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Original Article

Cadaveric Study Of Septomarginal Trabecular Arteries

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ABSTRACT

Aim- To analyze the morphological features of the septomarginal trabecular artery. **Methods-** A total of 100 cadaveric human hearts were studied by dissection method. The artery supplying the septomarginal trabecula was dissected thoroughly from its origin till it pierced the septomarginal trabecula. The course, diameter at the origin, length of this artery was noted. Presence of myocardial bridges in relation to the left anterior descending LAD and septomarginal trabecular artery was noted. **Results-** The blood supply of septomarginal trabecula in all cases was derived from one of the interventricular septal branches of the LAD artery. Total 101 arteries were dissected since one of the trabeculae received a dual blood supply from two septal branches. It was predominantly i.e. in 61.4% of cases derived from the 2nd interventricular septal branch of the LAD artery. **Conclusion-** The origin of the Septomarginal trabecular arteries was constant i.e from LAD artery. Usually one of the first four branches of the LAD serves as the artery to the septomarginal trabecula. The artery arises at an obtuse angle to the LAD. The caliber of this artery is proved to be sufficient for application of a stent. The presence of myocardial bridge may affect the artery functionally but less likely morphologically. Considering the development of new hemodynamic procedures for the diagnosis and treatment of cardiovascular diseases, the knowledge regarding this small artery is necessary, particularly in view of recent proposals for the revascularization of this vessel and its visualization on the coronariography.

1. Introduction

The Septomarginal Trabecula is a specialized bridge extending from right side of ventricular septum to the base of anterior papillary muscle. It reinforces the septal surface where, at the base, it divides into limbs that embrace the supraventricular crest. The trabecula conveys right branch of the atrioventricular bundle through the interventricular septum which plays an essential role in ventricular function since it contains important elements of the cardiac conduction system and comprises a large portion of the myocardium[1,2,3]. Towards the apex, the trabecula supports the anterior papillary muscle of the tricuspid valve and, from this point, crosses to the parietal wall of the ventricle as the 'moderator band' (this alternative name records an old idea that the septomarginal trabecula prevents overdistension of the ventricle)[4].

The septum is considered to be the most densely vascularized portion of the heart,[5] and is perfused mainly by anterior and posterior interventricular septal branches arising from the coronary arteries[2]. Anterior interventricular septal branches emerging from the proximal segments of the left anterior interventricular artery also supply blood to the septomarginal trabecula.

Function of septomarginal trabecula depends on its blood supply which is derived from anterior interventricular septal branch originating from epicardial and/or intramyocardial LAD artery. Coronary arteries are characterized by subepicardial localization. The coronary artery may dip into the myocardium for varying lengths and then reappear on heart's surface. This segment of coronary artery is known as tunneled artery[4]. The muscle overlying the intramyocardial segment of the epicardial coronary artery (Tunneled artery) is termed as the myocardial bridge (MB). LAD artery is most prone to have myocardial bridges which may affect the blood supply of septomarginal trabecula.

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The coronary arteries fill in diastole. With each systole the coronary artery is compressed. This systolic contraction is followed by delayed diastolic relaxation which is identified in humans as an important mechanism contributing to ischemia with frame-by-frame analysis of IVUS images[6,7]. The likelihood of ischemia also increases with the intramyocardial depth of the tunneled segment. An increase in sympathetic drive during stress or exercise likely facilitates 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[8]. Endothelial dysfunction and coronary artery spasm may also contribute to constriction of the tunneled segment. If the tunneled LAD segment of the artery is compressed during systole, it can lead to reduced blood supply to the area distal to obstruction & in anterior interventricular septal branches and may produce disturbance in heart conduction. This reduction of blood supply to moderator band also depends on diameter of anterior intrventricular septal branch at its origin from LAD artery, its distance from coronary ostium, its angulation with LAD artery, etc.

According to previous studies the anterior inertventricular septal branch to the septomarginal trabecula is accessible to revascularization and other hemodynamic interventions if it meets the procedural requirements[6].

