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The Relationship Between Coronary Anatomy and Angina Pectoris During Stent Balloon Dilatation in Patients Undergoing Percutaneous Coronary Intervention

Perkütan Koroner Girişim Uygulanan Hastalarda Stent Balon Dilatasyonu Esnasında Koroner Anatomi ve Angina Pektoris Arasındaki İlişki

ABSTRACT

Objective: Angina pectoris (AP) is defined as a clinical symptom characterized by sensations such as pressure-heaviness, burning, squeezing, or discomfort in different parts of the body, including the retrosternum, chest, jaw, neck, shoulders, and back. Limited publications exist on the impact of coronary artery disease localization on the placement, character, and severity of AP. This study aimed to investigate the relationship between the frequency of AP development due to myocardial ischemia during percutaneous coronary intervention (PCI), its character, severity, localization, and coronary anatomy.

Methods: A total of 128 patients were included in the study, with 146 lesions treated among them.

Results: Among patients who underwent PCI of the right coronary artery (RCA), 31.1% reported no complaints. Similar rates were observed in patients undergoing PCI of the left anterior descending (LAD) and circumflex (Cx) arteries, at 23.7% and 19.1%, respectively. Pressure-heaviness was frequently observed in PCI of the LAD and Cx arteries, while burning was the dominant symptom description in PCI of the RCA. The isolated retrosternal and left thoracic regions were the most common localizations in all main coronary arteries. Epigastric localization occurred most frequently in PCI of the RCA. In terms of the severity of angina, no significant difference was observed between the three coronary arteries.

Conclusion: Pressure-heaviness angina was commonly observed during PCI of the LAD and Cx, while burning angina was frequent during PCI of the RCA. The severity of AP was similar across the three main coronary arteries.

Keywords: Angina pectoris, coronary artery anatomy, angioplasty

ÖZET

Amaç: Anjina pektoris (AP), retrosternum, göğüs, çene, boyun, omuzlar ve sırt gibi vücudun farklı bölgelerinde basınç-ağırlık, yanma, sıkışma veya rahatsızlık hissi gibi farklı duyumlarla karakterize klinik bir semptom olarak tanımlanır. Koroner arter hastalığı lokalizasyonunun AP'nin yerleşimi, karakteri ve şiddeti üzerine etkisi ile ilgili sınırlı sayıda yayın bulunmaktadır. Bu çalışmada perkütan koroner girişim (PKG) sırasında ortaya çıkan miyokard iskemisine sekonder AP gelişme sıklığı, karakteri, şiddeti, lokalizasyonu ve koroner anatomisi arasındaki ilişkinin araştırılması amaçlanmıştır.

Yöntem: Çalışmaya toplam 128 hasta dahil edildi ve bu hastalarda 146 lezyon tedavi edildi.

Bulgular: Sağ koroner artere (RCA) PKG uygulanan hastaların %31,1'inde herhangi bir şikayet tariflenmezken, sol ön inen (LAD) ve sirkümfleks (Cx) arterlere PKG uygulanan hastalarda bu oran benzerdi (sırasıyla, %23,7 ve %19,1). LAD ve Cx arterlerin PKG'sinde basınç-ağırlık hissi sıklıkla gözlenirken, RCA'nın PKG'sinde yanma baskın semptom tanımıydı. Tüm ana koroner arterlerde izole retrosternal ve sol torasik bölge en sık yerleşim yeriydi. Epigastrik lokalizasyon en sık RCA'nın PKG'sinde meydana geldi. Angina şiddeti açısından üç koroner arter arasında fark görülmedi.

Sonuç: LAD ve Cx'te PKG sırasında basınç-ağırlıklı angina ve RCA'da PKG sırasında yanma anginası sık gözlendi. AP'nin şiddeti üç ana koroner arter arasında benzerdi.

Anahtar Kelimeler: Anjina pektoris, koroner arter anatomisi, anjiyoplasti

ORIGINAL ARTICLE
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Cardiovascular diseases are among the leading causes of death worldwide, with coronary artery disease (CAD) ranking first.[1] The most common symptom of CAD is angina pectoris (AP). AP has been a well-known clinical condition since Heberden's description in 1768.[2] AP is defined as a clinical complaint characterized by sensations such as pressure-heaviness, burning, squeezing, crushing, shortness of breath, discomfort, or pain. These sensations can manifest in different parts of the body, including the chest, jaw, neck, shoulder, back, and arm.[2] The pathophysiology of angina is not yet fully understood. Although the topic has been discussed for many years, publications that delve into the effects of CAD's anatomy on the localization, character, and severity of AP are limited.

