

Histomorphometry of Brachiocephalic Artery of Iranian Pigeon (*Columba livia domestica*)

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Histological features of brachiocephalic arteries in different age groups of pigeons of both the sexes were investigated. Eighteen pigeons of 20, 50 and 120 days of age were euthanized to obtain left and right brachiocephalic arteries. Serial transverse sections of the brachiocephalic arteries were stained with hematoxylin-eosin stains. The diameter of the wall and the thickness of the tunica intima, tunica media and tunica adventitia were microscopically measured. The tunica media was the thickest of the three tunics. In males, on day 20 and 50 tunica media of right brachiocephalic artery was thicker than the left one ($P < 0.05$). There was no difference between thickness of other layers and diameter of the left and right artery wall ($P > 0.05$). On day 120, diameter of the right artery was more than the left one ($P = 0.01$). In females, tunica adventitia of the left artery on day 50 and 120 was thicker than the right one ($P = 0.003$ and $P = 0.004$, respectively). On day 50, tunica media of the right artery was thicker than the left ($P = 0.014$). The thickness of tunica media of the right artery wall was more than that of the left. In addition, the diameter and thickness of tunica media of the brachiocephalic arteries decreased from day 20 to 50. However, post day 50 it showed an increase. Thickness of tunica adventitia of the right brachiocephalic arteries in females decreased from day 20 to 50. Then it increased after day 50. Diameter of the brachiocephalic artery in females on day 120 was thicker than males ($P = 0.04$). Thickness of tunica adventitia of the right arteries in males was thicker than

females on day 50 ($P = 0.01$) and day 120 ($P = 0$). There was no difference between males and females in other cases ($P > 0.05$). In conclusion, brachiocephalic artery in pigeons contained elastic lamellae to resist comparatively high arterial pressure than that of the peripheral arteries.

KEY WORDS

Histomorphometry, brachiocephalic artery, age, sex, pigeon.

INTRODUCTION

Before the advent of radio, carrier pigeons were frequently used on the battlefield as a means for a mobile force to communicate with a stationary headquarters. The German apothecary Julius Neubronner used carrier pigeons to deliver urgent medication. The domesticated pigeon is a common laboratory bird but can also be used for meat production as well as for racing [1].

During flight, vessels transfer high energy metabolite supplies via blood to the wings. Brachiocephalic artery as a branch of the aorta is an important vessel which distributes blood to the wing arteries [2]. The aorta is the major arterial trunk of the body. It begins at the aortic ring and the base of the left ventricle and is divided into two parts, ascending and descending aorta. The first branches of the ascending aorta are the right and left coronary arteries that arise from its root. The next branches of the aorta are the prominent left and right brachiocephalic arteries originating from the left side of the ascending aorta. The left brachiocephalic artery takes a direct course; the right brachiocephalic artery curves ventral to the ascending aorta and proximal to the point at which it leaves the sac. Each brachiocephalic artery is about half the caliber of the arch of the

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aorta. As implied by their names, the brachiocephalic arteries are distributed to the arm and head regions. After a short craniolateral course, each brachiocephalic artery divides into subclavian and common carotid arteries [3].

The arterial segments have been classified into elastic, transitional and muscular types based on the histological characteristics and organization of connective tissue fibers and smooth muscle cells in three distinct tunics: tunica intima, tunica media and tunica adventitia. Tunica intima consists of a single layer of flattened endothelial cells on the internal elastic membrane. Tunica media is completely devoid of elastic lamellae and composed of predominantly smooth muscle cells with a few fine elastic tissue fibers. Tunica adventitia is mainly composed of collagen fibers [4, 5]. The aim of the present study was to determine the histological features of brachiocephalic arteries in different age groups of both the sexes of Iranian pigeon.

MATERIALS AND METHODS

Eighteen pigeons belonging to three different age groups (20, 50 and 120 days) maintained in the Animal Research Unit of the Veterinary School of Shiraz University were used in this study. The birds received feed and water ad libitum during the experiment and were euthanized by cervical dislocation and dissected. The left and right brachiocephalic arteries were removed and fixed in 10% buffered formalin solution. Serial transverse sections of 5 μ m thickness were cut along the brachiocephalic arteries. All sections were stained with hematoxylin-eosin [6]. The diameter of the artery wall and the thickness of the tunica intima, tunica media and tunica adventitia were measured using an ocular micrometer. Average of histometric parameters of left and right arteries were analyzed by Student's T-test (SPSS version 16.0). The average of histometric parameters of arteries on different days were compared between groups using one-way analysis of variance (ANOVA). The values of $P < 0.05$ were considered to be statistically significant.

