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Embryonic diffrentiation of the rectum of one humped camel (*camelus dromedarius*): A histomorphology

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Research Paper

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A research was conducted on the rectum of 35 foetuses of the one-humped camel collected from the Sokoto metropolitan abattoir, over a period of five months at different gestational ages for histomorphological differentiation. The approximate age of the fetuses was estimated and categorised into first, second and third trimester. Gross observation, result and discussion were critically highlighted, Histological observation of the tissues in this study revealed a complete structure of the tubular organ. The rectum was found to consist of four layers namely: *Tunica mucosa, Tunica sub mucosa, Tunica muscularis and Tunica serosa*. The epithelium of the *Tunica mucosa* was stratified squamous epithelium with varying degree of stratification along the length at first trimester and transformed to low columnar /cuboidal epithelium at second trimester. At third trimester, the epithelium was simple columnar epithelium. The lamina propria mucosa was found absent at first trimester but prominent at second and third trimester. The *Lamina mascularis* mucosa was found prominent at third trimester but not identified at first and second trimester. At first trimester of age, *tunica submucosa* was prominent while at second trimester, it consisted of connective tissue cells and fibres scattered all over the layers with preliminary blood vessels. The cells and fibres were undifferentiated at this stage. There was no evidence of secretory cells within the layer. At third trimester of age, the connective tissues and blood vessels were found prominent throughout the length of the rectum. The *tunica muscularis* of camel rectum consist of two band of smooth muscle sandwich with skeletal muscle layers. At first trimester this layer did not differentiate into these three zones but only longitudinal orientation of smooth muscle layer. At second trimester, the layers of three zones with clear demarcation was observed, while at third trimester, the skeletal muscle layer appeared to be much thicker than the two longitudinal smooth layer. A thin layer of connective tissue comprising of undifferentiated cells lined the rectum externally was observed in all the stages of development. Based on the above findings, it showed that development of the camels' rectum was morphological in succession over a period of time.

Key words: Camel, rectum, embryonic differenciation, histomorphology.

INTRODUCTION

The digestive anatomy and physiology of dromedarian camel at embryonic level is least understood when compared to Llama, Guanaco, Cattle, Sheep, Goat and Pig (Bello et al., 2012). The description of dromedarian

camel is usually made as if it is identical with Llama specie (Bello *et al*., 2012; Franco et al., 2004). Though, they are pseudo-ruminants that possess a three-chambered stomach, lacking the omasum that is part of the four-chambered stomach of the order Ruminantia (Belknap, 1994; Bello et al., 2012). The true camels (*Camelus dromedarius and Camelus bacterianus*) are closely related anatomically to the South American Camelids (Georgieva and Gerov, 1975; Wilson et al.,1990; Belknap, 1994; Umaru and Bello, 2012).

Research work dealing with morphology, physiology, pathology, gross and developmental anatomy of various organs and system of dromedarian camel has been carried out in many countries using foetal and adult camel (Georgieva and Gerov, 1975; Asari et al., 1985; Malie et al., 1987; Belknap, 1994; Franco et al., 2004; Bello et al., 2012; Umaru and Bello, 2012; Wilson et al.,1990). Despite the importance of camels' large intestine to its adaptation to desert environment, little attentions have been paid for the developmental changes of the caudal part of the small intestine in this area. Thus, paucity of information on the prenatal development of camel rectum exists; hence the present study was undertaken to bridge the information gap.

MATERIALS AND METHODS

The study was carried out on 35 foetuses of the one-humped camel collected from the metropolitan abattoir, Sokoto using standard animal ethics approved by the government, at different gestational ages. The collected foetuses were then taken to the Veterinary Anatomy laboratory of Usmanu Danfodiyo University; where the weight and age of the foetus were determined. The foetal body weight was measured using electrical (digital) weighing balance for the smaller foetuses and compression spring balance (AT-1422), size C-1, sensitivity of 20 kg X 50 g in Kilogram for the bigger foetuses. The approximate age of the foetuses was estimated by using the following formula adopted by El-wishy et al., 1981:

GA = (CVRL + 23.99)/0.366,

Where GA is age in days and CVRL is the Crown Vertebral Rump Length.

