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The Anatomical Study of Myocardial Bridges in Cadaveric Human Heart

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ABSTRACT

A band of heart muscle that covers a coronary artery is known as myocardial bridge. In the myocardial bridge, a part of the coronary artery dips underneath the heart muscle and then come out again. According to literature, for the most part, a myocardial bridge is harmless but few patients can develop myocardial ischemia because of it. This study was done on 50 cadaveric human hearts in department of Anatomy, Netaji Subhash Chandra Bose Medical College Jabalpur. The dissection was done under water. The visceral pericardium was removed, and by micro dissection the RCA and LCA were exposed and presence of myocardial bridges over various branches of coronary arteries and its lengths were noted. During study, myocardial bridges were found in 17 (34%) cases. Total 27 myocardial bridges were found. Out of these 27 bridges 13 bridges were found on LAD, 8 bridges were found on Left Diagonal Artery, 2 bridges on Left Marginal Artery, 2 bridges on PIVA and 2 on Posterior Right Diagonal Artery. The length of myocardial bridges ranged between 5 to 35 mm. The average length of myocardial bridges was 16.52 mm ± 7.41. The average length of myocardial bridge on various arteries was: on LAD 27.1 mm ± 11.39, on LDA 12.4 mm ± 5.68, on LMA 17.5 mm ± 3.54, on PIVA mm 14 ± 1.41 and on PRDA 25 mm. Myocardial bridging is a congenital, generally benign condition that is a common angiographic and autopsy finding. Thus Aim of present study was to see the incidence of myocardial bridges over various branches of coronary artery and review the available literature.

KEYWORDS Myocardial Bridge, Coronary artery.

Introduction:
Muscle overlying the intra-myocardial segment of an epicardial coronary artery, first mentioned by Reyman[1] in 1737 and first described angiographically by Portmann and Iwig[2] in 1960, is termed as myocardial bridge(MB) and the artery running within the myocardium is called a tunnelled artery. It remains clinically silent in the vast majority of cases.

However, some patients can develop myocardial ischemia because of a myocardial bridge. Luckily, most of the blood flow through the heart happens during the "rest" phase of the heartbeat, not during the "squeezing" phase. The tightening of the bridge on the artery can decrease blood flow enough so that myocardial ischemia develops, especially during exercise or when the heart is beating hastily. As such bridging is often seen in normal individuals, it is clear that not all arteries bridged by myocardial segments produce clinical symptoms thereby suggesting that this feature may simply be an anatomical variant. However, some authors who have considered these bridges as the cause of cardiac ischemia have suggested two potential mechanisms for their patho-physiology. The first is a phasic systolic compression of the bridged segment with persistent mid-to-late diastolic reduction in arterial diameter and second proposes a reduction in arterial flow. Both mechanisms may contribute to a reduced reserve in coronary blood flow.[3]

The accurate prevalence of myocardial bridging is not known. In autopsy series, myocardial bridging was found in 5% to 86% of the cases.[4,5,6] Myocardial bridges are most commonly localized in the middle segment of the left anterior descending coronary artery (LAD)[7] length of ≈10 to 30 mm. less frequently in the Left circumflex artery and occasionally seen in the Right Coronary Artery. Deformation is predominantly eccentric[8], as confirmed by intravascular ultrasound (IVUS) based studies. Intra-operative high-frequency epicardial echocardiography has been used to localize the muscle bridge and tunneled artery[9]

Material and method:
Study was done in 50 cadaveric human heart in department of anatomy Netaji Subhash Chandra Bose Medical College Jabalpur (M.P.). The dissection was done under water. The visceral pericardium was removed, and by micro dissection the RCA and LCA were exposed and presence of myocardial bridges over various branches of coronary arteries and its lengths were noted. Values are shown as mean ± SD.

Results
Table – 1: Presence of Myocardial Bridge(N=50)

Presence of Myocardial Bridge at	Number and percentage of specimens	
	No.	%
Left Anterior Descending Artery (LAD)	13	26
Left Diagonal Artery (LDA)	8	16
Left Marginal Artery (LMA)	2	4
Posterior Interventricular Artery (PIVA)	2	4
Posterior right diagonal Artery (PRDA)	2	4

Table –2: Mean length of myocardial bridge at various positions.

