## Original Article

# Three-Year Outcomes Post Percutaneous Coronary Intervention for Left Main Coronary Artery Disease

Karar Nadhm Obaid Aljabry [1,2]*, Samir Taha Abeid [1,2], Yasseen Abdulurda Yasseen [1,2], Firas R AL-Obaidi [3,4]

[1] Internal Medicine Department, Medicine College, University of Kufa, Najaf, Iraq.
[2] Al-Najaf Cardiac Center, Al Najaf, Iraq.
[3] Internal Medicine Department, AL-Zahraa College of Medicine, University of Basrah, Iraq.
[4] Basra Cardiac Center, Basra, Iraq.

**Citation:** Aljabry KNO, Abeid ST, Yasseen YA, Al-Obaidi FR. Three-Year Outcomes Post Percutaneous Coronary Intervention for Left Main Coronary Artery Disease. Res Heart Yield Transl Med 2026; 21(3):189-196.

https://doi.org/10.18502/rhythm.v21i3.22561

## Highlights

- Significant LMS disease is a critical form of CAD and represents in around 5-7%.
- In the recent era of technical improvement and new generation of drug eluting stents, PCI becomes a satisfactory alternative to bypass surgery.
- PCI is a safe and feasible strategy for Unprotected LMS disease management with negligible immediate and rare short- and long-term complications.
- Although two stent strategy predominates, single stent strategy carries lower MACCE outcome.

**Article info:**

**Received:** 24 Aug. 2025
**Revised:** 06 Sep. 2025
**Accepted:** 19 Apr. 2026

*** Corresponding Author:**
*Karar Nadhm Obaid Aljabry*
*Internal Medicine Department, Medicine College, University of Kufa, Najaf, Iraq.*
*Email: karar.n.ubaid@gmail.com.*

## ABSTRACT

**Introduction:** To identify the safety and long-term outcomes of percutaneous coronary intervention (PCI) using drug-eluting stents for unprotected left main coronary artery disease (ULMCAD) and to compare outcomes between provisional single-stent and double-stent techniques.

**Methods:** In this observational study, patients diagnosed with ULMCAD who underwent PCI were enrolled. Clinical data, angiographic characteristics, and outcomes at 1 and 3 years-including cardiac admission, cardiac death, target lesion revascularization (TLR), and major adverse cardiac and cerebrovascular events (MACCE)-were collected and analyzed at Al-Najaf Cardiac Center.

**Results:** Between January 2014 and January 2017, 500 patients were included in the study. Mean (SD) age was 65 (11) years, 364 patients (72.8%) were male, and hypertension was the most common risk factor, occurring in 353 patients (70.5%). Distal left main lesions were predominant, occurring in 425 patients (84.9%), and the double-stenting technique was used in 356 cases (71.3%). Procedural success was 100%, with no in-hospital mortality or major complications. At 1-year follow-up, cardiac death was recorded in 4 patients (0.8%), TLR in 8 patients (1.6%), and MACCE in 16 patients (3.1%). At 3-year follow-up, cardiac death increased to 8 patients (1.6%), TLR to 20 patients (4.4%), and MACCE to 41 patients (8.2%). Patients treated with a provisional single stent had significantly lower rates of cardiac hospital admission and MACCE compared with double stenting (1 [0.7%] vs 32 [9%]; P=.0403 and 3 [2.1%] vs 70 [20%]; P=.0054, respectively).

**Conclusion:** PCI with drug-eluting stents for ULMCAD was safe and effective, with favorable long-term outcomes in patients who were unfit for surgery or refused surgery. The provisional single-stent technique demonstrated better clinical outcomes than the double-stent approach.

