

MORPHOLOGICAL STUDY OF THE HUMAN MITRAL-AORTIC INTERVALVULAR FIBROSA

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ABSTRACT

The mitral-aortic intervalvular fibrosa of the heart is of great clinical and surgical importance, because of its involvement in the anatomical and functional integrity of these two valves. In this work, we examined the morphology of the mitral-aortic intervalvular fibrosa and its relationship to the mitral and aortic valves. Thirty formaldehyde-fixed adult human hearts of both sexes were dissected and the structural organization, dimensions and area of the mitral-aortic intervalvular fibrosa were determined. The mitral-aortic intervalvular fibrosa was a thin, translucent membranous area located between the root of the aortic artery and the left atrioventricular orifice. In most cases (63%), the mitral-aortic intervalvular fibrosa was approximately triangular in shape, with an area of $93.9 \pm 47.4 \text{ mm}^2$. The lower edge was associated with the anterior cusp of the mitral valve and was $18.0 \pm 2.2 \text{ mm}$ long, whereas the anterior edge was continuous with the left fibrous trigone and was $10.6 \pm 3.0 \text{ mm}$ long. The posterior edge was associated with the aortic wall and was continuous with the right fibrous trigone. This edge was $11.7 \pm 3.4 \text{ mm}$ long. These results may be useful for manufacturing prostheses to substitute this injured membrane.

Key words: Human heart, mitral-aortic intervalvular fibrosa, mitral-aortic membrane

INTRODUCTION

The mitral-aortic intervalvular fibrosa, also known as the mitral-aortic membrane, is a fibrous region of the heart that is of great clinical and surgical importance, because of its location between mitral and aortic valves and its involvement in the anatomical and functional integrity of these two valves. The mitral-aortic intervalvular fibrosa can be damaged by endocarditis, degenerative calcifications or surgery of the mitral or aortic valvular system [5]. Damage to the mitral-aortic intervalvular fibrosa during substitution of the aortic valve can lead to the formation of pseudoaneurysms or other complications [6,15]. Pseudoaneurysms can cause mitral valve dysfunction [7] and angina through compression of the left coronary artery [2,12]. In addition, rupture of this membrane during endocarditis may result in a secondary communication between the left ventricle and the left atrium [1].

There is little information about the structural organization of the mitral-aortic intervalvular fibrosa. The fibrous tissue of the mitral valve is reported to be continuous with the fibrous aortic ring, and a dis-

cret change in thickness marks the insertion of the mitral valve [10]. However, in some cases, the mitral fibrous ring is incomplete and does not occur in the antero-medial region of the orifice. This arrangement suggests a continuity between the collagenous fibers of the anterior cusp of the mitral valve and those of the mitral-aortic intervalvular fibrosa [3]. Considering the anatomical and physiological importance of this structure, in this work we examined the morphology of the mitral-aortic membrane and its relationship to neighboring structures. The findings reported here could be useful for manufacturing prostheses to replace injured membranes.

MATERIAL AND METHODS

Thirth hearts fixed in 10% formaldehyde solution were used and were from adult cadavers of both sexes with ages varying from 37 to 73 years old that belonged to the Department of Anatomy of the Center for Biological Sciences of the Federal University of Pernambuco.

The left and right atria were removed from the hearts through an incision along the coronary furrow, after which the epicardium was removed and the areas then cleaned. The anatomical region of interest was examined with transillumination to allow better visualization of its form and limits. The dimensions of the mitral-aortic intervalvular fibrosa were measured using a ruler and calipers and these values were used to calculate the area. The structural organization of the mitral-aortic intervalvular fibrosa was also recorded. The collected data were placed in tables and analyzed statistically. Later, the observed structures were photographed for documentation.

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RESULTS

The mitral-aortic intervalvular fibrosa was a membranous structure with a thin, translucent wall and was located between the root of the aortic artery and the left atrioventricular orifice. In most cases (19 hearts, 63%), the mitral-aortic membrane was triangular (Fig. 1). However, in six hearts (20%), the mitral-aortic intervalvular fibrosa was rectangular in the lower region and triangular in the upper region (Fig. 2), and in five hearts (17%) it was completely rectangular (Fig. 3).

