospital stay [1–3]. In 1992, Gagner described the first laparoscopic adrenalectomy (LA) by a transperitoneal approach with the patient in the lateral decubitus position [4, 5]. This initial experience has been followed by others using the same approach or, alternatively, the retroperitoneal approach with the patient in the prone or in the lateral decubitus position [6, 7] and the transperitoneal approach with the patient supine [8]. Several reports have confirmed the safety and efficacy of these techniques, and minimally, invasive adrenalectomy is presently considered the treatment of choice for a variety of benign lesions, including lesions of the medulla [9, 10].

The aim of the present chapter is to report the authors' experience with left laparoscopic adrenalectomy (LA) using an original transperitoneal submesocolic and retropancreatic approach with patient supine, to describe the patient's preparation for surgery as well as the operative details of this procedure.

2. Methods

In order to establish the diagnosis in case of adrenal secreting lesions, all patients undergo complete hormonal evaluation as previously reported [11]. Diurnal serum cortisol, dehydroepiandrosterone (DHEAS), plasma adrenocorticotrophic hormone (ACTH), testosterone, androstenedione, urinary free cortisol (UFC), 17-hydroxyprogesterone (17-OHP), renin activity, aldosterone and urinary catecholamine levels are measured, together with overnight 1-mg dexamethasone suppression test (DST) [11]. Aldosterone-producing adenoma, pheochromocytoma and Cushing's syndrome are diagnosed on the basis of high plasma aldosterone, plasma renin activity (PRA) ratio (>40) and unsuppressed aldosterone after sodium load, elevated urinary metanephrines, elevated UFC, abnormal serum cortisol, inadequate cortisol suppression after 1-mg dexamethasone and low and/or suppressed plasma ACTH [11]. When no specific signs and/or symptoms of autonomous hormone secretion are present, or abnormal hypothalamus-pituitary-adrenal axis tests and radiological imaging suggesting the presence of an adrenocortical lesion, a diagnosis of nonfunctioning adenoma is made [11].

All patients are studied with computed tomography (CT) scan and magnetic resonance imaging (MRI). An attenuation value of 10 or less Hounsfield units (HU) on unenhanced CT scan is suggestive for the presence of a benign adrenocortical adenoma [12]. Relative contrast washout of $>40\%$ and an absolute contrast washout of $>60\%$ are suggestive for an adenoma, with 92% specificity and 98% sensitivity rates, respectively [13, 14]. In all sequences during MRI,

adrenocortical adenomas are homogeneous, with mild gadolinium enhancement [12], with low or equal signal intensity as the liver on T2-weighted images may appear on lower signal intensity than the rest of the adrenal gland [12]. Chemical shift imaging can be done during MRI to identify fat within the lesion as decreased signal intensity relative to normal tissue [12]. For carcinomas, the attenuation on unenhanced studies is higher than 10HU on CT scan [15]. On contrast-enhanced studies, carcinomas enhance greedily due to their vascularity, and the enhancement pattern may be homogeneous, unless there is central necrosis [15, 16]. The relative percentage washout of carcinomas is <40% [17]. At MRI, adrenal carcinomas are noted for heterogeneity on T1-weighted images, with intermediate to high signal intensity [18]. Heterogeneity is also noted on T2-weighted images due to hemorrhage and/or necrosis [18]. Based on these criteria, adrenal lesions larger than 4cm in diameter or with smaller but having an imaging pattern suspicious of malignancy or of sub-clinically secreting tumors are an indication for laparoscopic adrenalectomy.

2.1. Patient's preoperative preparation

2.1.1. Pheochromocytoma

Alpha-blockers (doxazosin 20mg/day), starting at least 15 days before surgery, are administered. If patients reported episodes of tachycardia, beta-blockers are also administered (atenolol 100–200mg/day orally). On the day before surgery, treatment with alpha-blockers is discontinued, and intravenous (iv) normal saline 2000cc is administered to expand the plasma volume [19].

2.1.2. Conn's syndrome

Iv hydrocortisone 100mg is administered at induction of anesthesia. Iv spironolactone is used for potassium control [20].

2.1.3. Cushing's syndrome

Iv hydrocortisone 100mg is administered at induction of anesthesia and then iv hydrocortisone 50mg every 8h [20].

