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Clinical Outcomes of Adrenalectomy for Metastatic Adrenal Tumor: A 30-case Single-center Study

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Abstract

Background/Aim: The adrenal gland is a common site of metastasis from various primary malignancies, and adrenalectomy may provide long-term survival benefits in carefully selected patients. However, prognostic factors influencing overall survival (OS) after adrenalectomy for metastatic adrenal tumors remain insufficiently defined. In addition, the optimal surgical approach – particularly the appropriateness of laparoscopic *versus* open adrenalectomy – continues to be a subject of ongoing debate.

Patients and Methods: We retrospectively analyzed 30 patients who underwent adrenalectomy for metastatic adrenal tumors at a single institution between November 2006 and March 2025. Clinicopathological features, perioperative outcomes, and OS were evaluated. To examine differences in surgical invasiveness and prognosis, patients were stratified by tumor size (<5 cm *vs.* ≥5 cm).

Results: The median tumor size was 2.6 cm, and 93% of patients underwent laparoscopic adrenalectomy. Extended adrenalectomy was required in 20%, and the open conversion rate was 7%. Patients with tumors ≥5 cm exhibited longer operative time, greater blood loss, higher rates of extended adrenalectomy and open conversion, and more frequent perioperative complications. The median OS for the entire cohort was 130 months. Patients with tumors ≥5 cm had significantly worse OS (log-rank p=0.02). In multivariate analysis, tumor size ≥5 cm was identified as an independent predictor of poor OS [hazard ratio (HR)=4.985, p=0.045].

Conclusion: Adrenalectomy can achieve favorable long-term survival in selected patients with adrenal metastasis. Laparoscopic adrenalectomy is an effective minimally invasive option for tumors <5 cm, whereas tumors ≥5 cm are associated with greater surgical invasiveness and poorer prognosis, necessitating careful operative planning and consideration of open adrenalectomy.

Keywords: Metastatic adrenal tumor, adrenal metastasis, adrenalectomy.

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Introduction

The adrenal gland, which has a rich vascular supply, is a common site of metastasis from primary tumors such as those of the lung, kidney, breast, colon, and skin, particularly malignant melanoma (1). The prevalence of adrenal metastasis in autopsy studies of patients with extra-adrenal malignancies has been reported to range from 3.1% to 27% (1, 2). Although adrenal metastasis generally represents an advanced stage of disease and is often managed with systemic therapy or palliative care, previous reports have demonstrated that adrenalectomy may confer long-term survival benefits in carefully selected patients (3-6). According to the recent clinical practice guidelines jointly issued by the American Association of Clinical Endocrinology and the American Association of Endocrine Surgeons (AACE/AAES), surgical management of metastatic adrenal tumor should be individualized based on factors such as primary tumor type, timing of metastasis (synchronous or metachronous), disease-free interval, and tumor size (7). However, definite criteria for surgical indications and prognostic factors associated with postoperative survival have not yet been established.

The optimal surgical approach for metastatic adrenal tumors also remains controversial. While the remarkable advancement of minimally invasive techniques has established laparoscopic adrenalectomy as the standard treatment for benign adrenal tumors (8, 9), evidence regarding its use for metastatic adrenal tumors is mixed. Several studies have reported that laparoscopic adrenalectomy can achieve oncological outcomes and complication rates comparable to open adrenalectomy in appropriately selected patients (3, 10, 11). In contrast, open adrenalectomy remains preferred for large tumors, suspected local invasion, or aggressive primary malignancies, owing to concerns about tumor rupture and incomplete resection associated with laparoscopic procedures (12, 13).

Given these uncertainties, this study aimed to retrospectively evaluate the perioperative and survival outcomes of adrenalectomy for adrenal metastases at our institution and to identify prognostic factors that may help guide the selection of an appropriate surgical approach.

Patients and Methods

Study design and patients. This retrospective study included 30 patients who underwent adrenalectomy for metastatic adrenal tumors at Shiga University of Medical Science Hospital between November 2006 and March 2025. This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Shiga University of Medical Science Hospital (No. R2019-240). Patients who underwent concurrent adrenalectomy and ipsilateral nephrectomy for primary renal cell carcinoma were excluded. Adrenal metastasis was diagnosed by computed tomography (CT), magnetic resonance imaging (MRI), or positron emission tomography (PET) and was confirmed by histopathological examination of the resected specimens.