The area of the mitral-aortic intervalvular fibrosa was $93.9 \pm 47.4 \text{ mm}^2$. In most cases (57%), the posterior edge was associated with the root of the aortic artery and the right fibrous trigone and was $11.7 \pm 3.4 \text{ mm}$ long. Similarly, the anterior edge of the membrane was continuous with the root of the aortic artery and the left fibrous trigone was $10.6 \pm 3.1 \text{ mm}$ long. In six hearts (20%), the anterior edge was larger than the posterior while in seven hearts (23%), the two edges were of the same measure. The inferior edge of the mitral-aortic intervalvular fibrosa was continuous with the anterior cusp of the mitral valve and was $18.0 \pm 2.2 \text{ mm}$ long (Fig. 2).

DISCUSSION

The occurrence of pseudoaneurysms in the mitral-aortic intervalvular fibrosa is a rare, but potentially fatal complication of aortic and mitral valve surgeries, of valvular infective endocarditis and of thoracic trauma [6]. Since the mitral-aortic intervalvular fibrosa is relatively avascular and offers little resistance to infection [12], infection of this tissue may result in the formation of abscesses or pseudoaneurysms, or a direct communication from the left ventricular outflow to the left atrium [9]. Pseudoaneurysms in the mitral-aortic region represent a complication of infective endocarditis [1,4,9,12,14] since they may rupture into the pericardial sac to cause potentially fatal hemopericardium [4,8], or into the left atrium to cause mitral regurgitation [1,9,14]. In some cases, the pseudoaneurysm may remain intact and appear as a pulsating cavity of systolic expansion during examination [11,13,15]. In addition, a pseudoaneurysm in the mitral-aortic intervalvular fibrosa can compress the left coronary artery and lead to clinical signs of chest angina [2,12].

As shown here the mitral-aortic intervalvular fibrosa is an area of very thin tissue when compared

