A MULTIVARIATE ANALYSIS OF MYOCARDIAL BRIDGING WITH NO FIXED OBSTRUCTION

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INTRODUCTION

Myocardial bridging, a congenital abnormality, is a condition where a segment of major epicardial coronary artery goes intramurally through the myocardium below the muscle bridge[1]. Myocardial bridging was first identified by Reyman[2] and it was described angiographically by Portman and Iwig in 1960. The extent to which the coronary obstruction occurs depends on the location, thickness, length of muscle bridge, and the level of cardiac contractility. Estimated frequency of myocardial bridging that has been reported ranges from 1.5 to 16% when assessment is done using coronary angiography. However, in some autopsy series, it has been found to have to be 80%[3]. Conventionally, myocardial bridging has been regarded as a benign condition, but complications such as ischemia, acute coronary syndrome, coronary spasm, ventricular septal rupture, exercise induced atrioventricular conduction, stunning, arrhythmias, transient ventricular dysfunction and early death after cardiac transplantation, and sudden cardiac death have been reported[4].

Prevalence of myocardial bridging has not been reported consistently in the studies. It has been much higher at autopsy than on angiography[5]. Myocardial bridging has been reported to be highly prevalent in heart transplant recipients and in those with hypertrophic obstructive cardiomyopathy (HOCM)[6]. In the case of HOCM, more intense contraction may reveal the bridges which are otherwise undetectable. They are most commonly found in the mid left anterior descending coronary artery (LAD)[7]. When two parallel LAD branches are present, one often takes the intramural course. [8]
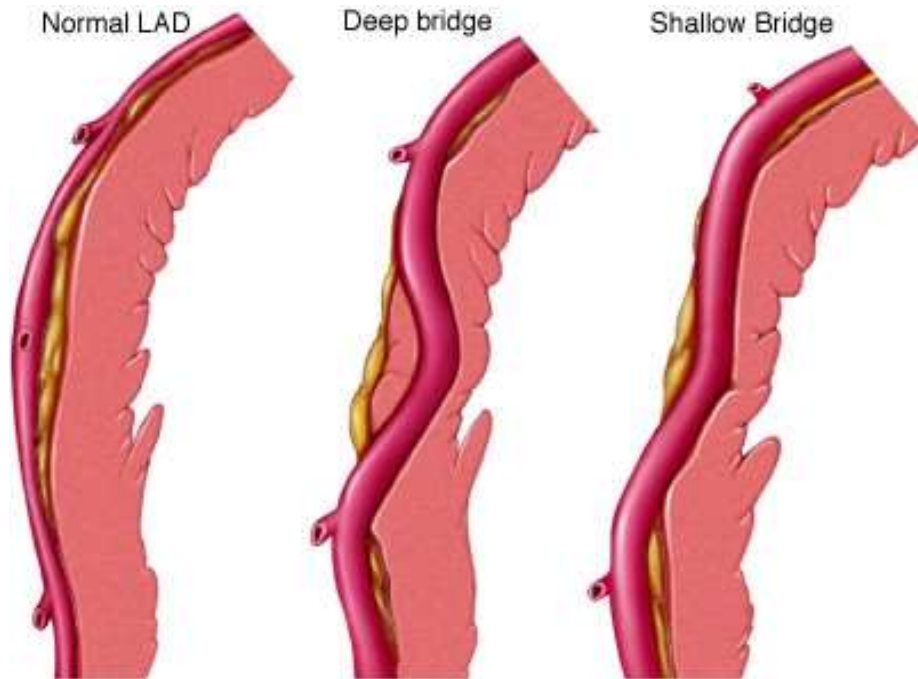
Coronary angiography is considered a diagnostic technique of gold standard for diagnosing myocardial bridges with characteristic milking effect and a step down - step up phenomenon caused by systolic compression of the myocardial segment. In symptomatic patients, initiation of therapy will improve quality of life. However, there is a lack of concrete evidence for promising effect on morbidity and mortality. Medication is recommended as first line therapy. Intracoronary administration of β-blocker reduced the vascular compression and the initial diastolic blood velocity. Systolic flow ratio was regulated and anginal symptoms got weakened. Surgical myotomy was first reported by Binet et al. for patients not responding to medication. Surgical myotomy abolishes clinical symptoms and is related to reversal of local myocardial ischemia and increase in coronary flow[9]. It is important that surgery should be advised for patients with severe angina and evidence of clinically established ischemia because there is a probability of accidently opening the right ventricle during the surgery. The risks associated with the surgery should be reviewed against the usually uneventful course even in patient with a significant level of systolic compression.