Despite the large number of studies on the vascularization of the interventricular septum, few reports have focused on the relationship between the anterior interventricular septal branches and the septomarginal trabecula.

Considering the development of new hemodynamic procedures for the diagnosis and treatment of cardiovascular diseases, an improvement in our knowledge of the morphology of the major anterior interventricular septal branch that irrigates the septomarginal trabecula is necessary.

2. Materials And Methods

A total of 100 cadaveric human hearts were included in this study irrespective of sex. All the parameters were studied by dissection method. The hearts procured from the dissection hall were thoroughly washed under running tap water to remove all clots. They were numbered. The entire course of left coronary artery (LCA) was traced by cleaning the epicardium and fat piecemeal using proper instruments.

The left coronary artery was dissected from its origin. The numbers of terminal branches originating from the main trunk of LCA were determined. The left anterior descending (LAD) artery extending from its origin to the apex of the heart and sometimes beyond it was dissected.

A meticulous dissection was carried out to study the course of anterior interventricular septal branches arising from the LAD artery. The dissection included the careful removal of the anterior wall of the right ventricle to expose the interventricular septum and preserve the septomarginal trabecula. The artery supplying the septomarginal trabecula was dissected from its origin till it pierced the trabecula. With the help of the Vernier's caliper the external diameter of this artery at its origin from LAD was measured. With the help of the silk thread and Vernier's caliper the length of this artery was measured. The method of silk thread was used for accurate measurements along curved course of the artery. Similarly the distance between the origin of the left coronary artery i.e. its ostium and origin of the septomarginal trabecular artery was measured.

3. RESULTS

Table 1: Distribution of study group as per, origin of septal branch from LAD that supplied septomarginal trabecula Green arrow-Right anterior papillary muscle

Blue arrow- Septomarginal trabecula

White arrow- Left anterior descending artery

Yellow arrow- 4th septal branch supplying the septomarginal trabecula

Branch 1st / 2nd of LAD	Frequency	Percent
1st	12	11.9
2nd	62	61.4
3rd	20	19.8
4th	7	6.9
Total	101	100.0

LAD-left anterior descending, Br-branch, LAD- left anterior descending

The interventricular septal branch supplying the septomarginal trabecula can arise from 1st, 2nd, 3rd or 4th branch of the LAD artery. 100 specimens showed presence of 101 branches since one of the hearts had a dual supply to septomarginal trabecula. Frequency of septomarginal branch arising from 1st branch was 12(11.9%), from 2nd it was 62(61.4%), from 3rd 20(19.8%) and from 4th branch it was 7(6.9%). It signifies that in most of the cases the artery supplying the septomarginal trabecula was arising from the 2nd septal branch of LAD artery.

Figure no.1: Septal branch of LAD artery supplying the septomarginal trabecula

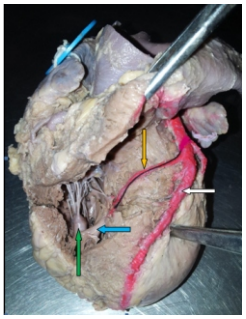


Table 2. Distribution of study group as per origin of septomarginal branch from LAD whether bridged or non-bridged

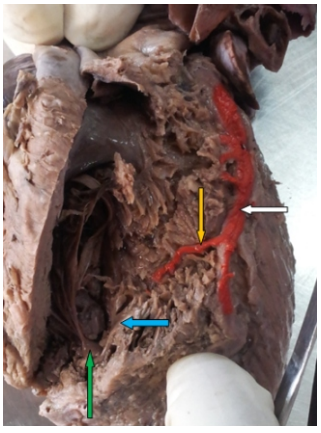
Bridged	Frequency	Percent
Bridged	22	21.8
Non-Bridge	79	78.2
Total	101	100.0

LAD-left anterior descending, Br-branch, LAD- left anterior descending

Out of 101(100%) septomarginal arteries 22(21.8%) were derived from the respective LAD arteries covered by the myocardial bridges. Amongst the rest i.e in 79 hearts it was coming from the respective non-bridged or normal LAD arteries.

