**“OVIDIUS” UNIVERSITY CONSTANTA**

# THE MORPHOLOGY OF THE VENTRICULAR WALLS

**Summary**

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# INTRODUCTION

In recent decades (late twentieth century), have been reported multiple anatomical variations in relation to the concepts described classic, so what once was described as an anatomical variant in some cases has become predominant, not Quite often proposing a revision of international anatomical terminology. From this finding does not dispense any morphology of the ventricular walls, among which were made clarifications macro and microscopic on their structure, particularly contractil and embryonic myocard , on vascularisation and nerves, but also on atrioventricular valves , aortic and lung, the fleshy trabeculaes and tendon chordae, both structurally and in terms of their external morphology: form, morphometry, number. This is the reason why I chose the topic of my doctoral dissertation, which specifically is addressed on the morphology of the papillary muscles of the two ventricles, describing also issues of the flashy trabeculaes in general (appearance, distribution, morphometry) and tendon chordae, with their different aspects: morphological types, number, dimensions. To sustain my afirmations there are a large number of studies published in the last 2-3 decades in the literature as a necessity because they performed multiple surgeries on the heart, requiring a good knowledge of the valvular system and papillary muscles involved in cardiac pathology. Xanthos states that "it is necessary also a review of their embryological development, which underpins their anatomical variations and explaining the appearance of congenital abnormalities or clinical syndromes". Many present authors of morphology and practicing surgeons [Xanthos, Gunn, Madu, Axel, Nigri], shows "the importance of resuming the study of the papillary muscles, which play an important role in contraction of the ventricles and the smooth operation of the atrioventricular valve, describing it as a new description of their anatomical characteristics. Better knowledge of their morphology helps in understanding their function, explaining the emergence of various existent pathologies". [Roberts] states that "Despite of the awareness of the inceasing papillary muscules

disease, there have been a number of gaps, which now indicates that our knowledge of the structure is incomplete.

"New methods of noninvasive imaging explloration (ultrasound, computed tomography, magnetic resonance) have braught clarifications on the morphologycal formations of the heart, but they have a special importance in the diagnosis, achieving optimal performance: for example, in highlighting rupture papillary muscle, transthoracic ultrasound has a sensitivity of 65-85% "[Himmelman, Sochowski, HozumiSchluter]. This makes [Spreewers] to assert that "only 10 years ago the fine detail of the heart (such as papillary muscles and determine the contours s) could not be determined, currently obtaining them is very useful for further analysis of heart, function and diagnose heart disease. " It has also allowed "to highlight the increase of trabeculation of myocardial walls,could be involved in cardiac arrhythmias" [Czarnecki, De Bonis], and states that "echocardiography is the method of imaging in primary choice for evaluation of non-invasive mechanical complications, such as acute mitral regurgitation, in the setting of myocardial infarction ". Intraoperative transesophageal echocardiography has become a routine exam in interventions as stenosis and mitral regurgitation, aortic stenosis and regurgitation or during replacement of aortic and mitral valves. [Gunn, Roberts, Barbour, Schunk] found that "after a heart attack can cause rupture of a papillary muscle, most commonly the posteromedial papillary muscle, probably because of less blood supply, which broke nearly three times frequently than anterior-lateral (73% and respectively 27%). " [Gunn, De Bonis, Solomon] said that "knowledge on the morphology of ventricular and improving the means of exploration, have resulted in many operative procedures of the papillary muscles, such as resection, repositioning and realigning their correct regurgitation, tricuspid due to injuries complex (not only treatable with annuloplastie), mitral valve replacement, which makes mortality in hospitals beeing approximately 7.1% [Xanthos, Czarnecki, Kavimani] ".

My work is structured, as required, into two chapters: a general part and a personal one. General section begins with an introduction, where i expose the reasons and the importance of the theme ,continuing with the presentation of the current state of knowledge, presented by classical anatomy (tests, Rouvière, Gray), but also modern anatomy (Chevrel, Kamina, Sckunke Bouchet) and

especially the many articles on the subject published in magazines. In the special part, i described first the method and the material that I worked, then I express my personal results that we have obtained, comparing them with the classical results, but also with the current ones, which we found in the literature consulted. In the conclusions chapter, i present practical applicability of the achieved results, relying also on the explanations given by other specialists.

I want to thank my colleagues in the discipline of anatomy, which helped me in achieving my thesis (especially the gentlemen doctors Ionescu Constantin and Toba Marius), teachers who were present in my commissions, presentation of scientific reports and Commission guidance and especially Prof. univ. dr Petru Bordei, scientific leader of the thesis, whose help and guidance i beneffit throughout achievement thesis.

# METHOD AND WORKING MATERIAL

In my study I used only the dissection on cords, in most cases formalinized,analyzing ventricular walls, thickness,flashy trabecular system's disposal of the heart, insisting on the the papillary muscles an don their tendon chordae. Hearts were obtained from forensic laboratory in Constanta, at random, from adult subjects, whether patients were known to have died of heart disease or not and without specifying gender of the subject. After opening the ventricles, studying the two ventricles wall thickness, trabecular's system aspect as a whole, in each ventricle, and appearance of the septomarginal trabeculae. The interior of the ventricular wall has been studied in the presence of the papillary muscles, and after removing them. I studied at the papillary muscles and the number of forms that could be in single or multiple muscular bodies,never encountering more than five muscular bodies in a papillary muscle group. We measured using caliper graduated in millimeters, the height of each papillary muscle body (from the base to its upper end) and its thickness at the base and at its upper extremity. Tendon chordaes we examined in terms of their origin and number at the level of each papillary muscle, the dimensions (length and thickness), orientation and how they end at the atrioventricular valves. We noted the presence of , faulse'tendon chordae which were disposed between the papillary muscles and between the papillary muscle and the ventricular wall. The results were compared with data in the literature, that I had the opportunity to consult. The morphological characteristics I described are supported by a variety of personal images and are illustrated with graphs and tables.

## PERSONAL RESULTS AND DISCUSSION

### COMPARISON OF PREVIOUS VENTRICULAR WALL THICKNESS, LEFT AND RIGHT

Except in cases of right ventricular myocardial hypertrophy, in all cases the anterior wall of the left ventricle was thicker than the corresponding wall of the right ventricle. On the 1/3 cranial, the thickness of the ventral wall from the right ventricle was 28.57 to 40.0% of the left ventricle. Most commonly represent 35.48 to 38.19% of the left wall thickness.
At the 1/3 medium at the right ventricular wall was less thick, representing 33.33 to 46.9% from the anterior left wall, from 33.33 to 38.1% of the left wall thickness.


Fig. 15.the thickness of the anterior wall of the left ventricle is greater in the middle 1/3 with 2.6 mm than with 0,8mm in 1/3 cranial and caudal than 1/3; 1/3 1/3 bottom is thicker than 1.8 mm cranial; So 1/3 cranial is the thickest. On1/3 caudal the right anterior ventricular wall thickness represents 19.75 to 42.86% of the left ventricular wall, most often representing 40.0 to 42.86% of the left wall thickness.


Fig. 24. In the third cranial right ventricular wall is 4.0 mm, 0.2 mm thicker than the middle 1/3 and 1/3 caudal than 1.0 mm. 1/3 caudal ventricular wall is 0.8 mm thinner than the middle third. In the third cranial wall as 36.36% of the wall thickness is left in the middle 1/3 34.55% and 42.86% caudal 1/3.

We found that the thickness of the ventricular walls, so the right ventricle and the left one, is not uniform and do not pose a gradual decrease from base to apex of the heart, and at the ventricular wall there is a difference in thickness between the anterior and posterior walls , the previous one being thicker at all three levels, measured with a difference of at least 0.8 mm and 4.0 mm maximum, most often the difference being 1.0 to 2.3 mm. I also note a representative thickness of the ventricular wall above the top of the left heart, and muscle level ,that is thicker, the ventricular wall as frequently, hence the smaller thickness difference at this level between the two ventricles. At level 1/3 and 1/3 middle cranial right ventricular wall thickness is most commonly, about one third of left ventricular wall thickness, as described in classical anatomy.

