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Drug-eluting stents versus coronary artery bypass grafting for the treatment of coronary artery disease: A meta-analysis of randomized and nonrandomized studies

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Background: We performed the present systematic review and meta-analysis of randomized and nonrandomized comparative studies in an attempt to compare the safety and efficacy of drug-eluting stents with coronary artery bypass grafting for patients with coronary artery disease.

Methods: Twenty-five eligible comparative studies (1 randomized and 24 nonrandomized) were assessed. Two reviewers independently appraised each study. Meta-analysis was performed by combining the results of reported incidence of morbidity, mortality, and repeat revascularization. The relative risk was used as a summary statistic.

Results: In these 25 studies 34,278 patients were compared, of whom 18,538 received drug-eluting stents and 15,740 underwent coronary artery bypass grafting. It must be acknowledged that this comparison represented a selected group of patients who received drug-eluting stents or underwent coronary artery bypass grafting. The accumulative incidences of all-cause mortality at 12 months (4.5% vs 4.0%, $P = .92$) and 24 months (6.2% vs 8.4%, $P = .27$) and 30-day myocardial infarction (1.4% vs 2.0%, $P = .60$) were similar, respectively, between the drug-eluting stent and coronary artery bypass grafting groups. Drug-eluting stents were associated with lower rates of all-cause mortality at 30 days (0.9% vs 2.3%, $P < .001$), stroke (0.4% vs 1.7%, $P < .001$), and 30-day major adverse cardiac and cerebrovascular events (3.6% vs 5.5%, $P < .04$). However, the coronary artery bypass grafting group had a lower incidence of postprocedural myocardial infarction (5.5% vs 4.7%, $P = .03$), repeat revascularization (22.2% vs 4.1%, $P < .001$), and 12-month major adverse cardiac and cerebrovascular events (16.7% vs 10.5%, $P < .001$). Subgroup analysis of patients with multivessel coronary artery disease showed similar results.

Conclusions: Drug-eluting stents are associated with less periprocedural risks but a higher incidence of postprocedural myocardial infarction, repeat revascularization, and 12-month major adverse cardiac and cerebrovascular events compared with coronary artery bypass grafting. (J Thorac Cardiovasc Surg 2011;141:1134-44)

Coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) are alternative revascularization techniques for symptomatic patients with coronary artery disease.[1] Increased experience with PCI and improved technological advent have expanded its use in patients with severe coronary artery disease and complex anatomic lesions. A meta-analysis by Mercado and colleagues[2] comparing randomized controlled trials (RCTs) of PCI with bare metal stents (BMSs) versus CABG demonstrated similar degrees of protection against death, myocardial infarction, and stroke for patients with multivessel coronary artery disease at 1 year after the initial procedure. However, repeat revascularization procedures remained more likely after use of BMSs. A subsequent meta-analysis by Daemen and coworkers[3] comparing RCTs on the long-term outcomes between PCI with BMSs and CABG (the Stent of Surgery trial, the Arterial Revascularization Therapies Study, Edstudio Randomizado Argentino de Angioplastia vs Cirugia II, and the Medicine, Angioplasty or Surgery Study II) indicated that BMSs were associated with a long-term safety profile similar to that of CABG but also reinforced higher revascularization and major adverse cardiac and cerebrovascular events (MACCEs) in the BMS group.[3]

Drug-eluting stents (DES) demonstrate similar rates of death and myocardial infarction but reduced rates of repeat

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Abbreviations and Acronyms

BMS = bare metal stent
CABG = coronary artery bypass grafting
CI = confidence interval
DES = drug-eluting stent
MACCE = major adverse cardiac and cerebrovascular event
PCI = percutaneous coronary intervention
RCT = randomized controlled trial
RR = relative risk
SYNTAX = Synergy Between PCI with Taxus and Cardiac Surgery

revascularization compared with BMSs,[4] thus increasing the percentage of patients with multivessel disease treated with PCI. However, recent data suggested a higher rate of thrombotic occlusion with DESs than BMSs.[5] The recent Synergy Between PCI with Taxus and Cardiac Surgery (SYNTAX) trial compared DESs versus CABG in patients with triple-vessel or left main coronary artery disease.[6] This RCT demonstrated that at 12 months the rates of death and myocardial infarction were similar between the 2 groups, but DESs were associated with a significantly higher rate of MACCEs (17.8% vs 12.4%, $P = .002$) and lower rate of stroke (0.6% vs 2.2%, $P = .003$). As is generally true with RCTs, the study population is predefined and hence subject to trial design bias. We performed the present systematic review and meta-analysis of the randomized and nonrandomized comparative studies in an attempt to assess the safety and efficacy of DESs versus CABG with the current clinical evidence.

