

Morphological and Morphometric Investigation of the *Musculus papillaris* and *Chordae tendineae* of the Donkey (*Equus asinus* L.)

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Abstract: In this study, 8 hearts of adult donkeys of both sexes were examined grossly. In the right ventricle, *Musculus papillaris* magnus (mp magnus) was observed to have 2-4 processing nipple like processes, which gave rise to *Chordae tendineae* (CT) that were observed to divide into 7-12 subbranches. *Musculi papillares parvi* (mmp parvi) were determined to have 2-3 headed nipple-like structures. The total number of CT varied between 7-12. *Musculus papillaris* subarteriosus (mp subarteriosus) had either no process or 1-3 process (headed nipple). The number of CT arising from this muscle was observed to vary between 8-11 in the left ventricle. The number of CT that originated from *Musculus papillaris* subatrialis (mp subatrialis) and *Musculus papillaris* subauricularis were determined to be 4-12 and 6-14, respectively. All of the CT divided, in turn, into subbranches before attaching to the apex, body and base of the cusps. *Trabecula septomarginalis* (TS) were observed to exist in both the right and left ventricles in all of the examined animals.

Key words: Anatomy, donkey, *Papillary muscle*, tendinous cord, *Equus asinus* L., CT, TS

INTRODUCTION

The *Tendinous cord*, *Trabecula carnea* (*Papillary muscle*, septomarginal band and false tendinous) and fibrous rings are essential structures that open and close the left and right atrioventricular orifices (Gryzbiak, 1985; Kuralay *et al.*, 1990; Nazari *et al.*, 2000; Özbag, 2001; Özbag *et al.*, 2003).

The pectinal muscles located on the wall of the atrium have changed their shape and become very eminent components on the wall of the ventricle and are called the *Trabecula carnea*. This structure possesses 3 types: simply comprised ridges or prominent ridges (Arinci and Elhan, 1995; Sison and Grossman, 1975; Snell, 1986), the so called moderator band or *Trabecula septomarginalis*, for it lies between the anterior and septal walls of the ventricular cavity like a bridge (Restivo *et al.*, 1989; Snell, 1986; Arinci and Elhan, 1995), or false chordae tendineae (This kind comprises elements of the stimulus transmission even though it does not contain fibrous or musculofibrous structures (Abdulla *et al.*, 1990; Cocchieri and Bardelli, 1992; Gerlis *et al.*, 1984; Gryzbiak, 1985; Lotkowski *et al.*, 1997)) and the so called *Papillary muscle* on the ventricular wall, which receives

fibrous tendinous cords on its free edges (Arinci and Elhan, 1995; Sisson and Grossman, 1975; Snell, 1986; Dyce *et al.*, 2002).

Angular, septal and parietal cusps are present in the right atrioventricular orifice (Budras *et al.*, 1994; Dursun, 2000; Schummer *et al.*, 1981). Moreover, parietal and septal cusps are seen in the left atrioventricular orifice (Dursun, 2000; Schummer *et al.*, 1981).

The aim of this study was to document the morphological and morphometric features of the valves, *Papillary muscles*, tendinous cords and septomarginal trabeculae present in the donkey (*Equus asinus* L.) heart. The data gathered hereby, would be a valuable contribution to the veterinary gross anatomy literature and clinical research.

MATERIALS AND METHODS

Eight hearts of adult donkeys of both sexes from laboratory cadavers of the Department of Anatomy were examined grossly. They were first rinsed with 0.9% physiological saline and were then fixed with 10% formaldehyde solution. Secondly, dissection of the hearts was carried out, measurements were performed with a

digital caliper (Mitutoyo Digimatic Calliper, Japan, 150 mm) and photographs were taken with a Canon A-1 digital camera (Japan).

The heart tissue was fixed for histological examination in 10% formalin buffer solution. Tissue specimens were trimmed, dehydrated in degree alcohol, cleared in xylol and embedded in paraffin wax. Sections with an approximate thickness of 4-6 μ were stained with Hematoxylin-Eosin (HE). Slides were examined under light microscope. Measurements of standard deviation were accomplished by SPSS packet programme (Ozdamar, 2002).

