

Anatomical Particularities of the Papillary Muscles, Tendonous Cordages of the Cardiac Valvular System at Swine (Segm. II - Left Ventricle)

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Abstract. This research brings new knowledge on the particularities concerning the compared anatomy of the cardiac particular parts. It involved a number of 12 dissected pig hearts where there were some anatomical aspects worth mentioning on the valve, muscular and papillary forms, and also on the tendinous cordages of the left ventricle. Compared to the classical descriptions, especially concerning the human hearts, in this case, the observations made on pig hearts revealed that there is a large variety from one individual to another regarding the distribution of the muscular forms found. They are singled or multi papillary, they have a variable origin and a different distribution of the tendinous cordages concerning their insertion on the atria-ventricular valves. These aspects are high lightened also by the original photo images included in this paper. The observations made on this forms reveals the fact that at swine there is no common feature to be established regarding the shape and ventricular-valves distribution of these forms. On the other hand, the papillary septal and marginal forms appear constantly, but they are variable from one individual to another regarding the origin and distribution. They are seen as having an important role in the myocardial distribution of their own cardiac excite-conductive system. The forms noticed in the left ventricle are much more developed compared to the right one. From a physiological and clinical aspect, we concluded that the anatomical particularities found and described are very difficult to correlate with the individual's specific cardiac activity.

Keywords: tendinous cordages, heart, papillary muscles, swine.

INTRODUCTION

In the heart's complex and vital role concerning the intra cardiac sanguine circuit, a special role is given to the proper muscle system represented especially by ventricle papillary forms and tendinous cordages, anatomical – functional elements connected strictly to the atria-ventricular cusped valve complex.

Starting from the embrionary stage, at the right and left atria-ventricular aperture the bi and tricuspid valves are attached under the aspect of some blades of mesenchimal condense, on the edges of the atria-ventricular valves from which they partially together come off along with the myocardial fibers; these last ones transforming themselves in tendinous cordages which fix the free margins of the valves on the myocardial wall. Overall, the mesenchimal

tissues of the valves are transformed in conjunctive tissue. The endocard covers the valves (1, 2, 5).

From an anatomical descriptive point of view, the septal - marginal muscular ventricle forms and the papillary ones are in direct connection to the superficial cuminitive fibers of the cardiac ventricle segments, that at the cardiac apex level determine the vortex (Vortex cordis) and continue with the intern myocardial ventricle plan. The papillary muscle forms are continuing fibers of the cordages inserted on the free margins of the atria-ventricle cusped valves (3, 6).

The existence of the possible anatomic particularities found from one individual to another and that are described in man (1) and not found as being described at domestic animals in the consulted literature, determined us to make some anatomical observations at the pig hearts.

MATERIALS AND METHODS

The observations were made on a number of 12 pig hearts that served also at the notes described in the first episode which refer to the particularities found in the right ventricle. On mentioning the anatomical particularities found in the case present at the left ventricle we took into consideration the sampled heart from the same subject in which the observations regarding the left ventricle were made. We mention the fact that the animals from which the hearts were collected were clinically healthy, of different ages and sizes, of common breed, being sacrificed through bleed out, for economical purposes. The technique of opening the cardiac ventricle cavities was made by two incisions parallel with the interventricular left dike (Sulcus paraconalis) corresponding to the cardiac ventricle walls (Fig. 1 and Fig. 2). In this way the intreventricular touch was avoided, as well as the atria-ventricle ones. The observations and anatomical particularities found are given in the photo images included in the text.

RESULTS AND DISCUSSION

In the anatomical aspect's description we will take into account the particularities found at one of the hearts taken into examination.

Case I (Fig. 4) represents one of the common situations in which two ventricle papillary muscles (pillers of I order) septal and parietal- are well seen, and the own tendinous cordages are meant separately to each correspondent valve cusp, septal cusp, respectively to the parietal one (Fig. 4, no. 1, 2, 3, 4, 5, 6). The exception is in this case two short cordages that belong to the papillary parietal muscle inserted on the crease parietal septal intercuspoid. In correlation with the functional role of the left cardiac ventricle, compared to the right one, there is a more powerful development of the muscle papillary forms, tendonous cordages as well as the left atria-ventricle cusps. The remarkable aspect is the spread image of the cordages on the edges of the two cusps. Also, a powerful papillary – parietal muscle fascia (sectioned) belonging to the septal papillary muscle is seen (Fig. 4, no. 11). The transversal septal – parietal muscle forms are very little developed.

