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Research Article

Effect of Coronary Arterial Dominance Post Primary Percutaneous Coronary Artery Intervention (PCI) during Hospital Stay and at 3-Month Follow-up

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Abstract

Background: Coronary vessel dominance, defined by the coronary artery that supplies the posterior descending artery (PDA) and posterolateral branches, influences the relative contribution of the different coronary arteries to the total left ventricular blood flow. This work aimed to evaluate the prognostic value of coronary arterial dominance post primary PCI, during hospital stay and at 3-month follow-up, which include; cardiac mortality, heart failure, non-fatal myocardial infarction, re-vascularization, stroke/TIA and re-admission for ACS.

Methods: This prospective observational study included 100 patients a with STEMI who underwent successful primary percutaneous coronary intervention with TIMI III flow and without procedural complications. Patients were divided into 3 groups according to coronary dominance: Right coronary dominant group (RCD), left coronary dominant group (LCD) and balanced coronary dominant group (BCD). All patients were subjected to transthoracic echocardiogram and coronary angiography and Primary percutaneous coronary intervention.

Results: Ticagrelor and clopidogrel during hospital stay and on hospital discharge were significantly used more with RCA group than LCX group and LCX & RCA group (P=0.021, 0.012), (P=0.018, 0.014), respectively. GPIIB/IIIA was significantly more used during hospital stay with RCA group than LCX group and LCX & RCA group(P=0.014). Nitrates was significantly used more on hospital discharge with RCA group than LCX group and LCX & RCA group (P<0.001).

Conclusions: Coronary arterial domi¬nance showed significant prognostic value in cases of myocardial Infarction after PCI, heart failure in LCX cases and in revascularization, heart failure, and stroke/TIA cases in RCA. Further, readmission for ACS was the most common outcome in all groups after 3-months follow-up.

Key-words: coronary arterial dominance; percutaneous coronary artery intervention; hospital stay; follow up

Introduction

Coronary vessel dominance, defined by the coronary artery that supplies the posterior descending artery (PDA) and posterolateral branches, influences the relative contribution of the different coronary arteries to the total left ventricular blood flow [1].

In a right-dominant circulation, the right coronary artery (RCA) supplies the posterior portion of the inter-ventricular septum and gives off the posterior descending artery. This contrasts with a left-dominant circulation, in which the left circumflex (LCX) artery supplies this territory. In a co-dominant circulation, supply of the posterior inter-ventricular septum is shared by the RCA and LCX. The prevalence of left dominance is 8%, whereas co-dominance has 7% population prevalence, [1] and right dominant system has a reported prevalence of 82–89% [2, 3]. In patients with a left dominant system, 60% of the left ventricular myocardium is supplied by the posterolateral branches and PDA originating from the LCx [4]. This less well-balanced coronary circulation might have a negative influence on prognosis of patients with coronary artery disease (CAD). Currently, the prognostic importance of coronary vessel dominance in patients presenting with first ST-segment elevation myocardial infarction (STEMI) remains uncertain [4].

Variations in coronary circulation are common, particularly with regard to the supply of the posterior wall of the left ventricle. While a right dominant coronary artery is most commonly observed, a left dominant system is considered to be a normal variant of the coronary anatomy [2, 3]. At present, little is known about the clinical relevance of this anatomical variation. A study screening 1620 post-mortem angiograms showed that the prevalence of a left dominant system decreased with age,

[3] suggesting a higher death rate among patients with a left dominant coronary artery system. An explanation could be that a larger amount of myocardium is at risk in these patients, resulting in more extensive myocardial infarction in case of a left coronary artery occlusion.

However, there is limited knowledge about the relation between coronary dominance patterns and the risk of various adverse clinical events that can occur following percutaneous coronary interventions (PCI). Previously, Goldberg et al. **[5]** showed that the presence of a left dominant system was associated with an increased mortality in patients presenting with acute coronary syndrome (ACS). Accordingly, a more recent registry (the Cath PCI registry) observed higher in-hospital mortality after PCI in patients with a left dominant system [1].