## CONSIDERATIONS ON TRABECULAR SYSTEM OF THE TWO VENTRICLES

Right ventricular flashy trabeculaes are less numerous than the left ventricle and while less bulky. They are elongated, branched, anastomosed decks, transverse and oblique muscle short. Can be arranged parallel, they can interbreed, giving each tendon chordaes, intertrabeculare chordaes or trabeculaes between two close (short chordae) or between two remote trabeculae (chordae long). Some are divergent trabeculaes (being joined at the base and cranial removed), others can be converged (spaced base and cranial area). Some trabeculae are arranged vertically or obliquely, others are transversely. Tendon chordaes may exist frequently between neighboring trabeculaes and papillary muscles, chordae, papillary trabeculaes. Between trabeculaes surrounding anastomosed or at a trabeculae can form spaces (holes), single or multiple, having various shapes: oval (most common), having the longest vertical axis or oblique, round or irregular, but smaller as the left ventricle. Near the base of the papillary muscles thicker trabeculaes can meet frequently with cylindrical basal portion. Trabeculaes which are at the end of their upper side are mounted to the papillary muscle of the base, the other end being inserted in the wall of the ventricular

trabeculaes, papillary muscle trabeculaes, fleshy based on being able to insert between the two roots thereof.
Septomarginal trabeculaes in its upper part is smooth, uniform, showing the insertion of the medial septal papillary muscle chordae tendineae or in the form of objects exhibiting small muscle, most often cone papillary muscle of arterial showing reduced muscle cone size. Trabeculae at the bottom of the posterior papillary muscle detaches lower taper from falling off chordae tendon posterior tricuspid valve intended. The septomarginal trabeculae's tendon chordae becomes detached cylindrical bundles, including the cone artery, which branches off the valve tendon chorae trabeculae be closer or nearer the valve. The bottom of the septomarginale trabeculae may have oblique transverse pin holes, the upper part of trabeculae, sometimes being smooth and uniform, showing the convexity and depression. Chordae tendon is detached from the trabeculae septomarginale area with pin holes is inserted between the pin holes on them and even their depth.

Fig. 27.septomarginal trabeculae pin holes present on its surface oblique and vertical, between the chordae tendineae originating from some originating chordae or on the notch in the notch.

Fig. 33. Zone "gill net" is observed that the delimitation of round or oval areas and is made by chordae tendon connecting trabeculae passing the previous adjacent trabeculaes.

The left ventricle, ventricular wall of the trabecular system has a more complex organization than the right ventricle. Thus, the area corresponding to the papillary muscles of the ventricular wall presents a large number of fleshy trabeculaes, anastomosed with each other and bridged muscle and chordae tendineaes. The roots

base papillary muscles are connected by bridges muscle and shows insertion of fleshy trabecular adjoining these structures connected by tendon chordae, connecting adjacent trabeculae or skip adjacent trabeculae, linking to another trabeculae or a bridge muscle. Between the structures in the muscle (muscle trabeculaes and bridges) and on the base of the papillary muscles is oval holes delimiting a number of spherical or irregular. To frog, lower insertion of papillary muscles, trabeculae show ventricular wall thinner and rich fleshy branched and anastomosed, forming a areolar area, marking holes smaller. Sometimes, fleshy trabeculae can be stacked one above passing (above the other) between trabeculaes and between the edges of holes, there chordae tendon
partitioning these spaces, and there trabeculo-parietal tendon chordae. This area is rich in parietal and multiple chordae tendon intertrabecular, thinner.
Outside the papillary muscle, ventricular wall presents surface area at the bottom fleshy trabeculaes, trabecular with variable shape, size and direction, strong anastomosed sometimes can be sticked one above another trabeculae passing nearby.

## THE MORPHOLOGICAL CHARACTERISTICS OF THE RIGHT VENTRICLE PAPILLARY MUSCLES

## ANTERIOR PAPILLARY MUSCLES

Right ventricular anterior papillary muscles I studied on 91 cords, finding a total of 139 papillary muscles.
In relation to the number of bodies muscle, we met four variants of anterior papillary muscle .
Anterior papillary muscle unique I met in 57 cases (62.64% of cases), representing 44.19% of the anterior papillary muscles. In 21 cases (23.08% of cases) anterior papillary muscle was double, the 42 papillary muscles representing 30.22% of the anterior papillary muscles of the right ventricle. Anterior papillary muscle muscular bodies of three I met in 12 cases (13.19% of cases), 36 papillary muscles representing 27.91% of the anterior papillary muscles. In

one case (1.10% of cases) have found four muscular bodies, which represented 2.88% of all papillary muscles.
In each 2 cases where papillary muscles were double and triple, I met variants which showed papillary muscles appearance of the letter "H" (in one case a "H" asymmetric) and the letter "N" returned.

Fig. 35. The right anterior papillary muscle dual lateral muscular body is cylindrical and conical medial muscular body. Above the base, the two bodies are joined by a transverese muscular bridge, which gives them the appearance of the letter "H". Gives a valve for the anterior chordae. medial muscular body gives chordae for the posterior valve.

Fig. 37. single anterior papillary muscle cylindrical, perforated base. Valve chordae become detached from upper end by six cylindrical beams side by side, some being joined at the base, giving chordae anterior and posterior leaflets. A valve chordae beam falls off the face of the anterior-medial means papillary muscle and a tendon stringing valvular detach from the base of the medial papillary muscle, chordae designed posterior cusp.

Anterior papillary muscles form is varied, 139 papillary muscles just showing eight anterior morphological types.
Papillary muscle is most often cone, meeting it in 69 cases (49.64% of the papillary muscles in the posterior), the unique papilaries meeting it in 31 cases (44.93% of conical papillaries) in double papillary 20 cases (28.99% of conical papillaries), triple papillary in 16 cases (23.19% of conical papillaries) and in two cases (2.90% of conical papillaries) in quadruple papillary muscle.

Anterior papillary muscle cylindrical shape I've ever met in 53 cases (38.13% of previous papillary muscles), papillary unique being cylindrical in 17 cases (32.08% of papilarii cylindrical), the double papilarii I met 18 cases with papillary cylindrical (33.96% of cases), papillary triple in 17 cases (32.08% of papilarii cylindrical), a case (1.89% of papilarii cylindrical) being papillary quadruple.

Fig. 38. The quadruple right anterior papillary muscle, 3 bodies (lateral and middle) is tapered, and the medial arcuate, being located at a distance from the other three bodies. The first two bodies in the middle portion of the muscle are united by a oblique muscular bridge, superolateral, inferior and medio-lateral. Muscular bodies 2 and 4 are united in their middle portion, by a stringing tendon obliquely, superolateral, medial, from segment vertical muscular body arched, moving above muscle body three, to the side (look for the letter "N") returned, and the muscular bodies two and three are joined along their entire length.

Fig. 40. The right anterior papillary muscle unique cylindrical having perforated base, presenting three roots, root side showing a vertical notch. The top end is detached tendon chordae seven cords cylindrical, three of which originate from muscle cone.
A cylindrical subvariant papillary muscle that I have described it, is the "pencil sharpened at one end," I met her in 2 cases out of 17 cases of papillary unique cylindrical (11.76% of muscles pailari unique cylindrical).

Fig. 42. anterior papillary muscle as double arcade, a medial body side and the other. Their bases are perforated. Lateral muscular body shows two muscle cones well represented, emerging from convex arch and beams that give rise to anterior valve chordae. Based bottom portion connected on both sides muscular bodies trabeculae. Medial muscular body of the convexity, gives rise to 2 cones that fall muscle valve chordae and valve chordae with a cone beam muscle located between the two cones muscular valve chordae inserting themselves on the back. Ascending and descending portions of the papillary muscles give rise to bridges and parietal chordae tendon.

Fig. 43.single anterior papillary muscle, shaped like a truncated cone, the large base disposed lower.
Shape of papillary muscle we previously encountered in 3 cases (2.21% of anterior papillary muscles straight), irregular appearance being given special detachment of the valve chordae entire area, also all cases are unique papillary muscles (5.26% of unique papillary muscles).

The appearance of a truncated cone of the right anterior papillary muscle, with lower large base willing, I met in 4 cases (2.94% of anterior papillary muscles straight),in all cases are unique to the papillary muscles (7.02% of unique papillary muscles).

