



Current state-of-the-art of adrenal surgery in Italy: the cancer risk in surgical adrenal lesions (CRISAL) survey

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Abstract

Adrenalectomies are growing worldwide because of the frequent diagnosis of incidentaloma and the use of minimally invasive surgery (MIS). The factors used to identify a malignant lesion and the best surgical technique are uncertain. In this context, the definition of high-volume center and expert surgeon is under debate. The Italian Society of Endoscopic Surgery and New Technologies (SICE) developed a nationwide survey to investigate the state-of-the-art of adrenal surgery in Italy. A web-based survey comprising 37 questions was developed and distributed to Italian surgeons involved in adrenal surgery. Two hundred forty-eight answers were analyzed. Consensus was reached among the survey participants regarding local infiltration (83%) and rapid growth of the lesion (81%) as markers of malignancy. Nearly 30% of the participants used MIS in case of malignant adrenal lesions. The lateral (50%) and anterior transperitoneal (44%) approaches were the most common among Italian surgeons. Approximately 40% of participants believe that 20–40 adrenalectomies/year are needed to define an expert surgeon and at least 20 procedures/year to define a high-volume center. Approximately half of participants performed < 10 adrenalectomies/year in centers with a median volume < 10 procedures/year. Based on participant feedback, this survey highlights local infiltration and rapid growth as the most significant markers of malignant adrenal lesions. While open adrenalectomy remains the gold standard for suspected malignant lesions, nearly 30% of the participants practice MIS even in these cases. The lateral and anterior transperitoneal approaches emerge as the most familiar for Italian surgeons. A substantial proportion of Italian patients with adrenal lesions undergo surgery performed by surgeons with an annual case volume < 10 procedures, at centers with a low annual volume of adrenalectomies. Moreover, there is a lack of standardized definitions for ‘expert surgeon’ and ‘high-volume center’ in this context.

Keywords Adrenal lesions · Cancer risk · Expert adrenal surgeon · High-volume center · Surgery · Survey

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Introduction

The global rate of adrenal surgery has increased steadily over the past 2 decades [1–4]. This trend can be attributed to the early diagnosis of incidentalomas and the more frequent use of minimally invasive surgery (MIS) [5–7].

The risk of adrenocortical carcinoma (ACC) rises with the increasing lesion size [8–11]. While hormonal activity is observed in up to 60% of malignant adrenal lesions [12–14] and hypercortisolism is a strong indicator of malignancy [15, 16], data on the specific cancer risk associated with secreting lesions remain unclear.

As reported in the literature, cancer risk is critical in choosing surgical approach [15, 16]. Although current guidelines suggest open adrenalectomy for lesions with preoperative features suspicious of malignancy (size \geq 6 cm,

radiological features suggestive of malignancy, history of neoplastic disease, rapid growth) [4, 8–10], several authors have reported the safety and feasibility of MIS in these cases too [1, 4, 5].

Since no clear superiority of one MIS procedure over another (lateral, posterior, anterior approach) in terms of perioperative outcomes has been demonstrated, the guidelines agree on using surgeon's most familiar approach [8–10].

Finally, guidelines emphasize the importance of a multi-disciplinary management and surgical expertise in the case of patients undergoing adrenalectomy [17]; however, in Italy, the fundamental requirements to define a high-volume center in adrenal surgery and an "experienced" adrenal pathology surgeon are still debated [3, 4].

This nationwide survey aims to report the current state-of-the-art of adrenal surgery in Italy. Specifically, the CRISAL survey explores the criteria currently used to define an oncological-risky lesion in adrenal gland, a high-volume center and experienced adrenal surgeons. Moreover, the survey reports the different surgical approaches and the application of Enhanced Recovery After Surgery (ERAS) pathway in adrenalectomy.

Methods

This study was conducted according to the ethical guidelines for good research and practice published by the World Health Organization [18] and to the E-Surveys Checklist for Reporting Results of Internet (CHERRIES) [19].

The steering committee of the CRISAL study (D.C., M.I., and R.P) has lunched, under the aegis of The Italian Society of Endoscopic Surgery and New Technologies (SICE), a web-based survey to investigate the current state-of-the-art regarding adrenal surgery and the risk of cancer in surgical adrenal lesions in Italy.