Position of Myocardial bridge at	Total (mean length in mm ± SD)
Left Anterior Descending Artery (LAD)	27.1 ± 11.39
Left Diagonal Artery (LDA)	12.4 ± 5.68
Left Marginal Artery (LMA)	17.5 ± 3.54
Posterior Interventricular Artery (PIVA)	14 ± 1.41
Posterior right diagonal Artery (PRDA)	25

During study of myocardial bridges, they were found in 17 (34%) cases. Total 27 myocardial bridges were found in 50 hearts. As shown in table 1 out of these 27 bridges 13 were found on LAD, 8 bridges were found on Left Diagonal Artery, 2 bridges on Left Marginal Artery, 2 bridges on PIVA and 2 on Posterior Right Diagonal Artery.

As shown in table No. 2, the length of myocardial bridges ranged between 5 to 35 mm. The average length of myocardial bridges was 16.52 mm ± 7.41. The average length of myocardial bridge on various arteries was: on LAD 27.1 mm ± 11.39, on LDA 12.4 mm ± 5.68, on LMA 17.5 mm ± 3.54, on PIVA mm 14 ± 1.41 and on PRDA 25 mm

Discussion:

Table-3: Numbers of Myocardial Bridges found

Presence of Myocardial Bridge at	H. Saidi et al (2010) (N= 109)	Present study (N=50)
Left Anterior Descending Artery (LAD)	40	13
Left Diagonal Artery (LDA)	0	8
Left Marginal Artery (LMA)	1	2
Posterior Interventricular Artery (PIVA)	0	2
Left Circumflex Artery (LCxA)	1	0
Right Coronary Artery (RCA)	1	0
Posterior right diagonal Artery (PRDA)	0	2
Others	2	0

Various studies have been done over myocardial bridges; their presence and their length. Finding based upon few studies are as under:

According to H. Saidi et al [10](2010), in their study on 109 hearts they found total 45 myocardial bridges. Out of these myocardial bridges, most of bridges were found on LAD, being accurate 40 bridges i.e. 88.89%. Remaining 5 bridges were found at various arteries viz. one on LMA, one on LCx, one on RCA and two on other. As stated in the study, average length of total Myocardial Bridge was 22.66 ± 11.94 mm. Average length of Myocardial bridges in males was 22.49 ± 11.67 and the same in women was 23.22 ± 13.52.

In the presence of two parallel LAD branches, one frequently takes an intramural course, diagonal and marginal branches may involved in 18% and 40% of cases, respectively[11].

Juilliere Y, Berder V et al (1995) noted that among 7467 consecutive coronary angiograms performed during over a 8-year period, 61 patients had myocardial bridge of the left anterior descending coronary artery. The overall prevalence of myocardial bridges was 0.82% .[12]

Mavi A, Sercelik A et al (2008) noted that myocardial bridges were present in 29 (0.4%) out of 7200 cases in which coronary angiographies had been performed. The locations of the myocardial bridges were in the left anterior descending coronary artery in 28 cases, and the left circumflex coronary artery in 1 case only. Myocardial bridges were most commonly found in the middle segment of the left anterior descending coronary artery (78.5%).[13]

Angiographically, myocardial bridges are almost exclusively spotted in the LAD. They are located at a depth of 1 to 10 mm. Myocardial bridges have conventionally been considered to be a benign condition, but several recent studies have demonstrated that their clinical complications may be dangerous; these complications include ischemia and acute coronary syndromes, coronary spasm, ventricular septal rupture, arrhythmias (including supra-ventricular tachycardia and ventricular tachycardia), exercise-induced atrioventricular conduction blocks transient ventricular dysfunction and sudden death. The prognosis of patients with myocardial bridges, therefore, is not as benign as it was believed to be in the past.[14]

Schwarz et al. studied 15 patients who had myocardial bridging, in which the luminal diameter was decreased at least 70% during systole.[15] Myocardial bridging occurs frequently in patients with hypertrophic cardiomyopathy, with a prevalence as high as 30%.[16,17]

Myocardial bridge predisposes to the development of atherosclerosis in the coronary artery segment proximal to the bridge. This may indicate that myocardial bridge should be considered as an anatomic risk factor in the evaluation of Coronary Arterial Disease (CAD). Atherosclerotic changes have been shown to affect the segment immediately proximal to the myocardial bridge, whereas, the occurrence of atheromatous changes in the tunneled coronary segment is still controversial. Some investigators think that the tunneled segment is spared, but others believe that this segment is not protected.[18]

It has been demonstrated that the intima of the tunneled artery is considerably thinner than that of the proximal segment of the artery. Morphological changes in the endothelial cells have also been noted, which suggests that the intima in the artery underneath the myocardial bridge may be sheltered by hemodynamic factors. Some studies have reported that the expression of vasoactive agents (endothelin-1, endothelial nitric oxide synthase, angiotensin converting enzyme) and the expansion of the atherosclerotic process are diminished in the myocardial bridge compared with the proximal and subsequent artery segments. The preliminary data obtained up to now, therefore, propose that the myocardial bridge is associated with a greater development of atherosclerosis in the proximal artery segment compared with the tunneled artery.[19.]

