

Anatomical and Ultra-sonographic Study of the Aortic Arch Branches in the Native Goat (*Capra hircus*)

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Abstract

Five health adult goats of Iraqi local breed of both sexes, were collected from Diyala Governorate weighing range between (6-8kg±40.11), and their ages were between (1-3) months. Ultrasound Scanner technique was used to study the aortic arch branches; ultrasonic examinations were done with a real-time B-Mode scanner supplied with a 7.5 MHz-linear array rectal transducer. All these goats were euthanized. The aortic arch of the goats is extended cranially, dorsally, and turn caudally situated below the vertebra columns at the level of the third intercostal space, above the pulmonary trunk. The aortic arch gives two branches in which the short branch called left-subclavian artery and large brachiocephalic trunk. Moreover, the brachiocephalic trunk is a great vessel cranial branch that yields two large branches; right-subclavian artery and bicarotid trunk which divided into left-common carotid artery and right-common carotid artery.

Keywords: Anatomy, Aortic arch, Branches, Native goat, Ultrasonography.

Introduction

The goat subspecies; *Capra aegagrus hircus*, is a domestic member of the Bovidae family that is sheep-like species of which both belong to the sub-family of goat-antelope, Caprinae. Interestingly, 300 of goat distinct breeds are present [1]. Economically, goats are beneficial for the production of food meat and fiber-based materials plus help in controlling vegetation restoration [2]. According to their adjustment to different climate conditions, goats are present global wide in continents such as Asia, Africa, Americas, and Europe [3].

Ultrasonography for organ inspection in male and female ruminants provides a detailed-real-time non-invasive exploration technique depending on type and the site of the probe plus the frequency of the operation [4, 7]. The aims of the current study were to gain knowledge about abnormal branches rooted from the aortic arch, provide anatomical-based characteristics, determine the vascular architecture of the aortic arch in Iraqi goats.

The great arteries originated from the heart (left ventricles) include aorta that curved to right, forming an arch that its branches arise from aortic arch with different patterns according to the species of mammals [8]. The superior mediastinum is its location. Usually, the arch is divided into three branches that include the brachiocephalic trunk, the left-common carotid artery, and left subclavian artery supplying head, neck, and upper limbs [9, 10]. The aortic arch in most domestic animals and in rabbits joins the pulmonary trunk via ligamentum arteriosum, the remain of the fetal ductus arteriosus [9, 11].

The aorta in most domestic animals is the main systemic arterial trunk and ascends to curve sharply backwards forming the arch to reach the eighth or ninth thoracic vertebra. The branches originated from the aortal arch in human supply the head arrangement of branches arising from the aorta considering the differences in posture and locomotion between the animals and man [8, 12]. The

aortic-arch cranial-branch is the brachiocephalic trunk that supplies blood to the head limbs, head, neck, and ventral portion of chest.

The brachiocephalic trunk initiates the right subclavian artery and bicarotid trunk. In pig, cat, and dog, the left subclavian artery takes a separate, more distal origin from the arch of the aorta [9]. The bicarotid trunk in ruminants (cow, sheep, and goat) is a short common trunk, which originates from the common brachiocephalic trunk, extends cranially, and branches into the common carotid arteries, left and right [12]. The two branches of the brachiocephalic in canine supply caudal pole of thymus [13].

Some author mentioned the abnormal branches of the arch of the aorta and compared with the normal case in goat explained by other reporters in which the large branch originates from the arch of the aorta called brachiocephalic trunk. This trunk gives both left and right subclavian arteries. About 5 to 6 cm after the origin of these arteries, they feed the front half of the thoracic and the fore limbs [14].

Some researchers showed in human that the aortic arch provides two branches that arise from the surface of the upper convex that belongs to the arch; the brachiocephalic is the first branch, and the left subclavian artery is the second branch. Moreover, the root of the brachiocephalic trunk gives the left common carotid artery [8, 15]. The anomalous in the distribution via the origins of the vessels belong to the large aortic arch in human may induce alterations in the cerebral hemodynamics generating disorders in brain [16].