The questionnaire was developed by the steering committee. Once a general agreement among the steering committee members concerning all questions was reached, the electronic questionnaire was tested for its functionality and published online using Google Form (Google LLC, Mountain View, California US). The link to complete the questionnaire was sent to all SICE members and other potential participants by web invitation.

The questionnaire consisted of 37 questions divided as follows: personal data (11 questions), personal opinions (10 questions), and data from clinical practice (16 questions). All answers were mandatory and the estimated mean time to complete the survey was 10 min.

The questionnaire was available online from March 15, 2023, to December 4, 2023. In addition, the link was sent through the mailing list of SICE and personal invitations

from the steering committee. Moreover, the link was available on the SICE website (<https://siceitalia.com/area-medico/studi-sperimentali/study-augmented-reality>), in the area dedicated to the scientific research that is proposed and endorsed by the Society.

Statistical analysis

Continuous covariates were reported as median and interquartile range (IQR), while categorical ones as absolute and relative frequencies. The Fisher's exact test and the Mann–Whitney one were applied for the inferential analyses, for categorical and continuous variables, respectively. All *p* values were obtained by the two-sided exact method, at the conventional 5% significance level. Consensus was considered to have been reached when the percentage of agreement was $\geq 75\%$, as reported in the literature [20]. Data were analyzed as of June 2024 by R 4.4.0 (R Foundation for Statistical Computing, Vienna-A, <http://www.R-project.org>).

Results

Two-hundred and forty-eight Italian surgeons sent their complete responses to the questionnaire, and their answers were analyzed. Tables 1–3 report the results of the participants' data. Most of the participants were men (125, 68%) with a median age of 36 years (IQR: 32–45), and most of them were attending surgeons (201, 81%), while the others were residents in surgery (47, 19%).

Most of the participants worked at a Hospital Agency integrated with the National Health System Hospital (122, 49%) or a university-affiliated agency (111, 45%) (Table 1). Only 6% of the participants practice in private hospitals. As reported in Fig. 1, many participants were from Northern and Central Italy, and 115 participants (46%) were SICE members.

Table 1 Results from personal data

Gender ratio, women (%):men (%)	76 (30.6):172 (69.4)
Median age, years (IQR)	36 (32–45)
Residents, <i>n</i> (%)	47 (19.0)
Clinical practice hospital, <i>n</i> (%)	111 (44.8)
Academic	122 (49.2)
Public	15 (6.0)
Private	
Italian Society of Endoscopic Surgery (SICE) member, <i>n</i> (%)	115 (46.4)
Median time of practice after the end of the residency, years (IQR)	4 (1–12)

IQR interquartile range

Participants	n	%	Hospitals	n	%
Abruzzo	1	0.4	Abruzzo	1	0.4
Basilicata	1	0.4	Basilicata	1	0.4
Calabria	4	1.6	Calabria	2	0.8
Campania	16	6.5	Campania	5	2
Emilia-Romagna	18	7.3	Emilia-Romagna	8	3.2
Friuli-Venezia Giulia	6	2.4	Friuli-Venezia Giulia	3	1.2
Lazio	70	28.2	Lazio	12	4.8
Liguria	5	2	Liguria	3	1.2
Lombardia	50	20.2	Lombardia	21	8.5
Marche	12	4.8	Marche	5	2
Molise	0	0	Molise	0	0
Piemonte	6	2.4	Piemonte	3	1.2
Puglia	8	3.2	Puglia	5	2
Sardegna	8	3.2	Sardegna	2	0.8
Sicilia	10	4	Sicilia	6	2.4
Toscana	16	6.5	Toscana	7	2.8
Trentino-Alto Adige	1	0.4	Trentino-Alto Adige	1	0.4
Umbria	3	1.2	Umbria	3	1.2
Valle d'Aosta	0	0	Valle d'Aosta	0	0
Veneto	13	5.2	Veneto	8	3.2
Tot	248	100	Tot	96	100

