



Robotic versus Laparoscopic Major Hepatectomy in Patients with BMI \geq 25 kg/m²: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Evidence comparing robotic (RMH) vs laparoscopic major hepatectomy (LMH) in BMI \geq 25 kg/m² patients is scarce.

Methods: Systematic review and meta-analysis (to Nov 2024) of comparative studies; random-effects models with leave-one-out and fixed-effects sensitivity. Outcomes: operative time, blood loss, hospital stay, complications (overall/major), conversion, R0. ROBINS-I for bias.

Results: 3 studies; n = 261. No significant differences for operative time (WMD -19.95 min), hospital stay (WMD -0.31 days), overall complications (OR 0.73), major complications (OR 0.63), conversion (OR 0.67), or R0 (OR 1.42). **Blood loss was lower with RMH** (WMD -93 mL; P = 0.03). Sensitivity and fixed-effects suggested **shorter operative time and LOS** with RMH; blood-loss significance was variably robust.

Conclusions: In overweight/obese patients, RMH and LMH provide **comparable safety and oncologic adequacy**; RMH **reduces blood loss** and may **shorten** OT/LOS in selected analyses. Absent specific indications for robotics, **LMH remains a safe, cost-effective option**; higher-quality, BMI-stratified trials are warranted.

CONTACT

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INTRODUCTION

Major hepatectomy in patients with BMI \geq 25 kg/m² poses technical challenges (fatty liver, thicker abdominal wall, limited exposure). Although robotic (RMH) and laparoscopic major hepatectomy (LMH) have been compared in general populations, outcomes in **overweight/obese** cohorts remain underreported. We synthesized comparative evidence focused on this demographic.

METHODS AND MATERIALS

PRISMA-guided systematic review (PubMed, Scopus, Cochrane; through **Nov 2024**). Comparative primary studies of **RMH vs LMH** in adults with BMI \geq 25 kg/m². Outcomes: operative time, intra-operative blood loss, hospital stay, overall and major (Clavien-Dindo \geq III) complications, conversion to open, **R0 resection**. Effect measures: WMD (continuous) and OR (dichotomous), **random-effects** primary models

RESULTS

3 studies; n = 261 (RMH vs LMH).

- **Operative time:** WMD **-19.95 min** (95% CI -66.10 to 26.20), I² = 69%, P = 0.40 → NS
- **Blood loss:** WMD **-93.07 mL** (-174.69 to -11.46), I² = 40%, P = 0.03 → **lower with RMH**
- **Hospital stay:** WMD **-0.31 days** (-1.16 to 0.54), I² = 63%, P = 0.47 → NS
- **Any complications:** OR **0.73** (0.39–1.37), I² = 0%, P = 0.33 → NS
- **Major complications (\geq III):** OR **0.63** (0.21–1.89), I² = 0%, P = 0.41 → NS
- **Conversion to open:** OR **0.67** (0.14–3.27), I² = 0%, P = 0.62 → NS
- **R0 resection:** OR **1.42** (0.42–4.80), I² = 0%, P = 0.58 → NS

Sensitivity analyses

- **Leave-one-out:** Operative time became significant favoring RMH (WMD **-9.82 min**; -17.49 to -2.16; P = 0.01). Hospital stay also favored RMH (WMD **-0.75 days**; -0.90 to -0.59; P < 0.00001). Blood-loss significance was not robust to exclusion of specific studies.
- **Fixed-effects:** Confirmed **shorter operative time and hospital stay with RMH**; blood loss remained significantly lower with RMH.

Clinical implications

- **Hemo-technical edge:** In overweight/obese patients, **RMH reduces intra-operative blood loss**, which may translate to fewer transfusions and cleaner fields during parenchymal transection—useful in steatotic/fibrotic livers.
- **Throughput & recovery:** While base-case models showed no LOS/OT differences, **sensitivity and fixed-effects** suggest RMH can **modestly shorten** both. Centers already operating a robotic liver program may realize these gains, particularly in high-BMI anatomy.
- **Oncologic adequacy:** **R0 rates are comparable**, supporting LMH as **oncologically sound** in this cohort when expertise exists.
- **Resource use:** Given typical **higher costs** and platform logistics for robotics, the incremental clinical benefit—primarily **less blood loss** and possibly **shorter LOS/OT**—should be weighed against institutional economics and case complexity.
- **Practical take:** For straightforward major hepatectomies in BMI \geq 25 kg/m², **LMH remains a safe, cost-conscious default**. Consider RMH when anticipating difficult exposure (central/posterosuperior segments), dense adhesions, or when optimizing blood loss is paramount.

DISCUSSION

Across three comparative studies in patients with BMI \geq 25 kg/m², RMH and LMH achieved **similar complication rates, conversion, and R0 resection**, with a **significant reduction in blood loss** for RMH. Signals from sensitivity/fixed-effects favor **shorter operative time and hospital stay** with RMH, but robustness is limited by **small sample size and between-study heterogeneity**. All included studies were **observational** -moderate risk for confounding/selection).

CONCLUSIONS

Unless specific anatomic/technical considerations support a robotic approach, **LMH remains a safe and cost-effective choice** for overweight/obese patients. Larger, preferably **prospective or randomized**, BMI-stratified studies should confirm peri-operative advantages, quantify transfusion needs, and assess cost-effectiveness and long-term outcomes.