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Farklı Koyun Irkı Kalplerine Ait Musculus papillaris ve Chordae tendineae Üzerinde Makroanatomik ve Morfometrik Bir Çalışma

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Özet

Koyun deneysel çalışmalarda kullanılan ve kullanılması halen tartışılan bir ruminant'tır. Koyun kalbinin kalp cerrahisinde bir model olarak kullanılabileceği öne sürülmektedir. Bu nedenle, çalışmada farklı koyun ırkı (Tuj, Akkaraman, İvesi) kalplerinin ventriculus cordis'inde bulunan bazı morfometrik veriler belirlendi ve karşılaştırıldı. Bu amaçla, 30 erkek koyun kalbi kullanıldı. Chordae tendineae'nin uzunluğu , kapakçıklara tutunma sayısı, musculi papillares'in tepe çıkıntı sayısı , trabecula septomarginalis'in sayısı ve uzunluğu belirlendi. Çalışmada chordae tendineae'nın tüm uzunluk değerlerindeki farkların istatistiksel olarak önemli olduğu saptandı. Sonuç olarak bu çalışma hem deneysel hem de eğitim amaçlı koyun kalbi modeli oluşturmada ventriculus cordis morfometrisi bakımından ırk faktörünün göz önüne alınması gerekliliğini ortaya koymuştur.

Anahtar sözcükler: Chordae tendinea, Kalp, Koyun, Morfometri, Musculus papillaris

A Macroanatomical and Morphometrical Study on the Tendinous Cords and Papillary Muscles of the Hearts of the Different Sheep Races

Abstract

Sheep (Ovis Aries) is a ruminant used in the experimental studies and still debated regarding its usage. In the some studies have been claimed that the heart of sheep have been used as a model in the heart surgery. For this reason, in this study, it was purposed that some morphometrical values finding in the ventriculus cordis of the different sheep races (Tuj, Akkaraman, Ivesi) were determined and compared. For this purpose, the hearts of the 30 male sheep were used. Length, holding the number to valve of the chordae tendineae and number of the top bulge of the musculi papillares, number and length of trabecula septomarginalis were determined. In the study, it was detected that differences of all length values of chordae tendineae among sheep races were statistically significant. In conclusion this study has been presented necessity of taking into account of race factor in terms of morphometry of ventriculus cordis in stages of creating sheep hearts' model for both experimental and educational.

Keywords: Chordae tendinea, Cor, Sheep, Morphometry, Musculus papillaris

Introduction

Sheep (Ovis Aries) is a ruminant used frequently in experimental studies (1-3). particularly in the studies conducted on respiratoric (4-7) and cardiovascular (8-10) diseases. Researchers have claimed that the heart of sheep can be considered as a suitable model in human heart surgery (8). Although sheep is used as an experimental model (11,12), in particular in heart surgery (9,10,13-15), lack of comparative data in sheep hearts is eminent.

Tuj, Akkaraman, and Ivesi are local sheep breeds living in East, Middle and Southeastern Anatolia Regions, respectively (16).

Valva atrioventriculare dextrum is composed by cuspis septalis (CS), cuspis parietalis (CP) and cuspis angularis (CA), valva atrioventricularis sinistrum is composed by cuspis septalis (CS) and cuspis parietalis (CP). The cusps are connected to mm. papillares (MMP) via chordae tendineae (CT). This connection facilitates the function of the valves in the diastole and sistole phases of the heart (17). There are m. papillaris magnus (MPM), mm. papillares parvi (MPP) and m. papillaris subarteriosus (MPSA) in the ventriculus dexter, m. papillaris subatrialis (MPSAtr) and m. papillaris subauricularis (MPSAur) in the ventriculus sinister (2,17,18). Moreover, there is a formation called trabecula septomarginalis (TS) extending in between interventricular septum and parietal wall in both ventriculus dexter and sinister (17).