RESULTS

The arterial segments from brachiocephalic were elastic type and consisted of three distinct tunics: the tunica intima, tunica media and tunica adventitia. The tunica media of the elastic arteries was thicker than other layers ($P < 0.05$, Fig 1).

In the male pigeons, on day 20 (Fig 1A), tunica media of the right brachiocephalic artery was thicker than the left one ($P = 0.03$, Table 1). There was no significant difference between the thickness of other layers and diameters of the left and right artery wall on day 20 ($P > 0.05$). On day 50, tunica media of the right brachiocephalic artery was thicker than the left one (Fig 1B, $P = 0.03$). However, there was no significant difference between the thickness of other layers and diameters of the left and right artery walls on day 50 ($P > 0.05$). On day 120, diameter of the right artery was more than the left one ($P = 0.01$). A non-significant difference was observed between the thickness of other layers of the left and right artery walls on day 120 ($P > 0.05$).

In the female pigeons, non-significant difference was observed between layers and diameters of the left and right arteries on day 20 ($P > 0.05$, Table 2). On day 50, tunica adventitia of the left artery was thicker than the right one ($P = 0.003$). However, tunica media of the right was thicker than the left ($P = 0.01$). There was a non-significant difference between the thickness of tunica intima and diameters of the left and right artery walls on day 50 ($P > 0.05$). On day 120, thickness of tunica adventitia of the left was more than the right ($P = 0.004$). However, the difference between thickness of other layers of left and right arteries and diameter of brachiocephalic artery was not significant ($P > 0.05$).

In the male pigeons, average diameter of the left brachiocephalic artery on day 120 (Fig. 1C) was more than that of day 20 and day 50 ($P < 0.05$) and on day 20 it was more than that of day 50 ($P = 0$). In females also, average diameter of the left arteries on day 120 was more than day 20 and day 50 ($P < 0.01$) and on day 20 was more than day 50 ($P = 0$). In males, average diameter of the wall of right brachiocephalic arteries on day 20 and day 120 was more than day 50

($P < 0.01$). There was no significant difference between diameters of the wall of right brachiocephalic arteries on day 20 and day 120 ($P > 0.05$). In females, average diameters of the wall of right arteries on day 20 and 120 was more than that of day 50 ($P < 0.01$). There was no significant difference between diameters of the wall of right brachiocephalic arteries on day 20 and day 120 ($P > 0.05$). In all pigeons, the diameter of tunica adventitia of the left and right arteries and average thickness of tunica intima of the wall of left and right arteries varied non-significantly ($P > 0.05$).

On day 20 average thickness of tunica adventitia of the right arteries in females was more than that of day 120 ($P = 0.001$). However, it differed non-significantly on day 20 and day 50 and between day 120 and day 50 ($P > 0.05$).

On day 120, the average thickness of tunica media of the right arteries in males was more than day 50 ($P = 0.01$). However, it differed non-significantly on day 20 and day 50 and between day 120 and day 50 ($P > 0.05$).

In females, average thickness of tunica media of the right arteries on day 120 was more than day 20 and 50 ($P = 0.03$) showing a non-significant difference between thickness of tunica media on day 20 and day 50 ($P > 0.05$). Average thickness of tunica media of the left arteries on day 120 was more than day 20 and day 50 in males ($P = 0.019$ and $P = 0.002$, respectively) and in females ($P = 0.002$ and $P = 0.001$, respectively). There was no significant difference between thickness of tunica media on day 20 and 50 in both sex ($P > 0.05$).

Diameter of the brachiocephalic artery in females on day 120 was more than that of males ($P = 0.05$) with a non-significant difference between males and females on day 20 and 50 ($P > 0.05$). A non-significant difference was also observed between males and females in thickness of tunica intima and media of left and right arteries wall in three age groups. Tunica adventitia of the right arteries in males was thicker than that of females on day 50 ($P = 0.01$) and day 120 ($P = 0$). There was no significant different between males and females in thickness of other layers of the left and right brachiocephalic artery walls ($P > 0.05$).

