



Contemporary Percutaneous Coronary Intervention for Patients with Acute Myocardial Infarction and Left Main Culprit Lesions: A Report from the NCDR®



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Abstract

Background: The characteristics and in-hospital outcomes of PCI for LM AMI have not been studied in a large patient population

Objectives: To describe the incidence, characteristics, in-hospital outcomes and prognostic determinants of percutaneous coronary interventions (PCI) for acute myocardial infarction (AMI) due to unprotected left main coronary artery UPLMCA lesions.

Methods: The characteristics and in-hospital outcomes of PCI for LM AMI were studied in the CathPCI Registry® between 2004 and 2008.

Results: 434 patients underwent PCI for ST elevation MI (STEMI) and 387 patients underwent PCI for Non STEMI due UPLMCA lesions. Cardiogenic shock and class 4 NYHA were present in 66.4% and 74.9% of patients with STEMI respectively compared with 31.9% and 51.7% of patients with NSTEMI. The in-hospital mortality rate was 58% in the UPLMCA STEMI patients and 28% in the UPLMCA NSTEMI patients compared to 19% in a cohort of 116 patients with protected LMCA (PLMCA) STEMI and 6% in a cohort of 610 patients with PLMCA NSTEMI PCIs. Significant variables associated with in-hospital mortality were age/10 years increase (odds ratio [OR]=1.2; 95% confidence interval [CI]: 1.02-1.4), primary PCI (OR=0.6; CI: 0.4-0.97), GFR/10 unit increase (OR=0.9; CI: 0.8-0.97), UPLMCA NSTEMI (OR=2.6; CI: 1.5-4.2), UPLMCA STEMI (OR=5.0; CI: 3.0-8.4), cardiogenic shock (OR=7.5; CI: 5.2-10.8), pre PCI IABP placement (OR=2.3; CI: 1.1-4.7), salvage PCI (OR=4.3; CI: 2.3-8.1), and pre PCI TIMI flow 0/1 (OR=2.3; CI: 1.6-3.3).

Conclusion: PCI for UPLMCA AMI carries a very high in-hospital mortality rate, particularly in patients presenting with STEMI and cardiogenic shock.

Keywords: PCI; Acute myocardial infarction; Left main

Introduction

Percutaneous coronary intervention (PCI) of unprotected left main coronary artery (UPLMCA) is considered a class IIa indication in patients with ST-elevation myocardial infarction (STEMI) with less than TIMI-3 flow and PCI can be performed more rapidly and safely than coronary bypass surgery (CABG). In unstable angina/NSTEMI patients with left main culprit lesion, PCI is class IIa if the patient is not a candidate for CABG [1]. Contemporary studies have shown favorable short and long term outcomes of UPLMCA PCI with comparable mortality, myocardial infarction (MI), or stroke rates to coronary bypass grafting (CABG) and a higher rate of repeat revascularization [2-4]. However, most of these studies included stable patients and excluded patients with acute MI (AMI).

Acute LMCA occlusion is a rare and catastrophic event. Its incidence, clinical features, outcomes, and prognostic determinants have been reported in few and small single center series of consecutive patients [5-8] and in one multicenter registry of LMCA PCI [9]. The incidence of AMI due to LMCA obstruction ranges between 0.8% to 2.4% [5,7,8]. AMI due UPLMCA, particularly ST elevation MI (STEMI), was associated with cardiogenic shock in up to 80% of patients, pulmonary edema in up to 95% of patients, respiratory failure requiring mechanical ventilatory support in up to 90% of patients and an in-hospital mortality rate that approached 65% [5-18].

We studied the incidence, clinical and angiographic features, in-hospital outcomes and prognostic determinants of contemporary PCI for STEMI due to UPLMCA lesions from a large cohort of patients enrolled in the CathPCI Registry. The characteristics and outcomes of these patients were compared to those who underwent PCI for STEMI due to protected LMCA (PLMCA) and for non STEMI due to PLMCA and UPLMCA.

Methods

The CathPCI Registry® database

The CathPCI Registry is a national quality improvement program with a goal of measuring and improving the care of patients undergoing PCI. The registry is an initiative of the American College of Cardiology Foundation and The Society for Cardiovascular Angiography and Interventions. Details of data collection procedures and quality control measures have been previously described [19]. Data are abstracted from patient medical records

and catheterization laboratory reports by trained data managers at each participating facility, and submitted quarterly to the central data facility. Data elements include patient demographics, medications administered in hospital, medical history and comorbidity, clinical characteristics at admission, coronary anatomy, lesion characteristics, procedural characteristics, adverse outcomes, and discharge status and medications (<https://www.ncdr.com/webncdr/DefaultCathPCI.aspx>).

