Anatomical and Morphological study of the Heart's Chambers and valves in Iraqi ducks *Anser platyrhuncha*

Mohammed Senan hassan and Razaq J. Mohammed
Department of Anatomy and Histology, College of Veterinary Medicine, University of Baghdad, Iraq.
E-mail: Muhammed197637@gmail.com
Received:12 /06/2018
Accepted: 30/01/2019
Publishing: 04 / 08/2019

Summary

Twenty Iraqi ducks hearts (10 male and 10 female) have been used for demonstration and illustration of heart's valves and chambers as well as anatomical and morphological site of view to explain what modifications had been take place for ducks heart to perform his normal life at the circumstances of high blood pressure and pulse rate. The heart which has distinctly pointed apex was built in simple manner located in a transparent taught heart pericardial sac. It was pyramidal in shape externally and has a longitudinal salcus passing to the right side, the anterior of the heart is divided into two unequal anterior chamber similar to those of mammalian hear. The heart valves are modified in order to minimize the fraction that occur as a result of high blood pressure and pulse rate of the duck heart , also the muscular trabeculae replace the chordate tendineae , which were present in the mammalian heart in order to minimize the fraction resulting from high pulse rate..
Keywords: Duck, Heart, Valve.

Introduction

Duck is considered as one of the most important domestic birds, that is why that the duck characterized by high ability of tolerance (1and 2), they can be breed in farms when that much of expenses are not needed. In agriculture duck play a role in turning up the soil and eradication of the weeds, therefore duck are kept in the farm particularly in cotton farms(3 and 4) .

The birds circulatory system was one of the most highly organized system in the animal kingdom, the high blood pressure about 240 mmHg and the pulse rate up to 400 p/min. (2-5) place a great effort on the circulatory system, the heart which has a relatively high organ weight, are capable of high producing efficiency accordingly, the conduction system of the heart in all domestic animals and birds can be explained as following: The function of the right side of the heart is to collect deoxygenated blood in the right atrium from the body by mean of right and left cranial and single caudal vena cava and via the right atrioventricular valve, the blood pass to right ventricular and from the right ventricle the blood is pumped throughout tricuspid valve through the pulmonary artery in to the lungs, so that carbon dioxide can be dropped off and oxygen picked up, this happens through the passive process of gas exchange (5-7), the left side collects oxygenated blood from the lung into the left atrium, and from the left atrium the blood push to left ventricle , through the bicuspid valve, which in term pumps it out to the body by the aorta on both side. The ventricles are larger and stronger than the upper atria, the muscles wall whom surrounding the left ventricle are thicker than the wall surrounding the right ventricle due to higher force needed to pump the blood through the systemic circulation(8). Starting in the right atrium, the blood flow through the right atrioventricular valve to the right ventricle, here it is pumped out via the pulmonary similunar valve and travels through the pulmonary artery to the lungs from there, oxygenated blood returns back through the pulmonary vein to left atrium. It then travels through the mitral valve to the left ventricle, from where it is pumped via the aortic similunar valve to the aorta, which in term the blood is divided between the major arteries which supply the cranial and caudal part of the body(9), the blood travels in

the arteries to the smaller arterioles and finally to the fine capillaries which supply the blood over all fine part of the body. The deoxygenated blood then travels to venules which in term coalesce in to veins, then to the cranial and caudal vena cava and finally return back to right atrium where the process beg (7 and 9).

The bird need (2 – 4) time as much heart musculature in order to provide their tissue with the same amount of oxygen(8), proportionally more work is required for the birds heart in order to meet the great demand of body requirement of the bird. In this respect (9-11) mentioned that for each kilogram of body weight of the duck has (6.5-7.3) gm of heart weight in other water bird (11-12) gm, while in mammals the heart count form about 1/160 of total body weight (H\ B index) (7-9).