Case II In a particular way the four mamelon septal papillary muscle (Fig. 5a, 5b-a, b, c, d) of which the tendinous cordages are well individualized for each septal papillary and have a non spread aspect at the point of cusped septal insertions. The parietal papillary muscle is well developed, solitary, and the proper tendinous cordages are very short, not spread, destined exclusively to the homologous cusped. A special importance is given to the existence

of the well developed muscular septo-marginal, to which we attribute a great role in the myocardial distribution of the own cardiac excite conducting system (Fig. 5b, no. 11).

Case III At this topic is noticeable the unequal development of the cusps valves in favor for the parietal cusp greater than the septum one. This feature functionally corresponds to the proper development of the parietal papillary muscle (Fig. 6, no. 3, 4, 10). The tendon cusps of this part are very short, thick and unbranched (Fig. 6, no. 5). The septal papillary muscle is with three mamelons (Fig. 6, no. 9) and less developed compared with the parietal one. The tendon's cusps are also short individual formations for each papillary muscle and ramified cusp. Noteworthy is the absence of the septo-marginal ventricular transverse formations (pillars of ord. III). In contrast there are two papilo-parietal muscle bundles belonging to the two papillary muscles, of which a septo-marginal formation (Fig. 6, no. 6) and one parietal-septal detached from the parietal papillary muscle (Fig. 6, no. 6b). The role of these formations is assigned to the one described in the second case

In **Case IV** the parietal papillary muscle aspect is observed which is with two mamelons (Fig. 7, no. 3, 3'), in which case the own well-developed tendon cusps are intended for the perietal homologous cusps, and also for the septum (Fig. 7, no. 4, 5).

Case V shows a strong development of the septal cusps to which multiple septal papillary muscles correspond, belonging to the multi mamelon cordage (Fig. 8, no. 1, 4, 7). It should be noted that one of the well-developed septal papillary formations, have cordage for parietal cusp (Fig. 7, no. 8) and parietal papillary muscle has cordage for septal cusp (Fig. 7, no. 9). A particular feature is the presence of a medial fold intercuspidal, branched at both ends corresponding to the two cusps (Fig. 7, no. 3).

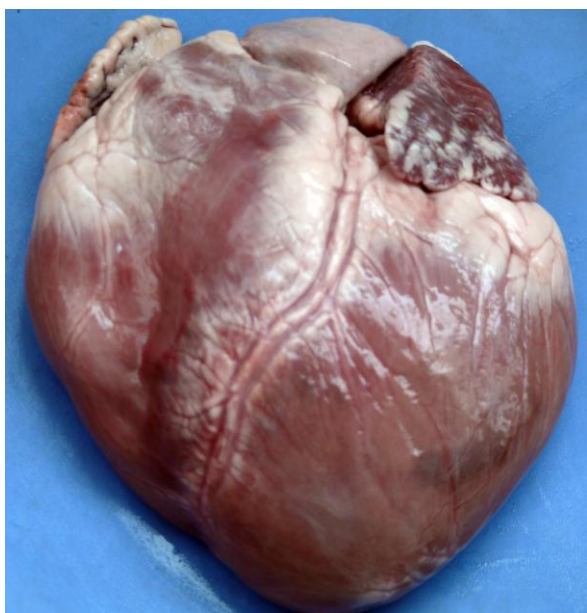


Fig. 1. The paraconal side of the heart on which the incisions were made to open the ventricular cavities.

