



Morphological Study of Right Ventricular Papillary Muscles

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Abstract

Introduction: Papillary muscles play an important role in the integrity of tricuspid valve complex. Right ventricle normally has 3 papillary muscles. Papillary muscles can present with many heads. Variations in the anatomy of papillary muscles can lead to functional alterations and so focus is done on the morphology of papillary muscles of right ventricle in this study.

Materials and Methods: The study was conducted in 45 adult human heart obtained from embalmed cadavers in Institute of Anatomy, Madras Medical College, Chennai, Tamilnadu by conventional dissection method.

Results: Anterior and posterior papillary muscles were present in all heart specimens. Septal papillary muscles were present only in 77.8%. Anterior papillary muscle presented with single belly in 37 hearts, double bellies in 7 specimens and triple bellies in 1 heart. Posterior papillary muscle presented with single belly in 17 hearts, double bellies in 20 hearts and triple bellies in 8 hearts. Septal papillary muscle was absent in 10 hearts, presented with one belly in 7 hearts, double bellies in 14 hearts and triple bellies in 10 hearts and four bellies in 4 hearts.

Conclusion: Variations in papillary muscles is clinically significant for assessing the cardiac function and a wide knowledge of such variations is important for cardiologists.

Keywords: Heart, Papillary muscle, Right ventricle, Tricuspid, Variation

Introduction

Tricuspid Valve sometimes called the “Forgotten Valve” and a “Second-Class Structure” in Cardiac Surgery. It can be a potential source of considerable morbidity and mortality, both when it is a primary site of disease and when it is secondarily involved in left heart or pulmonary vascular disease[1].

The Tricuspid valve complex consists of functional units which include Tricuspid annulus, valve leaflets, chordae tendineae and papillary muscles. The papillary muscles of the heart are pillar-like muscles

seen within the cavity of ventricles, attached to their walls. They have an integral role in proper cardiac valvular function[2].

The right ventricle contains three papillary muscles, classically described as anterior, posterior, and septal [3]. The anterior is larger and arises from the anterior wall, the posterior arises from the inferior wall, and the smallest of them all, the septal arises from the inter-ventricular septum. Chordae tendineae form the thin fibrous connection between the papillary muscles and the mitral and tricuspid valve leaflets [4]. Physiologic variants of the papillary muscles can

include modifications in muscle morphology, ventricular wall origin, and chordae attachment. Morphological variants can be described based on the number of papillary muscle heads and the presence of shared or separate basal origins [5].

Numerous variations in configuration of the cusp tissue and chordal/papillary support of the tricuspid valve make the interior of right ventricle as unique to each individual as one’s finger print [6].

Advances in echocardiography, invasive cardiology and surgical reconstruction of Tricuspid valves necessitate an appreciation of the many variations in the anatomy of the Tricuspid valve for Interventional Cardiologists and Cardiac Surgeons.

Materials And Methods

The study was conducted in 45 adult human hearts obtained from embalmed cadavers in Institute of Anatomy, Madras Medical College, Chennai, Tamilnadu by conventional dissection method after duly getting clearance from the Institutional Review Board. Heart is sectioned along its acute margin. The section passed near the antero posterior commissure of the right atrioventricular valve with an incision from the right atrium to the apex of the right ventricle. After opening, the heart is washed under running tap water to remove blood

clots. Dissection of myocardium was carried out from the right AV fibrous ring to the origin of papillary muscles, preserving the integrity of the valve apparatus. Papillary muscles were observed for its presence and number. The same was photographed for its documentation.

Results

In the present study, Anterior and posterior papillary muscles were present in 45 hearts (100%). The septal papillary muscles were present only in 35 hearts (77.8%).

The anterior papillary muscles were the largest and arose from anterolateral ventricular wall and thier chordae tendineae attached to anterior and posterior cusps. Posterior papillary muscles were smaller compared to anterior papillary muscle and arose from inferior wall of right ventricle, its chordae were attached to posterior and septal cusps. Septal papillary muscles were small, multiple (Figure 1) and arose mostly from interventricular septum and some arose from posterior septal limb of septomarginal trabeculae. In 10 heart specimens there were no septal papillary muscles, where chordae arose directly from ventricular wall (Figure 2). Number of bellies of the papillary muscles were enlisted in Table no.1

Table 1 : Number of Bellies present in each Papillary Muscle

No. of Bellies	Anterior Papillary Muscle	Septal Papillary Muscle	Posterior Papillary Muscle
Absent	0	10(22.2%)	0
Single	37(82.2%)	7(15.6%)	17(37.8%)
Two	7(15.6%)	14(31.1%)	20(44.4%)
Three	1(2.2%)	10(22.2%)	8(17.8%)
Four	0	4(8.9%)	0

