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ORIGINAL ARTICLE

Stent Implantation Results in Long Lesions and Small Coronary Vessels

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ABSTRACT

Background: Data on the outcomes of stent implantation in long lesions (≥28 mm) in small (≤2.5 mm) coronary vessels is limited.

Aim: To investigate the acute outcomes of stenting in long and small coronary lesions.

Study Design: Retrospective cohort study.

Methods: Patients with stable coronary artery disease or acute coronary syndrome (ACS) who had undergone percutaneous coronary revascularization to native coronary arteries with stents ≤2.5 mm in size and ≥28 mm in length were assessed. Post-procedural analyses were performed with using Quantitative Coronary Analysis software system to evaluate stent oversizing. Acute complications, such as edge dissection and distal thrombus embolism were also recorded.

Results: A total of 161 consecutive patients (127 male, mean age: 62.7±9.0 years) were included. Most of the lesions were mid or proximal segments of the coronary arteries. Edge dissection was detected in 30 patients. Stent oversizing and reduced post-procedural TIMI flow grade were significantly higher in patients with edge dissection. Stent oversizing emerged as an independent predictor of edge dissection, with oversizing of >25% compared to the distal vessel diameter predicted edge dissection with a sensitivity of 83.3% and specificity of 80.2%. In addition to edge dissection, distal embolism was more frequently observed in procedures with stent oversizing. TIMI flow grade 1-2 rates were found to be significantly higher in patients presenting with ACS.

Conclusion: Stenting in long lesions with small sized stents is related to a high risk of edge dissection, especially in procedures involving stent oversizing.

Keywords: Coronary stenting, edge dissection, stent oversizing

INTRODUCTION

Coronary stenting has been a treatment of choice for symptomatic coronary artery disease (CAD). With advancements in interventional techniques and devices used in coronary intervention, the corresponding success rates are increasing along with a reduction in the complication rates. Complications occur due to either the existing comorbidities or coronary artery anatomy or the characteristics of the lesions.

Most trials typically include larger vessels (≥3 mm) as target vessels and smaller vessels are excluded.[1,2] Early studies involving bare metal stent (BMS) have demonstrated a relation between a smaller final minimal lumen diameter and the occurrence of in-stent restenosis (ISR) during follow-up.[3,4] As under-sizing in coronary lesions may enhance ISR, the selection of appropriate stent size is deemed crucial.

Drug-eluting stents (DES) have better outcomes in contrast to BMS in small vessels due to their ability to significantly suppress neo-intimal proliferation through the drug elution process.[5] However, the benefits of DES are mostly attenuated in patients with long coronary lesions due to the increased risk of adverse procedural outcomes.[6] Another major complication associated with DES is stent thrombosis (ST). Delayed intimal healing and increased intimal inflammation increase the risk of late ST, especially in high-risk lesions such as long coronary lesions.[7] Late ST is closely related to stent malapposition, and under-expanded stents in coronary lesions result in a higher incidence of ST.[8]

Achieving optimal stent apposition is more challenging in cases where the vessel anatomy is tapered and the lesion is long. In these lesions, there is a distinctive difference between the proximal and distal end of the vessel. The deployment of a stent-targeting distal vessel diameter may lead to the development of late ST as the proximal portion of the stent may be undersized and under-expanded, and the deployment of a stent targeting proximal vessel diameter may result in over-expansion and edge dissection, leading to abrupt vessel closure and ISR.[9]

Data on the evaluation of the effects and outcomes of stent implantation, especially in long (≥28 mm) and small (≤2.5 mm)

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coronary vessels, are limited. This study aimed to investigate the acute outcomes of stent implantation in small coronary arteries with long target lesions.