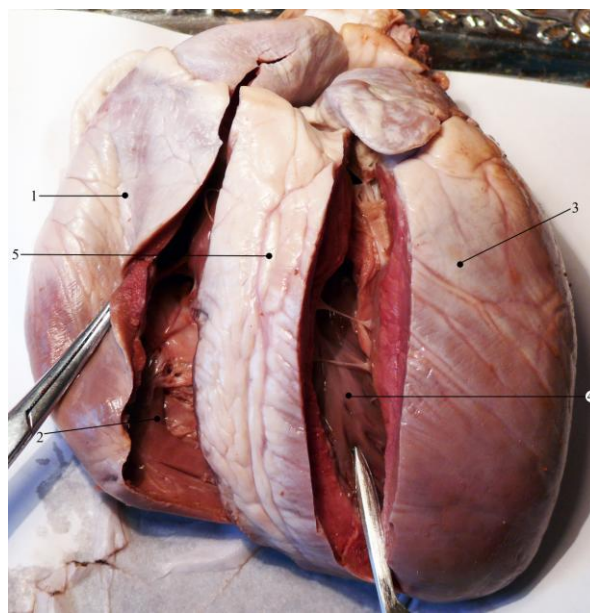


Fig. 2. The opened cardiac ventricular cavities: 1. Right ventricle; 2. The right ventricle cavity; 3. The left ventricle; 4. The left ventricle cavity; 5. The longitudinal dyke of the left ventricle (s. Sulcus paraconalis).

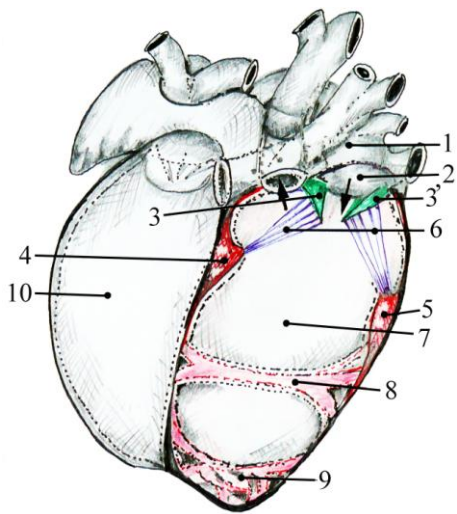


Fig. 3. The anatomical sketch of the left ventricle myocardial forms, the tendinous cordages and the two cusped atria-ventricle system: 1. Left atria; 2. The left atria-ventricular orificium; 3. The septal cusp; 3'. The parietal cusp; 4. The septal papillary muscle (s. subauricular); 5. The septal papillary muscle (s. subatrial); 6. The tendinous cordages; 7. The left ventricle cavity; 8. The septal marginal muscles; 9. The apical muscle trabecule; 10. The right ventricle.

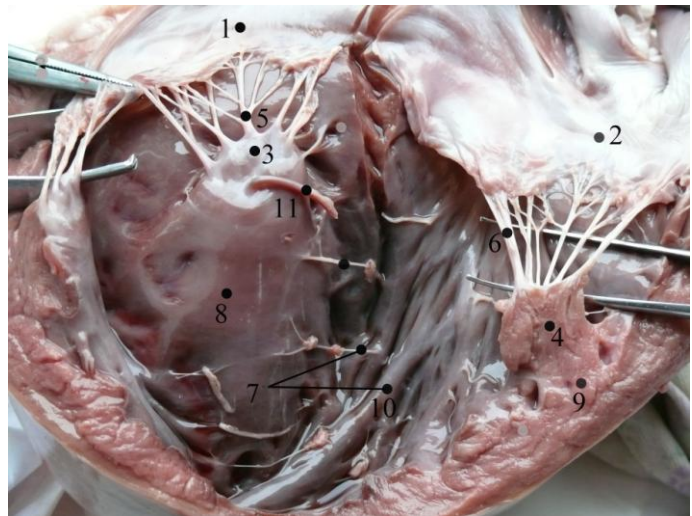


Fig. 4. The anatomic configuration of the bicusped ventricle muscle system of the cusped cordages in the left ventricle: 1. The atria ventricle septal cusp; 2. The parietal atria-ventricle cusp; 3. The septal papillary muscle; 4. The parietal papillary muscle; 5, 6. The tendinous cusps' cordages; 7. The septoparietal muscles; 8. The inter ventricle wall (s. septal); 9. The parietal ventricle wall; 10. The apical trabecular muscles; 11. The septal muscle which comes off the septal papillary muscle.

