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Pre-natal Morphology of Male Reproductive Organs of *Camelus dromedarius*

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Abstract

The reproductive system is a key to survival of specie. The male reproductive system plays a vital role in the production, formation, maturation, and transportation of spermatozoa to the female specie. Little attention has been given to the male fetal reproductive system in *Camelus dromedarius*. The study was aimed to document the normal gross morphology of the male fetal one-humped dromedary. Forty-five (45) male fetal reproductive organs were used. The fetus age was determined classified into 3 trimesters. The foetuses were dissected from the xiphoid region through the abdominal wall to the preputial orifice to expose and examine the reproductive organs. Morphologically, the testicles were oblong, pale in color and located in the abdominal cavity at the first trimester, moved caudally with a condensing gubernaculum at the 2nd trimester. But did not descend into the scrotum at the third trimester. Ultimately, the testis did not descend before birth. The epididymis was close in contact with the testis throughout its fetal life. Vas deference coursed from the cauda epididymis to the prostate at the base of the bladder. The penis presented a cylindrical form at the first trimester. It was distinct into base, body and glans at the second trimester with a slight arc mid-way of its body. The sigmoid flexure was noted to be curlier at the third trimester. The reproductive organs of the male fetal *Camelus dromedarius* have some considerable differences from other domesticated animals especially the ruminants

KEYWORDS
Camelus dromedarius, Accessory sex glands, Male, Epididymis, Testis, Penis

INTRODUCTION

Camels are useful to humans. They play a great role in the economic and social life of nomadic tribes as well as a major source of food security (Farah *et al*., 2007). Camels also serve as means of transportation (Skidmore, 2005), source for wool and used in race and tourism (Faye and Brey 2005), Camels' dung is used as an organic fertilizers and in fuel (Fernandez-Barca, 1993), also, as a source of milk as therapeutics (Abrhaley and Leta, 2018) and for meat consumption and meat by-product (Farah and Fisher, 2004). Despite this, the *Camelus dromedarius* has a slow reproductive cycle characterized by long gestation, late reproductive perception, long calving period and mortality in young (Faye and Brey 2005). Genetic characteristics and environmental based factors contribute to the indications of fertility in animal as reported by Mukasa-Mugera (1981). The peculiar characteristics of camels necessitate the room for researchers to explore the reproductive capacity of male and female camel right from fetal stage.

The anatomical study of adult dromedary has been performed over the years, the male genital system (Degen and Lee, 1982; Hafez and Hafez, 2001), the anatomy of the testis (Tingari *et al*, 1984; Pasha *et al*., 2011; Mahmud *et al*., 2015) and the accessory sex gland (Mahmud *et al*., 2016). In adult females, the genital organs (ElWishy, 1988; Albaghdady, 2006; Umaru and Bello, 2012); ovary and uterus were studied by Jaji *et al.* (2011). The anatomical studies on the female prenatal reproductive system were on ovary by Jaji *et al.* (2011); Abdel-Elrazik *et al.* (2013) and Oyelowo *et al.* (2018). Few studies have been done on the male fetal reproductive system in Camelus dromedaries such as Sonfada *et al.* (2012). Hence, this study aimed to add to the literature

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of normal gross morphology of the male reproductive organs of Camelus dromedaries.

MATERIALS AND METHODS

Sample collection

This work was approved by the University of Abuja's Ethics Committee on Animal Use (UAECAU), with reference number UAECAU/2022/0009. The study was conducted using a total number of forty-five (45) male fetuses. The fetal wastages from Sokoto Metropolitan Abattoir, Sokoto State and Kano Municipal Abattoir, Kano State were used in this study. The uteri were opened, and fetuses were detached from fetal membranes. The fetal aging formula described by El-Wishy *et al.* (1981) as shown below was used to determine the ages of the fetuses while fetal classification into trimesters were done using the description of Sonfada *et al.* (2012). The fetuses were sexed using modified method of Ranjbar *et al.* (2007). Male fetuses were identified by the existence of an anogenital ridge that spanned the length from the anus to the penis. Fetuses were further dissected using the modified method of Habel (1970) at the Gross Anatomy Unit of the Department of Veterinary Anatomy, Usmanu Danfodiyo University, Sokoto, Nigeria.