MATERIALS AND METHODS

Patient Population

This retrospective study was approved by the Marmara University Faculty of Medicine Research Ethics Committee, which waived the requirement for obtaining informed consent for the investigation and presentation of deanonymized medical data. The present investigation adheres with the principles outlined in the Declaration of Helsinki (approval number: 09.2017.532, date: 29.09.2017). A total of 161 consecutive patients aged ≥18 years, who underwent percutaneous coronary revascularization for native coronary arteries due to stable angina or acute coronary syndrome (ACS), with stents of ≤2.5 mm in size and ≥28 mm in length in our cardiology department during 2013-2020 were retrospectively assessed. As the inclusion criteria were long and the diameter of the lesions was small, the lesions in larger vessels such as the left main coronary artery lesions were excluded. Demographic and clinical data of all patients were retrieved from the hospital's electronic medical databank system (MEDIN 3.0, Ankara, Türkiye). Cardiovascular risk factors, such as hyperlipidemia, diabetes mellitus, and smoking were recorded.

Stent implantation was performed in patients admitted with ACS or in symptomatic patients with ischemia symptoms due to CAD. ACS patients were defined as patients who were diagnosed with ST segment-elevated myocardial infarction (MI), non-ST segment elevated MI, or patients with unstable angina pectoris.[10] Patients with stable CAD had documented ischemia based on echocardiography, treadmill test, or cardiac scintigraphy, without any increase in cardiac troponin levels or dynamic ischemic changes in the electrocardiogram.

Previous studies have described stents as long if their length was >25 mm, very long if the length was >40 mm, and small if the cross-sectional area was <5.1 mm^2, which is approximately <2.6 mm in diameter.[11-13] Therefore, we included patients who were implanted with stents ≤2.5 mm in diameter and ≥28 mm in length. All stents used during the procedure were DES.

The following patients were excluded from the study: those implanted with stents of length ≤28 mm or size ≥2.5 mm; those with left main coronary disease, severely tortuous coronary vessels, severe vasospasm despite nitroglycerin administration, intervention to non-native coronary artery, and coronary cineangiogram unsuitable for Quantitative Coronary Analysis (QCA); who had failed records in the system; who had cardiogenic shock or mechanical ventilation, allergy to antiplatelet drugs, heparin, contrast agent, or stainless steel.

Stent Implantation

All patients received the necessary antiplatelet and anticoagulant medication before and during the procedure. After the procedure, the patients received acetylsalicylic acid 100 mg/day as well as either clopidogrel 75 mg/day or ticagrelor 180 mg/day or prasugrel 10 mg/day. The administration of glycoprotein 2b/3a inhibitors was left at the operator's discretion.

Stent implantation procedures was performed according to standard techniques using a commercially available angiographic system (Artis Zee biplane; Siemens Healthcare, Erlangen, Germany). The coronary procedures were performed via trans-femoral (77%) or trans-radial (23%) access, through six or seven French guiding catheters. The location and characteristics of the lesions were recorded based on the American College of Cardiology/American Heart Association classification system.[14] Stents were expanded with nominal or higher pressures, with decisions regarding stent size selection, pre-dilatations, and post-dilatations left to the operator's discretion. The higher pressures applied by the operators in our clinic were defined as the burst pressures (maximum 16 atm), as specified in the user manuals of the branded balloons. The operators could freely decide the stent sizes with different methods, which were either visual estimation or sizing with the pre-dilation balloon or with a coronary analysis system. Intravascular ultrasound (IVUS) or optical coherence tomography (OCT) were not performed routinely during the procedures.

Angiographic Analysis

All coronary scopic views for each patient before and after the stent implantation were retrospectively evaluated by a single experienced cardiologist using a software system of QCA (Pie Medical Imaging, Maastricht, The Netherlands). The best views demonstrating the reference vessel in the longitudinal axis with a minimal curvature in the scopic view were selected for analysis. The same coronary view angle was maintained for the calculation of parameters before and after stent implantation. In the case of a vasospasm, the vessel was evaluated from the scopic view obtained after nitroglycerin administration. If the vasospasm continued in the subsequent scopic views after nitroglycerin administration, those patients were excluded from the study. During the analysis, calibration was performed using the guiding catheter when filled with contrast agent. The guiding catheter used for calibration was ≥6 French as advised.[15] After calibration, the scopic view was paused at the diastolic frame, where the coronary artery was most optimally filled with contrast. The measurement of the length was calculated from the non-diseased segments next to the diseased segment of the proximal and distal portions of the coronary lesion. After calibration and tracking of the coronary lesion, the system applied automatic edge detection of coronary vessels and provided the calculated parameters. Reference vessel diameter (RVD), minimal luminal diameter, length of the lesion, and proximal/distal diameters of the stents after implantation and post-dilatation, if performed, were measured in the end-diastolic frame. The best view after stent implantation which showed the stent in a perpendicular line and best filled with contrast agent was chosen. Proximal and distal parts of the stents after implantation were determined as a 3-mm distance from both the edges of the stent.

