



Acute and Intermediate-Term Results of Percutaneous Left Main Coronary Artery Interventions

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Abstract

Background: Left main coronary artery disease is considered a surgical indication in most centers. However, in some cases prohibited from surgery or in patients with prior bypass grafting, there is a need for percutaneous coronary intervention in LMCA disease scenarios.

Objectives: To assess the clinical outcomes among patients undergoing stent-based LMCA angioplasty.

Methods: We identified 34 consecutive patients who underwent PCI in LMCA at our institution. Procedural data and clinical outcomes were obtained for all patients.

Results: The mean age was 71 ± 12 years. There were 27 elective and 7 emergent procedures performed on 23 "protected" LMCA and 11 "unprotected" LMCA. In emergent procedures, the prevalence of cardiogenic shock (29% vs. 0%, $P = 0.04$) in patients with prior coronary bypass (29% vs. 8.5%, $P = 0.007$) was significantly higher compared to elective cases. Procedural success in emergent procedures was significantly lower than in elective procedures (71 vs. 100%, $P = 0.04$). In emergent versus elective procedures, the in-hospital mortality rate was higher (43 vs. 0%, $P = 0.006$). The rate of cumulative major adverse cardiac events at 1 and 6 months was 43% and 71% in emergent cases versus 0% and 33% in elective cases ($P < 0.05$ for both comparisons). In patients with "unprotected" LMCA the overall rate of major cardiac events at 1 month was higher compared to "protected" LMCA patients (27 vs. 0%, $P = 0.02$). Multivariate analysis revealed emergent procedure as an independent predictor for mortality and adverse cardiac events (odds ratio 6.7, 95% confidence interval 1.2–36; $P = 0.02$).

Conclusions: Percutaneous interventions in LMCA are feasible and relatively safe in carefully selected cases. Procedural outcomes and clinical prognosis is highly dependent on the nature of disease prior to angioplasty (e.g., elective vs. emergent procedure) as well as on protection of the LMCA by patent grafts.

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Clinical studies have consistently shown that significant left main coronary artery disease is of critical prognostic importance in the

natural history of coronary artery disease [1–4]. Despite the efficacy of coronary artery bypass surgery for LMCA disease, there is still a need to treat LMCA stenosis due to progression of disease or occasional bypass graft failure [5–8]. Prior experiences with balloon coronary angioplasty for LMCA were associated with high rates of procedural complications, mortality and restenosis [9]. The use of stents significantly improved the outcome of percutaneous coronary intervention in general, and in LMCA disease in particular [10–25]. In the present study we evaluated acute and intermediate-term results of PCI in LMCA interventions at our institution, and sought to distinguish clinical outcomes based on procedural urgency (i.e., emergent versus elective LMCA angioplasty procedures).

Patients and Methods

We used the Rabin Medical Center Interventional Cardiology Database to identify 34 consecutive patients who underwent PCI in the LMCA between January 2001 and December 2002. The clinical and angiographic characteristics were analyzed and compared between patients undergoing elective (27 patients) versus emergent procedures (7 patients). Cumulative in-hospital, 1 and 6 month outcomes (death, myocardial infarction, need for coronary bypass surgery, stent thrombosis, target vessel revascularization, and overall major adverse coronary events) were compared between elective and emergent procedures as well as between protected (23 patients), where a patent graft to the left anterior coronary artery was observed, and unprotected LMCA procedures (11 patients). All events were confirmed using telephone calls and source documentation obtained in case of any clinically relevant event. MACE was defined as death, MI, CABG or TVR hierarchical event. Procedural success was defined as angiographic residual diameter stenosis $< 20\%$ and optimized angiographic flow (i.e., TIMI 3 grade) without the occurrence of death, Q wave myocardial infarction or cerebrovascular accident

MACE = major adverse coronary events

MI = myocardial infarction

CABG = coronary artery bypass graft

TVR = target vessel revascularization

LMCA = left main coronary artery
PCI = percutaneous coronary intervention

after the procedure and until hospital discharge. Peri-procedural MI was defined based upon the appearance of a new pathologic Q wave on electrocardiogram or a creatine kinase level more than three times the normal value. Stent thrombosis was defined as a thrombotic occlusion event of the stent within 1 month after the intervention. In-hospital mortality was defined based on the occurrence of death from any cause during the hospital stay following the procedure. Renal failure was defined as creatinine level ≥ 1.5 mg/dl prior to the procedure.

The statistical analysis was performed using the Student *t*-test and chi-square test to compare nominal and categorical characteristics between groups. A *P* value < 0.05 was considered statistically significant. Univariate and multivariate linear regression analysis were used for mortality and MACE evaluation. All statistical analyses were performed using the StatView™ software (PC version).