Fetuses below 130 days were designated as first trimester, 131- 260 days as second trimester and 261 - 390 days as third trimester (Bello et al., 2012). Crown Vertebral Rump Length (CVRL) was measured (cm) as a curved line along the vertebral column from the point of the anterior fontanel or the frontal bone following the vertebral curvature to the base of the tail. Based on this, foetal samples were divided into 3 main groups as described by Bello et al. *(*2013). The digestive tract of each fetus was 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, to the neck up to the inter-mandibular space in order to remove the entire digestive tract. 1 cm^2 thick of sample from each segment was collected and fixed in 10% formalin solution. After fixation was achieved, the tissue sample was processed for paraffin blocks preparation. The sections of 5 µm were subjected to haematoxylin and eosin for routine morphology (Luiz and Jose, 2005). The standard sections were examined under light microscope and micrographs taken using Sony digital camera(X5) with 12.1 mega pixel.

RESULTS AND DISCUSSION

The study attempted to contribution to the histological differentiation of the camel large intestine. Result of the investigation revealed that there was an increase in the body weight, organ weight and individual segments of the large intestine in the fetuses with advancement in gestation period (Table 1). This is in agreement with the observations of (Jamdar and Ema, 1982; Bello et al. 2012 and Sonfada, 2008), who observed obvious body weight increase with advancement of gestation period in different species of animals. Bello et al. 2013, suggested that nutritional status and health condition of the dam played a vital role in the development of the fetus hence increase in weight of the fetus grossly, the color of the rectum was whitish at first trimester and grayish in second and third trimester. The rectum was divided into two main portions namely the sacculated part and the thin part which formed the long part of the rectum in the second and third trimesters. At first trimester the thin part was not differentiated. Similar findings were reported on the color and divisions of rectum of various animals at different gestational ages such as Llama (Smuts and Benzuidenhout, 1987; Malie et al.,1987) and nutria (Perez et al., 2008a). On the other hand, the sacculated part was not found in sheep (Sisson et al.,1975; May,1977), cattle (Wilson et al., 1990; Dyce et al., 2002) and pampas deer (Perez et al., 2008b). While in horse, there were two regions of sacculated portion with constriction between them prenatally (Sisson et al.,1975).

The internal mucosa of the rectum of the camel was pinkish at first trimester and grayish in color at second and third trimester, with thin longitudinal folds at the thin part and crossed longitudinal and circular folds at the sacculated portion. This is in line with the findings of some researchers, who reported that the internal mucosa of large intestine of other domestic animals had circular folds "Plicae Circulares"(Junqueira et al., 1995; Dellmann and Eurell, 1998).

Histological observation of the tissues in this study revealed a complete structure of the tubular organ. The rectum was found to consist of four layers namely: *Tunica mucosa, Tunica sub mucosa, Tunica muscularis and*

Table 1: The CVRL and weight of fetuses at various trimesters (mean±SEM).

Parameters	First Trimester	Second Trimester	Third Trimester
Number of sample (N)	13	11	11
CVRL (cm)	20.06 ± 3.0	60.27 ± 4.0	103.83 ± 6.0
Fetal weight (Kg)	1.40 ± 0. 6	6.10 ± 0.5	17.87 ± 0.6