RESULTS AND DISCUSSION

Gross anatomical observation of the cusps

Right side: The septal (Cs) (Fig. 1b, 2f, 3a, 4h), parietal (Cp) (Fig. 1c, 5d, 2e, 4g) and angular (Ca) (Fig. 5e, 2d, 3b, 4f) cusps were present in the atrioventricular orifice, being sail-like structures. Due to this shape, the atrioventricular orifice was observed not to close completely. A number of 2-3 smaller cusp-like components were observed to close the areas where the real cusps could not reach to close. *Chordae tendineae* originating from the papillary muscle attached to the base, centre or apex of the cusps. Some measurements of the cusps have been displayed in Table 1. *Cusps septalis* was significantly thicker, Ca wider and Cp longer.

The area between the Cp and Cs was closed by an accessory small cusp-like structure in 2 animals (No. 1 and 8). Likewise, the area between the Cp and Ca was filled with 2 similar components in one animal (No. 3). These structures were determined to be located in antero-septal, antero-posterior (Fig. 1e) and postero-septal (Fig. 4d) position. *Chordae tendineae*, hence, connected them not to one point but to several areas since, it gave many smaller branches before connection.

Left side: The parietal (Fig. 6, 7b) and septal (Fig. 8, 9b), cusps were found in the left atrioventricular orifice. A number of 1-2 smaller cusp-like components were also seen hereby. *Chordae tendineae* arising from the *Papillary muscle* attached to the base, centre or apex of the cusps. As seen in Table 2, Cp was longer but Cs was significantly thicker and wider.

Both Cp and Cs were determined not to close the atrioventricular orifice completely. A smaller cusp-like component in 2 animals (No. 4 and 8) and 2 components in 2 animals (No. 2 and 7) were observed to aid in closure. Similar to the right side, CT, hereby also, attached to these structures via smaller branches.

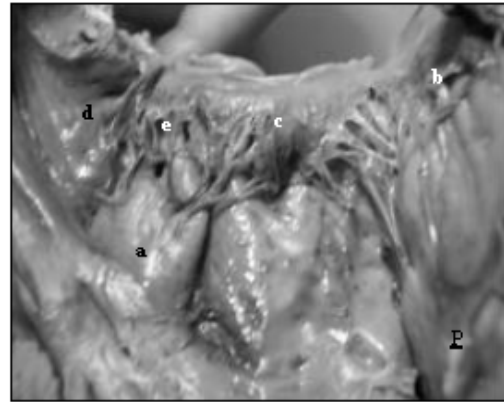


Fig. 1: Right ventricle, a: *Musculus papillaris magnus*, b: *Cusps septalis*, c: *Cusps parietalis*, d: *Cusps angularis*, e: region of between cusps (Commissura) (anterioposterior cusp)

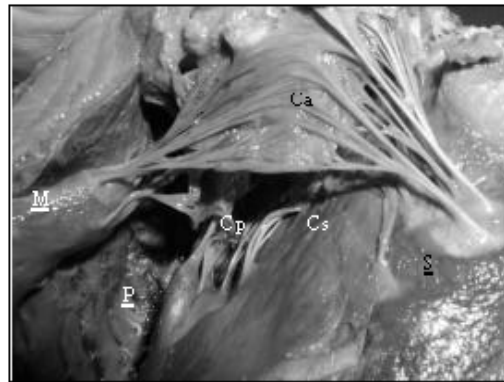


Fig. 2: Right ventricle. a: *Musculus papillaris magnus*, b: *Musculi papillares parvi*, c: *Musculus papillaris subarteriosus*, d: *Cusps angularis*, e: *Cusps parietalis*, f: *Cusps septalis*

Right ventricle: *Musculus papillaris magnus* (Fig. 1, 5, 2, 4a) was determined to be located just below the Cp (Fig. 1c, 5d, 2e, 4g) and to be a large structure. Measurements of thickness and length are shown in Table 2. Although, they seemed to have only one root, there were, on their surface, nipple-like smaller components that gave rise to *Chordae tendineae*. There were 2 in 4 animals (No. 3, 6, 7, 8), 3 in four animals (No. 1, 2, 5, 6) and 4 in one animal (No. 6), attaching either to the apex or body of the mp magnus. These structures were also sometimes observed to be located independently.

