Conversion from Robotic to Open Adrenalectomy in Cases of Adrenal Malignancy: A Retrospective Cohort Study Using the National Cancer Database (NCDB)

Vatsala Kapoor; Melissa Easley, MD; Mohammed Nofal, MD; Richard Aldan, MD; Tucker Bettis, MD; Emily Hammond, MD; Aaron Bolduc, MD; Danny Yakoub, MD PhD ; Medical College of Georgia at Augusta University

INTRODUCTION

- With increasing popularity of robotic adrenalectomies (RA), conversion from robotic to open adrenalectomy (OA) becomes increasingly relevant.
- Factors associated with conversion from RA to OA and implications of conversion are not well-defined.
- **Objective:** To identify factors associated with conversion from robotic to open adrenalectomy, factors associated with postoperative residual tumor after RA, and to compare overall survival (OS) between converted and nonconverted patients.

METHODS

Data Collection:

• The National Cancer Database (2004-2022) was queried for patients undergoing RA for malignancy.

Statistical Analysis:

- Performed using IBM SPSS Statistics, version 29.
- Descriptive statistics were used to compare converted and non-converted patients as well as patients with postoperative residual tumor versus those without.
- Chi-square or Fisher's exact tests were used for categorical variables and independent-sample t-tests or Mann-Whitney U tests were used for continuous variables.
- Univariate and multivariate logistic regression analyses were used to identify characteristics associated with conversion and postoperative residual tumor.
- OS was compared between converted and non-converted patients using the Kaplan-Meier method. Subgroup stratification by tumor histology was also performed.

RESULTS

Table I. Variables Associated with RA to OA Conversion in Multivariate Analysis

Variable	Level	Odds Ratio	P-Value
Tumor Grade	Low Grade (I & II)	Reference	
	High Grade (III & IV)	5.460	0.017
Tumor Size	N/A	1.014	0.046

RESULTS CONTINUED

Table II. Variables Associated with Postoperative Residual Tumor in Multivariate Analysis

Variable	Level	Odds Ratio	P-Value
Tumor Grade	Low Grade (I & II)	Reference	
	High Grade (III & IV)	4.202	0.005
Tumor Stage	Early Stage (I & II)	Reference	
	Advanced Stage (III & IV)	3.993	< 0.001

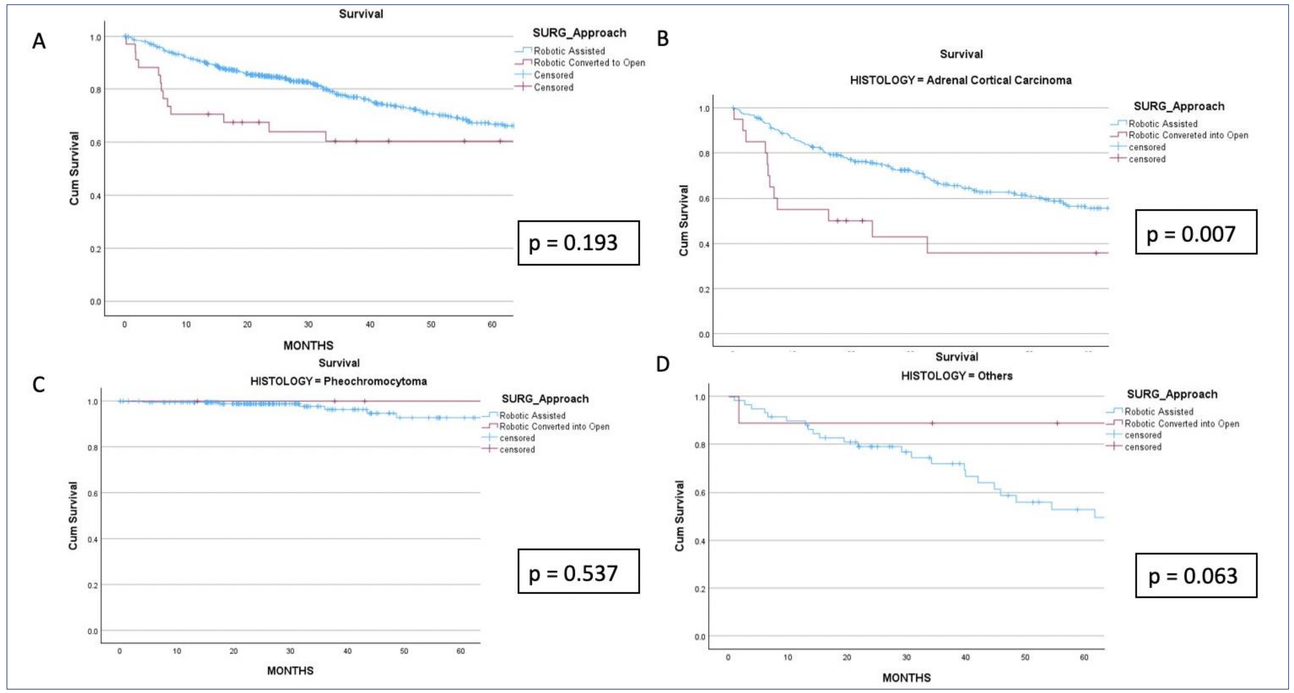

Figure 1. Kaplan-Meier curves comparing overall survival stratified by surgical approach (Robotic Assisted vs. Robotic Converted to Open) (A) Overall survival for the entire cohort (B) Survival for patients with Adrenal Cortical Carcinoma (C) Survival for patients with Pheochromocytoma (D) Survival for patients with other histological subtypes