2.2. Surgical technique

2.2.1. Left adrenalectomy: transperitoneal anterior submesocolic and retropancreatic approach

Surgery is performed under general anesthesia. An orogastric tube and urinary catheter are positioned. Intraoperative patients' monitoring includes intra-arterial radial artery catheter for continuous blood pressure measurement and a central venous catheter (subclavian or internal jugular access) for rapid infusion of liquids. Pneumoperitoneum is usually established with a Veress needle at the umbilicus or with an open technique and Hasson cannula, in case of the presence of abdominal scars from previous surgery. Pneumoperitoneum is set at a pressure of 12–13mmHg, with carbon dioxide flow adjusted at 30lt/min. Four trocars and a 30°/45°

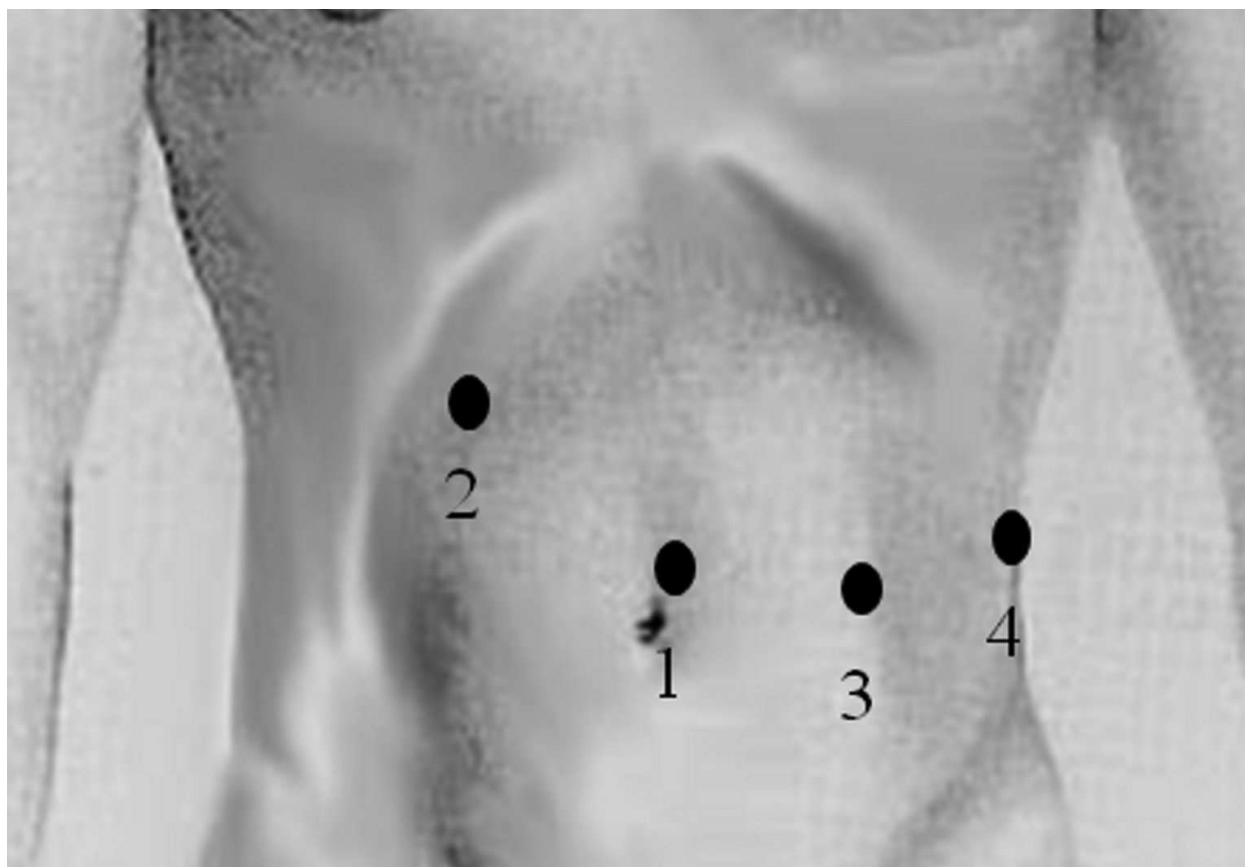


Figure 1. Trocars' position during left transperitoneal submesocolic and retropancreatic adrenalectomy. The surgeon and first assistant stand on the left of the patient, while the second assistant stands on the right.

forward oblique optic are used. This approach is performed with the patient supine, in slight anti-Trendelenburg position and with the operating table turned 30° with the side opposite the lesion down, to facilitate exposure of the surgical field. The surgeon stands on the side which is ipsilateral to the lesion.