The total number of *Chordae tendineae* was 8-12. They, in turn, divided into smaller branches, attaching to the Ca and Cp. The number of *Chordae tendineae* attaching to the Cp was 4 in 4 animals (No. 1, 3, 4, 6), 6 in

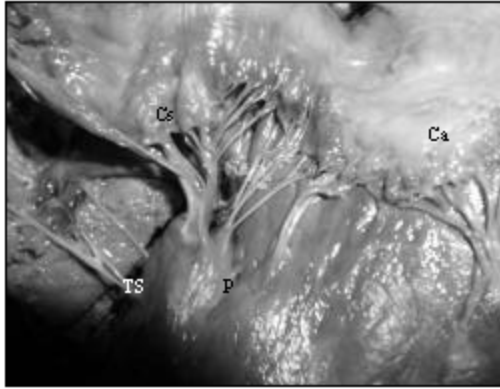


Fig. 3: Right ventricle. a: *Cuspis septalis*, b: *Cuspis angularis*, c: *Musculi papillares parvi*, d: *Trabecula septomarginalis*

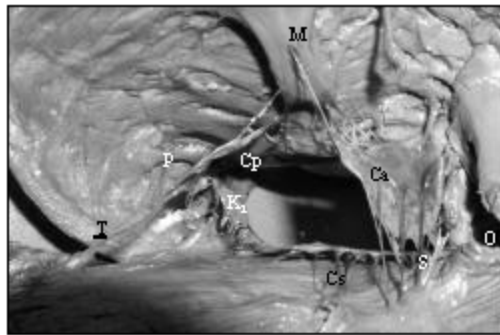


Fig. 4: Right ventricle. a: *Musculus papillaris magnus* b: *Musculi papillares parvi*, c: *Musculus papillaris subarteriosus*, d: Region of between cusps (Commissura) (posterioseptal cusp), e: *Ostium trunci pulmonale*, f: *Cuspis angularis* g: *Cuspis parietalis*, h: *Cuspis septalis*

2 animals (No. 7, 8) and 7 in 2 animals (No. 2, 5). Likewise, *Chordae tendineae* adhering to the Ca were 4 in 3 animals (No. 1, 4, 7), 5 in 3 animals (No. 2, 5, 6) and 2 in 2 animals (No. 3, 8).

Trabeculae septomarginalis were observed to arise from the ventral end of the mp magnus and to extend to the septal wall, between the septal and parietal walls. The number of TS with different thickness values was 1-5 and variances existed even in the same species. The TS was very thick in the animal possessing a thick muscle layer. One TS extending from the distal border of mp magnus to septum was 25.29 mm in the 1st animal. It was a like a trunk in the 5th animal and was divided into 2 branches at a distance of 8.53 mm to its origin, resembling a V shape. There were 3 TSs in the 2nd animal. The first 2 were 20.22 and 23.36 mm long respectively. The 3rd one extended a distance of 18.50 mm and divided into 2

Table 1: Measurements of some features from the left side

Number of animals/8	Min. (mm)	Max. (mm)	Mean	SD
TT	14.91	19.97	17.2987	1.6075
TL	15.60	23.32	18.9050	2.7654
AT	12.44	19.99	17.8863	2.4741
AL	16.42	35.85	26.3063	6.5656
CPT	0.35	0.59	0.4762	7.745E-02
CPLW	16.49	30.42	22.7613	5.4014
CPLB	18.17	27.42	22.6325	3.3549
CST	0.48	0.64	0.5688	5.768E-02
CSLW	17.42	29.31	23.9563	4.2062
CSLB	17.48	29.17	23.2575	3.6990

TT-TL: Thickness and length of *Musculus papillaris subatrial*, AT-AL: Thickness and length of *Musculus papillaris subartericular*, CPT: Thickness of *Cuspis parietalis*, CPW: Width of *Cuspis parietalis*, CPLB: Length of *Cuspis parietalis*, CST: Thickness of *Cuspis septalis*, CSW: Width of *Cuspis septalis*, CSLB: length of *Cuspis septalis*