Clinical data was obtained from institutional medical records. The following variables were reviewed: age, sex, body mass index (BMI), adrenal tumor size, tumor laterality, primary tumor type, interval from the initial diagnosis of primary tumor to adrenal metastasis, timing of adrenal metastasis (synchronous or metachronous), presence of extra-adrenal metastasis before or at the time of adrenalectomy, surgical approach (open, transperitoneal laparoscopic, or retroperitoneal laparoscopic), operative time, blood loss, conversion to open surgery, perioperative complications, length of postoperative hospital stay, surgical margin status, recurrence (locoregional or distant), and survival outcomes.

Definitions and outcome measures. Synchronous metastasis was defined as metastasis detected within six months after the initial diagnosis of the primary tumor, whereas metachronous metastasis was defined as metastasis detected more than six months after the primary tumor diagnosis. The surgical approach was determined through discussion among the surgical team based on each patient's clinical characteristics and tumor

findings. Extended adrenalectomy was defined as adrenalectomy combined with resection of adjacent organs. Postoperative complications occurring within 30 days after adrenalectomy were classified as Clavien–Dindo grade 2 or higher, and major complications were defined as grade 3 or higher. Follow-up protocols after adrenalectomy were not standardized across departments; however, most patients underwent periodic surveillance, primarily with CT imaging at 3-6-month intervals. The primary outcome was overall survival (OS), defined as the time from adrenalectomy to death or last follow-up.

Statistical analysis. Continuous variables are expressed as median values with interquartile ranges (IQR), and categorical variables as numbers and percentages. To evaluate the influence of tumor size on perioperative and survival outcomes, patients were stratified into two groups according to tumor diameter (<5 cm *vs.* ≥5 cm). Differences between these groups were assessed using the Mann–Whitney *U*-test or Fisher's exact test, as appropriate. Survival curves were generated using the Kaplan–Meier method and compared between the two tumor-size groups using the log-rank test. Univariate and multivariate analyses were performed using the Cox proportional hazards regression model to identify prognostic factors for OS. A *p*-value <0.05 was considered statistically significant. All statistical analyses were performed using EZR version 1.68 (Saitama Medical Center, Jichi Medical University, Saitama, Japan), a graphical user interface for R version 4.5.1 (The R Foundation for Statistical Computing, Vienna, Austria).

Results

Patient characteristics. A total of 30 patients who underwent adrenalectomy for metastatic adrenal tumors were included. The baseline clinical characteristics are summarized in Table I. The median age was 67 years [interquartile range (IQR)=62-74], and 27 patients (90%) were male. The median body mass index (BMI) was 22.4 kg/m^2 (IQR=21.0-24.3).

Table I. *Patient characteristics.*

	n=30
Age (years)	67 (62-74)
Sex	
Male	27 (90)
Female	3 (10)
BMI (kg/m^2)	22.4 (21.0-24.3)
Size of adrenal tumor (cm)	2.6 (2.2-4.3)
Laterality of adrenal tumor	
Right	16 (53)
Left	14 (47)
Type of primary tumor	
Lung cancer	13 (44)
Renal cell carcinoma	10 (33)
Sarcoma	3 (10)
Esophageal cancer	2 (7)
Malignant melanoma	1 (3)
Unknown primary	1 (3)
Interval to adrenal metastasis (months)	18 (5-48)
Timing of adrenal metastasis	
Synchronous (<6 months)	8 (27)
Metachronous (≥6 months)	22 (73)
Prior extra-adrenal metastasis	10 (33)
Extra-adrenal metastasis at adrenalectomy	5 (17)
Follow-up after adrenalectomy (months)	26 (10-90)

Values are presented as median [interquartile range (IQR)] or number (%). BMI: Body mass index.