Left ventricular (LV) systolic dysfunction and remodeling have been strongly associated with short- and long-term outcomes of patients with STEMI undergoing primary percutaneous coronary intervention (PCI) [6]. Independent correlates of LV systolic dysfunction and remodelling after STEMI include infarct size, heart rate, and severity of coronary artery disease [7-9]. LV dysfunction affected by coronary arterial dominance, as Yip et al. [10] showed that a left dominant system was independently predictive of failed reperfusion in patients with LCx artery infarction. The effect of coronary arterial dominance on LV dysfunction and remodelling at follow-up is unclear [5].

The aim of this work was to evaluate the prognostic value of coronary arterial dominance post primary PCI, during hospital stay and at 3-month follow-up, which include; cardiac mortality, heart failure, non-fatal myocardial infarction, re-vascularization, stroke/TIA and re-admission for ACS.

Patients and Methods

This prospective observational study included 100 patients a with STEMI who underwent successful primary percutaneous coronary intervention with TIMI III flow and without procedural complications. Exclusion criteria: Prior coronary artery bypass graft to assess the effect of specific culprit vessel site without confounding by by-pass grafts, previous PCI, usuccessful PCI, cardiogenic shock, STEMI with mechanical complication, left main disease >50%, previous myocardial infarction, valvular heart disease, atrial dysrhythmias, end stage renal failure and abnormal liver function. Patients were divided into 3 groups according to coronary dominance: Right coronary dominant group, (RCD), left coronary dominant group, (LCD) and balanced coronary dominant group, (BCD).

Transthoracic echocardiogram

2-dimensional echocardiography was performed within 48 hours of admission and at 3-month follow-up. Routine Images were obtained at rest. M-mode, 2-dimensional, and Doppler images acquired. Systolic LV function was assessed. LV ejection fraction (LVEF) was calculated [(226)]. Subsequently, the LV was divided into 16 segments to calculate the wall motion score index (WMSI). Every segment was individually assessed and scored based on its motion and systolic thickening as the following: Normokinesis or hyperkinesis =1, Hypokinesis =2, Akinesis =3, Dyskinesis =4 and Aneurysm = 5. WMSI was calculated as the sum of the segment scores divided by the number of segments visualized [(226)]. WMSI classified as the following: 1 is norma1, 1-1.49 is mild impairment, 1.5-1.99 is moderate impairment and ≥ 2 is severe impairment.

Coronary angiography and Primary percutaneous coronary intervention

The images of the coronary angiography and PCI were obtained according to standardized angiographic projections [11]. During the analysis coronary vessel dominance, the culprit vessel and culprit lesion and severity of CAD were recorded. The extent of CAD was expressed as the presence of one-, two- or three-vessel disease (stenosis causing $\geq$ 70 % luminal narrowing). Complete revascularization were defined as treating all present significant coronary artery stenosis ($\geq$ 70 % luminal narrowing) during primary PCI or during secondary revascularization before discharge. Angiographic success of PCI was defined as TIMI III flow with residual stenosis below 0%.

Angiographic assessment of Coronary arterial dominance [12]

Coronary arterial dominance was defined according to the following definition: Right coronary dominant if the PDA and at least one posterolateral branches originating from the right coronary artery (RCA). Left coronary dominant if the PDA and the posterolateral branches originating from the LCx. Balanced coronary dominant if the PDA originating from the RCA in combination with posterolateral branches originating from the LCx artery **[12].**

The Brain Natriuretic Peptide

Test used: We used Alere Triage® BNP Test is a rapid, point of care fluorescence immunoassay designed to be used with the Alere Triage® Meters for the quantitative measurement of B-type natriuretic peptide (BNP) in EDTA anticoagulated whole blood or plasma specimens. The test procedure involves the addition of several drops of an EDTA

Statistical Analysis

All variables were expressed as mean ± standard deviation. The Chi-square test was used to analyse categorical variables. Student's t test and analysis of variance were used for continuous variables. Univariate and multivariate analyses were performed to identify independent predictors of no-premature atherosclerosis. Statistical analysis were made using SPSS 19.0. A P value <0.05 were considered statistically significant.