Since the study included acute and total occlusions. Some patients experienced diminished distal flow. The analysis of these lesions was performed after the first pre-dilation balloon and nitroglycerin administration if applied.

Post-procedural analysis and events such as side-branch occlusion, intramural hematoma, vessel rupture, distal thrombus embolism, edge dissection, in-hospital ST, MI, and death were recorded.

Acute MI was diagnosed according to the latest MI guidelines.[10] Coronary flows was classified based on the results of TIMI analysis.[16] Edge dissection was defined as disruptions of the arterial lumen surface in the stent edges defined as the 5-mm regions immediately adjacent to the stent borders, distally and proximally, which were visible in at least two consecutive cross-sectional angiographic images. Distal thrombus embolism was defined as the presence of a new filling defect or abrupt cutoff in one of the distal coronary artery branches after stenting the target lesions. The oversizing calculation was applied to evaluate the degree of stent oversizing for the target vessel. Oversizing was calculated using the following formula:

Nominal stent diameter - RVD/RVD × 100.

In case of overlapping stents, the average nominal stent diameter was used for calculation.

The intraobserver coefficient of variation was 2.1%.

Statistical Analysis

All statistical tests were performed using a commercially available software program (Statistical Package for the Social Sciences version 20.0 for Windows, Chicago, IL, USA). All continuous variables were assessed for normal distribution by the Kolmogorov-Smirnov test and presented as the mean [standard deviation (SD)] values and the categorical variables were expressed as numbers or percentages. A chi-square test was performed to compare categorical variables. Univariable and multivariable logistic regression analyses (with the parameters found to be significant in univariable analysis) were performed to explore the associations with edge dissection. A receiver operating characteristic curve analysis and Youden index [max (sensitivity + specificity – 1)] were performed to detect the optimal cut-off value of stent oversizing in predicting edge dissection. $P<0.05$ was considered to indicate statistical significance.

RESULTS

A total of 161 consecutive patients [127 male (78.9%), mean age (SD): 62 (9) years] were included in this retrospective analysis. The characteristics of the patients together with the lesion- and procedure-related characteristics and events are summarized in Table 1. A total of 84 patients had ACS. Most of the lesions were in the mid and proximal segments of the coronary arteries. As a procedural complication, edge dissection was detected in 30 patients. Vasospasm was recorded in nearly half of the patient population, while most of the patients had TIMI flow-grade 3. Side-branch occlusion and MI during the procedure were noted in 15 and 7 patients, respectively.

Table 2 presents the lesion- and procedure-related characteristics and post-procedural events of the patients based on the presence of edge dissection. Stent oversizing and reduced post-procedural TIMI flow grade were significantly higher in patients with edge dissection. ROC analysis and the Youden index were used to detect the optimal cut-off value of stent oversizing for predicting edge dissection. As a result, a stent oversizing of >25% predicted edge dissection with a sensitivity of 83.3% and a specificity of 80.2% (area under curve 85.2) was recorded.