Fig. 44. anterior papillary muscle straight and irregular. The body is connected to the papillary muscle to the middle side of the ventricular wall by a muscular bridge and chordae tendineae. Valve chordae beams detached from all over the upper half of the body and the muscular side trabeculae.

Fig. 45. fusiform right anterior papillary muscle. The body is bound by multiple chordae tendon in the middle portion of the ventricular wall. On the medial aspect of the body, the upper third stringing, emerges a parietal and above the base of a posterior papillary muscle tendon chordae.

Fusiform appearance of right anterior papillary muscle I met also in 3 cases (2.16% of papillary muscles prior right), one case to the papillary muscles single, double and triple.

In one single case (each 0.74% of cases) had papillary muscles shaped "Y" back (in case of triple papillary muscle, triple 2.78% of the papillary muscles) and the appearance of the letter "V" back in If a double right anterior papillary muscle (2.38% of double papillary muscles).

In a number of cases we studied 117, the base look right anterior papillary muscle, finding that most commonly papillary muscle base is unique, perforated, aspect met in 72 cases (61.54% of cases) in the remaining cases was papillary muscle base perforated, in 45 cases (38.46% of cases), showing that two root implant, in 24 cases (53.33% of perforated roots) or three roots, in 18 cases (40% of cases); or four roots in 3 (6.67% of cases).

Fig. 46. triple right anterior papillary muscle, united (contact) completely between the first two, both being tapered, sending the valve and valve chordae rear, and the third has shaped "Y" back, having divided into two basic roots , sends thesnterior valve chordae.

Fig. 47. The right anterior papillary muscle dual cone-shaped body having lateral and medial shaped the letter "V" back.

If multiple papillary muscles (double, triple or quadruple), only when I met double papillary muscles cases of both papillary muscles, showed the same form layout found in 8 cases (19.05% of cases), 7 cases of conical muscle and one case of arched papillary muscles.

Fig. 51. anterior double papillary, both muscular bodies being tapered, one above and one posterior and slightly lateral.

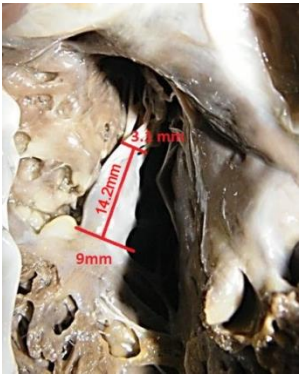


Fig. 54.single anterior papillary muscle, conical, which valve chordae tendon becomes detached from its top and side to side superolateral. The height of the papillary muscle is 14.2 mm, the thickness is 9.0 mm at the base and at

the upper end has the thickness of 3.1 mm.

## RIGHT ANTERIOR PAPILLARY MUSCLE SIZE

We conducted assessing the scale of the papillary muscles and their width measuring their height, width measuring at the base and a tip (upper extreminties). Right anterior papillary muscle size I appreciated on a number of 45 cases.
The height of papillary muscle as we previously found between 10,0-21-24,0 mm, height 24 mm met only in one case (2.27% of cases). The thickness of the base of the papillary muscle as we previously found between 2.9 to 9.0 mm, most commonly, in 15 cases (33.33% of cases), I found this thickness between 7,0- 7.5 mm. Thick at the tip (upper end) right anterior papillary muscle we found between 2.2 to 9.0 mm, most commonly this thickness, in 12 cases (26.67% of cases) was between 3.0 -3.9 mm.

## MORPHOLOGY OF THE RIGHT POSTERIOR PAPILLARY MUSCLES

Posterior papillary muscle of the right ventricle I studied in a total of 66 cords, which presented 108 papillary muscles. Single papillary muscle I have encountered in 38 cases (57.58% of cases), 38 papillary muscles representing 35.19% of the posterior papillary muscles).

In 10 cases (15.15% of the cases) the papillary muscle were triple, the 30 muscles representing 27.73% of the total posterior papillary muscles, and 2 cases (3.03% of cases) was quadruple posterior papillary muscle, the 8 papillary muscles representing 7.41% of posterior papillaries.

In case of papillary muscles with multiple muscular bodies, in four of the 70 cases of papillary muscles (5.71% of cases), two muscular bodies close together, united by a muscular bridge, realized shape "N" returned in two cases papillary muscles being

double and one triple, one case to the papillary muscles and quadruple.

Fig. 55.single posterior papillary muscle conical, with perforated base, presenting three roots, valvular chordae himself detaching from its peak. Parietal chordae on his medial face. In 16 cases (24.24% of cases) had posterior double papillary muscle, 32 papillary muscles representing 29.63% of the posterior papillary muscles.

Fig. 56. posterior papillary muscle as double cone. Valve chordae beams emerging from the tip and medial superolateral.

Fig. 57. posterior papillary muscle triple, lateral and medial muscular

Fig. 58. posterior papillary muscle triple as having a muscular body and two

bodies being tapered and medium muscular body, cylindrical. From the tip of the medial muscular body, emerges a single beam valve chordae, anterior passing middle muscular body, distributing the posterior cusp.

bodies earlier cylindrical posterior lateral one side and the other medial tapered cylindrical, united by a bridge infero-lateral oblique muscle thick, forming the letter "N" returned.

Most commonly, the posterior papillary muscle present a conical aspect found in 58 cases (53.70% of cases). In 21 cases (36.21% of cases), I met conical muscle in papillary single in 27 cases (48.28% of cases) in papillary double in 8 cases (13.79% of cases) in papillary triple and 2 cases (3.45% of cases) in the quadruple papillary muscle.

Cylindrical posterior papillary muscle I met in 44 cases (40.74% of cases), 13 cases (29.55% of cases) cylindrical I met in papillary single in 3 (6.82% of cases) in papillary double in 22 cases (50.0% of cases) in papillary triple and 6 cases (13.64% of cases) in papillary quadruple.

In 3 cases (2.78% of cases) I met a papillary muscles that have irregular Foma, all cases being seen in the papillary muscle unique.

Fig. 59. posterior papillary muscle as irregular, showing detachment of the multiple tendon valvular bundles, from the upper half of the body muscles.

Fig. 60. right posterior papillary muscles double, medial one arcuated and lateral at the "Y" back. Arcuate papillary valve chordae on emerging from the convexity, and the anterior-medial face and the front of the descending portion (side) of the arch ( "U" or horseshoe back). From the "Y" reversed one the valvular chordae turn

one, on top, and on its sides
superolateral and superomedial.

In 2 cases (1.85% of cases) posterior papillary muscle have shaped "Y" back, a case being unique papillary and in one case papillaries being double.
In one case (0.93% of cases) I met a papillary muscle arcuated (at double papillary)

On the 93 papillary muscles (86.11% of the total tracked posterior papillary muscles), we found that the base of the ventricular wall was perforated, and there is a single base in 39 cases (41.94% of cases); in 54 cases (58.06% of cases) 2-3 showing the base root implant, of varying thickness, which were fixed to the ventricular wall. In 36 cases (66.67% of cases) based papillary muscle implantation of this two roots, and in 18 cases (33.33% of cases) presented three roots.
If the papillary muscles are multiple (double, triple or quadruple) only if papillary muscles double I encountered cases of both papillary muscles showed the same form, layout found in 12 cases out of 16 cases (75% of cases), in 11 cases were conical muscle, and in one case the muscle take the form of the letter "N" returned. In cases of triple papillary muscles I have not met any case in which three bodies have an identical form, meeting 9 of the 10 cases with triple in which 2 of the 3 bodies muscles had the same form (90% of cases ), in the case of quadruplets muscles in both cases, three of the four muscle bodies had the same shape.

Fig. 63. posterior papillary muscle quadruple, from which three bodies are cylindrical and one conical muscle, being unequal in size. Medial muscular bodies are joined together by a musclar bridge, thus giving the appearance of the letter "N" returned irregular.

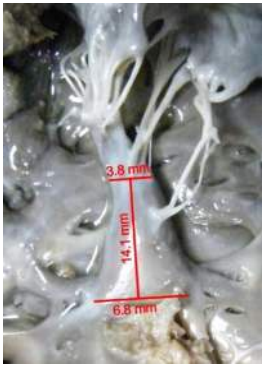


Fig. 64. posterior papillary muscle,single, conical. Third of upper body muscle, anterior-medial emerge stringing two beams and a single for septal leaflet. From the middle portion of the front face of the body, emerges a thick beam valve chordae that splits into two beams that will give the septal valvular chordae. The height of the papillary muscle is 14.1 mm, the thickness at the base is 6.8 mm and the thickness at the upper end by 3.8 mm.

