

Off-Pump Versus On-Pump Coronary Revascularization: Meta-Analysis of Mid- and Long-Term Outcomes

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Background. Early outcomes for off-pump coronary artery bypass grafting (OPCAB) have been extensively compared with on-pump coronary revascularization (ONCAB); however, the long-term effects of OPCAB continue to be debated. This study aims to compare the mid-term (>1year; ≤5 years) and long-term (>5 years) survival and major adverse cardiovascular and cerebrovascular events of OPCAB versus ONCAB.

Methods. A systematic search identified 32 studies meeting our inclusion criteria. These were analyzed using random effects modeling, with subgroup evaluation according to study type. Primary outcomes were mid- and long-term survival over a follow-up period greater than 1 year. Secondary outcomes were mid- and long-term events including repeat revascularization, myocardial infarction, angina, heart failure, and cerebrovascular accidents.

Results. Off-pump coronary artery bypass grafting confers similar overall mid-term survival when compared with ONCAB (hazard ratio, 1.06; 95% confidence interval, 0.95 to 1.19; $p = 0.31$). On-pump coronary artery bypass

grafting was associated with a significant trend towards a long-term survival advantage (hazard ratio, 1.06; 95% confidence interval, 1.00 to 1.13; $p = 0.05$); however, this was no longer present when subgroup analysis of only randomized controlled trials, registry-based studies, and propensity-matched studies was performed. There was an increase in angina recurrence among two studies after OPCAB, but no difference was seen in 11 other studies reporting data as odds ratio. No significant differences were observed in other secondary outcomes.

Conclusions. This analysis demonstrates comparable mid-term mortality and mid- to long-term morbidity between OPCAB and ONCAB. On-pump coronary artery bypass grafting may be associated with improved long-term survival when all study types are analyzed; however, analysis of only randomized controlled trials and propensity-matched studies demonstrates comparable long-term mortality between OPCAB and ONCAB.

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Despite the potential advantages of avoiding cardiopulmonary bypass, there is continued debate as to whether off-pump coronary artery bypass grafting surgery (OPCAB) provides any benefit over on-pump coronary revascularization (ONCAB). In non-high-risk patients, early outcomes appear comparable between the two techniques [1]; however, concerns remain over long-term outcomes and the potential effects of incomplete revascularization. During the past 15 years, there has been a growing body of evidence comparing the two procedures over a more extended time frame, and there is a mounting need for these to be systematically analyzed. Previous meta-analyses have also called for the need to evaluate late clinical outcomes [2].

The purpose of this meta-analysis is threefold: whether (1) OPCAB is associated with improved mid-term and long-term survival compared with ONCAB; (2) there is consistency across different study groups; and (3) differences in morbidity exist during follow-up. The emphasis of this study is follow-up and late outcomes, to shed further light as to whether these techniques offer comparable results over a more prolonged period.

Patients and Methods

Literature Search

A literature search was performed using PubMed, EMBASE, Web of Science, and Google Scholar until October 2013 using the MeSH headings “coronary artery bypass,” “coronary artery bypass, off-pump,” “survival,” “mortality,” and “follow-up studies.” Randomized controlled trials (RCTs) and observational studies in any language published after 1990 were selected. Additional citation review was performed both manually and using PubMed’s related article search feature (Fig 1).

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Abbreviations and Acronyms

| | |
|-------|---|
| CABG | = coronary artery bypass grafting |
| HR | = hazard ratio |
| NOE | = number of events |
| NOS | = Newcastle-Ottawa Quality Assessment Scale |
| ONCAB | = on-pump coronary artery bypass |
| OPCAB | = off-pump coronary artery bypass |
| RCT | = randomized controlled trial |

Selection Criteria

All articles comparing survival of conventional OPCAB with ONCAB, with overall follow-up of greater than 1 year, were included. We excluded studies that (1) involved fewer than 50 initial participants in either group, (2) used concomitant interventions, (3) comprised low-risk, high-risk, or subpopulation groups with no data available for the more complete cohort, and (4) contained duplicate data from the same institution(s), in which case

the more-credible, recently published data with the greater follow-up period was selected.