Figure no. 2: Myocardial bridge on middle part of LAD artery

Figure3. The 4th anterior septal branch of Left anterior descending artery supplying the septomarginal trabecula



Green arrow-Right anterior papillary muscle
Blue arrow- Septomarginal trabecula
White arrow- Left anterior descending artery
Yellow arrow- 4th septal branch supplying the septomarginal trabecula

Table No 3: Comparison among study group for length of septomarginal artery

Length	N	Mean (mm)	Std Dev	Median	IQR	Minimum (mm)	Maximum (mm	Unpaired T test	P value
Bridged	22	42.42	10.33	38.41	19.64	25.87	65.44	1.678	0.097
Non-Bridge	79	38.63	9.11	38.93	11.67	19.67	67.64	Difference is not significant	

(mm-millimeter, N-number, std Dev- standard deviation)

The septomarginal trabecular arteries arising from the bridged LAD were 22 having mean length of 42.42mm (range 25.87-65.44mm), standard deviation of 10.33, median of 38.41and IQR of 25.87. The same parameters for the arteries arising from non-bridged LAD were mean 38.63 (range 19.67-67.64), standard deviation of 9.11, median of 38.93. The unpaired t test gave results as 1.678 and the p value was 0.097. It shows that there is no relation of length of septomarginal trabecular artery and presence of MB at its origin. In both the cases the length was more or less same.

Table No 4: Comparison among study group for, diameter of septomarginal artery

Diam	N	Mean (mm)	Std Dev	Median	IQR	Minimum	Maximum	Unpaired T test	P value
Bridged	22	2.36	0.55	2.33	0.70	1.30	3.87	-0.114	0.909
Non-Bridge	79	2.38	0.55	2.24	0.88	1.11	3.70	Difference is not significant	

(Diam-diameter, N-number, mm-millimeter)

The diameter of the septomarginal trabecular artery at the origin from the main trunk of LAD artery, when it was bridged, had mean of 2.36 (range 1.30-3.87mm) with standard deviation of 0.55, median of 2.33. The same parameters for the arteries arising from non-bridged LAD were mean 2.38 (range 1.11-3.70), standard deviation of 0.55, median of 2.24, IQR of 0.88.The unpaired t test gave results of -0.114 and the p value was 0.909. There is no relation of diameter of septomarginal trabecular artery and presence of MB at its origin. In both the cases the diameter was more or less same.

Table No 5: Comparison among study group for, Distance from coronary ostium and origin of septomarginal artery

Distn from coronary ost	N	Mean (mm)	Std Dev	Median	IQR	Minimum	Maximum	Unpaired T test	P value
Bridged	22	44.17	9.51	43.76	8.57	1.30	73.59	1.655	0.101
Non-Bridge	79	39.95	10.81	40.93	13.74	1.11	67.34	Difference is not significant	

(Distn-distance, Ost-ostium)

The distance of the origin of septomarginal trabecular artery from the left coronary ostium, when it was bridged, had mean of 44.17 (range 33-73.59mm) with standard deviation of 9.51, median of 43.76 and IQR of 8.57. The unpaired t test gave results of -0.114 and the p value was 0.909. and when it was non bridged the distance was 39.95mm.

4. DISCUSSION

The aim of this study was to examine the morphological features of the anterior interventricular septal branches that supply blood to the septomarginal trabecula. The vascularization of the septomarginal trabecula is almost always derived from the LAD artery via the first, second or third anterior interventricular septal branches[7].