DISCUSSION

In pigeons the arterial segments from brachiocephalic are elastic type, similar to arterial segments aorta of Wistar rats [7], aorta, brachiocephalic and subclavian of dogs [8], main arteries of mammary glands of Japanese dog [9], common carotid artery and external carotid artery in Lori Bakhtiari sheep and goats [10], from the ascending aorta to the thoracic aorta in miniature swine [11], ascending aorta, aortic arch, brachiocephalic trunk, subclavian artery, and the thoracic aorta of black Bengal goats [4], ascending aorta, aortic arch, brachiocephalic trunk, subclavian artery, and the thoracic aorta of guinea pig [5] and brachiocephalic arteries of chicken [12]. The present observation showed that the tunica media of the brachiocephalic artery wall was thicker than other layers an observation which falls in line with the earlier reports [7, 9]. In all pigeons, the thickness of tunica media of the right artery was more than that of left artery. This finding corroborates the observations of [12] in chicken. In males, thickness of tunica media of right brachiocephalic artery increased faster than the left one. Therefore on day 120, diameter of the right artery was more than the left. Whereas, in females, thickness of tunica adventitia of the left artery grew faster than that of right one. Therefore, on day 50 and 120, tunica adventitia of the left artery was thicker than the right artery. However, on day 120, there was no significant difference between diameter of right and left artery.

In all pigeons the diameter of the brachiocephalic arteries and thickness of tunica media increased from day 50. Diameter of the brachiocephalic artery in females on day 120 was more than that of males. Thickness of tunica adventitia of the right arteries in males was more than females after day 50. In conclusion, brachiocephalic artery in pigeons contained more elastic lamellae to resist comparatively high arterial pressure than that of the peripheral arteries.

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TABLES

Table 1. Histomorphometric measurement of separated layers & diameter (μm) of the left and right brachiocephalic arteries in different ages in male pigeons (Mean \pm SD; n=3)

Age	Position	Diameter of artery	Tunica intima	Tunica adventitia	Tunica media
Day 20	Right	2654.0 \pm 56.1 ^a	25.0 \pm 0.0	28.3 \pm 7.6	503.6 \pm 15.5 ^{*ab}
	Left	2528.6 \pm 14.4 ^a	25.0 \pm 0.0	32.6 \pm 2.5	420.0 \pm 26.4 ^{*a}
Day 50	Right	2293.6 \pm 27.3 ^b	25.4 \pm 0.7	31.6 \pm 2.8	476.6 \pm 20.8 ^{*a}
	Left	2162.5 \pm 33.0 ^b	24.1 \pm 1.4	30.6 \pm 1.1	381.3 \pm 18.0 ^{*a}
Day 120	Right	2742.3 \pm 51.5 ^{*a}	23.3 \pm 2.8	30.0 \pm 0.0	559.6 \pm 34.3 ^b
	Left	2619.0 \pm 34.6 ^{*c}	24.0 \pm 1.0	27.3 \pm 2.5	481.6 \pm 10.4 ^b

Asterisks show statistically significant difference between left and right brachiocephalic arteries in the same age ($P<0.05$). The different superscript letters in the same columns and in the same side of brachiocephalic arteries show statistically significant difference between different ages ($P<0.05$).

Table 2. Histomorphometric measurement of separated layers diameter (μm) of the left and right brachiocephalic arteries in different ages in female pigeons (Mean \pm SD; n=3)

Age	Position	Diameter of artery	Tunica intima	Tunica adventitia	Tunica media
Day 20	Right	2627.3 \pm 55.1 ^a	25.0 \pm 0.0	30.6 \pm 0.5 ^a	471.6 \pm 22.5 ^a
	Left	2635.0 \pm 35.0 ^a	24.6 \pm 0.5	30.6 \pm 0.5	430.0 \pm 20.0 ^a
Day 50	Right	2178.3 \pm 34.6 ^b	25.0 \pm 5.0	21.6 \pm 2.8 ^{*ab}	466.0 \pm 7.9 ^{*a}
	Left	2229.0 \pm 19.3 ^b	28.3 \pm 2.8	32.6 \pm 2.0 [*]	402.0 \pm 7.2 ^{*a}
Day 120	Right	2779.0 \pm 25.9 ^a	25.0 \pm 0.0	25.3 \pm 0.5 ^{*b}	580.0 \pm 20.0 ^b
	Left	2749.0 \pm 11.0 ^c	26.1 \pm 1.2	30.6 \pm 1.1 [*]	525.0 \pm 25.0 ^b

Asterisks show statistically significant difference between left and right brachiocephalic arteries in the same age ($P<0.05$). The different superscript letters in the same columns and in the same side of brachiocephalic arteries show statistically significant difference between different ages ($P<0.05$).

FIGURES

Fig 1. Length (L) of the tunica intima (In), tunica media (Me) and tunica adventitia (Ad) of brachiocephalic artery in pigeon. A) Male pigeon on day 20, B) Male pigeon on day 50, and C) Female pigeon on day 120. Haematoxylin and eosin staining. Index line is 200 μ m.

