DOI: https://doi.org/10.53350/pjmhs221610935

ORIGINAL ARTICLE

Association between the Angle of the Left Subclavian Artery and Procedural Time for Percutenous Coronary Intervention in Acute Coronary Syndrome Patients

AFTAB AHMED SOLANGI[1], NASRULLAH[1], AMIR JAMIL[1], MUHAMMAD TAHIR[2], JALALUDIN[3], IMRAN ABID[4]
[1]*Medical Officer (FCPS Cardiology), Punjab Institute of Cardiology, Lahore*
[2]*Medical Officer/ Resident (FCPS Cardiology), Punjab Institute of Cardiology, Lahore*
[3]*Post Graduate Resident (FCPS Cardiology), Punjab Institute of Cardiology, Lahore*
[4]*Assistant Professor Cardiology, Punjab Institute of Cardiology, Lahore*
Corresponding author: Nasrullah, Email: nasrullah_jan80@yahoo.com

ABSTRACT

Background and Aim: Patients with acute coronary syndrome who receive radial access by percutaneous coronary intervention (PCI) are less likely to experience clinical adverse events. The present study aimed to associate the PCI procedural time with left subclavian artery angle in acute coronary syndrome patients.

Material and Methods: This retrospective study was carried out on 124 consecutive patients who underwent percutaneous coronary intervention in Punjab Institute of Cardiology, Lahore from June 2021 to June 2022. Prior to study conduction, the ethical committee approved the study protocol. After a CT scan on admission, patients with PCI via an LRA were included in this study. The angle of left subclavian artery was measured on CT scan through coronal view as an indicator for tortuosity and was related with procedural time and clinical variables. SPSS version 26 was used for data analysis.

Results: Of the total 124 consecutive patients who underwent PCI, the left radial approach was used in 60 (48.4%) acute coronary syndrome patients. The overall mean age was 64.8±12.6 years. There were 37 (29.8%) females and 87 (70.2%) males. Severe tortuosity patients (left subclavian artery angle <70 degree) had higher incidence of female gender (41.6% vs. 14.2%, p<0.001), older age (73.8±9.87 vs. 59.6±14.2 years, P<0.005), higher subclavian artery calcification (72.6% vs. 32.8%, P=0.001), and hypertension (92.6% vs. 74.8%, P<0.01) than those with angle of left subclavian artery ≥70 degrees. Total procedural time (ρ=-0.29, P=0.003), and sheath cannulation to first balloon time (ρ=-0.48, P<0.001) were negatively associated with left subclavian artery angle.

Conclusion: The present study found that Left subclavian artery lower angles are indicators of tortuosity via left radial approach significantly associated with total procedural time and sheath insertion long duration to the first balloon time during percutaneous coronary intervention.

Keywords: Acute coronary syndrome, Percutaneous coronary intervention, left radial access

INTRODUCTION

Percutaneous coronary intervention (PCI) via left radial access (LRA) is significantly related to reduction in adverse clinical outcome as compared to acute coronary syndrome patient's femoral access [1-3]. Acute coronary syndrome (ACS) suspected patients should be risk stratified based on ACS susceptibility and adverse outcomes for effective treatment option [4, 5]. Acute coronary syndrome patients with hemodynamic instability and refractory angina, urgent invasive strategy is recommended as per recent medical practice guidelines [6, 7]. This early invasive strategy might prevent ischemic stroke [8]. Additionally, variations in arterial anatomy including right subclavian artery tortuosity affect the duration and outcomes of transradial procedural [9]. Numerous studies reported that LRA use in St-elevated MI patients is significantly associated with reperfusion times and comparable success rate as compared to right radial access [10]. Consequently, LRA is an alternate approach in ACS patients compared to RRA due to right hand persons preferred while considering the different vascular complication risk.