Table 1. Patient and lesion- and procedure-related characteristics

Variables	Findings
Age (years)	62±9
Male sex (%)	127 (78.9%)
Smoking (%)	124 (77.0%)
Diabetes mellitus (%)	66 (41.0%)
Family history of coronary artery disease (%)	41 (25.5%)
Admission syndrome	
Stable angina pectoris (elective) (%)	77 (47.8%)
ST segment elevated myocardial infarction (%)	37 (23.0%)
Non-ST segment elevated myocardial infarction (%)	47 (29.2%)
Treated coronary arteries	
Left anterior descending (proximal/mid/distal) (%)	16 (9.9%) / 28 (17.4%) / 5 (3.1%)
Right coronary artery (proximal/mid/distal) (%)	13 (8.1%) / 13 (8.1%) / 8 (5.0%)
Left circumflex artery (proximal/mid/distal) (%)	14 (8.7%) / 22 (13.7%) / 6 (3.7%)
Ramus intermedius artery (%)	6 (3.7%)
Obtuse marginal artery (%)	19 (11.8%)
Diagonal (%)	5 (3.1%)
Posterior descending artery (%)	4 (2.5%)
Posterior lateral artery (%)	2 (1.2%)
Lesion characteristics	
Length (mm)	34.92±12.71
Calcification (%)	94 (58.4%)
Procedural characteristics	
Access (femoral/radial) (%)	124 (77.0%) / 37 (23.0%)
Predilatation (%)	149 (92.5%)
Predilatation balloon size (mm)	2.01±0.25
Predilatation balloon length (mm)	16.97±3.62
Predilatation balloon pressure (ATM)	14.6±1.2
Post-dilatation (%)	77 (47.8%)
Post-dilatation balloon size (mm)	2.63±0.21
Stent overlapping (%)	45 (27.9%)
Stent length (mm)	32.66±6.07
Stent diameter (mm)	2.41±0.11
Stent oversizing (%)	23.18 (19.96)
Stent oversizing >10% (%)	73 (45.3%)
Stent oversizing >25% (%)	51 (31.7%)
Procedural/post procedural events	
Vasospasm (%)	77 (47.8%)
Side branch occlusion (%)	15 (9.3%)
Intramural hematoma (%)	2 (1.2%)
Coronary rupture (%)	1 (0.6%)
Distal embolism (%)	11 (6.8%)
Edge dissection (%)	30 (18.6%)
TIMI flow grade 1-2 vs. 3 (%)	23 (14.3%) / 138 (85.7%)
Acute stent thrombosis (%)	2 (1.2%)
Myocardial infarction associated with PCI (%)	7 (4.3%)
In-hospital cardiovascular death (%)	4 (2.5%)
In-hospital all-cause death (%)	6 (3.7%)

ST: Stent thrombosis, PCI: Percutaneous coronary intervention

Stent oversizing of >25% was observed in 51 patients. Table 3 presents the lesion- and procedure-related characteristics and post-procedural events in accordance with the presence of stent oversizing of >25%. The stent-oversizing group showed significantly higher rates of edge dissection, vasospasm, and distal embolism.

The lesion- and procedure-related characteristics and post-procedural events were compared based on their presentation with ACS (Table 4). The frequency of reduced TIMI flow grade was higher in patients presenting with ACS.

Table 2. Characteristics and events in accordance with the presence of edge dissection

	Edge dissection (+) (n=30)	Edge dissection (-) (n=131)	p value
TIMI flow grade 1-2/3 (%)	11 (36.7%) / 19 (63.3%)	12 (9.2%) / 119 (90.8%)	**<0.001**
Stent oversizing (%)	51.43 (21.13)	16.71 (12.82)	**<0.001**
Stent oversizing >25% (%)	25 (83.3%)	26 (19.8%)	**<0.001**
Intramural hematoma (%)	0 (0%)	2 (1.5%)	1.0
Vasospasm (%)	15 (50%)	62 (47.3%)	0.79
Coronary rupture (%)	0 (0%)	1 (0.8%)	1.0
Acute stent thrombosis (%)	0 (0%)	2 (1.5%)	1.0
Distal embolism (%)	4 (13.3%)	7 (3%)	0.25
Side branch occlusion (%)	4 (13.3%)	11 (8.4%)	0.48
Myocardial infarction (%)	2 (6.7%)	5 (3.8%)	0.62
In-hospital cardiovascular death (%)	1 (3.3%)	3 (2.3%)	0.57
Stent overlapping (%)	12 (40%)	33 (25.2%)	0.10
Access (femoral/radial) (%)	24 (80%) / 6 (20%)	100 (76.3%) / 31 (23.7%)	0.67
Predilatation (%)	29 (96.7%)	120 (91.6%)	0.47
Predilatation balloon size (mm)	2.1±0.21	2.2±0.22	0.31
Predilatation balloon pressure (ATM)	14.7±1.3	15.6±1.2	0.52
Post-dilatation (%)	15 (50.0%)	62 (47.3%)	0.79
Post-dilatation balloon size (mm)	2.58±1.4	2.61±1.5	0.43
Calcification (%)	18 (60%)	76 (58%)	0.84