After induction of pneumoperitoneum, the first 12-mm optical trocar (n. 1) is inserted on the left of the midline above the umbilicus (**Figure 1**). A second 12-mm trocar (n. 2) is inserted under vision on the right midclavicular line below the right costal arch. The third and fourth 12-mm trocars are placed one on the left midclavicular line along with the transverse umbilical line (n. 3) and other on the left anterior axillary line (n. 4), respectively (**Figure 1**). The 10-mm laparoscope is introduced from trocar (n. 3), while trocars 1 and 4 are the operating ones. With atraumatic forceps introduced from trocar (n. 2), the transverse mesocolon is raised by the assistant. This maneuver discloses the first jejunal loop at the ligament of Treitz, and it shows the arch of the inferior mesenteric vein. The operative table is tilted with the left side of the patient up, which allows the surgeon to displace the first jejunal loops on the patient's right side (**Figure 2**). The posterior peritoneum is opened at the insertion of the transverse mesocolon and posteriorly to the lower edge of the pancreas, between the first jejunal loop and the arch of the inferior mesenteric vein or immediately lateral to this vessel, according to

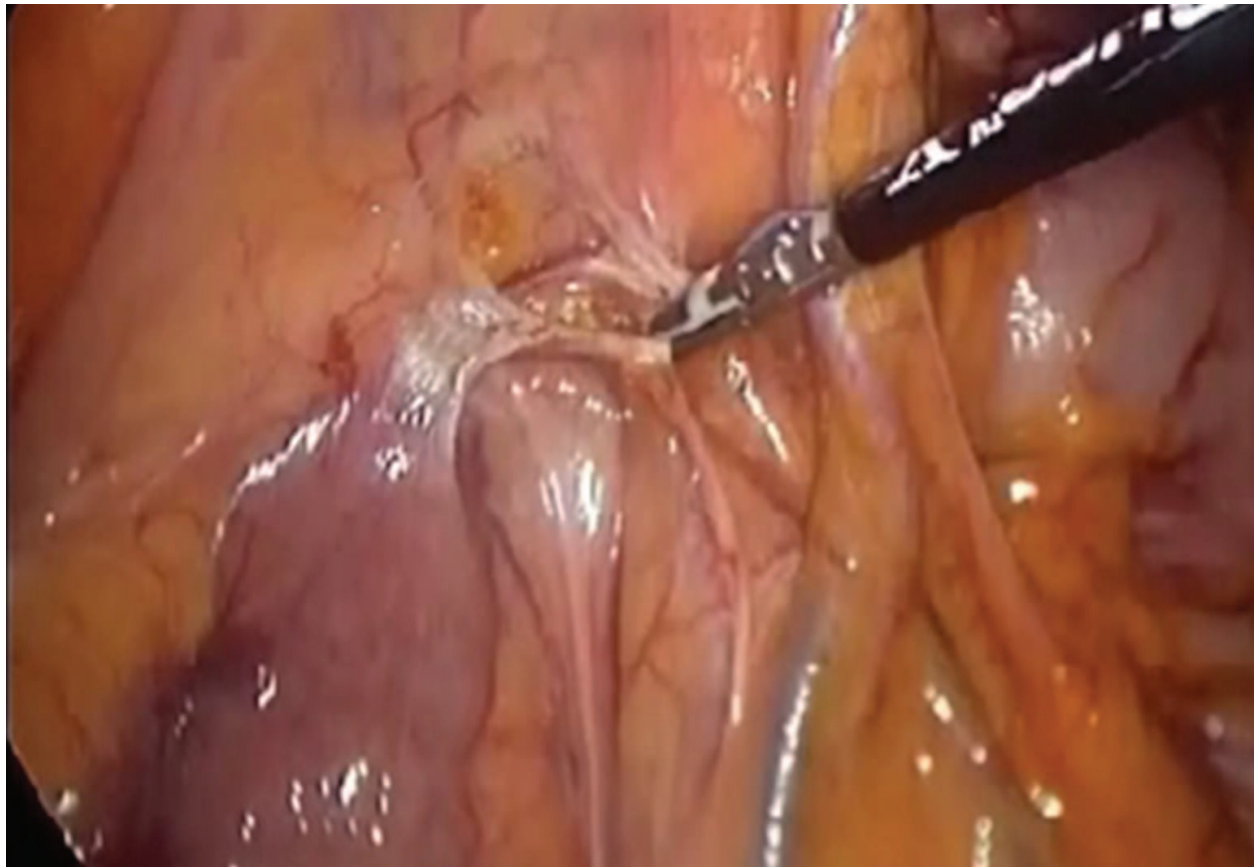


Figure 2. After raising the transverse mesocolon and displacing the first jejunal loop on the patient's right side, the posterior peritoneum is divided close to the arch of the inferior mesenteric vein.

its distance from the jejunum. Toldt's fascia appears at this point as a whitish film. The dissection then proceeds posteriorly along the retro-pancreatic space, after raising the body of the pancreas with an atraumatic instrument held by the surgeon's left hand. The splenic vein is visible at this point running along the posterior aspect of the pancreas. Gerota's fascia is now opened to visualize the left renal vein, which is followed medially, until the left inferior adrenal vein is identified. This is cautiously prepared and divided between clips (AcuClip, Tyco/Healtcare, Norwalk, Connecticut, USA, **Figure 3**). No manipulation of the left adrenal gland has yet occurred prior to division of the adrenal vein because the gland is located cranially to this vessel. Only at this point, the gland is mobilized using a radiofrequency (LigaSure™ tissue fusion, Covidien, Mansfield, Massachusetts, USA) or ultrasonic (Ultracision, Harmonic Scalpel, Ethicon Endo Surgery, Cincinnati, Ohio, USA) device, and the specimen is removed from the abdominal cavity inside a specimen retrieval bag after slightly enlarging the periumbilical trocar incision [19].

