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One-Stent Versus Two-Stent Techniques for Unprotected Distal Left Main Bifurcational Lesions: Early and Late Outcomes

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Abstract

Background and aim: Left main disease account for 3–5% of the coronary lesions. PCI on coronary bifurcation lesions is considered a challenge for any cardiologist. These lesions include a wide spectrum of anatomic complexity varying from simple lesions, which can be managed with a single stent, to complex lesions necessitating more complex procedures. The goal of the present study was to compare the clinical outcomes of PCI with single-stent vs. double-stent implantation for the management of ULMCA distal bifurcation lesions.

Patients and methods: A total of 60 cases with ULMCA distal bifurcation lesions eligible for PCI were included in the current study. Cases were divided into 2 main groups: one-stent group (20 cases) and two-stents group (40 cases). All patients underwent follow up during hospitalization and post-discharge at 1 and 6 months.

Results: Comparison between the study groups as regards the lesional and angiographic characteristics demonstrated that cases in the one-stent group had significantly lower SYNTAX score (21.70 ± 5.58 versus 24.88 ± 4.93 , $P = 0.028$) and lower frequency of true bifurcation lesion (65.0% versus 100.0%, $P < 0.001$) and higher frequency of 1,1.0 Median class (55.0% versus 7.5%, $P < 0.001$). Besides, both groups had similar early post-interventional outcomes including hematoma and used target vessel revascularization techniques. Also, no significant differences were reported between both groups as regards the 6-month outcome parameters, including cardiac death, TV MI, TVR, and TL failure.

Conclusions: Both single-stent and two-stents techniques are technically feasible and safe techniques for management of ULMCA with comparable outcomes.

Keywords: Left main disease, PCI, ULMCA

1. Introduction

Left main disease account for 3–5% of the coronary lesions. Affected patients are prone to develop fatal cardiovascular events such as ventricular fibrillation, cardiac arrest and cardiac shock. Among the different anatomical types of coronary artery disease (CAD), severe ULMCA lesion is the greatest-risk type which is linked to worse outcome in comparison to non-LMCA CAD.¹

Three anatomical regions are often involved in ULMCA: the LMCA's origin from the aorta, a mid-

segment, and distal bifurcation segment. In comparison to nonbifurcation lesions, ULMCA bifurcation lesions are challenging for any cardiologist, being of wide lumen and plaque burden, local higher blood flow and lower stress, greater distal bifurcation angles and local anatomical complexity.²

Coronary artery bypass grafting (CABG) has been considered as the standard of care for revascularization of severe LMCA lesion for a long time.³ During this era, PCI was carried out mainly in surgically-unfit individuals. Since the LMCA is the initial portion of coronary tree with a relatively wide

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diameter and a short length, its stenosis is considered as an attractive target, even during the early PCI period.⁴

However, as technical evolving continued, the recommendations of last guidelines in 2014 European Society of Cardiology/European Association for Cardio-Thoracic Surgery and 2014 ACC/AHA/American Association for Thoracic Surgery/SCAI/Society of Thoracic Surgeons guidelines provided Class II and Class III indications of PCI among those having low to intermediate anatomical complexity and those having highly complex lesions, respectively.^{5,6}

PCI on a lesion at the coronary bifurcation has been considered a challenging task for interventionalists.⁷ Preliminary studies demonstrated that double kissing crush and Culotte stenting effectively treated bifurcation lesions.^{8–11} Whereas many other studies suggested that the two-stent approaches might be linked to poor outcome.^{12,13}

The goal of this work was to compare the clinical outcomes of PCI with single-stent vs. double-stent implantation as a treatment of ULMCA distal bifurcation lesions.

2. Patients and methods

The current prospective study was carried out at Al-Azhar University Hospitals, Cairo, Egypt and Almokkatam insurance hospital in the period from January 2018 to December 2021. Approval was obtained from the ethical committee of Al-Azhar Faculty of Medicine. Each of the participants provided an informed consent before participation.

Sixty cases complaining of ULMCA distal bifurcation lesions eligible for PCI were enrolled in our study. Patients were excluded if they had single left main trunk lesion (ostial or mid shaft), left main trifurcation anatomy, protected left main disease (Post-CABG), depressed LV systolic function (below 30%), intolerance to dual antiplatelets therapy or renal impairment.

Each patient was submitted to detailed history taking, clinical assessment, 2D transthoracic echocardiographic imaging and standard laboratory investigations (serum creatinine, creatinine clearance, complete blood count and international normalized ratio). Obtained angiographic data included LM anatomy (Medina classification), location and length of the lesion and dominance of the left system.

