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Feasibility of Percutaneous Coronary Interventions in Early Postcoronary Artery Bypass Graft Occlusion or Stenosis

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Background: *With continuing technical advances in percutaneous coronary interventions (PCI) for coronary artery disease (CAD), patients undergoing coronary artery bypass surgery (CABG) often have complex coronary anatomy that is not ideal for PCI. Because of the complex anatomy, these patients have a higher risk of early graft occlusion. The feasibility of PCI in the treatment of early graft occlusion is not well established.*
Methods: *A retrospective chart review was performed of patients presenting with recurrent ischemia within three months post-CABG and at one-year follow-up.*
Results: *Forty-six patients with 156 grafts were identified. Three presented with STEMI, 21 with NSTEMI, 21 with unstable angina, and one with congestive heart failure. Sixty-three grafts were occluded or stenosed (>70%). Twenty-seven grafts (43%) in 17 patients were not amenable to PCI. The other 34 grafts (54%) in 23 patients underwent successful PCI. PCI was performed upon native vessels and occluded grafts with equal frequency. Six patients had patent grafts. At one-year follow-up, six of 23 patients in the PCI group were readmitted with ischemia; five vessels (14%) in four patients had restenosed. There were no deaths. In the group with no PCI, 11 of 23 patients were readmitted with ischemia with one death.*
Conclusion: *PCI for early post-CABG occlusion was safely performed in slightly more than half of target vessels. PCI was performed upon native vessels and occluded grafts with equal frequency. After initial PCI success, the clinical target vessel restenosis rate was 14% at one-year follow-up.* (J Interven Cardiol 2007;20:204–208)

Introduction

The introduction of percutaneous coronary interventions (PCI) and stenting has led to a change in the profile of patients undergoing coronary artery bypass surgery (CABG). Patients who currently undergo CABG are older, with more complex anatomy and diffuse coronary artery disease (CAD) than before.[1–6] Therefore, these patients are more likely to present with ischemic complications early post-CABG because of smaller target vessels and poor distal runoff.[1,2] Myocardial infarction (MI) may occur in 5 to 10% of patients early post-CABG and is associated with increased in-hospital mortality (9.7 vs. 1.0% in those without new Q-waves).[7–9] Small sample size and case reports characterized studies in the 1980s and 1990s that evaluated the feasibility of PCI in the management of early post-CABG graft failure.[10–17] We studied the feasibility of PCI in contemporary patients presenting with acute coronary syndrome (ACS) within 90 days of bypass surgery.

Methods

A retrospective chart review was performed of patients presenting with recurrent ischemia within three months' post-CABG and at one-year follow-up. Between January 2000 and December 2004, a total of 46 patients with 156 grafts presented with ACS within three months of their CABG and underwent cardiac

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catheterization at St. John Hospital and Medical Center, Detroit, MI. The patients' charts were reviewed at their physician's offices and at St. John Hospital and Medical Center for clinical data related to the admission for postoperative ischemia and at subsequent follow-up for one year.

Results

A total of 46 (1.2%) patients with 156 grafts out of 3,767 patients who had CABG presented with ACS within three months of their CABG and underwent cardiac catheterization. Twenty-one patients presented with an NSTEMI, 21 with unstable angina, three with a STEMI, and one with congestive heart failure. All patients underwent cardiac catheterization. There were a total of 156 grafts of which 102 were saphenous vein grafts (SVG), 40 left internal mammary artery (LIMA), one right internal mammary artery (RIMA), and 13 radial artery grafts. Sixty-three grafts were totally occluded or had a significant stenosis of >70%: 52 were SVGs, six LIMAs, one RIMA, and four radial arteries. Seventeen PCIs were performed upon native arteries, 15 upon SVGs, and three upon radial arteries, one upon LIMA, and none to RIMA. Two of the PCIs to SGVs were determined to be unsuccessful because of no significant improvement in angiographic appearance or blood flow after low-pressure balloon inflation at the aorto-ostial anastomosis. These two patients had no recurrence of ischemic symptoms at one-year follow-up. The patients' baseline characteristics are shown in Table 1. The angiographic findings related to the occluded or stenosed grafts are shown in Tables 2 and 3 and Figure 1. At one-year follow-up, six patients in the PCI group developed symptoms of ACS in whom four patients with five grafts (14%) the symptoms were related to target vessels. Three of the target vessels were treated medically and two were successfully revascularized by PCI. The one-year follow-up data are shown in Table 4.