Materials and Methods

Twenty hearts of adult Iraqi ducks from both sex (10 male and 10 female) have been used in this study. All ducks were collected from different Iraqi governorates (Baghdad, Al dywanea , koot and Babylon). The sample were taken after the slaughtering of the animals then washed by normal saline and fixed in 10% formalin for 72 hours(12). The injection of the coronary arteries was carried out from the ascending aorta by using surgical canula (Gauge 14) while the heart veins injections were injected through the sinus venous this process completed by injection of the small heart veins near the apex of the ducks heart. Latex mixed with red colored carmine stain were used for this purposes. After injection all specimens were sucked in (5%) formalin (12), four days later longitudinal dissection of the specimens had been conducted. Latex was helpful to demonstrate the topography of vessels distribution system by dissection.

Results and Discussion

The position of the heart in domestic ducks were extended from the second to the fifth ribs and the apex, slightly displaced to the right of the muscular stomach. Heart lies within the thorax, and in front of the liver and it is attached to the sternum by the fibrous pericardium which has been connected with the liver. The apex of the heart points caudo ventrally with distinctly pointed apex (Fig.1), the anterior of the heart was divided into left and right atrium (Fig.2). The lower two ventriculi characterized by its smooth walled appearance, the muscular trabeculae are present only in the left anterior chamber, valve like structure exit the sinus venous(sinus valve) which can be stretched by valvularis pectorals muscle, it has two flaps and could close the opening of the two cranial and caudal vena cava (Fig. 3).

The left heart auricle is larger than the right auricle, the tricuspid of the left atrioventricular valve is pointed structure and therefore exit in the heart apex, where there are three slightly projecting papillary muscle(Fig.4). The thick walled left ventricle is shaped like appointed pyramidal muscular bars on its interior give the cross section a rosette like appearance. (Fig. 4).

Our research revealed that the right atrioventricular valve is formed by single muscle plate unprovided by chordate tendineae which split off from side wall of the right chamber (Fig.5), this muscle plate situated at the site of entry into the right ventricle and with contraction joins the chamber septum with its free edge and it acts as a valve for the right atrioventricular orifice, this preventing the flow of blood into atrium during ventricular systole and is thus analogous to the tricuspid valve of the mammalian heart. The coronary vessels provide the heart with blood, the larger one is divided after its brunched from the aorta into superficial and deep branches, In general the larger heart vessels are located deeper in the musculature but in duck the superficial branches were larger (Fig .6). The heart weight in ducks were 1.666% of the total body weight for female and 1.628% of the total body weight for male, (Table, 1).

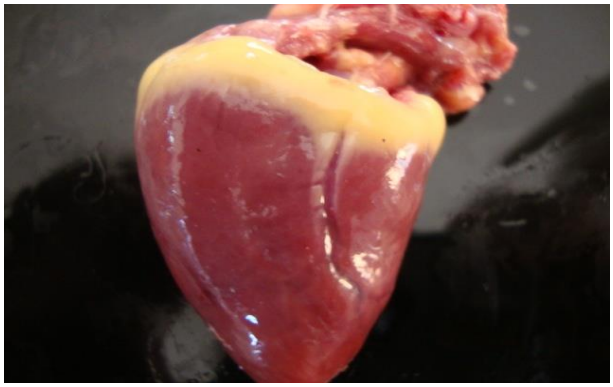
Table, 1: showing heart wt, body wt and h/b index of male and female of Iraqi ducks.

	Female	Male
Heart weight (gm)	21.026 ± 5.231	24.736 ± 5722
Body weight (gm)	1261.4 ± 314.1	1519.7 ± 245.3
H/B---index	1.666 ± 0.0007	1.6 28 ±0.0006

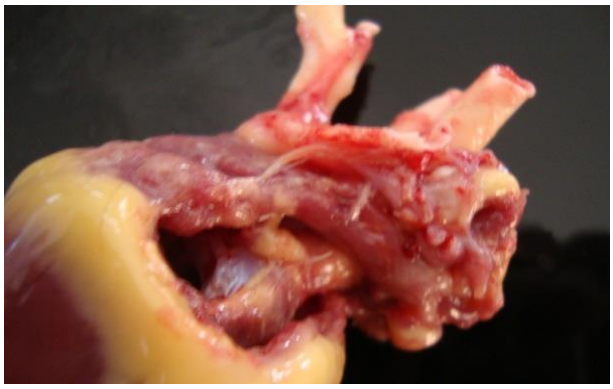
In the heart of the duck the projecting part of the valve apparatus were very short, their by reducing fraction resistance to a minimum degree that is why the pulse rate in the duck is very high which may reach (400p/min)(12).

