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One-year clinical follow-up and outcomes in patients after drug-eluting stent implantation for unprotected left main coronary stenosis: A single center study from Turkey

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ABSTRACT

Objective. Although there are many randomized trials about unprotected left main percutaneous coronary intervention (ULMPCI), there are few data from Turkey. Therefore, we aimed to present the first data about ULMPCI, determine SYNTAX and EuroSCORE II scores, clinical and demographic data of patients; monitor mortality, morbidity and need for revascularization during 1-year follow-up. **Methods and Results**. A retrospective 1-year follow-up study of 53 patients who underwent ULMPCI was conducted. Primary endpoint was occurrence of major adverse cardiovascular and cerebrovascular events (MACCE), based on sudden cardiac death (SCD), myocardial infarction (MI), target vessel revascularization (TVR), target lesion revascularization (TLR), stent thrombosis and stroke. Complete revascularization rate was 100%. At 1- year follow-up of the patients, acute coronary syndrome and related cardiac death occurred in 1 (1.9%) of the patients at 8 months, and 1 (1.9%) patient developed restenosis at 9 months. The rate of life without MACCE was 96.2%. A comparison of MACCE rates between diabetic and non-diabetic patients revealed MACCE occurred in 2 patients with diabetes, but this was not statistically significant (p = 0.111). One of these patients was in the low–middle-risk group according to SYNTAX score and the other was in the high-risk group (p = 0.216). **Conclusions**. In selected patient groups with left main coronary artery disease (patients with low–middle SYNTAX score and high risk of coronary artery bypass grafting surgery, CABG), PCI is a safe and effective treatment option alternative to CABG with high process success and low MACCE rate.

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Introduction

Left main coronary artery (LMCA) lesions are detected in 5-10% of patients who undergo coronary angiography for coronary artery disease; patients with critical LMCA (>50% stenosis) lesions have a 3-year mortality rate of only 50% when followed by medical therapy [1].

Coronary artery bypass grafting (CABG) surgery, which began in 1967 due to its positive effects on pain and quality of life in patients with coronary artery disease, has been accepted as the standard treatment for coronary lesions accompanied by LMCA lesions [2, 3].

When percutaneous coronary intervention (PCI) was started in 1977, it was thought that it would be an appropriate treatment method in single vascular lesions [4], although CABG is accepted as the standard treatment for coronary artery disease for unprotected left main coronary artery (ULMCA) lesions. In recent years, technical improvements in PCI, stent technology and antiplatelet therapies mean that it is increasingly considered as a treatment option alternative to CABG because of benefits on mortality and morbidity. SYNTAX, NOBLE and EXCEL studies performed in this area are important because they are the largest randomized studies regarding evaluating the long-term safety and efficacy of CABG and PCI [5-7]. Findings from such studies demonstrate that PCI is a significant alternative to CABG in patients with low (<23) and moderate (23-32) SYNTAX scores in terms of revascularization technique for ULMCA lesions according to current guidelines [8].

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We determined the SYNTAX and EuroSCORE II scores, and clinical and demographic data of patients who underwent stent implantation for critical LMCA lesions in our center, and examined the mortality, morbidity and revascularization needs of the patients during 1-year follow-up.

Materials and Methods

1. Study population

The study included 53 patients who underwent left main percutaneous coronary intervention (LMPCI) between 2009-2014. The criteria for applying PCI to the LMCA were the presence of ≥ 50% *de novo* lesion on coronary angiography, and the presence of symptomatic or documented myocardial ischemia. Intravascular ultrasound (IVUS) was used in patients with an intermediate lesion in coronary angiography. The measurement of the minimum lumen area (MLA) < 6.0 mm^2 in IVUS was considered as significant stenosis.

Patients with ST elevation myocardial infarction (STEMI) and cardiogenic shock; non-STEMI; additional valve disease requiring surgical intervention; previous CABG or valve operation; severe peripheral arterial disease; severe carotid artery stenosis; renal failure requiring dialysis; overt heart failure symptoms and contraindications to bilateral antiplatelet therapy were excluded from the study.