Long term prognosis in patients with isolated myocardial bridging is normally good. Myocardial bridging can occasionally be associated with clinically significant complications although it is considered a benign condition. A significant number of research studies and reports have augmented the understanding of the pathophysiological mechanisms that are related with these complications. It is important to consider myocardial bridging particularly in patients at low risk for coronary atherosclerosis, angina like chest pain or clinically relevant myocardial ischemia.

Abstract

One of the main diagnosis in the case of Coronary Artery Disease (CAD) is the myocardial bridging. This myocardial bridging can be either typical or atypical angina pectoris. Moreover, it can occasionally manifest as Acute Myocardial Infarction (AMI) or sudden death. Among the common public, this condition of myocardial bridging is relatively common and it is a benign pathology and the patients at low risk for CAD can be affected by this. But when it is symptomatic, it can appear to be stable or unstable angina, ventricular and supraventricular arrhythmias, sudden death and AMI; however, AMI and sudden death are rare. This condition is rarely diagnosed because a few patients present the symptoms and there are unavailability and constrained utilization of the diagnostic techniques. Hence, the treatment methods and pathophysiological mechanisms are not completely revealed. It is reported that there is a major discrepancy in the prevalence of myocardial bridging between the conventional angiography (average 5%, range 0.5% to 16%)[10,11] and the autopsy findings (average 33%, range 15% to 85%)[12]. Therefore, the detection of myocardial bridging is important as it is related to the cardiomyopathy and ischemic heart disease.

AIM

- To determine the prevalence of myocardial bridging and correlation with symptoms.
- To correlate the degree of flow reduction with TMT and symptoms of the patients. in a large urban Indian population of adults undergoing coronary angiography in Katuri Medical College & Hospital.

Keywords:

Coronary Artery Disease (CAD); ischemic heart disease; myocardial bridging; cardiac transplantation; coronary spasm

RESEARCH METHODOLOGY

The factor that differentiates observational and experimental study is that in experimental study design the study group comprises of subjects are either subjected to an intervention or not, whereas in the observational study design the investigator does not have any control over the study subjects. The investigator only observes and evaluate the strength of the association between the exposure and disease variable.

Retrospective study selects its subjects based on the exposure status and outcome data which were measured in the past are reconstructed for analysis. Retrospective cohort studies, which are otherwise called historical cohort studies, looks at the past to investigate certain medical events or outcomes, Advantages of retrospective study design are investigator's limited control over data collection and, since the data is immediately available, this study design is less expensive and time consuming. In addition, retrospective studies like prospective studies provide specific advantages of measuring disease occurrence and its association with an exposure. The most important factor in cohort studies such as retrospective study is categorizing the selected set of subjects based on the status at the start of the investigation. A prominent characteristic of subject selection is to have the exposed and unexposed groups from the same source population.

This study was conducted at KATURI MEDICAL COLLEGE & HOSPITAL, GUNTUR. The study retrospectively analyzed the angiographic data of 142 patients who were undergoing coronary angiography for deducting myocardial bridging. There were 104 men and 38 women; mean age-53.55 years; age range-28 TO 78 The patients were admitted at KATURI MEDICAL COLLEGE & HOSPITAL between FEB-2016 and JUNE-2023 with the diagnosis of likelihood for coronary artery disease and thus required diagnostic angiography. Each patient had one or more risk factors of coronary artery disease such as diabetes mellitus,

and hypertension. Patient characteristics such as age, gender, vascular risk factors and clinical presentation such as angina were recorded.

