

# Robotic versus Laparoscopic Adrenalectomy for Pheochromocytoma in Patients with BMI $\geq$ 25 kg/m<sup>2</sup>: A Systematic Review and Meta-Analysis

Konstantinos Kossenias<sup>1</sup>, Michael K. Konstantinides<sup>1</sup>, Nikolaos Karountzos<sup>1</sup>, Alexandros Barlas<sup>2</sup>, Dimitrios Vardakostas<sup>2</sup>, Panoraia Paraskeva<sup>2</sup>, Dionysios Prevezanos<sup>1</sup>, Dimitrios Vlahos<sup>1</sup>, Charalampos Douligeris<sup>1</sup>, Nikolaos Nikiteas<sup>1</sup>, Dimitrios Mantas<sup>1</sup>  
<sup>1</sup>2<sup>nd</sup> Department of Propedeutic Surgery, LAIKO General Hospital of Athens  
<sup>2</sup>Department of Renal Transplant Surgery, LAIKO General Hospital of Athens

## ABSTRACT

**Background:** The role of robotic adrenalectomy (RA) versus laparoscopic adrenalectomy (LA) for pheochromocytoma in overweight/obese patients (BMI  $\geq$  25 kg/m<sup>2</sup>) remains uncertain.  
**Methods:** PRISMA/Cochrane systematic review and random-effects meta-analysis of studies comparing RA vs LA for pheochromocytoma (PubMed, Scopus, Cochrane; to Jan 2025).  
Outcomes: blood loss, operative time, hospital stay, conversion, complications, transfusion; sensitivity and heterogeneity analyses; PROSPERO CRD42024616287.  
**Results:** 4 studies; n = 475 (RA 243; LA 232). RA yielded shorter hospital stay (WMD -0.58 days; P = 0.001) and similar operative time, blood loss, conversion, complications, and transfusion rates. Sensitivity analyses confirmed robustness, with blood loss trending lower for RA.  
**Conclusions:** In patients with BMI  $\geq$  25 kg/m<sup>2</sup>, RA shortens hospital stay while maintaining comparable safety and efficacy to LA. Given limited evidence, LA remains standard; high-quality RCTs are needed to validate long-term and economic outcomes.

## CONTACT

KONSTANTINOS KOSSENAS  
KOSSENASWORK@GMAIL.com

## INTRODUCTION

Laparoscopic adrenalectomy (LA) remains the gold standard for pheochromocytoma, but robotic adrenalectomy (RA) may offer ergonomic and visualization advantages—particularly in overweight and obese (BMI  $\geq$  25 kg/m<sup>2</sup>) patients, where limited exposure can increase complexity. Current evidence, however, has not focused specifically on this subgroup.

## METHODS AND MATERIALS

PRISMA- and Cochrane-guided systematic review and meta-analysis (PROSPERO CRD42024616287).  
Databases: PubMed, Scopus, Cochrane Library (through Jan 2025).  
Included: Comparative studies of RA vs LA for pheochromocytoma in adults with BMI  $\geq$  25 kg/m<sup>2</sup>.  
Outcomes: blood loss, operative time, hospital stay, conversion, total complications, transfusion rate.  
Models: Random-effects (DerSimonian–Laird)

## RESULTS

4 studies; n = 475 (RA = 243, LA = 232).  
•**Blood loss:** WMD -34.6 mL (95% CI -72.3 to 3.1), P = 0.07; I<sup>2</sup> = 86% → NS (trend favoring RA)  
•**Operative time:** WMD -6.3 min (-22.5 to 10.0), P = 0.45; I<sup>2</sup> = 60% → NS  
•**Hospital stay:** WMD -0.58 days (-0.93 to -0.22); P = 0.001; I<sup>2</sup> = 73% → significantly shorter with RA  
•**Conversion:** OR 0.38 (0.12–1.23), P = 0.11; I<sup>2</sup> = 0% → NS  
•**Total complications:** OR 1.20 (0.61–2.38), P = 0.60; I<sup>2</sup> = 0% → NS  
•**Transfusions:** OR 0.57 (0.13–2.49), P = 0.45; I<sup>2</sup> = 36% → NS  
**Sensitivity analyses:**  
•Excluding specific studies rendered blood loss significant in favor of RA.  
•Overall direction and significance of other outcomes remained unchanged.

## Clinical implications

•**Enhanced recovery:** RA reduced length of stay by ~0.6 days, suggesting faster postoperative recovery in overweight patients—potentially from improved dexterity and access within deeper operative fields.  
•**Equivalent safety:** Complication, conversion, and transfusion rates were comparable, confirming oncologic and perioperative safety parity with LA.  
•**Blood loss signal:** Although non-significant overall, sensitivity suggests a consistent trend toward lower blood loss with RA, aligning with robotic precision advantages.  
•**Resource allocation:** Given similar outcomes and higher cost, LA remains the pragmatic standard, reserving RA for technically demanding cases (large lesions, posterior or right-sided glands, dense adiposity).  
•**Future work:** Prospective, BMI-stratified RCTs should address long-term outcomes (recurrence, cost, quality of life) and standardize intraoperative metrics.

## DISCUSSION

In overweight and obese patients with pheochromocytoma, RA offers shorter hospital stay and potentially reduced blood loss while maintaining equivalent operative time, safety, and oncologic adequacy compared with LA.

## CONCLUSIONS

Given limited data (only 4 studies, all observational), conclusions should be viewed as preliminary. Until larger prospective studies confirm long-term or cost benefits, LA remains the reference approach, with RA reserved for high-complexity anatomy or when institutional expertise favors robotics.