Majority of physician considered PCI through right radial artery as a preferred choice for carrying out the procedure and are acceptable to patients due to fast recovery and vascular complications reduction as compared to PCI through femoral aorta and artery causing longer exposure to X-rays, difficulties in catheter placement, catheter deliveries time consumption, and poor recoil support. There is paucity of data regarding the patient's outcomes in early or delayed PCI. Patients were stratified into high, intermediate, and low risk groups. Left subclavian artery angular changes were hypothesized on CT due to PCI time influenced by tortuosity via LRA in ACS patients. The present study aimed to evaluate the association of left subclavian artery angle and procedural time for PCI in ACS patients.

METHODOLOGY

This retrospective study was carried out on 124 consecutive patients who underwent percutaneous coronary intervention in Punjab Institute of Cardiology, Lahore from June 2021 to June 2022. Prior to study conduction, the ethical committee approved the study protocol. After a CT scan on admission, patients with PCI via an LRA were included in this study. The left subclavian artery angle was measured on CT scan through coronal view as an indicator for tortuosity and was related with procedural time and clinical variables. LRA is the preferred option for PCI unless there is a left handed person, poor radial pulse, arterial line inserted, and had paralyzed side. CT was not performed in all ACS patients. All the patients underwent PCI via other arterial access approach, myocardial infarction patients (2-28 days), non-native coronary vessel patients undergone PCI, and physiological testing in PCI guided patients were excluded. Multi-slice helical CT was used with elevated upper limbs during admission time after percutaneous coronary artery. Initially, the left subclavian artery was identified through coronal plane image. In the center of the blood vessel, two points each 5 mm away were selected in the left subclavian artery. On a horizontal plan, the angle of line connection between two points was measured. Lower angle was selected and estimated by two independent cardiologists. SPSS version 26 was used for data analysis. Numerical variables were expressed as mean and standard deviation whereas categorical variables were described as frequency and percentage. Sheath cannulation and total procedural time were not distributed normally. All the descriptive statistics was done taking 95% confidence interval and 5% level of significance.

RESULTS

Of the total 124 consecutive patients who underwent PCI, the left radial approach was used in 60 (48.4%) acute coronary syndrome patients. The overall mean age was 64.8±12.6 years. There were 37 (29.8%) females and 87 (70.2%) males. Severe tortuosity patients (angle of left subclavian artery <70 degree) had higher incidence of female gender (41.6% vs. 14.2%, p<0.001), older age (73.8±9.87 vs. 59.6±14.2 years, P<0.005), higher subclavian artery calcification (72.6% vs. 32.8%, P=0.001), and hypertension (92.6%

vs. 74.8%, P<0.01) than those with left subclavian artery angle ≥70 degrees as shown in Figure-2. Total procedural time (ρ=-0.29, P=0.003), and sheath cannulation to first balloon time (ρ=-0.48, P<0.001) were negatively associated with left subclavian artery angle. Figure-1 illustrates the gender's distribution. Table-I represents the different comorbidities in angle of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees. Laboratory findings of both angle of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees are shown in Table-II. Table-III compares the PCI procedure in angle of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees. Table-IV shows the CT findings in both angles of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees.

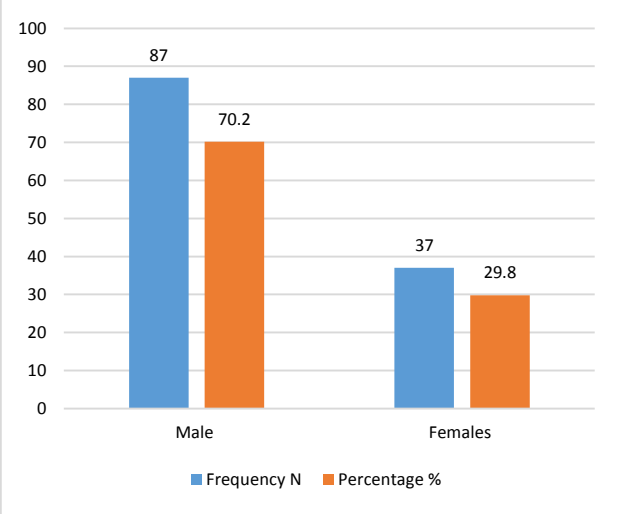

Figure-1: Gender's distribution (n=124)