Table 2: Measurements of some features from the right side

Number of animals/8	Min. (mm)	Max. (mm)	Mean	SD
MT	7.84	19.53	14.0275	1.3968
ML	15.12	22.12	19.4563	0.9055
PL	10.18	23.14	15.8450	1.3729
PT	6.41	13.37	9.2087	0.8139
SL	7.27	17.91	12.6300	1.1658
ST	3.37	13.60	8.4725	1.0484
CPT	0.25	0.59	0.4600	4.000E-02
CPW	16.29	28.63	21.3600	1.8766
CPLB	16.09	25.56	21.1288	1.0509
CST	0.34	0.76	0.5812	4.430E-02
CSW	16.51	36.74	23.8438	2.0844
CSLB	12.48	22.18	18.1513	1.2472
CAT	0.38	0.61	0.4938	2.764E-02
CAW	22.54	34.01	28.5150	1.5843
CALE	13.41	24.87	20.7550	1.5387

MT-ML: Thickness and length of *Musculus papillaris magnus*, PT-PL: Thickness and length of *Musculi papillares parvi*, ST-SL: Thickness and length of *Musculus papillaris subarteriosus*, CPT: Thickness of *Cuspis parietalis*, CPW-B: Width and length of *Cuspis parietalis*, CST: Thickness of *Cuspis septalis*, CSW: Width of *Cuspis septalis*, CSLB: Length of *Cuspis septalis*, CAT: Thickness of *Cuspis angularis* CAW: Width of *Cuspis angularis*, CALE: Length of *Cuspis angularis*

subbranches. They attached to the septal wall after coursing 10.17 and 11.00 mm, respectively. There were 5 TS in the 4th animal. Their lengths were 34.30, 30.36, 13.83, 9.21 and 8.71 mm.

Musculi papillares parvi (Fig 5, 2, 4b, 3c) were situated between Cp and Cs and were smaller than mp magnus. The length and thickness of this muscle is shown in Table 1. It was seen as only one root, possessing nipple like processes, which gave rise to CT. These processes were located on the apex and body of the mmp parvi. Their number was 2 in 3 animals (No. 1, 3, 5) and 3 in 5 animals (No. 2, 4, 6, 7, 8). Heads emerged from the end, centre or origin of the mmp parvi. The number of heads was determined to be 2 (No. 1, 3, 5) and 3 (No. 2, 4, 6, 7, 8). Summing up 7-12, *Chordae tendineae* were observed to divide, in turn, into subbranches and to attach to the apex, body and base of the Cs and Cp.

Numbers of CT attaching to the Cp were 3 in 2 animals (No. 2, 5), 4 in 2 animals (No. 1, 3) and 6 in 3 animals (No. 6- 8). Those determined to attach to the Cs were 4 in 1 animal (No. 2), 5 in 3 animals (No. 1, 3, 8) and 6 in 4 animals (No. 4-7).

Trabecula septomarginalis were determined to arise from the ventral edge of mmp parvi and to attach to the septal wall. Similarly, *Trabeculae carnae* were observed to be located on the ventral edge of the ventricle, between the septal and parietal walls. The number of *Trabecula septomarginalis* was 2 in 2 animals (No. 3, 7). One of the *Trabecula septomarginalis* in the 3rd animal had only one root, which extended an approximate distance of 12.95 mm and divided into 2 subbranches. These coursed 8.45 and 6.47 mm and attached to the septal wall. There were 3 TSs in the 6th animal. Their lengths were 17.02, 16.84 and 13.41 mm.

Musculus papillaris subarteriosus (Fig 5, 2, 4c), was observed to be very small and to be located just under the Ca. This muscle had either no process in 3 animals (No. 1, 3, 8) or only one root in one animal (No. 4). Moreover, it was determined to be in the form of a 2-headed nipple-like component in 2 animals (No. 2, 5), or as 3-headed nipple-like structure in 2 animals (No. 6, 7). The number of CT arising from this muscle was 8-11 and they divided, in turn, into subbranches before attaching to the apex, body and base of the Cs and Ca.

