

Prevalence of myocardial bridge in angiographic population—A study from rural part of western India

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ABSTRACT

Introduction: Intramural course of coronary artery is known as myocardial bridge (MB). Its prevalence is highly variable. Very few studies have been conducted in India, mostly from southern state and that too covering urban population. There are no studies from western India. In this study we aimed to estimate the prevalence of MB in coronary angiogram from rural part of western India. **Methods and Results:** A total of 4,438 patients underwent coronary angiography for various indications during the study period of 69 months. Mean age of the study population was 53.6 ± 11.2 years. MB was found in 212 (4.77%) of patients, predominantly in males. Unstable angina was the most common presentation among males (28.7%), whereas chronic stable angina was being the most common presentation among females (22.6%). Majority of MBs were seen in left anterior descending artery in its mid part (61%). Mean diameter compression of the affected segment was $32.6\% \pm 11.8\%$, with no significant difference seen among males and females or between mid and distal left anterior descending artery. **Conclusion:** Our study showed the prevalence of MB similar to other Indian studies. Left anterior descending artery was most common artery involved. Mean compression was not statistically significant among either sex.

Keywords: Left anterior descending coronary artery, milking effect, myocardial bridge

Introduction

The intramural course of the epicardial coronary segment is called as “myocardial bridge” (MB). The bridge segment often gets compressed during systole, the phenomenon known as “milking effect” or a “step down or step up.”^[1] Left anterior descending artery (LAD) is most commonly involved in MB. Although being known for more than two centuries, this phenomenon was described in detail by Geiringer in 1951.^[2] Portsmann and Iwing first demonstrated this phenomenon during

coronary angiography in 1960.^[3] Initially thought to be clinically non-significant, later studies revealed that MB in left anterior descending artery can be associated with myocardial ischemia and sudden cardiac death.^[4]

Although prevalence of MB in various studies has been highly variable, a higher incidence has been observed in patients with hypertrophic obstructive cardiomyopathy (HOCM).^[5,6] It has been observed to be present in up to 86% of cases in autopsy series,^[7] but it was seen only in 0.5–1.6% in most angiographic studies.^[8] Although coronary angiography is considered as a gold standard for diagnosing this entity, other modalities like intravascular sonography and multidetector computed tomography (MDCT) are also useful for diagnosis.^[9,10]

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To the best of our knowledge, only three studies are available in Indian literature describing MB, all involving south Indian population.^[11-13]

This study was undertaken with the aim to assess the clinical profile and angiographic prevalence of MB in the patients undergoing coronary angiography in a tertiary level centre in rural western India.

Material and Methods

This study involved assessment of 4,438 patients, who underwent coronary angiography for various indications between January 2013 and September 2018 at Pramukhswami Medical College, Anand, Gujarat, a tertiary level centre. The study was started after ethical clearance of ethics committee of Pramukhswami Medical College, Anand, Gujarat, India. Systolic compression along with partial or complete release of the compression during diastole was labelled as MB. All patients with the presence of MB were included, irrespective of the percentage of systolic compression and it was analyzed qualitatively and quantitatively. These assessments were done without nitroglycerine (NTG) injection. Various coronary risk factors and clinical presentations in the patients were analyzed.

Chi-square test and Fisher–Freeman–Halton test was used for categorical variables and unpaired *t*-test was used for continuous variables. A *P* value of less than 0.05 was considered statistically significant.

Results

During the study period, 4,438 patients underwent coronary angiogram for various indications. Out of all the patient who underwent coronary angiography, 3,190 (71.9%) were males.

MB was identified in 212 (4.77%) patients [Table 1]. Mean age of the study population was 53.6 ± 11.2 years.

Among all the identified cases, diabetes, hypertension, obesity, smoking, and tobacco chewing was observed in 21.2%, 36.8%, 3.3%, 29.7%, and 15.1%, respectively [Table 2]. Table 3 highlights the various indications for performing coronary angiography in patients with MB.

Majority of MB were in LAD with 61% located in mid-LAD and remaining in distal LAD. One patient had an additional mid-right coronary artery (RCA) MB and another had an additional left circumflex artery (LCX) bridge. Mean diameter compression of the affected segment was $32.6\% \pm 11.8\%$ with no significant difference seen among males and females (32.9 vs. 30.7%, *P* = 0.361) and between mid-LAD and distal LAD (32.6% vs. 32.5%, *P* = 0.965). 63% of males have MB in mid-LAD compared to 48.4% in females, the difference was not statistically significant (*P* = 0.163).

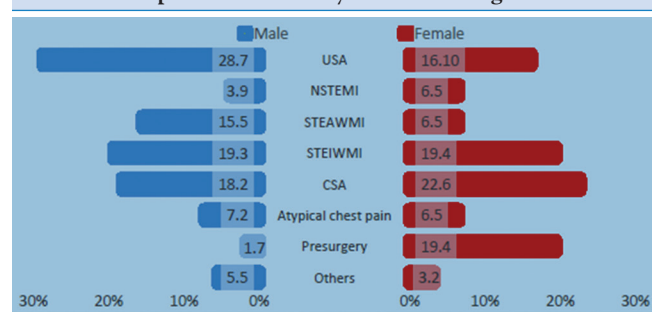
Table 1: Sex wise distribution of myocardial bridge

	Male	Female	Total
With bridge	181	31	212
Without bridge	3009	1217	4226
Total	3190	1248	4438

Table 2: Clinical characteristic of patients with myocardial bridge

	53.6±11.2 years
Mean age	53.6±11.2 years
Diabetes	21.2%
Hypertension	36.8%
Obesity	3.3%
Smoking	29.7%
Tobacco chewing	15.1%

Table 3: Indication for coronary angiography among patients with Myocardial Bridge



Unstable angina (USA) was most common presentation among males (28.7%), whereas chronic stable angina (CSA) was the most common presentation among females (22.6%) (Fisher–Freeman–Halton statistics 17.12, *P* = 0.008).