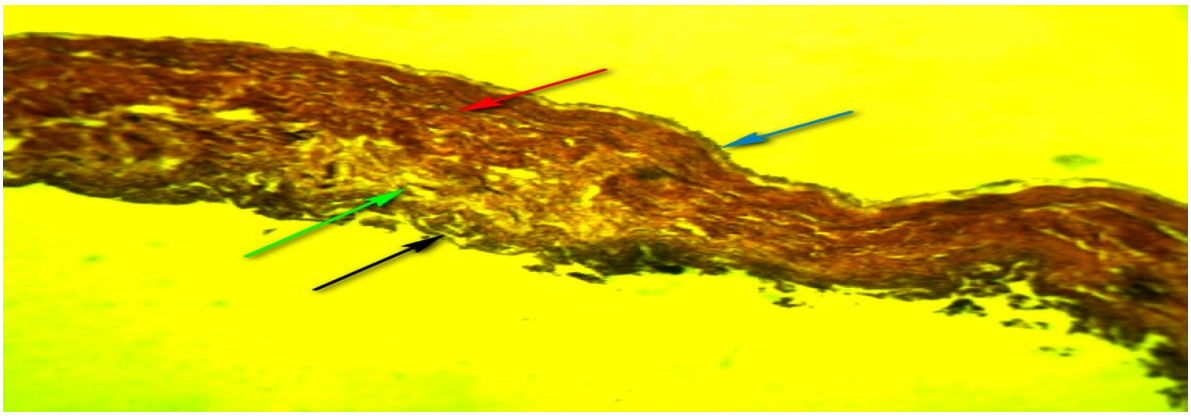

Plate 1. Transverse section of the rectum at first trimester showing Epithelium (Black arrow), Submucosa (Green arrow), tunica muscularis (Red arrow), serosa (Blue arrow), 150x.

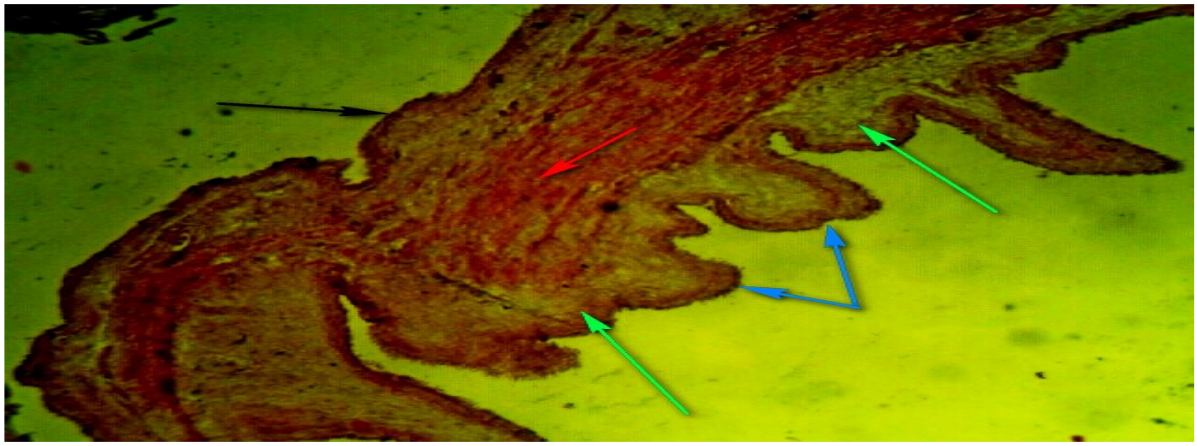

Plate 2. Transverse section of the rectum at second trimester showing Epithelium (Blue arrow), Submucosa (Green arrow), internal (circular) layer of tunica muscularis (Tm2), external (longitudinal) layer of tunica muscularis (Tm1),Skeletal muscle (Red arrow) serosa (Black arrow), 400x.

Tunica serosa. The distinguishing features observed in the developmental stage at tunica mucosa were, *lamina epithalialis, lamina propria mucosa* and *lamina muscularis mucosa*. At *tunica muscularis* the divisions were inner circular muscularis layer and outer longitudinal muscularis layer.

At first trimester, the thin portion was small and straight in shape. At second and third trimesters, the sacculated portion of the rectum was prominent, large and rounded in shape followed by thin part. The thin part was directed craniodorsally touching the base of the sacral bone. The study findings agree with those reported in Llama by Smuts and Benzuidenhout, (1987) who concluded that the rectum begins at the pelvic inlet called colo-rectal junction below the fifth lumbar vertebrae at second and third trimester.

From the study, the epithelium of the *Tunica mucosa* was stratified squamous epithelium with varying degree of stratification along the length at first trimester (Plate 1) and transformed to low collumnar /cuboidal epithelium at second trimester (Plate 2). At third trimester, the epithelium was simple collumnar epithelium (Plate 3).