There were 4 CT in 2 animals (No. 2, 8), attaching to the Cs, 5 CT in 5 animals (No. 1, 3, 4, 5, 6) and 8 CT in one animal (No. 7). Likewise, the number of CT attaching to the Ca was 3 in one animal (No. 7), 4 in 2 animals (No. 2, 6), 5 in 3 animals (No. 3, 4, 8) and 6 in 2 animals (No. 1, 5).

Trabecula septomarginalis originating from the ventral edge of mp subarteriosus attached to either the parietal or septal wall. There was only one TS being 5.25 mm in 1 animal (No. 8) and were 2 in 1 animal (No. 5), being 16.84 and 13.41 mm.

Left ventricle: *Musculus papillaris subatrialis* (Fig. 6, 7a), was observed to be large and to be located right under the Cp. This muscle was also determined to have only one root and to possess nipple-like processes arising from the apex or body of the muscle. There were 2 in 3 animals (No. 5, 7, 8), 3 in 3 animals (No. 1, 2, 6) and 4 in 2 animals (No. 3, 4). The total number of *Chordae tendineae* originating from the muscle was determined to be 4-12. They also subdivided into smaller branches, attaching to the apex, body and base of the Cs and Cp.

The number of CT attaching to the Cp was 2 in 1 animal (No. 2), 3 in 3 animals (No. 1, 3, 6), 4 in 1 animal (No. 8), 5 in 2 animals (No. 4, 5) and 7 in 1 animal (No. 7).

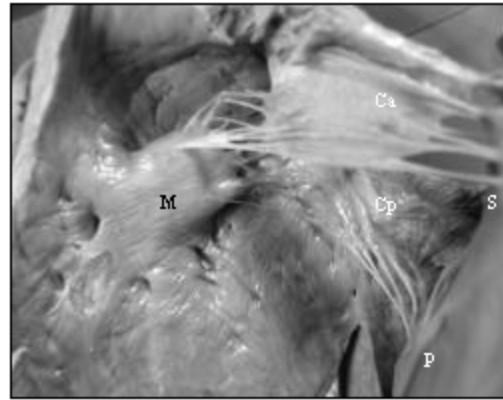


Fig. 5: Right ventricle. a: *Musculus papillaris magnus* b: *Musculi papillares parvi*, c: *Musculus papillaris subarteriosus*, d: *Cuspis parietalis*, e: *Cuspis angularis*

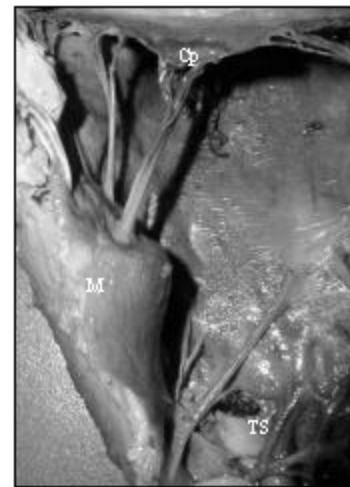


Fig. 6: Left ventricle. a: *Musculus papillaris subatrialis*, b: *Cuspis parietalis*, c: *Trabecula septomarginalis*

Those attaching to the Cs were 2 in 3 animals (No. 2, 4, 5), 3 in 2 animals (No. 3, 8), 4 in 2 animals (No. 1, 6) and 5 in 1 animal (No. 7).

Trabeculae septomarginalis (Fig. 6, 7c) were observed to arise from the ventral edge of mp subatrialis and to extend between the parietal and parietal or parietal and septal walls. There was only one TS in the 4th animal. It resembled a V shape after a course of 30.12 mm. The TS in the 5th animal was observed to extend a distance of 18.01 mm parallel to the septal wall individually before dividing into 2 parts. The 1st branch attached to the parietal wall and the second one to the septal wall. There were 2 TSs with 21.48 and 10.84 mm length in the 6th