Several studies have been performed on anatomical structures of the heart in various

species including human (19), camel, sheep and monkey (20), dog and goat (21), donkey (22), and rabbit and guinea pig (23). On the other hand, there are very few studies comparatively performed on the subject. For this reason, this study aimed at documenting some morphometric parameters including numbers and lengths of the CT and MMP in the hearts of the different sheep breeds (Tuj, Akkaraman, Ivesi).

Materials and Methods

Hearts of the 30 male sheep (10-Tuj, mean: 102±13 g, 10-Ivesi, mean: 110±8.4 g, 10-Akkaraman, mean: 120±14.8 g), with the age of 3-15 months, were used in the study. The hearts were provided from the Slaughterhouse of Kars Municipality, Aksaray Municipality and Ceylanpinar (Sanliurfa) TIGEM. They were fixed using 10% formaldehyde solution, and numbers and lengths of the CT, top bulge of the MMP, and numbers and lengths of the TS were determined. Electronic calliper (0.001, BTS, U.K.) was used to obtain measurements. The data were analysed with the one way ANOVA and Kruskal-Wallis tests of the SPSS (16.0).

Results

Macroanatomical Observations

There were additional m. papillaris (1 piece) and accessory valve (1 piece) determined in the ventriculus dexter of the number 2 Tuj sheep. There were additional m. papillaris (3 pieces) in the ventriculus dexter of the number 3 Tuj sheep. Basal cord (BC) (4 pieces) was observed in the ventriculus dexter of the number 4 Tuj sheep. A BC and accessory valve were observed in the ventriculus dexter of the number 6 Tuj sheep. There was one piece BC in the ventriculus dexter of the number 3 and 8 Akkaraman sheep. An additional MP (1 piece) was determined in the ventriculus dexter of the number 7 Ivesi sheep. Moreover, there were additional MP (1 piece) and accessory valve (1 piece) in the ventriculus dexter of the number 8 Ivesi sheep.

Locations and numbers of the false chordae tendineae (FCT) observed in this study were summarized at Table 1. The presence ratio of the FCT was 70% in the Tuj, 30% in the Akkaraman, and 0% in the Ivesi.

Table1. Number and location of FCT in the hearts of sheep breeds.

Race	Tuj		Akkaraman		Ivesi	
	FCT					
No	Count	Place	Count	Place	Count	Place
1	1	MPSAtr	-	-	-	-
2	1	MPSAtr				
3	4	MPSA	2	MPSAtr		
4	2	MPM,MPSAur	1	MPSAtr		
5	-	-	-	-		
6	2	MPSAtr				
7	1	MPSAtr				
8	2	MPM,MPSAur	1	MPSAtr		
9	2	MPSAtr	-	-		
10	-	-				

Morphometrical Examination

In this study, values obtained on CT and MMP were shown at the Table 2. Accordingly, A significant difference was detected among the length values of CT among sheep breeds ($p<0.05$). Meaningful differences were observed on the CT, MPSA and MPSAur results between Tuj and Akkaraman, and on the CT, MPM, MPP and MPSAtr among the Tuj, Akkaraman and Ivesi. It was determined that there were lined up as Akkaraman, Ivesi and Tuj from long to short in terms of extent of CT.

There was no statistically significant difference on the number and distribution ratio to cusps in the MPSA, MPSAtr and MPSAur ($p>0.05$). However, it was identified that number and distribution ratio to cusps of CT and MPM, and number of commissural CT and MPP in the Tuj were higher than those in Akkaraman and Tuj ($p<0.05$).

A significant difference was detected in MPP with regard to the number of top bulge of the MMP. The number of top bulge of MPP in Ivesi was significantly higher than that in Akkaraman and Tuj ($p<0.05$).

Trabecula septomarginalis was present in the ventriculus dexter of all of the sheep breeds used in this study, and its lengths in the Tuj, Akkaraman and Ivesi were 14.64, 19.33 and 17. 20 mm, respectively. Besides, the difference between Tuj and Akkaraman related to length of TS was statistically important. Moreover, the rate of incidence of TS in the ventriculus sinister was changeable in Tuj, Akkaraman and Ivesi, with the values of 50%, 66% and 66%, and its lengths were 13.04, 17.65 and 14.28 mm, respectively.