Results

The baseline characteristics of the 34 patients are presented in Table 1. The overall mean age was 70 ± 11 years. There were more patients with prior CABG (29% vs. 8.5%, $P = 0.007$) and renal failure (57 vs. 3.7%, $P = 0.004$) and more cardiogenic shock events (29 vs. 0%, $P = 0.04$) among patients who underwent emergent versus elective procedures. There was a strong trend towards more impaired left ventricular function (defined as $<40\%$) in emergent compared to elective patients (57 vs. 18%, $P = 0.06$).

Angiographic characteristics indicated that in emergent patients there was a strong trend towards lower prevalence of multivessel coronary disease (57 vs. 93%, $P = 0.06$) and post-procedure flow (TIMI classification 2.6 ± 1.1 vs. 3.0 ± 0.1 , $P = 0.05$) and higher prevalence of ostial left main lesion location (57 vs. 18%, $P = 0.06$). In patients who underwent emergent procedures there was a higher prevalence of intra-aortic balloon pump use (57 vs. 3.7%, $P = 0.004$) and procedural success was lower (71 vs. 100%, $P = 0.04$) compared to elective patients.

Cumulative outcomes in elective versus emergent patients are shown in Table 2. In emergent compared to elective patients, there was higher in-hospital and 1 month mortality rates (43 vs. 0%, $P = 0.006$), 6 month death (57 vs. 7.4%, $P = 0.01$), in-hospital and 1 month MACE rates (43 vs. 0%, $P = 0.006$) and 6 month MACE rate (71 vs. 33%, $P = 0.01$).

Cumulative outcomes in "protected" versus "unprotected" LMCA procedures showed that in unprotected LMCA procedures there were significantly higher in-hospital and 1 month mortality and MACE rates (27 vs. 0%, $P = 0.02$). Six months TVR tended to be higher in protected LMCA procedures than in unprotected LMCA procedures (30 vs. 0%, $P = 0.07$).

Multivariate analysis identified emergent procedure as the most powerful independent risk factor for 6 month mortality and MACE rates (odds ratio 6.7, confidence limit 1.2–36; $P = 0.02$). Likewise, emergent procedure was found to be an independent risk factor with a marginal level of significance for 1 month mortality and MACE rates (odds ratio 8.3, confidence limit 0.9–8.0; $P = 0.06$).

Representative cases of left main percutaneous coronary intervention are highlighted in Figures 1 and 2.

Table 1. Baseline characteristics

	Elective procedures (n=27)	Emergent procedures (n=7)	P value
Mean age (yrs)	71 \pm 12	70 \pm 11	NS
Male gender	78%	71%	NS
Unstable angina	37%	29%	NS
Acute MI (primary)	30%	29%	NS
Cardiogenic shock	0	29%	0.04
Diabetes mellitus	22%	14%	NS
Hypertension	63%	57%	NS
Hyperlipidemia	78%	43%	NS
Smoking	18%	14%	NS
Prior MI	22%	14%	NS
Prior CABG	8.5%	29%	0.007
Prior stroke	7.4%	29%	NS
Renal failure	3.7%	57%	0.004
PVD	15%	57%	NS
LVEF $<40\%$	18%	57%	0.06

PVD = peripheral vascular disease, LVEF = left ventricular ejection fraction, NS = not significant.

Table 2. Cumulative outcomes in elective versus emergent LMCA procedures

	Elective procedures (n=27)	Emergent procedures (n=7)	P value
Death			
In-hospital	0	3(43%)	0.006
One month	0	3(43%)	0.006
Six months	2(7.4%)	4(57%)	0.01
MI			
In-hospital	0	0	NS
One month	0	0	NS
Six months	3(11%)	1(14%)	NS
CABG			
In-hospital	0	1(14%)	NS
One month	0	1(14%)	NS
Six months	1(3.7%)	2(29%)	NS
Stent thrombosis			
In-hospital	0	0	NS
One month	0	0	NS
TVR			
In-hospital	0	0	NS
One month	0	0	NS
Six months	6(22%)	1(14%)	NS
MACE			
In-hospital	0	3(43%)	0.006
One month	0	3(43%)	0.006
Six months	9(33%)	5(71%)	0.01

Discussion

This study evaluated the angiographic and clinical results of contemporary angioplasty techniques in left main coronary artery disease patients prohibited from surgical intervention. Our results indicate that the procedure in this high risk anatomic location is technically feasible and relatively safe. Our patients were prohibited from coronary bypass surgery or repeated

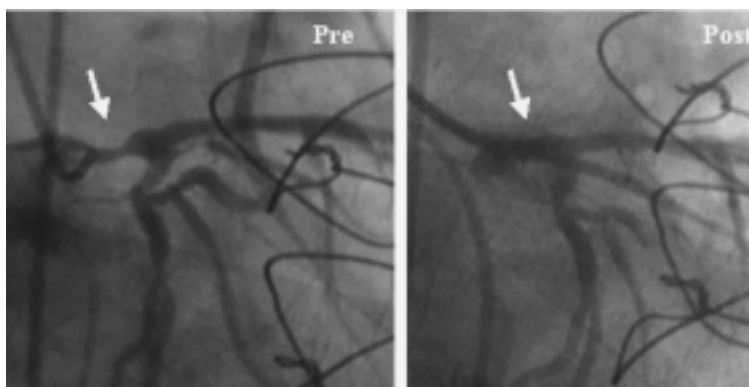


Figure 1. Unprotected ostial left main stenosis in an elderly patient treated electively using cutting balloon angioplasty followed by stenting.

