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Percutaneous coronary intervention with drug-eluting stent versus coronary artery bypass grafting: A meta-analysis of patients with left main coronary artery disease

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ABSTRACT

Background: The relative efficacy and safety of percutaneous coronary intervention (PCI) with drug-eluting stents (DES), in comparison to coronary artery bypass grafting (CABG) for left main coronary artery disease (LMCAD) remains controversial.
Methods: We performed a meta-analysis of randomised studies comparing patients with LMCAD treated with PCI with DES versus those treated with CABG, with respect to clinical outcomes at 1, 3 and 5 years. A secondary meta-analysis was performed according to low (<32), or high (≥33) SYNTAX score.
Results: Five studies comprising 4595 patients were included. There was no significant difference in all-cause death at all time points or when stratified with respect to SYNTAX score. The need for repeat revascularization was significantly higher with PCI at all time-points, and regardless of SYNTAX score. There was significant association between need for repeat revascularization with PCI and diabetics ($p = 0.04$). At 5 years, non-fatal MI was higher with PCI owing to increased non-procedural events (OR 3.00; CI 1.45–6.21; $p = 0.003$). CABG showed higher rate of stroke at 1 year (OR 0.21; CI 0.07–0.63; $p = 0.005$). There was no difference in non-fatal MI or stroke at other time points, nor according to SYNTAX score.
Conclusions: PCI with DES or CABG are equivalent strategies for LMCAD up to 5 years with respect to death, regardless of SYNTAX score. PCI increases the rate of non-procedural MI at 5 years. CABG avoids the need for repeat revascularization, especially in diabetics, but this benefit is offset by higher rate of stroke in the first year of follow up.

1. Introduction

Coronary artery bypass grafting (CABG) is considered the gold standard for the vast majority of patients with left main coronary artery disease (LMCAD) [1,2]. However, over the past decade, there have been a number of studies reporting comparable results between percutaneous coronary intervention (PCI) with drug-eluting stents (DES) and surgical revascularization for the treatment of LMCAD [3–5]. This has been attributed to advances in stent technology, intra-procedural imaging allowing stent optimization, as well as advances in pharmacotherapy to reduce peri-procedural and long term thrombosis risk and restenosis. Consequently, there has been uncertainty regarding the optimal revascularization strategy, especially in light of the recent publication of two additional dedicated multi-centre randomised trials of LMCAD [6,7].

Although previous meta-analyses comparing PCI with DES and CABG have demonstrated equipoise between the two strategies, the analyses included observational data [3–5]. A recent meta-analysis of randomised trial data from the longest available follow-up has demonstrated no difference in clinical outcomes between PCI with DES and CABG in patients with LMCAD [8]. Our aim was to perform a comprehensive systematic review and meta-analysis of randomised clinical trials in order to evaluate clinical outcomes at short (1 year), medium (3 years) and long (5 years) follow-up duration, and stratify according

Abbreviations: CABG, coronary artery bypass grafting; DAPT, dual antiplatelet therapy; DES, drug-eluting metal stents; LMCAD, left main coronary artery disease; MACCE, major adverse cardiovascular and cerebrovascular events; MI, myocardial infarction; PCI, percutaneous coronary intervention.

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to coronary disease complexity using the SYNTAX (Synergy Between Percutaneous Coronary Intervention With TAXUS and Cardiac Surgery) score.

2. Methods

2.1. Study objectives and design

The outcomes of interest were all-cause death, non-fatal myocardial infarction (MI), repeat revascularization, stroke, defined according to the original study protocols, at 1, 3 and 5 years. We also performed a secondary meta-analysis according to SYNTAX score, bimodally classified as low (<32) or high SYNTAX score (≥33) at maximum follow-up duration. A SYNTAX score cut-off of >33 was found to be useful in distinguishing high risk patients after PCI [9,10]. Inclusion criteria were randomised controlled trials comparing PCI with DES versus CABG for LMCAD, and reporting clinical outcomes. The study was designed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) statement [11] and Cochrane methodology [12]. A complete PRISMA 2009 checklist has been followed to guide reporting of our meta-analysis.

2.2. Study search strategy

Using Medline, Embase, Scopus, and the Cochrane Library, we performed searches of articles published until December 2016, without language restrictions. Eligible studies were identified using various combinations of the terms: left main, drug-eluting stent, percutaneous, coronary, myocardial infarction, angina, angioplasty, bypass, grafting, and intervention in the abstract or title. Reference lists of the retrieved articles were reviewed to identify further eligible studies. When two similar studies were reported from the same institution, the most recent publication was included in the analysis. Two reviewers independently reviewed all titles, or titles and abstracts from the search results to identify articles according to fulfillment of inclusion criteria. Selected trials were compared, and disagreement was resolved by team discussion and consensus. Studies were excluded from the meta-analysis if they were duplicates, single-arm studies or included the use of bare-metal stent (Supplemental Fig. 1).