Patient population

The patient population was derived from the subset of patients in the CathPCI Registry who underwent PCI for AMI due to a LMCA lesion between 1/04 and 3/08 at 811 US hospitals (Figure 1). The patient population of LMCA culprit lesions was divided into 4 groups: STEMI from UPLMCA, NSTEMI from UPLMCA, STEMI from PLMCA, and NSTEMI from PLMCA. For practical reasons, patients who had a prior CABG were categorized as having a PLMCA.

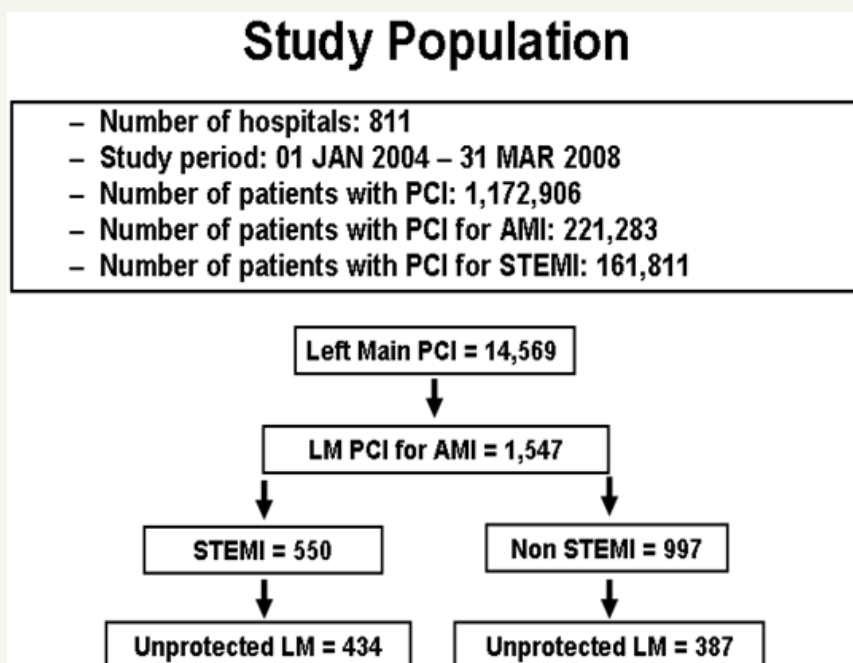


Figure 1: The Derivation of the Patient Population from the CathPCI Registry.

AMI: Acute Myocardial Infarction; LM: Left Main; NSTEMI: Non ST Elevation Myocardial Infarction; STEMI: ST Elevation Myocardial Infarction

Statistical Analysis

The statistical analysis was performed by the Duke Clinical Research Institute that serves as the primary analytic center for the CathPCI Registry. Categorical variables are reported as % and continuous variables are reported as mean±standard deviation (SD). The Pearson chi-square test was used for all categorical variables and the Kruskal-Wallis test was used for continuous variables. The univariate and multivariate independent factors associated with in-hospital mortality were determined. Logistic regression modeling with generalized estimating equations was used to develop the multivariable model examining factors significantly associated with

mortality. Patients were excluded from the in-hospital outcomes analysis if they were transferred out from the hospital participating in the CathPCI Registry.

Results

Prevalence of PCI for LM AMI

The prevalence of PCI of UPLMCA STEMI was 0.037% among all index PCIs, 0.19% among PCIs for AMI and 0.27% among PCIs for STEMI. The prevalence of PCI of UPLMCA NSTEMI was 0.032% among all index PCIs, 0.17% among PCIs for AMI and 0.65% among PCIs for NSTEMI.

Baseline characteristics

Patients who presented with a STEMI due to an UPLMCA were younger and had lower prevalence of cardiac risk factors and comorbidities compared to those who presented with a NSTEMI or PLMCA STEMI (Table 1). Patients with UPLMCA STEMI had

higher prevalence of NYHA Class 4 CHF and cardiogenic shock on presentation compared to the NSTEMI patients and to the STEMI patients with PLMCA (Table 2). Around 25% of STEMI patients were transferred in for primary PCI. Salvage PCI and emergent PCI were performed in 16% and 81% of patients with UPLMCA STEMI respectively.

Table 1: Clinical characteristics.