Before intervention, all patients received dual antiplatelets therapy; according to revascularization guidelines. Coronary angioplasty and stent implantation were done through the femoral approach. Stenting procedure were chosen at the operator's preference based on the coronary

arteriography results combined with pathologic features of LMCA distal bifurcation lesions. A one-stent approach is defined as a stent crossover procedure (from LAD to left main) with or without a safety coronary wire placed in the left circumflex coronary artery (LCX), to be succeeded by kissing balloon dilatation after releasing the main stent. An additional stent was used if there is obvious residual diameter stenosis at the ostial left circumflex coronary artery. Two-stent techniques utilized in the present study included: crush technique with its variants, and T-stenting or TAP aiming at full coverage of the diseased portion.

Each of the patients was followed during hospitalization and following discharged at 1 and 6 months. Adverse outcomes which include myocardial infarction, target lesion revascularization (TLR), angina pectoris, death as well as acute in-stent thrombosis were monitored. Coronary angiogram was scheduled at 6 months post-discharge from the hospital, or earlier whenever indicated.

In the present study, the main outcomes were successful PCI, coronary restenosis, TLR, total vessel revascularization (TVR) and mortality. Successful PCI is defined as Thrombosis In Myocardial Infarction (TIMI) flow grade 3 with a residual stenosis <20% with no mortality, MI, or emergency CABG prior to discharging patients. All mortalities were considered of cardiac origin except if non-cardiac causes were reported. Coronary restenosis is defined as stenosis >50% measured via visual evaluation. TLR and TVR are defined as any repeat revascularization for target lesions whose diameter stenosis >50% within 5 mm proximal or distal to stent.

Data were presented as numbers and precents or means and standard deviations. Cartological data underwent comparison by Fisher's exact test or chi-square test whereas numerical data underwent comparison by *t*-test. All statistical calculations were computed utilizing SPSS 25 with *P* value is < 0.05 was considered statistically significant.

3. Results

In our study, sixty cases with ULMCA distal bifurcation lesions were divided into two main groups: one-stent group (*n* = 20) and two-stents group (*n* = 40). Comparison between the studied groups as regards the baseline data showed non-statistically significant differences (Table 1). Comparison between both groups regarding the lesional and angiographic characteristics revealed that cases in the one-stent group had a significantly lower SYNTAX score (21.70 ± 5.58 versus 24.88 ± 4.93 ,

Table 1. Baseline characteristics in the studied groups.

	Single-stent N = 20t	Two-stent N = 40	P value
Age (years) mean \pm SD	63.30 \pm 5.04	66.23 \pm 5.78	0.059
Male/female n	17/3	30/10	0.38
Body weight (kg) mean \pm SD	87.80 \pm 6.42	91.73 \pm 8.94	0.463
Associated risk factors n (%)			
Dyslipidemia	18 (90.0)	37 (92.5)	0.741
Diabetes	11 (55.0)	28 (70.0)	0.251
HTN	16 (80.0)	34 (85.0)	0.624
Current smoker	11 (55.0)	19 (47.5)	0.584
Peripheral vascular Disease	2 (10.0)	2 (5.0)	0.464
Previous stroke or TIA	–	–	NA
Previous MI	7 (35.0)	13 (32.5)	0.846
Previous PCI	4 (20.0)	12 (30.0)	0.409
Positive Family history	4 (20.0)	10 (25.0)	0.666
LVEF n (%)			
Good LVEF (>55%)	17 (85.0)	35 (87.5)	0.788
Fair LVEF (40–55%)	3 (15.0)	5 (12.5)	
CHA2D2 Vasc Score mean \pm SD	2.50 \pm 1.10	3.03 \pm 0.53	0.086

Table 2. Lesion and angiographic characteristics in the studied groups.

	Single-stent N = 20	Two-stent N = 40	P value
Dominant RCA n (%)	15 (75.0)	36 (90.0)	0.125
Multi-vessel disease n (%)	11 (55.0)	22 (55.0)	NA
SYNTAX score mean \pm SD	21.70 \pm 5.58	24.88 \pm 4.93	0.028
True bifurcation lesion n (%)	13 (65.0)	40 (100.0)	<0.001
Bifurcation angle	84.75 \pm 14.73	84.00 \pm 15.82	0.860
Medina class n (%)			
1,1,0	11 (55.0)	3 (7.5)	
1,1,1	0 (0.0)	25 (62.5)	<0.001
0,1,1	2 (10.0)	12 (30.0)	
0,1,0	6 (30.0)	–	
0,0,1	1 (5.0)	–	

$P = 0.028$) and lower frequency of true bifurcation lesion (65.0% versus 100.0%, $P < 0.001$) and higher frequency of 1,1,0 Medina class (55.0% versus 7.5%, $P < 0.001$) (Table 2).

The studied groups showed comparable results as regards technical (75.0 versus 85.0%, $P = 0.345$) and

procedural (95.0 versus 97.5%, $P = 0.611$) success. Other procedural specifications are listed in Table 3.