**Keywords:** Left Main Coronary Artery Disease; Percutaneous Coronary Intervention; Drug-Eluting Stents

## Introduction

Left main coronary artery disease (LMCAD) is one of the most critical forms of CAD because of the extensive myocardial territory at risk. In patients with left-dominant coronary circulation, the left main stem (LMS) supplies approximately 84% of the left ventricular myocardium.[1] Consequently, significant stenosis in the LMS poses a substantial threat to myocardial perfusion and often leads to severe clinical outcomes. Coronary angiographic studies have reported that 5% to 7% of patients have significant LMS disease.[2] Without revascularization, prognosis is poor. Indeed, 3-year mortality in medically managed patients with significant LMS disease can reach as high as 50%.[3]

Coronary artery bypass grafting (CABG) has historically been the gold standard for treating LMCAD. Multiple studies have confirmed the survival benefit of CABG over medical therapy alone.[4-7] Nonetheless, percutaneous coronary intervention (PCI) was initially reserved for patients considered high risk or inoperable. With the advent of the drug-eluting stent (DES), improved procedural techniques, and enhanced adjunctive pharmacotherapy, PCI has emerged as a feasible and increasingly accepted alternative in selected cases of LMCAD.[8]

The LMS originates from the aortic root and typically bifurcates into the left anterior descending (LAD) and left circumflex (LCx) arteries. Angiographic studies in healthy individuals show the average diameter of the LMS to be 4.5 (0.5) mm in males and 3.9 (0.4) mm in females.[9] The length of the LMS is highly variable, ranging from 2 mm to 40 mm.[10] A short LMS has been associated with congenital conditions such as bicuspid aortic valve.[11] Anatomical variants of the LMS are clinically relevant, particularly during revascularization planning. In approximately two-thirds of individuals, the LMS bifurcates into the LAD and LCx arteries, whereas the remaining third exhibits a trifurcation pattern with the additional presence of a ramus intermedius branch.[12]

Occasionally, the LAD and LCx may arise independently from the aorta, resulting in the absence of a defined LMS. This is the most common anomaly and is often associated with aortic valve disease in adults, although it occurs in less than 1% of the population.[13,14] Other rare anomalies include the origin of the LAD or LCx from the right coronary artery or from a noncoronary sinus.[14] The prevalence of atherosclerotic LMS disease increases with age and symptom severity. In men older than 65 years presenting with New York Heart Association (NYHA) functional class II, III, and IV angina, the reported prevalence is approximately 11%, 13%, and 9%, respectively.[15] Nonatherosclerotic causes of LMCAD are rare: tertiary syphilis accounts for 1 case per 100 000.[16] Takayasu arteritis for 2 to 3 cases per million[16], and spontaneous coronary artery dissection remains an exceptionally rare event.[17]

There is a strong association between LMCAD and extracoronary vascular disease, particularly carotid artery stenosis. Studies have shown that carotid artery disease is present in 40% of patients with LMCAD, compared with 5% in those with single-vessel coronary disease.[18,19] This finding highlights the systemic nature of atherosclerosis and the importance of comprehensive cardiovascular risk assessment.

Several scoring systems are drawn upon to predict outcomes in patients with LMS disease undergoing either PCI or CABG. The SYNTAX score is an anatomy-based tool that stratifies patients based on lesion complexity. In the SYNTAX trial, low scores generally included patients with ostial LMS lesions and single-vessel disease involving the LMS, whereas high scores reflected multivessel disease including LMS involvement.[20,21]

A meaningful appraisal of LMS lesions is essential to appropriate therapeutic strategies, and intravascular ultrasound (IVUS), fractional flow reserve (FFR), or optical coherence tomography (OCT) may assist this process. IVUS provides information on vessel wall structure; FFR provides pressure-flow data; and OCT provides high-resolution images and may be useful for identifying stent-related problems. Management has advanced from balloon angioplasty for LMS disease, which was associated with high restenosis rates and mortality. Bare-metal stent

reduced acute complications but did not eliminate restenosis; drug-eluting stents have improved outcomes. Current options include a provisional single-stent (SS) T-stenting approach, which is evidence-based practice for the majority of less complex cases and is associated with better long-term outcomes, or double-stent (DS) techniques, which depend on bifurcation angles and lesion morphology.[22-25]

The present study aimed to evaluate the safety and clinical outcomes at 1- and 3-year follow-up after PCI for LMCAD at Al-Najaf Cardiac Center, with a comparative analysis of provisional SS vs DS techniques.

## Methods

### Study Design and Population

This observational study included patients with ULMCAD who underwent PCI with DES implantation at Al-Najaf Cardiac Center between January 2014 and January 2017. Only patients with recorded 1- and 3-year follow-up and known outcomes were included in the study.