The median tumor size was 2.6 cm (IQR=2.2-4.3). Sixteen patients (53%) had right-sided tumors. The most common primary malignancies were lung cancer (n=13, 44%) and renal cell carcinoma (n=10, 33%), followed by sarcoma (n=3, 10%), esophageal cancer (n=2, 7%), malignant melanoma (n=1, 3%), and unknown primary (n=1, 3%). The median interval from the initial diagnosis of the primary malignancy to adrenal metastasis was 18 months (IQR=5-48). Eight patients (27%) had synchronous and 22 (73%) had metachronous metastases. 10 patients (33%) had a history of prior extra-adrenal metastasis, and five (17%) had concurrent extra-adrenal metastasis at the time of adrenalectomy. The median follow-up period after adrenalectomy was 26 months (IQR=10-90).

Perioperative and pathological outcomes. Perioperative and pathological outcomes are summarized in Table II. Of the 30 patients, 28 (93%) underwent laparoscopic adrenalectomy, including 24 (80%) transperitoneal and

Table II. *Comparison of perioperative and pathological outcomes according to tumor size (<5 cm vs. ≥5 cm).*

	All patients (n=30)	Tumor <5 cm (n=24)	Tumor ≥5 cm (n=6)	*p*-Value
Surgical approach				
Laparoscopic	28 (93)	24 (100)	4 (67)	
Open	2 (7)	0 (0)	2 (33)	
Operative time (min)	209 (173-314)	186 (160-242)	344 (314-490)	0.012
Blood loss (ml)	30 (0-100)	10 (0-50)	250 (150-2,048)	0.017
Extent of adrenalectomy				0.035
Only adrenalectomy	24 (80)	21 (88)	3 (50)	
Adrenalectomy with single-organ resection	4 (13)	3 (12)	1 (17)	
Adrenalectomy with multi-organ resection	2 (7)	0 (0)	2 (33)	
Open conversion*	2 (7)	0 (0)	2 (50)	0.012
Intraoperative complication	6 (20)	2 (8)	4 (67)	<0.001
30-day postoperative complication	5 (17)	2 (8)	3 (50)	0.041
Hospital stay after surgery (days)	6 (5-10)	5 (3-8)	12 (7-24)	0.031
Positive surgical margin	4 (13)	2 (8)	2 (33)	0.169

Values are presented as median (IQR) or number (%). *p*-Values indicate comparisons between the tumor <5 cm and ≥5 cm groups. *Open conversion was assessed only among patients who underwent laparoscopic adrenalectomy.

four (13%) retroperitoneal approaches, while two (7%) underwent open adrenalectomy. Conversion to open surgery was required in two patients (7%) because of intraoperative bleeding or dense adhesions. The median operative time was 209 min (IQR=173-314), and median blood loss 30 ml (IQR=0-100). Extended adrenalectomy was performed in six patients (20%) due to tumor invasion or severe adhesions, including single-organ resection in four (13%) and multi-organ resection in two (7%). Resected organs included the kidney, liver, spleen, pancreas, and lymph nodes. Intraoperative complications occurred in six patients (20%), including liver injury in three (10%), diaphragm injury in two (7%), and tumor capsule rupture in one (3%). 30-day postoperative complications occurred in five patients (17%), including adrenal insufficiency in two (7%), pneumonia in one (3%), pancreatic fistula in one (3%), and ischemic colitis in one (3%) (Table III). No major complications were observed. The median postoperative hospital stay was six days (IQR=5-10). Positive surgical margins were found in four patients (13%) (Table II).

To assess the impact of tumor size on perioperative outcomes, we compared patients with tumors <5 cm and ≥5 cm. Patients with tumors ≥5 cm had significantly longer operative time (186 *vs.* 344 min; p=0.012) and greater blood loss (10 *vs.* 250 ml; p=0.017). The rate of the extended adrenalectomy (12% *vs.* 50%; p=0.035) and open conversion (0% *vs.* 50%; p=0.012) were also higher in the ≥5 cm group. Intraoperative complications (20% *vs.* 67%; p<0.001) and 30-day postoperative complications (8% *vs.* 50%; p=0.041) were significantly more frequent in the ≥5 cm group. The median postoperative hospital stay was significantly longer in the ≥5 cm group (5 *vs.* 12 days; p=0.031). Although the rate of positive surgical margins tended to be higher in the ≥5 cm group (8% *vs.* 33%), the difference was not statistically significant (p=0.169).

