

Ventricle Shape: Why Three Atrioventricular Leaflets on the Right Side?

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ABSTRACT

Introduction: despite the evidence about the development of AVV the reason why there is a difference in the number of leaflets between the heart sides remains poorly understood. The present manuscript proposes a hypothesis based on ventricular shape to explain this questioning.

Short Communication: the left ventricle has a structure formed mainly by the anterior, posterior, and septal walls that are not very distinct due to its circular configuration. On the other hand, the right ventricle has a very evident triangular shape formed by three well-defined walls, anterior, posterior, and septal, including the formation of the right margin of the heart at the junction of the anterior and posterior walls.

Conclusion: considering morphological and functional terms, two leaflets can occlude a circular structure, however, three leaflets are necessary to occlude a triangular structure as occurs in the right ventricle. "The shape and plastic image of function".

Keywords: Atrioventricular valve; Endocardio; Anatomy.

Introduction

The right and left atrioventricular valves (AVV) garnish their respective ostiums, these are obliterated during ventricular systole¹. The right atrioventricular valve is composed of three valves (anterior, posterior, and septal); the left is formed by two leaflets (anterior and posterior)^{1,2}. The AVVs on both sides are formed by a fold of endocardium, being an inner layer of the

heart consisting of elastic tissue. The larger leaflets are related to the outflow of blood from the ventricle, that is, the anterior leaflets of both^{1,2}.

In this context, the atrioventricular ostia and their respective fibrous rings have different shapes. The right ostium is triangular with walls forming acute angles; the left has a more rounded or oval appearance (Figure 1). The AVV of the heart play a crucial role in

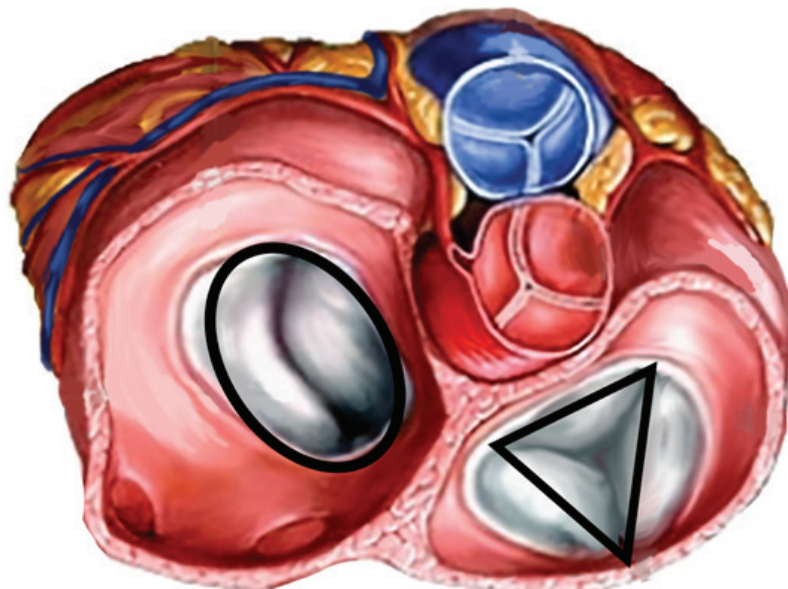


Figure 1. As valvas atrioventriculares esquerda e direita acompanham o formato dos seus respectivos óstios atrioventriculares esquerdo (circular) e direito (triangular).

the correct functioning of blood flow in the systemic and pulmonary circulation³. Despite the evidence about the development of AVV the reason why there is a difference in the number of leaflets between the heart sides remains poorly understood. The present manuscript proposes a hypothesis based on ventricular shape to explain this questioning.

Short Communication

The beginnings of AVV start from the fifth week of embryological development⁴. During this period, a gradual transformation of endocardial to mesenchymal epithelial tissue is mediated by several molecular processes, growth factors, signaling cascades, and transcription factors⁴. The anatomical description of AVV supports the hypothesis that there is an embryologic morphological pattern that induces the formation of three leaflets in the right ventricle and two in the left. In addition, there is also a “positional” pattern of fixing with anterior and posterior leaflets being described for both ventricles and a third septal leaflets for the right, which is generally smaller in relation to the others.