Table-1: Comparison of different comorbidities in angle of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees

Comorbidities	Angle of left subclavian artery <70 degree N=29 (%)	Angle of left subclavian artery ≥70 degrees N=31 (%)	P-value
Hypertension	27 (92.6)	23 (74.8)	<0.01
Diabetes	11 (37.9)	12 (37.9)	0.76
Dyslipidemia	18 (62.1)	21 (67.7)	0.20
Smoking	16 (55.1)	22 (71)	0.81
Previous PCI	6 (20.7)	4 (12.9)	0.48
Statin	8 (27.6)	11 (35.5)	0.53

Table-2: Comparison of Laboratory findings of both angle of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees

Parameters	Angle of left subclavian artery <70 degree N=29	Angle of left subclavian artery ≥70 degrees N=31	P-value
HbA1c (%)	6.2 ±0.7	6.1 ±1.2	0.67
T-chol (mg/dL)	202.0±46.8	214.1±56.4	0.29
LDL (mg/dL)	115.6±42.6	131.2±48.8	0.21
HDL (mg/dL)	44.6±10.7	46.8±11.6	0.41
TG (mg/dL)	116 (80, 192)	120 (88, 162)	0.91
Creatinine	0.96±0.48	0.91±0.42	0.92

Table-3: Comparison of PCI procedure in angle of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees.

PCI procedure	Angle of left subclavian artery <70 degree N=29	Angle of left subclavian artery ≥70 degrees N=31	P-value
Fluoroscopy time (min)	22.6 (12.5, 37.9)	14.4 (12.3, 26.6)	0.08
Total procedure time (min)	80.4±44.3	58.9±28.6	0.012
Sheath insertion to the first balloon time (min)	32.6±12.3	22.2±6.8	<0.001
Contrast medium volume	138.6±36.4	131.6±46.4	0.53
Changing guiding catheter	4 (13.8%)	3 (9.7%)	0.29
Back up catheter	22 (75.9%)	21 (67.7%)	0.51
Micro-catheter used for culprit lesion wire crossing	10 (34.5%)	5 (16.1%)	0.05
Multiple stent implantation	9 (31%)	10 (32.3%)	0.76
Temporary pace maker	8 (27.6%)	8 (25.8%)	0.65

Table-4: Comparison of CT findings in angle of left subclavian artery <70 degree versus angle of left subclavian artery ≥70 degrees.

CT findings	Angle of left subclavian artery <70 degree N=29	Angle of left subclavian artery ≥70 degrees N=31	P-value
Subclavian artery calcification presence	21 (72.4%)	11 (35.5%)	0.001
Angle of the aortic root (degrees)	45.4±8.3	41.6±8.6	0.21

DISCUSSION

The present study found that left subclavian artery lower angle was associated with female gender, hypertension in ACS patients, and older age of patients underwent left radial PCI and had moderate association with prevalence of CIN and longer duration of sheath insertion to the first balloon time. From the last few decades, a growing number of patients have undergone PCI through radial artery route with increasing cases in which direct PCI and interventional PCI were carried out. A previous study reported that PCIs were performed through the right radial and left radial artery in 89.4% and 10.6% respectively [11]. Another study found that the majority of physicians have chosen a radially artery route for performing PCI on a routine basis [12]. Yet, in emergency cases, the femoral artery route is related to severe drawbacks. Many vascular complications were associated with femoral routes. The catheter entrance direction through ascending aorta in left radial artery is similar to aorta through femoral artery.