Near-infrared indocyanine green (NIR-ICG) fluorescence may be employed during surgery and may be useful to aid in vascular structures and adrenal gland identification amidst retroperitoneal and perirenal fat, particularly in obese patients, to improve the safety of laparoscopic adrenalectomy.



Figure 3. The left adrenal vein is divided between clips. Confluence of the diaphragmatic vein to the left adrenal vein is visible.

3. Discussion

Surgery is the standard treatment of Conn's syndrome, Cushing's disease, pheochromocytoma, primary adrenal cancer and adrenal metastases. After the introduction of minimally invasive adrenalectomy, this has now become the treatment of choice [8, 21–26]. Minimally, invasive adrenalectomy is mostly performed either with a transperitoneal lateral approach or with a retroperitoneal approach [4]. The laparoscopic transperitoneal anterior approach has been proposed only by few centers [8, 11, 19, 23, 24, 26].

The transperitoneal lateral approach, originally described by Gagner et al. [4], is performed with the patient in the lateral decubitus position. It gives excellent exposure of the operative field with a wide working space, and it facilitates orientation by providing readily identifiable anatomical landmarks [27]. Its proponents report several advantages, such as a rapid and direct access to the gland without the need to retract any organ and with minimal patient trauma [28], a clear operative field due to gravity that keeps blood and bowel away from it and the need for less surgical dissection on the left side, as compared to the anterior approach [26]. By the authors' opinion, the main disadvantage of the lateral approach is that it does not provide early ligation of the adrenal vein prior to gland manipulation, which the authors

believe to be important so as to avoid pressure instability in case of secreting adenomas, and particularly of pheochromocytoma, and which would also be oncologically correct [11, 19, 29].

Retroperitoneal adrenalectomy (RA) has also been reported to be safe and effective [21, 30, 31]. According to its proponents, it is preferred to reduce the risks and possible complications of a transperitoneal access, such as incisional hernias and paralytic ileus from bowel manipulation [4, 7]. It has been reported to require less analgesics due to lower postoperative pain [27] and to be associated with earlier recovery of bowel function, possibly leading to shorter hospital stay [27]. However, minimal postoperative pain, early liquid diet and a short hospital stay have been reported also after a laparoscopic approach [5, 6, 26, 27]. RA is preferred in patients with abdominal adhesions from previous surgery and in obese patients [32]. Moreover, several authors reported a shorter operative time [28]. According to Walz et al. [33], a 7 cm hormonally active tumor or a 4–7 cm nonfunctioning tumor may be indications for a retroperitoneal approach. By the opinion of these authors, severe obesity, simultaneous abdominal pathology, patients with evident signs of malignancy or a tumor exceeding 8 cm are contraindications for the retroperitoneal approach [33]. In our opinion, the patient's position during RA is unfavorable for rapid conversion to open surgery in case of major bleeding and may itself impair or worsen the hemodynamic conditions of the patient [8].

Moreover, both lateral LA and RA do not allow to perform associated surgical procedures [11, 19, 34]. In lateral LA, exploration of the contralateral gland is not possible without repositioning the patient [11, 19, 34], which increases the operative time.

To reduce the risk of catecholamines, hormones or neoplastic cells spread from the adrenal gland, the authors introduced the laparoscopic transperitoneal submesocolic and retropancreatic approach with the patient supine. This approach was originally described by Pierre Delbet in 1912 [35]. Its main advantages are the limited extent of the dissection and early identification, ligation and division of the left adrenal vein which is obtained prior to any gland manipulation. This aspect is particularly important in case of secreting lesions. In fact, the authors consider early clipping of the main adrenal vein to be of utmost importance, together with avoiding any manipulation of the gland prior to adrenal vein ligation [11, 19, 24, 26, 36].

With respect to the transperitoneal anterior and lateral approaches, it does not require mobilization of the left colonic flexure or of the spleno-pancreatic complex to gain access to the adrenal gland, with reduction of the operative time and of potential operative risks. However, it does require experience in advanced laparoscopic surgery because the operation is conducted in a restricted working space adjacent to major venous vessels, such as the left renal and splenic veins, and the aorta [11, 19, 37].

