ANGIOGRAPHIC PREVALENCE OF MYOCARDIAL MUSCLE BRIDGING IN PATIENTS WITH CHEST PAIN

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ABSTRACT

Objective: To determine the angiographic prevalence of myocardial bridging in patients with chest pain.
Study Design: Prospective observational study.
Place and Duration of Study: Army Cardiac Center, Lahore over a period of seven years, from Jan 2011 to Dec 2017.
Methodolgy: In this prospective observational study, we evaluated the findings of coronary angiograms of patients who presented with chest pain during the period of seven years (2011-2017). The number of patients with myocardial bridge were identified. The location of Muscle Bridge and percentage of systolic squeeze was noted down.
Results: Of 15,007 patients, 45 patients (0.29%) were found to have myocardial muscle bridge. Forty four (97.8%) of these patients had Left Anterior Descending (LAD) Artery involved. 53.3% of the patients had more than 50% systolic squeeze.
Conclusion: The prevalence of MB in our setting is low in angiographic study. LAD is the most common intramural artery.

Keywords: Coronary angiography, MB (Myocardial bridging), Left anterior descending (LAD) artery.

INTRODUCTION

The coronary arteries lie on the surface of muscular layer of heart, the myocardium, and are therefore termed as epicardial vessels. The arteries may dip into the myocardium just to reappear on the surface of heart again, at variable lengths of dipping. The muscle tissue that overlies this intramyocardial segment of such a coronary artery is called as the muscle bridge (MB). The prevalence of MB reported is variable, being described as low as less than 0.5% angiographically and as high as more than 80% in in several autopsy series[1,2].

MB is mostly found in Left anterior descending artery[3]. Various autopsy and ultrasound studies have revealed that the intramural and distal parts of the tunneled vessels are less likely to have atherosclerotic plaques[4]. Atherosclerosis, the most important risk factor for ischemic heart disease, usually effects the proximal part of bridged vessel[5].

It is reported that people with MB usually remain asymptomatic. The benign nature of MB is attributed to the fact that the effect of muscle Bridge is mostly a systolic event; As in normal circumstances only 15% of coronary blood flow occurs during systole and 85% occurs during diastole. The increase in left ventricular (LV) diastolic dysfunction, generally associated with aging, ischemic heart disease (IHD) or myocardial hypertrophy; may unmask the effect of MB. These patients may experience hemodynamic compromise during cardiac systole, causing angina, acute coronary syndrome, ventricular septal rupture, left ventricular dysfunction, arrhythmia and sudden cardiac death[6,7]. These patients usually present with acute chest pain in emergency departments which on investigations are diagnosed having MB.

MB is usually diagnosed incidentally on invasive imaging modalities like coronary angiography (CAG), intracoronary doppler, intravascular ultrasound (IVUS) and noninvasively with

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cardiac computed tomography angiography (CTA). Intracoronary functional evaluation is done with fractional flow reserve (FFR) and instantaneous wave free ratio (iFR)[8]. Although CTA is more sensitive and noninvasive but CAG is more widely done. Secondly CAG is both diagnostic and interventional modality having more significance clinically.

The reported prevalence of MB in angiographic series is far less i.e. 0.5-40% with mean 7%[7]. A study on Chinese patients showed an angiographic prevalence of 2.7%[9]. A study conducted in India in 2015 reports prevalence of MB as 3.17%[10]. Probable reason behind this discrepancy is that the pathologic series include thin bridges or even myocardial loops with little hemodynamic consequence. While angiographic significance, on the other hand, depends on multiple factors including bridge length, depth/thickness, orientation of myocardial fibers to the artery, coronary smooth muscle tone, the presence of a proximal fixed coronary obstruction, the presence of surrounding fat, the state of myocardial contractility at the time of angiography, and observer experience[7].

The prevalence of MB reported in other studies is quite variable. All the studies conducted until now were retrospective. To our knowledge no study has yet been done in Pakistani population to check prevalence of MB. Therefore we conducted this prospective study to provide useful data on the true angiographic prevalence of MB in a large sample size and to see the vessel most likely to be affected.

METHODOLOGY

This prospective observational case study was conducted in two Cath Labs of Army Cardiac Center, Lahore over a period of seven years, from January 2011 to December 2017. All the patients admitted with complain of chest pain (typical and atypical), stable angina, acute coronary syndrome (ACS), STEMI, NSTEMI for diagnostic coronary angiography were enrolled in the study. Patients with hypertrophic cardiomyopathy and transplanted hearts were excluded.