X = CVRL (cm) + 29.66/0.366.

Where: X = Age in days

CVRL = Crown Vertebral Rump Length

Male fetal dissection

The skin was reflected from the abdominal wall from the preputial orifice, around the placenta and to the xiphoid region. A lateral incision was made along the prepuce and penis at the neck of the scrotum. The skin was reflected laterally, and the lateral wall of the scrotum was exposed. The pubis and ischium were cut through laterally to the penis, and shaft of ilium was also cut. The placenta was detached alongside with the bladder and kidneys for easy examination of the reproductive organs insitu. After which the organs were separated for individual gross description.

RESULTS

Testes

The testis was seen in the abdominal cavity, close to the caudal border of respective kidneys. The testis was tubular in shape with a rounded caudal border. At this stage the gubernaculum was condensing gradually, and the testes moved caudally in the 1st trimester fetus (Fig. 1). By the 2nd trimester, it was seen that the testis was oblong in shape and pale in colour (Fig. 2). The testes moved caudally away from the metanephros. The left testis was attached to the fascia of the left metanephros while the right testis was attached to the liver. Each testis had a convex lateral surface. The cranial border was seen to be smaller and typically round than the caudal border. It was situated at the inguinal canal and the testis was seen to have slightly increased in size, and the gubernaculum was still attached (Fig. 3).

The 3rd trimester fetus had a dark colour testis which was ovoid in shape, the lateral and medial surfaces were convex, but the lateral was more convex than the medial (Figs 1 and 4). The cranial border was seen to be convex and the caudal was slightly flat. The position of the testis had descended farther down the inguinal ring but not to the scrotal sac. The scrotal sac was seen to have a gelatinous-like substance which was soft to touch.

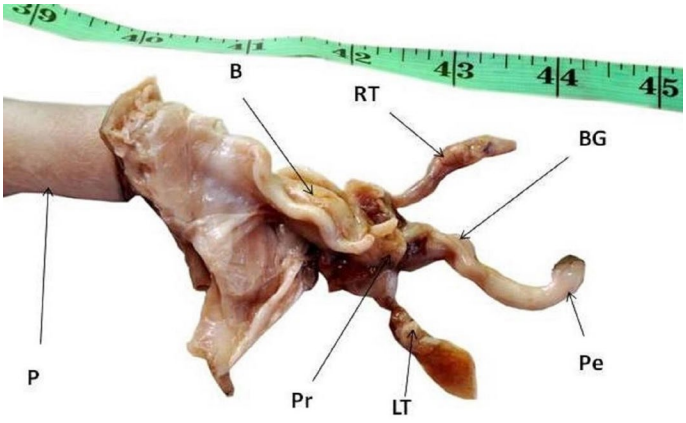

Fig. 1. Photograph of gross features of genital organs of 1st trimester male Camelus dromedarius showing B-bladder, RT- testes and epididymis, BG- bulbourethral gland, Pe- glans penis, LT- left testes, Pr- prostate and P-placenta

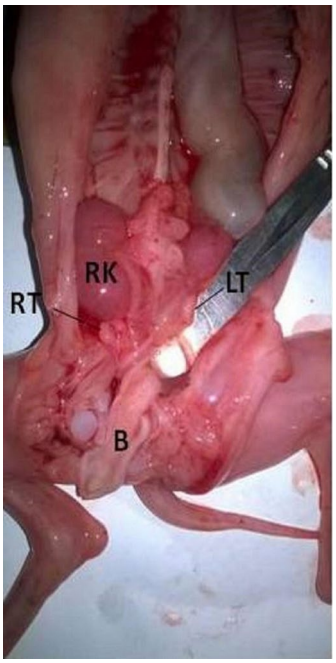

Fig. 2. Photomicrograph of gross features of abdominal organs 2nd trimester male *Camelus dromedarius* showing RK- right kidney, RT- right testes, LT- left testes and B-bladder.