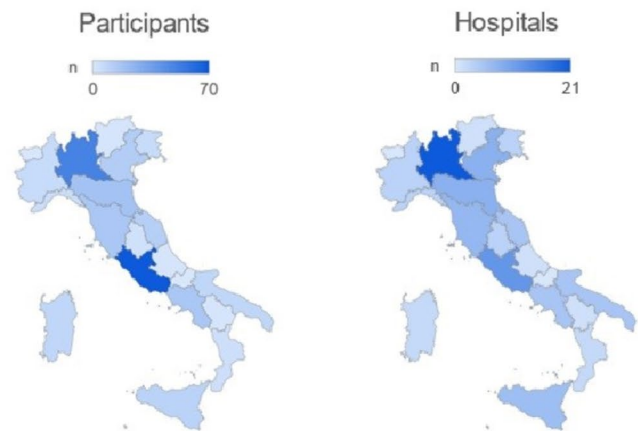


Fig. 1 Participants’ Italian regions of practice

Table 2 reports results on the participants’ personal opinions section. Consensus was reached among the survey participants regarding local infiltration (83%) and rapid growth of the lesion (81%) as markers of malignancy.

Lesion size > 6 cm emerged as important markers of malignancy too, but without reaching consensus (67%). Most participants believe that radiological signs of local infiltration (73%), limited surgeon experience (70%), and large lesion (60%) are the main predictive factors of difficult adrenalectomy. The lateral (125, 50%) and anterior transperitoneal (108, 44%) approaches were found to be the most familiar for Italian surgeons. Over half of the participants defined adrenal lesions measuring ≥ 6 cm as “large lesions”. Limited experience in MIS represents the main contraindication for both laparoscopic and robotic adrenalectomy. Radiological signs of local infiltration, not high-volume center and lesion size are other contraindications for MIS. While nearly all participants recognized the importance of a national adrenal disease registry, only 20% were aware of existing one. There was no clear consensus on defining either an expert surgeon or a high-volume center. However, 36% of participants believed that 20–40 adrenalectomies were required to be considered an expert surgeon, 42% believe that at least 20 adrenalectomies/year are necessary for a high-volume center, while 38% believe that at least 50 are necessary.

Table 3 reports results on the participants’ clinical practice section. The majority of the participants (221, 89%) perform < 10 adrenalectomies/year and practice at hospitals that perform < 20 adrenalectomies/year (200, 81%). Almost half of the participating centers (122, 49%) have a multidisciplinary meeting on adrenal pathology, while approximately 30% have a dedicated adrenal surgery pathologist.

The most familiar approach (157, 63%) and the lesion size (52, 21%) are the mainly involved factors in the

decision-making process for the surgical approach. Hormonal activity (2, 1%), lesion side (16, 6.5%), and the need for associated procedures (14, 6%) appear to have a lesser influence on the choice of surgical approach. The open approach is the most frequently used in case of malignant lesion (178, 72%), although almost 30% of participants use MIS (laparoscopic or robotic) even in cases of suspicion or certainty of a malignant lesion.

During left-sided adrenalectomy, nearly half of the participants (119, 48%) do not fix the spleen, while spleen mobilization is not required in 31% of cases.

In case of MIS, bleeding emerged to be the most common cause of conversion to open surgery (181, 73%), followed by vascular infiltration (140, 57%), technical difficulties (84, 34%), and lesion size (51, 21%).

There was a consensus among the participants (207, 84%) regarding bleeding as the primary cause for re-intervention, followed by iatrogenic injuries (125, 50%) and the need of radicalization (50, 20%).

Regarding ERAS items for adrenalectomy, there is consensus on the early mobilization (235, 95%), the use of MIS (222, 90%), and individualized nutrition schedule (201, 81%). Almost 73% of the participants do not use antibiotic therapy; urinary catheter is not used or is removed on post-operative day one by 57% of the participants and surgical drain is placed by most of the participants (176, 71%).

Discussion

The current study investigated the current state-of-the-art regarding adrenal surgery in Italy. We explored the risk of cancer in surgical adrenal lesions, the different surgical approaches for adrenalectomy and the perspectives of young