Table 3. Comparison of characteristics and events according to the extent of stent oversizing

	Stent oversizing (+) (n=51)	Stent oversizing (-) (n=110)	p value
TIMI flow grade 1-2/3 (%)	12 (23.5%) / 39 (76.5%)	11 (10%) / 99 (90%)	**0.022**
Edge dissection (%)	25 (49%)	5 (4.5%)	**<0.001**
Vasospasm (%)	32 (62.7%)	45 (40.9%)	**0.010**
Distal embolism (%)	7 (13.7%)	4 (3.6%)	**0.038**
Side branch occlusion (%)	6 (11.8%)	9 (8.2%)	0.47
Intramural hematoma (%)	2 (3.9%)	0 (0%)	0.99
Coronary rupture (%)	1 (2%)	0 (0%)	0.32
Acute stent thrombosis (%)	1 (2%)	1 (0.9%)	0.54
Myocardial infarction (%)	4 (7.8%)	3 (2.7%)	0.21
In-hospital cardiovascular death (%)	2 (3.9%)	2 (1.8%)	0.59
Stent overlapping (%)	19 (37.3%)	26 (23.6%)	0.07
Access (femoral/radial) (%)	44 (86.3%) / 7 (13.7%)	80 (72.7%) / 30 (27.3%)	0.06
Predilatation (%)	50 (98%)	99 (90%)	0.11
Predilatation balloon size (mm)	2.0±0.22	2.01±0.21	0.92
Predilatation balloon pressure (ATM)	14.8±1.2	14.4±1.1	0.61
Post-dilatation (%)	27 (52.9%)	50 (45.5%)	0.38
Post-dilatation balloon size (mm)	2.6±1.5	2.5±1.4	0.43
Calcification (%)	34 (66.7%)	60 (54.5%)	0.15

Edge dissection was associated with stent oversizing and the size of the reference vessel, albeit no significant associations were found between edge dissection and lesion length, pressure of pre-dilatation, post-dilatation balloon, and stent inflation pressure. However, only stent oversizing of >25% remained as an independent predictor of edge dissection in the multivariable logistic regression model (odds ratio: 18.82, p<0.001) (Table 5).

DISCUSSION

The primary objective of this study was to evaluate the impact of stent oversizing during implantation in long lesions in small-sized coronary vessels, with a focus on its association with peri-procedural complications, particularly edge dissection, vasospasm, and distal embolism. This issue has particular clinical relevance, considering that coronary interventions in small and long lesions are associated with lower procedural success rates and higher complication rates.[17] Our findings indicate that oversizing stent during implantation in long, small lesions is associated with an increased risk of peri-procedural complications, particularly edge dissection, vasospasm, and distal embolism. These complications can lead to adverse clinical outcomes, including vessel closure and, possibly, re-intervention. Specifically, oversizing stents by >25% in relation to the distal vessel diameter can significantly increase the risk of edge dissection; this complication can compromise the long-term patency of the vessel. Our study thus provides valuable insights into the optimal stent-sizing strategies that can mitigate these risks, thereby ultimately enhancing procedural success and reducing the occurrence of complications in this challenging subset of patients.

Due to the potential complications of tapered vessels by their nature, the optimal strategy or appropriate stent deployment in these vessels is critical. Due to the tapered nature of anatomy, there may be a significant difference in size between the distal and the proximal segments of the vessels, especially in long coronary lesions. Stent selection targeting proximal or distal vessel diameters is challenging and may incur procedural complications such as edge dissection and abrupt vessel closure. In most of these procedures, stents are selected based on their distal diameter, and the proximal portion of the stent is post-dilated. However, overexpansion or aggressive post-dilatation may cause a disproportionate increase in the nominal stent diameter, stent strut fracture, or arterial wall dissection.[18] When the stent size is determined according to the proximal or middle-vessel diameter, the risk of distal edge dissection increases because of the significant difference in the distal and middle portion sizes of stents. We demonstrated that distal diameter-referenced stent deployment of <25% oversizing in long lesions had a statistically lower risk of edge dissection when compared to oversizing by >25%. These findings are of clinical significance because they offer a strategy for reducing the risk of complications and improving procedural success rates in a population of patients that is particularly challenging to treat. By

