

## ORIGINAL ARTICLE

## Prevalence and three-year follow-up of patients with isolated myocardial bridge in the mid-Black Sea region: a retrospective single-center study

### Orta Karadeniz Bölgesi'nde izole miyokart köprüsü sıklığı, kliniği ve üç yıllık prognozu: Tek merkezli geriye dönük çalışma

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#### ABSTRACT

**Objective:** Myocardial bridge (MB), also known as muscular bridge, is a rare congenital disease with relatively good prognosis. However, it has been associated with unstable angina, myocardial infarction, and sudden cardiac death. Incidence and prognosis of patients diagnosed with isolated MB after having undergone coronary angiography are evaluated in the present retrospective study.

**Methods:** Coronary angiograms of 18,250 patients, obtained between 2008 and 2011, were reexamined for presence of MB at the cardiology clinic. Of these patients, 241 (0.95%) had MB, and 181 (0.99%) had it as an isolated finding. Patients with isolated MB were divided into 2 groups according to severity of the lesion in the cardiac systole. Group 1 was comprised of patients with non-critical (<70%) stenosis; group 2 was comprised of patients with critical ( $\geq$ 70%) stenosis. Demographic characteristics, symptoms at initial diagnosis, and coronary angiographic findings regarding localization and severity of stenosis were noted. Follow-up was performed by phone, with outpatient clinic visits, and by reviewing hospital records.

**Results:** Twenty-five patients (13%) had critical stenosis (group 2), and 146 (87%) had non-critical stenosis (group 1). Mean follow-up duration was 38 $\pm$ 7 months. Recurrent angina and repeated coronary angiography were reported in 15 group 1 patients (10.2%) and in 2 group 2 patients (8.0%) (p=non-significant). No instance of myocardial infarction was reported.

**Conclusion:** Isolated MB seems to be a relatively benign disease, a conclusion made in accordance with those of previous studies. Symptoms and prognosis are not determined by degree of stenosis generated by the muscular bridge.

#### ÖZET

**Amaç:** Miyokart köprüsü (MK), bazen adale köprüsü olarak da tanımlanan, göreceli olarak iyi prognoza sahip, nadir doğumsal bir hastalıktır. Literatürde, kararsız anjina, miyokart enfarktüsü ve ani ölümlerle de ilişkisi olduğu gösterilmiştir. Bu geriye dönük çalışmada, koroner anjiyografi yapılan hastalarda izole MK tanısı konan hasta sıklığını ve prognozunu inceledik.

**Yöntemler:** Kardiyoloji kliniğinde 2008–2011 yılları arasında koroner anjiyografi yapılan 18250 hastanın kayıtları geriye dönük olarak incelendi. Saptanan 241 (%0.95) MK'li hastanın, 181'inde (%0.99) izole MK gözlemlendi. İzole MK'li hastalar kalp sistolündeki lezyonun derecesine göre iki gruba ayrıldı. Lezyon derecesi <70 Grup 1 (kritik olmayan darlık) ve lezyon derecesi  $\geq$ 70 Grup 2 (kritik darlık) olarak tanımlandı. Çalışmaya alınan hastaların demografik özellikleri, hastaneye ilk başvuru yakınmaları, eşlik eden hastalıklar, koroner anjiyografi bulguları (darlığın lokalizasyonu ve yüzdesi) ve prognozları hastane arşiv kayıtlarından elde edildi. Hasta bilgilerine telefon, poliklinik ve hastane kayıtlarından ulaşıldı.

**Bulgular:** Yirmi beş (%13) hastada kritik darlık (Grup 2) ve 146 hastada (%87) kritik olmayan darlık (Grup 1) saptandı. Ortalama takip süresi 38 $\pm$ 7 aydı. Grup 1'deki hastaların 15 (%10.2) ve Grup 2'deki hastaların 2'sine (%8) (p=anlamsız) tekrar eden anjina atakları nedeniyle yeniden koroner anjiyografi yapılmıştı. Takip sürecinde hiçbir hastada miyokart enfarktüsü görülmedi.