Table 2 Results from personal opinions

Markers of malignant adrenal lesion, <i>n</i> (%)	
Local infiltration	206 (83.1)
Rapid growth	201 (81.0)
Size > 6 cm	165 (66.5)
FDG-PET scan uptake	83 (33.5)
High radiodensity	45 (18.1)
Hormonal activity	36 (14.5)
History of cancer	34 (13.7)
Age > 65 years	18 (7.3)
Markers of difficult adrenalectomy, <i>n</i> (%)	
Radiological signs of local infiltration	180 (72.6)
Limited experience in MIS	173 (69.8)
Large lesion	148 (59.7)
Obesity	93 (37.5)
Not high-volume center	66 (26.6)
Bilateral lesions	20 (8.1)
Hormonal activity	18 (7.3)
Open surgery	13 (5.2)
Laparoscopic surgery	10 (4.0)
None	2 (0.8)
Small lesion	2 (0.8)
Robotic surgery	-
Most familiar approach, <i>n</i> (%)	
Lateral transperitoneal	125 (50.4)
Anterior transperitoneal	108 (43.5)
Lateral retroperitoneal	13 (5.2)
Prone retroperitoneal	2 (0.8)
Definition of large lesion, <i>n</i> (%)	
≥ 4 cm	39 (15.7)
≥ 5 cm	42 (16.9)
≥ 6 cm	137 (55.2)
≥ 8 cm	16 (6.5)
≥ 10 cm	14 (5.6)
Absolute contraindications to laparoscopic adrenalectomy, <i>n</i> (%)	
Limited experience in MIS	172 (69.4)
Radiological signs of local infiltration	105 (42.3)
Not high-volume center	73 (29.4)
Lesion size	70 (28.2)
None	33 (13.3)
High suspicion of malignancy, regardless of size	27 (10.9)
ASA score 3–4	17 (6.9)
Bilateral lesions	12 (4.8)
Obesity	10 (4.0)
Hormonal activity	5 (2.0)
Absolute contraindications to robotic adrenalectomy, <i>n</i> (%)	
Limited experience in MIS	160 (64.5)
Not high-volume center	87 (35.1)
Radiological signs of local infiltration	82 (33.1)
Lesion size	54 (21.8)
None	44 (17.7)
High suspicion of malignancy, regardless of size	20 (8.1)

Table 2 (continued)

Bilateral lesions	13 (5.2)
ASA 3–4	12 (4.8)
Obesity	8 (3.2)
Previous abdominal surgery	3 (1.2)
Hormonal activity	2 (0.8)
Surgeons who know the existence of an adrenal disease registry, <i>n</i> (%)	50 (20.2)
Surgeons who believe the development of a national adrenal disease registry is important, <i>n</i> (%)	236 (95.2)
Minimum number of adrenalectomies/year to define an expert surgeon, <i>n</i> (%)	
At least 20	61 (24.6)
21–40	90 (36.3)
41–100	70 (28.2)
> 100	7 (2.8)
Experience cannot be calculated based on the number of adrenalectomies alone	20 (8.1)
Minimum number of adrenalectomies/year to define a high-volume center, <i>n</i> (%)	
At least 20	103 (41.5)
At least 50	95 (38.3)
> 50	39 (15.7)
> 100	8 (3.2)
> 200	1 (0.4)
High-volume center cannot be calculated based on the number of adrenalectomies alone	2 (0.8)

FDG-PET fludeoxyglucose-18 positron emission tomography, *MIS* minimally invasive surgery, *ASA* American Society of Anesthesiologists

and senior general surgeons on the definition of high-volume center and expert adrenal surgeon have been investigated.

To this aim, a 37-question survey was administered electronically to all SICE members and other eligible participants.

Overall, the responses of 248 surgeons were analyzed. Most of the participants were young (median age 36 years), men (172, 69%) and attending surgeons (201, 81%).

Consensus was reached among the survey participants regarding local infiltration (83%) and rapid growth of the lesion (81%) as markers of malignancy. Conversely, other independent risk factors for cancer reported in the literature (lesion size > 6 cm, high Hounsfield density, male sex, older age, non-incident diagnosis and ¹⁸F-fluorodeoxyglucose positron emission tomography (PET) ratio > 1.5) did not appear to be as predictive of malignancy among Italian surgeons [12, 14, 23, 24].

Computed tomography (CT) is the most frequently employed imaging modality for adrenal evaluation. Magnetic resonance imaging (MRI) also plays a significant role in the assessment of adrenal pathology, particularly in delineating the extent of local invasion in cases of ACC [25].