Table 4. Comparison of events based on the presentation with acute coronary syndrome or stable angina

	Acute coronary syndromes (n=84)	Stable angina (n=77)	p value
TIMI flow grade 1-2/3 (n, %)	18 (21.4%) / 66 (78.6%)	5 (6.5%) / 72 (93.5%)	**0.007**
Stent oversizing >25% (n, %)	29 (34.5%)	22 (28.6%)	0.42
Edge dissection (n, %)	11 (13.1%)	19 (24.7%)	0.06
Intramural hematoma (n, %)	1 (1.2%)	1 (1.3%)	1
Vasospasm (n, %)	40 (47.6%)	37 (48.1%)	0.96
Coronary rupture (n, %)	0 (0%)	1 (1.3%)	0.48
Acute stent thrombosis (n, %)	2 (2.4%)	0 (0%)	0.50
Distal embolism (n, %)	8 (9.5%)	3 (3.9%)	0.22
Side branch occlusion (n, %)	10 (11.9%)	5 (6.5%)	0.24
In hospital cardiovascular death (n, %)	2 (2.4%)	2 (2.6%)	1
Stent overlapping (n, %)	22 (26.2%)	23 (29.9%)	0.60

Table 5. The results of logistic regression analysis for edge dissection

	Univariable logistic regression			Multivariable logistic regression		
	Odds ratio	95% CI	p value	Odds ratio	95% CI	p value
Stent oversizing >25%	20.19	7.05-57.81	**<0.001**	18.82	3.95-89.62	**<0.001**
Lesion length	1.02	1-1.05	0.53			
Pre-dilatation balloon pressure	1.1	0.8-1.6	0.39			
Post-dilatation balloon pressure	0.78	0.5-1.1	0.08			
Stent inflation pressure	0.9	0.8-1	0.12			
Size of the reference vessel	0.08	0.02-0.3	**0.032**	0.1	0.08-1.02	0.54

CI: Confidence interval

carefully selecting the stent sizes based on the distal diameter and by avoiding excessive oversizing, physicians can minimize the risk of edge dissection and enhance the overall outcome of interventions in small-sized coronary vessels.

Our results align with those of previous studies that investigated stent-deployment strategies in tapered arteries. For instance, Shen et al.[19] investigated the best strategy to deploy a coronary stent to the tapered arteries with the best apposition. For this purpose, they compared the selection of proximal, middle, and distal diameters as the RVD so as to deploy a stent and found that the proximal diameter-referenced expansion provided the best apposition together with the highest arterial wall stress, which may have led to edge dissection while the distal diameter-referenced expansion provided the lowest arterial wall stress together with incomplete stent apposition. The authors suggested that middle diameter-referenced expansion resulted in adequate stent apposition with reasonable arterial wall stress. However, their study was not specific to small-sized coronary arteries. For instance, Kitahara et al.[20] evaluated stent-size selection and the outcomes of DES in coronary lesions and speculated that, in small vessels, the selection of larger stents have shown better expansion of the stents while avoiding post-dilatation and without increasing the edge dissection. However, they considered that larger stent-size selections could be inappropriate in chronic total occlusions, severely calcified lesions, and eccentric lesions owing to the increased risk of complication. In their study, the percentage of stent oversizing was defined as >10%. Kobayashi et al.[13] investigated the relation between IVUS-detected edge dissection and DES implantation and demonstrated calcification, stent expansion, and plaque burden as independent predictors for edge dissection. In our study, no significant relation was noted between edge dissection and post-dilation pressure as well as the presence of calcification. This difference may be attributed to the difference in the diagnostic methods employed to evaluate edge dissection.

