Clinical and morphological evaluation of coronary bifurcation lesions

Koroner bifurkasyon lezyonlarının klinik ve morfolojik değerlendirilmesi

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ABSTRACT

Objectives: We aimed to investigate the anatomical and morphological characterization of coronary bifurcation lesions.

Study design: The study population consisted of 542 stable patients who underwent coronary angiography. Bifurcation lesions were defined as a lesion ≥50% diameter stenosis involving a main branch and/or contiguous side branch with a diameter of ≥2.5 mm. Using these criteria, the presence and number of bifurcation lesions, bifurcation lesion location, lesion classification according to Medina classification and the angle of the bifurcation lesion were determined.

Results: According to the bifurcation definition 19.3% (n=105) of our patients had bifurcation lesions. In 77% of all bifurcation lesions, the bifurcation angle was <70°. About 37% of all lesions were concordant with the Medina 1.1.1 classification. Approximately 56% of bifurcation lesions were in the LAD region, 25.4% in the Cx region, and 12.5% in the RCA region. Medina 1.1.1 was the most frequently observed in the LAD and RCA regions, while it was least common in the Cx and LMCA regions. Diabetes was observed to be significantly higher in those with bifurcation lesions than in those without.

Conclusion: Bifurcation lesions are frequently observed in coronary angiography practice. Angiographic characteristics and the relationship of these lesions with clinical conditions may be a crucial factor in choosing the appropriate interventional procedure.

ÖZET

Amaç: Koroner bifurkasyon lezyonlarının anatomik ve morfolojik özelliklerini araştırmayı amaçladık.

Çalışma planı: Çalışmaya koroner anjiyografi yapılan 542 stabil hasta alındı. Bifurkasyon lezyonları en az 2.5 mm çaplı ve en az %50 darlık olan ana dal ve yan dal lezyonları olarak tanımlandı. Bu ölçütler kullanılarak, bifurkasyon lezyonlarının varlığı ve sayısı, bu lezyonların bulunduğu damarlar, Medina sınıflandırmasına göre lezyonun tipi ve bifurkasyon lezyonunun açısı belirlendi.

Bulgular: Bifurkasyon tanımına göre hastaların %19.3'ünde (n=105) bifurkasyon lezyonu vardı. Bunların %77'sinde, bifurkasyon açısı 70°'nin altında idi. Tüm lezyonların yaklaşık %37'si Medina 1.1.1 sınıflandırması ile uyumlu idi. Tüm bifurkasyon lezyonlarının yaklaşık %56'sı sol ön inen arter (LAD), %25.4'ü sirkumfleks arter (Cx) ve %12.5'i sağ koroner arter (RCA) bölgesinde idi. Medina 1.1.1 tip lezyonlar en sık LAD ve RCA'da gözlenirken en az Cx ve sol ana koroner bölgesinde saptandı. Diyabet bifurkasyon lezyonu olan hastalarda olmayanlara göre anlamlı olarak yüksek sıklıkta saptandı.

Sonuç: Bifurkasyon lezyonları koroner anjiyografi pratiğinde sıkça gözlenmektedir. Bunların anjiyografik özellikleri ve bu lezyonların klinik durumla ile ilişkisi uygun girişimsel tedavinin seçiminde çok önemli olabilir.

In the field of interventional cardiology, complex coronary lesions such as bifurcation lesions are important due to both the difficulties in the technique of the procedures and the frequency of long term adverse events.[1,2] A number of classification systems are used for the classification of these lesions and for determin-

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ing the preferred invasive procedural technique.[1,3] One of these systems is the Medina classification system.[4] Medina classification helps to assess coronary bifurcation lesions comprehensively through angiographic and morphological aspects. Better knowledge on angiographic and morphological characteristics of lesions might enable better understanding and treatment of bifurcation lesions. No comprehensive anatomical-morphological definition of coronary bifurcation lesions has been published previously. In this study, we aimed to investigate the incidence of coronary bifurcation lesions, the angiographic and morphological characteristics, and their relationship with clinical conditions.

Abbreviations:

CABG	*Coronary artery bypass grafting*
Cx	*Circumflex artery*
LAD	*Left anterior descending artery*
LMCA	*Left main coronary artery*
PCI	*Percutaneous coronary intervention*
RCA	*Right coronary artery*

PATIENTS AND METHODS

The study population consisted of 542 patients with stable angina pectoris with evidence of objective ischemia (positive treadmill or myocardial perfusion) that underwent coronary angiography for suspected coronary artery disease between January 2010 and June 2010. The number of patients who underwent coronary artery bypass grafting (CABG) was 302, while the number of patients that underwent percutaneous coronary intervention (PCI) was 240. Patients with histories of ST elevation myocardial infarction, CABG or PCI and non-critical angiographic coronary artery disease were excluded from the study. The main clinical characteristics of the patients were recorded. The presence of diabetes was defined as at least two fasting blood glucose levels of over 126 mg/dl or use of anti-diabetic medication, and hypertension was defined as at least two blood pressure levels of over 140/90 mmHg or antihypertensive medication use. Obesity was defined as a body mass index of over 30 kg/m^2 (Body mass index= [body weight-kg]/[length-m]^2). Chronic renal disease was defined as a predicted glomerular filtration rate of <60 mL/min/1.73 m^2. When calculating the predicted GFR, the Cockcroft formula was used ([140-age] x [weight-kg] x [0.85 in women] / [72 x creatinine]). Our study was approved by the local ethics committee.

