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Article *in* Journal of Medical Sciences · March 2016

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Sch. J. App. Med. Sci., 2016; 4(3C):806-811 **ISSN 2347-954X (Print)**

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Original Research Article

Medicolegal importance of radiographic images of humerus in determination of age in sheep and goat

Gehan B. Youssef*, Bakry HH, El-Shwarrby RM, Nabila M. Abd El-Aliem, Elham .A El-Shewy
Forensic medicine and Toxicology dept. Faculty of Veterinary Medicine, *Educational hospital, Benha Univ. Egypt

***Corresponding author**
Gehan B.Youssef
Email: drgehan222@yahoo.com

Abstract: This work was done on 54 sheep and 54 goats at different farms in Kalyobia governorate to estimate the age of the animals through radiographic images. Radiographic images of the humerus bone in both sheep and goat were shot at different ages. The length and radiographic characters of the humerus bones were varied in species and age advances. The humerus lengths were increased steadily from (9.03±0.05) centimeter (cm) and (11.22±0.07 cm) at the age of 2 months in sheep and goat respectively. The humerus length increased till reached (18.10± 0.09 cm) and (17.87± 0.04 cm) at the age of 48 months in sheep and goat respectively. The growth plate opened at the age of 2-8 months then ossification begin and complete closure of the epiphyseal plates appeared at the age of 42-48 months in sheep while in goat the complete epiphyseal closure occurred at the age of 36-42 months.
Keywords: Humerus-Radiographic images-Age determination-Sheep-Goat.

INTRODUCTION

Sheep and goats are widely spread in different areas in Egypt and adapted to different climatic conditions even in Delta or in South Egypt and are found in all different farming and production systems. It consume low amount of food because of their small body size in compared to large ruminants. These animals are of high economic value since; they give meat, wool and milk. They also characterized by high fertility rate in comparison to the other animals[1]. Radiography is the creation of radiographs; photographs made by exposing a photographic film or other image receptors to x-rays. Since x-rays penetrate solid objects, but slightly attenuated by them, the picture reveals the internal structure of the object. Forensic radiography is the creation of radiographs for the purpose of assisting with legal investigations and forensic radiology is the interpretation of these images to assist such investigation [2]. Radiography is form of medical imaging; it uses x-rays to produce images[3].

The cartilage between the primary and the secondary ossification centers is called epiphyseal plate, epiphyseal line, growth plate, physis, epiphyseal cartilage and epiphyseal disk[4, 5].The radiographic important of the investigation of secondary ossification centers is in determining an animal's age [6].

The age of closure of the epiphyseal plates has been reported to vary according to animal's breed and species[7-9], also the physiology of growth plate and the time of closure of growth plate are complex and vary among bones as studied by Kilborn *et al.;* [10]. At puberty, the bone growth stop and the growth plate was closed at this time while the appositional bone growth still working and progress which lead to change in the shape of the bone [11].

The osteometric differences of humerus of Bari goat and Dumbi sheep and revealed that the Bari goat has relatively longer humerus than those of the Dumbi sheep and the difference was highly significant between kids and lambs but no statistical difference in between and among adult groups of both species of goat and sheep [12]. The aim of the current study is to estimate and determined the sheep and goat age via the radiographic images.

MATERIAL AND METHODS

This study was done on 108 animals (54 male goats (Bucks), and 54 male sheep (Ram), their age ranged from 2 months to 4 years. They were apparent healthy and not suffer from any diseases or anomalies by physical and clinical investigations. These animals were collected from different small ruminant farms in Kalyuobia Governorate; Farm of Faculty of Veterinary medicine, Farm of Faculty of Agriculture, Benha University and Farm of Ministry of Agriculture at Moshtoher village.

Radiography of humerus

The animal is placed on its side with the examined limb down and the humerus resting on the plate. The limb is slightly extended and the fore limb is drawn caudally and secured. The x-ray beam is directed vertically to the center of the humerus.