The height of the posterior papillary muscle as we found, is between 8.5 to 15.2 mm in 13 cases (23.53% of cases), most commonly between 13.0 to 13.8 mm. Posterior papillary muscle thickness at the base as we found between 2.5-7.5 mm, in 14 cases (27.45% of cases), most commonly, 3.2-3.8 mm thickness. The thickness of the upper end of the posterior papillary muscle between 2.0 to 7.5 mm was right, most commonly, in 21 cases (41.18% of cases) was 2.0 to 2.8 mm thickness.

## THE MORPHOLOGY OF THE SEPTAL PAPILLARY MUSCLES

Septal papillary muscles, we took into account the papillary muscle conical, I watched a total of 83 cords, presenting a number of 219 papillary septic originating in septomarginal trabeculae, being

represented either by a number valve beams 2-6 (which will further branch to a variable number of chordae tendineae), to which can be added a number of chordae tendineae 1-5 simple, unique, both types (single beam and chordae) being present or not at the level of their origin muscle cone, variable in size. Of these papillary bundles of chordae tendon and tendon chordae simple, we found that in 51 cases (23.29% of cases) had muscle cones of various sizes (from 4.2 to 8.5 mm) thick at 3.0-4.5 mm at the base and upper end of 2.0 to 4.5 mm, which can be considered true small papillary muscles. In 168 cases (76.61% of cases) showed no conical muscle, detaching it directly on the surface of the septomarginal trabeculae.

Fig. 66. double arterial muscle cone , cones beeing stacked . One with (superior) and the other without cone. Caudal valve chordae are two bundles, starting at the trabecular notch, upper and lower muscle without cone, cone muscle (which is inserted in the middle trabeculae septomarginal) from starting valvular chordae for septal.

Fig. 67. arterial muscle cone contains no muscle being represented by a beam valve chordae. Under it the papillary muscles septal are represented by six bodies muscle willing cranio-caudal who send chordae only valve septal: upper conical second, smaller, linked by two bridges to base that described above, third, conical, longer and slightly thinner than the upper fourth, located deeper cylindrical base with two roots, fifth and sixth, conical, are joined in their portion medium being separated at the base and in third their top where each one presents muscle cone, which emerges from the top of one beam chordae tendon.

I met one case in which the seotal papillary muscles were represented by six conical muscular bodies,well represented, comparable in size with the papillary muscles front and rear, especially bodies, 3, 4, 5 and 6, the second body beeing shorter. From their peaks one beam himself gives valvular chordae for septal valve, which branch closer to 3-4 tendon chordae

Arterial muscle cone I found present in all cases, studying it in 57 cases găsidu it unique in 15 cases (26.32% of cases). In 30 cases (52.63% of cases) was arterial muscle double cone, and in 12 cases (21.05% of cases) was threefold.

Fig. 69. unique arterial muscle cone, which gives rise to 4 valvular beams wich gives chordae to anterior leaflet. Under it there are only 4 chordae without muscle cone muscle.

Fig. 70. Muscle cone represented by three beams arterial valve chordae. Below it are four bundles valve chordae and a simple stringing, which is inserted without muscle cone on the side (three beams) and middle septomarginal trabeculae that give septal valvular chordae

The 57 cases that presented a total of 111 arterial muscle cone, representing the unique 13.51%, 54.05% the double and triple the 32.43%.

From the total of the muscles we studied in 28 cases (25.23% of cases) presented at the origin muscular cone of different sizes and in 83 cases (74.77% of cases)the muscles showed no muscular cone.

Fig. 72. papillary muscles of arterial triple cone: upper, middle and lower muscle cone, without sending the valve chordae and anterior giving a

Fig. 73. inferior posterior papillary muscle unique, tapered.

middle beam and the valve septum
chordae.

I described 8 cases of posterior papillary muscle of the right ventricle's angle, having conical shape (7 cases) or cylindrical (one case), which send their tendon chordae at the septal and posterior leaflets in 5 cases (62.5% of cases) muscle was unique, and in 3 cases was double.

Fig. 74. papillary muscles of the lower's angle double, both being tapered willing superior, which sends its valvular chordae and other inferior septal, the chordaes beein for theposterior valve.

# DISCUSSIONS

Right ventricular anterior papillary muscle, after [18,19,26] is the most voluminous and most prominent of the papillary muscles of the right ventricle. [5,27,28] found it present in all cases, the aspect that I found myself in the study. Regarding the number of anterior papillary muscles, it states that "frequently is unique" because for [1] the right anterior papillary muscle "can have 2, 3 and even 4 muscular bodies." Shape to [Rouvière] "above the papillary muscle is conical" and not mentioning other form thereof. [29] found that "most frequently (without giving percentages) of the right ventricle papillary muscles were tapered and cylindrical." I have described eight variants of papillary form above, single and multiple variants of papillary muscles in forms describing double "H" being mentioned by [1,30,31,32,33] but without indicating percentages. I have not met variant "V", but the form of "V" back, but I described in the "N" returned. For [Test Bouchet] "chordae papillary previously numbered about 10, emerging from the muscular cone on top of the papillary muscle," I encountered that these chordae can be drawn on the faces of the medial, lateral or anterior papillary, both anterior and posterior.

| AUTHOR | SINGLE | DOUBLE | TRIPLE | QUADRUPLE |
|---|---|---|---|---|
| Nigri | 81% | 19% | - | - |
| Pessotto | 59,26% | 29,63% | 11,11% | - |
| ***Per. results*** | ***44,19%*** | ***30,22%*** | ***27,91%*** | ***2,88%*** |

Table no. 2. The number of muscular bodies at the right anterior papillary muscle.

Right posterior papillary muscle as [18.19] considers to be "muscular bodies represented by 1-3" and [Rouvière] as "muscular bodies consisting of 1-2". [Filipoiu] "mentions three variants: 1. a single papillary muscle, but bulky, having branched top; 2. a posterior muscle group consisting of 2-3 muscular bodies; 3. absence of

posterior papillary muscle, tendon strings that would be matched by inserting themselves directly, or through small dimples on the septal ventricular walls and posterior'. Posterior papillary muscle of the right ventricle [1,5] I find "present in all cases," and I also observed in the study. [34] states, but a small number of cases (15 cords), "that in the right ventricle, papillary muscles anteriorly and posteriorly, the most common presenting conical and cylindrical shape," but without indicating percentages.

| AUTHOR | SINGLE | DOUBLE | TRIPLE | QUADRUPLE |
|---|---|---|---|---|
| Nigri | 25,41% | 46,8% | 21,5% | 6,3% |
| Pessotto | 52,38% | 33,33% | 11,90% | 2,38% |
| ***Per. results*** | ***35,19%*** | ***29,63%*** | ***27,73%*** | ***7,41%*** |

Table no. 3. The number of the muscular bodies at theright posterior papillary muscle.

**Septal papillary muscle** ,after [1,18,19,22] "is represented by chordae that fall either directly or by means of small fleshy formations, genuine papillary muscles in miniature". For [35], "there are several internal papillary muscles implanted on the interventricular septum, of which one is always important and above-located". After [Filipoiu], "septal papillary muscle can sometimes have 1-2 dimples, suggesting the presence of a papillary muscle." I have found that most frequently at septum chordae are drawn both by cones muscle, whose number is variable and directly, with no cone muscle, encountering only rare cases where chordae valve emerge from one type morphological. [Nigri] septal papillary muscles finds an average length of 5.59 mm, I'm finding the minimum value lower by 1.39 mm and the maximum value higher by 2.91 mm. [Nigri] believes that "when the valve chordae emerge without any muscle cone, absent variant that found in 21.5% of cases."

| AUTORUL | percentage % |
|---|---|
| Nigri | 78,5 |
| Jezyk | 82,0 |
| ***Pers. cases*** | ***23,29*** |

Table no. 4. the presence of the muscular bodies at the septal papillaries.