The left ventricle has a structure formed mainly by the anterior, posterior, and septal walls that are not very distinct due to its circular configuration⁵. On the other hand, the right ventricle has a very evident triangular shape formed by three well-defined walls, anterior, posterior, and septal, including the formation of the

right margin of the heart at the junction of the anterior and posterior walls^{4,5}. The interventricular septum has a convexity facing the right ventricle and an evident concavity in the left, thus justifying the characteristic shape of each ventricle. The AVV are attached to two fibrous rings, right and left. The left atrioventricular ostium is generally circular, while the right atrium presents a flattening in the interventricular septum that accompanies the convexity of that region^{1,4}.

Considering all this evidence and that the heart has a mesenchymal site for each wall of the right ventricle^{3,4}, we hypothesize that there is this need to have three mesenchymal origins in the right ventricle due to its triangular shape (Figure 2). It is possible that the convexity of the interventricular septum on the right side requires this third septal leaflet, while the left ventricle due to its circular shape is supplied by two leaflets.

The prevalence of cases for right ventricular regurgitation indicates the complexity between the shape of right ventricle and its AVV, which is crucial for the functional mechanism⁴⁻⁶. In addition, the morphology of the right ventricle have been associated to several outcomes post-surgical⁷.

In conclusion, considering morphological and functional terms, two leaflets can occlude a circular structure, however, three leaflets are necessary to occlude a triangular structure as occurs in the right ventricle. “The shape and plastic image of function”.

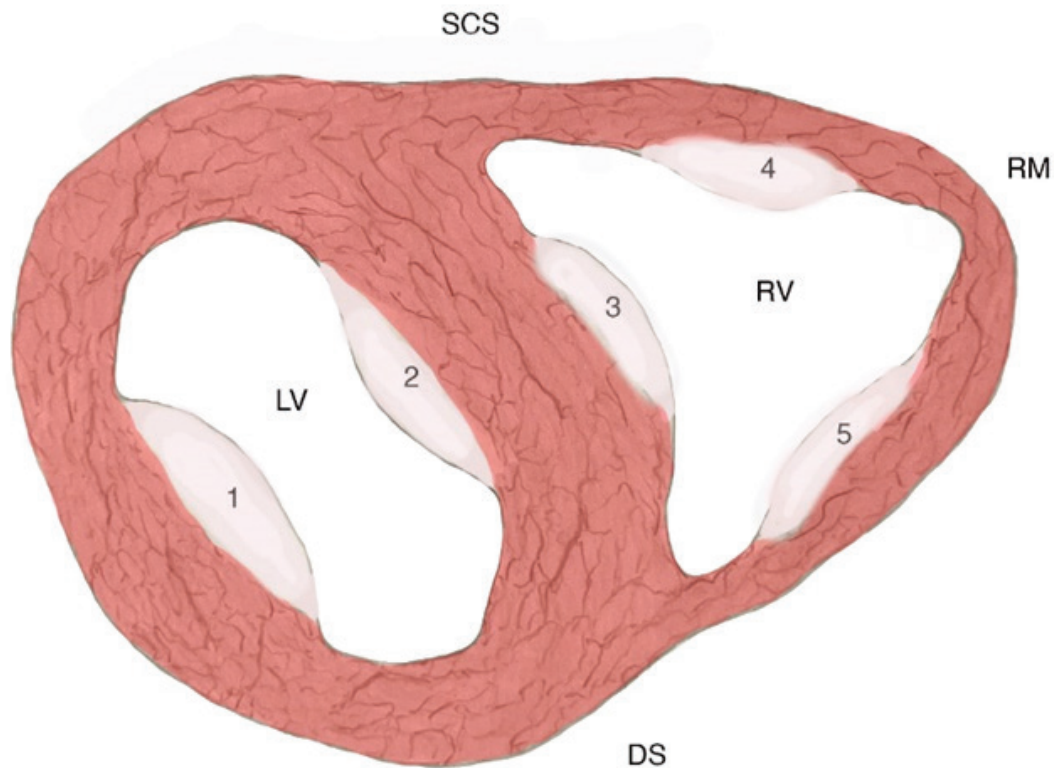


Figure 2. Superior view of the ventricles in a transversal section. The schematic illustration shows the beginning of the mesenchymal development of the atrioventricular valves. Of note, the triangular shape of the right ventricle with 3 primordial sites: septal, anterior, and posterior. SCS, sternocostal surface; DS, diaphragmatic surface; LV, left ventricle; RV, right ventricle; RM, margo right. 1 and 2, left atrioventricular valves. 3, 4, and 5, right atrioventricular valves.

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