DESs in Multivessel Disease

Lessons learned from large registry experience.

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For patients with limitation of ordinary physical activity secondary to angina and disease in one or two vessels, it is generally considered reasonable to perform percutaneous coronary intervention (PCI) for relief of symptoms.[1] In the near term, PCI relieves angina and ischemia better than optimal medical therapy, and significant reductions in ischemia (≥5% of the myocardium) are associated with a trend toward reductions in death or myocardial infarction (MI) in patients with moderate-to-severe ischemia (≥10% ischemic myocardium).[2] PCI is also considered reasonable in patients with two- or three-vessel disease unless they have diabetes or reduced left ventricular function and are eligible for coronary artery bypass grafting (CABG) with an arterial conduit.[1] For patients with three-vessel disease or two-vessel disease involving the proximal left anterior descending (LAD) artery with high-risk features, data from prospective randomized trials and multiple observational studies suggest CABG should generally be performed.[3]

The preceding guidelines regarding methods of revascularization for coronary disease in the setting of chronic stable angina are largely derived from data initially comparing medical therapy to CABG, followed by PCI with balloon angioplasty to CABG, and then PCI with bare-metal stent (BMS) placement to CABG. Over the years, there have been considerable advances in the optimal medical therapy of coronary artery disease and in the techniques for both PCI and CABG. With CABG, methods of myocardial protection and anesthetic techniques were refined, whereas PCI has seen the development of newer periprocedural medications to include dual-antiplatelet therapy and advanced stent designs.[3,4]

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One of the more exciting developments for PCI has been the development and regulatory approval of drug-eluting stents (DESs). Contemporary data suggest that the relative reduction in target vessel revascularization (TVR) approaches 50% compared to BMS placement, with less than 10% of patients requiring repeat procedures.[5,6] Following the development of newer technologies such as DESs, accepted standards are bound to be questioned. The first challenge was defining the role of DESs in single-vessel disease, which has largely been identified, whereas the second and ongoing challenge is defining the role of DES efficacy and safety in multivessel disease. Although large randomized prospective trials are ongoing, it is important to evaluate the currently available data on DESs in multivessel disease.

CURRENT UTILIZATION OF DESs

In 2005, 2 years after DESs were initially approved, more than 90% of patients treated with stents in the US received a DES. Reports of stent thrombosis and increased event rates late after delivery tempered the initial enthusiasm, with the proportion of DES use

TABLE 1. MULTIVESSEL PCI (BMS) VERSUS CABG

Trial	No. of Patients Randomized	Follow-Up (y)	Death (%)	MI (%)	Angina Relief (%)	Repeat Revascularization (%)
ARTS[10]	1,205	5	No Δ	No Δ	CABG* 85 vs 79	CABG 9 vs 30
AWESOME[11]	454	5	No Δ	-	No Δ	CABG 4 vs 11
ERACI II[12]	450	5	No Δ	No Δ	CABG 92 vs 85	CABG 8 vs 29
MASS II[13]	611†	5	No Δ	No Δ	PCI 77 vs 74	CABG 4 vs 33
SoS[14]	988	2	CABG 1 vs 3	PCI 5 vs 8	PCI 79 vs 66	CABG 6 vs 21

**Procedure represents superior therapy.*
†203 patients assigned to medical therapy.

declining to 60% to 70%.[4,7,8] In 2007, however, a pooled analysis from randomized trials of DESs in single-vessel coronary disease confirmed the long-term benefits in repeat target lesion revascularization and TVR when compared to BMSs.[6] The 40% to 60% reduction in TVR was not associated with any significant increase in either death or MI, despite a small increase in late stent thrombosis with DESs. Reassessment of an additional year of real-world experience from the Swedish Coronary Angiography and Angioplasty Registry (SCAAR) was also reassuring, as a large cohort including 13,785 patients treated with DES confirmed a 50% reduction in clinical restenosis without any significant difference in mortality or MI at 4 years (European Society of Cardiology Congress 2007).[7]