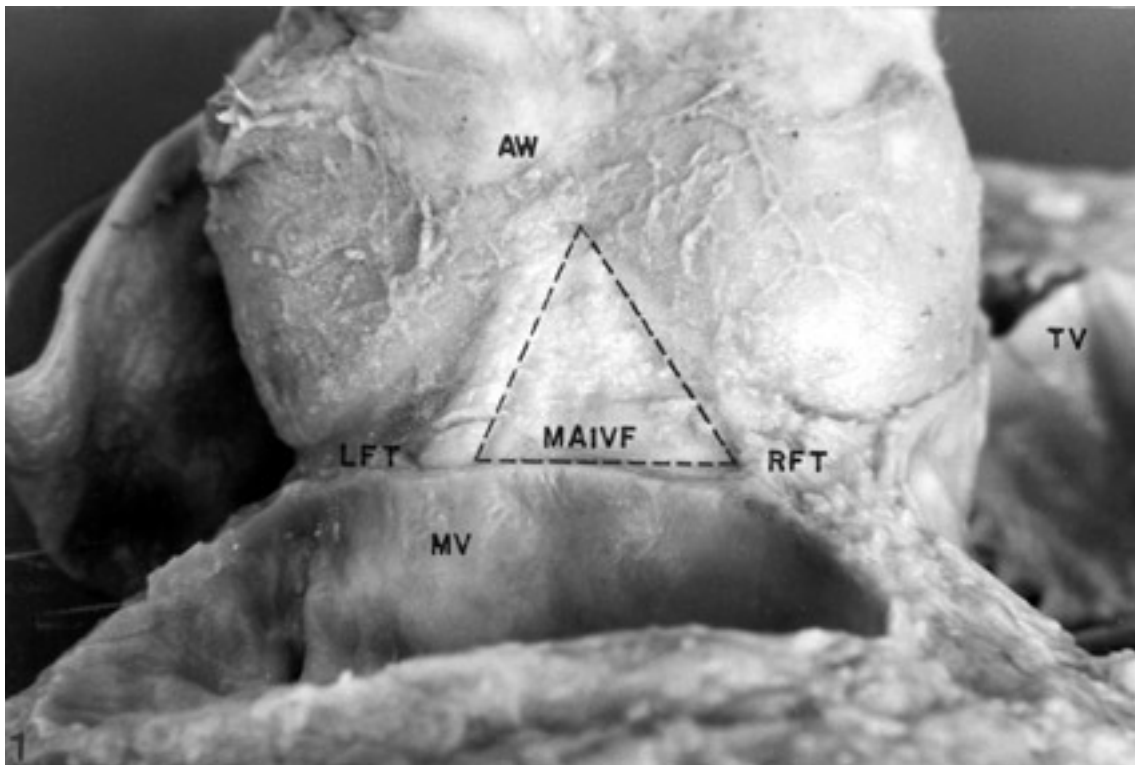


Figure 1. Photograph of a heart after removal of the atrium showing the triangular aspect of the mitral-aortic intervalvular fibrosa (MAIVF). AW- aortic wall, MV- mitral valve, TV- tricuspid valve, RFT- right fibrous trigone.

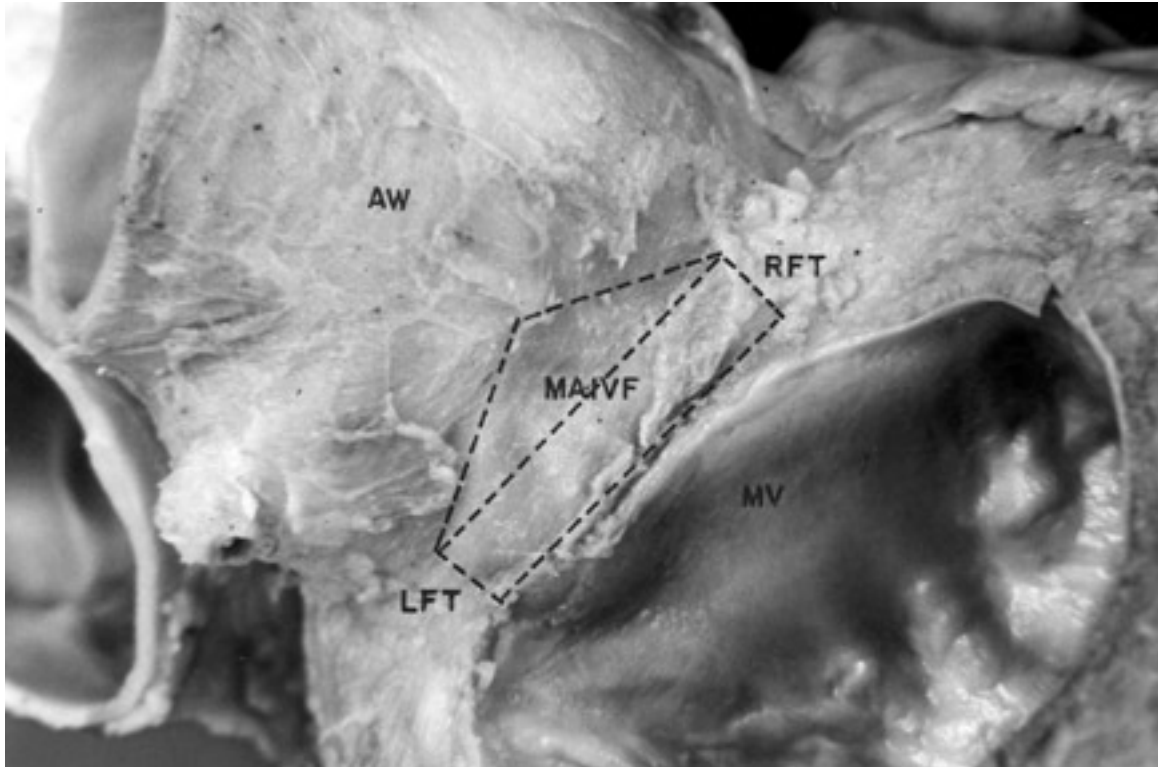


Figure 2. Photograph of a heart showing the upper triangular and lower rectangular aspects of the mitral-aortic intervalvular fibrosa (MAIVF). AW- aortic wall, MV- mitral valve, RFT- right fibrous trigone, LFT- left fibrous trigone.