Percutaneous coronary intervention (PCI) is a treatment method that, by its nature, temporarily interrupts coronary flow. This procedure offers a unique opportunity to evaluate the frequency, character, and location of AP, as well as its relationship with coronary anatomy, especially during the inflation of the balloon and the momentary cessation of coronary flow. This study aimed to investigate the relationship between the frequency of AP development, which is secondary to myocardial ischemia that occurs iatrogenically during PCI, and its characteristics, including severity, localization, and the associated coronary anatomy.

Materials and Methods

Patients

Patients who underwent PCI for non-ST-segment acute coronary or chronic coronary syndromes at our cardiology clinic between December 2019 and June 2021 were enrolled in the study. The exclusion criteria included being under 18 years of age, cardiogenic shock, chronic total occlusion (CTO), ST-segment elevation myocardial infarction (STEMI), confusion and disorientation, Alzheimer's, dementia, any prior cerebrovascular event, and being intubated. Following the application of inclusion and exclusion criteria, 128 patients were included in the study, with a total of 146 lesions treated.

Study Protocol

Demographic and clinical data of the included patients, such as age, gender, body mass index, blood pressure, heart rate, smoking habits, diabetes, hypertension, hyperlipidemia, chronic obstructive pulmonary disease (COPD), and previous history of myocardial infarction, were collected. The estimated glomerular filtration rate (eGFR) was calculated using the Modification of Diet in Renal Disease formula.[3] Pre-PCI electrocardiography (ECG) was evaluated, and the left ventricular ejection fraction (LVEF) was noted from transthoracic echocardiography.

ABBREVIATIONS

AMI	Acute Myocardial Infarction
AP	Angina Pectoris
CAD	Coronary Artery Disease
COPD	Chronic Obstructive Pulmonary Disease
CTO	Chronic Total Occlusion
Cx	Circumflex Artery
eGFR	Estimated Glomerular Filtration Rate
LAD	Left Anterior Descending Artery
LVEF	Left Ventricular Ejection Fraction
NSTE-ACS	Non-ST Acute Coronary Syndrome
PCI	Percutaneous Coronary Intervention
RCA	Right Coronary Artery
STEMI	ST Segment Elevation Myocardial Infarction
VAS	Visual Analogue Scale

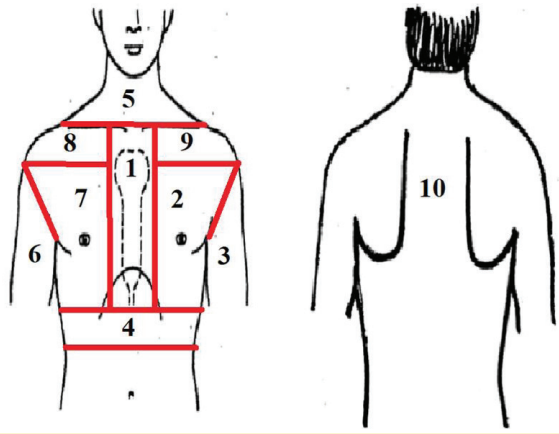

Figure 1. Localization of Angina Pectoris: 1) Retrosternal, 2) Left chest, 3) Left arm, 4) Epigastric region, 5) Neck-chin, 6) Right arm, 7) Right chest, 8) Right shoulder, 9) Left shoulder, 10) Back.