For both mid-LAD and distal LAD MB, unstable angina remained the leading presentation (24.8% in mid-LAD subgroup vs, 30.1% in distal LAD subgroup) with next most common being chronic stable angina in mid-LAD subgroup (23.3%) and ST elevation anterior wall myocardial infarction in distal LAD subgroup (16.9%). Overall 11.3% of patients with MB in LAD had history of anterior wall myocardial infarction, culprit artery being same containing bridge segment.

Discussion

MB is an incidental finding, encountered frequently during coronary angiography. It may be occasionally associated with symptoms suggestive of myocardial ischemia. Atherosclerosis often develops immediately proximal to the bridged segment, possibly due to alteration in shear stress, while the compressed segment itself often spared.^[5] Ferreira *et al.* described two types of MB, that is, superficial and deep.^[14] Deep MB is diagnosed by visible systolic compression during coronary angiography. Most of bridge described in autopsy series was not seen angiographically.

Prevalence of MB during coronary angiography is highly variable, ranging from 0.5 to 16%.^[9,15-20] A higher prevalence was observed in studies using NTG injection as a provocative measure.^[18,21] Reasons for this observation has been hypothesized that NTG increases the vessel wall compliance and contractility leading to more extensive systolic coronary artery compression. Highest MB angiographic prevalence (36%) was described by H. Teragawa *et al.*^[21] since they used aggressive provocation test. We found the prevalence of MB to be 4.77% in our study, which was similar to the prevalence described in previous studies described in Indian literature (0.6-4.86%) [Table 4].

We found a higher prevalence of MB in male population which is similar to previous Indian studies.

In our study, we observed MB most commonly in the LAD and infrequently in LCX and RCA, which is consistent with previously described literature.^[21-24]

In our study, most common presentation in patients with MB was UA in males and CSA with females. While in the study by PK Ashokan *et al.*,^[11] most common presentation was exertional angina in both CAD and non-CAD group.

Most of symptomatic patients with isolated MB who presented with chronic stable angina were managed with beta-blocker therapy.^[1,25]

Mid-LAD was predominantly the site for MB in our study that was similar to the study by Ayfer Mavi *et al.*^[17] but in contrast to study by Cay S *et al.*^[16] where an almost equal distribution was observed in either segments. Interestingly, we did not find any MB in proximal LAD segment similar to some other large studies.^[17] Some difference in the segmental distribution in mid- and distal LAD segments in studies could be due to the nomenclature used, as we identified the LAD segments based on that proposed by syntax trial^[26] while most of studies cited in this manuscript was done prior to SYNTAX era. We did not find any statistically significant differences in the segmental distribution of MB among between either sex. We could not find any atherosclerotic plaque angiographically within the bridge segment, an observation similar to other studies.^[27] Mean diameter compression of the affected segment was $32.6\% \pm 11.8\%$, and it was not statistically different between either segment (mid or distal) or sex. The most of other studies found to have higher mean compression due to inclusion as more than 50% systolic compression.^[11,13]

Our study had few limitations. Firstly, echocardiographic

correlation with MB was not done. Various studies have found higher prevalence of MB in patients with HOCM and diastolic dysfunction. Secondly, we had many cases where stenotic and ectatic lesion was very close to MB, and hence both overestimation and underestimation of MB is likely. Thirdly, casual association between MB and clinical presentation was not analyzed, neither follow-up of isolated MB cases were done. Our study will be helpful to primary care where invasive angiography can be avoided in middle-aged patients who present with anginal symptoms but respond very well to beta blockers. Also, MB compression in majority was less than 50% which means medical management is all that is required in majority of patients.

Conclusion

MB is more often an incidental finding in angiography than a cause for ischemic symptoms. Prevalence of MB in our study is in agreement with previous Indian studies. Nearby all MBs were seen in LAD, mostly in mid segment. Though significant compression can produce cardiac ischemia at high heart rate, isolated MB being cause of ischemic symptoms is rare owing to coronary flow being predominantly diastolic and compression in MB being predominantly systolic. High propensity to develop atherosclerotic plaque and risk of rupture at the edge of MB can occasionally present with acute coronary syndrome though casual association needs further studies.

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Conflicts of interest

There are no conflicts of interest.

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Table 4: Previous Indian studies assessing prevalence of Myocardial Bridge

Study	Year Region	Sample size	Prevalence
Hari Krishnan <i>et al.</i> ^[12]	1999 Kerala	3200	0.6%
Sujatha M <i>et al.</i> ^[13]	2015 Andhra Pradesh	2015	3.17%
PK Ashokan <i>et al.</i> ^[11]	2018 North Kerala	3146	4.86%

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