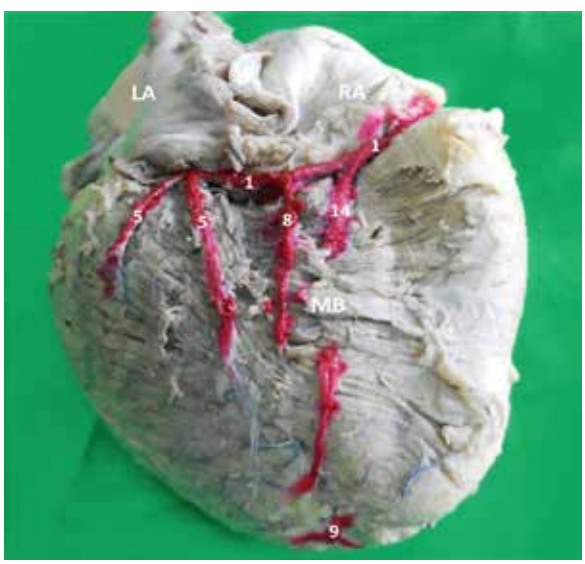
Therapeutic approaches that have been attempted for myocardial bridging include b-blockers[13,] calcium channel blockers, stents[20-25] minimally invasive coronary artery bypass grafting (CABG)[26] and surgical myotomy[27-29.] In addition, myocardial bridging may present a technical challenge during coronary arterial bypass because surgical exposure of the intramuscular coronary artery may be difficult and may require the use of intraoperative echocardiography [30,31]

Conclusion:

Myocardial bridging is a congenital, usually benign condition that is a common angiographic and autopsy finding. As some literature says it is an anatomical variant only and some states that it is an anatomic risk factor in the evaluation of CAD. Further, data are needed to establish the role of myocardial bridges in, myocardial ischemia, acute coronary syndromes, coronary spasm, ventricular septal rupture, arrhythmia, so, more study is required to be conducted on the topic.

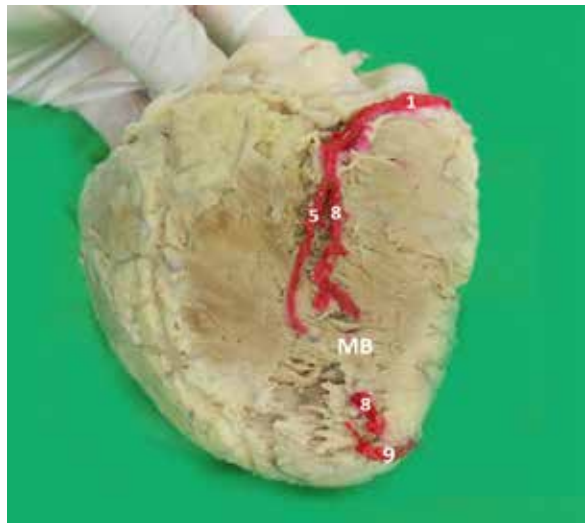
Photograph No. 1 – Myocardial bridges over LAD & LDA. (Anterior view)

Photograph No. 2– Myocardial bridge over left marginal artery. (Lateral view)



Photograph No. 3 – Myocardial bridge over posterior right diagonal artery. (Posterior view)

Photograph No. 4– Myocardial bridge over LAD. (Anterior view)



Photograph No. 5 – Myocardial bridge over posterior interventricular artery

Key to Photographs

1 -Right Coronary Artery
2 -Left Coronary Artery
3 -Right Conus Artery
4 -Atrial branch
5 -Ventricular branch
6 -Sinu-atrial Nodal Artery
7 -Right Marginal Artery
8 -Posterior Interventricular Artery
9 -Left Anterior descending Artery (Anterior Interventricular Artery)
10 -Left Circumflex Artery
11 -Left Marginal Artery
12 -Left Diagonal Artery
13 -Intermediate artery/ Ramus diagonalis/ Median artery
14 -Posterior Right Diagonal Artery
15 -Atrioventricular Nodal Artery
16 -Third Coronary Artery
17 -Fourth Coronary Artery
RA -Right Atrium
LA -Left Atrium
AA-Ascending Aorta
PT -Pulmonary trunk
AAS - Anterior Aortic Sinus
PAS - Posterior Aortic Sinus

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