In case of LA or RA for pheochromocytoma, because of the complexity of the disease, the operation should be performed only in centers with a well established, multidisciplinary experience in the diagnosis and treatment of adrenal gland pathology. In fact, surgery for pheochromocytoma is at risk of hypotensive or hypertensive crisis, or both, due to an excess in catecholamine release, which cannot be completely prevented even by adequate preoperative preparation with α -blockers [10]. The aim of medical treatment prior to surgery is not the

reduction of hormonal secretion but the prevention of the peripheral effects of catecholamines secreted by the tumor, so that the patient may undergo surgery under the best cardiovascular conditions [38]. Advances in intraoperative monitoring and the introduction of preoperative α 1-receptors' blockade have radically reduced the mortality rate [39]. A significant increase in the rates of plasma norepinephrine release related to mobilization of the adrenal gland has been reported during LA with a lateral approach [39]. One study also reported that severe hypertension was triggered by direct manipulation of the adrenal gland [10]. Instead, no significant intraoperative change in blood pressure was observed following this surgical strategy in case of pheochromocytoma [19]. Based on the authors' data, the anterior laparoscopic submesocolic and retropancreatic approach for treatment of secreting adrenal lesions is safe [11, 19, 24].

Authors	N	Approach	Mean age (years)	Mean oper. time (min.)	Conversion (%)	Morbidity (%)	H.S. (days)
Hazzan [2]	24	Lateral	45.4	188	7	16	4
Vargas [3]	20	Lateral	47	193	10	10	3.1
Gagner [5]	100	Lateral	46	130	3	12	2.5
Bonjer [6]	79	RP	50	114	6.3	10.1	2
Salomon [7]	21	RP	46	116	0	19	3.4
Lang [9]	56	RP	36.2	52	1.8	1.7	5.2
Janetschek [10]	19	Lateral	49.7	150	0	16	7
Mohammadi-Fallah [27]	11	Lateral	43	129	0	9.1	3.6
	12	RP	42	128	8.3	8.3	3.1
Dickson [30]	23	Lateral	42	145	4.3	8.7	3.1
	23	RP	47	100	13	13	1.9
Fernández-Cruz [31]	16	Lateral	36	89	12.5	12.5	3
	14	RP	47	105	14.2	0	2.75
Walz [33]	560	RP	49.2	67	1.7	11.8	–
Cabalag [44]	13	Lateral	47	105	0	30.7	2
	10	RP	61	90	0	10	1
Paganini [11]	19	LASA	54	92	0	0	4.4
Paganini [19]	37	LASA	54	82.7	0	0	3.85
Matsuda [29]	75	Anterior	–	221	0	3.9	10.2
Linos [45]	18	Anterior	48.7	116	5.5	0	2.3

N, number of patients; H.S, hospital stay; RP, retroperitoneal; LASA, left anterior submesocolic approach.

Table 1. Patient series reported in the literature.

Some authors [40, 41] consider tumors larger than 6 cm to be a contraindication for a minimally invasive approach, due to the risk of malignancy. In the authors' experience, the size of the largest lesion up to 10 cm in diameter did not affect the feasibility and the outcome of the procedure or the operative time [11, 19, 24]. This observation has been confirmed by Parnaby et al. [42], whose results are in agreement with the authors' experience [11, 19, 24].

Moreover, the supine position of the patient allows one to perform associated diagnostic [43] or operative procedures, such as contralateral adrenalectomy, without the need to reposition the patient on the operative table. In the authors' experience, the submesocolic approach was associated with a significant reduction in the operative time, as compared to the laparoscopic traditional anterior approach, which compares favorably also with the operative time of the lateral and retroperitoneal approaches reported in the literature (**Table 1**) [2, 3, 5–7, 9–11, 19, 27, 29–31, 33, 44, 45].

Independently from the approach that is followed, the recent introduction of a dedicated laparoscopic instrumentation to detect near-infrared fluorescence with indocyanine green (NIR-ICG) improves visualization of the inferior adrenal vein and of the adrenal gland with respect to the surrounding fat, making their identification easier [46, 47]. In the authors' opinion, this instrumentation might improve the safety of the procedure, as well as the oncological outcome in case of adrenal cancer or metastases.

LA with transperitoneal submesocolic and retropancreatic approach has proven to be safe and effective [11, 19, 24], and its results are in line with those reported in the most recent literature [48] after RA and lateral LA. Early ligation of the adrenal vein is the most important technical feature of this technique in every type of lesion. For more objective results, a multicenter randomized clinical trial comparing the submesocolic approach with lateral LA and RA for left adrenalectomy would be required.

