

Perioperative Outcomes of Robotic versus Laparoscopic Donor Nephrectomy: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: The relative advantages of robotic versus laparoscopic donor nephrectomy (RDN vs LDN) remain uncertain.

Methods: PRISMA-guided systematic review and meta-analysis of comparative studies (PubMed, Scopus, Cochrane; to Nov 2024). Random-effects (Hartung–Knapp–Sidik–Jonkman) models pooled odds ratios (OR) and mean differences (MD) with 95% CIs; heterogeneity assessed via I².

Results: 4 studies; n = 640 (RDN 305; LDN 335). RDN had **longer operative time** (MD 23.49 min; P = 0.04) but **lower total complications** (OR 0.58; P = 0.04) and **shorter hospital stay** (MD -0.65 days; P = 0.02). Conversion (OR 1.55; P = 0.82) and warm ischemia time (MD 0.81 min; P = 0.17) were similar. Heterogeneity low-to-moderate; sensitivity confirmed stability.

Conclusions: RDN provides **faster recovery and fewer complications** without compromising safety or graft-related parameters, albeit with longer operative time. LDN remains a valid and cost-effective standard where robotic systems are unavailable.

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INTRODUCTION

Laparoscopic donor nephrectomy (LDN) is the current gold standard for living kidney donation. However, **robotic donor nephrectomy (RDN)** offers improved dexterity, tremor filtration, and ergonomics that may enhance safety and reduce surgeon fatigue. Evidence comparing these two minimally invasive techniques remains limited and fragmented.

METHODS AND MATERIALS

A **PRISMA/Cochrane** systematic review and meta-analysis was conducted (searches in **PubMed, Scopus, Cochrane Library** through **Nov 2024**). Included: comparative studies evaluating **RDN vs LDN** in living kidney donors. Statistical analysis: random-effects **Hartung–Knapp–Sidik–Jonkman** method for pooled estimates; heterogeneity assessed via I²; **sensitivity analyses** applied for outcomes with moderate heterogeneity.

RESULTS

Four studies; n = 640 (RDN 305; LDN 335).

- Conversion:** no significant difference (OR **1.55**, 95% CI 0.00–5.6×10⁸; P = 0.82; I² = **48%**).
- Operative time: longer with RDN** (MD **23.49 min**, 95% CI 3.58–43.39; P = 0.04; I² = **0%**).
- Total postoperative complications: lower in RDN** (OR **0.58**, 95% CI 0.35–0.98; P = 0.04; I² = **0%**).
- Length of stay: shorter with RDN** (MD **-0.65 days**, 95% CI -1.19 to -0.12; P = 0.02; I² = **56%**).
- Warm ischemia time:** no significant difference (MD **0.81 min**, 95% CI -0.82–2.45; P = 0.17; I² = **61%**).

Sensitivity analyses confirmed the robustness of complication and LOS results; heterogeneity for WIT decreased when excluding Luke et al., but effect direction remained unchanged.

Clinical implications

Enhanced recovery: RDN shortened **hospital stay by ~0.6 days**, suggesting faster postoperative convalescence.

Safety parity: Despite slightly longer operative duration, **overall and major complication rates were lower** with RDN, supporting its safety profile.

Translational relevance: Comparable warm ischemia and conversion rates indicate **no compromise to graft integrity** or donor safety.

Adoption strategy: RDN may be preferable in **centers with established robotic programs**, especially for donors with **complex anatomy, high BMI, or posterior hilar vessels**.

Resource considerations: In institutions with limited robotic access, LDN remains a **cost-effective and evidence-supported standard**.

DISCUSSION

Across four comparative studies, **RDN demonstrated shorter hospital stay and fewer postoperative complications** compared to LDN, at the expense of **slightly longer operative time**. Conversion and warm ischemia time were comparable, indicating **equivalent donor safety and graft viability**. These findings highlight RDN as a **safe and effective minimally invasive alternative** to LDN in experienced hands.

CONCLUSIONS

RDN offers modest perioperative benefits with comparable safety to LDN. Larger, multicenter, prospective studies are needed to validate these findings and explore **long-term donor and recipient outcomes, quality of life, and cost-effectiveness**.