Figure 1 : Four Small Septal Papillary Muscle

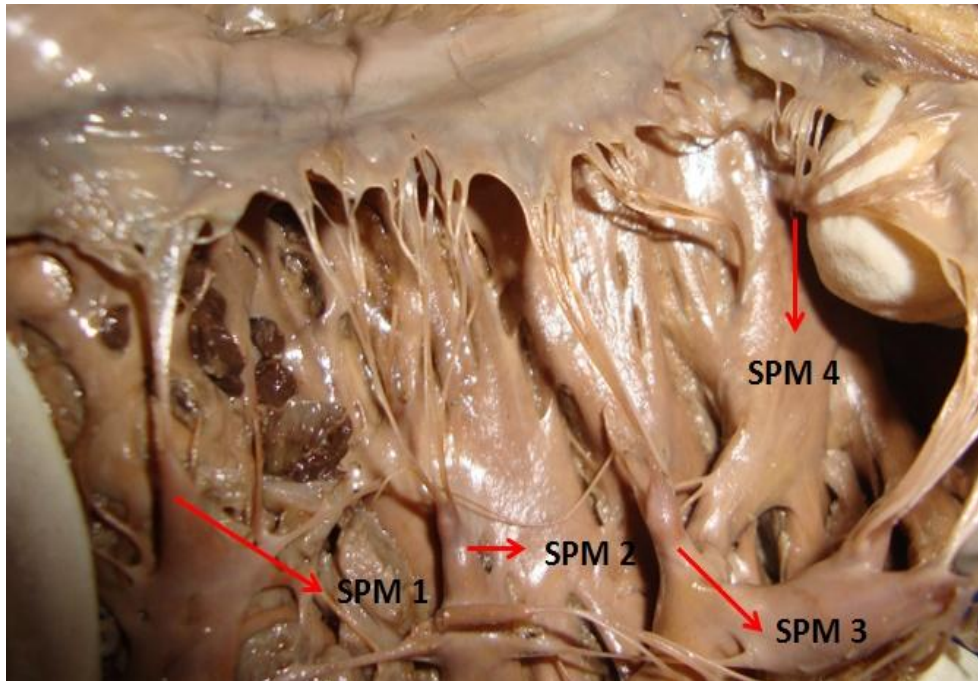


Figure 2 : Absent Septal Papillary Muscle-Chordae Tendinae directly arising from ventricular wall.



Discussion

Papillary muscles play an important role in the closure of tricuspid valve so as to prevent ventricular blood from passing back into the right atrium[7] and

also prevents overextension by drawing atrioventricular valve annulus toward the apex [8]. Papillary muscles in the right ventricle also plays an important role by helping in contraction of the

right ventricle by drawing the tricuspid valve towards apex and causing the shortening of the long axis and the chamber becomes spherical which helps in ejecting blood[9].

Severe tricuspid regurgitation and right ventricular dilatation due to papillary muscle rupture was reported by M Nagumo et al[10].

Many cadaveric and radiological studies pertaining to papillary muscles of right ventricle have been done. Right ventricle normally has 3 papillary muscles. Two major papillary muscles in the right ventricle are located in anterior, posterior positions and a third smaller muscle has a medial position [11]. Ekin O. Aktas et al has stated that there can be a maximum of nine papillary muscle in right ventricle [12]. Anubha Saha and Sanchita Roy have stated that posterior and septal muscle were absent in 15.38% and 55.76%, respectively [3]

The concept of multi apical and multi-segmental papillary muscles were introduced by Grochowski P and classified right ventricular papillary muscle into 14 types [13] and M. Skwarek et al observed 467 papillary muscles belonging 1 to 16 types [14].

G.R. Nigri et al stated that the anterior papillary muscle presented one head in 81% and two heads in 19%. The posterior papillary muscle had one head in 25.4%, two heads in 46.8%, three heads in 21.5% and four heads in 6.3%. The septal papillary muscles was one headed in 41.7% and presented two heads in 16.5% the presence of a 3 and 4 heads appeared in 12.7% and 7.6% respectively [15].

The number of papillary muscles in the present study is nearer to the study of the G.R. Nigri et al.

Conclusion

Papillary muscles are an important part of atrioventricular valve complex. Variations in the papillary muscles may alter the functions of valve. Knowledge about the variations in the Papillary muscles of heart will be of great use to the cardiologist and cardiac surgeons, in echocardiography, interventional cardiology.

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