Predictors of Procedural Success Among Filipino Patients who Underwent Multi-Vessel Percutaneous Coronary Intervention

Philipp C. Ines, M.D.*; Eduardo L. Tin Hay, M.D.**

Abstract

Background: The leading cause of mortality in the country is heart disease with a rate of 94.5 deaths per 100,000 Filipinos. Multi-vessel coronary artery disease (MV-CAD) patients carry an increased procedural risk especially those with increased lesion complexity or unfavorable anatomy.

Objective: The study aims to determine the variables that will predict procedural success and clinical outcome among MV-CAD patients undergoing percutaneous coronary intervention

Setting: Philippine Heart Center, Quezon City, Philippines

Methodology: This retrospective cohort study obtained data from the four-year Philippine Heart Center Registry consisting of 1,030 patients who underwent Multi-Vessel Percutaneous Coronary Intervention (MV-PCI) from January 2009 to January 2012 at the Cardiac Catheterization Laboratory.

Results: Significant predictors for improved procedural success and reduced risk for major cardiovascular events was evident in male patients, those with mild diastolic dysfunction (grade I or II) and patients on statin therapy. The variables with unfavorable procedural and clinical outcome are female patients, those with unstable angina, STEMI, heart failure, COPD, the need for IABP counterpulsation and a left main artery coronary lesion.

Conclusion: The results reflect a local "real-life scenario" providing important information on the predictors of outcome among Filipino patients with multi-vessel disease undergoing percutaneous coronary intervention. The information obtained is clinically relevant for both cardiologist and interventionist providing an important risk stratification and contributing to the holistic delivery of cardiovascular care.

Keywords: multi-vessel disease, procedural success, coronary artery disease, percutaneous coronary intervention

Background

Coronary Artery Disease (CAD) is the leading cause of mortality worldwide. The latest report (2010) from the Center for Disease Control (CDC) and Prevention[1] ranked heart disease as the number one cause of mortality with 193.6 deaths per 100,000. According to the Department of Health (DOH)[2], on their latest statistics (2004 – 2009), the leading cause of mortality in the country is heart disease with a rate of 94.5 deaths per 100,000 Filipinos. Heart disease has been on the rise since the early 1980s in the country, overtaking other diseases like pneumonia as the number one cause of death among Filipinos.

In 1960, Robert Hans Goetz (1910–2000) successfully performed the first human coronary artery bypass grafting (CABG) surgery[3]. This has been the sole point of care for patients with CAD prior to the balloon angioplasty era. A revolution in the field of cardiovascular medicine was marked when the first peripheral human balloon angioplasty was performed by Andreas Gruentzig[4] (1939-1985) in 1977. Since then, the advancement of the field of interventional cardiology has steadily increased with improved patient safety profile. The arrival of the second generation drug eluting stents (DES) further improved success in revascularization,[5] reducing the occurrence of stent thrombosis and restenosis. These breakthrough were compounded by the invention of smaller catheters and the advent of devices aimed at overcoming heavily calcified lesions (e.g. rotational atherectomy). With this transformational technology and the improvement of equipment and techniques, Percutaneous Coronary Intervention (PCI) has now been utilized in more complex coronary artery lesions and multi-vessel disease (MVD). However, it remains debatable whether PCI will be the preferred initial strategy in the future in patients with multi-vessel disease and/or left main artery (LMA) disease[6].

The subset of patients with Multi-Vessel (MV)

*Clinical Research Fellow, Invasive Cardiology Division, Philippine Heart Center, Quezon City
**Active Consultant, Invasive Cardiology Division, Philippine Heart Center, Quezon City

Corresponding Author: Philipp C. Ines, M.D., Philippine Heart Center, Quezon City, Philippines
Email: philipp_md@yahoo.com

