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From Scope to Scalpel: A Review of the Timing and Outcomes of Conversion in Minimally Invasive Liver Resections

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Abstract

Background: Minimally invasive liver resection (MILR), encompassing laparoscopic and robotic techniques, has transformed hepatobiliary surgery. Despite its advantages, intraoperative conversion to open surgery remains a critical event, often associated with increased blood loss, morbidity, and longer hospital stay. Timing of conversion - whether early or delayed - emerges as a key determinant of patient outcomes yet remains poorly defined in the literature.

Aim: This review synthesizes current evidence on the indications, timing, and outcomes of conversion in MILR, with a focus on identifying risk factors, perioperative consequences, and existing knowledge gaps.

Methods: A systematic search of PubMed, MEDLINE, and Embase was performed (2010-2025). We included studies comparing converted vs. non-converted MILR. A quantitative synthesis was performed for key outcomes.

Results: Fifteen studies (15,834 patients) were included. A quantitative analysis revealed that conversion was associated with significantly increased blood loss (mean difference: 450 mL), higher overall morbidity (OR: 2.5), and longer hospital stays (mean difference: 4.2 days). We propose an operational definition: Early Conversion (<60 mins or pre-parenchymal transection), **Late Conversion** (>60 mins or post-parenchymal transection), and Emergency Conversion (life-threatening event). We propose operational definitions for conversion timing (Early, Late, Emergency) and developed a decision-making algorithm.

Conclusion: Conversion during MILR is a pivotal safety measure, but its timing substantially influences outcomes. There is a pressing need for a national, prospective, multicentre UK-based audit to define optimal conversion timing, identify modifiable risk factors, and inform standardised intraoperative decision-making frameworks.

Keywords: laparoscopic liver resection, robotic liver surgery, conversion to open surgery, timing of conversion, perioperative outcomes