The Journal of Cardiovascular Diseases
J Cardiovasc Dis 2022;18(3):116 - 122

ORIGINAL ARTICLE
DOI: 10.55958/jcvd.v18i3.128

EFFECT OF CLINICAL AND LESIONAL CHARACTERISTICS ON SIDE BRANCH COMPROMISE DURING PROVISIONAL BIFURCATION STENTING

Nasrullah[a*], Imran Abid[a], Aftab Ahmed Solangi[a], Zahirullah[b], Rizwan Ahmed Yaqoob[a], Khurshid Ali[c]

[a]Punjab Institute of Cardiology, Lahore. [b]District Head Quarter Hospital, Charsadda. [c]District Head Quarter Hospital, Batkhela.

Date of Submission: 01-12-2022; Date of Acceptance: 06-12-2022; Date of Publication: 15-12-2022

ABSTRACT:

BACKGROUND: *One of the most serious side effects of percutaneous coronary intervention (PCI) for bifurcation lesions is major side branch (SB) blockage. PCI is used to treat coronary bifurcations lesions in about 15-20% of cases. Because of the risk of SB compromise, PCI of coronary bifurcation lesions is frequently thought to be a difficult procedure.*

AIMS & OBJECTIVE: *The goal of this study was to investigate the clinical and lesional predictability of severe SB blockage during coronary bifurcation intervention.*

MATERIAL & METHODS: *It was a retrospective study performed at Cardiac Catheterization Lab, Punjab Institute of Cardiology, Lahore. It was a six months study from 15th April 2022 to 14th Oct, 2022. 93 patients enrolled using non-probability sampling technique. Patients between the ages of 30 and 70 of either gender, with coronary bifurcation lesions undergoing PCI and at least one significant SB were included. Data was entered in the predesigned proforma. SPSS version 24 was used to analyze our data.*

RESULTS: *In our study a total of 93 patients were enrolled, the mean age of the cases was 53.30 ± 1.12. There were 68 (73%) male and 25 (27%) females in our study. There were 52 (56%) diabetic, 50 (54%) hypertensive, 63 (68%) smokers and 42 (45%) hypercholestrolemic patients were present in our study. In our study 36 (39%) patients were found with family history of CAD and 6 (7%) patients found with recent MI. LAD was the most frequently involed vessel in our study. The mean of lesion length was 28.82 ± 10.91 in this study. SB angle was 41º-50º in most of the cases 20 (22%), side branch diameter stenosis post MV stenting was 70-75% in 40 (43%) cases. Medina classification 1,1,1 was found in 43 (46%) cases. In 62 (67%) cases no side branch jailing was observed. Side branch predilatation before MV stenting was found in 72 (77%) cases. Need of stenting in SB was found in 60 (65%) cases. Most frequently used technique for SB provisional stenting was DK crush and mini crush in this study.*

CONCLUSION: *Among clinical and angiographic findings of coronary bifurcation lesions location of bifurcation, side branch angle, lesion length, diameter stenosis of SB before MV stenting, TIMI flow grade of SB before MV stenting were predictive of major SB occlusion after MV stenting.*

KEY WORDS: *Bifurcation Lesions, SB, PCI*

Correspondence : Nasrullah, Punjab Institute of Cardiology, Lahore. Email: nasrullah_jan80@yahoo.com
Author's Contribution: NU: Conducted the study and wrote the article. IA: Helped in conducting the study and article. AAS: Helped in rearranging the data & table. ZU: Helped in data correction and analysis. RAY: Helped in literature search and study design. KA: Helped in questionnaire design , data analysis and data interpretation.

INTRODUCTION:

Approximately 15-20% of coronary bifurcation lesions are treated with PCI. Because of the possibility of side branch (SB) damage, PCI in coronary bifurcation lesions is frequently seen as a difficult task.[1] The current preferred method to coronary bifurcations is a single-stent technique with a provisional approach to the SB, owing to reduced procedure times and clinical non-inferiority versus a two-stent strategy.[2] SB blockage after main vessel (MV) stenting, on the other hand, is a rare but major procedural complication for the provisional method. Depending on the size of the SB and the myocardial region subtended by it, SB obstruction might result in vascular closure and ischemia, with clinically severe myocardial infarction and even mortality. As a result, the optimum intervention technique, particularly for major SB with severe disease, remains debatable.[3-4]