The coronary angiography was performed via standard technique on Siemens machine. Two independent trained readers separately analyzed the coronary angiography (CAG) findings for the presence of muscle bridge (MB). The muscle bridge was labelled when the coronary artery underwent luminal diameter narrowing during systole in comparison with the diastolic phase. The percentage of vessel lumen narrowing during systole was noted as either more than 50% or less than 50% (systolic squeeze). The presence of myocardial muscle bridge and the percentage of systolic squeeze was noted. The frequency of artery involved in Muscle Bridge and gender distribution of MB identified cases was observed. Statistical analysis was performed using SPSS-25.

RESULTS

In our study, a total of 15,007 patients meeting the inclusion and exclusion criteria underwent coronary angiography. Among these patients, 9764 (65.1%) patients were males and 5243 (34.9%) patients were females.

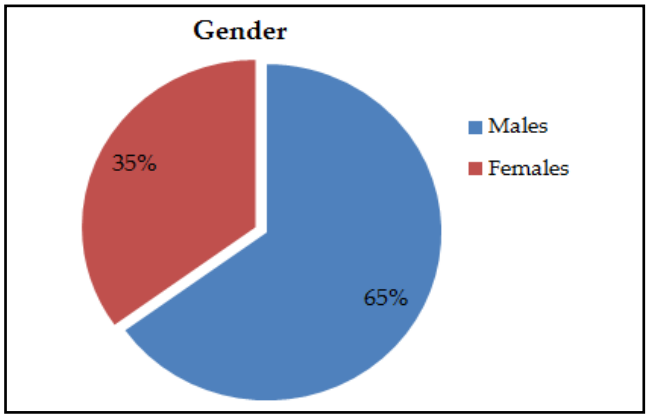

Figure-1: Frequency distribution of gender.

The myocardial muscle bridge was observed in 45 (0.29%) patients. Mean age of patients with MB was 56.47 years with minimum of 19 years and maximum of 77 years. It was observed that 24 patients (53.3%) had more than 50% systolic squeeze and 21 patients (46.7%) had less than 50% systolic squeeze.

DISCUSSION

Myocardial Muscle Bridge is a known cause of myocardial ischemia[12]. The tunneled coronary artery undergoes systolic compression that disappears mostly in diastole. The potential hemodynamic impact of myocardial bridge has been documented in acute myocardial infarction[13]. Certain populations, namely hypertrophic cardiomyopathy patients and heart transplant patients, have rates much higher than the general population[14,15].

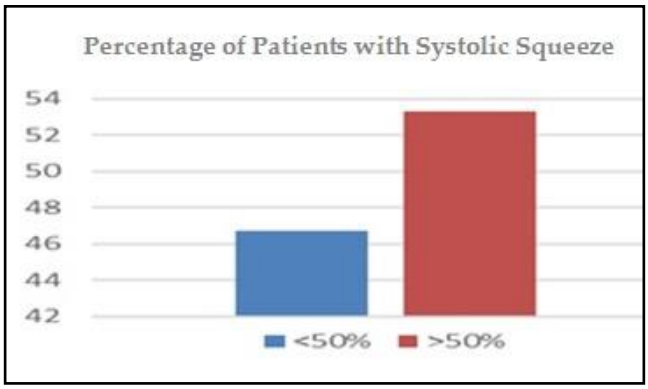

Figure-2: Percentage of patients with systolic squeeze

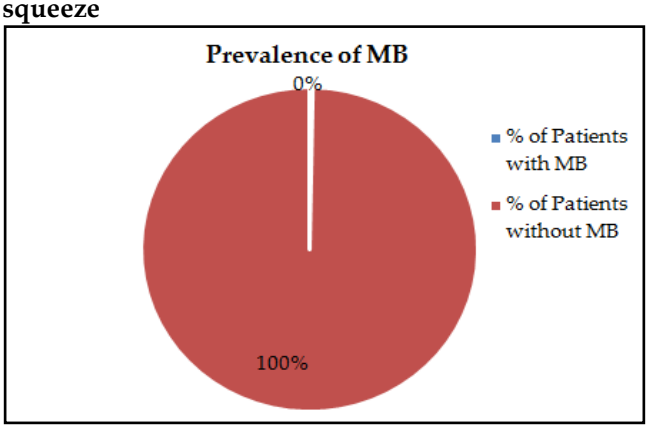

Figure-3: Prevalence of muscle bridge in patients.

