

The Pattern Comparison of Changes of Heart Macro-Structure in the Fowl

Rahmat Allah Fatahian Dehkordi¹ and Ali Parchami¹⁺

¹Department of Anatomical sciences, Faculty of Veterinary Medicine, University of Shahrekord, Shahrekord, Iran

Abstract. The aim of present study was to investigate gender effects on micro and macro structures of heart in the fowl. Ten male and ten female native chickens were taken from farm of household bird's maintenance from districts of Shahrekord. The hearts were removed from the thoracic cavity. Body and heart weight, macroscopic morphometric parameters (heart length, heart diameter) and microscopic morphometric parameters (thickness of the left and right ventricular wall) were measured. Results showed that there were no significant differences among the sexes regards to heart weight, heart length and thickness of right ventricular wall. However thickness o left ventricular wall was significantly greater in males as compared to females.

Keywords: Fowl, Heart structure, Micrometer, Thickness

1. Introduction

Among individuals dependent on avian groups, there is a great variety in the structure of particular systems that is the result of their adaptability to condition of different environments. Among special attention should be paid to the circulatory system and heart of birds [1]. Morphological examination of the heart of rare and valuable birds is difficult to do; Nevertheless in several avian species, included the fowl, primarily heart size, according to weight, was determined by Grubb (1983) [2], Hartmann (1955) [3] and Brush (1966) [4] and heart weights in some birds have summarized by Sturkie (1986) [5]. Das et al. (1997) explained Gross and biometrical components on the heart of indian duck [6] and a detailed description of gross microscopic anatomy of the heart from adult fowl was presented by lu et al. (1993) [7].

Numerous studies have been conducted on histomorphologic evaluations of the heart in the certain species of birds [8-121], but few studies have been done on histological structure and the morphologic changes of the heart in related to sex effect. Pannwitz and Berg (1998) conducted a morphologic assessment of sex effect on heart weight as well as mass of the ventricular and auricular walls in strain of turkeys (Hybrid B-6). They show that was not differ between both sexes [11]. Thaxton (2002) measured heart weight, length, diameter and thickness of the right ventricular wall and left ventricular wall in broilers male and female and results indicated that males have greater heart weight, heart length, and left ventricular wall thickness than females [10].

However, in birds especially in fowl, studies of sex effect on the heart structure were limited. Therefore, this study aims to investigate sex effect on the histomorphometric properties of heart of the native fowl in Shahrekord district.

2. Materials and Methods

⁺ Corresponding author. Tel.: +(98 381 4424427); fax: +(98 381 4424427).
E-mail address: (parchami431rf@yahoo.com)

The study was conducted on 20 hearts of native adult fowl (10 males with weight 2225 ± 298.6 g and 10 females with weight 2077 ± 186.7 g). The birds were taken from farm of household bird's maintenance from districts of Shahrekord. The heart was removed by dissection of thoracic cavity and firstly the aorta then pulmonary vessels and common vena cava were removed near their points of attachment to the heart. The finding of gross anatomy such as heart and length weight from the anterior aspect of the atria and at the apex of the ventricles and heart diameter in the coronary groove were measured by making a cross section of the heart. Thickness of ventricles was measured by calipers for determination of the index of ventricles cardiac morphometry. The tissue samples were immediately fixed in 10% buffered formaldehyde solution and followed by alcohol dehydration and embedding in paraffin. Five-micrometer thick sections were stained with haematoxylin–eosin for study of histomorphometrical properties of heart and were interpreted under light microscope.

Results are exhibited as mean \pm SD and the data were analyzed using one-sample t-test analysis of variance between two sexes, at significance level 0.05.

3. Results

Mean morphometric and histometric measurements of the heart structure presented in Table 1.