Coronary Artery Disease (CAD) are characterized as those who have multiple co-morbidities including diabetes mellitus, prior myocardial infarction and systolic dysfunction[7]. PCI among these patients carry an increased procedural risk especially those with increased lesion complexity or unfavorable anatomy (e.g. calcified bifurcation lesions, small diffusely diseased vessels and chronic total occlusions). In a meta-analysis[8] including the ARTS (Arterial Revascularization Therapies Study), ERACI-II (Argentine trial of PTCA versus CABG), MASS-II (Medical, Angioplasty and Surgery Study), and the SoS (Stent Or Surgery) Trials, multi-vessel percutaneous coronary intervention (MV-PCI) was found to have a long-term safety profile similar to that of surgical revascularization. The severity of coronary artery disease may be a particularly important determinant of long-term survival particularly in patients with diabetes as exemplified in the BARI (Bypass Angioplasty Revascularization Investigation) trial[9]. Brener SJ et.al.[10] found several predictors of mortality in a Proportional-Hazard Analyses of multi-vessel CAD patients undergoing revascularization. The results include age, diabetes, chronic kidney disease (CKD), peripheral vascular disease (PVD), chronic obstructive pulmonary disease (COPD), prior myocardial infarction and left ventricular ejection fraction. Another high-risk subset[11] of patients are those presenting in cardiogenic shock. Mechanical support with an Intra-aortic Balloon Pump (IABP) counterpulsation in patients in cardiogenic shock provide a temporary but effective early medical stabilization. In the IABP-SHOCK II (SHould we emergently revascularize Occluded Coronaries in cardiogenic shocK?)[12] Trial, investigators found no significant reduction in the 30-day mortality in patients with cardiogenic shock, complicating an acute myocardial infarction for whom an early revascularization strategy was planned.

This retrospective cohort study aims to determine the variables that are associated with procedural success and clinical outcome (MACCE) among patients with multi-vessel coronary artery disease undergoing percutaneous coronary intervention (PCI). Data from the Philippine Heart Center Registry may reflect a "real-life scenario" locally and statistical analysis may provide important information on the predictors of outcome among Filipino patients. This effort places value on the risk stratification and improvement of cardiovascular care in patients with multi-vessel disease.

Methods

The objective of this study is to determine the predictors of procedural success and clinical outcome among patients undergoing multi-vessel percutaneous coronary intervention.

Study Design

This is a retrospective cohort study.

Study Population

The study obtained data from the Philippine Heart Center (PHC) Percutaneous Coronary Intervention (PCI) Registry of the Department of Education, Training and Research (DETR). This four-year registry is composed of 1,809 patients who underwent the intervention from January 2009 to January 2012 at the Cardiac Catheterization Laboratory of the Division of Invasive Cardiology. A total of 1,030 patients with Multi-Vessel PCI (MV-PCI) were included in the study (Figure 1).

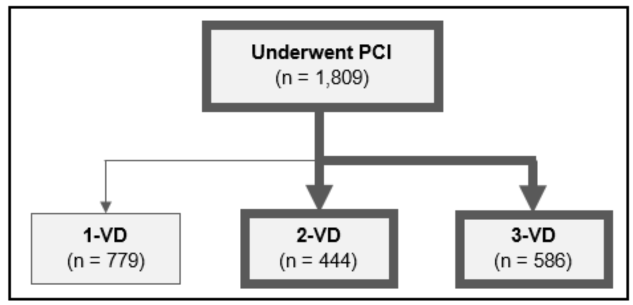

Figure 1: **Philippine Heart Center Percutaneous Coronary Intervention Registry (2009 – 2012). Abbreviation: VD – Vessel Disease.**

Definitions

Multi-Vessel Percutaneous Coronary Intervention (MV-PCI) - Percutaneous Coronary Intervention on patients with more than two (≥2) significant Coronary Artery Disease (2-vessel disease and 3-vessel disease)

Angiographic success - the attainment of residual diameter stenosis of less than 50%, which is generally associated with at least a 20% improvement in diameter stenosis and relief of ischemia

Procedural success – defined as angiographic success without the occurrence of major complications (death, MI, or CABG surgery) within 30 days of the procedure

Clinical success – defined as procedural success without the need for urgent repeat PCI or surgical revascularization within the first 30 days of the procedure

Identification of Variables

Independent Variables

1. **Patient profile.** This includes the patients' age, sex, body mass index (BMI) and history of smoking.
2. **Co-Morbidities.** This variable includes the history of hypertension, diabetes mellitus (DM), dyslipidemia, previous acute coronary

disease (ACS), chronic kidney disease (CKD) including those on maintenance hemodialysis (HD), peripheral vascular disease (PVD), chronic obstructive pulmonary disease (COPD), cerebrovascular disease (CVD), previous PCI and previous CABG.