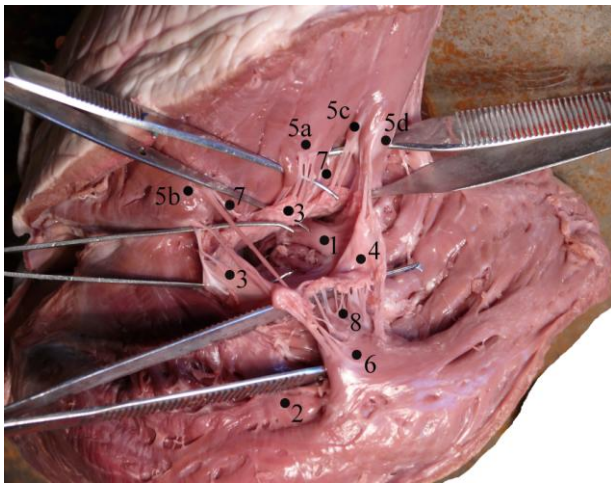


Fig. 5a. The papillary forms characteristics and the cusps' cordages:

1. The left atria cavity and the two cusped atria ventricle orificium; 2. The left ventricle cavity; 3. The septal cusp; 4. The parietal cusp; 5. The septal papillary muscle, mamelon (a, b, c, d); 6. The parietal papillary muscle; 7. The tendinous cordages; 8. The tendonous cordages.

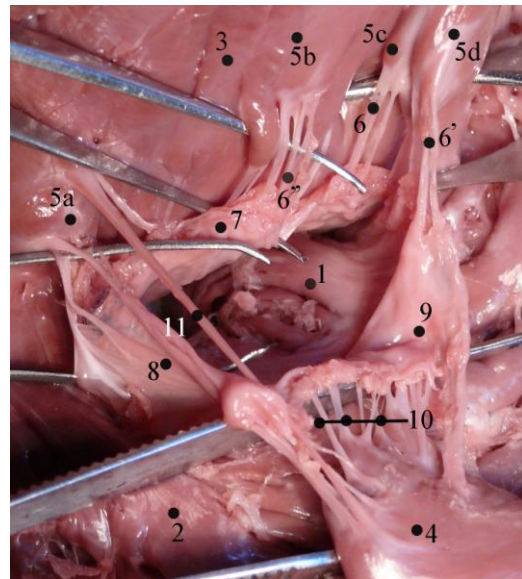


Fig. 5b. Details for fig. 5a with the high lightening of the septal pillar (a, b, c, d) and of the proper cusps' cordages for each mamelon (6, 6', 6''):

1. The left atria cavity and the bicusped atria-ventricle orificium; 2. The left ventricle cavity; 3. The septal inter ventricle wall; 4. The parietal ventricle wall; 5. The multi-mamelon septal papillary muscle (a, b, c, d); 6, 6', 6''. The septal tendinous cordages; 7. The septal cusp; 8. The intercusp valve fold; 9. The parietal cusp; 10. The parietal tendinous cordages; 11. The septal- parietal muscle cord.

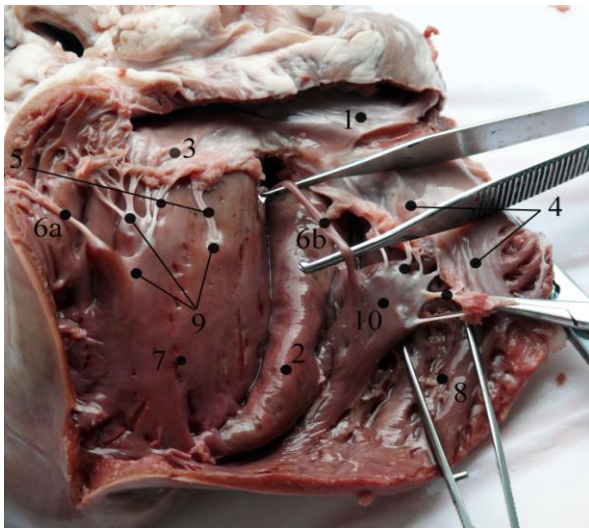


Fig. 6. Particular aspects of the papillary tendon muscle, and papillary-parietal formations cordages 6a and 6b: 1. Left atrial cavity; 2. Left ventricular cavity; 3. Septal cusp; 4. Parietal cusp; 5. 5'. The cusp tendinous cordages; 6a and 6b. Papilo-parietal muscle formations; 7. Interventricular septal wall s. 8. Parietal ventricular wall; 9. Papillary muscles septic three mamelon.

