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INCIDENCE OF CORONARY ARTERY DOMINANCE AND PROGNOSIS IN PATIENTS WITH ACS UNDERGOING PERCUTANEOUS INTERVENTIONS

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ABSTRACT

Objectives: The objective of this study was to assess the Incidence in terms of presentation and in-hospital course between patients with right vs. left dominant arterial circulation undergoing percutaneous coronary intervention (PCI

Methodology: We included consecutive adult (≥18 years) patients diagnosed with STE-ACS/NSTE-ACS undergoing PPCI /Emergent PCI . Patients were categorized into right vs. left dominant circulation on left heart catheterization. Demographic, clinical characteristics, presentation, and hospital course were compared between the matched (propensity matched) and unmatched cohort of patients with right vs. left dominance.

Results: We included 900 patients, out of which 81.3% (720) were males and mean age was 54.59 ± 11.3 years. On coronary angiogram left dominance was observed in 14.3% (111). Single vessel disease was higher with left compared to right dominant system, 53.2% vs. 43.5%, respectively. The rate of slow flow/no-reflow (15.4% vs. 7.2%; p=0.0230), heart failure (9.3% vs. 6.3%; p=0.299), and in-hospital mortality (5.1% vs. 3.6%, p=0.493) were not different between right vs. left dominance, respectively. In the matched cohorts, the frequency of slow flow/no-reflow (15.3% vs. 7.2%; p=0.056), heart failure (6.3% vs. 6.3%; p>0.999), and mortality (5.4% vs. 3.6%, p=0.493) were not different between right vs. left dominance, respectively.

Conclusion: No significant increase in complications and outcomes is witnessed among patients with left dominant arterial circulation undergoing primary PCI for culprit proximal LAD. However, careful handling of left main during intervention is warranted due lack of support from right system.

Keywords: Coronary Dominance, Proximal LAD, STE-ACS patients, Primary PCI

INTRODUCTION

The cardiovascular diseases (CVD), characterized as diseases involves blood vessels and heart, are the leading cause of global morbidity and mortality.[1] According to estimates of the global burden of diseases (GBD) study, the prevalent case of CVD in Pakistan increased by 3.6% from 3717.5 to 3850.8 cases per 100,000 population with an incidence rate ratio of 1.001 [95% CI: 1.000 to 1.002] between the year 1990 to 2019, respectively.[2] The ischemic heart diseases (IHD) remained the main variant of CVD accounting for 49% of the total CVD burden at global level.[3] The "ST-segment elevation myocardial infarction (STEMI)" is reported to be the most common and most fatal manifestation of IHD.[4] However, significant improvements in survival and outcomes has been recorded in recent years the introduction of "primary percutaneous coronary intervention (PCI)" and other advancements in the therapeutic and nontherapeutic treatment and management modalities.[5] Even with the primary PCI, a substantial proportion of patients experiences adverse outcomes. Hence, identification of high risk individuals is of paramount importance and multiple modalities have been developed and validated for this purpose.[6,7] In addition to the clinical factors, anatomical factors also plays a significant role in risk stratification of these patients.[7]

Coronary artery dominance is a common coronary artery variant which had shown a significant influence on outcomes. The left dominant circulation system has been reported to be associated a higher risk of post-PCI non-fatal myocardial infarction, immediate mortality, and re-infarciton.[8-10] The association of left dominant circulation with the adverse outcomes is hypothesized to be driven by the unbalanced supply of blood to the cardiac muscle, increased risk of failed intervention due to difficult course of the left circumflex artery, and absence of sufficient collateralized blood circulation.[7] In routine clinical practice, the stenosis of left anterior descending artery (LAD) is given attention due to its distinctive prognostic role. Hence, length and dominance are the two cardinal anatomical characteristics with significant clinical implications

METHODOLOGY

This was a single-center observational study, conducted between January 2020 and June 2020 at the largest cardiac hospital in Peshawar, Pakistan. Study was approved by the ethical review board of the "Hayatabad Medical Complex 'and verbal consent for participation was obtained from all the study participants.

Study inclusion criteria were; consecutive adult (≥18 years) patients diagnosed with Acute Coronary Syndrome undergoing PCI. Patients with consent refusal, patients, or patients with co-dominant circulation system were excluded.