3. **Clinical presentation at the time of PCI.** The clinical presentation of the patient upon admission or prior to transfer to our institution which includes chronic stable angina (CSA), unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI), ST-elevation myocardial infarction (STEMI), heart failure (HF) and the need for intra-aortic balloon pump (IABP) counterpulsation placement.
4. **Echocardiographic parameters.** Echocardiographic parameters obtained from the registry were the following: ejection fraction (EF) of ≥40% or <40%, left ventricular hypertrophy (LVH) and diastolic dysfunction (DD).
5. **Medications.** The use of the following medications: aspirin, clopidogrel, beta-blocker, statin, ACE inhibitors/Angiotensin Receptor Blocker (ACEi/ARB), calcium channel blocker (CCB), nitrate, glycoprotein IIb/IIIa inhibitor (GpIIb/IIIa) or other anti-platelets (e.g. cilostazol).

Dependent Variables

1. **Procedural Success.** Those patients with successful PCI without the occurrence of major cardiovascular events (MACCE).
2. **Major Adverse Cardiovascular Events (MACCE).** This includes events such as death, myocardial infarction and cerebrovascular disease.
3. **Procedural Complications.** This includes those patients who developed renal failure, arrhythmia, hypersensitivity reaction, bleeding, vascular complication and the need for urgent coronary artery bypass.

Statistical Analysis

Data were encoded in Microsoft Excel 2010 and analyzed in the Stata SE version 12 (Texas USA). Descriptive statistics used included frequency and percentages for categorical variables and mean with standard deviation was used for continuous variables. The association of the variables with the outcome was analyzed using inferential statistics by logistic regression. The univariate analysis was used for single predictor variables and multivariate analysis for multiple significant predictor variables. The computed odds ratio (OR) with a confidence interval (CI) set at 95% was used to determine the strength of association between the variable and the outcome (MACE and procedural success). A p-value of <0.5 was considered statistically significant.

Results

A. Descriptive Statistics

The registry included patients with a mean age of 61 years and mean BMI of 25.8 kg/m^2. (Table I) The majority of patients undergoing percutaneous coronary intervention are males at 78.2% as compared to females which comprise the 21.8%. This may be due to the more symptomatic CAD exhibited by males. Smokers are found in almost half of the patient population at 45.4%. The most common co-morbidity (Table I) found were hypertension (67.7%), diabetes mellitus (41.2%) and previous acute coronary event (25.1%). The most common presentation at the time of percutaneous coronary intervention were chronic stable angina (43.9%) and ST-elevation myocardial infarction (24.0%). Noteworthy to mention that heart failure and the need for mechanical intra-aortic balloon pump insertion was found in 18.0% and 3.1%, respectively. During admission a two-dimensional echocardiography was done. The parameters obtained from the registry for this study are the ejection fraction, left ventricular enlargement (LVH) and the presence of diastolic dysfunction (Table I). The retrievable echocardiographic data of the 1,030 registry patients were 364 (35.3%). Prior to admission, most of the diagnostics were done in the patients' locality or provinces. Most of these patients have an ejection fraction (EF) of less than 40% (82.0%). LVH and diastolic dysfunction were found in 72.0% and 65.9% of patients respectively. aspirin (86.0%), clopidogrel (89.9%), angiotensin-converting enzyme inhibitor or angiotensin receptor blocker (65.2%), statin (79.9%), nitrates (46.1%) and beta-blocker (45.0%) are the most common medications given to patients with MVD undergoing PCI (Table I).