Table 1: Mean values of Mean histomorphometric features of the heart in both sexes in native fowl

Sex	male		female	
	Mean \pm SD	CI	Mean \pm SD	CI
Heart length	3.45 \pm 0.2	3.11-3.78	3.3 \pm 0.18	3.0-3.5
Heart weight	25 \pm 1.8	22.09-27.9	22.25 \pm 1.7	19.53-24.96
Body weight	2225 \pm 298.6	1749.4-2700.1	2077 \pm 186.7	1780.2-2374.7
Heart diameter	3.2 \pm 0.21	2.85-3.54	2.7 \pm 0.18	2.4-2.99
Left ventricle thickness	5.27 \pm 0.17	5-5.5	4.47 \pm 0.26	4.0-4.8
Right ventricle thickness	1.88 \pm 0.15	1.64-2.13	1.83 \pm 0.05	1.74-1.91
Left epicard	108.25 \pm 10.6	91.24-125.2	106 \pm 8.16	93-118.9
Right epicard	56.27 \pm 2.85	47.18-65.36	55.6 \pm 4.91	47.7-63.4
Left myocard	3797.5 \pm 125.2	3598.1-3996.8	3072.5 \pm 95	2921.3-3223.6
Right myocard	1182.5 \pm 55.6	1094-1270.9	1051.2 \pm 84.7	977-1125.4

With analysis of obtain results was indicated that mean gross of body and heart weights and Heart length have not significantly different between males and females gender. In females fowl, heart diameter were significantly decreased and left ventricular thickness were increased in male fowls than those of females and this increased was statically significant. Results obtained from this study also revealed that mean of right ventricular thickness did not significant differ between two sexes.

The morphometry of the left and right epicardial layers and endocardial layers in male and female showed that there is not any significant statically different ($P < 0.05$).

Measurements of left myocardium layer was developed and significantly increased in male fowl than those of females but this measurement for right myocardium layer was not significant both sexes.

4. Discussion

In world papers, there are not many publications concerning the histomorphometric structure of fowl heart related to sex. Similar our finding, study of gross and histological properties of heart carried out by Thaxton (2002) that compared male and female heart in broiler [10]. In other study, morphological evaluations of the heart were conducted by Rajpal et al. (1992, 1993) [12-13] and Das et al. (1997) [6] in the Indian duck (*Anas platyrhynchos*) and the single comb white Leghorn, respectively; but they were not measured differences attributable to sex. A comprehensive morphological study was performed by Aydinlioğlu et al. (1998) in chick hearts [9]. They were suggested that although chick heart has no the tricuspid valve similar to that of the human heart, it shows a great anatomical similarity with the human heart.

Heart morphometric measurements in the current study revealed that the differences were not statistically significant mainly for gross heart weight and length and body weight between males and females gender.

Thaxton (2002) at hatching, 20, 34, and 48th d of age, indicated that Gross heart length in males and females did not differ at hatching and 20 d of age in broiler. This researcher represented that at both 34 and 48 days of age males possessed longer hearts than females and also gross heart weight were heavier in males, as compared to females, at 34 and 48 d of age, but did not differ from females at hatching and 20 day of age. However, these gross findings at 34 and 48 days of age in broiler are adverse with data of get the current study [10].

In present study indicated that left myocardial layer had significantly increased in male birds in contrast with those female. The increased thickness of the myocardial layer of heart could be theoretically related to testosterone receptors on the myocardium cells in male gender. It seems that existence of sex hormones (testosterone) in male birds and presence of testosterone receptors in hart myocardial cells together cause that myocardial cells reacted and will be increase histological measurements of heart, included size and diameter, and as a results of increased thickness of left and right ventricles in male those than females. On the other hand, after the change in the heart myocytes size, gross measurement of left ventricle thickness increase in males. McGill et al. (1980) indicted that atrial and ventricular myocardial cells of hearts in female rhesus monkeys and baboons contain androgen receptors [14]. However, were suggested that sex steroid hormones may affect on the myocardial function and cells directly and may were generalize some of the peculiar differences in heart structure between men and women. Next investigations revealed various aspects of the heart measured (included left ventricular dimensions, etc) using steroids affect the function, size, shape and activity of the heart [15] and Marsh et al. [16] showed the existence of testosterone receptor transcripts in isolated cardiac myocytes from animals and humans.