Inclusion criteria were as follows: patients diagnosed with LMCAD involving 1, 2, or 3 vessels, presenting with stable angina, unstable angina, non–Q wave myocardial infarction, or Q wave myocardial infarction; patients with silent ischemia diagnosed by noninvasive tests such as treadmill test or dobutamine stress echocardiography; and patients who refused CABG despite surgical recommendation.

Exclusion criteria were as follows: presence of significant comorbidities including advanced renal failure, malignancy, or bleeding tendency; noncompliance with prescribed medications; and history of CABG.

### Data Collection

Clinical data, hospital admissions, procedural details, and outcomes were collected from hospital records at Al-Najaf Cardiac Center. Follow-up information regarding clinical status was obtained through outpatient clinic visits, telephone interviews, or communication with referring physicians.

### PCI

All patients received pretreatment with aspirin (300 mg) and clopidogrel (600 mg), followed by intravenous heparin (100–150 IU/kg) during the procedure. Arterial access was predominantly via the transfemoral route; transradial access was used selectively. Sheaths ranged from 6F to 8F, with guiding catheters of 6F or 7F. Predilation was performed using balloon inflation at pressures exceeding 15 atm to achieve adequate lumen diameter and facilitate stent deployment. Rotational atherectomy (Rotablator) guided by IVUS was employed in 2 patients with heavily calcified lesions. Stents were deployed at high pressures (>15 atm). Following sheath removal, patients were monitored for 24 hours after the procedure.

### Follow-up

Patients were followed up at 1 year and 3 years after PCI to assess MACCE outcomes, including cardiac and noncardiac death, myocardial infarction, stroke, and repeat revascularization. Long-term survival data were collected via clinic visits, telephone interviews, or through referring physicians.

### Statistical Analysis

Data analysis was performed using SPSS, version 23.0 (IBM Corp). Continuous variables are presented as mean (SD), whereas categorical variables are expressed as frequency and percentage. Comparisons between groups were performed using the $\chi 2$ test for categorical data and the student t test or analysis of variance (ANOVA) for continuous variables. A P value of less than .05 was considered statistically significant.

## Results

### Demographic and Clinical Characteristics

A total of 500 patients with ULMCAD were included. Most patients were men (72.8%), and hypertension was the predominant risk factor (70.5%). Clinical presentations were almost equally divided between stable angina (51.2%) and unstable angina (47.3%) (Table 1).

## Angiographic and Procedural Characteristics

The transfemoral approach was used in 473 cases (94.6%). Distal LMS involvement was predominant in 425 cases (84.9%), with bifurcation lesions in 407 cases (81.4%). The DS technique with final kissing balloon inflation was the most frequently used PCI technique in 356 cases (71.3%) (Table 2).

## Procedural Success and Complications

Procedural success was 100%, with no immediate periprocedural complications or deaths (Table 3).

## Clinical Follow-up Outcomes

No MACCE events occurred at hospital discharge. At 1-year and 3-year follow-up, MACCE rates were 16 (3.1%) and 41 (8.2%), respectively (Table 4).

## Comparison Between DS and Provisional SS

DS was significantly associated with higher rates of cardiac hospital admission and MACCE compared with provisional SS, with rates of 1 (0.7%) vs 32 (9%) (P=.0403) and 3 (2.1%) vs 70 (20%) (P=0054), respectively (Table 5).

**Table 1.** Baseline Demographic and Clinical Characteristics (n=500)

| Variables | | N (%) |
|---|---|---|
| Age (year) | (mean ± SD) | 65 ± 11 |
| Sex | Male | 364 (72.8) |
| | Female | 136 (27.2) |
| Diabetes Mellitus | | 151 (30.2) |
| Hypertension | | 353 (70.5) |
| Smoking | | 326 (65.1) |
| Family History of CAD | | 113 (22.5) |
| COPD | | 60 (12.0) |
| Peripheral Artery Disease | | 10 (1.9) |
| Stroke | | 4 (0.8) |
| Clinical Presentation | Stable Angina | 256 (51.2) |
| | Unstable Angina | 237 (47.3) |
| | Myocardial Infarction | 8 (1.5) |
| | Renal Impairment | 12 (2.3) |
| | Previous CABG | 0 (0) |