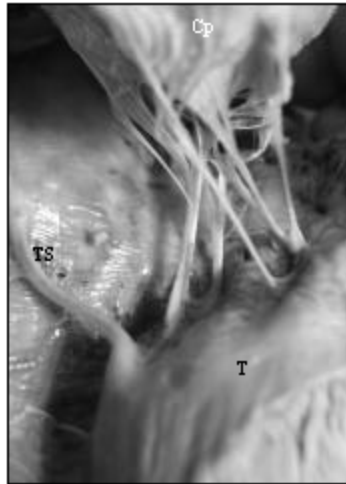


Fig. 7: Left ventricle. a: *Musculus papillaris subatrialis*, b: *Cuspis parietalis*, c: *Trabecula septomarginalis*

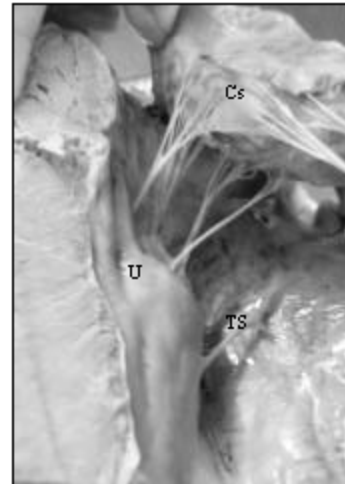


Fig. 9: Left ventricle, a: *Musculus papillaris subauricularis*, b: *Cuspis septalis*, c: *Trabecula septomarginalis*

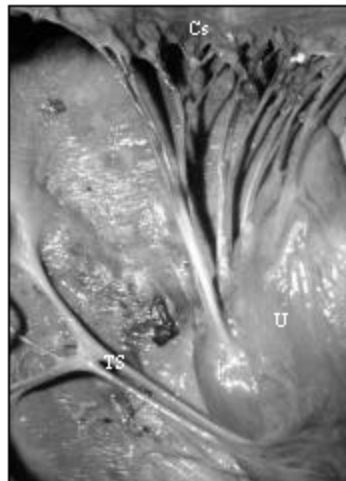


Fig. 8: Left ventricle, a: *Musculus papillaris subauricularis*, b: *Cuspis septalis*, c: *Trabecula septomarginalis*

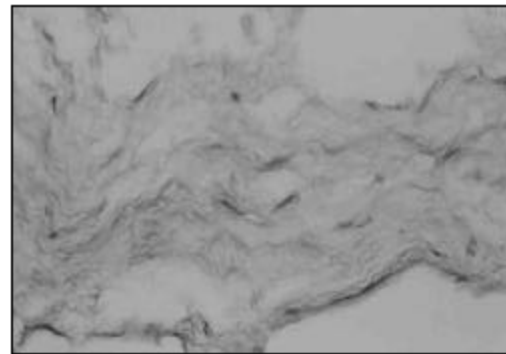


Fig. 10: *Chordae tendinae*, HE x200

animal, resembling an X shape. The TS in the 7th animal was very thin and was observed to form a network.

Musculus papillaris subauricularis (Fig. 8, 9a) was also quite large and was determined to be located under the Cs. It was also observed to have only one root, comprising ripple-like processes either arising from the apex and the body of the muscle, or processes that were freely located. These processes were assessed to be 1 in 1 animal (No. 6), 2 in 3 animals (No. 3, 4, 7) and 4 in 1 animal (No. 1). The total number of CT originating from the muscle was 6-14. These also subdivided into smaller branches and attached to the apex, body and base of the Cs and Cp.

The number of CT extending to Cp were 3 in 4 animals (No. 1, 3, 4, 5), 4 in 2 animals (No. 2, 6), 7 in 1 animal (No. 5) and 8 in 1 animal (No. 7), while those extending to Cs were 1 in 1 animal (No. 8), 2 in 1 animal (No. 4), 5 in 2 animals (No. 2, 6) and 6 in 3 animals (No. 1, 3, 7).

There were also TS (Fig. 7, 9c) arising from the ventral edge of the mp subauricularis and lying between the parietal and parietal or parietal and septal walls. Their numbers were only 1 with 21.55 mm in the 5th animal, 5 with 20.23, 9.12, 8.25, 7.12 and 6.49 mm in the 4th animal, 1 as a root with 27.57 mm in the 2nd animal. The last 1 gave 2 subbranches; one attached to the septal wall after coursing 10.30 mm, the other with 12.85 mm attached to the parietal wall. Thus, the *Trabecula Septomarginalis* were several and thin in the 7th animal. They were observed to be located on the apex of the heart and to form a network.