Artery tortuosity is difficult to evaluate through angiography and previous investigations reported that CT imaging used as an indicator of artery tortuosity is quantitative assessment of right subclavian artery angle [13, 14]. Prior to cardiac catheterization, CT imaging is not required in ACS patients. However, CT imaging for angle assessment might have clinical advantage over other modalities particularly in ACS patients as they often undergo CT examination before aortic dissection detection before PCI in ACS patients [15, 16].

Female gender, older age, and presence of comorbidities such as hypertension and diabetes were significantly associated with left subclavian artery tortuosity in the present study. A study conducted by J. Maeremans et al [17] reported that severe tortuosity was significantly associated with consecutive patients who underwent right radial artery through coronary angiography done initially. Another study showed that right subclavian artery severe tortuosity clinical predictors were older age, female gender, and a short stature [18].

Patients with an angle of the left subclavian artery of <70 degrees were also found to have a high risk of CIN. Atherosclerosis was associated with CIN related various risk factors. Similar findings were reported in previous studies [19-21]. The left subclavian artery angular changes are considered for different risk factors representation on the CT images.

Another approach of LRA might not be needed to change in cases where the left subclavian angle is lower. Previous studies reported that severe tortuosity clinical predictors might be similar due to brachiocephalic left or right subclavian arteries [22, 23]. The subclavian artery lower angle increases the risk of longer procedural time in ACS patients who are hemodynamically unstable. Comparing the left subclavian artery angle, <70 degree had higher CIN incidence than ≥70 degrees group.

CONCLUSION

The present study found that Left subclavian artery lower angles are indicators of tortuosity via left radial approach significantly associated with total procedural time and sheath insertion long duration to the first balloon time during percutaneous coronary intervention.