Basal coronary angiographies of the patients were evaluated by two experienced cardiologists and cardiovascular surgeon (as a heart team), and the SYNTAX scoring system was used to categorize the patients into low (SYNTAX <23), moderate (SYNTAX 23-32) and high (SYNTAX >32) risk groups. EuroSCOREs were also determined. PCI and CABG were presented as treatment alternatives to patients with low-to-medium risk (SYNTAX ≤32), while PCI was advised to patients who had a high SYNTAX score (>32) and a higher risk of surgery because of their comorbid status. After the written consent of the patients who accepted PCI, their operations were performed.

The follow-up data of patients who underwent this procedure were examined retrospectively. Ethics Committee approval was obtained for this research.

2. Medication and process properties

Each patient was administered a loading dose of 600 mg clopidogrel and 300 mg aspirin at least 5 days prior to the planned surgery. Subsequent maintenance doses (75 mg clopidogrel and 100 mg aspirin) were given daily for at least 12 months after PCI. Since the patients did not have acute coronary syndrome, ticagrolor or prasugrel could not be used.

PCI was performed via femoral approach. Operations were performed by 2 different operators. Ostial and midshaft LMCA lesions were conducted by using a 6F introducer sheath and Judkins guiding catheters. Stent implantation was done after balloon pre-dilatation. Post-dilatation was done with a non-compliant balloon. For distal LMCA lesions, a 7U introducer sheath and Extra back-up (EBU) guiding catheters were used. A single stent approach was preferred in patients who did not present a true Medina bifurcation lesion or had a true Medina bifurcation lesion with a lateral branch lesion length of <5 mm. In this case, the T-stenting and small protrusion (TAP) technique was applied to the second stent.

Two different stent strategies Double kissing (DK) crush and mini-crush were preferred in cases with a true Medina bifurcation lesion where the side branch lesion length was ≥ 5 mm. Two stent kissing balloon dilatations were performed with non-compliant balloons.

The patients who underwent PCI were closely monitored during the first 24 h for complications. Troponin levels were checked for the determination of procedure-related infarct and myocardial damage at the end of the procedures.

3. Clinical and angiographic follow-up

The patients who were discharged after the PCI procedure were followed-up in the hospital at 1, 3, 6 and 12 months, by clinical examination or by telephone.

Coronary angiography was performed on some of the patients as the control; one portion during the second session (staged procedure), and one portion for the indication (in cases of suspected ischemia in clinical or after routine noninvasive tests).

4. Endpoints

Primary endpoint was the MACCE (major cardiac and cerebrovascular events) rate during the 1-year follow-up. MACCE was based on sudden cardiac death (SCD), myocardial infarction (MI), target vessel revascularization (TVR), target lesion revascularization (TLR), stent thrombosis and stroke.

5. Definitions

Procedural success: TVR/TLR with a residual diameter stenosis of <10% and TIMI 3 flow without any major procedural complication or immediate post-procedure adverse event like MI, acute stent thrombosis, need for emergency target revascularization, or SCD.

Complete anatomic revascularization: Treatment of all coronary artery segments >1.5 mm in diameter with ≥50% diameter stenosis.

Restenosis: Recurrence of narrowing of the target lesion up to 5 mm in the segment proximal and distal to the stent.

TLR: Repeat intervention of the target lesion up to 5 mm in the segment proximal and distal to the stent.

TVR: Repeat intervention of any segment of the coronary vessel proximal or distal to the target lesion, involving its branches and/or the target lesion itself.

Assessment of intermediate coronary lesion: minimal lumen area (MLA) < 6.0 mm^2 during intravascular ultrasound (IVUS).

SCD: Any death due to proximate cardiac cause (e.g, MI, low-output failure, fatal arrhythmia), unwitnessed death and death of unknown cause, and all procedure-related deaths, including those related to concomitant treatment.