Results

All patient's characteristics, ECG STEMI were insignificantly different among the studied groups. There was insignificant difference in approach of catheterization (femoral or radial) between the three groups. **[**Error! Not a valid bookmark self-reference.**]**

Table 1: Patient's characteristics, ECG STEMI and approach to catheterization among three groups

		LCX (n = 29)	RCA (n = 70)	LCX & RCA (n = 11)	P value
Age (years)	**Mean ± SD**	54.45 ± 10.54	54.70 ± 9.71	61.36 ± 7.68	0.099
	Range	37 - 76	28 - 75	47 - 73	
Gender	**Male**	22 (75.86%)	58 (82.86%)	9 (81.82%)	0.720
	Female	7 (24.14%)	12 (17.14%)	2 (18.18%)	
Hypertension		23 (79.31%)	56 (80.00%)	8 (72.73%)	0.859
DM		16 (55.17%)	47 (67.14%)	7 (63.64%)	0.530
Smoker		11 (37.93%)	36 (51.43%)	7 (63.64%)	0.282
ECG STEMI					
Inferior		22 (75.86%)	52 (74.29%)	8 (72.73%)	0.976
Posterior		9 (31.03%)	16 (22.86%)	2 (18.18%)	0.604
Approach to catheterization					
Femoral		24 (82.76%)	64 (91.43%)	9 (81.82%)	0.376
Radial		5 (17.24%)	6 (8.57%)	2 (18.18%)	0.376

LCX: Left Circumflex coronary artery**, RCA:** Right coronary artery, DM: Diabetes mellites

There is insignificant difference in CKMB, serum creatinine and type of stent and wire (soft and DES) and its diameter, length, and number of stents used among the three groups **[**Error! Reference source not found.**]**

Table 2: CKMB, Serum creatine, troponin T and Type of stent and wire used in PCI among three groups

		LCX (n = 29)	RCA (n = 70)	BCD (n = 11)	P value
CKMB	**Mean ± SD**	78.17 ± 17.01	82.39 ± 13.03	89.64 ± 11.29	0.070
	Range	110 - 80	120 - 85	105 - 90	
Serum Creatine	**Mean ± SD**	1.07 ± 0.15	1.03 ± 0.16	1.13 ± 0.20	0.204
	Range	0.8 - 1.3	0.7 - 1.3	0.8 - 1.4	
Positive serum troponin T		29 (100%)	70 (100%)	11 (100%)	---
Type of stent and wire used in PCI					
Soft		3 (10.34%)	10 (14.29%)	2 (18.18%)	0.785
DES		26 (89.66%)	60 (85.71%)	9 (81.82%)	0.785
Diameter	**Mean ± SD**	3.18 ± 0.49	3.20 ± 0.41	3.27 ± 0.45	0.666
	Range	2 - 4	2.25 - 4	2.5 - 4	
Length	**Mean ± SD**	45.66 ± 24.36	38.41 ± 16.28	41.82 ± 18.57	0.223
	Range	15 - 96	15 - 86	18 - 78	
Number of Stents	**Mean ± SD**	1.45 ± 0.57	1.26 ± 0.44	1.45 ± 0.52	0.17
	Range	1 - 3	1 - 2	1 - 2	

LCX: Left Circumflex coronary artery, **RCA:** Right coronary artery, **CKMB:** Creatine kinase-MB

Low-density lipoprotein was significantly higher in LCX & RCA group than RCA group and LCX group and was significantly higher in RCA group than LCX group ($p < 0.001$).

High-density lipoprotein was significantly lower in LCX group than RCA group ($p = 0.021$), but there was insignificant difference between LCX

group and LCX & RCA group, and between RCA group and LCX & RCA group. **[Table 3**

EF was significantly higher in RCA group than LCX group and LCX & RCA group, and was significantly higher in LCX & RCA group than LCX group.

