

Morphometric Study on the Developing Female Reproductive System of the Dromedary (*Camelus dromedarius*)

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Abstract

The study was conducted to understand the normal morphometry of the development of female reproductive organs of the dromedary (*Camelus dromedarius*). Reproductive organs of apparently normal fetuses ($n = 24$) were collected from Maiduguri metropolitan abattoir after the slaughter of pregnant dromedary cows. The fetus was aged and grouped into 2–4 months, 4–7 months, 7–10 months, and 10–13 months, representing quarters of pregnancy. The reproductive systems were dissected out of the fetus, and all the organs were measured by using standard measurement techniques. All the parameters measured increased chronologically. In the fourth quarter, the left and right horn measured 7.50 ± 1.86 cm and 5.80 ± 0.79 cm, respectively, the uterine body, cervix, vagina, and

vestibule measured 4.28 ± 0.17 cm, 4.69 ± 0.09 cm, 6.75 ± 0.21 cm, and 3.68 ± 0.19 cm, respectively, whereas the whole reproductive tract measured 57.73 ± 1.04 cm. The uterine body and uterine horn had the longest and shortest lengths. The developmental pattern of the female reproductive organs in the dromedary camel reported in this study is the first of its kind. The knowledge of the developmental pattern of the reproductive structures will aid in understanding reproductive cycles, congenital anomalies, and their etiology so that the anomalies can be treated.

Keywords: Camel, cervix, fetus, ovary, uterus, vagina

Introduction

Camels belong to the family *Camelidae* and the genera *Camelus* (the old-world camel), *Lama* (the new-world camel), and *Vicugna* (Wilson & Reeder, 2005). The genus *Camelus* comprises two species *Camelus dromedarius* (one-humped or Arabian camel) and *Camelus bactrianus* (two-humped camel). The one-humped camel, also called the dromedary, is well adapted to the climatic conditions of arid steppes and deserts and can go several days without water by concentrating its urine (Gebreyohanes & Assen, 2017).

Camel population in the world has been estimated at 25 million heads (FAOSTAT, 2009), the bulk (>80%) of which is found in Africa (Faye, 2015). There had been a steady increase in the number of camels in Nigeria especially in the Northern region where their importance as traditional means of transportation and agricultural production cannot be overlooked despite modern transportation systems and machineries (Nwosu et al., 2003). The population of dromedary in Nigeria was 20,500 heads of camel (FAOSTAT, 2013).

There has been increasing interest in camel research lately, due to its ability to survive and reproduce in harsh and hostile environments. Proper documentation on its breeding characteristics, pregnancy, and parturition and components of the female reproductive system have been studied (Elwishy, 1988). However, there has been little information on the prenatal development of this system. Therefore, this study was aimed at documenting information on the developing female reproductive system of the dromedary.

Methods

A total of 24 fetal dromedaries from apparently healthy pregnant dromedary cows were collected from the Maiduguri metropolitan abattoir after slaughter. Their body weights (kg) and crown-rump length (cm) were measured using the diamond spring balance, 100% spun polyester sewing thread (Two birds brand®) and a superior tailoring rule (Butterfly brand®), respectively. Each fetus was aged and assigned to its appropriate age group using the crown-rump length and body weight measurements and developmental horizons adopted from Jaji et al. (2011).

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The developing reproductive organs were collected immediately after evisceration. Scalpels and blades were used to incise, excise, separate, and debride the organs. One hundred percent spun polyester sewing thread (Two birds brand®) and a superior tailoring rule (Butterfly brand®) were used to measure lengths along the ovaries, uteri, vagina, and vestibules, as adopted from Jaji et al. (2012).