Previously, studies showed different patterns of the aortic arch branching, classified of japons cadavers as three types; A, B, and C [15]. In human stated (91,4%) branches are directly originated from aortic usual three branches and variation were found about (9.6%) [16, 17] that is believed that a few anomalies of the aortic arch belongs to chromosome 22q11 deletion [18].

Information regarding arteries originated from aortic arch in domestic animals are limited; most studies conducted were on laboratory mammals as guinea pig [19], porcupines [20], rabbit [11, 21], mole-rat [22, 23], and red squirrels [24].

Materials and Methods

Five health adult goats of Iraqi local breed of both sexes, were collected from Diyala Governorate weighing range between (6-8kg±40.11), and their ages were between (1-3) months. Ultrasound Scanner technique was used to study the aortic arch branches; ultrasonic examinations were done with a real-time B-Mode scanner supplied with a 7.5MHz-linear array rectal transducer. All these goats were euthanized. The types of the scanner (Welld ultrasound, Shenzhen well. D. Medical Electronics). Ultrasound scanners were recorded using a Light wave record and play video, USB 2.0 TV BOX recorder for further analysis. The goats were scanned in lateral recumbency after shaving the site of examination (Fig. 2).

These goats were euthanized with intra muscular injection of xylazine (Rompum**) at 35m/kg B.W+(ketamine***) at 5mg/kg B.W. [24]. The opening of the chest was done by bone cutter and removing the ribs from second to six. After opening the thoracic cavity, cannula of plastic 0.5cm in diameter and 10-15 cm in length was inserted into the thoracic aorta, and colored latex was injected and left the carcasses for 24hrs. Later, they were kept in 10% formalin till the study of the patterns of arteries originated from aortic arch was initiated. A Vernier was used in the measurements of the arteries.

Results

The aorta in the native goat was situated in thoracic cavity, the aorta up dive than curved which forms the aortic arch, and it was extended cranially, dorsally, and turn caudally situated below the vertebra columns at the level of the third intercostal space, above the pulmonary trunk and jointed with pulmonary by ligaments in which these results are similar to those in horse [9, 10] that exit from left ventricle. The course of the aortic arch ceaseless with ascending aorta, it usually gives two branches; small one called left subclavian artery and large brachiocephalic trunk (Fig. 1).

The Brachiocephalic trunk is a great vessel of which the cranial branch yields into two branches that include bicarotid trunk and right subclavian artery. The bicarotid trunk was divided into left common artery and right common branches. The brachiocephalic

artery of the native goats supplied the head and the structures of the neck.

The ultrasonography pictures taken to the large vessels of the aortic arch included the aortic arch that gives brachiocephalic trunk and subclavian artery. The brachiocephalic trunk was divided into two branches; left subclavian artery and common carotid artery

(Fig. 2) used ultra-sonographic (Fig. 3). The anatomical measurement of the diameter of the aortic arch, brachiocephalic and bicarotid arteries were 7.3mm, 5.8mm, and 4.9mm respectively (Fig. 1), while the ultrasonographical measurements of the diameter of the aortic arch, brachiocephalic and bicarotid arteries were 5.32mm, 3.8mm, and 3.9mm respectively (Fig. 2) and (Table 1).

Table 1: Measurement of diameters of the arteries

Aortic arch branches (mm)	Anatomical (mm)	ultra-sonographic (mm)
Aortic arch	7.32±0.22	5±30.5
Brachiocephalic artery	5.8±0.3	3.8±0.37
Bicarotid artery	4.9±0.29	3.9±40

Discussion

The course of the aortic arch ceaseless with ascending aorta, it usually gives two branches small one called left subclavian artery and large brachiocephalic trunk (Fig. 1). These results are similar to those mentioned by [5, 12], in most domestic animals such as in cattle [10] and in sheep and goat [12]; in guinea [19], and in rabbit [11], but the branches arise from aortic arch in native goat is not resemble the aortic arch branching pattern found in human that states the aortic arch yield into three branches innominate artery, left common carotid, and left subclavian artery [11, 16, 17].