The research work has been revealed that the papillary muscle was present in the duck's heart, and strong muscle trabeculae which pass back from the free valve edge on aslant to the side wall replaced the chordate tendineae that present in mammalians heart, in this respect it is of important to mention (13-15), that some species of the avian kingdom such as chicken have been represented chordate tendineae in their heart , whom also explain that in chickens the muscle trabeculae combines with the heart septum and form a pouch open in front of the left ventricle also the chickens have (6.2 - 6.78) g of heart weight, and in pigeon (10 -12)g, in the black bird (25.64)g (3,14 and 17) while in mammals the heart a count form about 1/ 160 of total body weight there for birds which need (2-4) times as much heart musculature in order to provide their tissue with the same amount of oxygen(7,9,17and18) proportionally more works were required for the birds heart in order to obtain the same result as those provided by the mammalians heart.

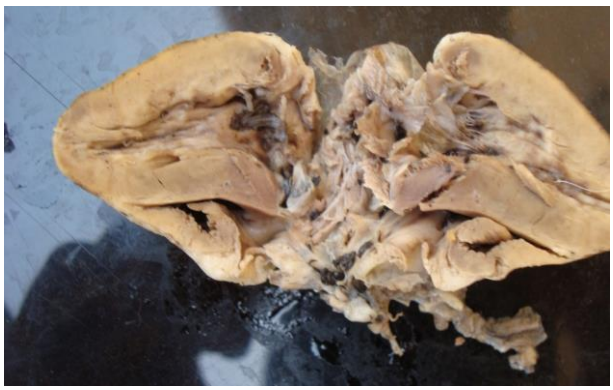
Figure,1: showing the pericardium was connected with the liver, the chest bone by mean of the hepatic peritoneal sac and fibrous pericardium (arrow) .



Figure,2: Showing heart of duck with distinctly pointed apex.

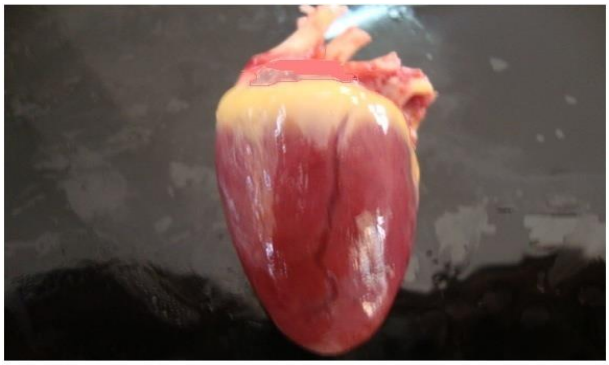


Figure,3: Showing sinus venosus _A, (sinus valve__B) .



Figure, 4 : Showing left atrio ventricular valve (tricuspid)(arrow.1)and papillary muscle (arrow.2).

Figure,5: showing right atrio ventricular valve, muscle plate unprovided by chordate tendineae.



Figure,6: Showing large superficial coronary artery (arrow) .