If papillary muscle of the arterial cone [30,31]states that "the most constant of septal papillaries and [Jeryk] finds it "present, cone-shaped muscle in 82% of cases, in 18% of cases being represented by simple tendon strings ". I found myself presenting muscular cone, variable in size, in 31.58% of cases, so a lower percentage of 50.42%.

Posterior papillary muscle of the lower's angle of the right ventricle [after 30,31], "is a separate entity, being the cases that can not be classified in the group of septal unclear, nor in the group event. Some authors propose that these be considered septal papillary muscles [37], others including them in the right ventricle posterior papillary muscles [38,39].

## ANATOMICAL CONSIDERATIONS ON THE LEFT VENTRICLE PAPILLARY MUSCLES

## LEFT ANTERIOR PAPILLARY MUSCLE

My results were obtained by analysis of a number of 58 cords, which presented 123 muscular bodies from the anterior papillary muscles in the left ventricle.

Single left anterior papillary muscle, I met on 12 cords (20.69% of cases), representing 9.76% of the left anterior papillary muscle. Double left anterior papillary muscles, I met on 33 cords (56.90% of cases), the total representing 53.66% the anterior muscles.

Triple left papillary muscles I met on 9 cords (15.52% of cases), representing 21.95% of the total left anterior papillary muscle. In 2 cases (3.45% of cases), we have met anterior quadruple papillary muscle, 8 muscular bodies representing 6.50% of the left anterior papillary muscles. Also in 2 cases (3.45% of cases), I foundanterior papillary with 5 muscular bodies, 10 bodies representing 8.13% of the left anterior papillary muscles.

Fig. 82. The left anterior papillary muscle,unique, tapered valvular chordae from the the top (for posterior valve) and the medial third of the top (for anterior valve). From its tip emerges laterally from the cone muscle, a tendon for stringing the ventricular wall.

Fig. 83. Double left anterior papillary muscle, both having a cylindrical shape and presenting at two basic roots. They are joined in their upper half, showing their upper extremity a muscular cone from where the bundles emerge for anterior valvular chordae.

Fig. 84. triple left anterior papillary muscle. In the lower half of their bodies are joined above and middle. Front body is cylindrical, medium muscular body tapered valve chordae gives them the top and front to

Fig. 85. Quadruple left anterior papillary muscle, the posterior bodies partially covered their earlier counterparts. Earlier bodies are tapered body posterolateral is tapered from front to detach chordae medial tendon that connects him to the posterior medial muscular body and ventricular wall. Above their base, the two bodies are joined

side upper 1/3. Tapered rear is muscular body.

by a rear transverse band, making the appearance of the letter "H". Posterior medial muscular body is cylindrical.

Of the 111 papillary muscles of the multiple left anterior, we encountered cases where bodies muscle area were joined by muscular bridges, making specific aspects, such as the appearance of the letter "N" reversed, met in 5 cases (4.50% of multiple muscles) general problem in 3 cases at double papillary muscles (9.10% of papillary muscles double) and in one case to the papillary muscles triple and quadruplets; the appearance of the letter "N", found in 2 cases only if double papillary muscles (1.80% of multiple papillary muscles and 6.06% of the papillary muscles double); the appearance of the letter "H", met in one case triple papillary muscles between middle and medial muscular bodies.

Fig. 86. The left anterior triple papillary muscle, three bodies being arranged linearly. The first two bodies muscle conical bases are joined above. The top end of the second body end is joined to the upper muscle of the muscle body of the third cylindrical deck by a muscle from which emerges a rear stringing for the valve. Muscle bodies 2 and 3 are joined to each other over their base by a muscle cross bridge, giving the appearance of the letter "H".

Fig. 87.anterior papillary muscle with five bodies, having two bodies arrenged anterior and two posterior, between the two groups being located in the middle, a fifth muscular body.

Of the total muscular bodies, most frequently they had a conical shape, aspect found in 67 cases (54.47% of total muscular bodies), the distribution is as follows: 9 cases where single muscle (13.43% of cases) double muscles 30 cases (44.78% of the cases), the triple 14 cases (20.89% of cases), 3 cases muscles quadruplets (4.48% of cases) and 10 cases in the muscles of five times (14 92% of cases). In 53 cases (43.09% of the cases) the left anterior papillary muscle had a cylindrical shape, one case is the sole muscles (1.89% of cases), 37 cases (69.81% of cases) muscles Cavity 10 cases (18.87% of cases) in the muscles of triple 5 cases (9.43% of cases) in the muscles of quadruplets.

Three forms of papillary muscles I've encountered in low percentages, are represented through its form in "torch" ( "torch"), aspect met in one case (0.81% of the papillary muscles) muscles triple; fusiform appearance, also met in one case and all the muscles triple; in 2 cases (1.63% of the papillary muscles), left anterior papillary have an irregular, both cases being the sole papilarii.

Fig. 88. triple left anterior papillary muscle, body side being erratic. On his medial surface arise two bodies, middle, giving fusiform leaflet chordae anterior and medial, the "torch" that gives the posterior cusp chordae.

Fig. 89. The left anterior papillary muscle muscle consists of two conical bodies, parallel. Above the base, the body has two lateral oblique cracks. The body side is muscular tip triple at the tip, showing three small muscle cones, which leaves from the top of bundles of chordae to the anterior and posterior leaflets. Top left muscular

body is unique in that fall bundles for valve chordae poasterior. There parietal chordae tendon.

The base of the left anterior papillary muscle I watched the 110 cases, finding a perforated, single, with a single root implantation in 38 cases (34.55% of cases) and being perforated, formed more roots implantation 72 cases (65.45% of cases). In 51 cases based implantation of left anterior papillary muscle present two roots (46.36% of cases), 16 cases (14.55% of cases) present three roots and in 5 cases (4.55% of cases) this four roots that were fixed to the ventricular wall.

If multiple muscles, found in 46 cases, we found that double muscles showed the same form in 19 cases (41.30% of all multiple muscles and the muscles double 57,58%) had the same shape, and in 14 cases (30 43% of multiple muscles and 42.42% of the double muscles), their shape was different. Muscles triple in each 4 cases (8.70% of multiple muscles and 44.44% of muscles triple) had 2 of 3 different shape or muscle had the same form and in one case (2.17% of multiple muscles and 11.11% of muscles triple), their shape was different. Muscles quadruplets in one case (2.17% of multiple muscles and muscles quadruplets 50%), 3 of 4 muscles or all muscles showed the same form. Muscles quadruplets in one case (2.17% of multiple muscles and muscles Quintuple 50%), 4 of 5 muscle or muscles showed all the same shape.

Fig. 90. Quadruple left anterior papillary

Fig. 91. The left anterior papillary

muscle, muscular bodies being arranged linearly, 2 bodies being joined in their upper third and situated side, the other two bodies being located medially joined by a band-lateral infero oblique muscle, which gives the appearance of the letter " N "back. All muscle cylindrical bodies.

muscle consists of 5 groups of muscles, with perforated bases 3 arranged on a plane and two in a plane above the rear, all 5 groups of muscles being tapered.

The left anterior papillary muscle's height we measured it on 51 papillary muscles, finding a range of 10 to 21.0 mm, the most frequent (23.53% of cases) which is between 15.0 to 15.8 mm . The thickness of the left anterior papillary muscle base we found between 2.5 to 9.5 mm, the difference between the two dimensions are 7.0 mm. In one case (1.96% of cases), the thickness was 2.5 mm, and most frequently, in 14 cases (27.45% of cases), left anterior papillary muscle have a thickness of 7.1 to 7,8 mm.
The thickness at the upper end of the left anterior papillary muscle we found between 1.8 to 9.5 mm, the papillary muscle with the greatest variability in thickness at its upper extremity.

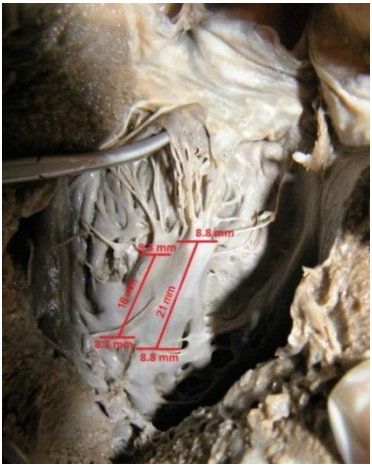


Fig.92 The height of the side panel 92 is 21.0 mm, the bottom and at the top with a thickness of 8.8 mm. Medial muscular body has a height of 18.0 mm thick at the base and the top end is 8.3 mm.