Myocardial bridging was described angiographically by Portmann and Iwig in 1960. The prevalence of this anomaly was more frequent than it was thought to be pathophysiological mechanisms of clinical presentations of myocardial bridge are supposed to be related to tendencies in the patients to develop atherosclerosis. Coronary angiography first began with the human heart catheterization in 1929.The method has evolved with a series of progressive technical and cultural developments. It has emerged into as a selective coronary angiography, direct needle vascular puncture, pre-shaped dedicated coronary catheters and refinement of radial access and thus has begun to make indispensable contribution to endovascular intervention. Characteristic angiographic feature of a myocardial bridge is systolic narrowing of an epicardial artery. This is most of the time completely resolved during the diastolic phase of the cardiac cycle. The diagnosis depends on the change in diameter between the systole and diastole within the bridged coronary segment. Coronary angiography presents a milking effect when there is 70 % and above reduction in minimal luminal diameter during systole and more than 35 % stable minimal luminal reduction during mid-to-late diastole. Intracoronary nitroglycerin injection is used to accentuate the systolic narrowing at the bridge, by dilating the blood vessels proximal to non-bridged coronary segments.

TECHNIQUE:

Quantitative coronary angiography (QCA) is a method to provide more objective interpretation of the coronary lumenogram than standard visual estimation. The greatest advantage of quantitative coronary angiography is its theoretical freedom from observer influences and bias, thereby minimizing significant potential intraobserver and interobserver variability.

EDGE DETECTION:

Once the image has been acquired and digitally processed, computer manipulation is performed. The most critical component of the computational analysis is the algorithm of boundary delineation within the area of interest. This method requires identification of the arterial segment to be analyzed and an accurate computer-assisted vessel edge delineation

In this study, Qualified cardiologists who determined the diameters of coronary lumen reviewed each angiogram retrospectively. Programmable digital caliper was used for angiographic quantification of systolic lumen compression. Systolic lumen diameter reduction and the length were measured. Left anterior oblique position as well as systolic lumen diameter reduction and length were measured.

Patients were divided into three groups corresponding to the degree of systolic compression. Patients in group 1 were those less than 50 per cent of systolic compression of the epicardial vessel imposed by myocardial bridge. It was considered as mild level. Patients in group were those with 50-70% systolic compression, which was of a moderaterange. Patients in whom there was more than 70% systolic compression,which was considered of a significant range, comprised the third group.

Cineangiographic projection that showed the highest level of bridging was used as to evaluate maximal systolic compression and the total length of the bridged segment. Every artery was observed closely for the presence of maximal percentage of systolic compression, myocardial bridging, total length of the bridging, and degree of flow reduction. Calibration with the given diameter of the coronary artery catheter was used to measure the length and diameter of arterial segment. In the caseof patients with multiple sites of bridging. The areaimpacted by bridging was defined using standard nomenclature of coronary artery disease. The degree of flow reduction was determined by the difference in the diastolic and systolic minimal luminal diameter (MLD).

Statistical Analysis

SPSS was used for data analysis. All data were verified for normal distribution prior to analysis and suitable test was used. All values were written as mean ± standard deviation unless they have not been suggested in the study. For determining the difference in the degree of flow reduction of MB, diameter and systolic lumen and length betweenthe end-systolic phase and end-diastolic phase independent sample test was used. Value less than 0.05 was considered statistically significant value

RESULTS

This study is a retrospective study. In this study evaluated patients seen between February 2016 and June 2023 admitted with a diagnosis of possible coronary artery disease (CAD) requiring diagnostic coronary angiography. The angiographic data of adult patients undergoing coronary angiography were retrospectively analyzed for the diagnosis of myocardialbridge. Quantitative coronary angiography was used for analysis. The sample size taken for the study n=142. Thus, using SPSS software the present study results analyzed. The analysis carried out was percentage analysis to find out the demographical information of respondents. Descriptive statistical measures were carried out in each variable. Analysis of Variance (ANOVA) is to compare the mean between more than two categorical variables. Chi-square analysis was used to find the association between categorical variables. P< 0.05 was considered statistically significant.

In relation to the prevalence of myocardial patients, of total 9464 angiogramspatients in 7 years in which 142 (1.5%) patients were affected by myocardialbridging.

In relation to sex of the patients, of total 142 patients, majority 104(73.2%) of the patients were male while 38 (26.8%) were female.