MI: An increase in the Creatine kinase MB CPK–MB level of more than three times the upper limit of the normal range associated with typical chest pain and fresh STEMI or new onset left bundle branch block (LBBB).

MACCE: Occurrence of non-fatal MI, SCD, RI, including TLR/TVR and any new vessel revascularization or cerebrovascular event during follow-up.

Stent thrombosis: Acute, subacute, or late, when the event occurred within 24 h, 30 days, <1 year, respectively. After the planned procedure, definite, probable, and possible stent thrombosis was defined according to the ARC definition.

6. Statistical analysis

Data were analyzed using IBM SPSS Statistical Software (IBM SPSS Statistics version 22.0). If the numerical variables conformed to a normal distribution, they were expressed as mean and standard deviation; if not, the median value was presented. The chi-square test was used for the evaluation and comparison of clinical and angiographic data. The results were interpreted according to Fisher's exact test because the sample size was small. Significance was set at $p < 0.05$.

Table 1. Patients demographics

Risk Factors and Coexisting Diseases (n=53)	
• Age	63.3 ± 12.4
• Male	35 (66,7%)
• Female	18 (33,3%)
• Hypertension	24 (45.3%)
• Diabetes mellitus	18 (34.0%)
• Dyslipidemia	23 (43.4%)
• Current smoking	21 (39.6%)
• Chronic renal failure	6 (11.3%)
• Peripheral arterial disease	7 (13.2%)
• Cerebrovascular Event	1 (1.9%)
Clinical Presentation and Findings (n=53)	
• Chronic stable angina	45 (84.9%)
• Unstable angina	8 (15.1%)
• LV EF <50%	11 (20.8%)
• LV EF > 50%	42 (79.2%)
EuroSCORE	1.97± 2.00

Results

- *Basic demographic profile*

Fifty-three patients who underwent LMPCI were included in this study. Patients' clinics, risk factors and other demographic data are presented in Table 1. Of the patients, 18 (33.3%) were female, and 35 (66.7%) were male. The mean age was 63.3 ± 12.4 years.

In terms of clinical risk factors, among the total patients, 24 (45.3%) had hypertension HT; 18 (34.0%) had diabetes; hyperlipidemia was present in 23 (43.4%); 21 (39.6%) were smokers.12 (22.6%) had previous MI, 22 (41.5%) had PCI history, 1 (1.9%) had stroke history; 6 (11.3%) patients had chronic renal failure, and 7 (13.2%) had a history of peripheral arterial disease.

Table 2. Angiographic and procedural characteristics of patients

SYNTAX score	23.0 ±7.34
Access site (n=53)	
• Femoral	53 (100%)
Number of vessels intervened (n=53)	
• LMCA	1 (1.9%)
• LMCA+ 1 additional vessel	22 (41.5%)
• LMCA+ 2 additional vessels	22 (41.5%)
• LMCA+ 3 additional vessels	8 (15.1%)
SYNTAX score risk scale (n=53)	
• Low (<22)	27 (50.9%)
• İntermediate (22–32)	20 (37.7%)
• High (>32)	6 (11.3%)
Lesion Site (n=53)	
• Bifurcation	46 (86.8%)
• Non-bifurcation	7 (13.2%)
Number of Stents (n=53)	
• Single stent	40 (75.5%)
• Multiple stents (≥2)	13 (24.5%)
Complete Revascularization	53 (100%)
Mean stent diameter (mm)	3.51 ± 0.36
Mean stent length (mm)	20.22 ± 7.12
Stent type	
• EES	25 (47.2%)
• BES	18 (34%)
• ZES	4 (7.5%)
• BMS	4 (7.5%)
• Other	2 (3.8%)
IVUS (n=53)	12 (22.6%)

Eight (15.1%) of the patients included in the study were admitted to our clinic with unstable angina and the remaining 45 (84.9%) had stabile coronary artery disease. Eleven (20.8%) of the patients had an EF (ejection fraction) below 50%, and the remaining 42 (79.2%) patients had an EF of > 50 %.