Two reviewers (U.C., C.R.) assessed studies based on title and abstract review. Relevant studies were then reviewed in full (Fig 1). Discrepancies were resolved by discussion with a third reviewer (T.A.).

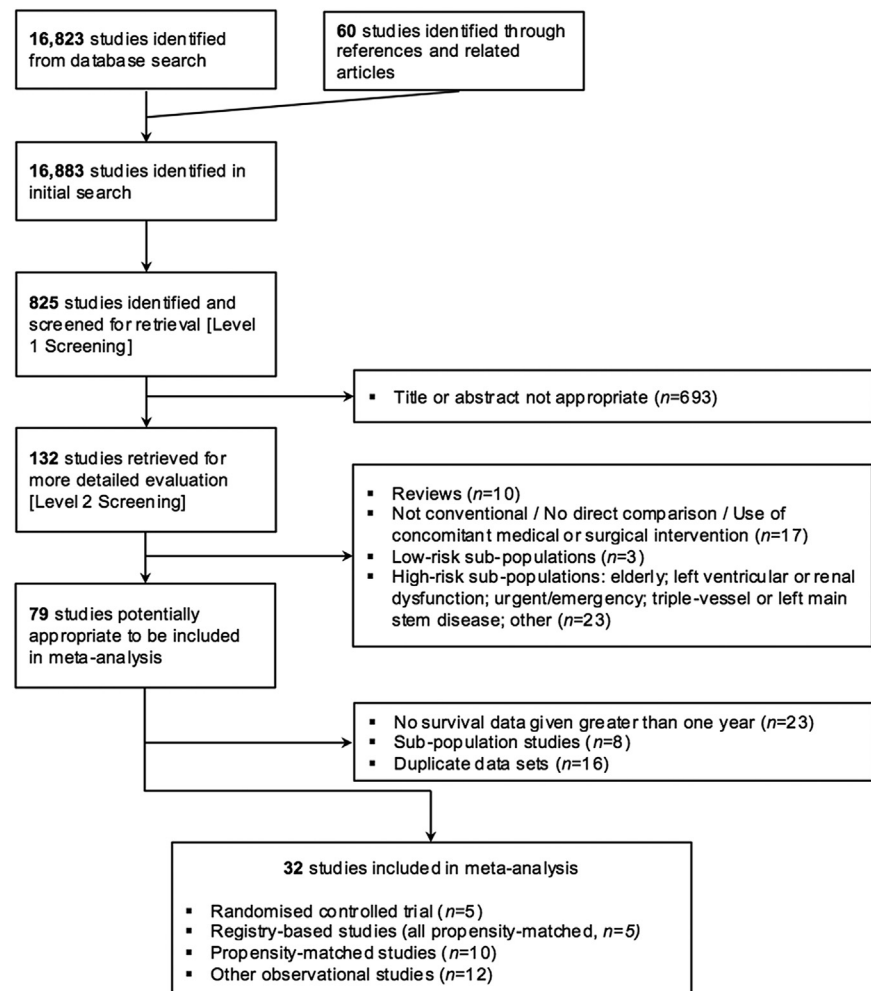
Data Collection

Data were recorded according to first author and publication year; study design as either RCTs, registry-based, propensity-matched, or other form of observational study; period of patient enrolment; follow-up; off-pump and on-pump participant numbers followed up for survival; inclusion and exclusion criteria; and outcome measures (Table 1).

Study Variables

Mid-term was defined as being a follow-up period (y) between 1 and 5 years, that is ($1 < y \leq 5$), and long-term as a period of greater than 5 years ($y > 5$). When median or mean follow-up period was not available, survival

Fig 1. Search strategy.



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