**Table 2.** Angiographic and Procedural Data (n=500)

| Variables | | N (%) |
|---|---|---|
| Access Site | Radial | 27 (5.4) |
| | Femoral | 473 (94.6) |
| Lesion Location | Ostial and Body LMS | 76 (15.1) |
| | Distal LMS | 425 (84.9) |
| | Bifurcation | 407 (81.4) |
| | Trifurcation | 17 (3.5) |
| | Isolated LMS | 31 (6.2) |
| Disease Extent | LMS + 1 Vessel Disease | 101 (20.2) |
| | LMS + 2 Vessel Disease | 128 (25.6) |
| | LMS + 3 Vessel Disease | 240 (48.1) |
| Treatment Details | Predilation | 345 (69.0) |
| | Direct Stenting | 151 (30.2) |
| | Rotational Atherectomy | 4 (0.8) |
| PCI Technique | Provisional Single Stent | 144 (28.7) |
| | Double Stenting | 356 (71.3) |
| Stent Type | Drug-Eluting Stent (DES) | 500 (100) |
| | Bare Metal Stent (BMS) | 0 (0) |
| Number of Stents Implanted | One | 82 (16.3) |
| | Two | 243 (48.5) |
| | Three | 151 (30.2) |
| | Four | 25 (5.0) |
| Nominal Stent Diameter (mm) | (mean ± SD) | 3.5 ± 0.5 |
| Total Stent Length (mm) | (mean ± SD) | 22.6 ± 18.4 |

**Table 3.** Procedural Success and Complications

| Variables | N (%) |
|---|---|
| Procedural Success | 500 (100) |
| Cardiogenic Shock | 0 (0) |
| Vascular Perforation | 0 (0) |
| LMCA Dissection | 0 (0) |
| Abrupt Closure | 0 (0) |
| Tamponade | 0 (0) |
| Aortic Dissection | 0 (0) |
| Emergent CABG | 0 (0) |
| Death During Procedure | 0 (0) |
| Other Complications | 0 (0) |

**Table 4.** Clinical Outcomes at Immediate, 1-Year and 3-Year Follow-Up

| Outcome | Immediate (n=500) | 1 Years (n=500) | 3 Years (n=500) |
|---|---|---|---|
| Cardiac Death | 0 (0.0%) | 4 (0.8%) | 8 (1.6%) |
| Non-Cardiac Death | 0 (0.0%) | 2 (0.4%) | 4 (0.8%) |
| Repeat Revascularization | 0 (0.0%) | 10 (2.0%) | 28 (5.6%) |
| Target Lesion | 0 (0.0%) | 8 (1.6%) | 20 (4.4%) |
| New Vessel | 0 (0.0%) | 2 (0.4%) | 8 (1.6%) |
| Stroke | 0 (0.0%) | 0 (0.0%) | 2 (0.4%) |
| MACCE | 0 (0.0%) | 16 (3.1%) | 41 (8.2%) |

**Table 5.** Clinical Outcomes by PCI Technique

| Outcome | Provisional Single Stenting (N=144) N (%) | Double Stenting (N=356) N (%) | Relative Risk (95% CI) | P |
|---|---|---|---|---|
| Cardiac Hospital Admission | 1 (0.7) | 32 (9) | 6.03 (1.3–44.8) | 0.0403 |
| Cardiac Death | 0 (0) | 12 (3.4) | 5.2 (0.3–92.3) | 0.0768 |
| Target Lesion Revascularization | 1 (0.7) | 27 (7.6) | 5.6 (0.75–42.0) | 0.0652 |
| Stroke | 0 (0) | 2 (0.6) | 1.2 (0.05–26.3) | 0.5 |
| MACCE | 3 (2.1) | 70 (20) | 7.2 (1.7–29.0) | 0.0054 |

## Discussion

Results of percutaneous treatment for LMS disease have evolved very favorably since DES became available along with better balloon dilation techniques and glycoprotein IIb/IIIa inhibitors.[26] Earlier reports had documented a higher early mortality with bare-metal stents because these approached restenosis within the stent more aggressively—in-stent restenosis. With DES, this complication has been practically eliminated because in-stent restenosis and target lesion revascularization (TLR) rates have been decreased.[12,27]

The risk of subacute stent thrombosis with current technology, including high-pressure implantation, IVUS guidance, and dual antiplatelet therapy, is currently considered to be close to 1%. Restenosis after balloon angioplasty is significantly mediated by elastic recoil because this area has demonstrated a very high content of elastic fibers in the aorto-ostial and proximal LMS segments. Stenting builds the vessels and also reduces restenosis, which is the problem of recurrent narrowing that was initially resolved.[12,28]