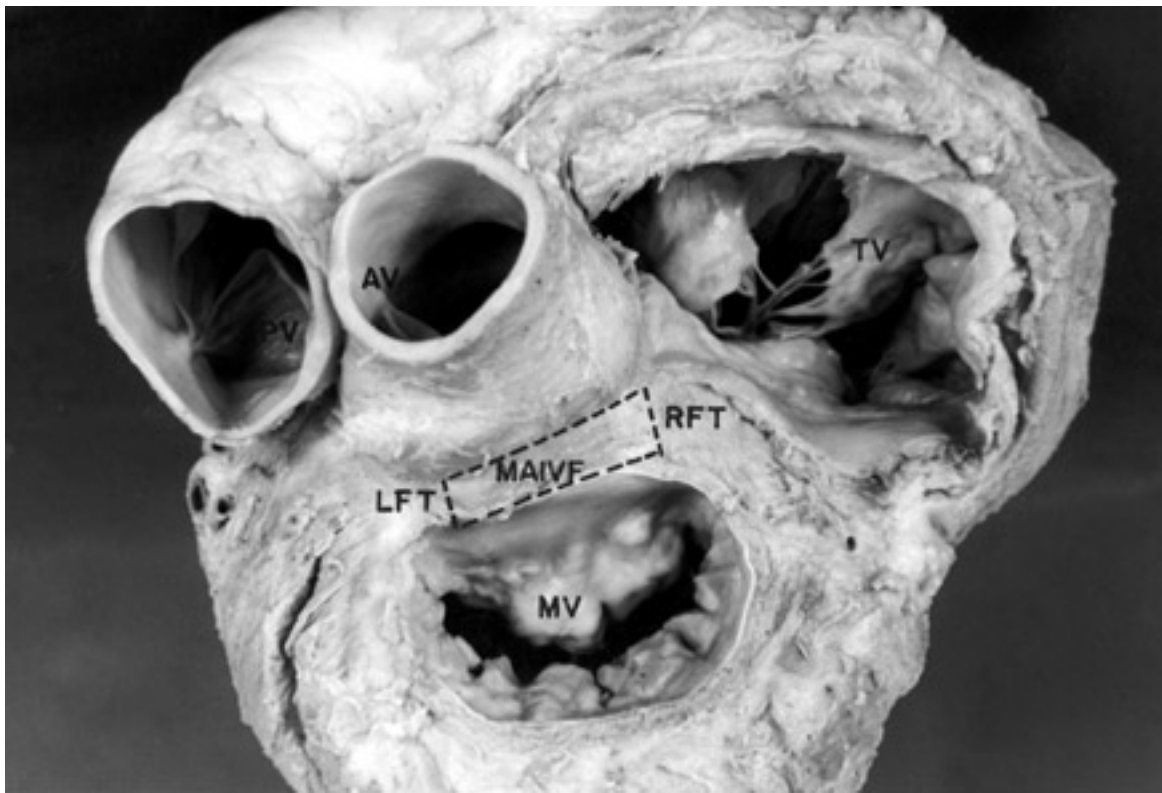


Figure 3. Photograph of a heart showing the rectangular aspect of the mitral-aortic intervalvular fibrosa (MAIVR). MV- mitral valve, TV- tricuspid valve, AV- aortic valve, PV- pulmonary valve, RFT- right fibrous trigone, LFT- left fibrous trigone.

with the aortic wall or the anterior cusp of the mitral valve. The fibrous mitral ring has been reported to be incomplete anteriorly in the mitral-aortic region and our findings agree with this condition. The thin, fragile constitution of this region increases its susceptibility to secondary dilation following valvular surgery, endocarditis or thoracic trauma and can lead to the appearance of pseudoaneurysms that may eventually rupture [3]. The propensity of this region to damage means that a detailed anatomical knowledge is necessary when planning surgical interventions in order to avoid complications such as pseudoaneurysms and mitral regurgitation [6,14]. In some cases of surgical intervention to replace the mitral and aortic valves, reconstruction of the mitral-aortic intervalvular fibrosa is used to prevent subsequent complications [5].

In most of the cases studied here the mitral-aortic intervalvular fibrosa was triangular in shape, and its base was continuous with the anterior cusp of the mitral valve. The sides of this triangle were approximately of the same length, with the posterior edge being continuous with the right fibrous trigone. The area of this membrane varied considerably among the hearts.