Brachiocephalic trunk is a great vessel in which the cranial branch yields into two branches that include bicarotid trunk and right subclavian artery. The bicarotid trunk was divided into left common and right common arteries. These results are in agreement with that in dog [9] and cat [10]

but in disagreement with that in goat [14]. In porcupines, three arteries were observed that originated from aortic arch which include first brachiocephalic artery, second left carotid common artery, and third left subclavian artery, but the bicarotid trunk was absent [20]. The brachiocephalic yields into three branches in rabbit [21, 22], in Guinea pig [19], in red squirrels and mole rat [23, 24], and in rat [22].

The brachiocephalic artery of the native goat supplied the head and the structures of the neck, and this result was stated in canine [13] and the left subclavian artery supplied the hand limb. The ultrasonography pictures taken to the large vessels of the aortic arch included the aortic arch that gives brachiocephalic trunk and subclavian artery. The brachiocephalic trunk was divided into two branches; left subclavian artery and common carotid artery (Fig. 2) used ultra-sonographic (Fig. 3). The ultrasonography pictures of the vessels are very important during the surgery.



Fig. 1: Illustrates the chest of the Iraqi goat showing the aortic arch: AA, and branches include, LS: left subclavian artery, BC: brachiocephalic trunk y RS: right subclavian artery and BI: bicarotid artery: D=diaphragm surface. MS=medial surface. Arrow purpols. Ventral border, black arrow caudal order

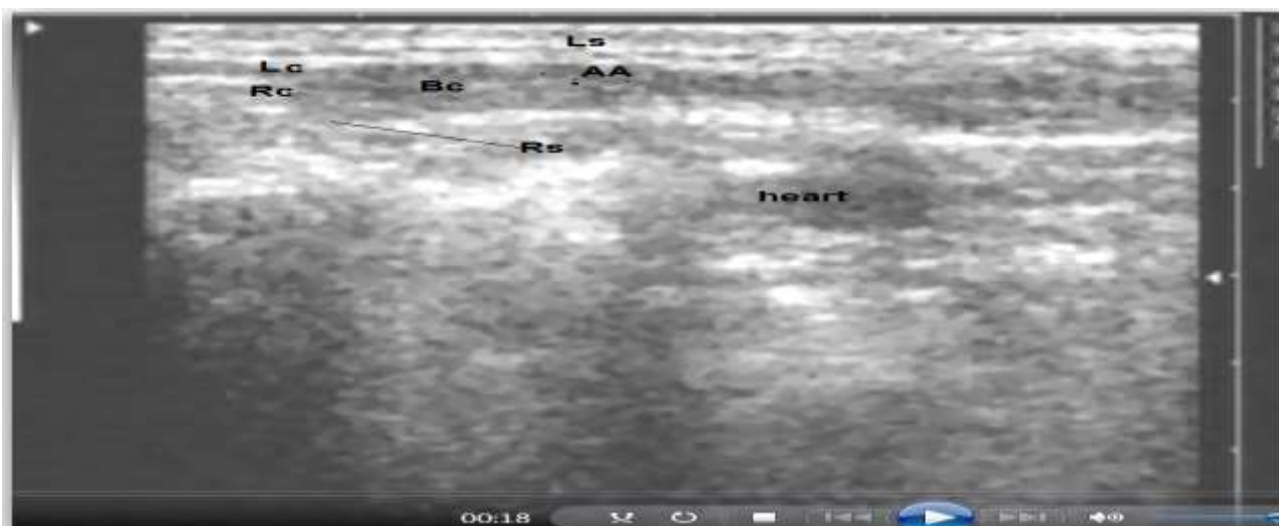


Fig. 2: Ultrasonographic pictures to aortic arch (AA) of the Iraqi goats and the main branches; brachiocephalic trunk (BC), Left subclavian artery (Rc) and right subclavian artery (Lc), left common carotid, Right common carotid (Rc)



Fig. 3: The ultrasonography pictures of the vessels

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