Table III. *Details of perioperative complications.*

Complications	n (%)
Intraoperative	6 (20)
Liver injury	3 (10)
Diaphragm injury	2 (7)
Tumor capsule rupture	1 (3)
30-day postoperative	5 (17)
Adrenal insufficiency	2 (7)
Pneumonia	1 (3)
Pancreatic fistula	1 (3)
Ischemic colitis	1 (3)

Values are presented as the number of patients, with percentages calculated from the entire cohort (n=30).

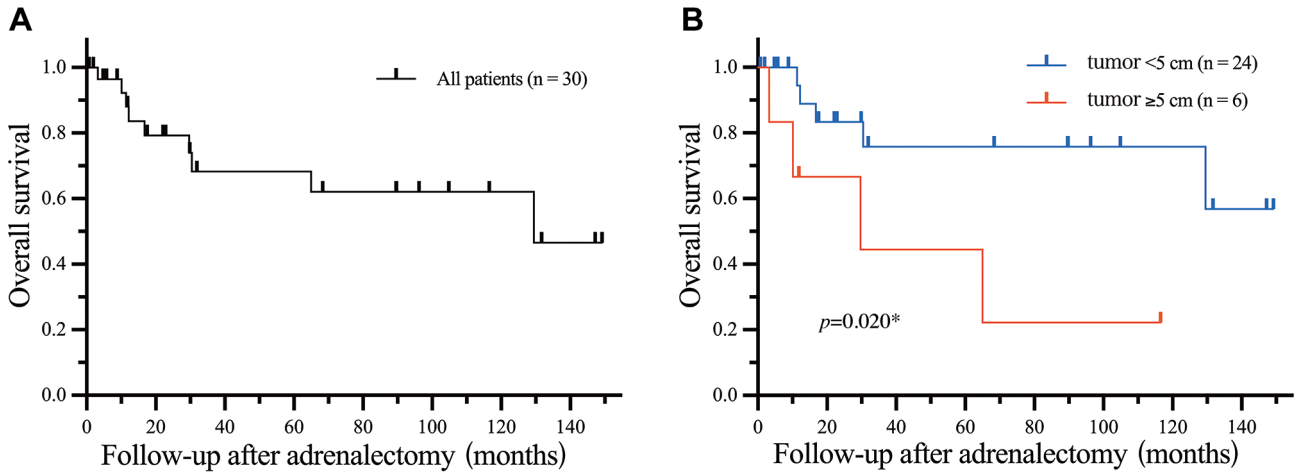

Figure 1. *Kaplan–Meier curves of overall survival. (A) Entire cohort of 30 patients undergoing adrenalectomy. (B) Comparison between patients with tumors <5 cm (n=24) and those with tumors ≥5 cm (n=6). *Statistical significance (*p<0.05) in log-rank test. Tick marks on survival curves indicate censored observations.*

Overall survival and prognostic factor. Over a median follow-up period of 26 months (IQR=10-90), locoregional recurrence was observed in four patients (13%) and distant recurrence in 14 (47%). Nine patients (30%) died of disease or other causes. The median OS for the entire cohort was 130 months [95% confidence interval (CI)=30-not reached]. The 1-, 2-, 5-, and 10-year OS rates were 88%, 79%, 68%, and 62%, respectively (Figure 1A). Patients with tumors ≥5 cm had significantly poorer OS compared with those with tumors <5 cm (5-year OS rate, 44% *vs.* 76%; median OS, 30 months *vs.* not reached; log-rank *p*=0.02) (Figure 1B). In univariate analysis, tumor size ≥5 cm was significantly associated with worse OS [hazard ratio (HR)=4.531; 95%CI=1.128-18.21; *p*=0.033). In multivariate analysis including tumor size ≥5 cm, extra-adrenal metastasis at adrenalectomy and positive surgical margin, tumor size ≥5 cm remained an independent predictor of poor OS (HR=4.985; 95%CI=1.033-24.06; *p*=0.045) (Table IV).

