

Original Article

Fetal differentiation of yankasa sheep (*Ovis aries*) kidney: A morphometric study

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Abstract

A morphometric study was conducted on the kidney of 17 fetuses of the Yankasa sheep (*Ovis aries*) collected from the Sokoto metropolitan abattoir, over a period of one month at different gestational ages. The approximate age of the fetuses was estimated from the crown vertebral rump length (CVRL) and samples were categorised into first, second and third trimester. Out of the seventeen (17) fetuses at different gestational age used for the study, 7 (48%) were females while 10 (52%) were males. 6(35%) fetuses belong to first trimester, 5(30%) belong to second trimester and 6(35%) belong to third trimesters of pregnancy respectively. The mean crown vertebrate-rump length (CVRL) ranged from 12.47 ± 1.80 cm at first trimester to 33.79 ± 1.52 cm at third trimester. All kidneys were found to be irregularly elongated and reddish-brown in colour. Both kidneys are smooth externally and internally lobulated, in which the intensity of the lobulation increases with the advancement in gestation. The surface was covered with a thin fibromuscular capsule. Both kidneys were located below the transverse processes of lumbar vertebrae of each side, with the right one being more cranial in all stages of development. Adipose tissue was found at the hilus of each kidney in the third trimester fetuses. A distinct renal pelvis with a well developed ureter originating from the middle of the renal pelvis was found in all kidneys. Base on the above findings, the gross differentiation of the Yankasa sheep kidney is similar to that of ovine, bovine, equine, llama, and guanaco but differs from that of the feline, canine and porcine. Mean while, considering the morphological features observed in the study, the bovine kidney may become fully matured and functional at post-natal age.

1. Introduction

Yankasa sheep's are member of a class of animals called ruminants. These animals ruminant (chew their cud). Unlike other animals, they have four-compartment stomachs especially designed to digest roughage (food high in fiber) such as grass, hay and silage [1]. Anatomically, the ruminant stomach comprises of the rumen, the honey-combed reticulum, the leaf like Omasum and the abomasum or true stomach [2]. The size relationship of four chambers changes as the animal grows up [1]. Small ruminants, (goat and sheeps) are increasingly becoming a major source of animal protein in Nigeria, contributing over 30 percent to total meat consumption in the country [3].

Sheep's are widely distributed throughout the world. The total world cattle population is estimated to be more than 1.4 billion head, with about 35 percent in Africa, 23 percent in Asia, 17 percent in South America, 12 percent in North and Central America, 10 percent in Europe, and 3 percent in Oceania [2].

Histomorphological studies of prenatal development of various organs in sheeps have been carried out extensively [4-11] but little of such studies have been conducted on the developmental changes of the yankasa sheeps kidney at prenatal life in this area. However, there is thus, paucity of information on the prenatal development of yankasa sheeps kidney [12]; hence the present study was undertaken to bridge the gap of the existing information.

2. Materials and method

The study was carried out on 17 fetuses of the yankasa sheeps collected from the metropolitan abattoir, Sokoto, Nigeria, at different gestational ages. The collected fetuses were then taken to the Veterinary Anatomy laboratory of Usmanu Danfodiyo University, where the weight and age of the fetus were determined. The fetal body weight was

measured using electrical (digital) weighing balance for the smaller fetuses and compression spring balance (AT-1422), size C-1, sensitivity of 20kg X 50g in Kilogram for the bigger fetuses. The approximate age of the fetuses was estimated using the following formula as adopted by Gall *et al*[13].

$$G.A = (CVRL + 30.15) / 2.74 \quad \dots \dots \dots \text{Where GA is in days}$$

Where GA(Gestational Age) is in days, CVRL(Crown Vertebral rump Length) is in centimeter, and measured as a curved line along the vertebral column from the point of the anterior frontal bone following the vertebral curvature to the base of the tail [3]. Based on this, the following guide was used to place the fetuses at the level of trimester:

- First Trimester = 1-51 days
- Second Trimester = 52-102 days
- Third trimester = 103-153days

The kidneys of each fetus were collected by placing the fetus on dorsal recumbency and a mid-ventral skin incision was made via the abdomino-pelvic region down to the thoracic region. The abdomino-thoracic content was removed entirely to gain access to the position of the kidneys.

1cm² thick of sample from each group was collected and fixed in 10% formalin solution. After fixation was achieved, the tissue sample was processed for paraffin blocks preparation. The sections of 5µm were subjected to haematoxylin and eosin for routine morphology [14]. The standard sections were examined under light microscope and micrographs taken using Sony camera with 12.1 mega pixel.

3. Result and discussion

Out of the twenty five (17) fetuses at different gestational age used for the study, seven (48%) were females while ten (52%) were males. 6(35%) fetuses belong to first trimester, 5(30%) belong to second

trimester and 6(35%) belong to third trimesters of pregnancy respectively. The mean crown vertebrate-rump length (CVRL) ranged from 12.47 ± 1.80 cm at first trimester to 33.79 ± 1.52 cm at third trimester as shown in table 1.