- *Procedural and angiographic characteristics*

Table 2 provides the procedural and angiographic characteristics. An isolated LMCA lesion was detected in 1 (1.9%) patient. One, two and three coronary lesions, in addition to an LMCA lesion, was detected in 22 (41.5%), 22 (41.5%) and 8 (15.1%) patients, respectively. According to the SYNTAX scores, 27 (50.9%) patients were in the low-risk group (median SYNTAX score was 18), 20 (37.7%) were in the middle-risk group (median SYNTAX score was 26), and 6 (11.3%) were in the high-risk group (median SYNTAX score was 34.5). The lowest SYNTAX score was 12, the highest score was 55, and the mean SYNTAX score was 23.0 ± 7.34.

Forty-six (86.8%) of the LMCAr lesions were in the bifurcation area. Provisional single stent strategy was applied in 40 (75.5%) of all revascularized LMCA lesions. Thirteen (24.5%) patients received a double stent using the DK crush, mini-crush or TAP techniques. In 53 (100%) patients, distal flow was achieved in all LMCA lesions. The shortest of the stents used during revascularization was 9 mm, the longest was 38 mm, and the average length was 20.22 ± 7.12 mm. The smallest diameter of the stent was 2.75 mm, the longest diameter was 4.0 mm, and the mean diameter was 3.51 ± 0.36 mm.

During the procedure, IVUS was used in 12 patients (22.6%). Fractional flow reserve (FFR) was performed in one patient group without IVUS, and the lesion was evaluated as critical.

- *Procedural and in-hospital outcome*

Technical and procedural success were both 100%. After the revascularization, postoperative in-hospital follow-ups, and 1, 3, 6 and 12-month follow-ups were performed. When the in-hospital mortality was examined, no cardiac death or any adverse events occurred. In the clinical follow-up of the patients, TLR was not needed at 3 and 6 months, and MACCE not developed.

At 1-year follow-up of the patients, ACS and related cardiac death occurred in 1 (1.9%) patient (at 8 month). In addition, 1 (1.9%) patient developed restenosis at 9 months. Among the remaining 51 (96.2%) patients, no TLR or MACCE occurred.

The Kaplan–Meier graphs for SCD and MACCE are shown in Figures 1 and 2, respectively.

Coronary angiography was performed in 7 (13.2%) patients in the first 6 months and 10 (18.9%) patients between 6 and 12 months. Control angiography was not performed in 36 (67.9%) patients because of their clinical, functional status, no anginal complaints, regular medication use and regular follow-up to clinical trials. Stent restenosis was detected in 1 (1.89%) patient.

A comparison of the MACCE rates between diabetic and non-diabetic patients at 1 -year follow-up revealed MACCE occurred in 2 patients with diabetes, but this was not statistically significant (p = 0.111) (Table 3). One of these patients was in the low– middle SYNTAX risk group, and the other was in the high-risk group (Table 4). There was not statistically significance for MACCE rates between risk groups (p = 0.216).

Table 3. Comparison of 1-year major adverse cardiac and cerebrovascular event (MACCE) rates of patients with and without diabetes.

			Diabetes mellitus		
			No	Yes	Total
1 year MACCE	No	Count, %	35 (68.6%)	16 (31.4%)	51 (100.0%)
	Yes	Count, %	0 (0.0%)	2 (100.0%)	2 (100.0%)
Total		Count, %	35 (66.0%)	18 (34.0%)	53 (100.0%)

Table 4. Comparison of low–middle-risk and high-risk patients in terms of 1-year major adverse cardiac and cerebrovascular event (MACCE) rates according to the SYNTAX score.