## LEFT POSTERIOR PAPILLARY MUSCLE

The left posterior papillary muscle I studied on a number of 72 cords, being found in 21 cases (29.17% of cases) unique, in 30 cases (41.67% of cases) was double, 9 cases (12.50% of cases) was threefold, and in 12 cases (16.67% of cases) was fourfold. In the 72 cords i have found 156 papillary muscle. Regarding the form of the left posterior papillary muscle, I found a number of 7 forms of the multiple muscles accounted on 49 cases, describing them and three issues, two bodies muscle bridged through muscle, taking the appearance of the letters "N", "N" and turned "H".

Fig. 94. The left posterior papillary muscles double, anterior, cylindrical, the second muscular body, conical, posterior

Fig. 95. The left posterior papillary muscles double, both muscular bodies are cylindrical and joined together by a bridge muscular broad-lateral oblique infero, creating the appearance of the letter "N" back, arms uneven thickness.

In case of the double left posterior papillary, whom I met in number of 49 cases, we have described three issues, two bodies muscle being bridged through muscle, taking the appearance of the letters "N" returned and shape of the letter "H ". The shape of the letter "N" returned I met in three cases, all posterior papillary muscles double (10% of 6.12% of the muscles double and multiple papillary muscles) and form the letter "H" I met also 3 cases, 2 cases at double muscles (muscles 6.67% of double and multiple papillary muscles 6.12 in)

and a case quadruplets muscles (2.08% and 2.04% of cavdrupli muscles of multiple muscles).
I met a conical shape in 60 cases (38.46% of cases) and cylindrical shape in 81 cases (51.92% of cases). The other five forms were represented by: fusiform papillary muscles in 8 cases (5.13% of cases), irregular in 6 cases (3.85 of cases), peg in 5 cases (3.21% of cases), Arcuate in 3 (1.92% of cases) and form the "flare" in one case (0.64% of cases).

Fig. 96. The left posterior papillary muscle quadruple consisting of two previous bodies, bulkier and 2 bodies back. The bodies of the previous muscle, both cylindrical, one medial and the other side, are joined to each other by a horizontal bridge muscle and linking them in their middle portion, giving the appearance of the letter "H".

Fig. 97. The left posterior papillary muscle, unique, tapered, oval foramen in the medial root.

Based left posterior papillary muscle, followed by 156 cases, we found it single, unperforated, drilled in 81 cases (51.92% of cases), in the other 75 cases (48.08% of cases) presenting more roots. In 48 cases (30.77% of total 64% of roots and multiple roots) present two roots, medial and lateral most frequently uneven. In 24 cases (15.38% of 32% of the roots of roots and multiple) this three roots, and in 3 (1.92% and 1.33% of the total number of roots of multi-rooted) showing four roots.
The height of the left posterior papillary muscle, I studied in 54 cases, finding a range from 8.0 to 21.0 mm, most commonly in

22.22% of cases, having a thickness of 15.0 to 15, 5 mm. Posterior papillary muscle thickness at the base of the left, studied 51 cases, we found between 3.5 to 9.4 mm, most commonly in 47.16% of cases, having a thickness of 6.1 to 7 8 mm. The thickness of the upper end of the left posterior papillary muscle, I found between 1.8 to 9.4 mm, most commonly in 76.47% of cases having a thickness of 4.0 to 7.6 mm. .

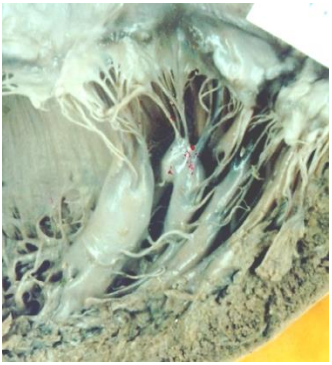

Fig. 99. The left posterior papillary muscle quadruple with muscular bodies arranged linearly, the side being cylindrical middle arcuate lateral and medial, middle and the medial being cylindrical. On the anterolateral body in the lower half and the medial root, arising chordae tendon for medial muscular body, passing above the middle muscular body. Arcuate and muscular body of convexity of the medial segment superolateral arm upward, the valve chordae arise rear and beneath arise chordae tendon that connects him to the middle medial muscular body.

Fig. 100. left posterior papillary muscle in "torch" (torch). It's implantation base, 2 root,and the lateral root presenting a oval foramen,showing a side and the bottom of another oval foramen higher. At the upper 1/3 to 2/3 lower union passes anterior to a second-order transverse trabeculae fleshy. At the upper end shows an oval foramen, its upper extremity is composed of two projections uneven stitched, medial and lateral, triangular, with higher base, the starting beams chordae with and without muscle cone to the anterior valve. From the lateral protrusion, slightly bulky medial leave two cone beam for valves front and rear and the side leaves an extension muscle that gives rise above a lower body muscle conical tip, which and face posterolateral go chordae for rear valve.

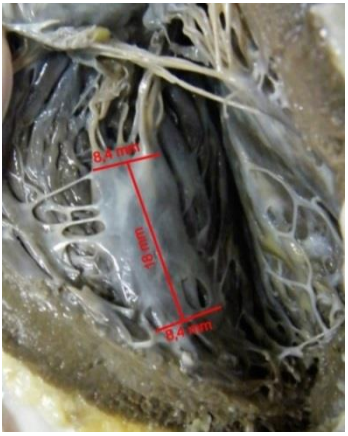


Fig. 101. left posterior papillary muscle unique, cylindrical. Detached top, three cones that give muscle chordae to both valves. Upper third of the medial side emerges a cone that gives three bulky bundles of the anterior leaflet chordae. On his medial face detach 4 chordae to the ventricular wall. Muscular's body height is 18.0 mm, the thickness at the base and at the upper end is 8.4 mm.

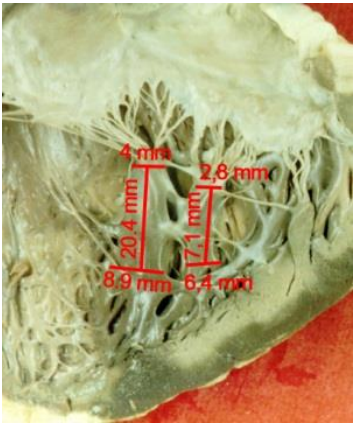


Fig.102 Double left posterior papillary muscle. Both muscular. Body height is 20.4 mm lateral thickness of 8.9 mm is based, and the peak of 4.0 mm. Muscle medial body has a height of 7.1 mm, the thickness of the core is 6.4 mm and the peak 2.8 mm.

## DISCUSSIONS

| AUTHOR | SINGLE | DOUBLE | TRIPLE | 4 BODY | 5 BODY | 6 BODY |
|---|---|---|---|---|---|---|
| Solomon | 67% | 27% | 4% | 1% | 1% | - |
| Kavimani | 62,2% | 31% | 2,2% | 7% | 4% | 2% |
| Gunnal | 3,44% | 43% | 31,9% | 21,55% | - | - |
| Roberts | 75% | - | - | - | - | - |
| ***Per cases.*** | ***20,69%*** | ***56,90%*** | ***15,52%*** | ***3,45%*** | ***3,45%*** | ***-*** |

Table 7.the number of bodies of the anterior papillary muscles, in the left ventricle.

On the left anterior papillary muscle unique my results are much lower than those of literature consulate, being lower by 41.51% compared to the results of [Kavimani] with 28.31%% versus [Gunn], 46, 31% lower than the [Solomon] and 54.31% to [Roberts]. In case of double papillary muscles my results are higher with 25.90% to [4], of 27.90% compared to [Gunn] and 29.90% to [Solomon]. In case of triple papillary muscles, my results are higher with13.32% compared [Kavimani] and 11.52% to [Solomon], and in the case of muscle quadruplets my results are higher with 2.45% compared to [ Solomon] and lower by 0.55% compared to [Kavimani]. In case of quintuple muscles my results are higher with 2.45% than the results of [Solomon] and 1.45% against [Kavimani]. Only [Kavimani] finds left anterior papillary muscle with 6 bodies and [Gunn] doesn't find left anterior papillary more than two bodies.