A 12-lead electrocardiogram (ECG) was performed in all the patients and ACS was diagnosed based on the ECG findings of "ST elevation in at least two contiguous leads >2mm in men or >1mm in women in leads V2 to V3 and/or >1mm in other contiguous chest leads or limb leads" along with history of "typical chest pain for at least 20 minutes" at the time of presentation in the emergency department and Patients with Chest pain but their Ecg were not suggestive of ST segment elevation but still they had chest pain and /or Raised Cardiac Enzymes

As per the institutional policy all the procedures were performed free of cost. Pre-and post-procedure pharmacological and non-pharmacological care was uniform for all the patient. coronary artery dominance was determined on the coronary angiogram. All the patients were observed for the development of post procedure complications and mortality during their hospital stay.

For the analysis, patients were categorized into two groups, the left and right dominance groups. Two groups were compared for the differences in demographic, clinical, and angiographic characteristics and post-procedure in-hospital morbidity was defined as either cerebrovascular accident (CVA)/stroke, heart failure, contrast-induced nephropathy (CIN), access site complications, major bleeding, or stent thrombosis. Data were analyzed using IBM SPSS version 21, for the comparison of categorical variables between the two groups, Chi-square test/Fisher's exact test was applied and independent sample t-test/Mann-Whitney U test was applied for comparison of continuous variables. In order to minimize the statistical bias a propensity matched cohort of right and left dominant patients was formed using software "R version 4.2.1" and library "MatchIt". The characteristics used in the

matching algorithm included: the demographic variables (such as; gender and age), clinical variables (such as; total ischemic time (minutes), blood pressure (mmHg), heart rate (bpm), random blood sugar (mg/dL), height (cm), weight (kg), body mass index (kg/m^2), and Killip class), co-morbid conditions (obesity, hypertensions, smoking, diabetes, history of ischemic heart diseases, and CVA/stroke), and angiographic characteristics (pre-procedure "left ventricular end-diastolic pressure (LVEDP mmHg)", "left ventricular ejection fraction (LVEF %)", "thrombolysis in myocardial infarction (TIMI)" flow grade, and number of vessels involved). Criteria for statistical significance was p-value ≤0.05.

RESULT

We included 900 patients, out of which 81.3% (720) were males and mean age was 54.59 ± 11.3 years. On coronary angiogram 14.3% (111) were found to have left dominant circulation. The clinical profile and distribution of risk factors were not statistically significant between the left vs. right dominant cohort (Table 1). However, comparatively higher proportion of patients with left dominant system had single vessel disease (53.2% (59/111) vs. 43.5% (289/664)). The frequency of morbidity was higher, but insignificant, in right dominant as compared to left dominant system with slow flow (15.4% vs. 7.2%; p=0.0.230) and heart failure (9.3% vs. 6.3%; p=0.299), respectively. Overall in-hospital mortality rate was observed to be 4.9% (38) with 5.1% (34/664) in right system vs. 3.6% (4/111) in left system (p=0.493), Table 1.