After obtaining standard pre-PCI informed consent, patients were taken to the coronary angiography laboratory. During PCI, vitals such as heart rate, blood pressure, oxygen saturation via pulse oximetry, level of consciousness, and any arrhythmias were monitored. Once the intra-arterial sheath was placed for the intervention, an intravenous anticoagulant (either unfractionated heparin or enoxaparin) was administered. After the stent balloon was inflated to the required pressure within the coronary lesion of the patient, a waiting period of one minute was observed to ensure the stent's optimal expansion. During this time, the patient's vital signs were closely monitored. The patient was then asked if they had any complaints and, if so, where they felt any discomfort. The specific regions of discomfort (such as left arm, left chest, left shoulder, retrosternal area, right arm, right chest, right shoulder, neck, chin, back, epigastrium) are indicated in Figure 1. The patient was also asked to describe the nature of the angina (e.g., pressure-heaviness, burning, crushing-squeezing, discomfort) and if they experienced shortness of breath. The severity of AP was assessed using the Visual Analogue Scale (VAS).[4] The patient rated their pain on a scale of 0 to 10, with 10 being the most severe. Notes were made regarding the location and number of angina occurrences, if the sensation was similar to their past experiences, and if any ECG changes were evident. These findings were recorded on the research forms.

Procedure

Before the procedure, each patient underwent a medical history review, physical examination, basic laboratory tests, and a resting ECG was obtained. Routine dual antiaggregant treatments were administered pre-PCI. According to the operator's preference, PCI was performed either via the femoral or radial artery. 6Fr femoral or 5-6Fr radial vascular sheaths were employed using the Seldinger technique. After positioning the guide catheter in the coronary ostium, the lesion was crossed with a 0.014 guidewire. Balloon pre-dilatation was performed when necessary. After navigating to the lesion with the stent, the stent balloon was inflated until optimal patency was achieved. The balloon remained inflated for one minute to ensure the stent adhered to the vessel wall. Meanwhile, the patient was questioned according to the study protocol.

The study was conducted in line with the ethical principles set forth in the Declaration of Helsinki and received approval from the Ethics Committee of Kocaeli University (Approval Number: 2019/290, 11/13/2022). Written informed consent was obtained from all patients.

Statistical Analysis

Continuous variables were expressed as mean and standard deviation. Categorical variables were presented as numbers and percentages. The one-way Analysis of Variance (ANOVA) method was used to compare the three groups. All statistical analyses were conducted using the IBM Statistical Package for the Social Sciences (SPSS) version 20.0 (Chicago, Illinois, USA).

Results

Baseline Characteristics

A total of 128 patients (75.8% male; average age 64.8 ± 9.3%) who met the inclusion criteria were consecutively included. The average ages of patients with left anterior descending (LAD), right coronary artery (RCA), and circumflex (Cx) lesions were similar (62.9 ± 9.2; 66.8 ± 9.6; and 65.1 ± 9.1; P = 0.140; respectively). Vital signs, including blood pressure and heart rate, were also similar across all patient groups. There were no statistically significant differences among the three groups concerning hypertension, diabetes, hyperlipidemia, previous PCI,

Table 1. Demographic and Clinical Characteristics of the Study Patients (n = 128)