Author details

Andrea Balla^{1*}, Silvia Quaresima¹, Ardit Seitaj¹, Andrea M. Isidori², Franco Iafrate³ and Alessandro M. Paganini^{1*}

*Address all correspondence to: andrea.balla@gmail.com and alessandro.paganini@uniroma1.it

1 Department of General Surgery and Surgical Specialties "Paride Stefanini", Sapienza University of Rome, Rome, Italy

2 Department of Experimental Medicine, Sapienza University of Rome, Rome, Italy

3 Department of Radiological Oncological and Pathological Sciences, Sapienza University of Rome, Rome, Italy

References

- [1] Wang HS, Li CC, Chou YH, Wang CJ, Wu WJ, Huang CH. Comparison of laparoscopic adrenalectomy with open surgery for adrenal tumors. *Kaohsiung J Med Sci*. 2009 Aug;25(8):438–44. doi:10.1016/S1607-551X(09)70539-X
- [2] Hazzan D, Shiloni E, Golijanin D, Jurim O, Gross D, Reissman P. Laparoscopic vs open adrenalectomy for benign adrenal neoplasm. *Surg Endosc*. 2001 Nov;15(11):1356–8.
- [3] Vargas HI, Kavoussi LR, Bartlett DL, Wagner JR, Venzon DJ, Fraker DL, Alexander HR, Linehan WM, Walther MM. Laparoscopic adrenalectomy: a new standard of care. *Urology*. 1997 May;49(5):673–8.
- [4] Gagner M, Lacroix A, Bolté E. Laparoscopic adrenalectomy in Cushing's syndrome and pheochromocytoma. *N Engl J Med*. 1992 Oct 1;327(14):1033.
- [5] Gagner M, Pomp A, Heniford BT, Pharand D, Lacroix A. Laparoscopic adrenalectomy: lessons learned from 100 consecutive procedures. *Ann Surg*. 1997 Sep;226(3):238–47.
- [6] Bonjer HJ, Sorm V, Berends FJ, Kazemier G, Steyerberg EW, de Herder WW, Bruining HA. Endoscopic retroperitoneal adrenalectomy: lessons learned from 111 consecutive cases. *Ann Surg*. 2000 Dec;232(6):796–803.
- [7] Salomon L, Rabii R, Soulie M, Mouly P, Hoznek A, Cicco A, Saint F, Alame W, Antiphon P, Chopin D, Plante P, Abbou CC. Experience with retroperitoneal laparoscopic adrenalectomy for pheochromocytoma. *J Urol*. 2001 Jun;165(6 Pt 1):1871–4.
- [8] Guerrieri M, Baldarelli M, Scarpelli M, Santini S, Lezoche G, Lezoche E. Laparoscopic adrenalectomy in pheochromocytomas. *J Endocrinol Invest*. 2005 Jun;28(6):523–7.
- [9] Lang B, Fu B, OuYang JZ, Wang BJ, Zhang GX, Xu K, Zhang J, Wang C, Shi TP, Zhou HX, Ma X, Zhang X. Retrospective comparison of retroperitoneoscopic versus open adrenalectomy for pheochromocytoma. *J Urol*. 2008 Jan;179(1):57–60.
- [10] Janetschek G, Finkenstedt G, Gasser R, Waibel UG, Peschel R, Bartsch G, Neumann HP. Laparoscopic surgery for pheochromocytoma: adrenalectomy, partial resection, excision of paragangliomas. *J Urol*. 1998 Aug;160(2):330–4.
- [11] Paganini AM, Guerrieri M, Balla A, Quaresima S, Isidori AM, Iafrate F, D'Ambrosio G, Lezoche G, Lezoche E. Management of adrenal incidentaloma by laparoscopic transperitoneal anterior and submesocolic approach. *Langenbecks Arch Surg*. 2016 Feb;401(1):71–9. doi:10.1007/s00423-015-1367-y
- [12] Thompson GB, Young WF Jr. Adrenal incidentaloma. *Curr Opin Oncol*. 2003 Jan;15(1):84–90.
- [13] Sahdev A, Reznick RH. Imaging evaluation of the non-functioning indeterminate adrenal mass. *Trends Endocrinol Metab*. 2004 Aug;15(6):271–6.
- [14] Szolar DH, Korobkin M, Reittner P, Berghold A, Bauernhofer T, Trummer H, Schoellnast H, Preidler KW, Samonigg H. Adrenocortical carcinomas and adrenal pheochromocytomas:

mass and enhancement loss evaluation at delayed contrast-enhanced CT. *Radiology*. 2005 Feb;234(2):479–85.