Table I: **Baseline characteristics (N = 1,030)**

	Mean ± SD	
Age (years)	61 ± 12 (21 – 103)	
BMI (kg/m2)	25.8 ± 4.6 (13 – 68)	
	N	(%)
Sex		
Male	798	78.2%
Female	222	21.8%
Smoker	468	45.4%
Co-Morbidities (N = 1,030)		
Hypertension	697	67.7%
Diabetes	424	41.2%
Dyslipidemia	155	15.0%
CVD	54	5.2%
CKD	52	5.0%

on HD	28	2.7%
COPD	18	1.8%
PVD	17	1.7%
Previous ACS	259	25.1%
Previous PCI	108	10.5%
Previous CABG	67	6.5%
Clinical presentation at the time of PCI (N = 837)		
CSA	367	43.9%
UA	103	12.3%
NSTEMI	166	19.8%
STEMI	201	24.0%
Presence of Heart Failure (N = 1,030)		
HF	185	18.0%
IABP	32	3.1%
Echocardiographic parameters (N = 346)*		
EF		
≥40%	62	17.9%
<40%	284	82.0%
LVH	249	72.0%
Diastolic Dysfunction	228	65.9%
Medications (N = 1,030)		
ASA	886	86.0%
Clopidogrel	926	89.9%
Cilostazol	69	6.7%
Beta-Blocker	464	45.0%
Statin	823	79.9%
ACEi/ARBs	671	65.2%
CCB	271	26.3%
Nitrates	475	46.1%
GpIIb/IIIa antagonist	41	4.0%

Abbreviations: BMI – Body Mass Index; SD – Standard Deviation; ACS – Acute Coronary Syndrome; PCI – Percutaneous Coronary Intervention; CABG – Coronary Artery Bypass Graft; CVD – Cerebrovascular Disease; CKD – Chronic Kidney Disease; HD – Hemodialysis; COPD – Chronic Obstructive Pulmonary Disease; PVD – Peripheral Vascular Disease. CSA – Chronic Stable Angina; UA – Unstable Angina; NSTEMI – Non-ST-Elevation Myocardial Infarction; STEMI – ST-Elevation Myocardial Infarction; HF – Heart Failure; IABP – Intra-Aortic Balloon Pump. EF – Ejection Fraction; LVEDD – Left Ventricular End Diastolic Diameter; LVH – Left Ventricular Hypertrophy. *Number of patients with retrievable echocardiography results.

After coronary angiography (CA), prior to PCI (Table II), the most common significant coronary artery lesion encountered was a left anterior descending artery stenosis (91.8%). This was followed in almost equal proportion by lesions in the left circumflex artery (75.7%) and right coronary artery (76.4%). There slightly more three (3) vessel disease (56.9%) than two (2) vessel disease (43.1%) in this cohort.

***Table II:* Coronary Artery Lesion (N = 1,030)**

Coronary Artery Disease BEFORE PCI		
	N	(%)
LMA	112	10.9%
LAD	945	91.8%
LCx	780	75.7%
RCA	787	76.4%
Ramus	92	8.9%
CAD 2-VD	444	43.1%
CAD 3-VD	586	56.9%
Coronary Artery Lesions with Angiographic Success AFTER PCI		
LMA	40	3.9%
LAD	675	65.5%
LCx	423	41.0%
RCA	484	47.0%
Diagonal branch	9	0.9%

Abbreviations: PCI – Percutaneous Coronary Intervention; LMA – Left Main Artery; LAD – Left Anterior Descending Artery; LCx – Left Circumflex Artery; Right Coronary Artery; CAD – Coronary Artery Disease; VD – Vessel Disease.

Angiographic Success (Table II) was achieved in 65.5% of left anterior descending artery, 47.0% of right coronary artery, 41.0% of left circumflex artery, 3.9% of left main artery and 0.9% of diagonal branch lesions. Note that in some cases, patients underwent incomplete revascularization or culprit vessel PCI for STEMI.

***Table III:* Outcome (N = 1,030)**

	n	(%)
Angiographic Success	1,030	100%
Procedural Success	990	96.1%
MACE	40	3.9%
Death	38	3.7%
Post-PCI Myocardial Infarction	1	0.1%
CVD	5	0.5%
Complications		
Vascular	5	0.5%
Renal Failure	3	0.3%
Hypersensitivity reaction	2	0.2%
Bleeding	6	0.6%
Emergency or Urgent CABG	3	0.3%

Abbreviations: MACE – Major Adverse Cardiovascular Events; PCI – Percutaneous Coronary Intervention; CVD – Cerebrovascular Disease; CABG – Coronary Artery Bypass Graft Surgery.