	LAD	RCA	Cx	*P*
Age (year), mean ± SD	62.9 ± 9.2	66.8 ± 9.6	65.1 ± 9.1	0.140
Male gender, n (%)	38 (76.0)	32 (76.2)	27 (75.0)	0.992
BMI (kg/m^2), mean ± SD	29.9 ± 5.4	27.1 ± 4.7	29.6 ± 5.2	0.025
Smoking, n (%)	16 (32.0)	11 (26.2)	5 (13.9)	0.159
LVEF (%), mean ± SD	56 ± 15	51 ± 16	52 ± 14	0.382
SBP (mmHg), mean ± SD	152 ± 27	146 ± 32	147 ± 23	0.527
DBP (mmHg), mean ± SD	80 ± 11	77 ± 19	76 ± 11	0.364
Heart rate (beats/min), mean ± SD	75 ± 10	73 ± 8	78 ± 10	0.078
eGFR (ml/min/1.73 m^2), mean ± SD	83.3 ± 23.8	74.5 ± 26.5	82.3 ± 32.7	0.359
Co-morbidities, n (%)				
Hypertension	42 (84.0)	34 (81.0)	35 (97.2)	0.084
Diabetes	28 (56.0)	17 (40.5)	22 (61.1)	0.076
Hyperlipidemia	43 (86.0)	30 (71.4)	29 (80.6)	0.225
Prior PCI	18 (36.0)	19 (45.2)	11 (30.6)	0.264
CABG	6 (12.0)	4 (9.5)	10 (27.8)	0.058
CVD	2 (4.0)	2 (4.8)	4 (11.1)	0.366
Peripheral artery disease	2 (4.0)	2 (4.8)	5 (13.5)	0.166
COPD	6 (12.0)	11 (26.2)	7 (19.4)	0.223
Heart failure	5 (10.0)	9 (21.4)	5 (13.9)	0.272
ECG findings, n (%)				
Sinus rhythm	49 (98.0)	40 (95.2)	33 (91.7)	0.397
Q-wave in basal ECG	7 (14.0)	8 (19.0)	3 (8..3)	0.204
ECG change during PCI	49 (98.0)	36 (85.7)	32 (88.9)	0.092
Medical therapy on admission, n (%)				
ASA	44 (88.0)	34 (81.0)	33 (91.7)	0.365
Beta-blocker	38 (76.0)	28 (66.7)	24 (66.7)	0.536
ACE-i or ARB	36 (72.0)	25 (59.5)	23 (63.9)	0.446
Statin	36 (72.0)	23 (54.8)	26 (72.2)	0.152
Calcium channel blocker	12 (24.0)	8 (19.0)	10 (27.8)	0.663
Nitrate	6 (12.0)	8 (19.0)	9 (25.0)	0.299
Trimetazidine	0 (0.0)	3 (7.1)	7 (19.4)	0.004
Ranolazine	1 (2.0)	2 (4.8)	3 (8.3)	0.397
Diuretic	4 (8.0)	3 (7.1)	7 (19.4)	0.157
Oral antidiabetic	28 (56.0)	16 (38.1)	22 (61.1)	0.044
Insulin	12 (24.0)	6 (14.3)	12 (33.3)	0.055

ACE-i, Angiotensin converting enyzme inhibitor; ASA, Acetylsalicylic acid; BMI, Body mass index; ARB, Angiotensin receptor blocker; BMI, Body mass index; CABG, Coronary artery bypass graft; COPD, Chronic obstructive pulmonary disease; CVD, Cerebrovascular disease; Cx, Circumflex artery; DBP, Diastolic blood pressure; ECG, Electrocardiography; eGFR, Estimated glomerular filtration rate; LAD, Left anterior descending artery; LVEF, Left ventricular ejection fraction; PCI, Percutaneous coronary intervention; RCA, Right coronary artery; SBP, Systolic blood pressure; SD, Standart deviation.

heart failure (HF), and peripheral artery disease. The percentages of patients using anti-ischemic treatments, including beta-blockers, calcium channel blockers (CCBs), ranolazine, and nitrates, were consistent across all groups. Only the use of trimetazidine was significantly higher in patients with Cx lesions (P = 0.004). The demographic and clinical characteristics of the patients are detailed in Table 1.

Angiographic Features

Approximately half of the patients in the study had stable angina, while the other half were diagnosed with non-ST acute coronary syndrome (NSTE-ACS). A total of 146 lesions were treated. In terms of vessels involved, isolated LAD lesions were the most commonly treated, followed by isolated RCA and Cx lesions. About 15% of the patients had interventions on two different vessels. The clinical diagnosis, angiography, and coronary intervention characteristics of the patient group are presented in Table 2.

Table 2. Clinical diagnosis and angiographic characteristics of the study population.

Clinical diagnosis, n (%)	
Stable angina pectoris	70 (54.7)
Unstable angina pectoris	27 (21.1)
Non-STelevation MI	31 (24.2)
Coronary lesion location, n (%)	
Isolated LAD	46 (35.9)
Isolated Cx	28 /21.9)
Isolated RCA	36 (28.1)
LAD and Cx	9 (7.0)
LAD and RCA	4 (3.1)
Cx and RCA	5 (3.9)
Total number of lesions	146
Type of stent, n (%)	
Drug-eluting stent	137 (93.4)
Bare metal stent	9 (6.6)
Stent diameter, length, and inflation pressure (mean ± SD)	
LAD, mm, mm, atm	3.2 ± 0.4; 22.3 ± 7.4; 13.4 ± 4.7
RCA, mm, mm, atm	3.1 ± 0.6; 21.9 ± 8.9; 14.7 ± 4.1
Cx, mm, mm, atm	2.9 ± 0.4; 21.1 ± 7.3; 12.7 ± 3.2

Cx, Circumflex artery; LAD, Left anterior descending artery; MI, Myocardial infarction; RCA, Right coronary artery; SD, Standard deviation.