- [15] Young WF Jr. Clinical practice. The incidentally discovered adrenal mass. *N Engl J Med*. 2007 Feb 8;356(6):601–10.
- [16] Lockhart ME, Smith JK, Kenney PJ. Imaging of adrenal masses. *Eur J Radiol*. 2002 Feb;41(2):95–112.
- [17] Slattery JM, Blake MA, Kalra MK, Misdraji J, Sweeney AT, Copeland PM, Mueller PR, Boland GW. Adrenocortical carcinoma: contrast washout characteristics on CT. *AJR Am J Roentgenol*. 2006 Jul;187(1):W21–4.
- [18] Ilias I, Sahdev A, Reznick RH, Grossman AB, Pacak K. The optimal imaging of adrenal tumours: a comparison of different methods. *Endocr Relat Cancer*. 2007 Sep;14(3):587–99.
- [19] Paganini AM, Balla A, Guerrieri M, Lezoche G, Campagnacci R, D'Ambrosio G, Quaresima S, Antonica MV, Lezoche E. Laparoscopic transperitoneal anterior adrenalectomy in pheochromocytoma: experience in 62 patients. *Surg Endosc*. 2014 Sep;28(9):2683–9. doi:10.1007/s00464-014-3528-4
- [20] Zacharias M, Haese A, Jurczok A, Stolzenburg JU, Fornara P. Transperitoneal laparoscopic adrenalectomy: outline of the preoperative management, surgical approach, and outcome. *Eur Urol*. 2006 Mar;49(3):448–59.
- [21] Hisano M, Vicentini FC, Srougi M. Retroperitoneoscopic adrenalectomy in pheochromocytoma. *Clinics (Sao Paulo)*. 2012;67(Suppl 1):161–7.
- [22] Chen H, Sippel RS, O'Dorisio MS, Vinik AI, Lloyd RV, Pacak K. North American Neuroendocrine Tumor Society (NANETS). The North American Neuroendocrine Tumor Society consensus guideline for the diagnosis and management of neuroendocrine tumors: pheochromocytoma, paraganglioma, and medullary thyroid cancer. *Pancreas*. 2010 Aug;39(6):775–83. doi:10.1097/MPA.0b013e3181ebb4f0
- [23] Feliciotti F, Paganini AM, Guerrieri M, Baldarelli M, De Sanctis A, Campagnacci R, Lezoche E. Laparoscopic anterior adrenalectomy for the treatment of adrenal metastases. *Surg Laparosc Endosc Percutan Tech*. 2003 Oct;13(5):328–33.
- [24] Lezoche E, Guerrieri M, Feliciotti F, Paganini AM, Perretta S, Baldarelli M, Bonjer J, Miccoli P. Anterior, lateral, and posterior retroperitoneal approaches in endoscopic adrenalectomy. *Surg Endosc*. 2002 Jan;16(1):96–9.
- [25] Brunt LM, Doherty GM, Norton JA, Soper NJ, Quasebarth MA, Moley JF. Laparoscopic adrenalectomy compared to open adrenalectomy for benign adrenal neoplasms. *J Am Coll Surg*. 1996 Jul;183(1):1–10.
- [26] Scoglio D, Balla A, Pacilè M, Guerrieri M, Lezoche G, D'Ambrosio G, Fabiani B, Ursi P, Paganini AM. Laparoscopic transperitoneal anterior adrenalectomy. *Ann Ital Chir*. 2013 Jul-Aug;84(4):411–6.
- [27] Mohammadi-Fallah MR, Mehdizadeh A, Badalzadeh A, Izadseresht B, Dadkhah N, Barbod A, Babaie M, Hamedanchi S. Comparison of transperitoneal versus retroperitoneal

