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Coronary Artery Bypass Graft Surgery Versus Percutaneous Coronary Intervention With First-Generation Drug-Eluting Stents

A Meta-Analysis of Randomized Controlled Trials

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Objectives This study sought to compare the efficacy of coronary artery bypass graft surgery (CABG) to that of percutaneous coronary intervention (PCI) with first-generation drug-eluting stents among patients with multivessel disease (MVD), unprotected left main (LM) disease, and single-vessel proximal left anterior descending (LAD) disease.

Background The efficacy and safety of CABG versus PCI with drug-eluting stents in patient subgroups remains controversial.

Methods We systematically searched Cardiosource, Circulation, Clinicaltrials.gov, the Cochrane Library, EMBASE, and Medline for articles published through June 2013 for randomized controlled trials comparing CABG with PCI. Primary endpoints included mortality, myocardial infarction, revascularization, and stroke. Data were meta-analyzed with random-effects models.

Results We identified 7 randomized controlled trials (N = 5,835): 2 of MVD (n = 2,410, 100% diabetic), 2 of LM disease (n = 1,206, 29.0% diabetic), 1 of 3-vessel or LM disease (n = 1,900, 25.5% diabetic), and 2 of single-vessel proximal LAD disease (n = 319, 36.3% diabetic). In MVD patients, CABG reduced the risk of mortality (risk ratio [RR]: 0.70, 95% confidence interval [CI]: 0.57 to 0.87), myocardial infarction (RR: 0.47, 95% CI: 0.36 to 0.61), and repeat revascularization (RR: 0.36, 95% CI: 0.24 to 0.52), but increased stroke risk (RR: 1.72, 95% CI: 1.02 to 2.90). In patients with LM disease, CABG reduced revascularization risk (RR: 0.60, 95% CI: 0.46 to 0.78) and increased stroke risk (RR: 2.89, 95% CI: 1.15 to 7.27). Data for patients with single-vessel proximal LAD disease were inconclusive.

Conclusions CABG is more efficacious than is PCI with first-generation drug-eluting stents in patients with LM and MVD, at the cost of increased rates of stroke. No conclusion can be drawn for patients with single-vessel proximal LAD disease. (J Am Coll Cardiol Intv 2014;7:497–506) © 2014 by the American College of Cardiology Foundation

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The efficacy and safety of coronary artery bypass graft surgery (CABG) versus percutaneous coronary intervention (PCI) with first-generation drug-eluting stents (DES) remains controversial for the treatment of various patient subgroups.

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Although this topic has been researched in many observational studies (1–5), the recommended procedural choice for patients within subgroups of vessel disease remains unclear due to a lack of data from randomized controlled trials (RCTs). Therefore, our objective was to conduct a meta-analysis of RCTs comparing the efficacy and safety of CABG to that of PCI with first-generation DES among patients with multivessel disease (MVD), unprotected left main (LM) disease, and single-vessel proximal left anterior descending artery (LAD) disease.

Abbreviations and Acronyms

CABG = coronary artery bypass graft surgery
CI = confidence interval
DES = drug-eluting stent(s)
EES = everolimus-eluting stent(s)
HR = hazard ratio
LAD = left anterior descending
LM = left main
MI = myocardial infarction
MIDCAB = minimally invasive direct coronary artery bypass graft surgery
MVD = multivessel disease
PES = paclitaxel-eluting stent(s)
PCI = percutaneous coronary intervention
RCT = randomized controlled trial(s)
RR = risk ratio
SES = sirolimus-eluting stent(s)

Methods

Search strategy. We systematically searched the Cochrane Library, EMBASE, and Medline for articles published through June 2013, with the terms "coronary angiography" and "coronary artery bypass surgery" and "coronary artery bypass graft" and "drug-eluting stents". The search was restricted to RCTs conducted in humans and published in English. In addition, we searched Cardiosource, Circulation, and Clinicaltrials.gov, and we hand-searched the bibliographies of previous studies, relevant reviews, and previous meta-analyses to identify additional studies not found by our initial search. We conducted and reported our meta-analysis according to guidelines described in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (6) statement.

Study selection. We restricted inclusion to RCTs that compared the efficacy and safety of CABG to that of PCI with first-generation DES, as well as reported outcomes of mortality, myocardial infarction (MI), revascularization, or stroke. In addition, we only included trials in which the majority of patients who underwent PCI received DES. All studies not published in English were excluded.

Data extraction. Data extraction was performed by 2 reviewers, with disagreements resolved by consensus or by a third reviewer. Extracted data included study design, enrollment period, duration of follow-up, vessel subtypes (MVD, LM disease, proximal LAD disease), and the number of patients assigned to each group. Baseline participant characteristics included age, sex, body mass index, type 2 diabetes mellitus, systemic hypertension, dyslipidemia, previous MI, mean ejection fraction, and smoking. Extracted outcomes of interest were all-cause mortality, MI, revascularization, and stroke. Outcome data were extracted as count data following an intention-to-treat approach at the maximum available follow-up for all trials but FREEDOM (Future Revascularization Evaluation in Patients With Diabetes Mellitus: Optimal Management of Multivessel Disease), where 5-year results were extracted.

Quality assessment. We used the Cochrane Collaboration tool for assessing risk of bias to determine the quality of included RCTs (7). This tool assesses the risk of selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias. Each RCT is categorized on the basis of criteria determining the likelihood of potential threats to validity. Quality assessment was independently performed by 2 reviewers.

Data analysis. We used DerSimonian-Laird random-effects meta-analysis models with inverse variance weighting to calculate relative risks and corresponding 95% confidence intervals (CIs). In our primary analyses, we restricted inclusion to trials in which all patients in the PCI group received DES. In sensitivity analyses, we included RCTs in which the majority of patients received DES rather than bare-metal stents. The amount of heterogeneity present was estimated using the I^2 statistic. To examine potential sources of heterogeneity, we stratified our analyses by the following 3 types of coronary disease: MVD, LM disease, and proximal LAD disease. We visually inspected funnel plots and used the Egger test to assess publication bias. All analyses were conducted using Stata (version 11.2, Stata Corp., College Station, Texas).

Results

Search results. A total of 6,431 potentially relevant studies were identified in our initial literature search (Fig. 1). After screening the titles and abstracts of these studies, the full-length texts of 68 potentially relevant publications were retrieved and assessed for eligibility. Of these, 7 studies met our inclusion criteria and were included in our meta-analysis. No additional studies were identified through our manual search of references of published studies, relevant reviews, and previous meta-analyses.

Study characteristics. The earliest RCT we identified comparing CABG with PCI with first-generation DES was published in 2005. Included studies had sample sizes ranging from 130 to 1,900 patients and had follow-up durations ranging from 6 to 60 months (Table 1). Three RCTs (8–10) and a subgroup analysis (11) from the SYNTAX (Synergy