The Relationship Between Coronary Anatomy and the Localization and Character of Angina Pectoris

During the angioplasty for the patients included in the study, 36 (24.6%) of the 146 lesions showed no complaints during coronary occlusion. Proportionally, this absence of complaints was observed most frequently with RCA lesions. 31.1% of patients undergoing RCA intervention reported no complaints, a rate that was similar for those with LAD and Cx (23.7% and 19.1%, respectively). The percentage of patients without anginal complaints was similar between diabetic and non-diabetic patients (25.4% vs. 24.6%; P = 0.919). Additionally, there were no statistically significant difference between patients with and without diabetes regarding the use of anti-ischemic treatments, which included beta-blockers, CCBs, nitrates, ranolazine, and trimetazidine (P = 0.606, P = 0.566, P = 0.826, P = 0.966, and P = 0.942; respectively).

While the intensity of angina pectoris was not statistically different among the three groups, it was slightly higher in interventions involving LAD and RCA compared to Cx (5.7 ± 2.1; 5.6 ± 2.1; and 5.1 ± 1.8; P = 0.395; respectively). The characteristics of angina pectoris were similar across all groups (P = 0.431). For LAD and Cx lesions, pressure-heaviness and squeezing-crushing were the predominant characteristics, while burning was a more prominent symptom for RCA lesions. The characteristics and severity of angina pectoris based on the anatomy of the coronary artery lesions are detailed in Table 3.

No significant differences were found between the three patient groups in terms of angina pectoris localization (P = 0.412). Isolated retrosternal angina localization was the most common for all three arteries. Complaints were noted in the retrosternal region in 70 (47.9%) of the 146 lesions, which includes those that began in the retrosternal area and spread elsewhere. The localization of angina pectoris based on the coronary artery lesions is presented in Table 4.

Table 3. Angina Pectoris Characteristics According to the Anatomy of Coronary Artery Lesions

	LAD lesion (n=59)	RCA lesion (n=45)	Cx lesion (n=42)	*P*
Degree of angina (mean ± SD)	5.7 ± 2.1	5.6 ± 2.1	5.1 ± 1.8	0.395
Characteristic of angina, n (%)				0.431
No complaint	14 (23.7)	14 (31.1)	8 (19.1)	
Pressure-heaviness	27 (45.8)	7 (15.5)	18 (42.9)	
Squeezing-crushing	4 (6.8)	7 (15.5)	11 (26.2)	
Sinking	1 (1.6)	2 (4.5)	0 (0.0)	
Burning	12 (20.3)	13 (28.9)	3 (7.1)	
Feeling of discomfort	0 (0.0)	1 (2.2)	1 (2.4)	
Shortness of breath	1 (1.6)	1 (2.2)	1 (2.4)	

Cx, Circumflex; LAD, Left anterior descending artery; RCA, Right coronary artery; SD, Standart deviation.

Table 4. Angina Pectoris Localization According to the Anatomy of Coronary Artery Lesions

	LAD lesion (n = 59)	RCA lesion (n = 45)	Cx lesion (n = 42)	*P*
Localization of angina pectoris, n (%)				0.412
Isolated retrosternal	20 (33.4)	9 (20.0)	15 (35.7)	
Isolated left chest	10 (16.7)	5 (11.1)	6 (14.3)	
Isolated right chest	1 (1.7)	0 (0.0)	1 (2.4)	
Isolated left arm	1 (1.7)	1 (2.2)	0 (0.0)	
Isolated neck-chin	1 (1.7)	1 (2.2)	1 (2.4)	
Isolated back	1 (1.7)	1 (2.2)	2 (4.8)	
Isolated epigastric	0 (0.0)	3 (6.7)	0 (0.0)	
Retrosternal radiation to the neck	2 (3.4)	5 (11.1)	2 (4.8)	
Radiation to the left chest	1 (1.7)	0 (0.0)	0 (0.0)	
Retrosternal radiation to both arms and back	3 (5.1)	2 (4.4)	3 (7.1)	
Retrosternal radiation to the left chest	3 (5.1)	2 (4.4)	0 (0.0)	
Retrosternal radiation to the left shoulder	1 (1.7)	0 (0.0)	1 (2.4)	
Retrosternal radiating to the left shoulder and neck	0 (0.0)	1 (2.2)	0 (0.0)	
Retrosternal radiation to the left and right chest	0 (0.0)	0 (0.0)	1 (2.4)	

Cx, Circumflex; LAD, Left anterior descending artery; RCA, Right coronary artery.