In case of mulitiple left anterolateral papillaries, characteristical forms ( "V", "Y", "H") are described by several authors without indicating percent [Gunn, Solomon] only [Kavimani] indicating shape "V" in a percentage of 2% of cases (found in one case), something that I did not have met, and forms the "Y" and "H" also in one single case ( 2% of cases). The appearance of the letter "H" I met myself in one case to the papillary muscles triple (between the bodies middle and medial), but I described two alternatives that we have not found quotes: form the letter "N" reversed and shape of the letter "N" normal.

After [Rouvière], "anterior papillary is irregular, cylindrical or cylindrical-conical, their chordae tendon detaching it from the top of the papillary muscles, which often shows 2-3 nipples" and after [Bouchet] anterior papillary muscle is conical tip in more or less rounded, presenting two nipples, which depart from the chordae tendineae ". After [Fradley, Deepack, Himmelman], "left anterolateral papillary muscle is greater and unique.

| AUTHOR | SINGLE | DOUBLE | TRIPLE | 4 BODY | 5 BODY | 6 BODY |
|---|---|---|---|---|---|---|
| Solomon | 50% | 36% | 11% | 3% | - | - |
| Kavimani | 62,2% | 32,0% | 2,2% | - | - | - |
| Gunnal | 49% | 29% | - | - | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| Roberts | 75% | - | - | - | - | - |
| ***Per cases.*** | ***29,17%*** | ***41,67%*** | ***12,50%*** | ***16,67%*** | ***7,45%*** | - |

Table 8. the number of bodies of the posterior papillary muscles, in the left ventricle.

Fig.105 Double left posterior papillary muscle.
Both bodies are cylindrical.

The shape of the papillary muscles, muscular bodies is very varied and different as described in the literature. Thus, the conical shape, which we have encountered most frequently (63.21% of cases), is cited by (Gunn) a smaller percentage with 12.21%, from the anterolateral papillary muscle encountering a more regular than 25.90% (Kavimani) and on the medial posterior papillary more frequent with 50.83% than the same author. Muscular arched shape of the body, found in 9.43% of cases is more regular than 5.43% (Gunn), which meets only in the medial posterior papillary I Intan it to both forms of papillary muscles left ventricular presence in our statistics this form of papillary muscle to the medial posterior papillary being more common than 8.25% (Gunn). The cylindrical shape of the body muscle, found in 18.87% of cases, we assimilated a muscular body shape with a flat top, described by (Gunn Kavimani), I met more frequently as just 0.87% than (Gunn) and

7.87% to (Kavimani). For (Hosapatna) muscular bodies of the left ventricle papillary muscles are always conical. Again,we mention the forms not found from literature: fusiform muscular body and "torch" (torch).

## COMPARATIVE STUDY BETWEEN THE PAPILLARY MUSCLES IN RIGHT VENTRICLE AND THE LEFT VENTRICLE PAPILLARY MUSCLES

We compared the morphological characteristics of the right papillary muscles with the left ones, in the number and shape of their height and their thickness at the base and their upper extremity.

## COMPARISON BETWEEN THE ANTERIOR PAPILLARY MUSCLES, RIGHT AND LEFT

Anterior single papillary muscles were most frequent with 41.95% than the left, and the left double papillary muscles were more frequent with 33.81% than the right ones. Papillary muscles triple and quadruplets I met more frequently in anterior left papillaries, where the triple with 2.33% and 2.35% for those with quadruplets. Quintuple papillary muscles I found only in left papillaries. The conical shape of the anterior left papillary muscle was more common with 4.83% than in anterior righteones and 4.96% for cylindrical papillary muscles. If irregular fusiform forms, I found that left papillary muscles were less frequent than the right anterior, with 1.40% for irregular papillary and 0.58% for papillary fusiform. Left anterior papillary muscles showed fewer forms than righteones, when encountering their arched forms, a truncated cone, the "Y" back in "V" back. As "the torch" i found it only in right anterior papillaries.
In case of double papillaries, shaped like the letter "H" I met in one case on both sides, as in "N" have found only in left anterior papillaries, and the shape of the letter "N" returned I met in one case in right anterior papillary muscles (muscles just 0.74% of double) and 5 cases from the left (7.58% of the left double muscles). Right anterior double papillary muscles, the same form in 19.05% of cases where the same form as anterior left in 25.39% of cases, so a difference of 6.34% for papillary left.

The base of the right anterior papillary muscle was unique in 53.33% of cases, those being left with less disposable 18.78% of cases. For bases with more roots, left papillary muscles showed higher percentages than the right papillaries, with 28.71% in cases with two roots, with 1.32% in cases with three roots and 2.34% in cases of 4 roots.
After [Bouchet] "origin of the papillary muscles is through more roots continue to the top of the columns, fleshy ventricle network of two three orders." [Christides] says that the left ventricle papillary muscles are stronger than those of the right ventricle papillary muscles, giving birth more frequently by the roots. " After [Gunn] "of the left ventricle papillary muscles are heavier than those of the right ventricle, given higher labor that it being conducted."

## COMPARISON BETWEEN THE LEFT AND RIGHT POSTERIOR PAPILLARY MUSCLES

Unique rigt posterior papillary muscles were more frequent with 29.41% than the left, and if left papillary muscles were the most frequent, double, by 17.43% than the righteones. Triple papillary muscles I have found more frequently in left posterior papillaries with 2.65% and in the case of quadruplets were more frequent with 13.64% the leftones. At the right posterior papillaries we haven't found papilariies with 5 muscular bodies.

The conical shape of the papillary muscles of the right posterior was more frequent with 15.24% more than the left posterior cylindrical papillary muscle, reduced if left with 11.18% posterior papillary muscles than righteones. If irregular shapes and curved, found that the left papillary muscles were more frequent than the right anterior with 1.07% for irregular papillary and 0.99% for arcuated papillaries. Left posterior papillary muscles showed a total of 2 cases in the form of "N" returned, the left showing 5 cases of this form. The righteones showed 2 cases of posterior papillary muscle "Y" back, left papilaries not showing this form, but had 2 cases of papillary of the letter "N" form. As "the torch" I found at both papillary muscles righteones, and the shape of the letter "H" I found at the posterior papillary muscles.
For bases with multiple roots, showed papillary muscles of the left lower percentages than just papilaries.At its height the right and left

posterior papillary muscle, we found that if unique papillary height was higher by an average of 2.5 mm for the left, if left papillary papillary muscles double heights were higher by up to 5 mm and in the case of papillary muscles triple difference between minimum and maximum size was 1.5 mm in favor of the left. Posterior papillary muscle thickness at the base of the two ventricles, it was higher for single and double left papillary muscles. on average by 2.7 mm to the papillary muscles finding a triple higher straight papillary muscles, with an average of 2.5. The thickness of the upper end of the posterior papillary muscle of the two ventricles, in the case of single papillary muscle, was greater for the posterior papillary muscles up to 4.5 mm, and in the case of double papillary muscle, the post had greater height up to 4.2 mm. If muscles posterior papillary muscle triple height was higher by up to 2.7 mm.

## TENDON CHORDAE

At the righ ventricle as I will refer in particular, to the chordae tendon departing from the papillary muscles front anterior and posterior septum chordae tendon presentation describing them septal papillary muscles. Most commonly, papillary muscle rigt chordae , front and rear, detach from their peak or immediately near him. Regardless of the detachment chordae specific form that is most commonly beam valve chordae and chordae tendon rarely simple, unique. Chordae tendon bundles can sometimes be joined at their base, giving rise to 106 unterior bunches chordae vavulare will branch out into different levels: close to home, halfway between the papillary muscle and valve or valve closer. Simple valve chordae at home, can remain such until their insertion valve or valve chordae can branch out 2-3.
There are rare cases where the valve chordae come off the upper third of the papillary muscle, above or at its waist level or even at the base of implantation, with or without the presence of a muscular cone. Chordae of beams, can detach chordae linking papilr of the ventricular wall muscle or chordae tendon that connects between them papillary muscles in the same group or different groups, in some cases going above neighboring papillary muscle. These, we called chordae or papillary-parietal or chordae interpapilare.