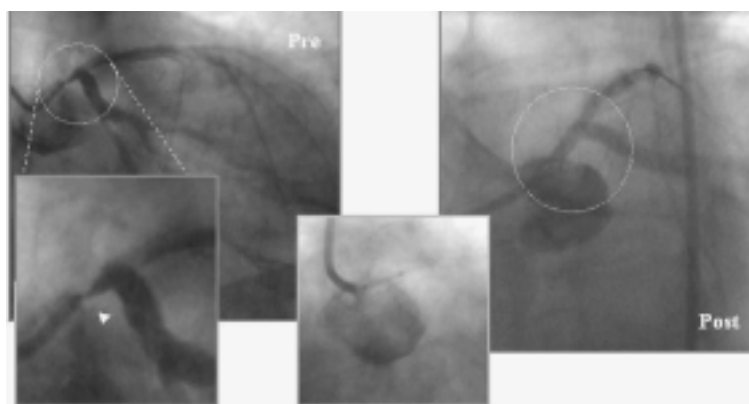


Figure 2. Protected left main stenosis (arrow) treated electively using a stent.

surgical intervention, indicating that percutaneous intervention could serve as a suitable management strategy in carefully selected patients who are candidates for this mode of revascularization. Moreover, drug-eluting stents became available in coronary angioplasty clinical practice, with improved effects on restenosis prevention via local suppression of neo-intimal formation. Since the primary hurdle for achieving sustained clinical benefit in the current series among elective/stable patients was the occurrence of restenosis, it is expected that the drug-coated stenting approach may further improve the long-term outcomes of percutaneous LMCA interventions. Finally, our study indicates that the most important prognostic variable was the clinical status prior to intervention, which may dictate the need for elective versus emergent intervention. Thus, based on our results, elective LMCA stenting especially with preserved left ventricular function is associated with excellent outcome, while emergent revascularization – mainly due to acute LMCA-related ischemic events – might be regarded as a catastrophic event regardless of the mode of revascularization and means of periprocedural cardiac support (e.g., intra-aortic balloon counterpulsation). Those cases are often associated with poor left ventricular function and greater myocardial jeopardy at a time of the LMCA revascularization.

Previous series reported mixed results and outcomes for LMCA interventions due to non-homogenous patient selection,

the degree of LMCA “protection,” and the use of various percutaneous approaches. For example, Silvestri et al. [21] reported 1 month mortality of up to 9% in 140 elective patients who underwent PCI in unprotected LMCA. However, in this report patients with cardiogenic shock or progressive myocardial infarction were excluded from analysis. Black and co-researchers [23] presented a 6 month mortality rate of 20% for unprotected LMCA interventions in 39 patients who were contraindicated for surgery, while the mortality rate was only 3.8% in 53 patients in whom surgery was feasible. Sperker et al. [25] reported a mortality rate of 33.3% in 18 patients who underwent emergent LMCA stent-based angioplasty, and no mortality in 15 elective patients after approximately 7 months of follow up. Park and associates [18] adopted a different approach towards LMCA stenting, based on intravascular ultrasonic imaging parameters of vessel diameter and plaque burden that dictated the need for atherectomy or not prior to LMCA stenting. Among 270 patients, these authors reported a 3 year mortality rate of 7.4% after stenting in unprotected LMCA disease and normal left ventricular function in most cases. In accordance with prior series [20–25], our limited study showed excellent cardiac prognosis in elective cases, while in emergent interventions the in-hospital mortality increased dramatically. The data are explained by high risk contributory factors in the emergently treated group of patients, such as cardiogenic shock, renal failure, left ventricle dysfunction, and lower pre-procedure coronary flow. Fortunately, in our series no cases of stent thrombosis occurred and the repeat revascularization rate (TVR) was acceptable at the 6 month follow-up using “bare-metal” stents in all treated patients, and the need for “compassionate” bypass (or redo bypass) surgery was also relatively low. Despite the increased prevalence of short-term mortality and overall major cardiac event rates in unprotected LMCA patients, only the emergent nature of the procedure was found by multivariate analysis to be an independent predictor for adverse prognostic outcomes.

The limitations of our study were the relatively small-sized population and retrospective data analysis collection. Nonetheless, based on our results we conclude that current angioplasty techniques in LMCA disease are feasible and relatively safe. Procedural outcomes and intermediate clinical prognosis are heavily dependent on the nature of angioplasty (elective versus emergent procedures) and, probably, on protection of the LMCA by patent grafts to the left coronary circulation.

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