Table no 6: Comparison of septal branches of LAD which gave the branch to septomarginal trabecula

Author and year	Septal br of LAD which served as artery to septomarginal trabecula (%)			
	1st br	2nd br	3rd br	4th br
Possatti LL et al[10] in 2005	52.5	42.5	5	-
Present study	11.9	61.4	19.8	6.9

(br-branch, LAD-left anterior descending)

Possatti LL et al[10] found the 1st interventricular septal branch of LAD artery serving as the septomarginal trabecular artery in highest i.e.52.5% cases. In many other studies it was usually the 2nd branch which served as the septomarginal artery. In present study the 2nd branch of the LAD artery, in most cases, i.e.61.4% served as the branch to septomarginal trabecula. The blood supply of trabecula was also found to be derived from 3rd branch of LAD in 5% and 19.8% cases according to Possatti et al[10] and present study respectively. Possatti LL et al[10] however did not report the 4th branch of LAD to be the artery of trabecula. In present study it was found to serve as the same in 6.9% cases.

Table No 7: comparison of the distance of septal branch to trabecula from coronary ostium

Author and year	Which br of LAD	Average dist (mm)
Possatti LL et al[10] in 2005	1st	32.62
	2nd	40.53
	3rd	34
Present study	1st	31.26
	2nd	47.8
	3rd	50.84
	4th	48.73

(br-branch, dist-distance, mm-millimeter, LAD- left anterior descending)

In present study the distance between the origin of 1st septal branch and the left coronary ostium was 31.26mm. The same distance for the 2nd, 3rd and 4th branches was 47.8mm, 50.84mm, 48.73mm respectively. All the findings in present study are having the higher values than Possatti et al[10].

Table No 8: Comparison of the external diameter of septal branches

Author and year	Average external diam (mm)
Possatti LL et al[10] in 2005	1.62± 0.37
Present study	2.36±0.55 (for bridged arteries) 2.38±0.55 (for non bridged arteries)

(diam-diameter, mm-millimeter)

According to Possatti LL et al[10] the external diameter at the origin of the interventricular septal branch ranged from 1.0 mm to 2.35 mm (mean: 1.62 ± 0.37 mm).

According to present study the external diameter was 2.36±0.55mm for the septal branches which at their origin were covered by the MB. It was almost same for the branches which were not covered at their origin by MB.

Stoney WS et al[11] stated that the interventricular septal branch was large enough to sustain a graft if the proximal portion was 1.5 mm in diameter, which was the case in 30% of the angiographies reviewed, as reported by Bedard P et al[12]. Topaz O et al[13,14] demonstrated that angioplasty provided an excellent method for revascularizing the interventricular septal branches, as long as the vessel diameter was at least 2 mm.

Vemuri DN et al[15] noted that the interventricular septal branch was large enough for hemodynamic interventions in approximately 30% of the patients, whereas in the present study 17.5% of the branches had a diameter >2 mm and were therefore suitable for angioplasty. Topaz O et al[13,14] encountered certain technical difficulties during angioplasty, particularly in relation to the sharp anatomical angle between the left anterior interventricular artery and the origin of the interventricular septal branch, and the marked tendency of atherosclerotic lesions to affect the ostium and the very proximal portion of this branch.

Based on angiographies, Kostis JB et al[16] reported that systolic obliteration and disappearance of blood supply of the septomarginal trabecula of the anterior interventricular septal

branches with subsequent diastolic reappearance occurred in aortic stenosis in association with myocardial bridges over the origin of a given vessel in 10% of cases.

Haupt HM[17]suggested that right ventricular infarction occurs when there is an obstruction to potential collateral flow from the left anterior descending coronary artery system, especially through the artery of the moderator band.

Pichard AD et al[18] observed septal perforator compression in patients with Idiopathic hypertrophic subaortic stenosis and in one patient with hypertrophic cardiomyopathy without obstruction.

Kostis JB et al[16]showed that in addition to cardiomyopathy, septal perforator compression occurs in patients with valvular aortic stenosis, in patients with severe obstructive lesions of the LAD and in patients with myocardial bridge.

The obstruction may facilitate the compression of the septal perforators by decreasing the intraluminal pressure in these vessels.

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