From the study, the result shows that with the advancement of gestation the morphometric data were increasing progressively as shown in table 2. This is in accordance with the finding of Hena et al[15], on pigeon, Bello et al[16] on cattle kidney and Bello et al [2] on camel digestive tract.

Table 1: The Mean CRVL, Mean Weight and Sex of the Yankasa sheeps' foetuses at various trimesters of age

Trimester	Mean CRVL (cm±SEM)	SEX		Mean Weight (g±SEM)
		Male	female	
1 st	12.47±1.80	4	2	126.15±4.74
2 nd	22.16±1.17	2	3	452.12±4.25
3 rd	33.79±1.52	4	2	1801.39±7.58
Total =		10	7	

Table 2: The Mean ±SEM of biometrical parameters of right and left Yankasa sheeps' kidneys in relation to stages of development

Parameters	1 st	2 nd	3 rd
	Trimester	Trimester	Trimester
Sample size	6	5	6
Mean Weight (g±SEM)			
Right Kidney	0.68±0.19	2.00±0.17	3.74±0.28
Left kidney	0.68±0.19	2.44±0.28	3.88±0.30
Mean Length (cm±SEM)			
Right kidney	1.27±0.19	2.36±0.11	2.86±0.04
Left kidney	1.44±0.13	2.48±0.05	3.88±0.30
Mean Width (cm±SEM)			
Right kidney	0.82±0.11	1.44±0.10	1.66±0.08
Left kidney	0.83±0.12	1.48±0.08	1.68±0.08
Mean Volume (cm ³ ±SEM)			
Right kidney	0.82±0.29	2.02±0.17	3.18±0.31
Left kidney	0.82±0.29	2.50±0.21	3.20±0.36



Plate 3: Photograph of yankasa sheep foetus at third trimester showing well closure of the abdominal skin with covered hairs (white arrow) with developed eye bulb (Black arrow) and well developed pinna (Blue arrow).



Plate 4: Photograph of yankasa sheep foetus at second trimester showing the position of the left ((Black arrow) and right kidneys (white arrow) insitu.



Plate 1: Photograph of yankasa sheep foetus at first trimester showing transparent abdomen (white arrow) with underdeveloped eye bulb (Black arrow).



Plate 2: Photograph of yankasa sheep foetus at second trimester showing well closure of the abdomen (white arrow) with developed eye bulb (Black arrow) and well developed pinna (Blue arrow)



Plate 5: Photograph of yankasa sheep foetus at third trimester showing the size of the left ((Black arrow) and right kidneys(white arrow).

From the result obtained in the study, all kidneys were found to be irregularly oval and reddish-brown in colour. Both kidneys are smooth externally and internally lobulated, in which the intensity of the lobulation increases with the advancement in gestation. The surface was covered with a thin fibro-muscular capsule. This is in accordance with the reports of Smuts and Bezuidenhout [17], Dyce [18]; Abdalla et al [19]; Salehi et al [1]; Bello et al [2]; Bello et al [16].

Both kidneys were located below the transverse processes of lumbar vertebrae of each side, with the right one being more cranial in second and third trimester of age (Fig. 2 and 3). Abdalla et al [19] reported that right kidney is situated under the first three lumbar vertebrae while the left one is found under the last three lumbar vertebrae. Bello et al [2] also reported that the right kidneys shifted rostrally more than the left in camel embryos at second trimester of age. Abdalla et al [19] also reported that the right and left kidneys shifted rostral with advancement of age in large ruminants. This cranial positioning of the kidneys might be due to relative variation in growth of different organs in the abdominal and pelvic cavities during various stages of embryonic development of the liver [1].

Adipose tissue was found at the hilus of each kidney in the third trimester fetuses. Dyce [18], and Bello et al [16] reported similar finding in large ruminant, the fat is sometime enough to hide the kidney completely. The fat protects against distorting pressures from neighboring organs. Salehi et al [1] also reported that adipose tissue surrounded the hilus and sides of the kidney.

A distinct renal pelvis with a well developed ureter originating from the middle of the renal pelvis was found in all kidneys from first to third trimester of age, similar to Pratt [20]; Sonfada [21], Sarma et al [22], and Salehi et al [1]. This confirms the development of renal pelvis and ureter in early phase of the gestation period in ruminant embryos [1,2]. The right ureter was found to have higher length than the left one in all foetuses at second and third trimester of age. Abdalla et al [19] also reported that the right ureter of the camel is longer than the left considering the positions of the kidneys and the bladder in adult kidneys.

4. Conclusion

In conclusion, the gross differentiation of the Yankasa sheep kidney is similar to that of caprine, bovine, equine, llama, and guanaco but differs from that of the feline, canine and porcine. Mean while, considering the morphological features observed in the study, the Yankasa sheep kidney may become fully matured and functional at post-natal age.

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