The equipoise between DESs and BMSs in mortality or MI and reduction in repeat TVR with DESs utilized both on and off label was recently confirmed in the National Heart, Lung, and Blood Institute Dynamic Registry. Even with off-label use (1,312 DESs and 2,110 BMSs), TVR was reduced by 37%. Subgroups appearing not to benefit from the expected drug-eluting effects on restenosis were those treated for restenosis or disease in a large-diameter vessel to include the left main coronary artery.[9]

BMS EXPERIENCE IN MULTIVESSEL DISEASE

The role of DESs in multivessel disease is less clear. A number of randomized clinical trials compared PCI with BMS versus CABG. With the exception of the Stent or Surgery (SoS) trial, there appeared to be no significant difference in the hard outcomes of either death or MI between the means of revascularization (Table 1). A consistent finding, however, was that repeat revascularization was required significantly more often with PCI than with CABG. A concerning finding from the largest of the trials (the Arterial Revascularization Therapies Study [ARTS]) revealed that patients in the diabetic subgroup demonstrated a trend toward increased mortality with stenting versus CABG.[10] In ARTS, diabetic patients who received stents had a statistically significant higher mortality rate and need for repeat revascularization than nondiabetic patients receiving stents (13.4% vs 6.8%; *P*=.03 and 42.9% vs 27.5%; *P*=.002, respectively). There was no statistically significant difference in mortality between diabetic and nondiabetic patients who underwent CABG.

The Diabetic Subgroup—Historical Perspectives From BARI

The subgroup analysis of diabetics in the ARTS trial mimicked the often-discussed results of the Bypass Angioplasty Revascularization Investigation (BARI) trial.[15] In the final 10-year follow-up of the BARI trial, which compared PCI with angioplasty versus CABG in multivessel disease (n=1,829), there was no significant difference in survival in the overall population (71% for angioplasty and 73.5% for CABG). For those with treated diabetes, survival was significantly better with CABG (57.9% vs 45.5%). In BARI, *treated diabetes* referred to a nonprespecified subgroup analysis of patients on either oral therapy or insulin therapy without regard to the presence of untreated diabetes in the control group. This survival benefit was restricted to diabetics who received at least one arterial graft (10-year survival was 64.3% vs 39.4%). Interestingly, although there was no difference in MI between PCI and CABG, CABG seemed to offer its greatest benefit to diabetics after spontaneous Q-wave MI. There was no difference in survival among patients without treated diabetes who received

either an arterial graft or vein grafts and, likewise, there was no difference in survival after Q-wave MI.

TRIALS OF DESs WITH HISTORIC CONTROLS

There are no large randomized clinical trials that have been published comparing DESs with CABG in multivessel disease. Trials comparing DESs versus historic BMS controls in multivessel disease have been performed. The ARTS II registry was designed to assess the efficacy of the sirolimus-eluting stent in patients (n=607) with multivessel coronary artery disease compared with those of the surgical (n=605) and PCI (n=600) arms of the ARTS I study, as measured by major adverse cardiac and cerebrovascular event (MACCE)-free survival at 1 year.[16] At 1 year, the results with the sirolimus-eluting stent were intermediate to that of the historic ARTS I-PCI and ARTS I-CABG arms for repeat revascularization (21.3%, 8.5%, and 4.2%, respectively). Use of DESs was, however, associated with a lower frequency of death, stroke, or MI, resulting in similar overall cardiac and cerebrovascular events with PCI with DES in ARTS II and CABG in ARTS. The Argentine Randomized Trial of Coronary Stents versus Bypass Surgery (ERACI III) trial prospectively enrolled 225 patients and compared their rates of MACCE after receiving DESs with those 500 patients in ERACI II who underwent either PCI with BMS or CABG. MACCE at 1 year was better with DESs versus CABG, whereas the MACCE rate was equivalent (22.7%) at 3 years.[17] In ERACI III, the rate of stent thrombosis was 3.1% and temporally related to discontinuation of dual-antiplatelet therapy in six of seven patients.