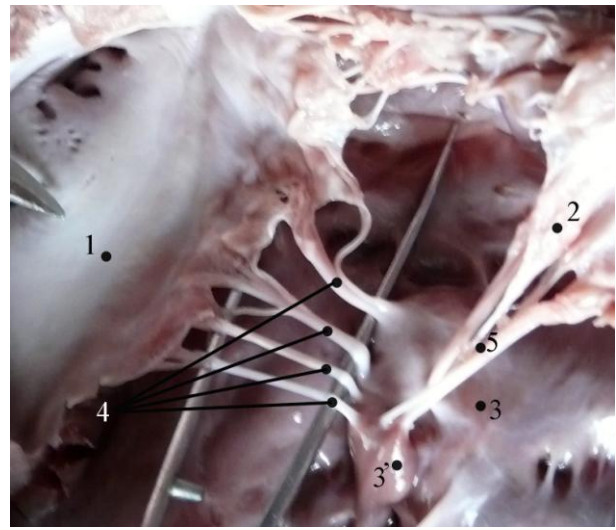


Fig. 7. Parietal aspect of the papillary muscle-tendon two mamelon cordages and own two atrioventricular cusps: 1. Septal cusp; 2. Parietal cusp; 3,3'. Parietal papillary muscle; 4. Septal cusp tendon own cordages; 5. The own tendon cordages for the mural cusp.

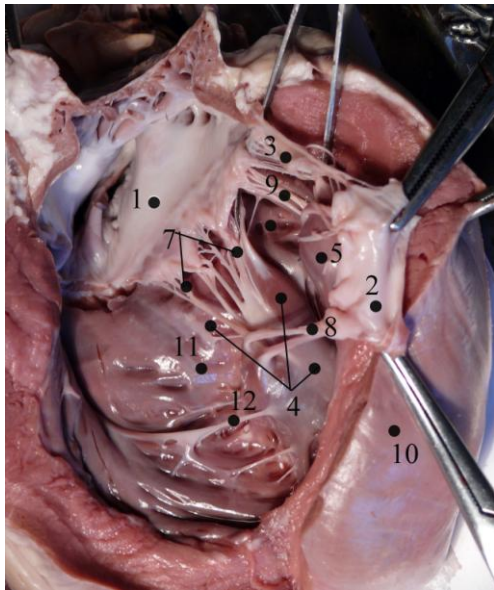


Fig. 8. The features of the common distribution belonging to the two categories cusp cordages of papillary muscle: 1. Septal cusp; 2. Parietal cusp (detached); 3. Intercusp fold; 4. The multiple septal papillary formations; 5. The parietal papillary muscle; 6. The left atrium cavity and left atrioventricular orifice-bicuspid; 7. Septal cusps cordages; 8. The cordages for a papillary septum formations, for the parietal cusp; 9. The cordage of the septal papillary muscle for the parietal cusp; 10. The Parietal ventricular wall; 11. The left ventricular cavity; 12. The septo-papillary transverse cordage.



Fig. 9. Detail on cordajele septal cusps (detached) papillary formations belonging to the septal and parietal papillary muscle: 1. Septal cusp (detached); 2. Parietal cusp, 3. Septal papillary formations; 4. Parietal papillary muscle; 5. Septal tendon cordages; 6. The tendinous parietal cordages.