	STEMI		NSTEMI			
	UPLMCA (N=434)	PLMCA (N=116)	UPLMCA (N=387)	PLMCA (N=610)	All (N=1547)	p-Value
Risk factors						
Age	62.9±14.6	66.6±9.7	73.5±12.1	69.3±10.1	68.3±12.6	<0.0001
Male	70.3%	75.9%	54.8%	70.3%	66.8%	<0.0001
Diabetes mellitus	18.7%	31.9%	36.4%	50.2%	36.5%	<0.0001
Hypertension	51.6%	81%	80.1%	87.5%	75.1%	<0.0001
Dyslipidemia	45.8%	86.2%	63.0%	85.7%	68.9%	<0.0001
Current/recent smoker	60.6%	67.2%	56.8%	68.4%	63.2%	<0.0001
Family history of CAD	14.1%	29.3%	15.2%	25.4%	20.0%	<0.0001
Body mass index ≥30	27.4%	31.0%	24.3%	37.4%	30.8%	<0.0001
Medical history						
Cerebrovascular disease	9.5%	16.4%	21.4%	23.6%	18.6%	<0.0001
Peripheral vascular disease	10.1%	32.8%	22.0%	33.1%	23.9%	<0.0001
Chronic lung disease	15.0%	21.6%	28.9%	27.0%	23.7%	<0.0001
Prior myocardial infarction (> 7 days)	16.4%	60.3%	30.8%	53.8%	38.0%	<0.0001
Prior congestive heart failure	6.7%	25.9%	24.8%	33.3%	23.1%	<0.0001
Prior renal failure	3.5%	9.5%	16.3%	17.2%	12.5%	<0.0001
Prior PCI	13.4%	46.5%	18.6%	41.3%	28.2%	<0.0001
MDRD GFR	62.0±24.4	61.0±26.1	55.7±26.5	63.0±52.4	60.7±39.0	0.0005
Medications*						
Beta blockers	50.7%	82.2%	74%	80.3%	71.2%	<0.0001
Statins	24.5%	66.4%	52.3%	70.2%	52.6%	<0.0001
Aspirin	82.2%	92.2%	91.2%	93.7%	89.7%	<0.0001
Clopidogrel	42.3%	72.2%	67%	74.3%	63.6%	<0.0001
Coumadin	3.9%	0.9%	6.7%	6.9%	5.6%	0.02
Any glycoprotein inhibitors	66.5%	68.1%	45.7%	52.7%	56.0%	<0.0001
Heparin	83.6%	74.1%	75.3%	68.8%	75.0%	<0.0001
Any low molecular heparin	8.1%	17.2%	23.1%	25.7%	19.5%	<0.0001
Thrombin inhibitors	12.9%	17.2%	25.3%	28.5%	22.5%	<0.0001
Thrombolytics	4.19%	2.6%	1.0%	0.7%	1.9%	0.0003

*Medications that were given prior to the PCI and does not distinguish between admission or pre procedural medications.

CAD: Coronary Artery Disease; GFR: Glomerular Filtration Rate; MDRD: Modification of Diet in Renal Disease; NSTEMI: Non ST Elevation Myocardial Infarction; PCI: Percutaneous Coronary Intervention; PLMCA: Protected Left Main Coronary Artery; STEMI: ST Elevation Myocardial Infarction; UPLMCA: Unprotected Left Main Coronary Artery

Table 2: Presentation characteristics.

	STEMI		NSTEMI			
	UPLMCA (N=434)	PLMCA (N=116)	UPLMCA (N=387)	PLMCA (N=610)	All (N=1547)	p-Value
Cardiac status						
NYHA class						
I	11.5%	16.4%	14.0%	16.1%	14.3%	<0.0001

II	2.7%	3.4%	8.3%	10.7%	7.3%	
III	10.8%	21.5%	26.1%	37.4%	25.9%	
IV	74.9%	58.6%	51.7%	35.9%	52.5%	
Cardiogenic shock	66.4%	31.9%	32.6%	8.0%	32.3%	<0.0001
Symptom onset						
T < 6 hrs	80.4%	80.2%	-	-	-	0.08
6hrs < T ≤ 12 hrs	8.5%	6.0%	-	-	-	
12hrs < T ≤ 24 hrs	3.9%	8.6%	-	-	-	
24hrs < T ≤ 48 hrs	1.8%	0.0%	-	-	-	
48hrs < T ≤ 7	4.4%	2.6%	-	-	-	
Silent myocardial infarction	0.9%	2.6%	-	-	-	
Presentation status						
Transfer for primary PCI	25.8%	27.6%	-	-		0.70
First door to balloon time (minutes)						
DTB < 90	49.3%	34.5%	-	-	-	0.002
90 ≤ DTB < 120	16.4%	16.4%	-	-	-	
DTB ≥ 120	34.3%	49.1%	-	-	-	
DTB median	92.0	116.5	-	-	-	
DTB mean	128.7±541.4	345.1±1227.7	-	-	-	

DTB: Door to Balloon; NSTEMI: Non ST Elevation Myocardial Infarction; NYHA: New York heart Association; PCI: Percutaneous Coronary Intervention; PLMCA: Protected Left Main Coronary Artery; STEMI: ST Elevation Myocardial Infarction; T: Time; UPLMCA: Unprotected Left Main Coronary Artery

Angiographic and PCI characteristics

Table 3: Left main PCI characteristics.