EF after 3 months was significantly different among the three groups (P =0.007). It was significantly higher in RCA group than LCX group and LCX & RCA group, and was significantly higher in LCX group than LCX & RCA group. **[Table 3**

Table 3: Dyslipidaemia and LV function by ECHO (simpson's method) before hospital discharge and after 3 months among three groups

		LCX (n = 29)	RCA (n = 70)	LCX & RCA (n = 11)	P value	Post hoc
Low-density lipoprotein	**Mean ± SD**	*148.79 ± 13.93*	*253.69 ± 12.35*	*349.09 ± 8.01*	**<0.001***	**P1: <0.001***
						P2: <0.001*
	Range	130 - 170	220 - 270	335 - 360		**P3: <0.001***
Cholesterol	**Mean ± SD**	243.79 ± 22.07	245.5 ± 26.51	242.73 ± 23.28	0.744	---
						---
	Range	210 - 285	170 - 300	210 - 290		---
Triglycerides	**Mean ± SD**	242.76 ± 29.75	244.59 ± 23.65	245.91 ± 18.28	0.921	---
						---
	Range	180 - 300	180 - 300	200 - 260		---
High-density lipoprotein	**Mean ± SD**	43.52 ± 5.96	46.84 ± 5.38	45.82 ± 5.42	**0.028***	**P1: 0.021***
						P2: 0.472
	Range	30 - 55	35 - 65	40 - 55		P3: 0.836
LV function by ECHO						
EF before discharge	**Mean ± SD**	42.85% ± 2.39%	51.01% ± 2.17%	48% ± 2.33%	**<0.001***	**P1:<0.001***
						P2:<0.001*
	Range	40% - 46%	48% - 58%	45% - 52%		**P3: <0.001***
EF after 3 months	**Mean ± SD**	54.85% ± 1.48%	55.01% ± 1.05%	53.67% ± 2.19%	**0.007***	**P1: 0.852**
						P2: 0.031*
	Range	52% - 58%	52% - 58%	50% - 56%		**P3: 0.004***
P value		**<0.001***	**<0.001***	**<0.001***		

LCX: Left Circumflex coronary artery, **RCA:** Right coronary artery, **P1:** Significance between LCX and RCA, **P2:** Significance between LCX and LCX & RCA, **P3:** Significance between RCA and LCX & RCA

BNP before discharge was significantly different among the three groups (P <0.001). It was significantly higher in LCX group than RCA group and LCX & RCA group, and was significantly higher in LCX & RCA group than RCA group. BNP after 3 months was significantly different among the three groups (P <0.001). It was significantly higher in LCX group than RCA group and LCX & RCA group, and was significantly higher in LCX & RCA group than RCA group. In-hospital and after 3-months outcomes were in significantly different among the groups. **[Table 4**

Table 4: BNP before hospital discharge and after 3 months and in-hospital and after 3-months outcomes among the three groups

		LCX (n = 29)	RCA (n = 70)	LCX & RCA (n = 11)	P value	Post hoc
BNP before discharge	**Mean ± SD**	793.93 ± 104.05	597 ± 93.74	631.83 ± 105.71	**<0.001***	**P1: <0.001***
						P2:<0.001*
	Range	482 – 975	450 – 1060	533 – 867		**P3:0.502**
BNP after 3 months	**Mean ± SD**	104.11 ± 31.79	58.07 ± 11.69	64.58 ± 19.69	**<0.001***	**P1:<0.001***
						P2:<0.001*
	Range	52 – 183	34 – 100	50 -125		**P3:0.536**
P value		**<0.001***	**<0.001***	**<0.001***		
In-hospital and after 3-months outcomes						
In-hospital clinical outcome	**Revascularization**	2 (6.9%)	3 (4.29%)	0	0.691	
	Cardiac Mortality	1 (3.45%)	1 (1.43%)	0		
	Myocardial Infarction after PCI	3 (10.34%)	2 (2.86%)	0		
	Heart Failure	3 (10.34%)	3 (4.29%)	2 (18.18%)		
	Stroke/TIA	2 (6.9%)	3 (4.29%)	3(27.27%)		
Outcome after 3-months follow-up	**Readmission for ACS**	4 (13.79%)	5 (7.14%)	3 (27.27%)	0.998	
	Revascularization	1 (3.45%)	1 (1.43%)	1 (9.09%)		
	Cardiac mortality	1 (3.45%)	1 (1.43%)	2 (18.18%)		
	Heart failure	2 (6.9%)	2 (2.86%)	1 (9.09%)		
	Stroke/TIA	1 (3.45%)	2 (2.86%)	2 (18.18%)		
	New Myocardial Infarction	2 (6.9%)	3 (4.29%)	2 (18.18%)		