			SYNTAX score		
			≤32	>32	Total
1 year MACCE	No	Count, %	46 (90.2%)	5 (9.8%)	51 (100.0%)
	Yes	Count, %	1 (50.0%)	1 (50.0%)	2 (100.0%)
Total		Count, %	47 (88.7%)	6 (11.3%)	53 (100.0%)

Discussions

This study included clinical and angiographic follow-up of patients who underwent LMPCI between 2009 and 2014. The main aim of the study was to determine the indication of PCI according to the SYNTAX scores and to apply PCI to the patients in the low–middle-risk group. Of the 53 patients included in the study, 47 (88.7%) were in the low-middle-risk group, so they had the option not only of CABG but also PCI. Six patients were in the high-risk group due to a high surgery risk of CABG because of their comorbid conditions or did not accept surgical treatment. Our study group included elective cases in which LMPCI could be performed in daily life.

In our study, the success rate and clinical success were 100%. There was no complication and MACCE during the in-hospital period. One-year follow-up showed 1 cardiac death. The 1-year survival rate was 98.1%. A total of 2 MACCEs were observed, with 1 restenosis at annual follow-up. Neither MI, nor TVR were noted. The rate of life without MACCE was 96.2%.

A. *Comparison of our study results to randomized study results*

The clinical and angiographic features and 1-year follow-up results of six prior randomized trials that compared PCI and CABG randomly LMCA lesions are provided in Table 5 and Table 6 [9].

Table 5: Clinical trials comparing percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG)

Study	Age	Diabetes	Distal LM	No of Diseased vessel 0/1/2/3%	Syntax Score	Complete Revascularization (overall, PCI, CABG)
LEMANS	61	18	58	0/9/23/68	23	84/79/89
SYNTAX Left Main	65	25	61	13/20/31/36	30	68/65/73
Boudriot et al	68	36	71	29/31/27/14	24	98/98/97
PRECOMBAT	62	32	65	10/17/32/41	25	69/68/70
EXCEL	66	29	80	163/292/325/162	20	NA
NOBLE	66	15	81	NA	22	92 (PCI only)

Table 6. Clinical outcomes meta-analysis beyond 1 year follow up

Study	PCI (%)	CABG (%)	Absolute Difference	P value
MACE	8.5	8.9	0.4	0.9
Death	5.5	6.6	1.2	0.07
MI	3.4	2.6	0.9	0.14
Stroke	0.6	1.8	1.2	0.01
TVR	8.7	4.5	4.2	<0.01

In the meta-analysis of these studies, in the PCI group, death at the end of the first year was 5.5%, MI was 3.4%, stroke 0.6%, TVR 8.7% and MACCE 8.5%, respectively. When we compare the results of the first year of our study with the meta-analysis results, our MACCE rate is significantly lower. Four main reasons were considered for this decrease in our MACCE rate:

- The most important reason is that our study group was initially determined according to the SYNTAX score, and 90% of the cases consisted of patients in the low–medium risk group, in which the PCI was similar to the CABG in LMCA or even better. Again, the average SYNTAX score of our study group was 23.0, which was lower than the average score of the first four studies that made the meta-analysis and this may have contributed to our MACCE rate.
- The differences between the clinical characteristics of the study groups may also be an important cause of the difference in MACCE rates. In our study, STEMI patients were excluded. About 85% of our patients had stable coronary artery disease. The rate of Non-ST ACS (unstable angina) patients was around 15%. The average EuroSCORE was 1.97. When we look at the clinical features of the patients with the LE MANS study, we see that the rate of patients with ACS is about 60%, and the average EuroSCORE is 6.0 which, represents a clinically high-risk group of patients, according to our study [10]. In the SYNTAX and PRECOMBAT studies, Non-ST ACS rate was 30% and 47%, respectively, and the average EuroSCORE was 3.9 and 2.6%, respectively [5, 11]. In a clinical study by Boudriot et al., the average EuroSCORE was 2.5 [12]. All these data indicate a higher clinical risk than our study group. Indeed, in these studies, one of the most important predictors of MACCE after PCI and CABG was shown to be the patients' basal EuroSCORE. Therefore, a lower MACCE rate may be expected in our study due to a lower baseline EuroSCORE.
- The differences between the stents used in PCI may also result in different clinical follow-up results.