	STEMI		NSTEMI			
	UPLMCA (N=434)	PLMCA (N=116)	UPLMCA (N=387)	PLMCA (N=610)	All (N=1547)	p-Value
PCI status						
Elective	0.2%	3.4%	9.8%	13.0%	7.9%	<0.0001
Urgent	3.0%	5.2%	44.7%	62.1%	36.9%	
Emergent	81.1%	86.2%	38.7%	24.7%	48.7%	
Salvage	15.7%	5.2%	6.7%	0.2%	6.5%	
Characteristics pre PCI						
Denovo lesion	97.7%	89.7%	98.5%	85.7%	92.6%	<0.0001
Bifurcation lesion	39.6%	25%	30.2%	27.5%	31.4%	0.0001
Lesion length (mm)	14.4±8.0	13.5±7.0	12.6±8.3	13.6±9.0	13.6±8.5	<0.0001
Lesion stenosis (%)	93.3±14.9	91.8±11.4	84.1±17.9	87.2±13.2	88.5±15.3	<0.0001
TIMI flow						
0	53%	32.8%	13.4%	10.2%	24.7%	<0.0001
1	19.1%	9.5%	11.1%	11.6%	13.5%	
2	12.4%	23.3%	18.6%	23.8%	19.3%	
3	14.5%	33.6%	56.3%	53.6%	41.8%	
Characteristics post PCI						
Lesion stenosis (%)	18.3±33.1	7.2±19.5	9.7±24.1	5.5±17.0	10.2±24.9	<0.0001
TIMI flow						
0	5.5%	0.9%	3.6%	1.6%	3.2%	<0.0001

1	7.8%	2.6%	1.8%	0.2%	2.9%	
2	14.8%	6.0%	3.6%	1.3%	6.0%	
3	71.2%	90.5%	90.7%	96.7%	87.6%	
No of vessel PCI						
2-vessel	96.5%	96.5%	92.8%	96.2%	95.5%	0.032
3-vessel	3.5%	3.5%	7.2%	3.8%	4.5%	
IABP placement						
Yes	69.6%	26.7%	43.7%	13.0%	37.6%	<0.0001
Prior	7.3%	6.5%	23.1%	17.7%		<.00001
During	89.1%	83.9%	74.0%	78.5%		
After	3.6%	9.7%	2.9%	3.8%		
Stent use (LM PCI)						
BMS	31.6%	22.4%	22.7%	15.7%	22.4%	<0.0001
DES	39.9%	61.2%	64.1%	76.1%	61.8%	
POBA (no stent)	28.6%	16.4%	13.2%	8.2%	15.8%	
Fluoro time (min)	21.4±15.8	17.5±13.0	23.2±13.2	21.8±17.8	23.6±16.2	<0.0001
Contrast volume (cc)	226.4±118.2	204.0±114.4	248.3±122.7	219.0±126.0	242.9±111.9	<0.0001

BMS: Bare Metal Stent; DES: Drug Eluting Stent; IABP: Intraaortic Balloon Pump; NSTEMI: Non ST Elevation Myocardial Infarction; PCI: Percutaneous Coronary Intervention; PLMCA: Protected Left Main Coronary Artery; POBA: Plain Old Balloon Angioplasty; STEMI: ST Elevation Myocardial Infarction; TIMI: Thrombolysis in Myocardial Infarction; UPLMCA: Unprotected Left Main Coronary Artery

The PCI characteristics are listed in Table 3. Patients with UPLMCA STEMI had significantly ($p<0.001$) more LM (55% vs 13%), proximal left anterior descending (LAD) (26% vs 9%) and left circumflex (LCX) (24% vs 13%) total occlusions and less right coronary artery (RCA) (9% vs 21%) total occlusions compared to the NSTEMI patients respectively. Patients with UPLMCA STEMI had more bifurcation lesions, longer lesions, more severe diameter stenosis, more residual diameter stenosis, and less pre and post PCI TIMI 3 flow compared to the NSTEMI patients. The majority

of STEMI and NSTEMI patients had 2 vessel PCI during the index procedure. An IABP was placed in 70% of patients with UPLMCA STEMI compared to 44% of patients with UPLMCA NSTEMI. The IABP was placed during the PCI in the majority of cases. Plain old balloon angioplasty was performed more commonly in the UPLMCA STEMI group compared to the UPLMCA NSTEMI group (29% vs 13%) and drug eluting stents were implanted more commonly in the UPLMCA NSTEMI group compared to the UPLMCA STEMI group (64% vs 40%).