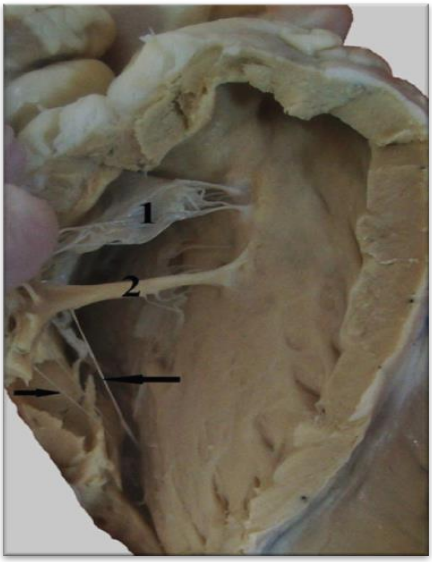

Figure 1. View of ventriculus dexter, 1. Cuspis angularis, 2. Trabecula septomarginalis, arrows: False chordae tendineae

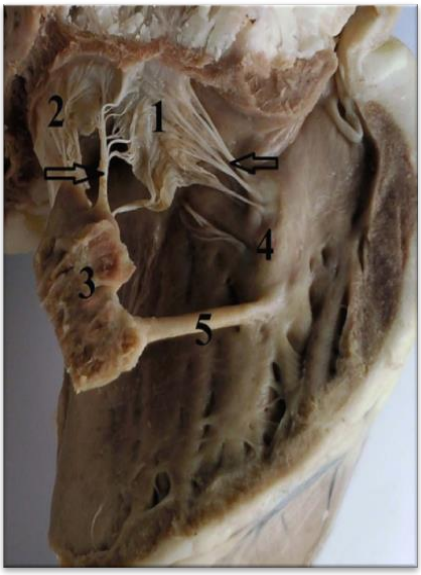

Figure 2. View of ventriculus dexter, 1. Cuspis angularis, 2. Cuspis parietalis, 3. M. papillaris magnus, 4. M. 5.Trabecula septomarginalis, arrows: Chordae tendineae

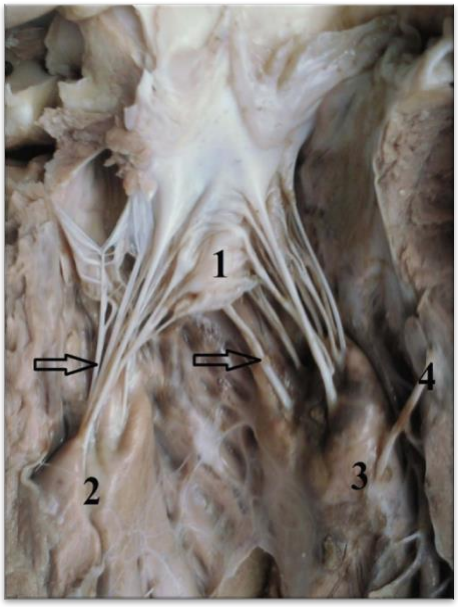

Figure 3. View of ventriculus sinister, 1. Cuspis parietalis, 2. M. papillaris subauricularis, 3. M. papillaris subatrialis, 4. Trabecula septomarginalis, arrows: Chordae tendineae

Table 2. The morphometric values of CT and MMP

Table 2. The morphometric values of CT and MMP. VD; ventriculus dexter, VS; ventriculus sinister, Com; commissural. * $p < 0.05$.