Discussion

Metastatic adrenal tumors exhibit substantial clinical variability, complicating treatment selection. Several reports, including a recent comprehensive review (14), suggest that surgical resection may be beneficial in selected patients with isolated adrenal metastasis. Nevertheless, clear criteria for candidate selection and operative approach remain undefined. In this study, we retrospectively analyzed 30 patients who underwent adrenalectomy for metastatic adrenal tumors and evaluated clinical outcomes. The median OS of 130 months observed in our cohort was notably longer than those of 29-63 months reported in previous studies (4, 15, 16). The median tumor size in prior reports ranged from 2.8 to 5.6 cm (3, 17, 18), whereas in our study, it was relatively small at 2.6 cm, which may have contributed to the favorable survival outcomes. Perioperative outcomes were also satisfactory, with an open conversion rate of 7% and a 30-day postoperative complication rate of 10%, both of which were better than previously reported open conversion rates of 9-11% and 30-day postoperative complication rates of 10-40% (6, 10, 18, 19). However, patients with larger tumors experienced significantly longer operative time, increased intraoperative blood loss, and prolonged hospitalization, along with higher rates of conversion to open surgery and perioperative complications. These findings indicate that tumor size is a major determinant of surgical invasiveness in adrenalectomy for metastatic disease.

Table IV. *Univariate and multivariate Cox regression analyses for overall survival.*

Variables	Overall survival					
	Univariate			Multivariate		
	HR	95%CI	*p*-Value	HR	95%CI	*p*-Value
Age (years)						
<67	Ref.	–	–			
≥67	1.030	(0.244-4.339)	0.968			
Sex						
Male	Ref.	–	–			
Female	0.849	(0.104-6.929)	0.879			
Size of adrenal tumor (cm)						
<5	Ref.	–	–	Ref.	–	–
≥5	4.531	(1.128-18.21)	0.033	4.985	(1.033-24.06)	0.045
Laterality of adrenal tumor						
Left	Ref.	–	–			
Right	1.567	(0.419-5.857)	0.504			
Primary tumor						
Renal cell carcinoma	Ref.	–	–			
Lung cancer	1.758	(0.389-7.939)	0.463			
Others*	1.037	(0.172-6.254)	0.968			
Timing of adrenal metastasis						
Synchronous (<6 months)	Ref.	–	–			
Metachronous (≥6 months)	0.624	(0.125-3.116)	0.566			
Prior extra-adrenal metastasis						
No	Ref.	–	–			
Yes	0.893	(0.178-4.473)	0.890			
Extra-adrenal metastasis at adrenalectomy						
No	Ref.	–	–	Ref.	–	–
Yes	1.759	(0.350-8.833)	0.492	2.984	(0.505-17.61)	0.227
Surgical margin status						
Negative	Ref.	–	–	Ref.	–	–
Positive	2.372	(0.472-11.90)	0.294	1.553	(0.254-9.480)	0.633

Hazard ratio (HR) was calculated using the Cox proportional hazards model. CI: Confidence interval; OS: overall survival; Ref: reference. *Others include sarcoma, esophageal cancer, malignant melanoma, and unknown primary.

Regarding prognostic factors, tumor size ≥5 cm emerged as an independent predictor of poor OS in our multivariate analysis. The clinical relevance of this cutoff is supported by prior retrospective evidence: Zerrweck *et al.* identified that 5 cm was the optimal threshold for predicting long-term survival based on receiver operating characteristic (ROC) analysis, and tumor size ≥5 cm remained independently associated with inferior outcomes in their multivariate model (20). Additional studies have similarly demonstrated that larger tumor size correlates with worse oncological outcome (4, 11, 18). Tumor size is also closely related to surgical difficulty. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) guidelines emphasize tumor size as a key determinant of operative invasiveness, noting longer operative times for adrenal tumors >5 cm (21). Consistent with these reports, our findings showed that tumors ≥5 cm were associated with prolonged operative time, greater blood loss, and higher perioperative morbidity. Other previously suggested prognostic factors – such as primary tumors other than renal cell carcinoma, synchronous metastasis, presence of extra-adrenal disease, and positive surgical margin (4, 11, 18, 20, 22) – did not reach statistical significance in our cohort. Collectively, existing evidence and our results underscore tumor size as a clinically meaningful parameter influencing both surgical complexity

and postoperative survival in patients undergoing adrenalectomy for metastatic disease.