Results of present study also show that heart diameter in males was greater than that of females and these differences were statically significant. keeping in mind that testosterone hormone effect on the heart myocardial layer, the seems that heart diameter numerically increase parallel with increased gross thickness of left and right ventricles, although increased thickness of right ventricle (included gross and microscopic measurements) wasn't significant in male than female. Thaxton (2002) revealed that gross heart diameter did not differ between sexes in broiler but males have greater left ventricular wall thickness than females [10].

5. Acknowledgment

This work was financially supported by the University of Shahrekord, Iran.

6. Reference

- [1]. C.M. Drabek, and Y. Tremblay. Morphological aspects of the heart of the northern rockhopper penguin (*Eudyptes chrysocome moseleyi*): possible implication in diving behavior and ecology? *Polar. Biol.* 2000, **23**: 812-816.
- [2]. B. Grubb. Allometric relations of cardiovascular function in birds. *Am. J. Physiol.* 1983, **245**: 567-572.
- [3]. F.A. Hartmann. Heart weight in birds. *Condor* 1955, **57**: 211-230.
- [4]. A.H. Brush. Avian heart size and cardiovascular performance. *AUK* 1966, **83**: 266-274.
- [5]. P.D. Sturkie. *Avian Physiology*, 4th edn. 586 pp. New York, Springer-Verlag. 1986.
- [6]. R.K. Das, U.K. Mishra, and S.C. Mishra. Gross and biometrical observations on the heart of Indian duck (*Anas platyrhynchos*). *Ind. J. Poult. Sci.* 1997, **32**(1): 93-96.
- [7]. Y. Lu, T.N. James, S. Yamamoto, and F. Teraski. Cardiac conduction system in the chicken: gross anatomy plus light and electron microscopy. *Anat. Rec.* 1993, **236**: 493-510.
- [8]. K. Dobrowolski, and R. Halba. Major problems of anatomical and morphological investigations in birds and their present status in Poland. *Przeegl. Zool.* 1970, **14**: 216-225.
- [9]. A. Aydinlioglu, M.C. Ragbetli, S. Ugras, and E. Erdogan. A morphological study in broiler chick hearts. *Folia Morphol.* 1998, **57**: 357-362.
- [10]. J.P. Thaxton. Heart growth in broilers. *Brit. Poult. Sci.* 2002, **43**: 24-27.
- [11]. G. Pannwitz, and R. Berg. Morphometric studies into the myocardium, kidney and adrenal glands of turkeys (fattening hybrid strain Big-6). *Arch. eür Geflügelkunde* 1998, **62**(5): 229-233.

- [12]. D.K. Rajpal, A.M. Shrivastava, M.R. Malik, J.S. Taluja, and M.L. Parmar. Studies on circumference and cross-sectional area of ventricles in heart of pre- and post-hatch fowl. *Ind. J. Anim. Sci.* 1992, **62**(12): 1164–1166.
- [13]. D.K. Rajpal, A.M. Shrivastava, M.R. Malik, J.S. Taluja, and A.M. Parmar. Topographic and morphometric studies on heart of fowl. *Ind. J. Anim. Sci.* 1993, **63**(2): 159–161.
- [14]. H.C. McGil, V.C. Anselmo, J.M. Buchanan, and P.J. Sheridan. The heart is a target organ for androgen. *Science* 1980, **207**(4432): 775-777.
- [15]. M.A. Sader, K.A. Griffiths and R.J. McCredie. Androgenic anabolic steroids and arterial structure and function in male bodybuilders. *J. Am. Coll. Cardiol.* 2001, 37(1): 224-230.
- [16]. J.D. Marsh, M.H. Lehmann, R.H. Ritchie, JK Gwathmey, G.E. Green and R.J. Schiebinger. Androgen receptors mediate hypertrophy in cardiac myocytes. *Circulation* 1998, **98**: 256–261.
- [17]. B.j. Bartyzel, A. Charuta1, K. Barszcz, A. Koleśnik, and H. Kobryń. Morphology of the aortic valve of gallus gallus f. domestica. *Bull. Vet. Inst. Pulawy* 2009, **53**: 147-151.