Approximately 89% of the stents used in our study were 2nd generation DESs (47.2% EES, 34% BES, 7.5% ZES), while the remaining were 1st-generation DES or bare metal stent (BMS). The use of DES in the LE MANS study was 37.3% and the 1st-generation was DES, respectively [10]. In the SYNTAX study, 1st-generation PES was used and in the PRECOMBAT study, 1st-generation SES was used [5, 11]. Numerous studies have shown that DES significantly decreases the MACCE rate compared to BMS. When comparing the 2nd-generation EES with 1st-generation PES, Planer et al. reported that EES was both more effective and safer [13]. Therefore, the intense use of the 2nd-generation DES and the intensive use of EES in our study may be the cause of our low MACCE frequency.

- Another reason for the difference in MACCE ratio may be the difference in the rate of patients who underwent complete revascularization. Faroog *et al*. reported that one of the most important predictors of the 5-year MACCE rate (for both PCI and CABG groups) was the incomplete revascularization of the data obtained from the 5-year follow-up of the SYNTAX study [14]. The presence of a residual SYNTAX score >8 was found to be a strong predictor for MACCE in patients without complete revascularization. In our study, the complete revascularization rate was 100%. This ratio was 79, 65, 98 and 68 in the LE MANS, SYNTAX, Boudriot et *al*. and PRECOMBAT trials, respectively [9]. Our high rate of complete revascularization may be another reason for our low MACCE rate.

In addition to these studies, 3- and 5-year results were reported for two more randomized trials (EXCEL and NOBLE), respectively [6, 7]. In EXCEL, a total of 1,905 patients with LMCA disease and low or intermediate anatomical complexity (SYNTAX score ≤32) were randomly assigned to CABG or PCI. In the NOBLE trial, 1,201 patients with LMCA disease were randomly assigned to CABG or PCI (11% of the patients received a 1st-generation DES and the rest a biolimus-eluting stent).

In the first 1 year, there was no significant difference in terms of CABG and PCI. Especially in the EXCEL study, the low–medium SYNTAX score group patients were included, the mean SYNTAX score was lower than previously mentioned randomized studies (SYNTAX score 20). Provisional stenting was used as stenting technique, and 2nd-generation DES was selected for PCI. All these factors explain how the results of the EXCEL study and our study are similar.

B. *Comparison of our study results with observational study results*

There are some reported observational studies in the literature about the follow-up results of patients undergoing PCI in LMCA lesions.

Cherradi *et al*. reported the 6-month follow-up of 101 consecutive patients who underwent LMCA.: 65% of the cases were ACS patients (22.8% STEMI), 87% was distal LMCA disease, and paclitaxel-releasing DES was used in all cases. At the 6-month follow-up, 2 of 8 cardiac deaths occurred at a rate of 8.6% MACCE [15]. The high MACCE ratio, according to our study, could be explained by the fact that the study population consisted of patients with high clinical risk of ACS and that the stent used in the study was 1st-generation DES.

Ben-Dor et al. reported the results of 71 consecutive patients who underwent LMCA intervention [16]. The cases consisted of patients with high clinical mortality risk (75% ACS, 16.9% cardiogenic shock, EuroSCORE 7.3). BMS was used in 49% and DES in 51% of the patients, respectively. The 12-month mortality was 19.7%. The MACCE ratio was significantly higher in patients with BMS compared to DES. The high mortality rate in the study may be explained by the high-risk patients and high BMS. Also, in that study, the low mortality rate (6.9% vs. 39%) seen in the 1st year of emergency PCI in those who underwent elective PCI was only supportive of the low mortality rate in our study, consisting of patients undergoing elective PCI.

Dores *et al*. described a 5-year follow-up of 95 consecutive LMCA patients with retrospective analysis , in which 42% of the patient population was ACS, and the mean SYNTAX score was 24.2 [17]. At the end of 5 years, a total of 28.4% MACCE was realized. Premise MI, hypertension and the EuroSCORE were detected as MACCE predictors. Also, the MACCE ratio was found to be low in DES.