X ray (Radiographic image)

The radiographic examinations were done for the animals of the present work. For radiographic shot, 100 kilovolts (kv), 60 milli Amperes (mA) digital device held in an accredited centre for diagnostic imaging in Toukh city, Kalyobia Governorate. Each animal was assessed to ensure they were not lamed and their limbs were free from any external evidence injury or disease.

The radiography is taken to the animals (sheep and goats) in lateral position according to Douglas *et al.;* (1987) [13]. Before any examination the animals was dried and groomed because of the fleece of the sheep often contain a large amount of dirt and becomes radiopaque when wet.

Statistical analysis

Statistical analysis was done for the estimated lengths of the humerus of sheep and goat. Data were represented as means ± SE (standard error).The differences were compared for statistical significance by ANOVA and post hoc Turkey's tests. Difference was considered significant at $p<0.05$. The statistical analysis was performed using Epi-Info version 6.1 [14].

RESULTS

Radiographic images of the sheep (ram) humerus

The humerus was long bone situated obliquely between the scapula and the radius and ulna .The humerus composed of one shaft and two extremities. The shaft was twisted cylindrical and the extremities were the proximal and distal extremities. The proximal extremity formed the shoulder joint with scapula while the distal extremity formed the elbow joint with the radius and ulna.

Radiolucent area (dark black) appeared in the radiographic images of the humerus in the epiphyseal plate and no ossification occurred between the diaphysis and epiphysis (growth plate opened).There was no epiphyseal closure (non- union) between epiphysis and diaphysis. This appeared at age of 2-8 months as shown in plate (1A).

Radiopaque area appeared in radiographic images of the humerus in the epiphyseal plate (the gap between the epiphysis and diaphysis began to decrease but complete union did not occur) in which the ossification between the epiphysis and diaphysis began (partial union).This was occurred at age of 10-14 months as shown in plate (1B).

The appearance of radiopaque area (white line) and the disappearance of radiolucent area in radiography of the humerus were considered as complete closure. There was complete ossification between epiphysis and diaphysis (total union).This was appeared at age of 18-30 months as shown in plate (1C).

The radiopaque line between the epiphysis and diaphysis disappeared and complete union occurred between the epiphysis and diaphysis of the humerus. The complete closure of the epiphyseal plate of the proximal and distal epiphyseal plates appeared at age of 42-48 months as shown in plate (1D).

The total lengths of the humerus of sheep were measured as shown in table (1). The statistical analysis showed that a highly significant difference ($p< 0.01$) in the measurement of the humerus lengths. In all measurements, the humerus lengths gradually increased with advancement of age. The humerus lengths were increased steadily from (9.03±0.05 cm) at the age of 2months till reached (18.10± 0.09 cm) at the age of 48 months.

Plate.1. showing the radiographic images of sheep humerus

In (1A), the epiphyseal plate opened at the age of 2 months. In (1B), showed decreased area between epiphysis and diaphysis but not complete union at the age of 12 months in (1C), showed disappearance of radiolucent area and complete closure started at the age of 28 months. In (1D), showed complete epiphyseal closure of the humerus at the age of at 48 months

Radiographic images of the goat humerus

The radiographic images of the humerus of the goat showed that appearance of radiolucent area in the epiphyseal plate and no ossification occurred between the diaphysis and epiphysis and the epiphyseal plate opened. There was no epiphyseal closure between epiphysis and diaphysis. This appeared at the age of 2-6 months as shown in plate (2A). Radiopaque area appeared in radiographic images of the humerus of the goat in the epiphyseal plate and the gap between the epiphysis and diaphysis began to decrease but complete union did not occur. The ossification between the epiphysis and diaphysis began to occur (partial union).This was occurred at the age of 10-12 months as shown in plate (2B). The appearance of radiopaque area and the disappearance of radiolucent area in radiography of the humerus of the goat were considered as complete closure. There was complete ossification between epiphysis and diaphysis .This was appeared at the age of 16-24 months as shown in plate (2C). The radiopaque line between the epiphysis and diaphysis disappeared and complete union occurred between the epiphysis and diaphysis of the humerus .the complete epiphyseal closure appeared first in the proximal epiphyseal plate then in the distal epiphyseal plate. This appeared at the age of 36-42 months as shown in plate (2D).