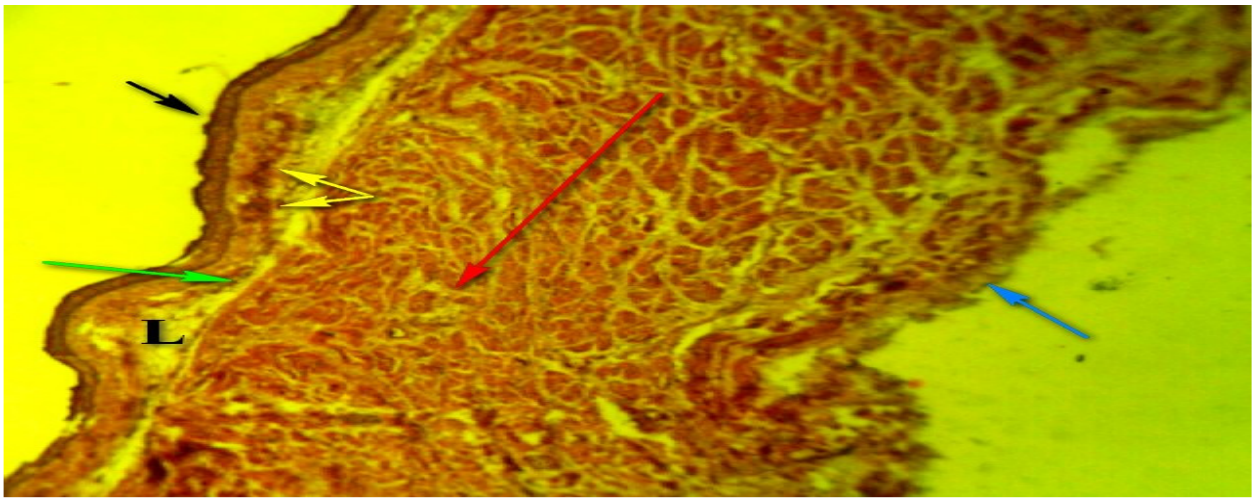

Plate 3. Transverse section of the rectum at third trimester showing simple columnar Epithelium (Black arrow), Submucosa (Yellow arrow), internal (circular) layer of tunica muscularis (Green arrow), external (longitudinal) layer of tunica muscularis (Blue arrow),Extensive skeletal muscle in between (Red arrow) serosa (Tser), 400x.

Similar observations were seen on Llama, cow, sheep, horse, rodent, human, monkey, dog and cat (May, 1977; Wilson et al., 1990; Bello et al., 2012; Asari et al., 1985; Bello et al., 2013; Franco et al., 2004; Umaru and Bello, 2012, Georgieva and Gerov, 1975).

The lamina propria mucosa was found absent at first trimester but prominent at second and third trimester (Plate 2 and Plate 3).

The *Lamina mascularis* mucosa was found prominent at third trimester but not identified at first and second trimester. The above finding showed that the development of the laminae of the camel's rectum was in succession.

At first trimester of age, *tunica submucosa* was prominent (Plate 1) while at second trimester, it consisted of connective tissue cells and fibres scattered all over the layers with preliminary blood vessels. The cells and fibres were undifferentiated at this stage. There was no evidence of secretory cells within the layer (Plate 2). At third trimester of age, the connective tissues and blood vessels were found prominent throughout the length of the rectum. The above findings were contrary to those of ruminant, horse (Georgieva and Gerov, 1975) and cat (Schummer et al.,1979), which showed the presence of submucosa lymphoid cells at the different region of the rectum in that specie of animals.The *tunica muscularis* of camel rectum consist of two band of smooth muscle sandwich with skeletal muscle layers. At first trimester this layer did not differentiate into these three zones but only longitudinal orientation of smooth muscle layer (Plate 1). At second trimester, the layers of three zones with clear demarcation was observed (Plate 2), while at third trimester, the skeletal muscle layer appeared to be much thicker than the two longitudinal smooth layers (Plate 3). The above finding was in conformity with that of Llama (Watrous et al., 1995) and Bacterian camel (Luciano et al., 1979).

A thin layer of connective tissue comprising of undifferentiated cells lined the rectum externally was observed in all the stages of development. This was observed at first trimester and became well developed at second and third trimester of age (Plate 1, 2 and 3).

Conclusion

The development of the camels' rectum based on embryonic stage was histologically in succession. The thin part of the rectum was not divided at first trimester but differentiated into two parts; the thin portion and the sacculated portion at second and third trimester. The information obtained in this study will serve as a base-line data for the camel specie in this environment.

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