METHODS

Search Strategy

Electronic searches were performed in 6 databases from their inception to September 2009: Medline, Embase, Pubmed, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Database of Abstracts of Review of Effectiveness. To achieve the maximum sensitivity of the search strategy and identify all trials comparing DESs and CABG, we used appropriate free text and thesaurus terms, including ''percutaneous coronary intervention,'' ''coronary angioplasty,'' ''coronary artery stenting,'' ''drug-eluting stent,'' and ''coronary artery bypass

TABLE 1. Summary of 25 comparative studies included in the present systematic review

Reference	Study design	Study population	Study period	No. of patients		Age of cohort (mean ± SD)		Ejection fraction (mean ± SD)	
				DES	CABG	DES	CABG	DES	CABG
Ben-Gal and coworkers[9]	OC	DM	2002–2005	86	86	NA	NA	NA	NA
Ben-Gal and coworkers[10]	OC	LAD	2002–2003	83	83	NA	NA	NA	NA
Briguori and coworkers[11]	OC	MVD, LAD, DM, OPCAB	2002–2004	69	149	63 ± 9	66 ± 9	54 ± 12	53 ± 9
Cheng and coworkers[12]	OC	LMCAD	2000–2007	94	216	68 ± 10	67 ± 9	56 ± 17	56 ± 20
Chieffo and coworkers[13]	OC	LMCAD	2002–2004	107	142	64 ± 10	68 ± 10	52 ± 10	52 ± 11
Domínguez-Franco and coworkers[14]	OC	MVD, LAD, DM	2000–2004	128	142	68	65	52 ± 13	54 ± 14
Gioia and coworkers[15]	OC	LV dysfunction	2002–2005	128	92	69 ± 10	68 ± 10	28 ± 6	27 ± 8
Hannan and coworkers[16]	OC	MVD	2003–2005	9963	7437	65 ± 12	66 ± 11	NA	NA
Hong and coworkers[17]	OC	LAD	2003	119	70	61 ± 10	61 ± 10	53 ± 9	52 ± 9
Javaid and coworkers[18]	OC	MVD	NA	979	701	66 ± 11	65 ± 11	NA	NA
Kukreja and coworkers[19]	OC	MVD, LAD	1997–2003	289	206	63 ± 10	62 ± 9	59 ± 12	61 ± 13
White and coworkers[20]	OC	LMCAD	2003–2005	50	123	72 ± 15	70 ± 10	51 ± 15	52 ± 10
Li and coworkers[21]	OC	MVD	2004–2005	1834	1886	58 ± 10	61 ± 9	NA	NA
Mäkikallio and coworkers[22]	OC	LMCAD	2005–2007	49	238	72 ± 10	70 ± 9	55 ± 12	54 ± 11
Moshkovitz and coworkers[23]	OC	LAD, OPCAB	2002–2003	116	116	NA	NA	NA	NA
Palmerini and coworkers[24]	OC	LMCAD	2003–2006	98	161	81*	78*	50*	53*
Park and coworkers[25]	OC	MVD	2003–2005	1547	1495	62 ± 10	62 ± 9	59 ± 9	56 ± 11
Sanmartín and coworkers[26]	OC	LMCAD	2000–2005	96	245	66 ± 13	66 ± 10	NA	NA
Serruys and coworkers[6]	RCT	MVD or LMCAD	2005–2007	903	897	65 ± 10	65 ± 10	NA	NA
Tarantini and coworkers[27]	OC	MVD, DM	2004–2005	93	127	65 ± 9	67 ± 7	62 ± 14	62 ± 14
Toutouzas and coworkers[28]	OC	LAD, DM	2001–2006	39	38	59 ± 13	61 ± 10	48 ± 7	49 ± 9
van Domburg and coworkers[29]	OC	MVD or LMCAD	2002	798	275	62 ± 11	64 ± 11	NA	NA
Yang[30]	OC	MVD	2003–2004	235	231	65 ± 10	65 ± 10	51 ± 9	50 ± 11
Yang and coworkers[31]	OC	MVD	2003–2005	441	390	63 ± 10	63 ± 8	58 ± 12	53 ± 14
Yi and coworkers[32]	OC	MVD, OPCAB	2003–2005	194	194	63 ± 10	62 ± 9	NA	NA

SD, Standard deviation; *DES*, drug-eluting stent; *CABG*, coronary artery bypass grafting; *OC*, observational cohort; *DM*, diabetes mellitus; *NA*, not applicable; *LAD*, left anterior descending coronary artery; *MVD*, multivessel disease; *OPCAB*, off-pump coronary artery bypass; *LMCAD*, left main coronary artery disease; *LV*, left ventricle; *RCT*, randomized controlled trial. *Median.