Procedural Success was observed in 96.1% of patients (Table III). Forty (3.9%) patients had major cardiovascular adverse events (MACE) with death in 3.7%, post-procedural myocardial infarction in 0.7% and new onset cerebrovascular disease in 0.5%. The most common procedural complication was bleeding (0.6%) and vascular complications (0.5%).

B. Inferential Statistics

To determine the association of variables with outcome (procedural success and MACE) logistic regression was utilized. Univariate statistical analysis was used for each variable (Table IV). Multivariate statistical analysis was used for multiple significant predictor variables (Table V). The odds ratio (OR) with a confidence interval (CI) set at 95% was used to determine the strength and direction of association with a p-value of less than 0.05 for statistical significance. The univariate analysis (Table IV) for gender found that females were at threefold (3x) increased risk as compared to males (OR = 0.326, 95% CI: 0.169 – 0.629, p = 0.001)

***Table IV:* Univariate Logistic Regression Analysis**

	Procedural Success mean ± SD	MACE mean ± SD	Odds Ratio (95% CI)	p-value
Age (years)	61.4 ± 11.6	62.8 ± 9.3	1.010 (0.983 – 1.038)	0.461
BMI (kg/m2)	25.9 ± 4.6	24.5 ± 5.2	0.922 (0.842 – 1.010)	0.080
	n (%)	n (%)		
Sex				
Male	777 (79.1%)	21 (55.3%)	0.326 (0.169 – 0.629)	0.001
Female	205 (20.9%)	17 (44.7%)		
Smoker	454 (45.9%)	14 (35%)	0.636 (0.328 – 1.232)	0.180
Hypertension	669 (67.6%)	28 (70%)	1.120 (0.562 – 2.230)	0.748
Diabetes	409 (41.3%)	15 (37.5%)	0.852 (0.444 – 1.637)	0.631
Dyslipidemia	153 (15.5%)	2 (5%)	0.287 (0.069 – 1.206)	0.088
CVD	52 (5.3%)	2 (5%)	0.949 (0.223 – 4.044)	0.944
CKD	50 (5.1%)	2 (5.0%)	0.939 (0.232 – 4.219)	0.989
on HD	27 (2.7%)	1 (2.5%)	0.915 (0.121 – 6.904)	0.931
COPD	16 (1.6%)	2 (5.0%)	3.204 (0.711 – 14.435)	0.129
PVD	15 (1.5%)	2 (5.0%)	3.421 (0.755 – 15.495)	0.111
Previous ACS	251 (25.4%)	8 (20.0%)	0.736 (0.335 – 1.618)	0.446
Previous PCI	103 (10.4%)	5 (12.5%)	1.230 (0.472 – 3.210)	0.672
Previous CABG	66 (6.7%)	1 (2.5%)	0.359 (0.049 – 2.654)	0.316
CSA	363 (45.2%)	4 (11.2%)	--	NS
UA	97 (12.1%)	6 (17.7%)	5.613 (1.553 – 20.287)	0.008
NSTEMI	160 (19.9%)	6 (17.7%)	3.403 (0.947 – 12.225)	0.061
STEMI	183 (22.8%)	18 (52.9%)	8.926 (2.278 – 26.759)	<0.0001
HF	159 (16.1%)	26 (65.0%)	9.706 (4.959 – 18.997)	<0.0001
IABP	17 (1.7%)	15 (37.5%)	34.341 (15.434 – 76.412)	<0.0001
EF				
≥40%	266 (83.1%)	18 (69.2%)	2.189 (0.906 – 5.292)	0.082
<40%	54 (16.9%)	8 (30.8%)		
LVH	231 (73.6%)	18 (69.2%)	0.808 (0.339 – 1.929)	0.632
Diastolic Dysfunction	218 (74.7%)	10 (43.5%)	0.261 (0.110 – 0.620)	0.002
ASA	850 (85.9%)	36 (90.0%)	1.482 (0.520 – 4.229)	0.462
Clopidogrel	889 (89.8%)	37 (92.5%)	1.401 (0.424 – 4.626)	0.580
Cilostazol	69 (7.0%)	0 (0%)	--	NS
Beta-Blocker	448 (45.3%)	16 (40.0%)	0.807 (0.423 – 1.537)	0.513
Statin	796 (80.4%)	27 (67.5%)	0.506 (0.256 – 0.999)	0.050
ACEi/ARBs	649 (65.6%)	22 (55.0%)	0.642 (0.340 – 1.214)	0.173
CCB	264 (26.7%)	7 (17.5%)	0.583 (0.255 – 1.335)	0.202
Nitrates	454 (45.9%)	21 (52.5%)	1.305 (0.693 – 2.457)	0.410
GpIIb/IIIa antagonist	39 (3.9%)	2 (5.0%)	1.283 (0.299 -5.513)	0.737
CAD (Pre-PCI)				
LMA	101 (10.2%)	11 (27.5%)	3.339 (1.619 – 6.886)	0.001
LAD	908 (91.7%)	37 (92.5%)	1.114 (0.336 – 3.691)	0.860
LCx	747 (75.5%)	33 (82.5%)	1.534 (0.670 – 3.511)	0.312
RCA	755 (76.3%)	32 (80.0%)	1.245 (0.566 – 2.739)	0.586
Ramus	85 (8.6%)	7 (17.5%)	2.258 (0.970 – 5.260)	0.059
CAD 2-VD	432 (43.6%)	12 (30.0%)	1.806 (0.908 – 3.594)	0.092
CAD 3-VD	558 (56.45)	28 (70.0%)		
Stented (Post-PCI)				
LMA	37 (3.7%)	3 (7.5%)	2.088 (0.616 – 7.085)	0.237
LAD	652 (65.9%)	23 (57.5%)	0.704 (0.370 – 1.331)	0.278
LCx	411 (41.5%)	12 (30.0%)	0.604 (0.303 – 1.201)	0.151
RCA	471 (47.6%)	13 (32.5%)	0.531 (0.271 – 1.040)	0.065
Diagonal branch	9 (0.9%)	0 (0%)	--	NS