Table 1. Baseline Clinical Characteristics

Variables	Number (%)
Patients	46
Lesions	63
Mean age (years ± SD)	64.8 ± 10.4
Male	24 (52)
Diabetes	13 (27)
Hypertension	37 (79)
Hyperlipidemia	28 (59)
Chronic kidney disease	4 (9)
Smoking	17 (36)
Prior myocardial infarction	20 (42)
Average LV ejection fraction (%)	50 ± 9
Average number of days after CABG	46.2 ± 24.3

SD = standard deviation.

Discussion

In the perioperative period and early post-CABG, graft failure is generally related to technical issues including failure to reverse the vein graft, a tight suture at the anastomosis, poor targets with poor runoff, injury to the graft during harvesting, and occasional grafting of vessels where the proximal stenosis is less than 70%. Graft failure early post-CABG generally leads to graft thrombosis.[6,18,19]

Over the last two decades, significant improvements have occurred in surgical technique, anesthesia, and pre- and postoperative care. These improvements have led to a steady reduction in morbidity after CABG, even though current patients exhibit a higher-risk profile than did patients in the 1980s. Estafanous[20] reported these findings in 5,051 patients who underwent CABG surgery from 1986 to 1988, compared to 2,793 patients who had CABG surgery from 1993 to 1994. The latter patients had a higher cardiovascular risk profile, yet the adjusted morbidity rate decreased from 14.5 to 8.8% with no change in the risk-adjusted in-hospital mortality (2.8 vs. 2.9%).[20]

Despite the improvements, MI may occur in 5 to 10% of patients following CABG. Before the recent advancement in PCI, these patients would usually be taken back for reoperation, which is associated with increased perioperative mortality and a lower likelihood of complete revascularization.[21] Other options of therapy in such patients with ACS have been entertained. Thrombolytic therapy is contraindicated early in the postoperative period because it carries the risk of

Table 2. Baseline Angiographic Characteristics

Coronary Artery Bypass Graft	Number (%)
Proximal (anastomotic) stenosis (>70%)	4 (6)
Focal stenosis (>70%) in body of graft	6 (10)
Diffuse stenosis (>70%)	7 (11)
Distal (anastomotic) stenosis (>70%)	16 (25)
Total occlusion	30 (48)

Table 3. Baseline Angiographic Characteristics of the PCI-Treated and Nonetreated Vessels

Target Lesion Location	Number of Grafts	Treatment		
		NO PCI	PCI to Native	PCI to Grafts
LIMA to left anterior descending	6	0	5	1
RIMA to obtuse marginal	1	1	0	0
Radial to left circumflex	1	0	0	1
Radial to right coronary artery	2	0	0	2
Radial to obtuse marginal	1	1	0	0
SVG to right coronary artery	13	4	5	4
SVG to left circumflex	9	4	5	0
SVG to diagonal	10	6	0	4
SVG to obtuse marginal	17	9	2	6
SVG to posterior descending artery	2	1	0	1
SVG to left anterior descending	1	1	0	0

LIMA = left internal mammary artery; SVG = saphenous vein graft; RIMA = right internal mammary artery; PCI = percutaneous coronary intervention.

intractable hemorrhage. However, intracoronary thrombolytic therapy with PCI was tried with good success in one case report.[22] Conservative medical therapy is not a suitable option in patients with STEMI. PCI is an attractive alternative to redo CABG in these patients, as it is less invasive and more expedient. In addition, a nonocclusive etiology (which was seen in 25 to 35% of patients early post-CABG) may also be diagnosed.[9–11] However, there are only small studies and case reports describing the feasibility of percutaneous intervention in the early post-CABG period.

Kahn et al.[10] reported a series of 45 patients from 1980 to 1989 with recurrent ischemia within 90 days post-CABG. They achieved successful percutaneous translaminal coronary angioplasty (PTCA) in 95% of attempted target lesions in native arteries and in 89% of attempted lesions in the grafts. However, there were two in-hospital deaths, two MIs, and two patients who required reoperations before discharge after unsuccessful PTCA.[10] Cutlip et al.[11] reported on 31 cases with recurrent ischemia within 30 days' post-CABG from 1989 to 1994. Fifteen were amenable to percutaneous revascularization. They performed PTCA to 17 grafts (five IMA and seven native vessels) with a success rate of 89%.[10] Reifart et al.[12] reported on 58 patients with evolving STEMI in the perioperative period from January to December of 1995. Three patients had emergent reoperation and 55 patients had coronary angiography. Twenty-nine out of 55 patients underwent PCI. Most of the interventions were performed on the native vessels, with a success rate of 69%. There were 2/29 in-hospital deaths, 2/29 STEMI, 7/29 NSTEMI, 4/29 reoperations, and no bleeding complications.[12]

In our study, 54% of target vessels were amenable to PCI in 46% of the patients. PCI was performed upon native vessels and occluded grafts with equal frequency, without major complications. At one-year follow-up, recurrent symptoms from target vessel restenosis occurred in five of 36 (14%) grafts. There were no deaths in the PCI group. However, the non-PCI group had one death and 11 were readmitted for ACS.