LCX: Left Circumflex coronary artery, **RCA:** Right coronary artery, **BNP:** B-type natriuretic peptide, *Significant as p value <0.05, **P1:** between LCX and RCA **P2:** between LCX and LCX and RCA **P3:** between RCA and LCX and RCA

Ticagrelor and clopidogrel during hospital stay and on hospital discharge were significantly more used with RCA group than LCX group and LCX & RCA group((P=0.021, 0.012), (P=0.018, 0.014) respectively). GPIIB/IIIA was significantly more used during hospital stay with RCA group than LCX group and LCX & RCA group(P=0.014). Nitrates was significantly more used on hospital discharge with RCA group than LCX group and LCX & RCA group (P<0.001) [Error! Not a valid bookmark self-reference.**].**

Table 5: Drugs received during hospital stay and on hospital discharge among the three groups

	LCX (n = 29)	RCA (n = 70)	LCX & RCA (n = 11)	P value
Nitrates	29 (100%)	70 (100%)	11 (100%)	---
BB	29 (100%)	70 (100%)	11 (100%)	---
ACI	29 (100%)	70 (100%)	11 (100%)	---
Ticagrelor	25 (86.21%)	43 (61.43%)	5 (45.45%)	**0.021***
STAIN	29 (100%)	70 (100%)	11 (100%)	---

GPIIB/IIIA	8 (27.59%)	16 (22.86%)	7 (63.64%)	**0.014***
Clopidogrel	3 (10.34%)	27 (38.57%)	6 (54.55%)	**0.018***
	LCX (n = 29)	**RCA (n = 70)**	**LCX & RCA (n = 11)**	**P value**
BB	29 (100%)	70 (100%)	11 (100%)	---
ACEI	29 (100%)	70 (100%)	11 (100%)	---
Aspirin	29 (100%)	70 (100%)	11 (100%)	---
Ticagrelor	25 (86.21%)	43 (61.43%)	5 (45.45%)	**0.012***
STATIN	29 (100%)	70 (100%)	11 (100%)	---
Diuretics	7 (24.14%)	30 (42.86%)	7 (63.64%)	**---**
Nitrates	6 (20.69%)	43 (61.43%)	11 (100.00%)	**<0.001***
Clopidogrel	4 (13.79%)	31 (44.29%)	6 (54.55%)	**0.014***

LCX: Left Circumflex coronary artery, **RCA:** Right coronary artery, **BB:** Beta-blocker, **ACEI:** Angiotensin converting enzyme inhibitor, *Significant as p value <0.05

Discussion:

Coronary artery dominance is associated with the extent of CAD with incidence and all-cause mortality of AMI but not with atherosclerotic involvement. Research has suggested difference in post-PCI outcome and mortality of patients with acute coronary syndrome (ACS) undergoing PCI based on their coronary artery dominance. Coronary artery dominance is also associated with 30-day mortality and early reinfarction after STEMI [13-15].

In our study, there was an insignificant difference CKMB between the three groups.

Our results were not in consistent with [16]. They observed that median CK-MB were significantly different, and the highest values were observed in LD group (195.79 U/L, respectively). Larger included sample size and ethnic consideration can explain this contradiction. However, **[17]** found that the peak level of CK-MB was significantly higher in LCX group than in RCA group. This difference could be justified by the large recruited sample size and excluding patients with codominant LCX & RCA.

In our study, there was insignificant difference in approach of catheterization (femoral or radial) between the three groups. Our findings were in agreement with [18] who observed no significant difference in catheterization (femoral or radial artery) between the right- or co-dominant anatomy (RD group) and those with left dominant anatomy (LD group).

In our study, there is insignificant difference in type of stent and wire (soft and DES) and its diameter, length, and number of stents used among the three groups.

In consistent with our results, [19] assessed two-year follow-up data of 1,387 patients from the randomized TWENTE trial. Based on the origin of the posterior descending coronary artery, coronary circulation was categorised into left and non-left dominance (i.e., right and balanced). This was in line with [16] results; as no significant difference was detected in terms of stent type, size, and number among right, left and Co-dominant groups.