Abbreviations: SD – Standard Deviation; MACE – Major Adverse Cardiovascular Events; CI – Confidence Interval; BMI – Body Mass Index; CVD – Cerebrovascular Disease; CKD – Chronic Kidney Disease; HD – Hemodialysis; COPD – Chronic Obstructive Pulmonary Disease; PVD – Peripheral Vascular Disease; ACS – Acute Coronary Syndrome; PCI – Percutaneous Coronary Intervention; CABG – Coronary Artery Bypass Graft Surgery; CSA – Chronic Stable Angina; UA – Unstable Angina; NSTEMI – Non-ST-Elevation Myocardial Infarction; STEMI – ST-Elevation Myocardial Infarction; HF – Heart Failure; IABP – Intra-Aortic Balloon Pump; NS – not significant; EF – Ejection Fraction; LVEDD – Left Ventricular End Diastolic Diameter; LVH – Left Ventricular Hypertrophy; ASA – Aspirin; ACEi/ARBs – Angiotensin-converting enzyme inhibitor/ Angiotensin receptor blocker; CCB – Calcium Channel Blocker; Gp IIb/IIIa antagonist – Glycoprotein IIb/IIIa antagonist; LMA – Left Main Artery; LAD – Left Anterior Descending Artery; LCx – Left Circumflex Artery; RCA – Right Coronary Artery; CAD – Coronary Artery Disease; VD – Vessel Disease.