ONGOING RANDOMIZED CLINICAL TRIALS

Ongoing clinical trials of DESs in multivessel disease include SYNTAX (SYNergy between percutaneous coronary intervention with TAXus and cardiac surgery), the NIH-sponsored FREEDOM (Future Revascularization Evaluation in Patients with Diabetes Mellitus: Optimal Management of Multivessel Disease), and VA CARDS (Coronary Artery Revascularization in Diabetes). SYNTAX is a multicenter trial that has randomized 1,500 patients with either three-vessel disease or left main disease to PCI with paclitaxel-eluting stents or CABG.[18] FREEDOM is enrolling only diabetic patients and will compare PCI with either sirolimus-eluting or paclitaxel-eluting stents versus CABG in 2,400 patients.[19] VA CARDS, like FREEDOM, is a randomized, multisite study of an estimated 790 diabetic patients with clinical indications for revascularization who will undergo either PCI with DESs or CABG (www.clinicaltrials.gov registration number NCT00326196).

SMALL REGISTRIES OF DESs VERSUS CABG IN MULTIVESSEL DISEASE

Multiple observational studies now exist that compare PCI with DESs and CABG in multivessel disease. At least three small (<1,000 patients) single-center registries have been published within the past year (Table 2).[20-22] The authors of these studies conclude that there is no difference in the short-term composite outcomes of death, MI, or stroke, but there is a clear and consistent benefit in repeat revascularization with CABG. The rates of repeat revascularization, although better than historic BMS trials (Table 1), may have been driven by incomplete revascularization during the index procedure. In a study by Yang et al, the rate of complete functional revascularization as defined by a lesion of ≥75% diameter stenosis was only 62.4% with DESs, whereas the rate for complete anatomic revascularization as defined by a lesion severity of >50% diameter stenosis was 97.9% in the CABG group.[21] In a study by Briguori et al, the average number of conduits placed during

TABLE 2. MULTIVESSEL PCI (DES) VERSUS CABG, SMALL REGISTRIES (<1,000 PATIENTS)

Registry	No. of Patients (PCI/CABG)	Population	Follow-Up (y)	Death	MI (%)	Stroke	Repeat Revascularization (%)
Briguori et al[20] (2007)	69/149	Diabetes mellitus; single center; Naples, Italy	1	No Δ	No Δ	No Δ	CABG* 5 vs 19
Yang et al[21] (2008)	441/390	Single center; Seoul, Korea	1	No Δ	CABG 0.3 vs 1.4	No Δ	CABG 1 vs 11
Yang et al[22] (2007)	235/231	Single center; Shanghai, China	2	No Δ	No Δ	No Δ	CABG 3 vs 10

* *Procedure represents superior therapy.*

TABLE 3. MULTIVESSEL PCI (DES) VERSUS CABG, LARGE REGISTRIES (>1,000 PATIENTS)

Registry	No. of Patients (PCI/CABG)	Population	Follow-Up (mo)	Death* (Survival % or HR†)		MI* (%) or MACCE (HR†)		Repeat Revascularization (%)	
				Two-vessel disease	Three-vessel disease	Two-vessel disease	Three-vessel disease		
Hannan et al[23] (2008)	9,963/7,463	NY state registries	18	CABG‡ 94 vs 92.7	CABG 96.0 vs 94.6	MI CABG 7.9 vs 10.3	MI CABG 5.5 vs 7.5	CABG‡ 5.2 vs 30.6	
Javaid et al[24] (2007)	879/701	Single center; Washington, DC	12	CABG 3.3	CABG 3.89	MACCE CABG 2.29	MACCE CABG 2.9	Two-vessel CABG§ 5.6 vs 13.3	Three-vessel CABG§ 5.7 vs 18.8

**Risk adjusted by proportional-hazards models.*
†Hazard ratio (HR) after multivariate adjustment for age, gender, dyslipidemia, diabetes, LAD involvement, previous CABG, peripheral vascular disease, chronic renal insufficiency..
‡Procedure represents superior therapy.
§Target vessel failure.