REFERENCES

1. Bansal RC, Graham BM, Jutzy KR, Shakudo M, Shah PM (1990) Left ventricular outflow tract to left atrial communication secondary to rupture of mitral-aortic intervalvular fibrosa in infective endocarditis: diagnosis by transesophageal echocardiography and color flow imaging. *J. Am. Coll. Cardiol.* **15**, 499-504.
2. Bier AJ, Lamphere JA, Daily PO (1995) Coronary artery compression caused by a large pseudoaneurysm of the mitral-aortic intervalvular fibrosa. *J. Am. Soc. Echocardiogr.* **8**, 753-756.
3. Cavalcanti JS, Oliveira Ede, Godoi ET, Santos LP, de Lima e Silva VX, Oliveira ML (1997) Mesoscopic study of the mitral valve and its fibrous ring. *Arq. Bras. Cardiol.* **69**, 243-246.
4. Chesler E, Korn ME, Porter GE, Reyes CN, Edwards JE (1968) False aneurysm of the left ventricle secondary to bacterial endocarditis with perforation of the mitral-aortic intervalvular fibrosa. *Circulation* **37**, 518-523.
5. David TE, Kuo J, Armstrong S (1997) Aortic and mitral valve replacement with reconstruction of the intervalvular fibrous body. *J. Thorac. Cardiovasc. Surg.* **114**, 766-771.
6. Delgado C, Barturen F (1999) Pseudoaneurysm of the mitral-aortic fibrosa secondary to the partial detachment of a mechanical aortic prosthesis. *Rev. Esp. Cardiol.* **52**, 348-350.
7. Espinosa-Caliani JS, Montijano A, Melero JM, Montiel A (2000) Pseudoaneurysm in the mitral-aortic intervalvular fibrosa. A cause of mitral regurgitation. *Eur. J. Cardiothorac. Surg.* **17**, 757-759.
8. Qizibash AH, Schwartz CJ (1973) False aneurysm of left ventricle due to perforation of mitral-aortic intervalvular fibrosa with rupture and cardiac tamponade. Rare complication of infective endocarditis. *Am. J. Cardiol.* **32**, 110-113.
9. Karalis DG, Bansal RC, Hauck AJ, Ross Jr J, Applegate PM, Jutzy KR, Mintz GS, Chandrasekaran K (1992) Transesophageal echocardiographic recognition of subaortic complications in aortic valve endocarditis. Clinical and surgical implications. *Circulation* **86**, 353-362.
10. Kopuz C, Erk K, Baris YS, Onderoglu S, Sinav A (1995) Morphometry of the fibrous ring of the mitral valve. *Anat. Anz.* **177**, 151-154.
11. Meyerowitz CB, Jacobs LE, Kotler MN, Ioli AW, Wertheimer JH (1991) Four-year follow-up of a pseudoaneurysm of the mitral-aortic fibrosa. *Am. Heart J.* **122**, 589-592.
12. Parashara DK, Jacobs LE, Kotler MN, Yazdanfar S, Spielman SR, Janzer SF, Bemis CE (1995) Angina caused by systolic compression of the left coronary artery as a result of pseudoaneurysm of the mitral-aortic intervalvular fibrosa. *Am. Heart J.* **129**, 417-421.
13. Reid CL, McKay C, Kawanishi DT, Edwards C, Rahimtoola SH, Chandraratna PA (1983) False aneurysm of mitral-aortic intervalvular fibrosa: diagnosis by 2 dimensional contrast echocardiography at cardiac catheterization. *Am. J. Cardiol.* **51**, 1801-1802.
14. Schwartz DR, Belkin RN, Pucillo AL, Burleson PD, Fish BG, Pooley RW, Weiss MB, Herman MV (1990) Aneurysm of the mitral-aortic intervalvular fibrosa complicating infective endocarditis: preoperative characterization by two-dimensional and color flow Doppler echocardiography, magnetic resonance imaging, and cineangiography. *Am. Heart J.* **119**, 196-199.
15. Sousa L, Branco L, Abreu J, Rasteiro R, Salomão S, Antunes AM (1999) A pseudoaneurysm of the mitral-aortic intervalvular fibrosis after aortic valve replacement. *Rev. Port. Cardiol.* **18**, 177-178.

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