Laparoscopic adrenalectomy has become the standard approach for benign adrenal tumors with advances in minimally invasive surgery (7, 23). Accumulating evidence also suggests that laparoscopic adrenalectomy may be a feasible option for selected patients with metastatic adrenal tumors. For metastatic lesions, laparoscopic adrenalectomy has been associated with reduced perioperative morbidity and shorter hospital stay compared with open surgery (24). Furthermore, overall survival has been reported to be comparable between laparoscopic and open adrenalectomy for metastatic adrenal tumors without adjacent organ invasion (11). Nevertheless, concerns persist regarding tumor spillage, port-site metastasis, and incomplete resection, particularly in large tumors or those with suspected local invasion (13, 25-27). Therefore, open adrenalectomy continues to be recommended in such situations. In our cohort, tumors ≥5 cm more frequently required complex surgical procedures, often because of dense adhesions to adjacent organs. Although tumor size is a major contributor to surgical complexity, recent evidence indicates that periadrenal tissue characteristics may also affect operative difficulty. Miyamoto *et al.* reported that higher Mayo Adhesive Probability (MAP) scores, reflecting adherent perinephric fat, were associated with longer operative time and increased technical difficulty in laparoscopic adrenalectomy (28). Considering these findings collectively, tumor size remains a practical and clinically meaningful indicator when selecting the surgical approach. Accordingly, laparoscopic adrenalectomy appears to be an appropriate option for tumors <5 cm, whereas open surgery may be considered for tumors ≥5 cm, depending on surgical complexity.

Study limitations. First, it is a retrospective analysis conducted at a single institution with a limited sample size. Second, the impact of systemic chemotherapy and radiotherapy for primary or metastatic lesions on survival outcomes was not fully evaluated. Third, the follow-up duration was short in some patients, which may limit the generalizability of our findings. In addition, the small number of events relative to covariates may reduce the stability of the multivariate analysis. Further multicenter collaborative studies are needed to establish optimal treatment strategies for metastatic adrenal tumors.

Conclusion

This study demonstrated that adrenalectomy for adrenal metastasis can provide favorable long-term survival in appropriately selected patients. Laparoscopic adrenalectomy is a useful minimally invasive option for tumors <5 cm. In contrast, tumors ≥5 cm are associated with greater surgical invasiveness and poorer prognosis, warranting careful selection of surgical candidates, including consideration of open adrenalectomy.

Conflicts of Interest

The Authors have no conflicts of interest to declare in relation to this study.

Authors' Contributions

MN: conceptualization, data curation, formal analysis, methodology, resources, writing of the manuscript. KY: investigation, methodology, review and editing of the manuscript. TK: conceptualization, data curation. SK: data curation, resources. MN: data curation, resources. AW: data curation, resources. KK: investigation, resources. TY: investigation, resources. KJ: investigation, resources. SK: review and editing of the manuscript, study supervision.

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The Authors have nothing to report.

Artificial Intelligence (AI) Disclosure

During the preparation of this manuscript, a large language model (ChatGPT-5, OpenAI) was used solely for

language editing and stylistic improvements in select paragraphs. No sections involving the data generation, statistical analysis, or interpretation of research data were produced by generative AI. All scientific content was created and verified by the authors.

References

1 Abrams HL, Spiro R, Goldstein N: Metastases in carcinoma. Analysis of 1000 autopsied cases. Cancer 3(1): 74-85, 1950. DOI: 10.1002/1097-0142(1950)3:1%3C74::AID-CNCR2820030111%3E3.0.CO;2-7

2 Lam KY, Lo CY: Metastatic tumours of the adrenal glands: a 30-year experience in a teaching hospital. Clin Endocrinol (Oxf) 56(1): 95-101, 2002. DOI: 10.1046/j.0300-0664.2001.01435.x

3 Strong VE, D'Angelica M, Tang L, Prete F, Gönen M, Coit D, Touijer KA, Fong Y, Brennan MF: Laparoscopic adrenalectomy for isolated adrenal metastasis. Ann Surg Oncol 14(12): 3392-3400, 2007. DOI: 10.1245/s10434-007-9520-7

4 Moreno P, de la Quintana Basarrate A, Musholt TJ, Paunovic I, Puccini M, Vidal O, Ortega J, Kraimps JL, Bollo Arocena E, Rodríguez JM, González López O, Del Pozo CD, Iacobone M, Veloso E, Del Pino JM, García Sanz I, Scott-Coombes D, Villar-Del-Moral J, Rodríguez JI, Vázquez Echarri J, González Sánchez C, Gutiérrez Rodríguez MT, Escoresca I, Nuño Vázquez-Garza J, Tobalina Aguirrezábal E, Martín J, Candel Arenas MF, Lorenz K, Martos JM, Ramia JM: Adrenalectomy for solid tumor metastases: Results of a multicenter European study. Surgery 154(6): 1215-1223, 2013. DOI: 10.1016/j.surg.2013.06.021