In the absence of clear radiological signs of malignancy and no evidence of hormonal activity, there is no unanimous agreement regarding the appropriate radiological and biochemical follow-up, which should, therefore, be tailored to each individual patient [25, 26]. According to

the American Association of Clinical Endocrinologists (AAACE) and the American Association of Endocrine Surgeons (AAES), lesions < 4 cm without clear signs of malignancy undergo radiological evaluation at 3, 6, and 12 months [23]. American College of Radiology (ARC) suggests no follow-up for clearly benign lesions, 12-month follow-up for lesions up to 2 cm with dubious radiological signs, and 6-month follow-up for lesions > 2 cm. [27]. Finally, the ESE does not recommend radiological follow-up for benign lesions up to 4 cm and recommends evaluation at 6–12 months in other cases. Surgical resection is indicated in cases of > 20% lesion growth or the appearance of radiological signs of malignancy [28].

The literature indicates that the risk of adrenal cancer increases with lesion size, reaching almost 38% in lesions exceeding 6 cm, although this risk appears lower in more recent case studies [14, 22–24, 29]. However, size alone can not be a single tool for preoperative assessment of adrenal cancer. Since the risk of cancer is critical in choosing surgical approach [13, 14, 20], many several cancer risk stratification algorithms have been developed [30–33].

Based on the present Italian survey, only 15% of the participants considered hormonal activity a predictive factor for malignant adrenal lesion. Furthermore, hormonal activity does not represent a contraindication to laparoscopic and robotic adrenalectomy, nor a predictive factor for complex adrenalectomy for most of the participants.

Table 3 Results from clinical practice

Number of adrenalectomies performed in your hospital on average in 1 year, <i>n</i> (%)	
0–10	126 (50.8)
11–20	74 (29.8)
21–30	29 (11.7)
31–40	11 (4.4)
> 40	8 (3.2)
Number of adrenalectomies performed by a single surgeon in a year, <i>n</i> (%)	
0–10	221 (89.1)
11–20	18 (7.3)
21–30	8 (3.2)
31–40	1 (0.4)
Median number of adrenalectomies performed in your hospital on average in 1 year, <i>n</i> (IQR 1–10)	
Open	1 (0–10)
Laparoscopic	8 (0–10)
Robotic	0 (0–10)
Cancer	3 (0–10)
Large lesions (> 6 cm)	4 (0–10)
Hospitals with a multidisciplinary meeting on adrenal pathology, <i>n</i> (%)	122 (49.2)
Hospitals with a pathologist dedicated to adrenal surgery, <i>n</i> (%)	76 (30.6)
Factors involved in the decision-making process for the surgical approach, <i>n</i> (%)	
Most familiar approach	157 (63.3)
Lesion size	52 (21.0)
Lesion side	16 (6.5)
Associated procedures	14 (5.6)
Hormonal activity	2 (0.8)
All the above	7 (2.8)
Surgical technique in malignant lesion (suspected or certain), <i>n</i> (%)	
Open	178 (71.8)
Robotic	36 (14.5)
Laparoscopic	34 (13.7)
Spleen fixing in left-sided adrenalectomy, <i>n</i> (%)	
Never	119 (48.0)
Spleen mobilization not required (submesocolic approach)	76 (30.6)
Glue	34 (13.7)
Stitch	11 (4.4)
Supine position for 24 h	8 (3.2)
Causes of conversion in case of MIS, <i>n</i> (%)	
Bleeding	181 (73)
Vascular infiltration	140 (56.5)
Technical difficulties (obesity, difficulty in finding the lesion)	84 (33.9)
Lesion size	51 (20.6)
Anesthetic reasons (hemodynamic instability)	22 (8.9)
Causes of re-intervention, <i>n</i> (%)	
Bleeding	207 (83.5)
Iatrogenic injury	125 (50.4)
Radicalization	50 (20.2)
Splenic infarction	23 (9.3)
Infection	10 (4.0)
Surgical drain use, yes (%): no (%)	176 (71): 72 (29)
Median hospital stay, days (IQR)	3 (3–5)
Enhanced recovery items for adrenalectomy, <i>n</i> (%)	

Table 3 (continued)

Earlier mobilization	235 (94.8)
MIS	222 (89.5)
Individualized nutrition schedule	201 (81.0)
No antibiotic	180 (72.6)
No urinary catheter, or removal on postoperative day 1	142 (57.3)
Psychological and pain assessment	129 (52.0)
No/little perioperative intravenous fluid	124 (50.0)
No surgical drain or removal in case of < 30 ml	124 (50.0)
Oral functional solution until 2 h before operation	88 (35.5)
Drink upon awakening from anesthesia	56 (22.6)
Oral intake 6 h after surgery	52 (21.0)

MIS minimally invasive surgery, IQR interquartile range

The literature indicates that up to 60% of malignant adrenal lesions have hormonal activity, with hypercortisolism being a strong indicator of malignancy [12, 13].

