Research Article

Myocardial bridges - A cadaveric study

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Abstract

Myocardial bridge is defined as an intramural segment of a coronary artery that normally courses epicardially. In the present study, dissection of coronary arteries was carried out in 150 adult human cadaveric hearts of unknown sex to find presence and location of myocardial bridges. Total incidence of myocardial bridges was noted to be 69.3%. Midportion of left anterior descending artery (LAD) is commonest part affected though almost all the significant branches of both the coronary arteries were involved. Most of the cases having myocardial bridges may remain asymptomatic but it may cause wide range of clinical complications such as angina, infraction, arrhythmias and sudden death.
Keywords: ischemia, myocardial bridges, mural coronary artery, tunneled artery.

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INTRODUCTION

The coronary arteries and their major branches travel along the surface of the heart under the epicardium but those in the atrioventricular and interventricular sulci are deeply sited, occasionally covered by overlying ventricular myocardium.[1] Epicardial artery may lie in the myocardium for part of its course and then reappears on heart's surface. So the muscle overlying the intra myocardial segment of an epicardial coronary artery is termed as myocardial bridge (MB). The artery coursing within the myocardium is called a tunneled artery.[2] This has been also called as a mural coronary artery or submerged coronary artery. This entity most commonly affects the mid-portion of the left anterior descending artery (LAD).[1,3-7] The clinical significance of myocardial bridges is uncertain. Myocardial bridges have traditionally been considered to be a benign congenital condition which is usually asymptomatic and has a favorable long-term outcome.[8,9] It has also been proposed that myocardial bridges offer a 'protective effect' from atherosclerosis within the coronary artery that is bridged when compared with non-bridged vessels of the same heart.[10] But there are many reports suggesting that the bridges could influence the dynamics of sclerotic changes and cause deficit of myocardium during high heart rate.[11] Myocardial bridges may contribute for the development of various clinical manifestations such as unstable angina[12,13], acute myocardial infarction[14,15], arrhythmia[16,17], sudden death[18,19] and other cardiac disturbances especially on exertion that may require surgical intervention. The prognosis of patients with myocardial bridges, therefore, is not as benign as it was believed to be in the past. Myocardial bridges have wide spectrum of morphological, functional, and clinical presentations which demand sound knowledge for accurate diagnosis and treatment of clinically significant cases. The present study has been undertaken for detailed anatomical study of myocardial bridges by dissection method.

MATERIAL AND METHODS

A study was conducted on 150 adult human cadaveric hearts collected from Department of Anatomy, B.V.D.U.Medical College and Hospital, Sangli and Pune. These hearts were preserved in 10% formalin. The epicardium and fat were removed piecemeal. Then two coronary arteries were dissected meticulously from origin to their termination and the presence and location of myocardial bridges were noted. Specimens showing myocardial bridges were numbered and photographed.

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RESULTS

Table 1: Showing incidence of myocardial bridges over arteries

Name of artery	No. of hearts	Percentage
Left anterior descending artery (LAD)	75	50
Obtuse marginal (left marginal) artery (OM)	27	18
Circumflex artery (Cx)	16	10.67
Right coronary artery (RCA)	19	12.67
Acute marginal (right marginal) artery (AMA)	9	6
Posterior interventricular artery (PIVA)	20	13.33
Right conus artery (RCoA)	2	1.33

Table 2: Showing distribution of myocardial bridges over left anterior descending Artery (LAD)

	No. of hearts showing myocardial bridges	Percentage
Proximal 1/3	24	16
Middle 1/3	48	32
Distal 1/3	3	2

In the present study, 69.3% incidence of myocardial bridges was noted. Midportion of left anterior descending artery (LAD) is commonest part affected though almost all the significant branches of both the coronary arteries were involved.

Table 3: Incidence of MBs and pattern of dominance

	MBs over LCA in RCAD	MBs over RCA in RCAD	MBs over LCA in LCAD	MBs over RCA in LCAD	MBs over LCA in CO	MBs over RCA in CO
No. of hearts	68	18	10	1	4	0
Percentage	45.33	12	6.66	0.66	2.66	0

LCA=Left coronary artery, RCAD= Right coronary artery dominance, LCAD= Left coronary artery dominance. CO= Co-dominance

An obstruction of the dominant artery due to MBs would result in widespread effect while in case of co-dominance or myocardial bridges on non-dominant coronary artery would reduce the severity of complications.

Figure 1: Myocardial bridge over middle 1/3 of left anterior descending artery

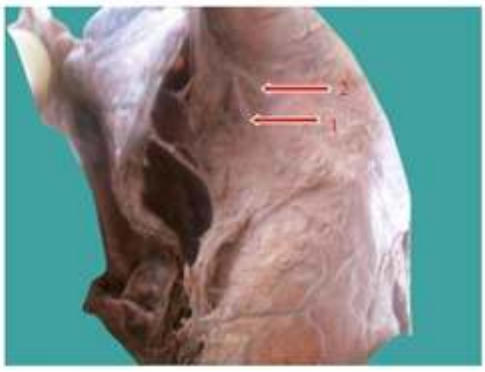

Figure 2: Myocardial bridges over right coronary artery (1) and its right conus branch (2)