In-hospital outcomes

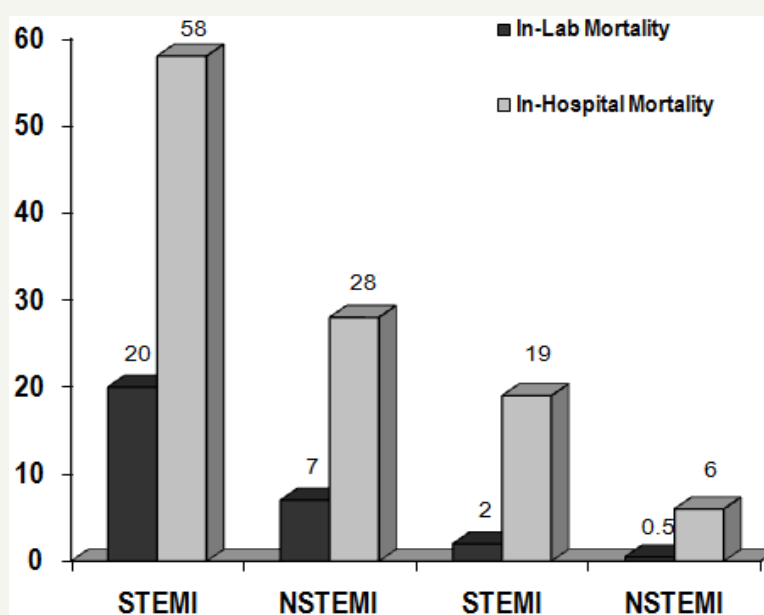


Figure 2: The In-lab and In-hospital Mortality Rates among the 4 Groups of LMCA AMI PCI.

NSTEMI: Non ST Elevation Myocardial Infarction; PLMCA: Protected Left Main Coronary Artery; STEMI: ST Elevation Myocardial Infarction; UPLMCA: Unprotected Left Main Coronary Artery

The in-hospital outcomes are listed in Table 4 & 5 and Figure 2. No reflow, dissections, and acute closures were common in the UPLMCA STEMI group (Table 4). The in-lab mortality rate was 17% in the UPLMCA STEMI patients compared to 5.6% in the UPLMCA NSTEMI patients and 1.7% in the PLMCA STEMI patients (Table 4). The in-hospital mortality rate approached 60% in the UPLMCA STEMI group (Table 4). Cardiac death accounted for 94% of the deaths in the UPLMCA STEMI group compared to 80% of the

deaths in the UPLMCA NSTEMI group. Of the total cohort of the 434 UPLMCA STEMI patients, 32% of patients were discharged to home. Referral to CABG occurred in 18% of patients with UPLMCA STEMI compared to 10% of the UPLMCA NSTEMI patients who underwent PCI. CABG referral includes patients undergoing PCI who were referred to CABG following the PCI procedure and does not include patients who were referred to CABG after coronary angiography only.

Table 4: Adverse outcomes.

	STEMI		NSTEMI			
	UPLMCA (N=434)	PLMCA (N=116)	UPLMCA (N=387)	PLMCA (N=610)	All (N=1547)	p-Value
In lab complications						
No reflow	6.0%	2.6%	1.3%	0.5%	2.4%	<0.0001
Dissection	3.9%	3.5%	5%	0.8%	2.8%	0.001
Perforation	0.2%	0%	0.3%	0.3%	0.3%	0.9
Acute closure	3.7%	1.7%	2.1%	0.8%	2.0%	0.01
Death (In-Lab)	17.3%	1.7%	5.6%	0.5%	6.5%	0.002
Patient disposition						
Died	215	20	87	34	356	
Discharged to home	139	83	201	522	945	
Discharged to nursing home	11	1	17	16	45	
Other	6	0	7	6	19	
Transferred to extended/acute care*	24	7	57	20	108	
Transferred to other hospital*	39	5	17	12	73	
In-hospital complications†	(N=371)	(N=104)	(N=312)	(N=578)	(N=1366)	
Any bleeding complications	51 (13.7%)	9 (8.7%)	37 (11.8%)	36 (6.2%)	133 (9.7%)	<0.0001
Any vascular complications	8 (2.2%)	2 (1.9%)	12 (3.8%)	10 (1.7%)	32 (2.3%)	0.37
Renal failure	36 (9.7%)	5 (4.8%)	15 (4.8%)	7 (1.2%)	63 (4.6%)	<0.0001
CVA/stroke	6 (1.6%)	1 (0.9%)	0 (0%)	2 (0.3%)	9 (0.6%)	0.01
Tamponade	0 (0%)	0 (0%)	1 (0.3%)	2 (0.3%)	3 (0.2%)	0.7
Procedural success	235 (63.3%)	95 (91.3%)	309 (99.0%)	556 (96.2%)	1195 (87.5%)	<0.0001
Death (In-lab)	75 (20.2%)	2 (1.9%)	22 (7.0%)	3 (0.5%)	102 (7.5%)	<0.0001
Death (Same day of PCI)	112 (30.2%)	4 (3.8%)	32 (10.2%)	6 (1.0%)	154 (11.3%)	<0.0001
Death (in-hospital)	215 (58.0%)	20 (19.2%)	87 (27.9%)	34 (5.9%)	356 (26.0%)	<0.0001
Referral to CABG						
Elective	2	0	2	0	4	
Urgent	8	4	15	3	30	
Emergent	43	2	8	1	54	
Salvage	9	0	2	0	11	
Transfer out for CABG	5	0	4	1	10	
Total CABG	67 (18.0%)	6 (5.8%)	31 (9.9%)	5 (0.8%)	109 (7.9%)	<0.0001

CABG: Coronary Artery Bypass Grafting; NSTEMI: Non ST Elevation Myocardial Infarction; PCI: Percutaneous Coronary Intervention; PLMCA: Protected Left Main Coronary Artery; STEMI: ST Elevation Myocardial Infarction; UPLMCA: Unprotected Left Main Coronary Artery

*excluded from in-hospital analysis.