The feasibility rate of PCI in our study was less than previously reported. PCI was performed in 50% of our

Table 4. One-Year Follow-Up in Both PCI and Non-PCI Groups (63 Grafts)

Variables	PCI Group		Non-PCI Group	
	Patients (23)	Grafts (36)	Patients (23)	Grafts (27)
Death	0	0	1 (4%)	1 (4%)
Ischemia with restenosis of target vessel	4 (17%)	5 (14%)	4 (17%)	6 (22%)
Ischemia with restenosis of non-target vessels	2 (9%)	3 (8%)	6 (26%)	6 (22%)
No recurrent ischemia (clinically patent target vessel)	17 (74%)	28 (78%)	12 (52%)	14 (52%)

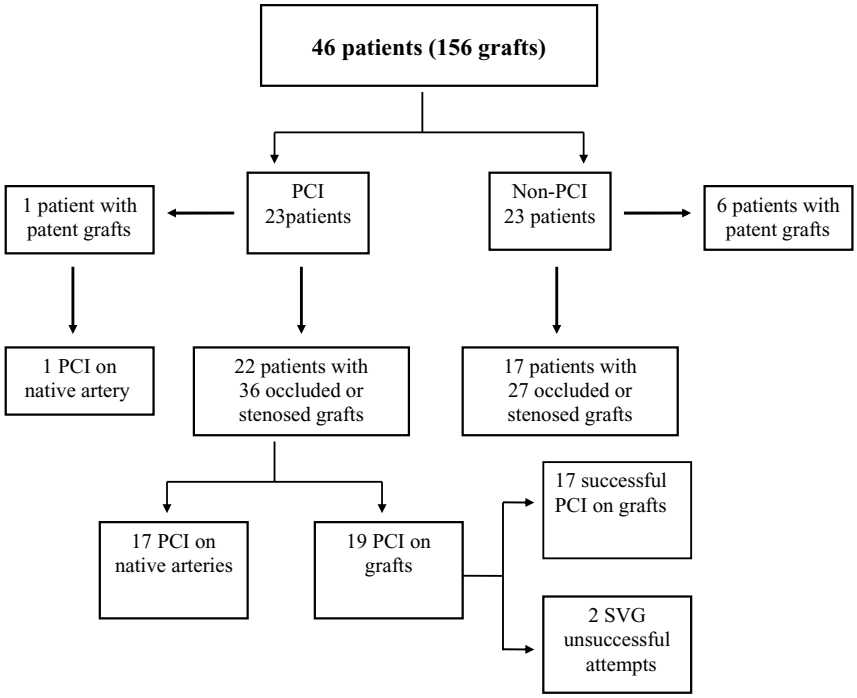

Figure 1. Diagnostic and interventional results of 46 patients with occluded or stenosed grafts early post-CABG. PCI = percutaneous interventions; SVG = saphenous vein graft.

patients compared to 100%, 71%, and 73% of patients in the studies by Kahn,[10] Cutlip,[11] and Reifart,[12] respectively. This difference is most likely secondary to the more aggressive recent approach to PCI and stenting, leading to the higher-risk population currently undergoing CABG.[1,2] The success rate of PCI in our patients with amenable target vessels was 94%, similar to the previous studies. However, we had no significant complications and no deaths, which may have been due to case selection, high volume center, and/or improved technology and techniques.[23] Seven patients (15%) had patent grafts, of whom two patients had pericarditis and four patients had severe native coronary arteries with poor distal runoff and one patient had PCI to native coronary artery. The rest of the patients who did not have PCI had severe native coronary artery disease that was not suitable for PCI and had poor distal runoff. Therefore, these patients were medically treated. Even though the current patient population undergoing CABG is at higher risk due to more complex anatomy, PCI early post-CABG in our study was safely and successfully performed in 54% of target vessels. Limitations of our study include its being retrospective and having a relatively small sample size. However, the current sample size is similar to that studied in previous studies.[10–12]

In conclusion, PCI for early post-CABG occlusion was safely performed in slightly more than half of target vessels. PCI was performed upon native vessels and occluded grafts with equal frequency. After initial PCI success, the clinical target vessel restenosis rate was 14% at one-year follow-up.

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