In the current study, we had 100% procedural success with low in-hospital mortality and very few periprocedural complications, which confirms that contemporary PCI is safe for LMS disease. The major clinical outcomes of cardiac death, TLR, stroke, and MACCE were assessed at discharge, 12 months, and 3 years. Of 500 participants, there were 9 deaths in the index cohort (6 cardiac), TLR was between 1.6% and 4.4%, and MACCE rates increased from 3.1% at 1 year to 8.2% at 3 years. This finding essentially confirms what earlier single-center studies have found: procedural success can be achieved with good long-term

outcomes.32, 33 For instance, both Chieffo et al[29] and Morice et al[30] reported relatively low mortality rates at follow-up (2.8% and 4.2%, respectively); their participants had similar clinical and angiographic characteristics. On the other hand, high-volume studies such as those by Pavei et al[31] and Vaquerizo et al[32] had higher overall deaths (10.1% and 9.3% at 2 years), possibly because of selection bias and procedural techniques.

Our results showed that SS provisional is better than DS in terms of clinical outcomes, which explains why the rates of cardiac hospital admission, cardiac death, TLR, and MACCE were lower with SS techniques.[33,34] Factors contributing to poorer outcomes with DS techniques include increased procedural complexity leading to lengthier procedure time, greater contrast and radiation exposure, and risk of myocardial injury. Other reasons DS has worse outcomes include incomplete ostial coverage of the side branch, increased metal layers, potential stent fractures, and focal restenosis at the ostium.

Karrowni et al[35] reported better clinical results for SS than DS in unprotected distal LMS disease, with lower TLR (10.1% vs 24.7%) and MACCE rates (20.1% vs 31.8%). Results from the BBC ONE study[36] were also in favor of provisional SS over complex DS, with significant differences in TLR and cardiac death rates (11.3% vs 3.2%). All these findings contrast with those from the CACTUS trial[37], which showed no statistically significant difference between provisional and crush DS techniques (15% vs 15.8% MACCE). This means that this debate has been ongoing and that there is a need for an individualized treatment strategy.[37]

## Study Limitations

The present study was performed at a single center (Al Najaf Cardiac Center); the results may, therefore, not be generalizable. Moreover, not all patients received full intravascular imaging with either IVUS or OCT; this would have provided better lesion assessment. Not standardizing the type of DES used may have also affected the comparability of outcomes. In addition, a longer follow-up period is needed to more accurately assess the long-term efficacy and safety of the intervention.

## Conclusion

PCI for ULMCAD using DES has demonstrated favorable long-term outcomes, few complications, and is a good alternative for high-risk surgical patients or those who refuse CABG. Among currently available stenting strategies, the provisional SS technique yields superior clinical outcomes compared with DS approaches such as T-stenting, TAP (T and small protrusion), or mini-crush, with possible greater reductions in rates of cardiac death, TLR, and MACCE.

## Declarations:

## Ethical Approval

Ethical approval was not required for conducting this research as there was no intervention beyond the standard of care for management and follow up of the study cohort.

## Funding

According to the authors, this article has no financial support.

## Conflict of Interest

The authors report no conflict of interest.

## Acknowledgments

The authors have no acknowledgement to disclose.

## References

1. Leaman DM, Brower RW, Meester GT, Serruys P, van den Brand M. Coronary artery atherosclerosis: severity of the disease, severity of angina pectoris and compromised left ventricular function. Circulation. 2018;63(2):285-99.
2. DeMots H, Rosch J, McAnulty JH, Rahimtoola SH. Left main coronary artery disease. Cardiovasc Clin. 1997;9(2):201-11.
3. Taylor HA, Deumite NJ, Chaitman BR, Davis KB, Killip T, Rogers WJ. Asymptomatic left main coronary artery disease in the Coronary Artery Surgery Study (CASS) registry. Circulation. 2018; 79(6):1171-9.

4. Yusuf S, Zucker D, Peduzzi P, Fisher LD, Takaro T, Kennedy JW, 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. 2013; 629-38.