†patients who were transferred out were excluded from in-hospital analysis (the number of patients in each category is less than on admission).

Correlates of in-hospital mortality

The significant univariate factors associated with in-hospital mortality in the UPLMCA STEMI group were age ≥ 65 years, cerebrovascular disease, GFR < 60 , cardiogenic shock, NYHA class of 4, salvage PCI, IABP use, total LM occlusion, LAD and LCX occlusions, < 3 pre and post PCI TIMI flow, $\geq 50\%$ residual diameter stenosis, bifurcation lesions, and no-reflow. Beta blocker and statin

use, thrombin inhibitor and glycoprotein inhibitor use and stent use were associated with improved in-hospital survival. The significant univariate factors associated with in-hospital mortality in the UPLMCA NSTEMI group were GFR < 60 , cardiogenic shock, NYHA class of 4, salvage PCI, IABP use, total LM occlusion, bifurcation lesions, < 3 pre and post PCI TIMI flow, and $\geq 50\%$ residual diameter stenosis. Beta blocker and statin use, thrombin inhibitor use and stent use were associated with improved in-hospital survival.

Table 5: Causes of death.

	STEMI		NSTEMI		All (N=356)	p-Value
	UPLMCA (N=215)	PLMCA (N=20)	UPLMCA (N=87)	PLMCA (N=34)		
Cardiac	94.4%	95.0%	80.5%	82.4%	89.9%	0.0009
Neurological	0.5%	0%	0.0%	5.9%	0.8%	
Renal	0.5%	0%	2.3%	0	0.8%	
Vascular	0.5%	0%	1.2%	5.9%	1.1%	
Infection	0.9%	0%	8.0%	0	2.5%	
Pulmonary	1.4%	5%	3.4%	2.9%	2.2%	
Other	1.9%	0%	4.6%	2.9%	2.5%	

In a multivariate model the significant factors associated with in-hospital mortality were increasing age, primary PCI, decreasing GFR, class 4 NYHA, UPLMCA STEMI and NSTEMI, cardiogenic shock, IABP use, salvage PCI, pre PCI TIMI 0/1 flow, and bifurcation lesions.

Cardiogenic shock, STEMI presentation, and salvage PCI were associated with highest odds ratio (OR) of in-hospital mortality of 7.5, 5.0, and 4.3 respectively (Table 6).

Table 6: Multivariate factors associated with in-hospital mortality.

Variable	OR [CI]	Wald Chi Square	p Value
Age /10 year increase	1.2 [1.02-1.4]	5.30	0.021
Female	0.8 [0.6-1.2]	1.11	0.29
Race: White vs Other	0.7 [0.5-1.1]	2.10	0.15
Diabetes mellitus	1.0 [0.7-1.4]	0.02	0.89
Primary PCI	0.6 [0.4-0.97]	4.34	0.03
CVD	1.3 [0.8-2.0]	1.02	0.32
Glomerular filtration rate/10 unit increase	0.9 [0.8-0.97]	7.25	0.007
NYHA class 4	1.2 [0.8-1.7]	0.83	0.36
NSTEMI - No prior CABG	2.6 [1.5-4.2]	13.4	0.0003
STEMI - No prior CABG	5.0 [3.0-8.4]	38.5	$< .0001$
STEMI - prior CABG	2.0 [0.96-3.9]	3.43	0.064
Cardiogenic Shock	7.5 [5.2-10.8]	113.41	$< .0001$
Pre IABP	2.3 [1.1-4.7]	5.51	0.018
Salvage PCI	4.3 [2.3-8.1]	19.87	$< .0001$
Pre-procedure TIMI flow 0/1	2.3 [1.6-3.3]	19.67	$< .0001$
Bifurcation lesion	1.2 [0.8-1.7]	1.1	0.3020
Annual PCI volume per 100 increase	1.0 [0.9-1.03]	0.3	0.6137

CI: Confidence Interval; CVD: Cerebrovascular Disease; IABP: Intraaortic Balloon Pump; NSTEMI: non ST Elevation Myocardial Infarction; NYHA: New York Heart Association; STEMI: non ST Elevation Myocardial Infarction; OR: Odds Ratio; PCI: Percutaneous Coronary Intervention; STEMI: ST Elevation Myocardial Infarction; TIMI: Thrombolysis in Myocardial Infarction