Discussion

In our study, no anginal complaints were noted in 36 (24.6%) of the 146 lesions or in 32 (25%) of all patients during balloon inflation lasting approximately one minute. Previous studies have similarly indicated that silent ischemia is a frequently observed phenomenon. In a study involving 105 stable coronary artery patients on traditional antianginal treatments, silent ischemia episodes were detected in 43% of the patients through Holter monitoring.[5] All of our participants clinically exhibited symptoms of angina. The observation that around a quarter of these patients did not report any complaints while the balloon was inflated for one minute may suggest that a significant portion of short-lived ischemic episodes in everyday practice manifest silently in patients who have not lost their pain perception. We noted silent ischemia more often in RCA lesions compared to LAD and Cx in terms of coronary localization. We could not find any data on this subject in the literature. Another finding of ours regarding silent ischemia is that, contrary to expectations, we did not observe silent ischemia more frequently in diabetic patients. In our study, the rates of not developing angina after balloon inflation were the same for diabetic or non-diabetic patients. A similar observation was also reported by Falcao and colleagues.[6] In their study, they investigated silent myocardial ischemia in diabetic and non-diabetic patients with CAD in a prospective manner. No statistically significant difference was observed between the rates of angina development during the exercise test for these 319 diabetic and 319 non-diabetic patients with CAD (40.7% in people with diabetes vs. 35.1% in non-diabetic patients).[6] Although the severity of angina experienced by our patients, graded using VAS, was slightly milder in Cx according to their coronary localization, there was no statistical difference. According to VAS, the severity of angina was 5.7 ± 2.1 in LAD, 5.6 ± 2.1 in RCA, and 5.1 ± 1.8 in Cx. The relationship between the size of the ischemic area and the severity of angina remains unclear.[7] Mild myocardial ischemia may cause severe angina pain, yet the phenomenon of 'silent' (painless) ischemia and even acute myocardial infarction (AMI) is also well-documented.[7,8] The severity and characteristics of angina pectoris as a presenting symptom in patients with AMI can vary greatly.[9,10] Unlike AMI, another factor affecting the severity of angina in angioplasty is the mechanical tension applied to the vessel during balloon and stent implantation. In a study by Tomai et al.[11], the inflation pressure was increased during the second balloon inflation for one group of patients undergoing balloon angioplasty, while it was maintained at the same pressure for the other group. The ST-segment change, which is secondary to ischemia, decreased in both groups during the second inflations. In other words, as the ischemic effect decreased, the severity of angina increased in the high-pressure group.[11] The fact that the pressure applied during the stent balloon inflating was lower in Cx lesions, which had a relatively low severity of angina in our patients, partially supports this finding. However, drawing a direct correlation between angina severity and coronary localization seems complex.

In our study, when evaluating the localization of angina independently from the coronary anatomy, we found that the most common complaint was in the retrosternal area. When combining isolated retrosternal complaints with those of retrosternal localization and dissemination, nearly half (47.9%) were located retrosternally. Everts et al.[12] reported that angina was localized in the retrosternal region in 46.7% of patients who presented with angina and were diagnosed with Myocardial Infarction (MI). Pasceri et al.[13] investigated the relationship between infarct site and angina localization in 104 AMI patients in a prospective observational study. They similarly observed angina most frequently in the retrosternal area, with 44% in anterior MI and 56% in inferior MI out of all MIs.[13] This aligns

