Comparison of Graft Patency Between Off-Pump and On-Pump Coronary Artery Bypass Grafting: An Updated Meta-Analysis

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Background. **Currently, off-pump coronary artery bypass grafting (OPCAB) and on-pump coronary artery bypass grafting (ONCAB) are 2 well-established therapeutic strategies for patients with coronary artery disease, and debate regarding which strategy provides superior graft patency is ongoing. The current study is a meta-analysis of randomized controlled trials that compared the graft patency between OPCAB and ONCAB.**

Methods. **Data sources were PubMed, the Cochrane Library, Google Scholar, and ISI Web of Knowledge (1966–2013). We identified studies comparing graft patency after the 2 procedures as the primary intervention for patients with multivessel coronary artery disease and conducted a meta-analysis of randomized controlled trials on graft patency.**

Results. **A literature search yielded 12 randomized controlled trials, for a total of 3,894 and 4,137 grafts performed during OPCAB and ONCAB procedures, respectively. Meta-analysis of these studies showed an increased risk of occlusion of all grafts (risk ratio [RR], 1.35; 95% confidence interval [CI], 1.16–1.57) and saphenous vein grafts (SVGs) (RR, 1.41; 95% CI, 1.24–1.60) in the OPCAB group, whereas there was no significant difference in graft occlusion of left internal mammary artery (LIMA) (RR, 1.15; 95% CI, 0.83–1.59) and radial artery (RR, 1.37; 95% CI, 0.76–2.47) grafts between OPCAB and ONCAB.**

Conclusions. **Meta-analysis of currently available randomized controlled trials on graft patency shows that ONCAB reduces the incidence of SVG graft occlusion significantly but does not affect LIMA and radial artery graft patency compared with OPCAB.**

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Every year, tens of thousands of patients with coronary artery disease undergo surgical revascularization with cardiopulmonary bypass (on-pump coronary artery bypass [ONCAB]) or without cardiopulmonary bypass (off-pump coronary artery bypass [OPCAB]). The question of which strategy is more safe and effective has been debated by cardiac surgeons since the 2 procedures were introduced. Many prospective randomized or retrospective studies [1–3] are available and focus on the clinical outcomes, including graft patency, of the 2 interventions. However, although meta-analyses have been conducted [4–6], results of graft patency in the literature are still controversial. Previous meta-analyses fail to provide clear-cut conclusions because the numbers of patients and grafts are relatively small; however, since their publication, some large randomized controlled trials and long-term outcomes have been published [7–9]. Therefore, we have conducted a new meta-analysis that includes more recent studies to evaluate the effects of OPCAB and ONCAB on graft patency.

Material and Methods

Search Strategy

We carried out a literature search using PubMed, the Cochrane Library, Google Scholar, and ISI Web of Knowledge of all studies published between 1966 and 2013 comparing graft patency between OPCAB and ONCAB procedures. The last search was through July 2013. Keywords included “off pump,” “off-pump,” “on pump,” “on-pump,” “CABG,” “coronary artery bypass grafting,” “graft patency,” and “randomized controlled trial.” To broaden the search, we used the “related articles” function. We reviewed all abstracts, studies, and citations irrespective of language.

Two reviewers (BZ and JZ) independently extracted the following data from each study: first author, year of publication, trial characteristics, study design, inclusion and exclusion criteria, graft type, timing of graft assessment, and patency rates of bypass grafts.

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Inclusion and Exclusion Criteria

To be eligible for inclusion in our meta-analysis, trials had to conform to the following criteria: prospective randomized study comparing OPCAB and ONCAB as primary interventions for multivessel coronary artery disease, graft patency assessed after the operation and data reported in the study regardless of the length of follow-up, and graft patency assessed by computed tomographic angiography (CTA) or coronary angiography (CAG). If the same group reported multiple studies on outcomes of interest at different follow-up points, we extracted patient characteristics from the first study and data for outcomes of interest from the later studies. When 2 studies by the same group reported the same outcomes of interest at similar follow-up points, we adopted either the higher quality or most informative publication.