				Tuj	*Akkaraman*	*Ivesi*
VD	MPSA	CT	*Length	8.02±1.5	13.37±2.66	11.05±2.61
			Count	8.33	6.83	7.50
			CS	3.17	3.17	3.83
			CA	3.33	2.67	2.33
			Com	1.83	1.00	1.17
			Top bulge	1.7	1.5	2.0
	MPM	CT	*Length	7.19±1.57	13.92 ±2.20	12.00±1.66
			Count*	12.33	6.83	7.17
			CP*	7.17	3.17	4.00
			CA*	3.33	2.17	2.00
			Com	1.83	1.50	1.17
			Top bulge	3.5	3.0	3.2
	MPP	CT	*Length	7.95±1.23	14.82±3.16	12.98±1.9
			Count	6.50	5.17	7.17
			CS	3.17	2.17	3.33
			CP	1.67	1.83	3.00
			Com*	1.67	1.17	0.83
			Top bulge*	2.2	2.8	3.5
VS	**MPSAtr**	**CT**	***Length**	**14.12±1.98**	**20±2.18**	**19.53±4**
			Count	**6.17**	**5.67**	**5.00**
			CS	**2.00**	**1.83**	**1.50**
			CP	**3.00**	**2.83**	**2.50**
			Com	**1.17**	**1.00**	**1.00**
			Top bulge	**2.5**	**2.8**	**2.3**
	MPSAur	**CT**	***Length**	**12.87±3.05**	**19.15±2.38**	**16.48±3.24**
			Count	**6.67**	**5.33**	**6.17**
			CS	**2.33**	**2.17**	**2.33**
			CP	**3.00**	**2.00**	**2.83**
			Com	**1.33**	**1.17**	**1.00**
			Top bulge	**2.7**	**2.8**	**2.2**

Discussion and Conclusion

In this study, the anatomical structures, (CT, MMP, TS, BC, FCT and cusps) located in the ventricles of the heart of different sheep breeds (Tuj, Akkaraman and Ivesi), were investigated in terms of macroanatomic and morphometric aspects. Sheep has been used as a model in surgery of heart valve due to its coagulation system and slow growing (8,10).

In this study, additional and unique MP and cusps (BC, FCT) have been determined in the heart of Tuj. Thus, various morphometric differences have been observed on the several parameters including length of CT, count and length of TS, and these differences were statistically significant ($p<0.05$). These differences were more often found in the ventriculus dexter among sheep races.

In the study, CT lengths of the ventriculus dexter and sinister of Tuj, Akkaraman and Ivesi have been determined respectively as 7.72, 14.04, and 12.01 mm, and 13.49, 19.57, and 18 mm. These results indicate that the longest CT is present in Akkaraman while the shortest being present in Tuj. The results thus clearly show that the longer the CT's are the lesser their number is, pointing out Tuj sheep having shorter and numerically more CT.

Ozbag et al. (24) has reported that average number of the CT resultant MPSAur and MPSAtr have been 5.60 and 6.24, respectively. In our study, these values have been found as 6.06 and 5.61, respectively. Hence, our results are numerically different from the related literature. Ozbag et al. (24) has notified that most of the CT in the ventriculus sinister clinged to CP. It has been shown that the values obtained from our study are paralleled to literature.

Motabagani (20) has declared in his study that the number of CT resultant MPM, MPSA and MPP have been as pieces of 10.60, 7.20 and 10.80, respectively. In our study, these values

have been determined as 8.78, 7.56 and 6.28, respectively. Accordingly, it is seen that the literature and our study has not been agreed for CT resultant the MPP and MPSA.

Ozbag et al. (21) has confirmed that the present r ate of FCT in the left ventricle of the sheep has been 86.8%. In the study, this rate in the sheep, Tuj, Akkaraman and Ivesi have been as 33.33 %, 70%, 30% and 0%, respectively. Upon these results, it can be suggested that sighting rate of FCT is in relation with the breed specific.

Ozbag et al. (25) has reported sighting rate of BC as 32%. In our study, rate of BC in Tuj, Akkaraman and Ivesi has been as 20%, 20% and 0%, respectively.

Consequently, in the study, some macroanatomic and morphometric data of the ventricles of the three sheep race breeding in the difference climate conditions have been investigated. According to this, it has been seen that race (Tuj, Akkaraman and Ivesi) has statistically affected anatomical structures in the ventricle, especially to morphometry of CT. Therefore, this study has been presented necessity of taking into account of race factor in stage of creating sheep hearts' model for both experimental and educational.

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