In addition, both groups had similar early post-interventional outcomes including hematoma and used target vessel revascularization techniques. Also, nonsignificant differences were reported

Table 3. Procedural characteristics in the studied groups.

	Single-stent N = 20	Two-stent N = 40	P value
Sheath Size n (%)			
6F	16 (80.0)	14 (35.0)	0.001
7F	4 (20.0)	26 (65.0)	
Double wire protection n (%)	12 (60.0)	40 (100.0)	<0.001
Preparation of main vessel n (%)	10 (50.0)	26 (65.0)	0.264
Preparation of side branch n (%)	2 (10.0)	29 (72.5)	<0.001
Crushing Balloon parked in MV before SB stent delivery n (%)	–	13 (32.5)	<0.001
Diameter of main vessel stent (mm) mean \pm SD	3.44 \pm 0.36	3.30 \pm 0.31	0.128
Length of main vessel stent (mm) mean \pm SD	29.40 \pm 8.38	27.45 \pm 9.77	0.449
POT after first stent n (%)	12 (60.0)	31 (77.5)	0.156
Rewiring second vessel n (%)	7 (35.0)	29 (72.5)	0.005
Kissing balloon after main vessel stent n (%)	7 (35.0)	18 (45.0)	0.459
MV lesion length >25 mm n (%)	17 (85.0)	28 (70.0)	0.206
Procedure duration (min.) mean \pm SD	36.80 \pm 9.73	73.78 \pm 13.33	<0.001
Technical success n (%)	15 (75.0)	34 (85.0)	0.345
Procedural success n (%)	19 (95.0)	39 (97.5)	0.611

Table 4. Early and late treatment outcome in the studied groups.

	Single-stent N = 20	Two-stent N = 40	P value
In-hospital complications n (%)			
Hematoma	2 (10.0)	4 (10.0)	1.0
Target vessel revascularization n (%)			
TVR total	2 (10.0)	5 (12.5)	0.776
CABG	1 (5.0)	1 (2.5)	0.611
Balloon PTCA	–	3 (7.5)	0.209
PCI	1 (5.0)	1 (2.5)	0.611
Target vessel MI n (%)	2 (10.0)	3 (7.5)	0.741
Total stent thrombosis n (%)	1 (5.0)	2 (5.0)	1.0
6-months outcome n (%)			
Cardiac Death	1 (5.0)	2 (5.0)	1.0
TV MI	2 (10.0)	4 (10.0)	1.0
TVR	2 (10.0)	5 (12.5)	0.775
TL Failure	5 (25.0)	11 (27.5)	0.836

between both groups as regards the 6-month outcome parameters including cardiac death, TV MI, TVR, and TL failure (Table 4).

4. Discussion

The present study showed comparable early and late outcome parameters between patients' groups submitted to single-stent or two-stents PCI interventions. Our findings are in consistence with findings by Gao *et al.*¹⁴ In a large single-center investigating including 1528 consecutive cases who had left main PCI, they comparatively evaluated stenting approach in individuals who had distal left main disease. At a mean of 4 years follow-up, rates of MACE (9.2% and 11.6% for one stent and two stents, respectively, $P = 0.23$), mortality, MI, and TVR were comparable among groups. Besides, two-stent strategy was not a predictor for MACE.

In another study, Zhang *et al.*,¹⁵ included 88 patients having distal ULMCA bifurcation lesions and underwent PCI with single or double stents implantation (50 cases and 38 cases in the one-stent group and two-stent group, respectively). There were no significant differences regarding the number of left main and multivessel disease, stenosis rate of left main, inner diameter of left main vessel, and distal bifurcation angle. The success rate was 100%. During hospitalization, no major adverse cardiovascular outcomes were observed among the 2 groups. During follow-up, restenosis was observed in 1 and 2 cases in single-stent group and double-stent group, respectively. Recurrence of angina and TLR was observed in 6 and 1 case in single-stent group, and 4 and 2 cases in double-stent group, respectively. There was no AMI, in-stent thrombosis and cardiac death in the 2 groups. The authors concluded that both stenting techniques

were effective for distal ULMCA bifurcation lesions with a significant success rate and safety.

In contrast, another study found that as compared with two-stent approach of ULMCA bifurcation intervention, a single-stent technique seemed to have better outcome and six-month MACE-free survival.¹⁶ Likewise, the prospective study of Chen *et al.*¹⁷ on 633 cases that had ULMCA bifurcation lesions (232 underwent one-stent strategy vs. 401 underwent two-stent strategy) found that with distal left main bifurcations, two-stent approach independently predicted the long-term MACE. DK crush was linked to a better long-term outcome.

4.1. Conclusions

As a conclusion, our study found that both single-stent and two-stents techniques are technically feasible and safe techniques for management of ULMCA with comparable outcomes.