Table 1: Comparison of clinical characteristics and hospital course of patients

	Total	Dominance		P-value
		Left	**Right**	
Total (N)	**900**	**179**	**721**	
Gender				
Male	81.3% (721)	80.2% (89)	81.5% (541)	0.746
Female	18.7% (179)	19.8% (22)	18.5% (123)	
Age (year)	54.59 ± 11.3	55.19 ± 11.79	54.49 ± 11.22	0.545
18 to 40 years	13.3% (103)	13.5% (15)	13.3% (88)	0.967
41 to 65 years	71.2% (552)	70.3% (78)	71.4% (474)	
Systolic blood pressure (mmHg)	135.25 ± 23.91	138.38 ± 25.99	134.73 ± 23.52	0.136
Heart rate (bpm)	88.04 ± 17.81	87.03 ± 17.4	88.21 ± 17.88	0.516
Random blood sugar (mg/dL)	195 [163 - 235]	206 [165 - 240]	192 [163 - 231.5]	0.117
Killip Class				
I	83.6% (648)	83.8% (93)	83.6% (555)	0.925
II	9.2% (71)	9.9% (11)	9% (60)	
III	4.5% (35)	4.5% (5)	4.5% (30)	
IV	2.7% (21)	1.8% (2)	2.9% (19)	
Co-morbid conditions				
Hypertension	51.7% (401)	55% (61)	51.2% (340)	0.464
Diabetes	34.1% (264)	35.1% (39)	33.9% (225)	0.797
Smoking	20.4% (158)	17.1% (19)	20.9% (139)	0.356
Ischemic heart diseases	9% (70)	10.8% (12)	8.7% (58)	0.480
Cerebrovascular accident/stroke	0.8% (6)	0.9% (1)	0.8% (5)	0.868
Height (cm)	164.95 ± 7.58	164.04 ± 8.92	165.11 ± 7.32	0.168
Weight (kg)	73.54 ± 9.91	72.08 ± 9.27	73.78 ± 10	0.094
Body mass index (BMI kg/m^2)	27.12 ± 4.04	26.92 ± 3.92	27.16 ± 4.07	0.567
Obesity	20.9% (162)	19.8% (22)	21.1% (140)	0.762
Pre-procedure LVEDP (mmHg)	24.16 ± 9.51	24.15 ± 9.33	24.16 ± 9.55	0.993
Pre-procedure ejection fraction (%)	36.9 ± 7.91	36.85 ± 7.83	36.91 ± 7.93	0.935
Number of involved vessels				
Single vessel disease	44.9% (348)	53.2% (59)	43.5% (289)	0.070
Two vessel disease	31% (240)	30.6% (34)	31% (206)	
Three vessel disease	24.1% (187)	16.2% (18)	25.5% (169)	

Pre-TIMI flow				
0	38.3% (297)	47.7% (53)	36.7% (244)	
I	9% (70)	8.1% (9)	9.2% (61)	0.177
II	27.5% (213)	22.5% (25)	28.3% (188)	
III	25.2% (195)	21.6% (24)	25.8% (171)	
Complications and outcomes				
Slow flow/no-reflow	14.2% (110)	7.2% (8)	15.4% (102)	0.230
Heart failure	8.9% (69)	6.3% (7)	9.3% (62)	0.299
Contrast induced nephropathy	1.9% (15)	3.6% (4)	1.7% (11)	0.168
Major bleeding	0.3% (2)	0% (0)	0.3% (2)	0.563
Cerebrovascular accident/stroke	0.1% (1)	0% (0)	0.2% (1)	0.682
Access site complications	0.4% (3)	0% (0)	0.5% (3)	0.478
In-hospital mortality	4.9% (38)	3.6% (4)	5.1% (34)	0.493

LVEDP=left ventricular end-diastolic pressure, TIMI=thrombolysis in myocardial infarction

In the propensity matched cohorts, the frequency of slow flow/no-reflow was higher, but insignificant, in right dominant as compared to left dominant system with rate of 15.3% vs. 7.2%; p=0.056, respectively. The mortality rate was 5.4% (6) in right system vs. 3.6% (4) in left system (p=0.518), Table 2.

Table 2: Comparison of clinical characteristics and hospital course of propensity matched cohort of patients with left vs. right dominant circulation undergoing primary percutaneous coronary intervention for culprit proximal left anterior descending artery

	Dominance		P-value
	Left	Right	
Total (N)	111	111	
Gender			
Male	80.2% (89)	84.7% (94)	0.378
Female	19.8% (22)	15.3% (17)	
Age (year)	55.19 ± 11.79	56.05 ± 11.42	0.583
18 to 40 years	13.5% (15)	9.9% (11)	
41 to 65 years	70.3% (78)	70.3% (78)	0.602
>65 years	16.2% (18)	19.8% (22)	
Total ischemic time (min)	373 [240 - 486]	333 [210 - 510]	0.370
Systolic blood pressure (mmHg)	138.38 ± 25.99	134.58 ± 20.38	0.227
Heart rate (bpm)	87.03 ± 17.4	85.6 ± 17.85	0.548
Random blood sugar (mg/dL)	206 [165 - 240]	200 [173 - 248]	0.684
Killip Class			
I	83.8% (93)	84.7% (94)	
II	9.9% (11)	9% (10)	
III	4.5% (5)	4.5% (5)	0.997
IV	1.8% (2)	1.8% (2)	
Co-morbid conditions			
Hypertension	55% (61)	55% (61)	>0.999
Diabetes	35.1% (39)	36% (40)	0.889
Smoking	17.1% (19)	17.1% (19)	>0.999
Ischemic heart diseases	10.8% (12)	14.4% (16)	0.419
Cerebrovascular accident/stroke	0.9% (1)	0% (0)	0.316
Height (cm)	164.04 ± 8.92	163.56 ± 8.13	0.677
Weight (kg)	72.08 ± 9.27	72.86 ± 11.09	0.568
Body mass index (BMI kg/m²)	26.92 ± 3.92	27.37 ± 4.68	0.435
Obesity	19.8% (22)	20.7% (23)	0.867
Pre-procedure LVEDP (mmHg)	24.15 ± 9.33	24.23 ± 10.06	0.950