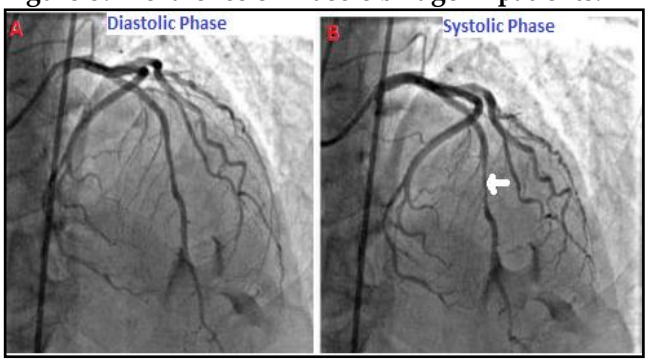

Figure-4: Normal calibre of LAD lumen during diastole, Figure B Luminal narrowing in systolic squeeze.

Coronary angiography (CAG) is an exquisite modality used widely for imaging of coronary arterial vasculature. It facilitates the assessment of dynamic changes in coronary circulation during systole and diastole. Although invasive coronary angiography, remains the imaging of choice for evaluation of patients with chest pain having unstable angina. MB is diagnosed by the visualization of coronary artery luminal narrowing in systolic phase. This due the fact the myocardium contracts and squeezes blood through the tunneled intramural vessel; the milking effect[16]. The angiographic appearance of myocardial bridges depends on factors like thickness, length of myocardial bridge and arrangement of cardiac muscle fibers.

The symptomatic patients are treated by reducing compression on intramural vessels. Beta blocker is the mainstay of treatment. It reduces heart rate and contractility[17]. Calcium channel blockers are also used. Surgical treatment includes myotomy and coronary artery bypass surgery. Myotomy or surgical unroofing is done if the coronary artery itself is normal[18]. CABG is performed in case of extensive (>25 mm) or deep (>5mm) myocardial bridging, concomitant coronary artery disease or when myotomy is surgically contraindicated[19,20].

In current study, the prevalence of MB on CAG in patients with chest pain is found to be 0.29% in patients. This low prevalence is due to the difference in the population under study, variation in observer measurement and less sensitive modality being used. A study from USA reports prevalence of MB in 14% of patients[21]. A Russian study reports prevalence of MB as 34%[22]. The have performed the study by utilizing CTA which is more vibrant in detecting MB. We have identified MB in LAD in 97.8% patients. This is consistent with results of other studies which report high prevalence of MB association with LAD. Left Anterior Descending Artery is by far

the most commonly involved artery in various studies too[3,6,23].

We observed that 53.3% of the patients with myocardial muscle bridge had more than 50% systolic squeeze, as compared to the Indian study which reports percentage systolic squeeze of more than 50% in all the patients[10]. The percentage of systolic squeeze of greater than 50% is considered clinically significant as it has a hemodynamic impact. As the lumen of intramural artery narrows during systole, the laminar blood flow proximal to the MB is affected. The proximal part of artery becomes prone to atherosclerosis due to turbulent blood flow. A cushion effect of myocardium bridge on tunneled vessel has also been described to have a protective effect on intramural segment of coronary artery[24]. The sympathetic stimulation caused by exercise or dobutamine may enhance the contraction of myocardial bridge (delayed relaxation) beyond systole thereby impairing the early increased blood flow of diastole, alongwith tachycardia, shortening diastolic perfusion time and hence causing ischemia[24].

This study has a few limitations. We have used coronary angiography for identification of MB. However, CTA is more specific for visualization MB as it gives picture of both tunneled vessel and surrounding myocardium. The length and depth of intramural course of artery cannot be addressed via CAG. The fractional flow reserve derived from CTA is also useful in detecting tunneled vessels and correlating clinically alongwith a potential prognostic role in myocardial bridging[2]. Secondly, intracoronary nitroglycerin can be used as it may dilate nonbridged segments so that the bridged segments can be detected easily. Using two dimentional modality, we could not comment on the depth of the intra-mural segment.

CONCLUSION

In our study, the angiographic prevalence of myocardial muscle bridge is luckily quite low in angina patients of our country. Among MB patients LADA is the most common artery involved. The systolic compression is significant in a little more than half of the myocardial bridged arteries. But for clinical significance physiological tests trump anatomical tests.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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