Fig.108 Right anterior papillary muscle double on the side of valve chordae to emerge from its peak, showing a lateral parietal stringing above its base. Medial papillary has in the tip, two cones from where fall muscle valve chordae. One valve chordae beam before it falls off the media, above his means and from the anterolateral.

Fig. 109. posterior papillary muscle as cylindrical, which presents four cones upper extremity muscle detached from the valve chordae. From the middle of the face medial muscle emerges a cone gives a closer stringing valvular branched septal valve.

Fig. 110. The right posterior papillary muscles, irregular, unique, widened at the basis of the valve chordae emerging from the top to the middle of his face, lateral and medial.

Fig. 111. Unique anterior right papilary muscle, cylindrical medial base by inserting themselves three fleshy trabeculae, which make a bound with ventricular wall. A valve chordae beam falls off the face of the anterior-medial of

the middle papillary muscle and a tendon stringing valvular detach from the base of the medial papillary muscle.

There are situations in which bodies muscle of a papillary muscle are joined by strips of muscle that I can give the appearance of a letter (N, Y, H), or decks muscle bound papillary muscle of the ventricular wall strengthening thus securing its base. Deck transverse or oblique muscle joining the two bodies muscle may have originated valve chordae, or chordae may originate and the space between two cones of the upper end of the papillary muscle. I found the right ventricle chordae tendon length between 5.5 mm-11.0 mm, the longest being the septal which reached to 11.0 mm, those of the posterior cusp ranged from 5.5 to 10.0 mm, while those of the anterior leaflet were 8-9 mm.

# CONCLUSIONS

From those presented in the previous chapters resulting high variability of the papillary muscles and chordae their tendon, this variability is also noted by [2,4,16,3,40] authors concluded from studies, variability of the ventricular papillary muscles on the number, shape and location, for the position and disposition of the chordae tendon and regarding the existence of links between muscular bodies of the papillary muscles (between the papillary muscles multiples) and links between the papillary muscles and the ventricular wall properly. This makes [Gunn] to assert that "there is no two complex papillary muscles that have the same structure as each case appears to be unique," and the [Solomon Nayak], who studied variations in the papillary muscles of left ventricle and mitral valve normal 100 cases to assert that "the mitral apparatus, including papillary muscles, are as unique to each individual as their fingerprints."

All these are important not only morphological, but also for the radiologist and surgeon, especially cardiovascular surgeon,[2] stating that "variability papillary muscles of two ventricles is important for the surgeon regarding surgical procedures dysfunction papillary muscle replacement a valve homograft states the use of mitral valve. Morphology and morphometry ventricular papillary muscles and chordae tendon and septomarginale trabeculae morphology can assist the surgeon during the surgical procedures performed to correct their defects. " [2] says that this variability is "a reason why it is important for scientists worldwide to study the variability of organic complexes chordae, papillary-valves, in order to establish specific architectural arrangement; This will allow physicians to adapt cardiothoracic surgical procedures in accordance with the model complex organic approached and obtain encouraging results ".

[41] show "the necessary studies to investigate the feasibility of carrying papillary muscle repositioning for mitral valve replacement procedures in patients with left ventricular dysfunction and determine early and late effects of the procedure used on clinical outcomes and

ventricular mechanics; papillary muscle repositioning ventricular remodeling can lead to more favorable compared with mitral valve replacement. "

[4] found that frequent "basis papillary muscle has no direct contact with the solid portion of the ventricular wall, coming into contact with trabeculae fleshy thereof (also observed frequently in the study), which probably makes it more vulnerable to breaking. " This attachment could be countered by the existence of multiple roots for fixing the base papillary muscle. But the existence of multiple roots (I finding up to 4 base roots that can fix ventricular papillary muscle to the wall), "would result in a slight delay in the transmission of nerve impulses papillary muscle contraction.

[1] states that "papillary muscle length decreases with increasing their number." I have not confirmed this assertion, frequently multiple papillary muscles with a greater length than the length of the sole. Instead, we found in some cases a decrease in muscle thickness multiples relative to single papillary muscle thickness. All [9] found that papillary anatomical variations may occur in association with other anomalies and syndromes.

After [2], "an increased number and size of the papillary muscles and their birth, can cause obstruction in the circulation ventricle and left ventricle causes for mitral regurgitation; where there are only two left ventricular papillary muscles, chordae take half of a single papillary muscle control; Thus, an ischemic event which affects the base of the papillary muscle will cause disfuncţionabilitatea half of chordae, leading to mitral regurgitation, mitral valve prolapse severe. Myocardial infarction will not affect mitral valve functions when there is a group of papillary muscles or disfuctionability will be minimal. "

That form papillary muscle affects blood flow ventricular passing, mentioned by several authors and obstruction of blood flow chances are greater when papillary muscle hypertrophy occurs or if the apex broad muscles. But "obstruction is commonly caused by abnormal insertion of a papillary muscle directly at the valve without chordae tendon interposition, in which case it is absolutely mandatory papillary muscle resection" [2]. "Papillary muscle facilitating best cardiovascular physiology and presenting minimum obstruction of blood flow is the cone attached to the heart wall cavity and the narrow tip."

[14] notes that "the most frequent rupture of a papillary muscle is found at the rear right that breaks more frequently than 3 times more than during the previous infarction, probably due to less blood supply; revealed a narrowing of the arterial lumen by atherosclerotic plaques, finding a larger (up to 75%) in patients with papillary rupture than those with fatal acute myocardial infarction. " After [42] posterior papillary muscle rupture was due to the fact that they chordae thinner aspect that I do not I highlighted the measurements. [43] recommends diagnostic ultrasound that would "have a sensitivity of 65-85% in the diagnosis of papillary muscle rupture," and [15] states that "a heart attack can also achieve papillary muscle myocardium; a decrease in blood perfusion can lead to muscle tissue necrosis and papillary muscle rupture, in which the valve does not close properly and blood will refl toward the atrium during ventricular systole. "

Improving the means of scan, which resulted in outstanding performance makes [12] to say that "ultrasound is the primary imaging method of choice for noninvasive evaluation of mechanical complications such as acute mitral regurgitation in the setting of myocardial inferct; echocardiographic features of importance include location papillary muscle rupture and chordae and papillary involvement in the direction and severity of mitral regurgitation and hemodynamic complications "and [43] intraoperative transesophageal echocardiography believes that ruptured chordae highlights the papillary level, indicating a need anuloplastiei prosthetic ring.

[44] saying that "at present the papillary muscles are described as posterolateral and anterior septal-lateral; Arrangement anterior-posterior difference, however, is marginal; as seen in tomographic images and echocardiograms cross-section muscles are positioned infero-septal and superolateral side "so it would be necessary to rename the papillary muscles appropriate to their situation on individual human life" aspect to be taken into account in the future.

For[30,31], "the study of papillary muscle tendon strings distribution is particularly important in cardiac surgery techniques progress in the repair of the tricuspid valve replacement cord after traumatic regurgitation, tricuspid valve repair surgical and invasive procedures valvuloplasty."

In the study revealed that it would be more correct to speak of bundles of chordae that originate in the papillary muscle and

subsequently at different distances from home branches into bundles less (which later give rise to chordae valve ) or valve chordae, which will insert the appropriate valve, often in the matginii free. Also codsider that off valve chordae should be described more and so-called false chordae: chordae tendon parietal, who started from different levels of ventricular papillary muscle wall; interpapilare chordae, papillary muscle of the bodies lying between the bodies of multiple muscle and chordae interpapilare papillary arranged between groups of ventruculului respect, as well as chordae disposed between roots base papillary muscle. Rarely found chordae tendon that begins in the muscle of a bridge between two muscular bodies.

In closing I want to remind that my study does not claim to have achieved knoladge all about the morphology of the papillary muscles and chordae, their tendons more being described many morphological thereof: structure, vascularisation, innervation and even details related to the form and number aspects that depend primarily on the number of cases that you worked, and the work methods used. But "when treating a subject, it is impossible to run out," as Montesquieu said ".

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