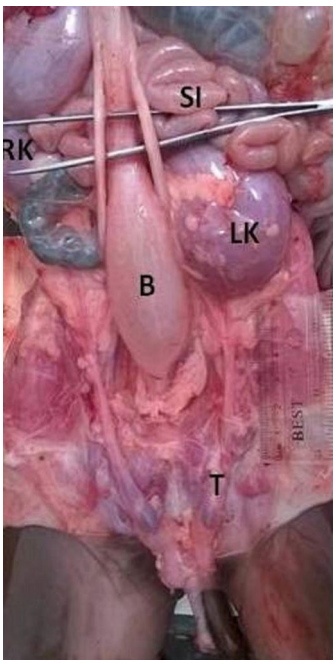

Fig. 3. Photomicrograph of gross features of abdominal organs of 3rd trimester male *Camelus dromedarius* f showing RK- right kidney, LK –left kidney, SI- small intestine and B-bladder, T= Testis.

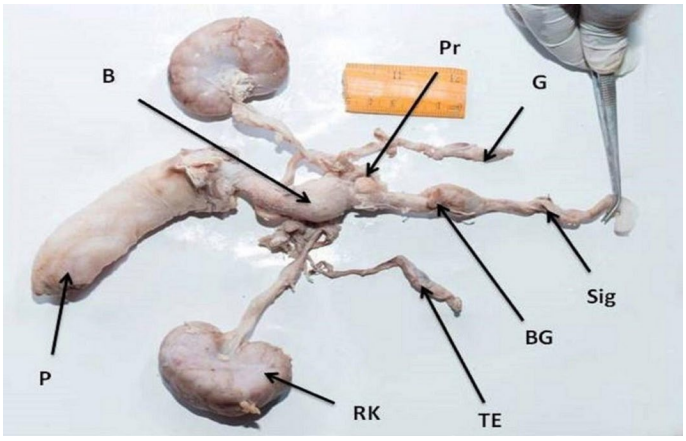

Fig. 4. Photograph of gross features of genital organs of 3rd trimester male *Camelus dromedarius* showing B-bladder, RK- right kidney, TE- testes & epididymis, BG- bulbourethral gland, Pe- glans penis, LT- left testes, Pr- prostate and P-placenta.

Epididymis

The epididymis of *Camelus dromedarius* fetus was in close contact with testis. In the 1st trimester, the epididymis was discovered to be inconspicuous (Fig. 3). By the 2nd trimester the epididymal parts were distinguishable having a white colour and roughly tubular in shape (Fig. 5). The cranial caput was observed to be partially folded into two on the round testicular cranial border. It continued as a straight tube down as the corpus. This continues caudally as the cauda which was seen to have a bulb shape. The epididymal duct was observed as coils of tubes that were squeezed into the visceral peritoneal covering. By the 3rd trimester, the epididymis was observed to be more distinct, with more tightly coiled tubules (Fig. 4). The visceral peritoneum was also seen to be covered by the parietal peritoneum.

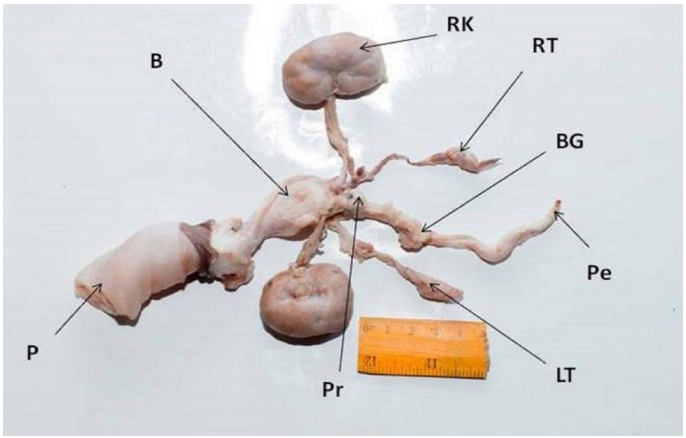

Fig. 5. Photograph of gross features of genital organs of 2nd trimester male *Camelus dromedarius* showing B-bladder, RK- right kidney, RT- testes& epididymis, BG- bulbourethral gland, Pe- glans penis, LT- left testes, Pr- prostate and P-placenta.