In relation to the frequency of age group of the patients, majority 54.2% of the patients were under 46-60 years's age group followed by, 23.2% of thepatients were >=60 years age group while 22.5% of the patients were <=45 years age group respectively.

In relation to the frequency of diabetes mellitus, majority 52.8% of thepatients are having diabetes mellitus while 47.2% of the patients do not havediabetes mellitus respectively.

In relation to the frequency of hypertension, majority 51.4% of the patients do not have hypertension while 48.6% of the patients have hypertension respectively.

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In relation to the frequency of treadmill test of the patients, out of 142 patients, majority 54.9% of the patients are nil while 45.1% of the patients arepositive respectively.

In relation to the frequency of angina of the patients, out of 142 patients, majority 71.1% of the patients are have angina while 28.9% of the patients don't have angina respectively.

In relation to the frequency of artery, out of 142 patients, majority 81% of the patients are have Mid-Segment Left anterior descending artery followed by, 17.6% of the patients have Distal Left anterior descending artery while 0.7% of the patients have Distal Right Coronary Artery and Anomalous Left Circumflex artery respectively.

In relation to the systolic length of the patients, majority 40.1% of the patients were 20 to 30 systolic length followed by, 31% of the patients were 10 to 20 systolic length, 25.4% of the patients are were 30 to 40 systolic length while least 1.4% of the patients were below 10 systolic length respectively.

In relation to the descriptive statistics of diastolic and systolic length of the patients. The average diastolic length is 25.37 SD 7.33 with maximum 40.4 and minimum 8.46, Minimal Lumen Diameter has average 15.21, SD 6.38 maximum 36 and minimum 0. While average length of systolic is 23.99,SD 7.29 with maximum 41.72 and minimum 8.44 respectively.

In Relationship between systolic length and diastolic length the Pearson correlation analysis, shows the linearity between the variables not the strength of association between dependent and independent variables represented by r and p value, while r is a degree of correlation and p signifiessignificance level. It is evident that diastolic length does showed a significant positive linear relationship with systolic length (r=0.898, p< 0.01).

In regards to the relationship between systolic length and diastolic length the Pearson correlation analysis, shows the linearity between the variables not the strength of association between dependent and independent variables represented by r and p value, while r is a degree of correlation and p signifies significance level. It is evident from the table that Systolic MLD% does showed a significant positive linear relationship with Diastolic MLD% (r=0.268, p< 0.01).

In relation to the mean difference in mean diastolic and systolic between male and female. Since p-value for diastolic length of MLD% (0.030<0.05) systolic length of hence MLD% (0.006<0.05), hence there is a significant difference in mean difference in mean diastolic and systolic between male and female. In male patients, diastolic length of MLD% has high mean (15.91±6.54) while compared to female patient's diastolic length of MLD% has low mean (13.29±5.57). In male patients, systolic length of MLD% has high mean (35.88±9.46) while compared to female patient'ssystolic length of MLD% has low mean (30.92±8.70).

In relation to the difference in mean diastolic and systolic length between hypertension. Since p>0.05, hence there is no significant difference in mean diastolic and systolic length between hypertension.

In relation to the difference in mean diastolic and systolic length between treadmill test. Since p>0.05, hence there is no significant difference in mean diastolic and systolic length between treadmill test.

In relation to the difference in mean diastolic and systolic lengthbetween angina. Since p-value for systolic length of MLD% (0.022<0.05), hence there is a significant difference in mean diastolic and systolic betweenangina. In systolic length of MLD% has high mean (37.41±9.95) while compared to systolic length of MLD% has low mean (33.39±9.48).

In relation to the association between treadmill test and sex, it is observed that 73.2% of the patients are belongs to male. Further 70.5% of themale patients have not done treadmill test while 76.6% of the male patients have positive treadmill test. From the observed chi-square value of 0.656 and p value of 0.418 which is greater than 0.05, hence there is no association between treadmill test and sex.

In relation to the association between angina and sex, it is observed that 73.2% of the angina patients belongs to male. Further 69.3% of the male patients have angina while 82.9% of the male patients have not angina. Fromthe observed chi-square value of 2.760 and p value of 0.097 which is greater than 0.05, hence there is no association between angina and sex.