in developing MACE in multi-vessel PCI. Conversely, procedural success were better in males. There was statistically significant increased risk for MACE in patients presenting as unstable angina (OR = 5.613, 95% CI: 1.553 – 20.287, p = 0.008) and STEMI (OR = 8.926, 95% CI: 2.278 – 26.759, p < 0.0001) during the intervention (Table IV). Patients presenting in heart failure (OR = 9.706, 95% CI: 4.959 – 18.997, p < 0.0001) and those necessitating IABP insertion (OR = 34.341, 95% CI: 15.434 – 76.412, p < 0.0001) were at the highest risk for MACE (unfavourable procedural success) among all variables by univariate logistical regression statistical analysis (Table IV). A significant left main artery stenosis (>50% of vessel lumen) was found at increased risk for MACE (OR = 3.339, 95% CI: 1.619 – 6.886, p = 0.001) and unfavorable outcome with procedural success as compared to other coronary artery lesions. Statins, on the other hand, demonstrated a protective effect (OR = 0.506, 95% CI: 0.256 – 0.999, p = 0.050) against MACE; thus, statistically significant favorable outcome with procedural success. Likewise, those with diastolic dysfunction showed significant protective benefit (OR = 0.261, 95% CI: 0.110 – 0.620, p = 0.002).

***Table V:* Predictors of Outcome: Multivariate Logistic Regression Analysis**

	Odds Ratio (95% CI)	p-value p-value
Unstable Angina	20.137 (2.507 – 161.726)	0.005
COPD	10.579 (1.049 – 106.630)	0.045
IABP	9.887 (1.067 – 40.512)	0.042
STEMI	6.573 (1.067 – 40.512)	0.042
Male	0.113 (0.025 – 0.517)	0.005
Diastolic Dysfunction	0.241 (0.062 – 0.946)	0.041

Abbreviations: CI – Confidence Interval; COPD – Chronic Obstructive Pulmonary Disease; UA – Unstable Angina; STEMI – ST-Elevation Myocardial Infarction; IABP – Intra-Aortic Balloon Pump.

Considering the interplay between several variables, a multivariate logistic regression analysis was pursued (Table V). Patients presenting as unstable angina (OR = 20.137) and STEMI (OR = 6.573) have significantly increased risk for MACE. Chronic Obstructive Pulmonary Disease (COPD) was found to be significantly associated with unfavorable outcome (OR = 10.579) in patients undergoing multi-vessel PCI. Patients with IABP also has an increased risk for MACE (OR = 9.887). The presence of diastolic dysfunction was found to have a protective effect towards MACE in this study (OR = 0.241). Males were associated with favourable outcome (OR = 0.113) as compared with females.

Particularly not significantly apparent in this cohort is the effect of diabetes and chronic kidney disease on MV-PCI. There were difference in outcome between patients with 2-VD and 3-VD. Patients with left ventricular systolic dysfunction, those with low ejection fraction, did not seem to affect the outcome. Although the retrievable echocardiographic results found in the study is just a fraction of the entire study population and this may play a part of the limitation in the evaluation of this particular variable.

Discussion

This retrospective cohort study included all 1,030 patient undergoing MV-PCI, which is an adequate population size from which to draw valuable inferences. Univariate logistic regression analysis showed unfavorable procedural and clinical outcome in terms of MACE for female patients, those with unstable angina or STEMI, those with heart failure and those requiring IABP counterpulsation and left main artery coronary lesion. In contrast, male patients, those with diastolic dysfunction and those on statins confer a protective effect against MACE for MV-PCI and this translates to better procedural success. Unstable angina, STEMI, those with COPD and the need for IABP in multivariate analysis showed unfavorable outcome. Males and diastolic dysfunction showed favorable outcome.

The epidemiology of coronary artery disease[13] differs between male and female. The female cardiac patients tend to be older at the onset of CAD, and have a poorer risk profile and longer pre-hospital delayed time than their male counterparts. Female patients were associated with higher all-cause mortality than males[14]. In this study males has three times (by univariate analysis) and nine times (by multivariate analysis) increased chance of procedural success as compared to females. The Malaysian National Cardiovascular Disease Database – Percutaneous Coronary Intervention (NCVD-PCI) Registry[15] from 2007–2009 found that women who underwent PCI were older with more co-morbidities which resulted in significantly higher in-hospital mortality for all PCI, STEMI and NSTEMI.