Figure 3: Myocardial bridge over posterior interventricular artery

DISCUSSION

Myocardial bridges were first described by Rayman (1737) and then by the Black.[20,21] Polacek was the first to use the term "myocardial bridge" to describe a short bridging segment of myocardial muscle band.[3] The first post mortem examination of myocardial bridges was performed by Geiringer (1951) who used the term "mural coronary.[2] First radiological description of myocardial bridges was done by Portman and Ingrid (1960).[22] Ferreira *et al* categorized two types of myocardial segments; superficial and deep. Superficial type of myocardial bridges does not seem to constrict the artery during systole but the deep muscle bridge could twist the vessel and thus compromise the diastolic flow.[4] Hence only the deep intramural segments can be associated with ischemia because they are the only segments that present the milking phenomenon. There is a wide variation in the incidence of hearts showing myocardial bridges depending upon method of study used. The incidences of MBs in autopsy studies (15–85%) are much higher than angiographic studies (0.5–2.5%).[5] This disparity is due to the fact that angiography easily detects only the cases of intramyocardial segments with a systolic compression effect, or milking, but does not detect the cases where milking is absent. The Polacek (1961) examined 70 hearts and reported highest incidence (85.7%) of myocardial bridges.[3] He also suggested that muscular bands are present from birth and their development is closely associated with the growth of adjacent artery. Peralta *et al* stressed that, even though myocardial bridges are congenital, symptoms or problems related to them during childhood are extraordinarily rare, suggesting that extrinsic and chrono-biological factors should influence the progression of that entity.[23] A high prevalence has been reported in heart transplant recipients and in patients with hypertrophic obstructive cardiomyopathy (HOCM).[24,25]

Table 4: Incidence of myocardial bridges (MBs)

Dissection method		Present study	Bharambe V 2008[26]	Loukas 2006[27]	Ferreira 1991 [5]	Geiringer 1951[2]
Total incidence		69.3%	56%	34.50%	55.60%	23%
LADA	PROX.1/3	16%	20%	43.2%	Mainly over LADA but other arteries are not specified	Over LADA
	MID.1/3	32%	28%			
	DIST.1/3	2%	8%			
Diagonal branch		-	16%	17.2%	-	-
OM		18%	8%	7.4%	-	-
RCA		12.67%	4%	18.50%	-	-
PIVA		13.33%	6%	6.1% over branch of LCA and 2.4% over branch of RCA	-	-
AMA		6%	-	4.9%	-	-
C_x		10.67%	-	-	-	-
RC_oA		1.33%				

Myocardial bridging is thought to be a benign anatomic variation since it is a common finding at autopsy of normal subjects and many patients with myocardial bridges remain asymptomatic throughout life. But several complications like angina, myocardial infarction, arrhythmias, exercise induced atrio-ventricular conduction block, transient ventricular dysfunction and sudden death have been reported due to myocardial

bridges.[12-19,27-29] Yukio Ishikawa stated two distinct mechanisms for explaining coronary heart disease in patient with myocardial bridges. One is direct compression of the LAD by myocardial bridge at cardiac systole, resulting in delayed arterial relaxation at diastole, reduced blood flow reserve, and decreased blood perfusion. The other is enhancement of coronary atherosclerosis narrowing of the LAD proximal to the MB, occurring because of endothelial injury provoked by retrograde blood flow up toward the left coronary ostium at cardiac systole.[30] Most of the patients having myocardial bridges present a decreased reserve of coronary flow which is lower than normal ischemia threshold. In these cases this flow reserve is sufficient in baseline situations and ischemia is only manifested in situations of increased oxygen demand like exercise, pacing-induced tachycardia, or stress produced by anaesthesia. Agirbasli M suggested that myocardial bridges should be added to the list of known causes of sudden death or myocardial infarction in young individuals after strenuous exercise.[31] The possible reason could be an increase in sympathetic drive during stress or exercise which may facilitate ischemia, because tachycardia leads to an increase of the systolic-diastolic time ratio at the expense of diastolic flow. Increased contractility during stress further aggravates systolic (and diastolic) compression.[32] Endothelial dysfunction and coronary artery spasm may also contribute to constriction of the tunneled segment. Hill *et al* (1981) found that surgical resection of the muscle bridge often relieved the functional disturbance. He also suggested that possibility of myocardial bridge should be born in mind in individuals with ischemia but no evidence of coronary atherosclerosis.[33] The MBs are the risk factor for certain surgical interventions particularly in aorto-coronary bypass that affect the left anterior descending artery. This is because the submerged portion of the artery is at only few millimeters from the right ventricle and there is a risk of perforation during surgical maneuvers to identify the artery.[34] Incidence of MBs over right conus artery and acute marginal artery reported in present study has a special importance. In cases that involve the handling of the right infundibulum for instance, to repair congenital trunco-conal cardiopathies or to replace cardiac valves, a conal artery or the initial portion of an acute marginal artery partially covered by MB may be sectioned.[35] The angiographic appearance at the site of myocardial bridge shows distortion resembling focal disease process and could result in misinterpretations in coronary angiographies.[3] Considering the epidemiological prevalence of this anomaly, clinical suspicion of a myocardial bridge should be made in all cases of typical or atypical chest pain in subjects who have a low probability of coronary atherosclerosis particularly in the young.

CONCLUSION

Midportion of left anterior descending artery is the commonest to be affected by myocardial bridges. Myocardial bridging even though considered as a benign condition, it can occasionally produce clinically important complications.

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