Therefore, although many ACCs have hormonal activity and this correlates with a worse prognosis, hormonal activity is not considered a major predictive factor of malignant lesion, and this aligns our findings [12–14, 21, 22].

Although current guidelines suggest open adrenalectomy for malignant adrenal lesions [22, 34, 35, 38], several authors have reported the safety and feasibility of MIS also in these cases, not only in technical terms, but also in terms of oncological outcomes. However, most of the studies are retrospective and involved small samples sizes [29, 36, 37, 39].

Donatini et al. compared the outcome of laparoscopic to open adrenalectomy in patients affected by ACC smaller than 10 cm, reporting no differences in postoperative morbidity and long-term oncological outcome (at least 51 ± 43 months of median follow-up) between the two groups, with a significant shorter length of stay in case of MIS [34]. However, this retrospective cohort study included only 34 patients, which could potentially limit the statistical power of the analysis [38].

In this study, open adrenalectomy was considered the gold standard for suspected malignancy. However, almost 30% of the participants practice MIS even in case of malignancy and less than 10% considered the malignant tumor an absolute contraindication to MIS. These findings align with the literature, emphasizing the importance of R0 resection over the surgical approach [34, 35].

Guidelines emphasize the importance of solid experience in MIS and that limited experience in MIS represents the main absolute contraindication for both laparoscopic and robotic adrenalectomy [22, 34, 35], and these aspects are well known to the surgical Italian community, as confirmed by the results of this survey.

It is interesting to note that, according to our results, there is no unanimous agreement in Italy on the definition

of expert surgeon and a high-volume center. Almost 40% of participants believed that 20–40 adrenalectomies were required to be considered an expert surgeon, while at least 20 procedures per year are required to define a high-volume center for almost 40% of participants. Furthermore, despite these results, most participants stated that patients affected by adrenal lesion are frequently treated by surgeons performing < 10 adrenalectomies per year in low-volume hospitals for adrenal surgery. These data reflect that an unanimous consensus is lacking worldwide [4, 34, 40, 41]. The European Society of Endocrinology (ESE)/European Network for the Study of Adrenal Tumors (ENSAT) clinical practice guidelines on the management of ACC, published in the 2018, recommend a minimum annual workload of 6 adrenalectomies per year, with a preference for more than 20 surgeries annually. Sufficient experience in oncological surgery is also crucial. For optimal clinical outcomes, the entire operative team, including anesthesiologists, should be well-trained in adrenal surgery [22].

In 2016, Palazzo et al., and 1 year later, Anderson et al. reported increased complications, costs, and length of stay for adrenalectomies performed by low-volume surgeons (< 6 cases/year) [41, 42]. The authors' starting point was precisely that, although studies on the safety of adrenalectomy come from high-volume centers, often, in clinical practice, the average surgeon who performs adrenalectomy handles only one case per year on average [4]. From this observation, arises the need to identify a threshold value of minimum adrenalectomies per surgeon to improve the surgical outcomes and centralize patients in high-volume centers [42].

In this survey, a multidisciplinary discussion is currently performed to validate surgical indications for adrenal lesions in approximately half of the hospitals (49%) and nearly one over three hospitals has a pathologist dedicated to adrenal surgery. Only 20% of participants are aware of the existence of an adrenal disease registry, but almost all (95%) agree on its importance.

Regarding the surgical technique aspect, since no clear superiority of one MIS approach over another (transperitoneal/retroperitoneal, anterior/lateral) in terms of perioperative outcomes has been demonstrated, the guidelines suggest that the surgeon should use the surgical approach for adrenalectomy with whom they are most familiar and the one that yields the best patient outcomes [33, 37].

As retrieved from the present survey, during the preoperative decision-making process, Italian surgeons choose the approach most familiar to them regardless of the patient's or lesion's characteristics. This results in the anterior and lateral transperitoneal approaches being selected by most of the participants.