Discussion

The current study represents the largest cohort of patients undergoing contemporary PCI of UPLMCA AMI. Although AMI due to a LMCA culprit lesion is a rare event, it carries a very poor in-hospital prognosis especially with a STEMI presentation. Patients

with UPLMCA STEMI had a high prevalence of cardiogenic shock (66%), NYHA Class 4 CHF (75%) and cardiac arrest (15%) on presentation and consequently had an in-hospital mortality that approached 60%. Also these patients tended to have lower procedural success rates, lower rates of pre and post PCI TIMI 3 flow and higher rates of residual post PCI stenosis all of which are

known factors that affect survival post PCI for AMI. A presentation with NSTEMI was associated with better outcomes compared to a STEMI presentation. A history of CABG prior to presentation for LM

PCI further conferred better outcomes in the STEMI and NSTEMI groups.

Table 7: Summary of Studies of UPLMCA PCI for AMI.

	Year	N	Presentation	Shock	In-hospital Death
DeLuca [5]	2003	24	STEMI	75%	58%
Tang [7]	2007	11	AMI	82%	82%
Yip [8]	2001	18	-	78%	33%
Marso [9]	1999	40	STEMI (70%)	92%	55%
Chia [10]	2009	20	STEMI	80%	65%
Hurtado [11]	2009	71	STEMI (59%)	66%	47%
Lee [12]	2008	62	STEMI (37%)	24%	8%
Lee [14]	2004	18	STEMI	78%	44%
Prasad [15]	2009	28	STEMI	62%	36%
Ramos [16]	2008	9	STEMI	78%	55%
Sakai [17]	2004	38	AMI	74%	55%
Tan [18]	2008	16	STEMI	69%	46%
Perdazzini [20]	2011	348	STEMI	12%	11%*
Valeur [21]	2005	12	STEMI	83%	58%
Yamane [22]	2005	25	STEMI (64%)	100%*	32% (30 day)
Jensen [23]	2010	71	STEMI	41%	31% (30 day)
Wang [28]	2006	11	STEMI	55%	46%
Christiansen [29]	2006	27	STEMI	?	37% (30 day)
Pappalardo [30]	2011	48	STEMI (45%)	45%	21%†

AMI: Acute Myocardial Infarction; STEMI: ST Elevation Myocardial Infarction.

*54% mortality rate in those who presented with shock.

†32% mortality rate in those who presented with shock (no details on those who presented with STEMI and shock).

The results of the current study confirm what has been observed in smaller studies of LMCA AMI. The reported mortality rate of PCI for UPLMCA AMI has ranged from 8% to 82% (Table 7). Cardiogenic shock was present in 24% to 100% of patients (Table 7). In one study, patients with UPLMCA MI who presented with cardiogenic shock had very high in-hospital mortality rates that approached 94% irrespective of management strategy that included medical management, CABG or PCI compared to an in-hospital mortality rate of 6% in those who did not have cardiogenic shock [6]. The AMIS Plus study included 348 patients with STEMI who underwent PCI of UPLMCA [20]. In the AMIS Plus study the frequency of cardiogenic shock was only 12.2% whereas it was 66% in our study and their in-hospital mortality rate was 10.9% [20]. However, the subset of patients who presented with cardiogenic shock had a 54.8% in-hospital mortality rate which is not much different from the mortality rate in our study.

Similar to our study, the small observational studies have reported that patients who had PCI for UPLMCA MI had high rates of TIMI 0 flow pre PCI (46-58%), low rates of post PCI TIMI 3 flow (83%), low angiographic success rates (75-82%), high procedural mortality rates (16-33%) and high rates of IABP use (75-100%) [11,12,15,21,22]. However, stent use in the UPLMCA PCI group in our study was lower (71%) compared to what has been reported (90-100%) [15]. In the ULTIMA registry of UPLMCA PCI in 40

patients who presented with AMI (70% with STEMI), the in-hospital mortality rate was 55% for the entire cohort, 70% for patients who had PTCA only and 35% for the patients who underwent stenting [9]. Stent use in our study was a significant covariate for decreasing in-hospital mortality by 50%.

In previous studies, the univariate predictors of in-hospital mortality were shock, preceding cardiac arrest, and angiographic failure in one study [15] and mechanical ventilation, IABP use, shock, distal LMCA stenosis, RCA occlusion, and incomplete revascularization in another study [11]. Other reported univariate predictors of survival were the presence of intercoronary collaterals, dominant RCA, incompletely occluded LMCA, absence of cardiogenic shock, absence of no-reflow and successful reperfusion [5-9,17]. Shock and incomplete revascularization were the only significant multivariate predictors of in-hospital mortality in 1 study [11] and shock was the most powerful multivariate predictor of in-hospital mortality in 2 other studies [6,20]. The most significant and strongest (OR >2) multivariate correlates of in-hospital mortality in our study were salvage PCI, pre PCI TIMI 0/1 flow, UPLMCA PCI and cardiogenic shock that had the highest OR of 7.5. Our study also compared the outcomes of UPLMCA PCI based on type of MI presentation. Patients with UPLMCA PCI for STEMI had higher rates of cardiogenic shock, worse presenting angiographic characteristics and worse outcomes compared to a non STEMI