The main goal of clinical trials that looked at bifurcation PCI was to find the best way to do it (e.g., provisional vs. 2-stent). But it can be said that there is no one method that should be used for everyone with a bifurcation lesion. [5] Recent studies, for example, have looked at how the anatomy of a bifurcation can help to figure out the best PCI strategy.[6] The best way to treat bifurcation lesions should take into account the unique qualities of each patient or lesion that make SB occlusion more or less likely.[7]

The risk of SB occlusion is the most important factor in choosing the best intervention strategy for coronary bifurcation. Previous research has shown that the risk of SB occlusion can be affected by a number of factors.[8] The potential roles of angiographic and PCI procedural indexes in SB occlusion have not been fully understood, though. So, clinical prediction models that use angiographic, PCI procedural, and clinical indexes may help doctors decide what to do.[9]

Nonetheless, side branch (SB) occlusion occurs in about 20% of cases after MV stent implantation. It could be associated with rewiring failure, peri-procedural MI, higher incidence of stent thrombosis in the first month post-stenting and an increase in the incidence of major adverse cardiac events (MACE) in patients with persistently occluded SB.[10] Various predictors have been studied that may increase the risk of SB occlusion during main branch stenting. Firstly, SB with ostial lesions was observed to occlude more than those without such lesions. Secondly, SB lesion length is an important factor for occlusion as it occurs frequently in SB with longer (>5 mm), diffuse lesions. Thirdly, plaque shift is another mechanism of SB occlusion. Greater plaque burden in the proximal MV segment is predictive of SB occlusion. However, plaque burden in the distal segment of the main branch does not seem to have an effect on occlusion of the SB.[11]

A study conducted in Korea has shown that whether patients have SB occlusion or not, the difference in predictors was significant, i.e. SB diameter 2.3 mm vs. 2.4 mm.[12] One study conducted in China showed that 4.9% patients had SB occlusion, the difference in predictors between SB occluded and non-occluded patients was insignificant, i.e. SB diameter (p=0.14), Lesion length (p=0.45), MV diameter (p=0.20) and MV lesions length (p=0.07).[13]

MATERIALS AND METHODS:

It was a retrospective study performed at Cardiac Catheterization Lab, Punjab Institute of Cardiology, Lahore. It was a six months study from 15th April 2022 to 14th Oct, 2022. 93 patients enrolled using non-probability sampling technique. Patients between the ages of 30 and 70, of either gender, with coronary bifurcation lesions undergoing PCI and at least one significant SB were included. Bifurcation lesion involving small side branch < 2mm. Patients undergoing elective SB stenting before MV stenting, already had PCI of index vessel or CABG before (on medical record) were excluded from study. Significant Side Branch was be defined as side branch > 2 mm, side branch diameter stenosis ≥70%. Compromised Side Branch was defined as any significant stenosis (≥70% diameter stenosis), dissection of the side branch, and/or final thrombolysis in myocardial infarction (TIMI) flow of < 3 as seen on angiographic views. Peri-procedural Myocardial Infarction (MI).
Location of Bifurcation: (a) LM (b) LAD (c) LCx (d) RCA.

DATA COLLECTION PROCEDURE:

After taking approval from hospital ethical committee, 93 patients fulfilling the selection criteria were included in the study from cardiac

catheterization laboratory of Punjab Institute of Cardiology, Lahore. Demographic and clinical information (name, age, gender, duration of infarction, diabetes mellitus, hypertension and smoking), anatomical characteristics (left main stem involvement, number of vessels involved) were noted. Coronary angiographic findings, such as the location of the bifurcation, the Medina classification, the baseline and post-procedure TIMI flow, the percentage of MV stenosis, the length of the MV lesion, the presence of blockage at the MV lesion and SB, and the distribution of plaque, were noted. Additionally, procedural traits like SB stenting, SB predilatation, KBI, and SB jailed wire were also noted.

STATISTICAL ANALYSIS:

SPSS version 24 was used to analyse the collected data. For numerical variables, mean and standard deviation were calculated. Frequency and percentage were used to present qualitative variables.

RESULTS:

In our study a total of 93 patients were enrolled, the mean age of the cases was 53.30 ± 1.12.