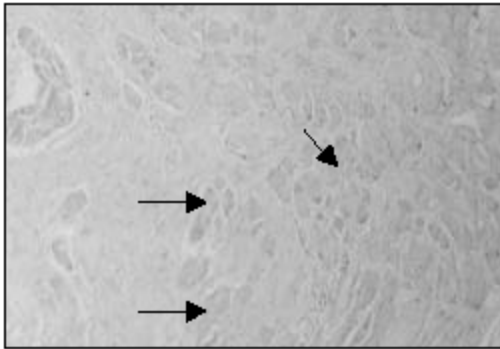


Fig 11: *Trabecula septomarginalis*, HE $\times 100$, \leftarrow : His fiber

Light microscopy: *Chordae tendineae* were fibrous in nature (Fig 10). *Trabecula septomarginalis* contained fibromuscular components and His fibrils (Fig 11) were in less number. It was also composed of muscle fibers. False *Chordae tendineae* was composed of musculofibrous component.

DISCUSSION

The *Papillary muscle*, tendinous cord, septomarginal band, false tendinous and fibrous rings are important structures that open and close atrioventricular orifices. Because of this, we consider that observation of the morphologic and morphometric investigation of these structures in different species with different aspect should be of concern.

The numbers of the cusps in the right ventricle have been reported to be 2-4 (Gerola *et al.*, 2001; Sutton *et al.*, 1995), 2-5 (Solomon and Nayak, 1994; Ulger *et al.*, 2003) and 4-6 (Wafae *et al.*, 1990). They were determined to be 3-5 in this study.

The width and length of Cp were measured as 21.36 ± 1.87 and 21.12 ± 1.05 mm, respectively. Similarly, they were 23.84 ± 2.08 and 18.15 ± 1.24 mm in Cs and 28.51 ± 1.58 and 20.75 ± 1.53 mm in Ca, respectively. Ulger *et al.* (2003), reported these values in humans as 1.63 ± 0.86 cm and 3.40 ± 1.02 cm in Cp, 1.63 ± 0.86 cm and 1.87 ± 0.45 cm in Cs and 3.17 ± 1.08 and 1.81 ± 0.37 cm in Ca, respectively. The cusps of the heart in donkeys have been determined to be similar to that of the human heart.

Chordae tendineae have been reported in the literature (Gryzbiak, 1985) to attach to the ventricular surface or edge of the cusps. They, in our study, were observed to attach to the edge, body, or even base of the cusps. These results are in parallel with the findings of Lam *et al.* (1970).

Wafae *et al.* (1990) indicated the number of the *Papillary muscle* in the right side to be 4 even though, we found that to be 3 in our study.

Nigri *et al.* (2001) documented that the posterior and anterior *Papillary muscles* were always present but the occurrence rate of the septal *Papillary muscle* in human was 21.5%. The latter was determined to exist in all the donkeys examined in addition to the first 2 indicated above.

A report Nigri *et al.* (2001) documented that the anterior *Papillary muscle* was 1-2 headed and 19.16 mm long. This report, thus, revealed that the posterior muscle had 1-4 heads and was 11.53 mm long and the septal muscle comprised 1-4 heads and was 5.59 mm long. This study, on the other hand, revealed that the mp magnus had 2-4 heads and was 19.45 ± 0.90 mm long the mmp parvi possessed 2-3 heads and was 15.84 ± 1.37 mm long and the mp subarteriosus had 1-3 heads and was 12.63 ± 1.16 mm long. Data belonging to humans and donkeys were determined to display similarity.

Literature Nigri *et al.* (2001) notified that the numbers of CT arising from *M. papillaris anterior* were between 1-11 m. *Papillaris posterior* were between 1-8 and *M. papillaris septalis* were between 1-5 in human. Furthermore, Duran (1981, 2000) reported the numbers of CT arising from each *Papillary muscle* to be between 6-10 in animals. This study revealed, on the other hand that those originating from mp magnus were 8-12. Again, 7-12 originated from mmp parvi and 8-11 from mp subarteriosus.