In relation to the association between artery and sex, it is observed that 73.2% of the artery patients are belongs to male. Further 64% of the male patients have Distal Left anterior descending artery while 75.7% of the male patients have Mid Segment Left anterior descending artery. From the observed chi-square value of 4.533 and p value of 0.209 which is greater than 0.05, hence there is no association between artery and sex.

In relation to the association between treadmill test and age group, it isobserved that 52.6% of the patients are belongs to 46-60years age group. From the observed chi-square value of 2.120 and p value of 0.346 which is greaterthan 0.05, hence there is no association between treadmill test and age group.

In relation to the association between angina and age group, it is observed that 53.7% of the angina patients are belongs to 46-60years age group. From the observed chi-square value of 0.133 and p value of 0.936 which is greater than 0.05, hence there is no association between angina and age group.

In relation to the association between artery and age group, it isobserved that 54.2% of the artery patients are belongs to 46-60years age group. Further 52% of the 46-60 year's age group patients have Distal Left anterior descending artery while 53.9% of the 46-60 years age group patients have Mid segment Left anterior descending artery. From the observed chi- square value of 1.746 and p value of 0.941 which is greater than 0.05, hence there is no association between artery and age group. In relation to the degreeof flow reduction, mean of degree of flow reduction is 19.338, standard deviation 9.971 with maximum 45.00 and minimum 1.000 respectively.

In relation to the the frequency of degree of flow reduction. Majority 56.3% of the patients are mild followed by, 25.4% of the patients are moderate and 18.3% of the patients are severe respectively.

In relation to the association between sex and degree of flow reduction,it is observed that 73.2% of the patients are belongs to male. Further 68.8% of the male patients have mild, 77.8% of the male patients have moderate and80.8% of the male patients have severe. From the observed chi-square

value of 1.953 and p value of 0.377 which is greater than 0.05, hence there is no association between sex and degree of flow reduction.

In relation to the association between diabetes mellitus and degree of flow reduction, it is observed that 52.8% of the patients are belongs to diabetes mellitus. Further 51.2% of the diabetes patients have mild, 52.8% of the patients have moderate and 57.7% of the patients have severe. From the observed chi-square value of 0.327 and p value of 0.849 which is greater than 0.05, hence there is no association between diabetes mellitus and degree of flow reduction.

In relation to the association between hypertension and degree of flow reduction, it is observed that 51.4% of the patients are not belongs to hypertension. Further 52.5% of the hypertension patients have mild, 52.8% of the patients have moderate and 69.2% of the patients have not severe. From the observed chi-square value of 4.048 and p value of 0.132 which is greater than 0.05, hence there is no association between hypertension and degree of flow reduction.

In relation to the association between treadmill test and degree of flow reduction, it is observed that 54.9% of the patients are not belongs to treadmill test. Further 55% of the patients have mild, 50% of the patients have and have not moderate and 61.5% of the patients have severe. From the observed chi- square value of 0.812 and p value of 0.666 which is greater than 0.05, hence there is no association between treadmill test and degree of flow reduction.

In relation to the association between angina and degree of flow reduction, it is observed that 71.1% of the patients are not belongs to angina. Further 77.5% of the patients have not mild, 66.7% of the patients have not moderate and 57.7% of the patients have not severe. From the observed chi- square value of 4.216 and p value of 0.121 which is greater than 0.05, hence there is no association between angina and degree of flow reduction.

In relation to the association between artery and degree of flow reduction, it is observed that 81% of the artery patients are belongs to Mid Segment Left anterior descending artery. Further 82.5% of the patients have mild, 75% of the patients have moderate and 84.6% of the patients have severe. From the observed chi-square value of 6.256 and p value of 0.395 which is greater than 0.05, hence there is no association between artery and degree of flow reduction.