We excluded studies in which the rates of graft patency were not reported or in which it was impossible to calculate these from the published results.

Statistical Analysis

We carried out our meta-analysis in accordance with Cochrane Collaboration recommendations and Quality of Reporting of Meta-analyses guidelines [10]. RRs were used as the common measure across studies; hazard ratios/odds ratios were sometimes considered equivalent to RRs. An RR less than 1 favored the OPCAB group, and the point estimate of the RR was considered statistically significant at the $p = 0.05$ level if the 95% CI did not include the value 1.

We used a random-effects model in which it was assumed that there was variation among studies, and the calculated RR therefore had a more conservative value [11]. The random-effects model is preferred in surgical research, largely because patients undergoing operations at different centers have varying risk profiles and selection criteria for each surgical technique. In this meta-analysis, we considered only randomized controlled trials that presented the highest quality of evidence. All analyses were conducted using Stata 12.0 software for Windows (StataCorp LP, College Station, TX).

We used 3 strategies to assess heterogeneity. First, heterogeneity among studies was evaluated using the Q-statistic. I^2 values of less than 25% were considered to have low heterogeneity, those of 25% to 50% were considered to have moderate heterogeneity, and those of greater than 75% were considered to have high heterogeneity. Second, we reanalyzed data using both random- and fixed-effects models or excluding the trials in which the grafts were assessed by CTA. Third, we evaluated publication bias using a funnel plot.

Results

Twelve randomized controlled trials [7–9, 12–20] published between 2003 and 2012 met the inclusion criteria (Fig 1). These studies included a total of 8,031 grafts with different follow-up times, from 21 days to 8 years; 48.5% were in the OPCAB group and 51.5% were in the ONCAB group. Puskas and colleagues [8, 21] and Lingaas and associates [14, 22] published 2 studies each at different follow-up points in the same group of patients; only the studies [8, 14] with a longer follow-up period were finally included in the meta-analysis. Our 2 reviewers had 100% agreement on data extraction. All trials were prospective randomized trials. A few trials used right internal mammary and gastroepiploic artery grafts, but the number was too small to be analyzed.

Table 1 presents the characteristics of the included trials. Table 2 presents the results of sensitivity analysis of the outcomes of interest.

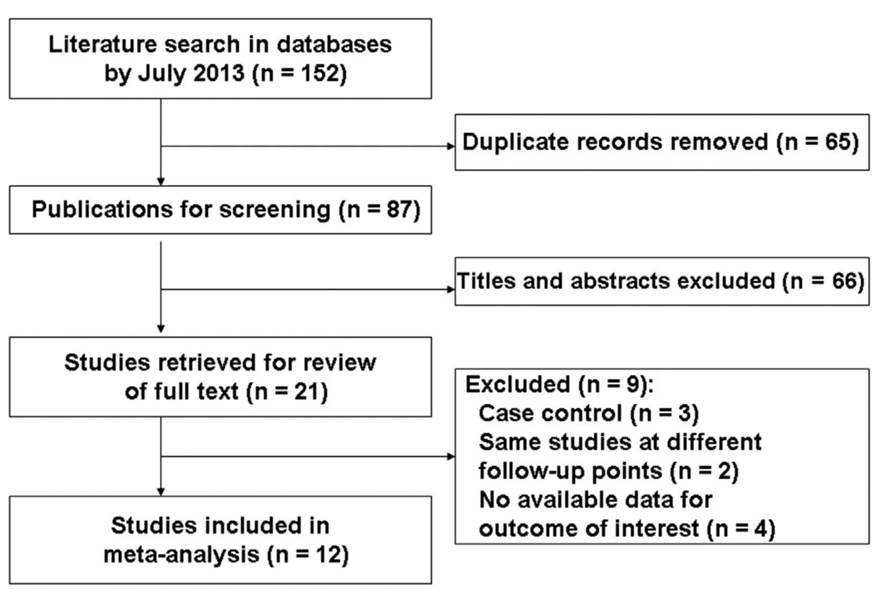

Fig 1. Flow diagram of selected studies.