Results

It was evident from the present study that the sex of the female dromedary fetus could be well identified by its external features as early as the first phase of development (2–4 months of intrauterine life). During this stage, separate vulvar and anal openings as well as prominent clitoris could be seen (Figure 1). The caudal row of its mammary gland teats has started bulging (Figure 2). Internally, the fetal tubular genitalia were well established by 4–7 months (Figure 3) but functionally immature. Before birth, the ovaries descended from below the kidneys to the pelvic brim adjacent to the uterine tubes. The cervix had definite transverse folds, and the vagina contained much mucus within its cavity. The prenatal ovaries studied were observed to be ovoid (Figure 3). The lengths of right and left ovaries, respectively, measured 1.18 ± 0.10 cm and 1.13 ± 0.06 cm in the first phase of prenatal life. These sizes significantly increased ($p < .05$ and $.005$) during the remaining phases. However, the right ovary recorded a relatively insignificant increase in size during the second phase of development (Table 1). In the same vein, the ovarian diameters of the right and left ovaries showed the same levels of significance in their increases along the phases of development, from the initial respective 1.04 ± 0.07 cm and 0.86 ± 0.09 cm recorded for the first phase of intrauterine life. The left and right ovaries showed a significant increase ($p < .005$) in weight till full term from the initial 0.15 ± 0.02 cm and 0.13 ± 0.03 , recorded for the first phase of intrauterine life. Segments of the tubular reproductive tract studied (from the uterine horns to the vestibule) also showed a similar pattern of increase in size (Table 2).



Figure 1

The Genitalia of a 2–3 Months Old Female Dromedary Fetus Depicting Its Separate Anal (A) and Vulva (V) Openings. Note the Obvious Clitoris (Arrow).



Figure 2

Female Dromedary Fetus (2–3 Months Old) Depicting the Start of Bulging of Its Caudal Row Mammary Teat.

Discussion, Conclusion, and Recommendations

This study documented the morphometry of the developing reproductive system of the female dromedary fetus. Without giving consideration to time events, the pattern of development of the female reproductive tract of the dromedary fetuses in this study has some

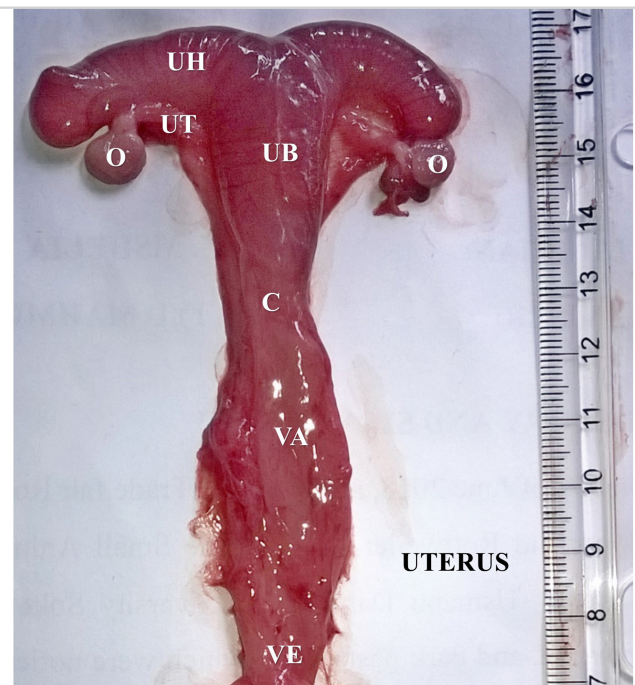


Figure 3

The Developing Reproductive System of a 7–10 Months Old Female Dromedary Fetus Depicting the Locations of Its Ovaries (O), Uterine Tubes (UT), Uterine Horns (UH), Uterine Body (UB), Cervix (C), Vagina (VA), and Vestibule (VE).