Definition and assessment of bifurcation lesion

A bifurcation is a division of a main parent branch into two daughter branches of at least 2.5 mm. Bifurcation lesions may involve the proximal main vessel, the distal main vessel and the side branch according to the Medina classification.[1] The smaller of the two daughter branches is designated as the 'side branch'. In the case of the main stem either the LCx or the LAD can be designated as the side branch depending on their respective calibers. Accordingly, the numeration was done according to the presence or absence of lesion in the main bifurcation vessel, distal bifurcation vessel and the side branches. The angle between the distal bifurcation vessel and the side branch vessel was defined as the bifurcation angle and was coded as over and under 70° (Figure 1).

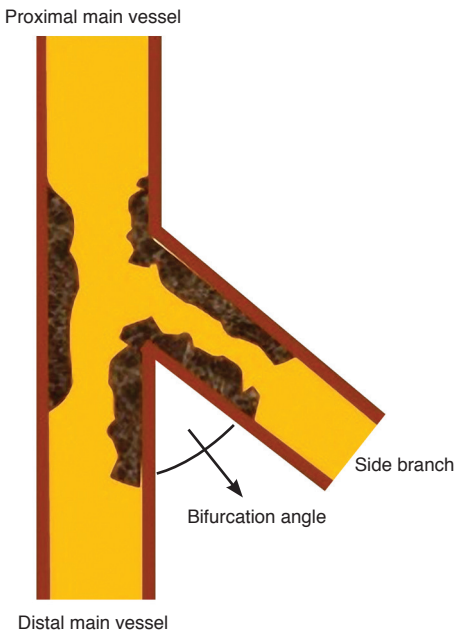

Figure 1. Schematic view of bifurcation lesions.

Statistical analysis

The categorical variables were expressed as percentages and the chi-square test was used for the intergroup analyses. A p value of <0.05 was accepted as statistically significant. For the statistical analysis, the SPSS 15.0 (Statistical Package for Social Science-SPSS, Inc., Chicago, Illinois, USA) pocket program was utilized.

RESULTS

The study population was composed of 542 patients. According to the bifurcation lesion definition (ves-

Table 1. Anatomical distribution of bifurcation lesions according to the coronary arteries

	Medina 1.1.1 (%)	Bifurcation angle <70 (%)
LAD-D1	35	74
LAD-D2	38	77
LAD-D3	21	70
Cx-OM1	28	74
Cx-OM2	33	69
Cx-OM3	31	77
Cx-PD-PL	24	78
RCA-PD-PL	38	78
LMCA-LAD-Cx	28	52

LAD: Left anterior descending artery; D: Diagonal artery; Cx: Circumflex artery; OM: Obtuse marginal artery; PD: Posterior descending artery; PL: Posterior lateral artery; RCA: Right coronary artery; LMCA: Left main coronary artery.

sel diameter ≥2.5 mm and stenosis ≥50%), 19.3% (n=105) of our patients had bifurcation lesions.

In 23% of patients with bifurcation lesions, there were more than one bifurcation lesions (a total of 154 bifurcation lesions). In 77% of all bifurcation lesions, the bifurcation angle was <70°. About 37 % of all lesions were concordant with the Medina 1.1.1 classification (Figure 2). Side branch lesions (medina 1.1.1, 1.0.1, 0.0.1 and 0.1.1) were present in about 58% of the patients. Of all the bifurcation lesions, about 56% were in the LAD region, 25.4% in the CX region, and 12.5% in the RCA region (Figure 2). The most frequently observed Medina lesion types and bifurcation angles according to the vessel region are summarized in Table 1. Accordingly, Medina 1.1.1 was observed most frequently in the LAD and RCA regions, while it was least common in the CX and LMCA regions. Those with bifurcation angles of <70º were similar in all regions; it was somewhat infrequent in the LMCA region (Table 1). Among all the bifurcation lesions, long lesions (>20 mm) were observed at a rate of 17% in the main bifurcation artery, at 19% in the distal bifurcation artery, and at a rate of 15% in the side branch artery. When taking into consideration all bifurcation lesions, 9% had significant calcification.

In the analysis performed on the entire population, only diabetes was observed to be significantly higher in those with bifurcation lesions than in those without (Table 2).

DISCUSSION

Our study results have revealed that coronary bifurcation lesions are observed quite often in angiography practice (19.3%), and that they are frequently seen in the LAD region, mostly angled acutely, and about 58% have side branch lesions. Besides, bifurcation lesions were found to occur frequent in individuals with diabetes.