A large angiographic study found that the prevalence of edge dissection related to DES was 1.7%.[21] When IVUS was used as an imaging tool for the diagnosis, the prevalence of edge dissection increased to 7.8% with DES, thereby demonstrating a high sensitivity of intravascular imaging in the determination of edge dissection when compared to conventional angiographic evaluation.[22] OCT is even more sensitive relative to IVUS, and higher rates of edge dissection have been detected with OCT in clinical trials.[23] In our study, the prevalence of edge dissection was 18.6%, which was diagnosed visually based on angiography images; this rate was distinctly higher in our study when compared to that in past studies. Moreover, this difference may be associated with the RVD. Most past studies included all coronary vessels treated with percutaneous coronary intervention and were not specific to small and long coronary lesions. In addition, intravascular imaging modalities were not used in the present study, which could have led to the underestimation of edge dissection in some patients. Further studies with intravascular imaging modalities are expected to clarify the exact rate of procedural outcomes in such patients.

In our study, the TIMI flow rate was significantly decreased in patients with ACS after stenting. Although there was no significant difference, the rate of acute ST, distal embolism, and in-hospital deaths was higher in patients with ACS. These findings are in accordance with the literature as the risk of distal embolism, vasospasm, no-reflow, and reduced TIMI flow rates were higher in patients with ACS.[24] Especially, when pre-dilation or post-dilation was performed in these patients, the risk of no-reflow and reduced TIMI flow increased; therefore, direct stenting was considered a safer approach. However, in the case of vasospasm and reduced coronary flow because of high thrombus burden, evaluating and estimating the distal reference diameter without pre-dilation becomes difficult in patients with ACS. Therefore, intravenous nitrate administration should be considered as an option to evaluate the RVD after gentle pre-dilatation using an under-sized balloon in the lack of contraindication.

Bouki et al.[25] demonstrated that patients with ST-segment elevated MI and small-sized culprit vessels showed a higher incidence of edge dissection when compared with larger vessels. In our study, the rates of edge dissection were similar in patients without or with ACS, suggesting that the improper vessel sizing and over-expanded stent implantation, rather than the presentation with ACS, was the main reason for post-procedural edge dissection. However, large-scale clinical trials including ACS patients with long and small-sized lesions are needed to clarify this aspect.

Study Limitations

There are several limitations to our study, including the retrospective single-center design of the study. The complications were assessed based on the recorded angiographic views and some complications may have been missed in the absence of proper angiographic view. The best technique for the detection of vessel diameters and the recognition of peri-procedural vascular complications is intravascular imaging modalities. We did not employ IVUS or OCT in our study as that may have caused the underestimation of edge-dissection rates. The characteristics of vessel wall anatomy may affect the outcome of stent implantations. We did not have detailed data about the anatomical characteristics owing to the lack of evaluation with imaging modalities, such as coronary computerized tomography. Finally, we did not evaluate the long-term outcomes of oversizing in small and long coronary lesions, which would provide apparent information about late ST and ISR.

CONCLUSION

In conclusion, our study findings provide valuable insights into the optimal strategy for stent sizing in long, small coronary lesions, suggesting that limiting oversizing to <25% of the distal diameter can reduce the risk of edge dissection. These findings have important clinical implications, considering that they may facilitate clinicians in selecting the appropriate stent size, thereby improving procedural success rates and reducing the occurrences of peri-procedural complications. Future large-scale trials incorporating advanced imaging techniques, such as IVUS and OCT, are essential to confirm these results and further refine the stent-deployment strategies proposed herein, so as to, ultimately, enhance the outcomes for patients with complex coronary lesions.

Ethics Committee Approval: The study was approved by the Marmara University Faculty of Medicine Research Ethics Committee (approval number: 09.2017.532, date: 29.09.2017).

Informed Consent: Because it is a retrospective study, informed consent is not required.

Authorship Contributions: Concept: A.Ç., E.G., M.S., N.S., K.T., Design: A.Ç., E.G., M.S., N.S., K.T., Data Collection or Processing: A.Ş., Z.D., K.T., Analysis or Interpretation: A.Ş., Z.D., A.Ç., E.G., M.S., N.S., B.Ö., K.T., Literature Search: A.Ş., Z.D., A.Ç., E.G., M.S., B.Ö., K.T., Writing: A.Ş., Z.D., A.Ç., E.G., M.S., N.S., B.Ö., K.T.

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