Intra-aortic Balloon Pump (IABP) was placed in patients in cardiogenic shock. These are patient subsets who usually have the highest risk stratification. Statistical analysis showed that IABP insertion has 34 times (by univariate) and 10 times (by multivariate analysis) increased risk of developing unfavorable clinical (MACE) and procedural outcome (success). The result of the study infer that the need for IABP placement is a surrogate marker for unfavorable subset for procedural success. The use of IABP counterpulsation did not reduce the 30-day mortality in acute myocardial infarction complicated by cardiogenic shock[16].

The ECLIPSE investigators[17] (Evaluation of COPD Longitudinally to Identify Predictive Surrogate Endpoints) found that patients with COPD have more coronary artery disease and wereas associated with increased dyspnea, reduced exercise capacity and increased mortality. The investigators concluded that in cardiac patients, the presence of COPD is associated with poor clinical outcomes. Similar outcomes were observed with the multivariate analysis in this study which showed an 11-fold increase risk for MACE in patients with COPD. The pathophysiological mechanisms underlying the vascular alterations observed in COPD[18] is mediated mainly by endothelial dysfunction and coagulopathy inducing a "pro-coagulant" state due to increased levels of tissue factor and factor VIIa.

The univariate analysis on patients with significant left main artery stenosis who underwent PCI in this study revealed a three-fold increased risk for MACE and had less favorable procedural success. The most common reason encountered for PCI in a significant left main artery disease is a patient with a high surgical risk. This served as an alternative in carefully selected patients and dependent on the degree of operator expertise. In the SYNTAX trial[19,20] 45% of patients with unprotected left main coronary artery disease had complex disease; thus, majority underwent surgical revascularization. The LE MANS[21] (Study of Unprotected Left Main Stenting Versus Bypass Surgery) trial showed that the outcome in both PCI and CABG groups were similar at 30 days and at one year follow-up. The composite endpoint (death, MI, or stroke) at two years of the PRECOMBAT[22] (Premier of Randomized Comparison of Bypass Surgery versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease) trial was 4.4% among patients with left main disease who underwent PCI as compared to 4.7% who had surgical revascularization.

Aside from multi-vessel CAD, the presence of heart failure, PCI in STEMI, urgent or emergency procedure, cardiogenic shock are factors associated with an increased risk of PCI-related death[23].

Inferential statistics both with univariate and multivariate analysis revealed significant favorable outcome in those patients with diastolic dysfunction. Among those with coronary artery disease and acute myocardial infarction, 90% and 60% of patients respectively, have been previously reported to have diastolic dysfunction[24]. It was emphasized that the presence of diastolic dysfunction was found to be the earliest presentation of LV dysfunction. In this study, those with diastolic dysfunction mostly are hypertensive and with preserved global systolic function (EF $\geq$ 50%). The majority of the registry patients presented have grade I or II diastolic dysfunction (impaired relaxation or pseudonormalization). According to Mandinov et.al.[24], diastolic dysfunction has a higher prevalence in the elderly with hypertensive heart disease and is generally associated with lower mortality but with higher morbidity.

Therapeutic nihilism[25] resulting from chronic kidney disease (CKD) patients having lower rates of reperfusion therapy (thrombolysis and primary angioplasty) may explain the small fraction of patients in this registry who underwent PCI. CKD patients are known to have the highest mortality after acute myocardial infarction[26]. In the Bypass Angioplasty Revascularization Investigation (BARI) trial[27], CKD patients was shown to have worsened long-term survival whether they underwent PCI or surgical revascularization.

Conclusion

In summary, this cohort found significant predictors for improved procedural success and reduced risk for major cardiovascular events which was evident in male patients, those with diastolic dysfunction and patients on statins. The variables with unfavorable procedural and clinical outcome are female patients, those with unstable angina, STEMI, heart failure, COPD, the need for IABP counterpulsation and a left main artery coronary lesion.

The results reflect a local "real-life scenario" providing important information on the predictors of outcome among Filipino patients with multi-vessel disease undergoing percutaneous coronary intervention. The information obtained is clinically relevant for both cardiologists and interventionists providing an important risk stratification and contributing to the holistic delivery of cardiovascular care.

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