REFERENCES

1. R. Ito, J. Yamashita, T. Chikamori et al., "Clinical differences of recent myocardial infarction compared with acute myocardial infarction-insights from the Tokyo CCU network multicenter registry," Circulation Journal, vol. 84, no. 9, pp. 1511–1518, 2020.
2. D. Weiss, C. Cavinato, A. Gray et al., "Mechanics-driven mechanobiological mechanisms of arterial tortuosity," Science Advances, vol. 6, no. 49, Article ID eabd3574, 2020.
3. R. Gorla, F. De Marco, A. Garatti et al., "Impact of aortic angle on transcatheter aortic valve implantation outcome with evolut-R, portico, and acurate-NEO," Catheterization and Cardiovascular Interventions, vol. 97, no. 1, pp. E135–E145, 2021.
4. S. Maeda, W. W. Chik, Y. Han et al., "Effects of age-related aortic root anatomic changes on left ventricular outEow tract pace-mapping morphologies: a cardiac magnetic resonance imaging validation study," Journal of Cardiovascular Electrophysiology, vol. 26, no. 9, pp. 994–999, 2015.
5. J. Park, K. H. Choi, J. M. Lee et al., "Prognostic implications of door-to-balloon time and onset-to-door time on mortality in patients with ST-segment-elevation myocardial infarction treated with primary percutaneous coronary intervention," Journal of American Heart Association, vol. 8, no. 9, Article ID e012188, 2019.
6. K. &ygesen, J. S. Alpert, A. S. Ja-e et al., "Fourth universal definition of myocardial infarction (2018)," Journal of the American College of Cardiology, vol. 72, no. 18, pp. 2231–2264, 2018.
7. K. Kimura, T. Kimura, M. Ishihara et al., "JCS 2018 guideline on diagnosis and treatment of acute coronary syndrome," Circulation Journal, vol. 83, no. 5, pp. 1085–1196, 2019.
8. A. Kurtul, M. Yarlioglues, and M. Duran, "Predictive value of CHA2DS2-VASC score for contrast-induced nephropathy after percutaneous coronary intervention for acute coronary syndrome," 4e American Journal of Cardiology, vol. 119, no. 6, pp. 819–825, 2017.
9. Y. Horiuchi, S. Tanimoto, J. Aoki et al., "Abdominal aortic aneurysm in patients with acute myocardial infarction: prevalence and risk factors," International Journal of Cardiology, vol. 205, pp. 56-57, 2016.
10. Q. Y. Zhu, S. Tai, L. Tang et al., "STEMI could be the primary presentation of acute aortic dissection," 4e American Journal of Emergency Medicine, vol. 35, no. 11, pp. 1713–1717, 2017.
11. S. Asada, K. Sakakura, Y. Taniguchi et al., "Association of the long Euoroscopy time with factors in contemporary primary percutaneous coronary interventions," PLoS One, vol. 15, no. 8, Article ID e0237362, 2020.
12. R. A. Abellas-Sequeiros, S. Raposeiras-Roub ´ ´ın, E. Abu-Assiet al., "Mehran contrast nephropathy risk score: is it still useful 10 years later?" Journal of Cardiology, vol. 67, no. 3, pp. 262–267, 2016.
13. Sawano M, Kohsaka S, Ishii H, Numasawa Y, Yamaji K, Inohara T, Amano T, Ikari Y, Nakamura M. One-Year Outcome After Percutaneous Coronary Intervention for Acute Coronary Syndrome—An Analysis of 20,042 Patients From a Japanese Nationwide Registry—. Circulation Journal. 2021 Sep 24;85(10):1756-67.
14. Siudak Z, Grygier M, Wojakowski W, Malinowski KP, Witkowski A, Gąsior M, Dudek D, Bartuś S. Clinical and procedural characteristics of COVID-19 patients treated with percutaneous coronary interventions. Catheterization and Cardiovascular Interventions. 2020 Nov;96(6):E568-75.
15. Iverson A, Stanberry LI, Tajti P, Garberich R, Antos A, Burke MN, Chavez I, Gössl M, Henry TD, Lips D, Mooney M. Prevalence, trends, and outcomes of higher-risk percutaneous coronary interventions among patients without acute coronary syndromes. Cardiovascular Revascularization Medicine. 2019 Apr 1;20(4):289-92.
16. J. Sapontis et al. Early procedural and health status outcomes after chronic total occlusion angioplasty: a report from the OPEN-CTO registry (outcomes, patient health status, and efficiency in chronic total occlusion hybrid procedures) JACC Cardiovasc Interv (2017)
17. J. Maeremans et al. The hybrid algorithm for treating chronic total occlusions in Europe: the RECHARGE registry J Am Coll Cardiol (2016)
18. S.A. Harding et al. A new algorithm for crossing chronic total occlusions from the asia pacific chronic total occlusion club JACC Cardiovasc Interv (2017).
19. Dudek D, Siudak Z, Legutko J, et al. Percutaneous interventions in cardiology in Poland in the year 2017. Summary report of the Association of Cardiovascular Interventions of the polish cardiac society AISN PTK and Jagiellonian University Medical College. Postepy Kardiol Interwencyjnej. 2018; 14: 422- 424.
20. Ibanez B, James S, Agewall S, et al. 2017 ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: the task force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J. 2018; 39: 119- 177.
21. Siudak Z, Tokarek T, Dziewierz A, et al. Reduced periprocedural mortality and bleeding rates of radial approach in ST-segment elevation myocardial infarction. Propensity score analysis of data from the ORPKI polish National Registry. EuroIntervention. 2017; 13: 843- 850.
22. Inohara T, Kohsaka S, Yamaji K, Ishii H, Amano T, Uemura S, et al. Risk stratification model for in-hospital death in patients undergoing percutaneous coronary intervention: A nationwide retrospective cohort study in Japan. BMJ Open 2019; 9: e026683.
23. Fanaroff AC, Zakroysky P, Wojdyla D, Kaltenbach LA, Sherwood MW, Roe MT, et al. Relationship between operator volume and long-term outcomes after percutaneous coronary intervention. Circulation 2019; 139: 458–472.