In relation to the association between age group and degree of flow reduction, it is observed that 54.2% of the patients are belongs to 46- 60 age group. Further 46.2% of 46-60 year's age group patients have mild followed by,75% of 46-60 years age group patients have moderate and 50% of 46-60 years age group patients have severe. From the observed chi-square value of 11.328 and p value of 0.023 which is less than 0.05, hence there is an association between age group and degree of flow reduction.
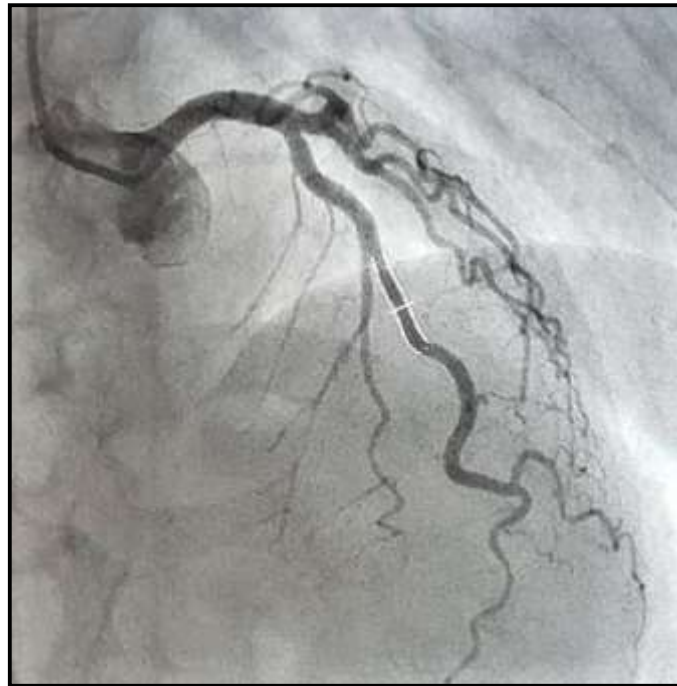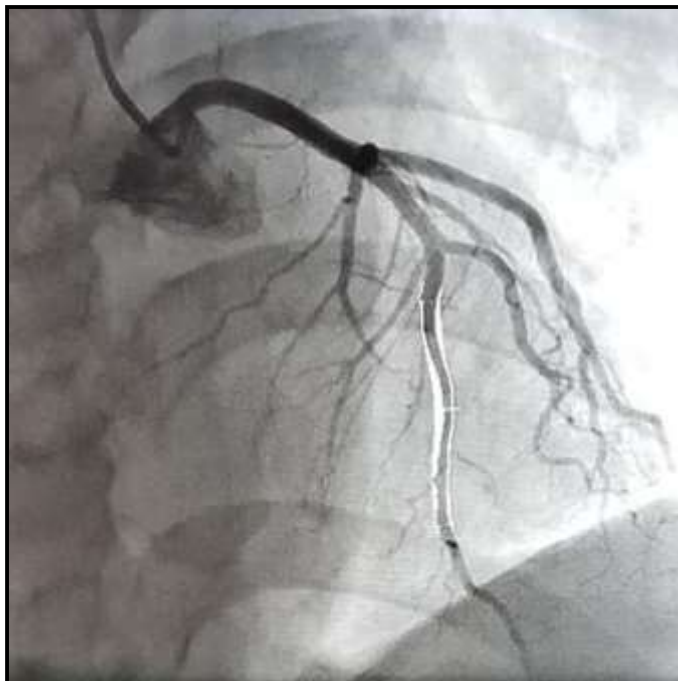
DIASTOLIC PHASE WITH SHORT SEGMENT
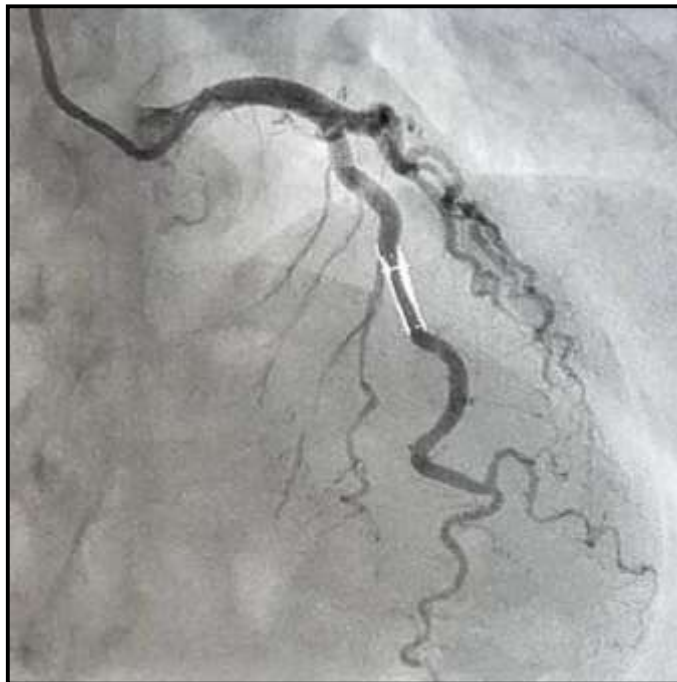
SYSTOLIC PHASE WITH MYOCARDIAL BRIDGING INVOLVING SHORT SEGMENT
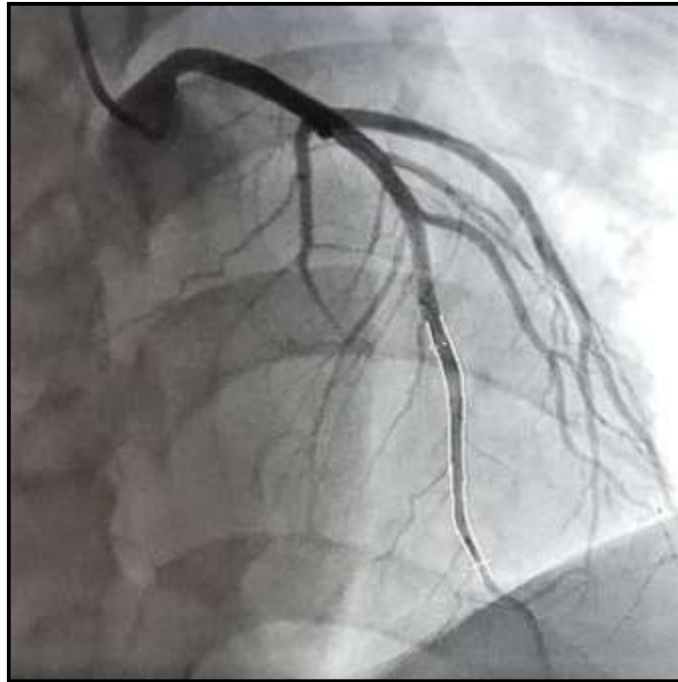
**DIASTOLIC PHASE WITHDISCRETE
LENGTH**