Moreover, [20] reported no significant difference between all studied group in stent length, number and diameter.

In the present study, EF before discharge was significantly different among the three groups (P <0.001). It was significantly higher in RCA group than LCX group and LCX & RCA group and was significantly higher in LCX & RCA group than LCX group.

Comparable to our findings, [17] found that EF was higher in RCA group than LCX group.

In our results, EF after 3 months was significantly different among the three groups (P =0.007). It was significantly higher in RCA group than LCX group and LCX & RCA group and was significantly higher in LCX group than LCX & RCA group.

Similarly, [21] conducted a study to compare the outcome of patients with CX versus right coronary artery (RCA) related STEMI. A total of 1683 consecutive patients with STEMI were studied. Patients who lacked STEMI were also included if they had persistent chest pain with signs of ischaemia or regional wall motion abnormalities on echocardiography. Coronary angioplasty was performed according to standard procedures. After the intervention, all patients received aspirin and clopidogrel or ticlopidine. The results showed that LVEF was significantly higher in patients with RCA- related MI treated by primary percutaneous intervention (PCI) when compared to LCX- related MI. Further, **[17]** results demonstrated that the left ventricular ejection fraction was notably lower in LCX group than RCA group after 30-Day. This difference could be related to the variety in duration of follow up.

In contrast, [20] found no significant difference in lower left ventricular ejection fraction after 3 months by both 2D and 3D echocardiography in patients with left dominant, right coronary dominant, and balanced coronary dominant groups.

Our findings were in line with [22] study which included one hundred fifty consecutive patients with acute inferior wall STEMI. Patients were divided into two groups according to the infarct related artery (LCX vs.

RCA). All patients underwent routine adjunctive angioplasty after TLT during the index hospitalization and clinical characteristics and outcomes were compared. There was lower left ventricular ejection fraction (LVEF) (p= 0.01) in patients with LCX occlusion compared with RCA.

In the present study, EF after 3 months was significantly higher than before discharge in the groups (p <0.001). Similarly**,** [20] found that after 3 months follow-up a significantly lower left ventricular ejection fraction at admission was observed by both 2D and 3D echocardiography in patients with a left dominant system.

In our study, regarding in-hospital clinical outcome, the most common outcomes in the LCX group were myocardial Infarction after PCI and heart failure each occurred in 3 (10.34%) patients, the most common outcomes in the RCA group were revascularization, heart failure, and stroke/TIA each occurred in 3 (4.29%) patients, the most common outcome in the LCX & RCA group was Stroke/TIA occurred in 3 (27%) patients.

In consistent with our results, **[17]** study results demonstrated that the frequency of advanced congestive heart failure was remarkably higher in group LCX than in RCA group (all P < 0.01), while the incidence of right ventricular infarction and complete heart block were notably higher in group RCA (all P < 0.01).

Furthermore, [23] conducted a prospective, observational, nonrandomized study and enrolled 200 consecutive patients with inferior wall STEMI. All patients were treated with emergency percutaneous coronary intervention during hospitalization and clinical characteristics and outcomes were compared. Group 1 included 100 patients presented with acute inferior wall STEMI caused by RCA occlusion and Group 2 included 100 patients presented with acute inferior wall STEMI caused by LCX occlusion. Total primary outcome in their study was higher in LCX group (p=0.048) that may be related to heart failure, stroke and bleeding which were more than RCA group.

Limitations: The study population was of limited size and the number of sites included in our registry. We only included patients with acute STEMI who were treated with primary PCI, which may have influenced the prevalence of CD pattern. Our findings must be interpreted in the context of acute STEMI treated with primary PCI, and they do not necessarily apply to all patients with acute STEMI.

Conclusion

Coronary arterial dominance showed significant prognostic value in cases of myocardial Infarction after PCI, heart failure in LCX cases and in revascularization, heart failure, and stroke/TIA cases in RCA. Further, readmission for ACS was the most common outcome in all groups after 3-months follow-up.

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Conflict of Interest: Nil

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