Gryzbiak (1985) mentioned that CT extending to the cusps in the commissura were fairly thin and originated from the edge of the *Papillary muscles*. These thin CT's attaching to the cusps in the commissura, in our study, did not originate directly from the *Papillary muscles*. They, in fact, originated from the other CT as smaller subbranches.

Chordae tendineae reported in literature (Gryzbiak, 1985), to be observed between the *Trabecula septomarginalis* and cusps were not observed in this research.

Restivo *et al.* (1989) showed that the *Trabeculae marginales* were located in 3 different regions. They were posteriorly located, below the chorda and between the first 2. In this study, however, they were seen generally on the distal edge of the *Papillary muscles*, mostly the apex of the heart, lying parallel to the distal edge of the counter *Papillary muscles* and attaching to the same wall.

Schummer *et al.* (1981) indicated different thick structures other than the *Trabeculae carneae*, lying between the parietal and septal walls. These components were reported to originate from the base of mp magnus and to extend to mp subarteriosus. Similar structures were also observed in this study.

The report of Schummer *et al.* (1981) regarding the presence of mp magnus in Carnivora on the septal wall was in parallel with our findings in donkeys used in this study.

The left *Trabeculae marginalis* (moderator band) was documented to be located specifically on the apex of the heart, arising from the bases of both *Papillary muscle* (Schummer *et al.*, 1981). In our study, 2 TS in the 5th animal were observed to resemble an X shape. Furthermore, there were very thin TS's observed on the floor of the ventricle, forming a network.

Ozbag (2001) reported the number of CT originating from *M. papillaris* anterior to be 8-14 in humans, 5-10 in dogs, 3-8 in sheep and 5-9 in goats. Those originating from *M. papillaris* posterior were also indicated to be 9-17, 5-11, 3-9 and 4-11, respectively. In this study, on the other hand, CT from mp subauricularis was 6-14 and those from mp subatrialis were 4-12.

The number of the cusps reported in the study of Ozbag (2001) as 4, was the same determined in this study carried out on donkeys.

There are literature reports Ozbag *et al.* (2003), Gerlis *et al.* (1984) and Abdulla *et al.* (1990) indicating *Trabeculae marginales* with different numbers and thickness to be located between, the *Papillary muscle*, the septal walls, the anterior walls, the *Papillary muscle* and septal wall and the *Papillary muscle* and anterior wall. Similar variations were also observed in our research.

The ratio of occurrence of false *Chordae tendineae* has been reported as 95% in literature (Gerlis *et al.*, 1984). We observed this structure in every ventricle of the heart examined in this study.

Although, Abdulla *et al.* (1990), Cocchieri and Bardelli (1992), Gerlis *et al.* (1984), Gryzbiak (1985) and Lotkowski *et al.* (1997) say that the structure of false *Chordae tendineae* did not contain fibrous or musculofibrous structure in their study, in this study was observed that the structure of false *Chordae tendineae* was composed of musculofibrous component.

Dyce *et al.* (2002) have revealed *Chordae tendineae* to be fibrous in nature. It was the case in our study also.

Ozbag *et al.* (2003) indicated that transversal section of the *Trabecula septomarginalis* was composed of fibrous or fibromuscular features and several blood vessels. Moreover, Abdulla *et al.* (1990) added that it contained myocardial tissue and His fibrils. Gerlis *et al.* (1984) also pointed out that its longitudinal section was comprised of muscle and elastic fibers and fibrous tissues and its transversal section had myocardial fibers. Findings of the sections of our study were also similar to what were reported in these literature.

CONCLUSION

On the whole, measurements of *Musculus papillaris*, cusps, *Trabecula septomarginalis* and *Chordae tendineae* of both ventricles in the donkey heart were fully documented. The results clearly suggested that the thicker the heart muscle is, the thicker and longer the *Musculus papillaris* are. This correlation is also valid for *Chordae tendineae* and *Papillary muscle*. This study on the macroanatomy of these structures in donkey may form a basic contribution to the literature of the veterinary anatomy and clinical for further related research.

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