**Sonuç:** İzole MK'li hastalar diğer çalışmalara benzer şekilde, göreceli olarak iyi seyirli bir prognoz sergilemiştir. Miyokart köprüsünün semptom ve prognozu darlık derecesinden bağımsız olarak bulunmuştur.

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**M**yocardial bridge (MB) is often seen in major epicardial coronary arteries and is defined as a coronary artery that has tunneled through a segment of the myocardium. It was first described in an autopsy conducted by Reyman in 1737,<sup>[1]</sup> and was identified on selective coronary angiography in 1960.<sup>[2]</sup> Systolic compression of the epicardial artery is visible on angiographic imaging. There is no specific classification for myocardial bridging. Myocardial obstruction ratio varies according to the location, length, and thickness of the MB. Reported incidence of MB on coronary angiography ranges from 1.5–16%, and it is most frequently observed in the left anterior descending artery (LAD), with a reported rate in autopsy studies as high as 86%.<sup>[3]</sup> Diagnosis can be made using quantitative angiography, intracoronary ultrasound, or Doppler flow measurement.<sup>[4–6]</sup> While MB is typically a benign anomaly, incidence of acute coronary syndrome,<sup>[7]</sup> malignant arrhythmias,<sup>[8]</sup> coronary spasm,<sup>[9]</sup> and sudden death<sup>[11]</sup> have been reported.

A 3-year clinical course of isolated MB in patients who had, for a range of reasons, undergone coronary angiography in the laboratory is examined in the present study.

## METHODS

The database of the cardiac catheterization laboratory of a high-volume heart center in the mid-Black Sea region of Turkey was reviewed. It included the records of 18,250 patients who had undergone coronary angiography between 2008 and 2011. Cardiac catheterization had been performed, and quantitative diameter measurements of the coronary arteries and MB had been obtained by 2 experienced invasive cardiologists using a workstation with dedicated Philips H5000 and Allura DCI software (Philips Healthcare, Eindhoven, Netherlands). MB was defined as systolic contraction in the epicardial coronary arteries. Patients with simultaneous coronary artery disease were excluded. Demographic features and angiographic findings were obtained from records. Primary endpoint was readmission for angina and repeated coronary angiograms during follow-up. Patients were divided into 2 groups depending on obstruction due to MB.<sup>[10]</sup> Group 1 was comprised of patients with non-critical (<70%) stenosis; group 2 was comprised of patients with criti-

cal ( $\geq 70\%$ ) stenosis. Clinical courses were obtained by phone. The study was approved by the hospital's ethics committee.

## Statistical analysis

Analysis was performed using SPSS predictive analytics software for Windows (version 18.0; SPSS Inc., Chicago, IL, USA). Kolmogorov-Smirnov test was used to determine normal distribution. Categorical variables were shown as numbers of cases with percentages, and normally distributed continuous variables were shown as mean $\pm$ SD. Student's t-test was used to analyze normally distributed continuous variables, and  $\chi^2$  test was used to analyze categorical variables. Kruskal-Wallis rank-sum test was used for non-normally distributed variables. Statistical significance was defined as a p value less than 0.05.

## RESULTS

Coronary angiography was performed following positive treadmill test in 86 patients (48%), positive myocardial perfusion imaging in 18 patients (10%), and electrocardiographic and clinical findings in 77 patients (42%). Isolated MB was observed in 181 patients (0.99%). Ninety-five percent of patients (171) were admitted with chest pain, and the remaining 5% (10) had palpitations and dyspnea. Average patient age was 56.7 $\pm$ 12 years. Average follow-up was 38 $\pm$ 7 months. Baseline characteristics of the patients are summarized in Table 1.

MB can affect any of the major epicardial coronary arteries, but involvement of the LAD was most common, with the mid-LAD being the most commonly reported location (Table 2). Clinical results of the patients with MB can be found in Table 3. One patient

**Table 1. Demographic data and incidence of muscular bridge**

	Results		
	n	%	Mean $\pm$ SD
Male	122	68.1	
Female	59	31.9	
Hypertension	20	11	
Diabetes mellitus	5	2.7	
Smoker	25	13.8	
Ages (years), n			56.7 $\pm$ 12

**Table 2. Angiographic results of myocardial bridge**

Segment	Non-critical (n)	Critical (n)	%
Left anterior descending coronary artery	145	23	94.4
Circumflex coronary artery	5	0	2.7
Right coronary artery	3	0	1.6
Left anterior descending coronary artery D1	3	0	1.6
Intermediate artery	0	1	0.55
Circumflex coronary artery OM1	0	1	0.55

D1: Diagonal; OM: Obtuse marginal.

