Comparative Outcomes of Minimally Invasive Coronary Artery Bypass and RACAB: A Systematic Review and Meta-Analysis

Maulidya Ayudika Dandanah[1,2,3], Stevanus Orlando[1,3], Yoo Sora Annisa Putri[1,3], Budhi Adhiwidjaja[3], Dicky Aligheri Wartono[3,4]

[1]Faculty of Medicine, Pelita Harapan University, Tangerang, Indonesia

[2]Faculty of Medicine, Veteran University of National Development, Jakarta, Indonesia

[3]Department of Cardiothoracic Surgery, Siloam Hospitals Lippo Village, Tangerang, Indonesia.

[4]National Cardiovascular Center, Harapan Kita, Jakarta, Indonesia

Background: Minimally invasive coronary artery bypass grafting (MICS-CABG) and robotic-assisted coronary artery bypass (RACAB) have emerged as alternatives to conventional sternotomy, aiming to reduce surgical trauma and improve recovery. While both avoid full sternotomy, direct comparisons of perioperative outcomes remain limited. Previous studies have compared robotic or minimally invasive CABG with conventional approaches, but direct evidence contrasting MICS-CABG and RACAB is limited. A systematic evaluation of MICS-CABG versus RACAB is warranted to guide surgical decision-making.

Methods: A systematic search of PubMed, PMC, ScienceDirect, and Google Scholar identified studies published up to September 2025. Eligible studies reported outcomes of MICS-CABG, MIDCAB, TECAB, RACAB, and RA-MIDCAB. Risk of bias was assessed using ROBINS-I, and outcome certainty was graded with Grading of Recommendation, Assessment, Development and Evaluation (GRADE). Intraoperative and postoperative outcomes were pooled using meta-analysis, with effect sizes expressed as odds ratios (ORs) or mean differences (MDs).

Results: Five studies comprising 844 patients (MICS: 434; RACAB: 410) published between 2011 and 2022 were included. Most studies had a serious risk of bias, though no publication bias was detected. Compared with RACAB, MICS was associated with significantly higher post-operative chest drainage (MD 135.36 mL, 95% CI 120.95–149.76, $p < 0.001$, GRADE low), slightly longer ICU stay (MD 0.24 days, 95% CI 0.14–0.34, $p < 0.01$, GRADE low), longer mechanical ventilation (MD 1.57 hours, 95% CI 0.76–2.39, $p < 0.01$, GRADE very low), and longer hospital stay (MD 1.96 days, 95% CI 1.84–2.08, $p < 0.001$, GRADE low). No significant differences were observed for operative time, transfusion requirements, re-operation for bleeding, pleural effusion, stroke, renal failure, mortality, conversion, atrial fibrillation, or myocardial infarction.

Conclusion: MICS-CABG and RACAB are comparably safe with respect to mortality and major complications. However, MICS is associated with greater post-operative drainage and prolonged recovery, whereas RACAB may offer efficiency advantages in the perioperative course. These findings highlight the importance of tailoring revascularization strategies to patient characteristics and institutional expertise. Larger high quality randomized controlled trials are required to confirm these results and assess long-term outcomes, including graft patency and quality of life.