Ampulla and Vas deferens

The vas deferens of *Camelus dromedarius* fetus in the 1st trimester was seen to be very frail, convoluted and short. It was also seen to be very thin in size, white, twisted tight and located in the abdominal cavity. The length was short. The course of the vas deferens originated from the cauda epididymis down to the prostate at the base of the bladder where it empties into the pelvic urethra (Fig. 2). The 2nd trimester was observed to have moved towards the pelvic cavity as it accompanies the epididymis. It had increased in size and a bit twisted tight at the junction to the cauda epididymis. The length was also seen to be longer and a bit thicker in size. The vas deferens was observed in the 3rd trimester to accompany the epididymis as it moves caudally towards the inguinal canal. It was also observed to appear more straight, longer, and thicker than the previous trimester.

Prostate gland

The prostate was observed to be the largest accessory gland in *Camelus dromedarius* fetus located at the base of the bladder. At the 1st trimester, it was seen to be a small bulb and pale in colour (Fig. 1). At the 2nd trimester the prostate was seen to have two parts, the partly heart shaped body which was situated dorsally to the prostatic urethra and the ventrally located disseminating part (Fig. 5). The prostate was pale in colour and solid to touch. The prostate body was observed to be fused with the prostatic urethra at about caudal one third of its length. It was also seen that the cranial part of the body was slightly wider than the caudal part. The disseminating part was seen to be very small compared to the size of the body. The 3rd trimester prostate was seen to be bigger and firmer to touch (Fig. 4).

Bulbourethral gland

The bulbourethral glands of *Camelus dromedarius* fetus were observed to be located at the base of the pelvic urethra. Each gland was seen to be on either side of the urethra at the dorso-medial border. Both were seen to be almond-shaped with an excretory duct into the urethra. Ischiocavernosus muscle also covers the gland partly (Figs. 1 and 4). The paired glands are enveloped in fibro-elastic covering.

Penis

The penis of *Camelus dromedarius* fetus was observed to be cylindrical in shape but no distinct demarcation on the parts was observed in the 1st trimester. In the 2nd trimester, the base, body and glans part could be differentiated. The bulb of the base was seen to be made up of bulbospongiosus muscle. About mid-way of the body is a slight arc. The arc or sigmoid flexure was seen caudal to the bulbospongiosus muscle. Parallel to this is a thin retractor penile muscle that inserts just after the end of the sigmoid flexure (Figs. 1 and 4). The muscle continues distally along the penile length as corpus spongiosum of the penis. The 3rd trimester revealed a thicker and longer penis with a prominent sigmoid flexure (Fig. 4). The free glans penis also increased in size and length.

DISCUSSION

In this study, the testes of fetal *Camelus dromedarius* were observed in the 1st trimester to be in the abdominal cavity. This is similar to the findings of Sharifabad and Salehi (2015) who described the fetal testes of *Camelus dromedarius* to be in the abdominal cavity at week 25 of age. This study also observed that the testes were close to the caudal border of respective kidneys. This was similar to the findings of Shukla (2015). The testis was tubular in shape with a rounded caudal border. Shukla (2015) had similar finding in Gaddi sheep with an elongated testis. After this stage the gubernaculum was condensing gradually, and the testes moved caudally.

By the 2nd trimester, it was seen that the testis was oblong in shape and pale in colour. The testes were observed to move caudally away from the metanephros. This is similar to the finding of Baishya and Vyas (1990) in Surti buffalo fetus , Farooqui *et al.* (2011) in capra hircus fetus and Shukla (2015) in Gaddi sheep fetus, as they made inference to the body growth and enlargement

of neighbouring organs pushed the testes caudally towards the inguinal ring.

In the present study, each testis had a convex lateral surface. The cranial border was seen to be smaller and typically round than the caudal border. This was also in agreement with the findings of Farooqui *et al*. (2011). The testis was seen to have slightly increased in size, and the gubernaculum was still attached.