5. Chaitman BR, Fisher LD, Bourassa MG, Davis K, Rogers WJ, Maynard C. Effect of coronary bypass surgery on survival patterns in subsets of patients with left main coronary artery disease. Report of the Collaborative Study in Coronary Artery Surgery (CASS). Am J Cardiol. 2006;98(1):54-9.

6. Tan WA, Tamai H, Park SJ, Plokker HW, Nobuyoshi M, Suzuki T, et al. Long-term clinical outcomes after unprotected left main trunk percutaneous revascularization in 279 patients. Circulation. 2001; 104(14):1609-14.

7. Caracciolo EA, Davis KB, Sopko G, Kaiser GC, Corley SD, Schaff H, et al. Comparison of surgical and medical group survival in patients with left main coronary artery disease. Long-term CASS experience. Circulation. 1995; 91(9):2325-34.

8. Niemelä M, Kervinen K, Erglis A, Holm NR, Maeng M, Christiansen EH, et al. Randomized comparison of final kissing balloon dilatation versus no final kissing balloon dilatation in patients with coronary bifurcation lesions treated with main vessel stenting: the Nordic-Baltic Bifurcation Study III. Circulation. 2011; 123(1):79-86.

9. Dodge JT Jr, Brown BG, Bolson EL, Dodge HT. Lumen diameter of normal human coronary arteries. Influence of age, sex, anatomic variation, and left ventricular hypertrophy or dilation. Circulation. 2000;86(1):232-46.

10. James TN. Anatomy of coronary arteries. New York: Paul B Hoeber; 1999. p. 12-18.

11. Friedman T, Mani A, Elefteriades JA. Bicuspid aortic valve: clinical approach and scientific review of a common clinical entity. Expert Rev Cardiovasc Ther. 2008;6(2):235-8.

12. Bergelson BA, Tommaso CL. Left main coronary artery disease: assessment, diagnosis, and therapy. Am Heart J. 1995;129(2):350-9.

13. Reese DE, Mikawa T, Bader DM. Development of the coronary vessel system. Circ Res. 2002; 91(9):761-8.

14. Yamanaka O, Hobbs RE. Coronary artery anomalies in 126,595 patients undergoing coronary arteriography. Cathet Cardiovasc Diagn. 1990; 21(1):28-40.

15. Smith SC Jr, Feldman TE, Hirshfeld JW Jr, Jacobs AK, Kern MJ, King SB 3rd, et al. ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/SCAI Writing Committee to Update 2001 Guidelines for Percutaneous Coronary Intervention). Circulation. 2006;113:e166-e286.

16. Tavora F, Burke A. Review of isolated ascending aortitis: differential diagnosis, including syphilitic, Takayasu's and giant cell aortitis. Pathology. 2006;38(4):302-08.

17. Atay Y, Yagdi T, Turkoglu C, Altintig A, Buket S. Spontaneous dissection ofthe left main coronary artery: a case report and review of the literature. J Card Surg. 1996;11:371-5.

18. Kallikazaros I, Tsioufis C, Sideris S, Stefanadis C, Toutouzas P. Carotidartery disease as a marker for the presence of severe coronary arterydisease in patients evaluated for chest pain. Stroke. 1999; 30(5):1002-7.

19. Eagle KA, Guyton RA, Davidoff R, Edwards FH, Ewy GA, Gardner TJ, et al. ACC/AHA 2004 guideline update for coronary arterybypass graft surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committeeto Update the 1999 Guidelines for Coronary Artery Bypass GraftSurgery). Circulation 2004;110:e340-e437.

20. Serruys PW, Onuma Y, Garg S, Sarno G, van den Brand M, Kappetein AP, et al. Assessment of the SYNTAX score in the Syntax study. EuroIntervention. 2009;5(1):50-56.

21. Sianos G, Morel MA, Kappetein AP, Morice MC, Colombo A, Dawkins K, et al. The SYNTAX Score: an angiographic tool grading the complexity of coronary artery disease. EuroIntervention. 2005; 1(2):219-27.

22. Garg S, Sarno G, Garcia-Garcia HM, Girasis C, Wykrzykowska J, Dawkins KD, et al. A new tool for the risk stratification of patients with complex coronary artery disease: the Clinical SYNTAX Score. Circ Cardiovasc Interv. 2010;3(4):317-26.