CABG was 2.5, and the number of vessels treated during DES placement was 1.6. Complete revascularization as defined by treatment of all diseased arterial systems with stenosis ≥50% was 76% with CABG and 52% in the DES group. Additionally, an often-overlooked point when comparing the differences in the harder outcomes of death, MI, and TVR with the means of revascularization is the inconveniences and morbidity inherent to each technique. In the two trials that reported it, the length of initial hospital stay was significantly shorter after PCI (4 days) than for CABG (11–14 days).[20,22]

LARGE REGISTRIES OF DESs VERSUS CABG IN MULTIVESSEL DISEASE

Two large registries (>1,000 patients) have now been published comparing PCI with DESs and CABG (Tables 3 and 4),[23,24] the largest of which by Hannan et al compared 17,400 patients treated with either DES or CABG in New York state. The data from this very large registry have its origins in two databases within the state that collect information on all residents of New York state who undergo either CABG or PCI. The endpoints of the study included in-hospital mortality, death within 30 days after treatment, and death, death or MI, and revascularization up to 18 months after treatment (Table 3). Differences in risk-adjusted, long-term rates of death and of death or MI were investigated by developing stepwise Cox proportional-hazards models. Adjusted Kaplan-Meier survival curves were also constructed for patients with two- and three-vessel disease.

In the study by Hannan et al, clinical differences were present between the patients who underwent either PCI or CABG (Table 4). Those who underwent CABG were older, more likely to have three-vessel disease, and had lower ejection fractions. The investigators found that there were no significant differences in adjusted in-hospital or 30-day mortality rates. At 18 months, CABG was associated with lower adjusted rates of death and the composite of death or MI for patients with either two- or three-vessel disease. The association between CABG and lower mortality rates for patients with two-vessel disease was consistent for patients with and without involvement of the proximal LAD artery (adjusted HRs of 0.71 and 0.69, respectively). In the subgroups assessed that include diabetic patients, octogenarians, and those with an ejection fraction <40%, there was no difference in death, but there was a lower incidence of death or MI in octogenarians and those with a low ejection fraction, but not in diabetics. Of note, 28.4% of patients in the DES group would undergo repeat PCI, only one quarter of whom (7%) would require TVR (Table 5).

In the single-center study by Javaid et al, a total of 1,680 patients were identified who underwent either PCI with DES or CABG (Tables 3 and 4). Proportional hazard Cox regression models were used to adjust for baseline variances. In the 1,080 patients with two-vessel disease, those who underwent CABG had a lower prevalence of renal insufficiency, peripheral vascular disease, and a higher ejection fraction. In the 600 patients with three-vessel disease, those who underwent CABG had a lower prevalence of renal insufficiency and were less likely to have presented with unstable angina. The CABG patients in the three-vessel cohort had a lower

TABLE 4. CLINICAL CHARACTERISTICS OF PATIENTS INCLUDED IN LARGE REGISTRIES

	Hannah et al[23]		Javaid et al[24]			
	PCI (DES) N=7,437	CABG N=9,963	Two-Vessel Disease		Three-Vessel Disease	
			PCI (DES) N=884	CABG N=196	PCI (DES) N=95	CABG N=505
Age (y)	65.4	66	No Δ	No Δ	No Δ	No Δ
≥80 years (%)	12.7	10.7	–	–	–	–
White (%)	82.1	87.7	–	–	–	–
Male (%)	67.2	72.5	No Δ	No Δ	No Δ	No Δ
Dyslipidemia	–	–	86.3	76	No Δ	No Δ
Left ventricular ejection fraction ≥40 (%)	84.2	77.7	–	–	–	–
Left ventricular ejection fraction (%)	–	–	47	50	50	47
Previous MI (%)	33.7	47.5	–	–	–	–
Heart failure (%)	10.1	15.7				
Unstable angina (%)	–	–	45.9	13.3	35.1	19.1
Previous CABG (%)	0	0	15.6	5.6	10.6	4.5
Three-vessel disease (%)	69.9	14.9	–	–	–	–
Cerebrovascular disease (%)	7.7	17.3	–	–	–	–
Peripheral vascular disease (%)	7	10.7	15.6	11.7	No Δ	No Δ
Diabetes (%)	32.7	38.2	No Δ	No Δ	No Δ	No Δ
Renal failure (%)	3.7	4.2	12.8	5.1	12.9	4.9

average ejection fraction than those who underwent PCI. Their overall results at 1 year demonstrated that CABG was superior for the endpoints of death and MACCE than PCI with DESs. Subgroup analysis suggested that the difference in mortality and MACCE between CABG and PCI was limited to the diabetic subgroup because there was no statistically significant difference in outcomes in the nondiabetic population. In both the two- and three-vessel cohorts, target vessel failure was less with CABG (Table 3).