Ethical approval

The study was approved by the ethical committee of Al-Azhar Faculty of Medicine and informed consent was obtained from all participants and all patients provided written informed consent before enrollment in the study.

Author contributions

All authors equally shared in formulating the idea, conception, and data collection statistics, writing and drafting the manuscript.

Data availability statement

Data of this research will be available upon reasonable request.

Conflict of interest

None.

References

1. Yusuf S, Zucker D, Peduzzi P, et al. Effect of coronary artery bypass graft surgery on survival: overview of 10-year results from randomised trials by the Coronary Artery Bypass Graft Surgery Trialists Collaboration. *Lancet*. 1994;344:563–570.
2. Farinha JB, Kaplan MA, Harris CN, et al. Disease of the left main coronary artery. Surgical treatment and long-term follow up in 267 patients. *Am J Cardiol*. 1978;42:124–128.
3. Caracciolo EA, Davis KB, Sopko G, et al. Comparison of surgical and medical group survival in patients with left main equivalent coronary artery disease. Long-term CASS experience. *Circulation*. 1995;91:2335–2344.

4. JHJr O'Keefe, Hartzler GO, Rutherford BD, et al. Left main coronary angioplasty: early and late results of 127 acute and elective procedures. *Am J Cardiol.* 1989;64:144–147.
5. Levine GN, Bates ER, Blankenship JC, et al. ACCF/AHA/SCAI guideline for percutaneous coronary intervention: a report of the american college of cardiology foundation/american heart association task force on practice guidelines and the society for cardiovascular angiography and interventions. *J Am Coll Cardiol.* 2011;58:e44–e122.
6. Windecker S, Kolh P, Alfonso F, et al. ESC/EACTS guidelines on myocardial revascularization. *Eur Heart J.* 2014;35:2541–2619.
7. Erglis A, Kumsars I, Niemelä M, et al. Randomized comparison of coronary bifurcation stenting with the crush versus the culotte technique using sirolimus eluting stents: the Nordic stent technique study. *Circ Cardiovasc Interv.* 2009;2:27.
8. Chen S, Zhang J, Ye F, et al. Study comparing the double kissing (DK) crush with classical crush for the treatment of coronary bifurcation lesions: the DKCRUSH-1 bifurcation study with drug-eluting stents. *Eur J Clin Invest.* 2008;38:361.
9. Adriaenssens T, Byrne RA, Dibra A, et al. Culotte stenting technique in coronary bifurcation disease: angiographic follow-up using dedicated quantitative coronary angiographic analysis and 12-month clinical outcomes. *Eur Heart J.* 2008;29:2868–2876.
10. Mehilli J, Kastrati A, Byrne RA, et al. Paclitaxel-versus sirolimus-eluting stents for unprotected left main coronary artery disease. *J Am Coll Cardiol.* 2009;53:1760–1768.
11. Kim YH, Park SW, Hong MK, et al. Comparison of simple and complex stenting techniques in the treatment of unprotected left main coronary artery bifurcation stenosis. *Am J Cardiol.* 2006;97:1597–1601.
12. Palmerini T, Marzocchi A, Tamburino C, et al. Impact of bifurcation technique on 2-year clinical outcomes in 773 patients with distal unprotected left main coronary artery stenosis treated with drug-eluting stents. *Circ Cardiovasc Interv.* 2008;1:185–192.
13. Hoyer A, Iakovou I, Ge L, et al. Long-term outcomes after stenting of bifurcation lesions with the 'crush' technique: predictors of an adverse outcome. *J Am Coll Cardiol.* 2006;47:1949–1958.
14. Gao Z, Xu B, Yang Y, et al. Comparison between one-stent versus two-stent technique for treatment of left main bifurcation lesions: a large single-center data. *Cathet Cardiovasc Interv.* 2015;85:1132–1138. <https://doi.org/10.1002/ccd.25849>. Epub 2015 Feb 18. PMID: 25614097.
15. Zhang J, Liu S, Geng T, Xu Z. One-stent versus two-stent techniques for distal unprotected left main coronary artery bifurcation lesions. *Int J Clin Exp Med.* 2015;8:14363–14370. PMID: 26550422; PMCID: PMC4613107.
16. Nasir M, Shafique HM, Hussain S, et al. Percutaneous coronary intervention for left main coronary artery bifurcation lesions: two-stent versus one-stent strategy for comparison of 6-month mace. *J Coll Physicians Surg Pak.* 2020;30:894–899. <https://doi.org/10.29271/jcpsp.2020.09.894>. PMID: 33036670.
17. Chen SL, Zhang Y, Xu B, et al. Five-year clinical follow-up of unprotected left main bifurcation lesion stenting: one-stent versus two-stent techniques versus double-kissing crush technique. *EuroIntervention.* 2012;8:803–814. <https://doi.org/10.4244/EIJV8I7A123>. PMID: 23171801.