The total lengths of the humerus of the goats were measured as shown in table (1). The statistical analysis of the lengths of the humerus of the goats showed that a highly significant difference ($p< 0.01$) in the measurement of the humerus lengths. In all measurements, the humerus length increased with the advancement of age. The lengths of the humerus were gradually increased from (11.22±0.07 cm) at the age of 2 months till reached (17.87± 0.04 cm) at the age of 48 months.

Plate.2. showing the radiographic images of sheep humerus

In (2A), showed the epiphyseal plate opened and no ossification was appeared at the age of 2 months. In (2B), showed appearance of radio opaque areas with the beginning of the ossification at age of at 10 months in (2C), showed complete closure of the humerus begins to occur at the age of 24 months. In (2D), showed complete epiphyseal closure and complete ossification of the humerus at the age of at 40 months

Table 1: Showing the lengths (cm) of the humerus bone of sheep and goat at different ages (months)

Age/Months	Sheep humerus (cm)	Goat humerus (cm)
2	9.03±0.05	11.22±0.07
4	9.12±0.10	12.64±0.13
6	9.58±0.12	13.74±0.13
8	10.29±0.42	14.47±0.14
10	11.29±0.20	14.45±0.17
12	12.77±0.21	14.71±0.12
14	14.07±0.14	14.87±0.14
16	15.64±0.17	14.90±0.18
18	17.14±0.20	15.18±0.06
20	16.71±0.24	15.27±0.08
22	16.96±0.06	15.88±0.07
24	17.07±0.09	15.90±0.10
26	17.21±0.09	16.08±0.04
28	17.21±0.15	16.48±0.15
30	17.26±0.14	16.91±0.07
36	17.73±0.15	17.19±0.13
42	17.98±0.14	17.65±0.11
48	18.10±0.09	17.87±0.04

Means values ±SD (Standard deviation) of humerus in different ages of sheep represent significant difference. ($p < 0.01$)

DISCUSSION

Radiological imaging is an effective method in estimation of the age of the animals through determination of the ossification and bone epiphyseal closure[15]. The endochondral ossification regions of the long bones are epiphyseal plates (growth plates). These epiphyseal plates are existed until the postnatal growth is completed and ossified after the process of postnatal growth[16, 17], In the present study, the determination of the age of animals was done by radiographic examination of the long bones of the sheep and goats.

In the present study the complete closure of the epiphyseal plates appeared on the radiographic images as the appearance of radiopaque area and disappearance of radiolucent appearance between the epiphysis and diaphysis. This result was agreement [18], who identified the complete closure of the epiphyseal plates by the displacement of radiopaque appearance with the radiolucent line between the epiphysis and diaphysis.

The present study was agreement with the results of Choi *et al.;* [19] and Das *et al.;* [20] in that the rat of bone growth in form of ossification and epiphyseal closure increased with age. The lengths of the long bones in our study gradually increased with advancement of age and this similar to the result of Lochi *et al*.[12].

The complete closure of the epiphyseal plates of the humerus in this study occurred at the age of (42-48) and (36-42) months in sheep and goats respectively while the closure of the epiphyseal plates of the humerus of Korean native goat was found after 12months as studied by Choi *et al.*[19]. In the present study, the total lengths of the humerus showed a highly statistical significant difference and the humerus lengths gradually increased with advancement of age from (9.03±0.05 to 18.10± 0.09) and (11.22±0.07 to 17.87± 0.04) cm in sheep and goats respectively, While the total length of humerus in adult Black Bengal goat was (12.06± 0.27) as stated by Siddiqui *et al.*[21].

The humerus of adult sheep in this study was longer than the humerus of adult goats and this agreement with the results of Okpe and Adamu[22] and Salami *et al*. [23] who found that the humerus of Yankasa sheep was significant longer than that of Red Sokoto goat .In contrast this result; the humerus of Dumbi sheep was shorter than the humerus of Bari goat Lochi *et al.;* [12].

CONCLUSION

The radiographic images can used as a significant tools in forensic medicine in determination of age in sheep and goat in farms.

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