Table 1

Morphometrics and Weights of Fetal Dromedary Ovaries

Approx. Age in Months	Left Ovary			Right Ovary		
	Length (cm)	Diameter (cm)	Weight (kg)	Length (cm)	Diameter (cm)	Weight (kg)
2–4	1.18 ± 0.10	1.04 ± 0.07	0.15 ± 0.02	1.13 ± 0.06	0.86 ± 0.09	0.13 ± 0.03
4–7	1.46 ± 0.06*	1.21 ± 0.05*	0.36 ± 0.10**	1.22 ± 0.10	1.36 ± 0.06**	0.35 ± 0.09**
7–10	1.52 ± 0.12**	1.45 ± 0.11**	0.52 ± 0.08**	1.47 ± 0.10**	1.38 ± 0.12**	0.51 ± 0.14**
10–13	1.82 ± 0.23**	1.60 ± 0.13**	0.56 ± 0.12**	1.59 ± 0.10**	1.47 ± 0.04**	0.52 ± 0.12**

Note: *Significant at .05.

**Significant at .005.

Table 2

Morphometric of Fetal Female Reproductive Tract in Dromedaries

Approx. Age in Months	Uterine Horn (cm)		Uterine Body (cm)	Cervix (cm)	Vagina (cm)	Vestibule (cm)	Whole Tract (kg)
	Right	Left					
2–4	4.10 ± 0.06	3.66 ± 0.15	2.56 ± 0.10	3.07 ± 0.10	4.95 ± 0.15	2.47 ± 0.10	7.45 ± 0.46
4–7	4.44 ± 0.17**	4.15 ± 0.15**	2.85 ± 0.11*	3.15 ± 0.10	5.20 ± 0.09*	2.70 ± 0.14*	28.85 ± 0.39**
7–10	6.33 ± 0.37**	6.22 ± 0.57**	3.66 ± 0.40**	4.23 ± 0.25**	6.23 ± 0.08**	3.35 ± 0.14**	41.60 ± 1.43**
10–13	7.50 ± 1.86**	5.80 ± 0.79**	4.28 ± 0.17**	4.69 ± 0.09**	6.75 ± 0.21**	3.68 ± 0.19**	57.73 ± 1.04**

Note: *Significant at .05.

**Significant at .005.

semblance with those of the goat (Sivachelvan et al., 2002). The vulvar and clitoris were located outside the body of the fetuses and were the first organs to develop (at 2–4 months), followed by the internal structures, tubular genitalia and ovaries (at 4–7 months). The vulva and clitoris (external genitalia) are thick skin folds useful in estrous detection (Prange & Duby, 2007). Vagina contained much mucus within its cavity, which according to Srikanthakumar et al. (2003) has been produced by the cervix. The cervix had definite transverse folds (muscular annular rings) similar to the adult dromedary cow reported by Srikanthakumar et al. (2003), and these folds facilitate the function of the cervix and prevent access of foreign bodies such as bacteria and viruses into the uterus (Prange & Duby, 2007). In this study, the uterine body had the shortest length, which disagrees with the work of Srikanthakumar et al. (2003) who reported cervix as the shortest part of the genital tract in adult dromedary cow. The uterine horn is the longest of all the parts of the genital tract, and the left uterine horn is longer than the right, and this agrees with the findings of Srikanthakumar et al. (2003).

The ovoid prenatal ovaries observed were similar to the report of Abdel-Elrazik et al. (2013) who grossly observed that the prenatal camel gonads are of three forms that could not be sexually determined: oval, circular, or bean-shaped. The last two are seen in older ages. A similar age-related morphology of prenatal ovaries has been observed in the Buffalo (El-Ghannam & El-Naggar, 1974).

The developmental pattern of the female reproductive organs in the dromedary camel reported in this study is the first of its kind. The knowledge of the developmental pattern of the reproductive

structures will aid in understanding reproductive cycles, congenital anomalies, and their etiology so that the anomalies can be treated (Abdel-Elrazik et al., 2013).

Ethics Committee Approval: This study was approved by the Institutional Animal Care and Use Committee, University of Ilorin. (Date: January 10, 2019, Ref.: FVERC/W0Q9/11).

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