RESULTS CONTINUED

- Of 737 RA patients, 5.7% (42) underwent conversion to OA.
- **High grade (III and IV)** and increasing **tumor diameter** were associated with **conversion**.
- Conversion likelihood increased by 50% and 100% when the largest tumor diameter was greater than 2.3cm and 4cm, respectively.
- **Advanced stage (III and IV)** and **high grade (III and IV)** tumors were associated with **postoperative residual tumor.**
- **Overall survival** was significantly **decreased among converted patients with ACC and rare adrenal tumors** compared to nonconverted counterparts.

CONCLUSIONS

- **High-grade and increasing tumor diameter** were associated with **RA to OA conversion.**
- **Tumor histology** was **NOT** associated with **RA to OA conversion.**
- **Advanced-stage and high-grade tumors** were associated with **postoperative residual tumor after RA.**
- Conversion from RA to OA had **negative implications with regards to mortality in patients with ACC and rare adrenal tumors.**

CLINICAL IMPLICATIONS

- **Increasing tumor diameter** is associated with **RA to OA conversion**, as seen in studies looking at LA to OA conversion.
- Although definitively identifying adrenal tumor grade is not common preoperatively, **increasing attention to CT findings** may assist with choosing the most appropriate surgical approach.
- **RA may be more suitable than LA for pheochromocytoma removal.**
- Because RA to OA conversion is associated with reduced OS in certain patient groups, it becomes essential to identify patients at increased risk of conversion.
- **Increasing consideration should be given to performing RA for patients with ACC and rare adrenal tumors.**

REFERENCES

1. Krokowicz L, Biczysko M, Szmyt K, Borejsza-Wysocki M, Banasiewicz T, Ledwosinski W, Bobkiewicz A (2023) Analysis of risk factors for conversion in laparoscopic adrenalectomy: a single-institution series of 256 patients. *Wideochir Inne Tech Maloinwazyjne*, DOI: 10.5114/witm.2023.126446, Apr 6, 2023.
2. Vidal O, Saavedra-Perez D, Martos JM, Quintana A, Rodríguez JI, Villar J, Moral A, Duran M, Valentini M, Fernandez-Cruz L (2020) Risk factors for open conversion of lateral transperitoneal laparoscopic adrenalectomy: retrospective cohort study of the Spanish Adrenal Surgery Group (SASG). *Surg Endosc* 34, 3690–3695.
3. Stefanidis, D., Goldfarb, M., Kercher, K.W. *et al.* SAGES guidelines for minimally invasive treatment of adrenal pathology. *Surg Endosc* **27**, 3960–3980 (2013). https://doi.org/10.1007/s00464-013-3169-z
4. Delozier OM, Stiles ZE, Deschner BW, Drake JA, Deneve JL, Glazer ES, Tsao MW, Yakoub D, Dickson PV (2020) Implications of Conversion during Attempted Minimally Invasive Adrenalectomy for Adrenocortical Carcinoma. *Ann Surg Oncol*, DOI: 10.1245/s10434-020-08824-9, Jul 11, 2020.
5. 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 (2022) American Association of Endocrine Surgeons Guidelines for Adrenalectomy: Executive Summary. *JAMA Surg* 157:870-877.
6. Dinnes J, Bancos I, Ferrante di Ruffano L, Chortis V, Davenport C, Bayliss S, Sahdev A, Guest P, Fassnacht M, Deeks JJ, Arlt W (2016) MANAGEMENT OF ENDOCRINE DISEASE: Imaging for the diagnosis of malignancy in incidentally discovered adrenal masses: a systematic review and meta-analysis. *Eur J Endocrinol* 175:R51-64.
7. Thompson LH, Nordenstrom E, Almquist M, *et al.* Risks Factors for complications after adrenalectomy: results for a comprehensive database. Langenbecks Arch Surg 2017;402:315-22. 10.1007/s00423-016-1535-8
8. Gokosimam M, Akbulut S, Erten O, Kahramangil B, Kim YS, Li P, Berber E (2020) An intra-operative video comparison of laparoscopic versus robotic transabdominal lateral adrenalectomy. *Int J Med Robot*, DOI: 10.1002/rcs.2203, Dec 13, 2020.