**SYSTOLIC PHASE WITH
MYOCARDIAL BRIDGING**

DISCUSSION

A total of 9464 angiograms patients in 7 years are considered in which 142 patients are affected by the myocardial bridging, which comes around 1.5%. In these 142 patients, the number of male and female patients is found to be 104 and 38 respectively and the percentage distribution is found to be 73.2% and 26.8%. The increased number of male patients with myocardial bridging is evident in another research done by Sujatha et al[13]. In this study, 64 myocardial bridge positive cases were considered. Among them about 62.5% had been male and about 37.5% had been female patients

Of 142 patients having myocardial bridging, majority of thepatients are under less than or equal to 45 age, which constitutesabout 22.2%. This is in line with the study done by Kantarci et al.[14]In the present study the most common artery involved in myocardial bridging is mid segment of the left anterior descendingartery with a frequency of 81.0% followed by distal segment ofLAD. Only 0.7% of the patients had anomalous LCX and distalRCA. Zeina et al.[15] also showed similarly 91% involvement of LAD.

In the Relationship between the systolic MLD% and diastolic MLD, it is clear that there is a positive linear relationship between the systolic MLD% and diastolic MLD%. This relationship is shown by the value of degree of correlation (r) which is 0.268, the p values of 0.030 for minimum lumen diameter percentage respectively show that there is a significant differencein mean between the male and the female for the diastolic length. For the systolic length, the p values are 0.006 for MLD. The p values for systolic length are 0.022 for MLD. This shows a significant difference in mean diastolic and systolic between angina.