presentation, which has also been reported in smaller observational studies. The Western Denmark Heart Registry studied 344 patients who underwent UPLMCA PCI (71 STEMI, 157 NSTEMI/unstable angina, 116 stable angina) [23]. Cardiogenic shock was present only in 40% of the STEMI patients who had the lowest pre PCI TIMI 3 flow (62%) [23]. The 30-day mortality rate was 31% in the STEMI group, 6.4% in the NSTEMI/unstable angina group and 3.4% in the stable angina group [23]. The 30-day mortality rate was 55.2% in the STEMI patients who had cardiogenic shock compared to 26.2% in those without cardiogenic shock [23]. In a large multicenter and observational study of 1101 patients who had UPLMCA PCI, 611 patients had unstable angina or NSTEMI [24]. The 2-year cardiac survival was 97% in stable patients, 88% in patients with unstable angina and 82% in patients with NSTEMI [24]. The subset of patients with ACS and UPLMCA revascularization from the GRACE registry included 1799 patients of whom 514 underwent PCI, 612 underwent CABG and 673 underwent no revascularization [25]. STEMI or new LBBB presentation occurred in 35% of patients. Cardiogenic shock or cardiac arrest was present in only 3.4% of patients. More patients with STEMI underwent PCI compared to CABG (57% vs 23%) [25]. Patients who underwent PCI also had higher prevalence of cardiac arrest, cardiogenic shock or Killip 4 class [25]. In-hospital death occurred in 11% of patients who had PCI, in 5.4% of patients who had CABG and in 7.6% of patients who were treated medically [25]. The in-hospital death rate was 34% in those patients who presented with cardiogenic shock or cardiac arrest (40% in the PCI group and 30% in the CABG group) [25]. Revascularization was associated with an early hazard of hospital death compared to no revascularization that was significant for PCI and not for CABG. However, from discharge to 6 months, both PCI and CABG were significantly associated with improved survival compared to no revascularization [25]. Although our study is not intended to compare outcomes of PCI and CABG, 18% of the 371 patients with UPLMCA PCI underwent CABG. The details regarding CABG referral are not available though around 78% of CABG referrals were emergent or salvage procedures.

Contemporary outcomes of PCI for AMI from the CathPCI Registry have been recently reported [26]. In a contemporary mortality risk prediction model for PCI from the CathPCI Registry, cardiogenic shock and PCI for STEMI (particularly when done emergently or as salvage) were among the factors that had the highest point score or weight [27]. In our study, the unadjusted in-hospital mortality rates of PCI of UPLMCA PCI remain substantial and are mainly driven by the high incidence of cardiogenic shock. The outcomes are similar to those of the shock registry where the overall 30-day survival with surgery was 40% in the surgical group when the left main was culprit artery compared to 16% in the PCI group [13]. The use of IABP in our study was not associated with improved survival. A possible explanation is that patients stable enough to undergo CABG for UPLMCA STEMI and shock have better outcomes than those who are resigned to PCI. The outcomes of PCI of UPLMCA STEMI have not changed over the years. It is not known if percutaneous LV assist devices such as Tandem Heart or Impella

could provide more support and improve survival in this high risk patient population.

Study Limitations

The CathPCI Registry does not represent all practices in the USA. Moreover, the accuracy of the reported data depends on the accuracy of the individual reporting hospitals without angiographic adjudication. The outcomes of the patients who underwent PCI and subsequently transferred out from the participating hospitals were not available for study. Excluding these patients from the in-hospital analysis reduced the overall sample size. Additionally, it is difficult to assess if there was a bias with the exclusion of these patients. Prior CABG was taken as a surrogate for the degree of LM protection from bypass grafts as there was no routine angiographic review and as it was not possible to define UPLMCA from the available data in the NCDR registry. The frequency of patients who presented with LM instant thrombosis as the culprit for the MI, the strategy for LM PCI (provisional LM stenting, bifurcation stenting technique) and long term outcomes were not available in our database. The number of patients who were referred to CABG after coronary angiography only was not available thus limiting the comparison of the outcomes between PCI and CABG for AMI due to UPLMCA. Furthermore, although we looked at associated outcomes, we could not determine causality from observational data.

Conclusion

PCI for UPLMCA AMI is a rare event that carries a very high in-hospital mortality rate. Patients with a STEMI presentation compared to a non STEMI have worse clinical and angiographic characteristics, higher rates of cardiogenic shock, and higher procedural and in-hospital mortality rates. Patients with CABG and a presumed protected LM have overall a lower risk profile and better in-hospital survival.

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