2.3. Data extraction

Data extraction was carried out independently and in duplicate by the study investigators. Results of data extraction were then compared, and discrepancies resolved by consensus. If results were incomplete or unclear, the study authors were contacted. Articles selected for the final review were checked to avoid inclusion of data published in duplicate. Data were collated from each study regarding baseline characteristics, including sample characteristics, dual antiplatelet duration, stent type, EuroSCORE, SYNTAX score, and clinical outcomes at 1, 3 and 5 years. All outcomes were defined according to the original study's protocol definition [Supplemental Table 1]. If target vessel revascularization was not reported, we used all repeat revascularizations instead. All-cause death data were used in the analysis, as cardiovascular death data were incomplete at our chosen time points of interest. Of note, peri-procedural MI was included in 4 trials [7,9,13,14], whereas 1 trial only assessed non-procedural MI [6].

2.4. Statistical analysis

Pooled odds ratio (OR) with 95% confidence interval (CI) were estimated for binary variables using a random-effects model by the method of DerSimonian and Laird [15]. A pooled analysis of the hazard ratio with 95% CI was also reported [Supplemental Table 2]. Heterogeneity between individual studies was explored by X^2 statistic and characterized with I^2 statistic. In sensitivity analysis, we included only studies that included patients who had non-procedural MI at 5 years. We examined the following relationships; (1) the log-transformed OR of the effect of PCI with DES on repeat revascularization risk and the log-transformed OR of the effect of PCI with DES on non-fatal MI risk at maximum follow-up duration, (2) the log-transformed OR of the effect of PCI with DES on repeat revascularization risk at maximum follow-up duration and the trial reported percentage of distal bifurcation or trifurcation involvement, and (3) the log-transformed OR of the effect of PCI with DES on repeat revascularization risk at maximum follow-up duration and the trial reported percentage of patients with diabetes mellitus.

The results from meta-analysis were shown using forest-plot. Publication bias was minimised by a comprehensive and inclusive literature search. In addition, funnel plot was used to investigate publication bias. All tests were two-sided, and statistical significance was fixed at 0.05 level. Analysis was carried out using Review Manager Software (RevMan V. 5.3) and Stata V. 11.2 (StataCorp, College Station, Texas, USA).

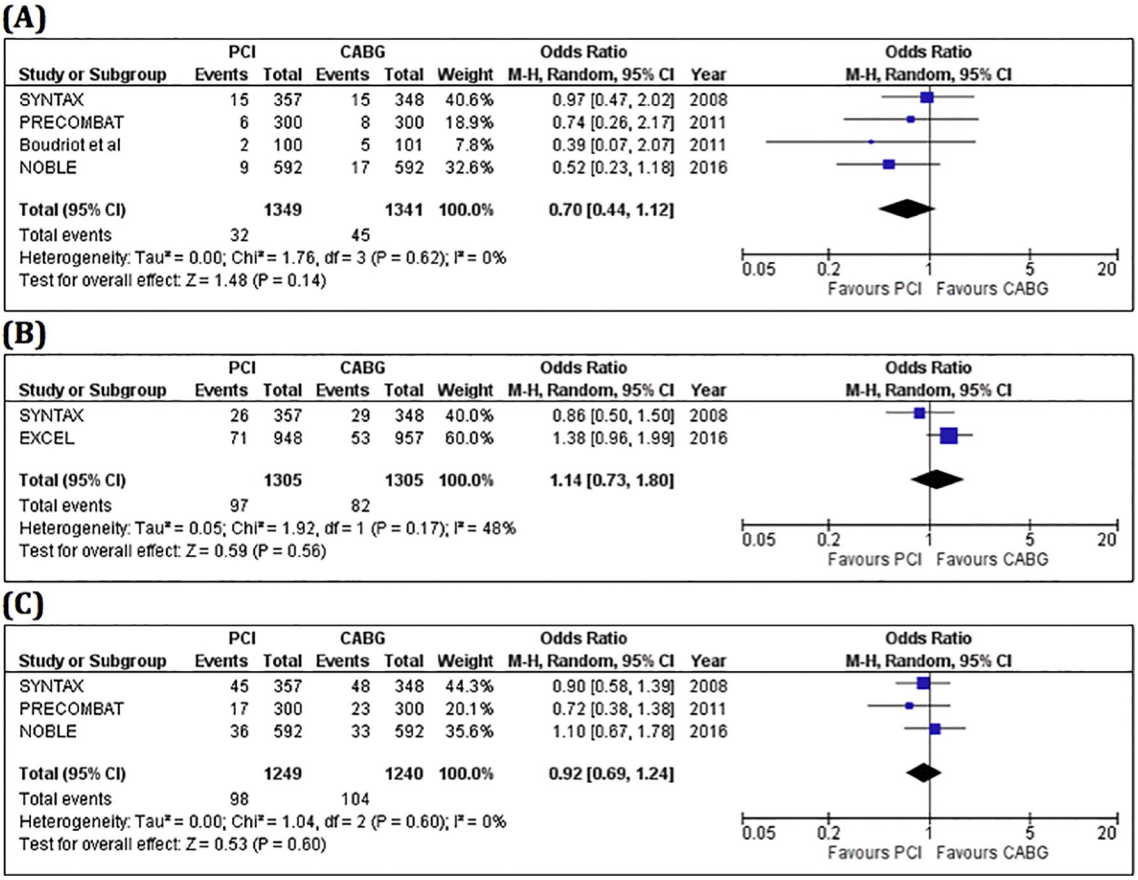

Fig. 1. Death with PCI with DES versus CABG in randomised studies in LMCAD. (A) 1 year, (B) 3 years and (C) 5 years.

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