By the 3rd trimester, the position, shape, colour and the curvature of the testis were as described by Ahmed (1994), Sonfada *et al*. (2012), Sharifabad and Salehi (2015) in *Camelus dromedarius* fetus and Farooqui *et al*. (2011) in capra hircus fetus. We also reported herein that the tests of *Camelus dromedarius* did not descend throught the gestation period. Abd-Elhafeez (2005) reported testicular descend around time of birth in donkeys. Evans (1993) and Zayed and Moustafa (1996) had similar observation on descend of testes of dogs after birth. This same finding is not in line with other authors in other species. Baishya (1989) reported testicular descend in the Surti buffalo testes at 213 days of gestation. Abdel-Raouf *et al*. (1974) reported testicular descend to the scrotum in calves at 6 months of gestation. Roberts (1971) and Evans and Sack (1973) reported testicular descend to the scrotum in calf of 20th week of gestation. Shukla (2015) reported the descend of testis Gaddi sheep at 140th day of gestation while Hejazi *et al*. (2011) reported that the testis remained in the middle of the inguinal canal up to 107 days of gestation and the complete descent of testis occurred at 153 days after conception in sheep. Klonish and Flower (2004) reported that in sheep the complete descent of the testes occurred at time of birth.

The epididymis of fetal *Camelus dromedarius* was in close contact with testis. It was inconspicuous in the 1st trimester, tubular in shape in the 2nd trimester and more distinctly shaped in the 3rd trimester as it moves alongside with the testis towards the abdominal cavity. This is similar to the observations of the Nielson and Torda (1983) in fetal rabbit, Sharma (2010) in fetal buffalo and Shukla (2015) in fetal Gaddi sheep.

The study observed the vas deferens of fetal *Camelus dromedarius* was similar to the observation made by Keith and Peraud (1999) in human, Raut (2003) and Vitthalrao (2007) in sheep. The course of the vas deferens originated from the cauda epididymis down to the prostate at the base of the bladder where it empties into the pelvic urethra. Similar to the findings of Smuts and Bezuidenhout (1987) in adult camels.

The 2nd trimester was observed to have moved towards the pelvic cavity as it accompanies the epididymis. It was had increased in size, a bit twisted tight at the junction to the cauda epididymis. Raut (2003) and Vitthalrao (2007) in sheep had similar findings. The length was also seen to be longer and a bit thicker in size. Raut (2003) and Gier and Morison (1970) described the elongation as due to inguinal migration of the testicles towards the scrotum

The vas deferens was observed in the 3rd trimester to accompany the epididymis as it moves caudally towards the inguinal canal and ensheathed within the spermatic cord. It was also observed to appear more straight, longer, and thicker than the previous trimester. This was in accordance with the observations made by Vitthalrao (2007) in sheep.

The prostate observed in this study to be the largest accessory gland in *Camelus dromedarius* fetus located at the base of the bladder. This observation is similar to the findings of Mahmud *et al*. (2015) in adult camels.

The bulbourethral glands of fetal *Camelus dromedarius* in this study were observed to be located at the base of the pelvic urethra. There is no similar study reported yet on this finding.

The present study revealed penis of fetal *Camelus dromedarius* to be cylindrical in shape but no distinct demarcation on the parts was observed in the 1st trimester. This was similar to the findings of Vitthalrao (2007) in sheep who reported that the phallus pulled the urethral folds to form the lateral wall of the urethral grove. In the 2nd trimester, base, body and glans part could be differentiated. This is in accordance with the findings of Vitthalrao (2007). The bulb of the base was seen to be made up of bulbospongiosus muscle. About mid-way of the body is a slight arc. This is in accordance to the findings of Anderson and Clark (1990), Farooqui *et al*. (2011) in goat and Vitthalrao (2007) in sheep. The 3rd trimester revealed a thicker in size penis, a thicker in size and curlier sigmoid flexure. The free glans penis also increased in size and length. This is in accordance with the reports of Farooqui *et al*. (2011) and Vitthalrao (2007) in goat and in sheep, respectively.

CONCLUSION

In this study, the reproductive organs of the male fetal *Camelus dromedarius* have some considerable differences from other domesticated animals especially the ruminants.

CONFLICT OF INTEREST

Authors declare that no conflict of interest exists.

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