In all above-mentioned observational studies, MACCE rates, which are equivalent to CABG, were higher than our study. The most important reason for this difference is that our working groups are different. Based on the LMCA intervention indications at that time, the patients were more urgent ACS cases and had a high risk of CABG. In our study, the indication (SYNTAX score) was determined from the outset and low-to-medium-risk elective patients, where PCI was an alternative to CABG, was taken. Therefore, our MACCE ratio is low. Another reason was the use of 2nd-generation DES in our study and the use of BMS and 1st-generation DES in the mentioned studies.

In the more recent NEST recording study (literature), 2-year follow-up results of 154 patients were presented [18]. Approximately 82% of the patients had a mean EuroSCORE of 4.7 and a SYNTAX score of 27.5 corresponded to patients with distal LMCA lesions. About 58% of patients with a 76% true Medina bifurcation lesion had two-stent techniques. Despite high-risk anatomic angiographic features, low SCD (1.3%) and TVR (12.3%) rates were provided at the end of 2 years. This result supports our result of the low MACCE ratio for a similar stent composition.

C. *Evaluation of the outcome of the distal LMCA PKG*

PKG is no longer discussed in ostial and mid-band LMCA lesions. However, discussions on PCI in distal LMCA lesions are ongoing. In our study, the presence of distal LMCA lesion was high (86.8%). However, in 75.5% of cases, a single stent approach was adequate. Two stent approaches were required in 24.5% of cases. As three different stent techniques, DK crush, mini-crush and TAP techniques were generally preferred. Although our distal LMCA ratio is high, our MACCE ratio is very low. It shows that the appropriate stent (2nd-generation DES) and technical (preferably provisional single stent, two-stents with appropriate technique if necessary) can be used in these lesions. The successful results reported from the NEST recording study with the distal LMCA ratio and with the 2nd-generation DES support this data. Kim *et al*. published the results of a 2-year follow-up of 84 cases of LMCA PKG [19]. The rate of MACE in distal LMCA lesions was higher than the number of stents used (1st-generation DES-SES), and technical reasons (provisional approach ratio was low, MACCE and restenosis rate were found) explain the high use of two stent techniques.

As in the SYNTAX and EXCEL study, in our study, we found a very low MACCE rate at the end of 1-year follow-up in our study group, where the majority of the patients with low–middle SYNTAX score, in which PKG was and CABG were the same. It suggests that PCI can be used as an alternative treatment to CABG in the patient groups mentioned. In line with this opinion, as stated in the *European Society of Cardiology (*ESC) Myocardial Revascularization Guidelines published in 2018, it has been reported that PCI can be used as an alternative method to CABG in patients with LMCA lesion and low SYNTAX score with class I indication and in patients with moderate SYNTAX score with class IIa indication.

Conclusions

The main result of our study is that in selected patient groups with LMCA disease (patients with low–middle SYNTAX score and high-risk of CABG), PCI is an important alternative treatment method with high process success and low MACCE rate.

Study limitations

The fact that our case number is relatively low is an important limitation of our study. Another limitation is that it is an observational study and it is not a randomized study with CABG. Although IVUS-guided intervention is recommended for all LMCA interventions, we could only use for intermediate lesions because of payment problem. Although EXCEL and NOBLE studies provide important data on the location and indication of PCI in LMCA lesions, there is a need for further large-scale randomized studies.

Authorship contributions

Concept – İ.H.İ, F.Y.C.; Design – İ.H.İ, E.P.; Supervision – İ.H.İ, E.P., F.Y.C; Materials – İ.H.İ, E.P., F.Y.C.; Data collection &/or processing –İ.H.İ.; Analysis and/or interpretation – İ.H.İ, E.P., F.Y.C.; Literature search –İ.H.İ.; Writing– İ.H.İ.; Critical revision – İ.H.İ, E.P., F.Y.C

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article. The manuscript was read and approved by all authors.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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