with our findings. When examining the anatomical relationship and anginal location together, the isolated retrosternal location was slightly more frequent in LAD and Cx lesions compared to RCA (33.4% in LAD, 20% in RCA, and 35.7% in Cx). However, when including retrosternal locations with extensions, RCA lesions were slightly less often retrosternal than other vessels, yet retrosternal locations dominated numerically across all anatomical localizations (49.1% in LAD; 42.2% in RCA; and 52.3% in Cx). The somatization of visceral angina is very complex in neural pathways and remains not fully comprehended. It is believed that afferent fibers in cardiac sympathetic fibers play the main role in transmitting angina pain. In this regard, the sympathetic sensory innervation, which is highly concentrated in the atria and ventricles, is relayed from the heart to the 5th thoracic sympathetic ganglion and the upper 5th thoracic dorsal roots of the spinal cord. The stimuli mediated by this sympathetic afferent pathway probably converge with stimuli from the somatic thoracic structures in the same spinal ascending neurons. It is believed that ischemia occurring in different myocardial regions is perceived in similar areas, such as retrosternal, arm, and back, due to this phenomenon.[14] Another significant observation related to coronary anatomy and angina localization was that epigastric complaints were specific to RCA, albeit relatively rare. We did not observe any epigastric-located complaints associated with other coronary arteries. Lichstein et al.[2], similar to our study, investigated the relationship between coronary artery lesion sites and angina localization during coronary angioplasty in a prospective observational study. Using a distinct analysis method, they examined 153 patients who showed ST-T changes on the ECG during balloon inflation. This study reported 86% RCA involvement in patients with epigastric complaints extending to the chin.[2] It has been noted that dermatomes constituting the angina complaint may range from C3 to T10. In this context, while the epigastric complaint resulting from thoracic dermatomes is expected, its association with RCA area ischemia is notable. In summary, drawing a direct correlation between coronary anatomy and the localization of angina solely based on its location seems complex.

Angina pectoris can be described as a visceral pain, and compared to somatic pain, it is harder to define. Regarding the character of angina, the pressure-heaviness sensation was predominant in LAD (45.8%) and Cx (42.9%) while the burning sensation was more prominent in RCA (28.9%). In LAD, the burning sensation was the second most common (20.3%), while in Cx, the crushing-squeezing sensation was noted (26.2%). In RCA, the crushing-squeezing sensation and the pressure-heaviness sensation both occurred as the second most frequent symptoms, each at 15.5%. Previously, no study has investigated the relationship between the character of angina and coronary localization. In a study closely related to ours, Malik et al.[15] examined 331 AMI patients, of which 308 (93.1%) presented with anginal complaints. The most common angina symptoms were chest heaviness (27.8%), followed by a burning sensation (14.5%), stabbing sensation (12.7%), squeezing sensation (10.6%), and choking sensation (9.6%).[15] D'Antono et al.[16] prospectively studied the symptoms of angina and exercise-induced myocardial perfusion defects in patients with stable coronary artery disease. Analyses were conducted on 38 women and 94 men who showed evidence of ischemia on both angina and myocardial perfusion imaging during exercise. The words used to describe angina were squeezing (56%), pressure (45%), sinking (36%), discomfort (36%), burning sensation (32%), and choking sensation (32%).[16] Coronary localization was not specified in these two studies, making it impossible to draw comparisons in this regard. However, the similarities in the frequency of angina characterizations across both studies are noteworthy.

Limitations

The main limitation of our study is that the number of patients included was below what was planned, due to the postponement of elective procedures because of the COVID-19 pandemic. Larger-scale studies are required to clarify our findings. The fact that the balloon time during the procedure was only about 1 minute suggests that this may be a short duration for the development and spread of angina.

Conclusion

During elective PCI, ischemia caused by balloon inflation resulted in about one-fourth of the patients not developing any complaints. Contrary to expectations, silent ischemia was similar in both diabetic and non-diabetic patients. We observed pressure-heaviness angina in the LAD and Cx arteries, and frequently, burning angina in the RCA. Additionally, we noticed that the most common localizations were isolated retrosternal and left thoracic regions across all coronaries. Epigastric localization was observed only in the RCA. It appears challenging to determine the coronary lesion anatomically based solely on the localization of angina. Regarding the severity of angina, there was no significant difference between the three main coronary arteries.

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Informed Consent: Written informed consent was obtained from all patients.

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