Out of 142 people, 83.6% of males are not having the hypertension, but 37.7% of the females are having the hypertension. The p value of 0.004 shows that there is an association between hypertension and sex. From table 23, of 142 people, both males and females, the high incidence of diabetes occurs in the age group of 57 to 62 years, which constitutes 28%.The next high incidence of diabetes is in the age above 63 years, which amounts to 22.7%.

Out of 142 patients with myocardial bridging 26 patients i.e 18.3% were found to have severe degree of flow reduction with a male predominance of 80.8% and 57.7% of the patients were found to have diabetes mellitus. The patients with hypertension in severe degree of flow reduction is 30.8% which is less compared to mild and moderate TMT positive patients with severe degree of stenosis were 61.5%.The patients presenting with angina in severe degree of flow reduction were 42.3% which is more than mild and moderate degree of flow reduction. The most frequent artery involved in the severe degree of flow reduction is mid LAD with 81%. Almost 50% of the patients were between 46-60years of age group.

The moderate degree of flow reduction is seen in around 36 i.e 25.4% in which 77.8% were found to be male and 52.8% having diabetes mellitus and hypertension. TMT positive patients with moderate degree of flow reduction was 50% and patients having angina were 33.3%.The most frequent artery involved is mid LAD which is 75% and almost 75% of the patients involved were between 46-60years of age.

The mild degree of flow reduction is seen in 80 patients i.e.56.3% in which 68.8% were male and 51.2% having diabetes mellitus and 52.5% with HTN. Almost 55% of the patients were TMT positive and 22.5% having angina. The most frequent artery involved is mid LAD which is 82.5%. Around 46.2% patients involved were between 46-60 years of age group.

25% of the patients who are greater than or equal to 63 years of age have mild flow reduction, 36.1% of the patients who are between 46 and 51 years of age have moderate flow reduction, while 34.6% of the patients who are less than or equal to 45 years have severe flow reduction. The chi square of 13.552 and p value of 0.094 show that there is no association between age group and flow reduction.

CONCLUSION

From this study, there is a positive linear relationship between diastolic length and systolic length and MLD% of both diastolic and systolic. With respect to gender, there is a significant mean difference in mean diastolic and systolic. Diabetes has no significant difference in mean diastolic and systolic. Moreover, hypertension has no significant difference in mean diastolic and systolic. Undergoing treadmill test does not have significant difference in mean diastolic and systolic. However, there is a significant difference in mean diastolic and systolic between the patients with angina and without angina. From this study, it is concluded that there is

an association between the gender of the patients and incidence of diabetes mellitus and hypertension. Moreover, there is relation between the age group and the incidence of diabetes mellitus. No relationship can be found between the sex of the patients and treadmill test, angina, and artery. Moreover, age group has no association with hypertension, treadmill test, angina, and artery. With respect to degree of flow reduction, it shows the relationship between the severe degree of flow reduction with angina and TMT. It says that there is a public relevance among the patients presenting with angina and positive TMT may be due to the degree of flow reduction due to myocardial bridging other than MI,CAD. Myocardial bridging is a congenital anomaly. It is the coronary condition with many manifestations. The clinical relevance of this condition is debated. A congenital anomaly where the epicardial artery takes an intramyocardial course is called myocardial bridging. The result is the accelerated atherosclerosis caused by the flow alteration in the coronary segment which is in close proximity to the bridged segment. The smooth muscles in the area and the morphological changes in endothelial cells and the favorable shear forces resulting in the increased vasoactive agent's spares the bridged portion from atherosclerosis. The decrease in coronary flow reserve and systolic coronary flow reversal close to the bridge is the result of hemodynamic effects of bridging. The consequence of this bridging results in angina to acute coronary syndrome to sudden cardiac death. The treatment involves beta blockers with medical treatment and non-dihydropyridine calcium channel blockers. Reflex sympathetic activation results in hypercontractility and nitrates are contra indicated because of secondary tachycardia. Surgical myotomy, stenting and coronary artery bypass surgery is suggested for refractive symptoms. For the patients with myocardial bridging, a prospective randomized trial is required to identify the best treatment strategy.

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