5 Romero Arenas MA, Sui D, Grubbs EG, Lee JE, Perrier ND: Adrenal metastectomy is safe in selected patients. World J Surg 38(6): 1336-1342, 2014. DOI: 10.1007/s00268-014-2454-x

6 Metman MJH, Viëtor CL, Seinen AJ, Berends AMA, Hemmer PHJ, Kerstens MN, Feelders RA, Franssen GJH, van Ginhoven TM, Kruijff S: Outcomes after surgical treatment of metastatic disease in the adrenal gland; valuable for the patient? Cancers (Basel) 14(1): 156, 2021. DOI: 10.3390/cancers14010156

7 Yip L, Duh QY, Wachtel H, Jimenez C, Sturgeon C, Lee C, Velázquez-Fernández D, Berber E, Hammer GD, Bancos I, Lee JA, Marko J, Morris-Wiseman LF, Hughes MS, Livhits MJ, Han MA, Smith PW, Wilhelm S, Asa SL, Fahey TJ 3rd, McKenzie TJ, Strong VE, Perrier ND: American Association of Endocrine Surgeons Guidelines for Adrenalectomy: Executive summary. JAMA Surg 157(10): 870-877, 2022. DOI: 10.1001/jamasurg.2022.3544

8 Jacobs JK, Goldstein RE, Geer RJ: Laparoscopic adrenalectomy. A new standard of care. Ann Surg 225(5): 495-501; discussion 501-2, 1997. DOI: 10.1097/00000658-199705000-00006

9 Riedinger CB: Laparoendoscopic single site, laparoscopic or open surgery for adrenal tumors: Selecting the optimal approach. World J Clin Urol 3(2): 54, 2014. DOI: 10.5410/wjcu.v3.i2.54

10 Matter M, Zingg T, Schiappacasse L: Laparoscopic adrenalectomy for metastatic disease. Eur J Surg Oncol 48(2): e144, 2022. DOI: 10.1016/j.ejso.2021.12.278

11 Kwak J, Bae HL, Jung Y, Choi J, Hwang H, Kim JH, Kim SJ, Lee KE: Comparative outcomes and prognostic indicators in adrenalectomy for adrenal metastasis. Surg Endosc 38(4): 1884-1893, 2024. DOI: 10.1007/s00464-024-10691-4

12 Kebebew E, Siperstein AE, Clark OH, Duh QY: Results of laparoscopic adrenalectomy for suspected and unsuspected malignant adrenal neoplasms. Arch Surg 137(8): 948, 2002. DOI: 10.1001/archsurg.137.8.948

13 Schiavone D, Torresan F, Negro S, Belluzzi A, Iacobone M: Adrenal malignancy: still a contraindication for laparoscopy? Laparosc Surg 3: 30-30, 2019. DOI: 10.21037/ls.2019.07.02

14 Spartalis E, Drikos I, Ioannidis A, Chrysikos D, Athanasiadis DI, Spartalis M, Avgerinos D: Metastatic carcinomas of the adrenal glands: from diagnosis to treatment. Anticancer Res 39(6): 2699-2710, 2019. DOI: 10.21873/anticanres.13395

15 Drake FT, Beninato T, Xiong MX, Shah NV, Kluijfhout WP, Feeney T, Suh I, Gosnell JE, Shen WT, Duh QY: Laparoscopic adrenalectomy for metastatic disease: Retrospective cohort with long-term, comprehensive follow-up. Surgery 165(5): 958-964, 2019. DOI: 10.1016/j.surg.2018.11.008

16 Hatano K, Horii S, Nakai Y, Nakayama M, Kakimoto K, Nishimura K: The outcomes of adrenalectomy for solitary adrenal metastasis: A 17-year single-center experience. Asia Pac J Clin Oncol 16(2): e86-e90, 2020. DOI: 10.1111/ajco.13078