23. Campos CM, van Klaveren D, Iqbal J, Onuma Y, Zhang YJ, Garcia-Garcia HM, et al. Predictive performance of SYNTAX Score II in patients with left main and multivessel coronary artery disease: analysis of CREDO-Kyoto registry. Circ J. 2014;78(8):1942-9.

24. Kim YH, Ahn JM, Park DW, Lee BK, Lee CW, Hong MK, et al. EuroSCORE as a predictor of death and myocardial infarction after unprotected left main coronary stenting. Am J Cardiol. 2006;98 (12):1567-70.

25. Mintz GS, Popma JJ, Pichard AD, Kent KM, Satler LF, Chuang YC, et al. Patterns of calcification in coronary artery disease. A statistical analysis of intravascular ultrasound and coronary angiography in 1155 lesions. Circulation. 1995;91(7):1959-65.

26. O'Keefe JH Jr, Hartzler GO, Rutherford BD, McConahay DR, Johnson WL, Giorgi LV, et al. Left main coronary angioplasty: early and late results of 127 acute and elective procedures. Am J Cardiol. 1999;64(3):144-7.

27. Eldar M, Schulhoff RN, Hertz I, Frankel R, Feld H, Shani J. Results of percutaneous transluminal coronary angioplasty of the left main coronary artery. Am J Cardiol. 2000;68(2):255-6.

28. Schomig A, Neumann FJ, Kastrati A, Schuhlen H, Blasini R, Hadamitzky M, et al. A randomized comparison of antiplatelet and anticoagulant therapy after the placement of coronary-artery stents. N Engl J Med. 2001;334(17):1084-9.

29. Chieffo A, Magni V, Latib A, Maisano F, Ielasi A, Montorfano M, et al. 5-year outcomes following percutaneous coronary intervention with drug-eluting stent implantation versus coronary artery bypass graft for unprotected left main coronary artery lesions: the Milan experience. JACC Cardiovasc Interv. 2010;3(6):595-601.

30. Morice MC, Serruys PW, Kappetein AP, Feldman TE, Stahle E, Colombo A, et al. Outcomes in patients with de novo left main disease treated with either percutaneous coronary intervention using paclitaxel-eluting stents or coronary artery bypass graft treatment in the Synergy Between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery (SYNTAX) trial. Circulation. 2010;121(24):2645-53.

31. Pavei A, Oreglia JA, Martin G, Tousek P, Sharif F, Farah B, et al. Long-term follow-up of percutaneous coronary intervention of unprotected left main lesions with drug eluting stents: predictors of clinical outcome. EuroIntervention. 2009;4(4):457-63.

32. Vaquerizo B, Lefevre T, Darremont O, Silvestri M, Louvard Y, Leymarie JL, et al. Unprotected left main stenting in the real world: two-year outcomes of the French left main taxus registry. Circulation. 2009; 119(17):2349-56.

33. Steigen TK, Maeng M, Wiseth R, Erglis A, Kumsars I, Narbute I, et al. Randomized study on simple versus complex stenting of coronary artery bifurcation lesions: the Nordic bifurcation study. Circulation. 2006;114(18):1955-61.

34. Baim DS, Mauri L, Cutlip DC. Drug-eluting stenting for unprotected left main coronary artery disease: are we ready to replace bypass surgery? J Am Coll Cardiol. 2006;47(4):878-81.

35. Karrowni W, Makki N, Dhaliwal AS, Vyas A, Blevins A, Dughman S, et al. Single versus double stenting for unprotected left main coronary artery bifurcation lesions: A systematic review and meta-analysis. J Invasive Cardiol. 2014;26(6):229-33.

36. Hildick-Smith D, de Belder AJ, Cooter N, Curzen NP, Clayton TC, Oldroyd KG, et al. Randomized trial of simple versus complex drug-eluting stenting for bifurcation lesions: the British Bifurcation Coronary Study: old, new, and evolving strategies. Circulation. 2010;121(10):1235-43.

37. Colombo A, Bramucci E, Saccà S, Violini R, Lettieri C, Zanini R, et al. Randomized study of the crush technique versus provisional side-branch stenting in true coronary bifurcations: the CACTUS (Coronary Bifurcations: Application of the Crushing Technique Using Sirolimus-Eluting Stents) study. Circulation. 2009;119(1):71-8.