Based on the findings of this survey and consistent with existing literature, other factors influencing the decision-making process include lesion size (21%), lesion site (6.5%), and the requirement for concomitant procedures (5.6%). As previously noted, lesion size correlates with the risk of malignancy, and some studies suggest superior outcomes with a transperitoneal approach compared to a retroperitoneal one [24, 28, 39, 43]. Regarding lesion laterality, as established in the literature, open right adrenalectomy is generally considered technically more challenging than the left one due to anatomical considerations (the right adrenal vein is shorter and drains directly into the inferior vena cava, in close proximity to the duodenum). Similarly, in MIS for left adrenalectomy, splenic flexure mobilization may result in an increased operative time compared to the open approach [44].

Although the retroperitoneal approach has been shown to be associated with better outcomes in cases of previous abdominal surgery or bilateral adrenalectomy, it is used by only 6% of participants in this survey [37].

There is considerable variability in surgical practice, with approximately one-third of the surveyed surgeons not performing spleen mobilization during left adrenalectomy. This variation may be attributed to the use of different surgical approaches, such as the retroperitoneal and the anterior transperitoneal submesocolic ones. This latter approach has proven to be feasible and safe even in the case of pheochromocytoma, allowing for early ligation of the adrenal vein, although it obviously requires extensive experience in MIS [45].

Bleeding was found to be the primary cause of conversion in case of MIS (73%) and for re-intervention (83.5%). Interestingly, more than 70% of survey participants reported using drain following adrenalectomy, even though the literature generally discourages routine drain for this procedure [46]. It should be noted that in the questions regarding the ERAS protocol, about half of the participants stated that they do not use drain or that they remove it if the output is < 30 ml/day; therefore, we believe that in the 70% who use it, a certain percentage removes it early. Another reason

could be that, as emerges from the results of this survey, adrenalectomies are often performed by surgeons who have performed < 10 adrenalectomies per year in low-volume hospitals for adrenal surgery, this could determine a greater prudence on the surgeon's part. Finally, it is widely recognized that drains are frequently used for prophylactic purposes and to provide mental reassurance to the surgeon.

Currently, little data are available in the literature regarding the application of ERAS pathway to adrenal surgery; however, ERAS protocols appear to be able to improve the perioperative outcomes of patients undergoing LA, in terms of pain control, hospital stay, and return to daily activities [47, 48]. According to our results, most of the participants report using early mobilization, MIS, personalized nutrition and do not use antibiotic prophylaxis.

In our opinion, both the disparity between the significance of surgical experience and the clinical practice of treating patients with adrenal lesion continue in low-volume centers, highlight the need for further studies with larger sample size.

The main limitation of the present study is that, although the sample is large ($n = 248$), there is a preponderance of young surgeons, which may limit the generalizability of the results to experienced surgeons, a common issue in survey-based research. Given that this study provides a contemporary snapshot of Italian adrenal surgery practice, rather than focusing on learning curves or specific surgical techniques, we considered the inclusion of residents appropriate. Finally, this paper represents the initial phase of an ongoing observational ambispective multicentric study registered with ClinicalTrials.gov (NCT03679468), which will report the clinical and surgical outcomes of a large patient cohort, ultimately enabling evidence-based conclusions. As a further limit, it focused on a single nation, which may yield divergent results in other countries. Moreover, expanding this inquiry to include urologists would be beneficial to explore potential variations in the treatment and management of patients presenting with adrenal lesions.

Conclusion

In conclusion, based on this study, local infiltration and rapid growth emerged as the most significant markers of malignant adrenal lesions.

Open adrenalectomy remains the gold standard in cases of suspected malignancy, but almost 30% of the participants reported performing MIS even in case of malignancy and less than 10% considered the malignancy an absolute contraindication to MIS.

The lateral and anterior transperitoneal approaches were found to be the most commonly used techniques by Italian surgeons.

In Italy, patients affected by adrenal lesions are often treated by surgeons who perform < 10 adrenalectomies/year in low-volume hospitals. There is no unanimous consensus on the definition of expert surgeon and high-volume center and this is a critical open question. This study represents a starting point for an ongoing ambispective observational multicentric study.

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