Table 1: Descriptive statistics of Demographics and Risk Factors

Mean ± SD		53.30 ± 1.12
Min - Max		31 - 70
Male		68 (73%)
Female		25 (27%)
Diabetic		52 (56%)
Non-Diabetic		41 (44%)
Hypertensive		50 (54%)
Non-Hypertensive		43 (46%)
Smokers		63 (68%)
Non-Smokers		30 (32%)
Hypercholestrolemic		42 (45%)
NonHypercholestrolemic		51 (55%)
Family history of CAD	**Yes**	36 (39%)
	No	57 (61%)
Recent MI	**Yes**	6 (7%)
	No	87 (93%)
Bifurcation Lesion		
LM		2 (2%)
LAD		59 (63%)
LCx		21 (23%)
RCA		11 (12%)

Table 2: Timi Flow Before And After Procedure		
Baseline MV	**TIMI-3**	73 (77.4%)
	TIMI-2	17 (18.3%)
	TIMI-1	4 (4.3%)
Baseline SB	**TIMI-3**	74 (79.6%)
	TIMI-2	17 (18.3%)
	TIMI-1	2 (2.2%)
Post procedure MV	**TIMI-3**	92 (98.9)
	TIMI-1	1 (1.1%)
Post procedure SB	**TIMI-3**	58 (62.4%)
	TIMI-2	27 (29.0%)
	TIMI-1	8 (8.6%)
Reference Diameter (mm) Mean ± SD		2.37± 0.20
Pre Procedure Diameter stenosis (%)	**70-75 %**	54(58%)
	76-80%	22(24%)
	81-85%	9(10%)
	86-90%	7(7%)
	91-95%	1(1%)

There were 68 (73%) male and 25 (27%) females in our study. There were 52 (56%) diabetic, 50 (54%) hypertensive, 63 (68%) smokers and 42 (45%) hypercholestrolemic patients were present in our study. In our study 36 (39%) patients were found with family history of CAD and 6 (7%) patients found with recent MI. LAD was most frequently utilized bifurcation lesion in our study.(Table-1)

In our study TIMI 3 was found most frequently in baseline MV 73 (77.4%) and in baseline SB 74 (79.6%) cases. Mean of reference diameter (mm) was 2.37 ± 0.20, 70 - 75% pre-procedure diameter stenosis was found in 54 (58%) cases. (Table-2)

Table 3 shows that mean of lesion length was 28.82 ± 10.91 in this study. SB angle was 41°-50° in most of the cases 20 (22%), side branch diameter stenosis post MV stenting was 70-75% in 40 (43%) cases. Medina classification 1,1,1 was found in 43 (46%) cases. In 62 (67%) cases no side branch jailing was observed. Side branch predilatation before MV stenting was found in 72 (77%) cases. Need of stenting in SB was found in 60 (65%) cases. Most frequently used technique for SB provisional stenting was DK crush and mini crush in this study.

DISCUSSIONS:

Due to the high risk of sudden blockage of a side branch (SB) or main vessel (MV) and in-stent restenosis, bifurcation lesions are hard to fix and

Table 3: Descriptive statistics of post-procedure characteristics.		
Lesion Length		28.82 ± 10.91
SB Angle	20°- 30°	15(16%)
	31°- 40°	17(18%)
	41°- 50°	20(22%)
	51°- 60°	17(18%)
	61°- 70°	14(15%)
	71°- 80°	8(9%)
	81°- 90°	2(2%)
Side Branch Diameter Stenosis Post MV stenting (%)	40-45%	1(1%)
	60-65%	4(4%)
	70-75%	40(43%)
	76-80%	21(23%)
	81-85%	15(16%)
	86-90%	9(10%)
	95-100%	3(3%)
Medina Classification	1,1,1	43(46%)
	1,1,0	4(4%)
	1,0,1	34(37%)
	0,1,1	7(8%)
	1,0,0	4(4%)
	0,1,0	1(1%)
	0,0,1	0(0%)
Side Branch Wire Jailing	Yes	31(33%)
	No	62(67%)
Side Branch Predilatation Before MV Stenting	Yes	72(77%)
	No	21(23%)
Side Branch Predilatation Before MV Stenting (Yes)	SB	30(32%)
	KBI	44(48%)
	No Predilatation	19(20%)
Need of Stenting in SB	Yes	60(65%)
	No	33(35%)
Technique used for SB provisional stenting	Tap Tech	12(13%)
	T Tech	4(4%)
	Cullotte Tech	12(13%)
	DK crush Mini crush	33(36%)
	Other	32(34%)

have a bad prognosis. [14] They make up 15% to 20% of all percutaneous coronary intervention (PCI) cases.[1] The goal of the study was to find out how predictable major SB occlusion is from a clinical and lesional point of view during coronary bifurcation intervention.