Coronary bifurcation lesions are frequently encountered in clinical practice. In many published studies, this rate has been reported as 15-20%.[5] Similarly, we found that the bifurcation lesion rate was approximately 20%. Furthermore, we found that most bifurcation angles were <70º, the Medina 1.1.1 type occurred at the greatest frequency, about 60% had side branch lesions, and the LAD region was the most prevalent.

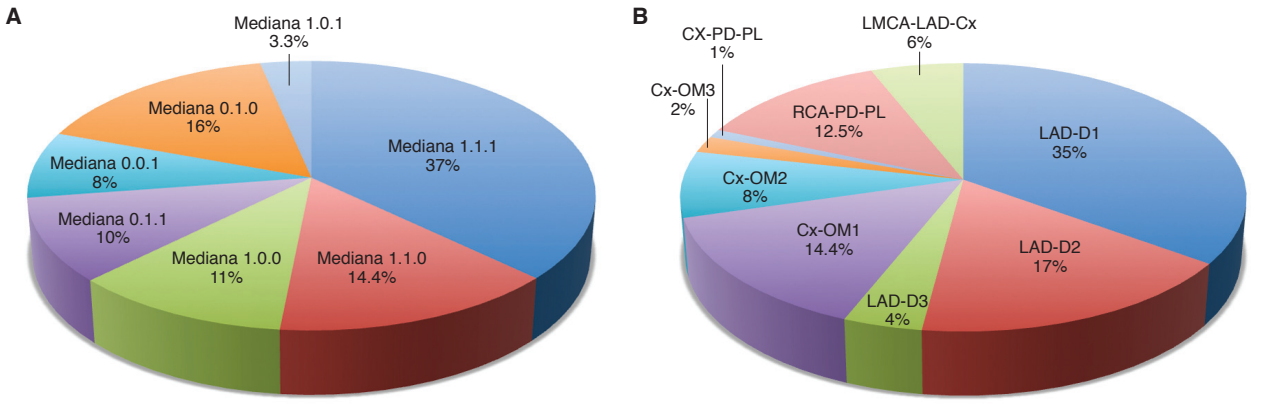

Figure 2. **(A)** Types of bifurcation lesions according to Medina classification and **(B)** the anatomical localization of bifurcation lesions.

Table 2. Atherosclerotic risk factors according to the presence and absence of coronary bifurcation lesions

	Bifurcation lesion		
	Present (n=105) (%)	Absent (n=437) (%)	*p*
Advanced age - Yes	38	33	0.23
Sex - Male	76	72	0.26
Diabetes - Yes	31	14	**<0.001**
Hypertension - Yes	51	46	0.13
Obesity - Yes	26	31	0.22
Smoking - Yes	41	44	0.57
Chronic renal disease - Yes	14	15	0.89

To the best of our knowledge, bifurcation lesions have not yet been defined in such detail anatomically.

Coronary bifurcation lesions are often seen in interventional practice and result in challenges in management.[6,7] The treatment of bifurcation lesions by percutaneous intervention accompanies low success and high re-stenosis rates compared to those without bifurcation lesions.[6,8,9] In spite of many defined techniques regarding percutaneous intervention of bifurcation lesions, side branch compromises are still the most important problem and play a triggering role in the development of many techniques.[2] The causes and consequences of side branch compromises during percutaneous coronary intervention may be comprehended by a well-defined bifurcation anatomy. Therefore, in this study, we analyzed the anatomy of bifurcation lesions comprehensively.

There is no comprehensive study related to the clinical evaluation of coronary bifurcation lesions. In the present study, we found that patients with coronary bifurcation lesions were frequently diabetic. Despite the fact that advanced age, diabetes and hypertension are well-known risk factors for CAD, the association between such clinical risk factors and complex lesions like bifurcation lesions has not been completely investigated. In one study, the presence of diabetes was shown to be related to bifurcation lesions.[10] Diabetes has been shown to be a predictive parameter for coronary lesions assessed by Syntax score in two other studies. However, a comprehensive analysis for complex lesions such as bifurcation or chronic total occlusion was not performed.[11,12] Diabetic patients are known to have increased atherosclerotic burden as well as higher rates for multivessel disease and a high number of complex lesions such as long lesions, and diffuse small vessels.[13,15]

Limitation

The major limitation of our study is the analysis of all bifurcation lesions irrespective of the clinical importance of the lesions. The other important limitation of the present study is the relatively small sample size; if more patients are assessed, a relationship with advanced age, hypertension and coronary artery disease risk factors may be elucidated with bifurcation lesions.

Bifurcation lesions are frequently observed in coronary angiography practice. Angiographic characteristics and the relationship of these lesions with clinical conditions may be crucial for choosing the interventional procedure.

Conflict-of-interest issues regarding the authorship or article: None declared

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Key words: Angioplasty, balloon, coronary; bifurcation lesions; coronary angiography; coronary stenosis.

Anahtar sözcükler: Anjiyoplasti, balon, koroner; çatallanma lezyonları; koroner anjiyografi; koroner darlık.