- laparoscopic adrenalectomy in a prospective randomized study. *J Laparoendosc Adv Surg Tech A*. 2013 Apr;23(4):362–6. doi:10.1089/lap.2012.0301
- [28] Chen W, Li F, Chen D, Zhu Y, He C, Du Y, Tan W. Retroperitoneal versus transperitoneal laparoscopic adrenalectomy in adrenal tumor: a meta-analysis. *Surg Laparosc Endosc Percutan Tech*. 2013 Apr;23(2):121–7. doi:10.1097/SLE.0b013e3182827b57
- [29] Matsuda T, Murota T, Kawakita M. Transperitoneal anterior laparoscopic adrenalectomy: the easiest technique. *Biomed Pharmacother*. 2000 Jun;54(Suppl 1):157s–60s.
- [30] Dickson PV, Alex GC, Grubbs EG, Ayala-Ramirez M, Jimenez C, Evans DB, Lee JE, Perrier ND. Posterior retroperitoneoscopic adrenalectomy is a safe and effective alternative to transabdominal laparoscopic adrenalectomy for pheochromocytoma. *Surgery*. 2011 Sep;150(3):452–8. doi:10.1016/j.surg.2011.07.004
- [31] Fernández-Cruz L, Saenz A, Taura P, Benarroch G, Astudillo E, Sabater L. Retroperitoneal approach in laparoscopic adrenalectomy: is it advantageous? *Surg Endosc*. 1999 Jan;13(1):86–90.
- [32] Nigri G, Rosman AS, Petrucciani N, Fancellu A, Pisano M, Zorcolo L, Ramacciato G, Melis M. Meta-analysis of trials comparing laparoscopic transperitoneal and retroperitoneal adrenalectomy. *Surgery*. 2013 Jan;153(1):111–9. doi:10.1016/j.surg.2012.05.042
- [33] Walz MK, Alesina PF, Wenger FA, Deligiannis A, Szuczik E, Petersenn S, Ommer A, Groeben H, Peitgen K, Janssen OE, Philipp T, Neumann HP, Schmid KW, Mann K. Posterior retroperitoneoscopic adrenalectomy--results of 560 procedures in 520 patients. *Surgery*. 2006 Dec;140(6):943–50.
- [34] Prager G, Heinz-Peer G, Passler C, Kaczirek K, Schindl M, Scheuba C, Niederle B. Surgical strategy in adrenal masses. *Eur J Radiol*. 2002 Jan;41(1):70–7.
- [35] Benedetti-Valentini S, Rossodivita I. Delbet's submesocolic approach for surgery of the left adrenal gland. *Osp Ital Chir*. 1968 Mar;18(3):285–8.
- [36] Janetschek G, Neumann HP. Laparoscopic surgery for pheochromocytoma. *Urol Clin North Am*. 2001 Feb;28(1):97–105.
- [37] Lezoche E, Guerrieri M, Crosta F, Lezoche G, Baldarelli M, Campagnacci R. Flank approach versus anterior sub-mesocolic access in left laparoscopic adrenalectomy: a prospective randomized study. *Surg Endosc*. 2008 Nov;22(11):2373–8. doi:10.1007/s00464-008-9783-5
- [38] Col V, de Cannière L, Collard E, Michel L, Donckier J. Laparoscopic adrenalectomy for phaeochromocytoma: endocrinological and surgical aspects of a new therapeutic approach. *Clin Endocrinol (Oxf)*. 1999 Jan;50(1):121–5.
- [39] Flávio Rocha M, Faramarzi-Roques R, Tauzin-Fin P, Vallee V, Leitao de Vasconcelos PR, Ballanger P. Laparoscopic surgery for pheochromocytoma. *Eur Urol*. 2004 Feb;45(2):226–32.

- [40] Cobb WS, Kercher KW, Sing RF, Heniford BT. Laparoscopic adrenalectomy for malignancy. *Am J Surg*. 2005 Apr;189(4):405–11.
- [41] Godellas CV, Prinz RA. Surgical approach to adrenal neoplasms: laparoscopic versus open adrenalectomy. *Surg Oncol Clin N Am*. 1998 Oct;7(4):807–17.
- [42] Parnaby CN, Chong PS, Chisholm L, Farrow J, Connell JM, O'Dwyer PJ. The role of laparoscopic adrenalectomy for adrenal tumours of 6 cm or greater. *Surg Endosc*. 2008 Mar;22(3):617–21.
- [43] Lucas SW, Spitz JD, Arregui ME. The use of intraoperative ultrasound in laparoscopic adrenal surgery: the Saint Vincent experience. *Surg Endosc*. 1999 Nov;13(11):1093–8.
- [44] Cabalag MS, Mann GB, Gorelik A, Miller JA. Comparison of outcomes after laparoscopic versus posterior retroperitoneoscopic adrenalectomy: a pilot study. *Surg Laparosc Endosc Percutan Tech*. 2014 Feb;24(1):62–6. doi:10.1097/SLE.0b013e31828fa71f
- [45] Linos DA, Stylopoulos N, Boukis M, Souvatzoglou A, Raptis S, Papadimitriou J. Anterior, posterior, or laparoscopic approach for the management of adrenal diseases? *Am J Surg*. 1997 Feb;173(2):120–5.
- [46] Sound S, Okoh AK, Bucak E, Yigitbas H, Dural C, Berber E. Intraoperative tumor localization and tissue distinction during robotic adrenalectomy using indocyanine green fluorescence imaging: a feasibility study. *Surg Endosc*. 2016 Feb;30(2):657–62. doi:10.1007/s00464-015-4256-0
- [47] DeLong JC, Chakedis JM, Hosseini A, Kelly KJ, Horgan S, Bouvet M. Indocyanine green (ICG) fluorescence-guided laparoscopic adrenalectomy. *J Surg Oncol*. 2015 Nov;112(6):650–3. doi:10.1002/jso.24057
- [48] Constantinides VA, Christakis I, Touska P, Palazzo FF. Systematic review and meta-analysis of retroperitoneoscopic versus laparoscopic adrenalectomy. *Br J Surg*. 2012 Dec;99(12):1639–48. doi:10.1002/bjs.8921

IntechOpen