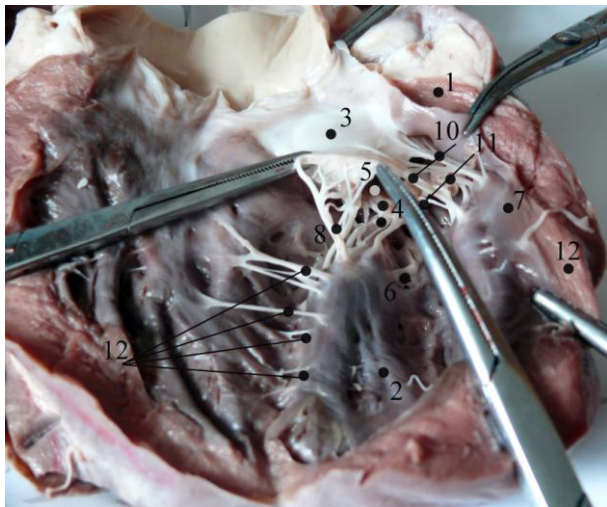


Fig. 10. Particulars regarding the appearance and distribution of functional cardiac septal papillary muscle, left: 1. Left atrial cavity; 2. Left ventricular cavity; 3. Septal cusp; 4. Parietal cusp; 5. Atrioventricular orifice; 6. Septal papillary muscle; 7. Parietal papillary muscle; 8. The septal papillary muscle cordages for septal cusp; 9. The cordages of the septal papillary muscle for the parietal cusp; 10. The parietal papillary cordages for the septal cusp; 11. The cordages of the parietal papillary muscles for the parietal cusp; 12. Multiple papillary septo-parietal cordage.

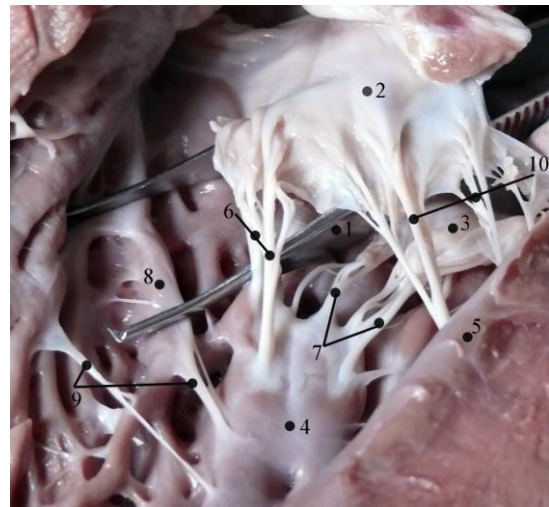


Fig. 11. Anatomical detail of particular aspects of left ventricular papillary muscles cordage distribution: 1. Left atrioventricular orifice; 2. Septal cusp; 3. Parietal cusp; 4. Septal papillary muscle; 5. Parietal papillary muscle; 6. The cordages of the septal papillary muscle for the septal cusp; 7. The septal papillary muscle cordages for the parietal cusp; 8. Parietal wall of the left ventricle; 9. Papilo - marginal parietal cordage; 10. Transverse cordage of the parietal papillary muscle for the septal cusp.

Case VI has one of the features unfound in any of our hearts taken in observation. Thus, the papillary formations cusps are well developed, the septal papillary muscle thickening is noticed, highly developed and with an elongated appearance (Fig. 10, no. 6). In addition to the heart cusp forms of the septal edge many septo-parietal with tendon are seen (Fig. 10, no. 12).

CONCLUSIONS

- Anatomically speaking, the valve-cusp system, papillary of the left ventricular cardiac tendon cusps, shows great variability from one subject to another;
- Similar to the wall thickness differences of both heart ventricles, there is a difference of development noticed in the papillary and cusps ventricular system belonging to the left ventricle;
- The left atrio-ventricular valves cusps may be unevenly developed;
- The tendon cordages of a cusp show a variability in terms of their papillary origin, unable to establish a common standard in this regard;
- In most cases the septal papillary muscle is with many mamelons or dispersed;
- The internal plan of the miocardic ventricular system is poorly represented in terms of transverse septo-marginal formations;
- The septo-marginal muscle formations existence with papillary origin have an important role in the management and distribution of the own cardiac excite-conductive system ;
- From a clinical point of view, we considered being difficult to assess the cardiac activity based on the variability and anatomical features found and existing form one individual to another.

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