Pre-procedure ejection fraction (%)	36.85 ± 7.83	36.17 ± 8.06	0.527
Number of involved vessels			
Single vessel disease	53.2% (59)	54.1% (60)	
Two vessel disease	30.6% (34)	30.6% (34)	0.982
Three vessel disease	16.2% (18)	15.3% (17)	
Pre-TIMI flow			
0	47.7% (53)	41.4% (46)	
I	8.1% (9)	7.2% (8)	
II	22.5% (25)	26.1% (29)	0.763
III	21.6% (24)	25.2% (28)	
Complications and outcomes			
Slow flow/no-reflow	7.2% (8)	15.3% (17)	0.056
Pump failure	6.3% (7)	6.3% (7)	>0.999
Contrast induced nephropathy	3.6% (4)	0.9% (1)	0.175
Major bleeding	0% (0)	0.9% (1)	0.316
Cerebrovascular accident/stroke	0% (0)	0.9% (1)	0.316
Access site complications	0% (0)	0% (0)	-
In-hospital mortality	3.6% (4)	5.4% (6)	0.518

LVEDP=left ventricular end-diastolic pressure, TIMI=thrombolysis in myocardial infarction

DISCUSSION

The stenosis of LAD has gained special attention to interventional cardiologists due to its distinctive prognostic role. Although, the left dominant circulation system is considered a normal entity but its prognostic role has been hypothesized mainly due to unbalanced supply of blood to the cardiac muscle.[10,11] Therefore, we conducted this study to evaluate the role of left dominant circulation system in determining the fate of ACS patients . It has been observed that, in this particular sub-groups of ACS patients, the clinical manifestation, risk factor distribution, most of the angiographic findings, and hospital course were not different between the left and right dominant groups. Contrary to the general perception, the rate of complications and in-hospital mortality were found to be relatively higher, but insignificant, for the patients with right dominant system compared to the left dominant circulation system. A single point of difference between the two groups was the proportion of single vessel disease, it has been observed that the 53.2% of the patients with left dominant system had single vessels disease as compared to 43.5% for the patients with right dominant system. This could be one of the possible reasons for the relatively lower event rate among patients with the left dominant system but the difference between the two groups remained evident even after the propensity matching for the said difference.

In our study we observed a higher proportion of single vessel involvement among patients with left dominance circulation. A similar observations were made by the Peng L et al.[16] with a higher frequency of triple-vessel involvement, 36.6% vs. 27.3%, among patients with right coronary dominance compared to the left coronary dominance.[16] It has been further reported to be an independent predictor of incidence of acute inferior wall myocardial infarction with adjusted odds ratio of 2.396 [95% confidence interval: 1.328-4.321].[17] Yan B et al.[18] confirms these observation with conclusion of severity of coronary artery diseases associated with right dominance with a mean Gensini score of 36.3±29.0 vs. 42.3±33.6; p=0.033 for patients with left vs. right dominance, respectively. However, no effect of coronary dominance on burden of coronary artery calcification has been reported.[8]

Single center experience with relatively small sample size and lack are of follow-up are the key limitations of this study.

CONCLUSION

In conclusion, we observed no significant increase in complications and outcomes among patients with left dominant arterial circulation undergoing PCI. The left dominant system was found to be

associated with a higher prevalence of single vessel involvement. However, careful handling of left main during intervention is warranted due to lack of support from the right system.

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