In our study a total of 93 patients were enrolled, the mean age of the cases was 53.30 ± 1.12. In a previous study by Zhang et al, (2015) the mean age was 57.5 ± 12.2. There were 68 (73%) male and 25 (27%) females in our study. Zhang et al, enrolled 83.9% male patients in his study from which 58.1% were hypertensive and 45.2% smokers. There were 52 (56%) diabetic, 50 (54%) hypertensive, 63 (68%) smokers and 42 (45%) hypercholestrolemic patients were present in our study. In our study 36 (39%) patients were found with history of CAD and 6 (7%) patients found with MI. LAD was most frequently utilized bifurcation lesion in our study. In a study by Zhang et al, (2015) most frequently used bifurcation lesion was LAD in 50% cases.[15] Most target bifurcations were located in the left anterior descending artery (68.9%) in another study.[16] Results supported our study.

In our study TIMI 3 was found most frequently in baseline MV 73 (77.4%) and in baseline SB 74 (79.6%) cases. In a previous study MV TIMI flow grade 3 was found in 91.9% cases and SB TIMI flow grade 3 was found in 94% cases.[16] Mean of reference diameter (mm) was 2.37 ± 0.20, in our study. Similarly in another study mean stent diameter (mm) was 2.59 ± 0.26. [16] In this study 70 - 75% pre-procedure diameter stenosis was found in 54 (58%) cases. The mean of lesion length was 28.82 ± 10.91 in this study. Peng et al, (2018) found lesion length as 23.9 ± 6.2 in his study. [16] Most frequently used technique for SB provisional stenting was DK crush mini crush in this study. Both jailed wire in SB and predilatation of SB were considered as potential factors affecting SB occlusion in a previous study. [17] In another study, the mean reference of SB was 2.3 ± 0.2 mm in SB occlusion group, and not all SBs were suitable for stent implantation.[18]

SB angle was 41°-50° in most of the cases 20 (22%), side branch diameter stenosis post MV stenting was 70-75% in 40 (43%) cases. Medina stratification 1,1,1 was found in 43 (46%) cases. In 62 (67%) cases no side branch jailing was observed. In another study medina classification 1,1,1 was found in 43.2% cases.[16] Side branch predilatation before MV stenting was found in 72 (77%) cases. Need of stenting in SB was found in 60 (65%) cases.

CONCLUSION:

Among clinical and angiographic findings of coronary bifurcation lesions location of bifurcation, side branch angle, lesion length, diameter stenosis of SB before MV stenting, TIMI flow grade of SB before MV stenting were predictive of major SB occlusion after MV stenting.

References:

1. Jyotsna M. Coronary Bifurcation Lesion–Management. Indian Journal of Cardiovascular Disease in Women-WINCARS. 2020 Jun;5(02):137-54..
2. Raphael CE, O'Kane PD. Contemporary approaches to bifurcation stenting. JRSM Cardiovascular Disease. 2021 Feb;10:2048004021992190.
3. Mohsin M, Khan HS, Saleem M, Afzal A. Assessment of predictors of side branch occlusion after main vessel stenting in coronary bifurcation lesions in patients undergoing percutaneous coronary intervention. J Coll Physicians Surg Pak. 2018 Oct 1:741-.
4. Ng AK, Jim MH. Percutaneous coronary intervention for bifurcation: how can we outperform the provisional strategy?. Clinical Cardiology. 2016 Nov;39(11):684-91.
5. Gwon HC. Understanding the coronary bifurcation stenting. Korean circulation journal. 2018 Jun 1;48(6):481-91.
6. Burzotta F, Lassen JF, Lefèvre T, Banning AP, Chatzizisis YS, Johnson TW, Ferenc M, Rathore S, Albiero R, Pan M, Darremont O. Percutaneous coronary intervention for bifurcation coronary lesions: the 15th consensus document from the European Bifurcation Club. EuroIntervention: journal of EuroPCR in collaboration with the Working Group on Interventional Cardiology of the European Society of Cardiology. 2021 Mar 19;16(16):1307.
7. Raphael CE, O'Kane PD. Contemporary approaches to bifurcation stenting. JRSM Cardiovascular Disease. 2021 Feb;10:2048004021992190.
8. Mohsin M, Khan HS, Saleem M, Afzal A. Assessment of predictors of side branch occlusion after main vessel stenting in coronary bifurcation lesions in patients undergoing percutaneous coronary intervention. J Coll Physicians Surg Pak. 2018 Oct 1:741-.
9. Zhang D, Yin D, Song C, Zhu C, Kirtane AJ, Xu B, Dou K. A randomised comparison of Conventional versus Intentional straTegy in patients