**Table 3. Clinical results**

	Non-critical n (%)	Critical n (%)	p
Recurrent angina and readmission for angina	18 (11.5)	2 (8)	Ns
Repeated coronary angiography	6 (3.8)	0 (0)	Ns
Major cardiac events	2 (1.24)	0 (0)	Ns

Ns: Non-significant.

died of intracranial hemorrhage, and 1 died of lung cancer. Two non-critical MB patients were readmitted due to major cardiac events. One underwent stent implantation due to spontaneous coronary artery dissection; the other underwent coronary artery bypass graft due to critical stenosis as a result of MB. Sixty-six patients were using beta-blockers (metoprolol, carvedilol, or bisoprolol), and 32 were using a non-dihydropyridine calcium-channel blocker. Eighty-one patients underwent no medical treatment. Follow-up coronary angiography was performed due to unstable angina pectoris in readmitted patients to determine whether non-significant stenosis and occlusive vasospasm had occurred.

## DISCUSSION

MB is defined as the tunneling of an epicardial coronary artery through the myocardium, as established by Reyman.<sup>[12]</sup> Although the condition is encountered by cardiovascular surgeons in approximately 15% of coronary bypass surgeries, it is reported that this rate fluctuates between 5% and 86% in autopsy studies.<sup>[13,14]</sup>

A 0.99% prevalence of MB among patients who had undergone coronary angiography was determined in the present study, a finding similar to several others.<sup>[15]</sup> Prevalence has been reported as 0.5–2.5%. In Turkey, Çiçek et al. reported a 0.83% prevalence in a

group who had undergone coronary angiography.<sup>[16]</sup>

LAD involvement is most commonly reported,<sup>[17]</sup> and was found in 94% of MB patients in the present study. Mortality rates are very low in patients with MB; Kramer et al.<sup>[18]</sup> reported no mortality in 5 years, and Çiçek et al. reported no cardiac mortality. Similarly, no cardiac mortality was found in the 38-month follow-up of MB patients in the present study.

MB caused  $\geq 70\%$  stenosis in 25 patients (13%), and no significant difference regarding symptoms or morbidity was found between the groups. One patient was admitted with ST-segment elevation myocardial infarction, and primary stent implantation was successfully performed. In another study, no myocardial infarction was observed.<sup>[10]</sup> It is possible to say with some certainty that MB carries relatively good prognosis. Nevertheless, connections with unstable angina, acute myocardial infarction, arrhythmia, and sudden death have been reported.<sup>[18–21]</sup>

In the treatment of MB, beta-blockers and non-dihydropyridine calcium-channel blockers should be considered first, due to their negative inotropic and chronotropic effects.<sup>[22]</sup> Nitrates used in coronary artery stenosis should be avoided due to their effects on systolic contraction rate and attendant worsening of symptoms.<sup>[23]</sup> Invasive treatment options should be reserved for use in patients who demonstrate symp-

toms despite medical treatment, such as those with ischemia-related heavy coronary artery disease.<sup>[24]</sup> Invasive treatment consists of myotomy to resect the MB and coronary artery bypass surgery. Although implantation has been reported, it carries a high risk of stent restenosis.<sup>[25-27]</sup> While these treatment options are in practice, no precise guidelines are available.

## Conclusion

Prevalence of MB in coronary arteries was 0.99% in the present group of patients in the mid-Black Sea region who had undergone coronary angiography. No mortality was observed in 3-year follow-up, and no remarkable differences regarding angina and cardiac morbidity were observed among patients with critical and noncritical narrowing.

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**Anahtar sözcükler:** Adale köprüsü; anjina; miyokart köprüsü.