LIMITATIONS OF REGISTRY DATA

Many limitations exist to registry data, mainly secondary to its observational nature. Differences may exist between patients undergoing PCI or CABG that are overlooked or disregarded. As discussed in the accompanying editorial to the most recent New York state registry, one such covariate not included in the risk-adjustment model might be dementia.[25] Another covariate that might favor CABG would be the presence of chronic total occlusions on angiography. Beyond baseline clinical differences, there is also inherent selection bias when the patient, under advice from his or her physician, selects whether to pursue medical therapy,

> "Provocative data from a few large registries suggest that while we await data from ongoing randomized trials, CABG using arterial conduits remains the standard of care . . ."

TABLE 5. CHARACTERISTICS OF REPEAT REVASCULARIZATION		
	Hannah et al[23]	
	PCI (DES) N=7,437	CABG N=9,963
TVR (%)	7	–
Repeat Revascularization		
PCI (%)	28.4	5.1
CABG (%)	2.2	0.1

PCI, or CABG. Propensity analysis is a means to account for this selection bias, but ultimately, propensity analysis should only be considered as provocative and hypothesis generating. Results from large randomized clinical trials are needed to draw definitive conclusions.

CONCLUSION

The clinical utility of DES in the treatment of multivessel disease is still being defined. While trials like SYNTAX, FREEDOM, and VA CARDS are being completed, we have data from multiple observational studies to guide the use of DES in contemporary practice.

ARTS II and ERACI III suggested that, as in single-vessel disease, DESs will reduce the need for TVR safely if dual-antiplatelet therapy is not discontinued early.[16,17] A number of recently completed smaller registries suggest that PCI with DES is still not as effective as CABG in reducing the need for repeat intervention. Provocative data from a few large registries suggest that while we await data from ongoing randomized trials, CABG using arterial conduits remains the standard of care, particularly in diabetics who require multivessel coronary revascularization.[20-24] It is expected that after the completion of these ongoing trials, the medical community will have a better understanding of the role for DESs in multivessel disease versus CABG, and will have a better ability to make more informed recommendations to patients regarding optimal choices for revascularization. ■