with high Risk prEdiction of Side branch OccLusion in coronary bifurcation interVEntion: rationale and design of the CIT-RESOLVE trial. BMJ open. 2017 Jun 1;7(6):e016044.
10. Peng XF, Huang JB, Xing ZH, Zhu ZW, Dong B, Meng XY, Fang ZF, Hu XQ, Zhou SH. Small side branch compromise related to main vessel stenting: a retrospective cohort study comparing different treatment strategies. Medicine. 2018 Aug;97(35).
11. Dou K, Zhang D, Xu B, Yang Y, Yin D, Qiao S, Wu Y, Yan H, You S, Wang Y, Wu Z. An angiographic tool for risk prediction of side branch occlusion in coronary bifurcation intervention: the RESOLVE score system (Risk prEdiction of Side branch OccLusion in coronary bifurcation interVEntion). JACC: Cardiovascular Interventions. 2015 Jan;8(1 Part A):39-46.
12. Dane, K.E., Lindsley, J.P., Streiff, M.B., Moliterno, A.R., Khalid, M.K. and Shanbhag, S., 2019. Successful use of emicizumab in a patient with refractory acquired hemophilia A and acute coronary syndrome requiring percutaneous coronary intervention. Research and practice in thrombosis and hemostasis, 3(3), pp.420-423.
13. Mohsin M, Khan HS, Saleem M, Afzal A. Assessment of predictors of side branch occlusion after main vessel stenting in coronary bifurcation lesions in patients undergoing percutaneous coronary intervention. J Coll Physicians Surg Pak. 2018 Oct 1:741-.
14. Pinkerton CA, Slack JD, Van Tassel JW, Orr CM. Angioplasty for dilatation of complex coronary artery bifurcation stenoses. The American journal of cardiology. 1985 Jun 1;55(13):1626-8.
15. Zhang D, Xu B, Yin D, Li YP, He Y, You SJ, Qiao SB, Wu YJ, Yan HB, Yang YJ, Gao RL. Clinical and angiographic predictors of major side branch occlusion after main vessel stenting in coronary bifurcation lesions. Chinese Medical Journal. 2015 Jun 5;128(11):1471-8.
16. Peng XF, Huang JB, Xing ZH, Zhu ZW, Dong B, Meng XY, Fang ZF, Hu XQ, Zhou SH. Small side branch compromise related to main vessel stenting: a retrospective cohort study comparing different treatment strategies. Medicine. 2018 Aug;97(35).
17. Hahn JY, Chun WJ, Kim JH, Song YB, Oh JH, Koo BK, Rha SW, Yu CW, Park JS, Jeong JO, Choi SH. Predictors and outcomes of side branch occlusion after main vessel stenting in coronary bifurcation lesions: results from the COBIS II Registry (COronary BIfurcation Stenting). Journal of the American College of Cardiology. 2013 Oct 29;62(18):1654-9.
18. Depta JP, Patel Y, Patel JS, Novak E, Yeung M, Zajarias A, Kurz HI, Lasala JM, Bach RG, Singh J. Long-term clinical outcomes with the use of a modified provisional jailed-balloon stenting technique for the treatment of nonleft main coronary bifurcation lesions. Catheterization and Cardiovascular Interventions. 2013 Nov 1;82(5):E637-46.