References

1. Barker, M.A.,(1993). A wonderful safety net for mammals , natural history , 8 : 102.
2. Barone R.(1999). Anatomical comparedes mamileres domestiques Lyon Labratoired Anatomi Eole Nationale Veterinaire Paris vigot . 1: (57).
3. Bradly, Orlando C.(1960). The stricture of fowl. Rev , tom , Grahame , 4th ed , Edinburgh , Oliver and Boyed , p.p: 125 – 134.
4. Breland , Osmond P. (1963). Manual of comparative anatomy, 2nd ed Mc Grow Hill book company New York p.p: 419 – 423.
5. Dyce, K. M, W.O. Sack and C .J .G. Wensing (2010). Text book of Veterinary Anatomy 4th ed , Library of Congress Cataloging P.P: 794-795.
6. Fisher, James,F. (1984). Sea bird. An introduction to the natural history of the sea birds of the Atlantic Boston, Houghton, Mifflin, p.p: 303 – 309.
7. Ganony, W.f. (1971). Review of medical physiology 5 th edition , large medical publication (LMP) California p.p: 389 – 414 .
8. Griffin. D. R. (1973). Sensory physiology and the orientation of animals Amer . Scientist. 41: 209.
9. Kent. C, Carr.R. k.(2001). comparative anatomy of the vertebrates , 9 th ed . Mc Graw Hill Hiesher Mc Graw Hill Higher education division of the Graw Hill companies , London . P.p: 318 – 324.
10. King, A.S., and J. Mclelland. (1986). Form and function in birds; Vols. 1-3 London, Academic press, 1979- 1985.
11. Tank red koch and E. R. win rossa, Anatomy of domastic birds(1973) edited by BERNARD H . SKOlD.and LOUIS De VRIS (1995) p.p: 100 – 104.
12. Tompset,D ,H.,(1970). Anatomical techniques, 2nd add. Long man group limited.p.p: 122-126.
13. King, A.S., and J.Mclelland(1984) Bird their structure and function.2nd ed .London, Bailliere Tindall.
14. Lucas .A. M., and P. R. Stettenheim(1972). A vian Anatomy ; Integument , part I and II . Agriculture Hand book 362 .Washington. D. C.U.S. Government printing office.
15. Marshail. R. J, Shepherd. J.T. (1968). Cardiac function in health and disease. W. B. Sanders company, Philadelphia p.p: 67 – 72.

16. Getty, A Sisson and Grossman's (1975). the anatomy of the domestic animals, 5th ed. W.B. Saunders Company. p .p . 164 – 564.
17. shievely, M.J.(1982). Columbia livia domestica. south west .Vet, 35,101-111.
18. Thaement. J. C. (1991). Atrioventricular node innervations in ultra-structural three dimension Am. J. Anat ., 128 : 239.

الخلاصه

دراسة تشريحة شكلية لتجاويف وصمامات القلب في البط المحلي

Anser_platyrhuncha

محمد سنا ن حسن و رزاق جعفر محمد
كلية الطب البيطري- جامعة بغداد
E-mail:Muhammed197637@gmail.com

شملت الدراسة عشرين قلبا من قلوب البط المحلي البالغة (10 ذ كور و 10 اناث) اجريت عليها دراسه تشريحيه عيانيه لتجاويف وصمامات القلب لغرض التعرف على التحويرات الحاصله في قلب البط المحلي لتمكنه من التكيف مع الارتفاع الكبير في ضغط الد م وعدد ضربات القلب. يتميز القلب في البط المحلي بأنة موجود في داخل كيس شغاف القلب الشفاف ويتميز بشكلة المخروطي من الناحيه الخارجيه مع قمته المدببة وتظهر الميازيب الطولية بشكل واضح للعيان ومميز وهي منحرفة الى الجانب الايمن. ينقسم القسم الأمامي من القلب الى نصفين غير متساويين كما هو عليه القلب في اللبائن بينما تتحور الصمامات القلبية في البط لتظهر بشكل تؤدي الى تقليل الاحتكاك الحاصل نتيجة الارتفاع الكبيرفي ضغط االدم و عدد ضربات القلب،كذلك فأن الحويجزات العضلية هي الاخرى تحل محل الحبال الوترية والتي تلاحظ في قلوب الحيوانات اللبونة للحصول على النتيجة المذكورة اعلاه وهو تقليل الاحتكاك.

الكلمات المفتاحية: البط، القلب، الصمام