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1. Smith SC Jr, Feldman TE, Hirshfeld JW Jr, et al. ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/SCAI Writing Committee to Update 2001 Guidelines for Percutaneous Coronary Intervention). Circulation. 2006;113:e166-e286.
2. Shaw LJ, Berman DS, Maron DJ, et al. Optimal medical therapy with or without percutaneous coronary intervention to reduce ischemic burden. Results from the Clinical Outcomes Utilizing Revascularization and Aggressive Drug Evaluation (COURAGE) trial nuclear substudy. Circulation. 2008;117:1283-1291.
3. Eagle KA, Guyton RA, Davidoff R, et al. ACC/AHA 2004 guideline update for coronary artery bypass graft surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1999 Guidelines for Coronary Artery Bypass Graft Surgery). Circulation. 2004;110:e340-e437.
4. King SB III, Smith SC Jr, Hirshfeld JW Jr, et al. 2007 focused update of the ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice guidelines. J Am Coll Cardiol. 2008;51:172-209.
5. Morice MC, Serruys PW, Sousa JE, et al. A randomized comparison of a sirolimus-eluting stent with a standard stent for coronary revascularization. N Engl J Med. 2002;346:1773-1780.
6. Stone GW, Moses JW, Ellis SG, et al. Safety and efficacy of sirolimus- and paclitaxel-eluting coronary stents. N Engl J Med. 2007;356:998-1008.
7. Lagerqvist B, James SK, Stenestrand U, et al. Long-term outcomes with drug-eluting stents versus bare-metal stents in Sweden. N Engl J Med. 2007;356:1009-1019.
8. Rodriguez AE, Mieres J, Fernandez-Pereira C, et al. Coronary stent thrombosis in the current drug-eluting stent era: insights from the ERACI III trial. J Am Coll Cardiol. 2006;47:205-207.
9. Marroquin OC, Selzer F, Mulukutla SR, et al. A comparison of bare-metal and drug-eluting stents for off-label indications. N Engl J Med. 2008;358:342-352.
10. Serruys PW, Ong AT, van Herwerden LA, et al. Five-year outcomes after coronary stenting versus bypass surgery for the treatment of multivessel disease: the final analysis of the Arterial Revascularization Therapies Study (ARTS) randomized trial. J Am Coll Cardiol. 2005;46:575-581.
11. Morrison DA, Sethi G, Sacks J, et al. Percutaneous coronary intervention versus coronary artery bypass graft surgery for patients with medically refractory myocardial ischemia and risk factors for adverse outcomes with bypass: a multicenter, randomized trial. Investigators of the Department of Veterans Affairs Cooperative Study #385, the Angina With Extremely Serious Operative Mortality Evaluation (AWESOME). J Am Coll Cardiol. 2001;38:143-149.
12. Rodriguez AE, Baldi J, Fernandez PC, et al. Five-year follow-up of the Argentine randomized trial of coronary angioplasty with stenting versus coronary bypass surgery in patients with multiple vessel disease (ERACI II). J Am Coll Cardiol. 2005;46:582-588.
13. Hueb W, Lopes NH, Gersh BJ, et al. Five-year follow-up of the Medicine, Angioplasty, or Surgery Study (MASS II): a randomized controlled clinical trial of 3 therapeutic strategies for multivessel coronary artery disease. Circulation. 2007;115:1082-1089.
14. Coronary artery bypass surgery versus percutaneous coronary intervention with stent implantation in patients with multivessel coronary artery disease (the Stent or Surgery trial): a randomized controlled trial. Lancet. 2002;360:965-970.
15. The final 10-year follow-up results from the BARI randomized trial. J Am Coll Cardiol. 2007;49:1600-1606.
16. Serruys PW, Ong AT, Maurice M, et al. Arterial revascularization therapies study part II-sirolimus-eluting stents for the treatment of patients with multivessel de novo coronary artery lesions. EuroIntervention. 2005;1:147-156.
17. Rodriguez AE, Maree AO, Mieres J, et al. Late loss of early benefit from drug-eluting stents when compared with bare-metal stents and coronary artery bypass surgery: 3 years follow-up of the ERACI III registry. Eur Heart J. 2007;28:2118-2125.
18. Ong AT, Serruys PW, Mohr FW, et al. The SYNergy between percutaneous coronary intervention with TAXus and cardiac surgery (SYNTAX) study: design, rationale, and run-in phase. Am Heart J. 2006;151:1194-1204.
19. Flaherty JD, Davidson CJ. Diabetes and coronary revascularization. JAMA. 2005;293:1501-1508.
20. Briguori C, Condorelli G, Airoldi F, et al. Comparison of coronary drug-eluting stents versus coronary artery bypass grafting in patients with diabetes mellitus. Am J Cardiol. 2007;99:779-784.
21. Yang JH, Gwon HC, Cho SJ, et al. Comparison of coronary artery bypass grafting with drug-eluting stent implantation for the treatment of multivessel coronary artery disease. Ann Thorac Surg. 2008;85:65-70.
22. Yang ZK, Shen WF, Zhang RY, et al. Coronary artery bypass surgery versus percutaneous coronary intervention with drug-eluting stent implantation in patients with multivessel coronary disease. J Interv Cardiol. 2007;20:10-16.
23. Hannan EL, Wu C, Walford G, et al. Drug-eluting stents vs. coronary-artery bypass grafting in multivessel coronary disease. N Engl J Med. 2008;358:331-341.
24. Javaid A, Steinberg DH, Buch AN, et al. Outcomes of coronary artery bypass grafting versus percutaneous coronary intervention with drug-eluting stents for patients with multivessel coronary artery disease. Circulation. 2007;116(Suppl):I200-I206.
25. Carrozza JP Jr. Drug-eluting stents—pushing the envelope beyond the labels? N Engl J Med. 2008;358:405-407.