17 Hwang EC, Hwang I, Jung SI, Kang TW, Kwon DD, Heo SH, Hwang JE, Kang SG, Kang SH, Lee JG, Kim JJ, Cheon J: Prognostic factors for recurrence-free and overall survival after adrenalectomy for metastatic carcinoma: a retrospective cohort pilot study. BMC Urol 14: 41, 2014. DOI: 10.1186/1471-2490-14-41

18 Goto T, Inoue T, Kobayashi T, Yamasaki T, Ishitoya S, Segawa T, Ito N, Shichiri Y, Okumura K, Okuno H, Kawakita M, Kanaoka T, Terada N, Mukai S, Sugi M, Kinoshita H, Kamoto T, Matsuda T, Ogawa O: Feasibility of laparoscopic adrenalectomy for metastatic adrenal tumors in selected patients: a retrospective multicenter study of Japanese populations. Int J Clin Oncol 25(1): 126-134, 2020. DOI: 10.1007/s10147-019-01533-8

19 Pędziwiatr M, Wierdak M, Natkaniec M, Matłok M, Białas M, Major P, Budzyński P, Hubalewska-Dydejczyk A, Budzyński A: Laparoscopic transperitoneal lateral adrenalectomy for malignant and potentially malignant adrenal tumours. BMC Surg 15: 101, 2015. DOI: 10.1186/s12893-015-0088-z

20 Zerrweck C, Caiazzo R, Clerquin B, Donatini G, Lamblin A, Khatib ZE, Arnalsteen L, Carnaille B, Pattou F: Renal origin

and size are independent predictors of survival after surgery for adrenal metastasis. Ann Surg Oncol 19(11): 3621-3626, 2012. DOI: 10.1245/s10434-012-2464-6

21 Stefanidis D, Goldfarb M, Kercher KW, Hope WW, Richardson W, Fanelli RD: SAGES guidelines for minimally invasive treatment of adrenal pathology. Surg Endosc 27(11): 3960-3980, 2013. DOI: 10.1007/s00464-013-3169-z

22 Goujon A, Schoentgen N, Betari R, Thoulouzan M, Vanalderwerelt V, Oumakhlouf S, Brichart N, Pradere B, Roumiguie M, Rammal A, Soulie M, Fournier G, Bensalah K, Bruyere F, Grise P, Joulin V, Manunta A, Saint F, Huyghe E, Nouhaud FX, Peyronnet B: Prognostic factors after adrenalectomy for adrenal metastasis. Int Urol Nephrol 52(10): 1869-1876, 2020. DOI: 10.1007/s11255-020-02496-w

23 Kebebew E, Siperstein AE, Duh QY: Laparoscopic adrenalectomy: the optimal surgical approach. J Laparoendosc Adv Surg Tech 11(6): 409-413, 2001. DOI: 10.1089/10926420152761941

24 Puccini M, Panicucci E, Candalise V, Ceccarelli C, Neri CM, Buccianti P, Miccoli P: The role of laparoscopic resection of metastases to adrenal glands. Gland Surg 6(4): 350-354, 2017. DOI: 10.21037/gs.2017.03.20

25 Saraiva P, Rodrigues H, Rodrigues P: Port site recurrence after laparoscopic adrenalectomy for metastatic melanoma. Int Braz J Urol 29(6): 520-521, 2003. DOI: 10.1590/s1677-55382003000600007

26 Sancho JJ, Triponez F, Montet X, Sitges-Serra A: Surgical management of adrenal metastases. Langenbecks Arch Surg 397(2): 179-194, 2012. DOI: 10.1007/s00423-011-0889-1

27 Bradley CT, Strong VE: Surgical management of adrenal metastases. J Surg Oncol 109(1): 31-35, 2014. DOI: 10.1002/jso.23461

28 Miyamoto T, Hori S, Onishi S, Tomizawa M, Shimizu T, Onishi K, Morizawa Y, Gotoh D, Nakai Y, Miyake M, Trimoto K, Tanaka N, Fujimoto K: Association of Mayo Adhesive Probability Score with perioperative outcomes and histological characteristics of adherent perinephric fat in laparoscopic adrenalectomy. In Vivo 38(6): 2836-2843, 2024. DOI: 10.21873/invivo.13764