

MACRO MORPHOLOGICAL STUDIES ON THE UTERUS OF SHE-CAMEL (*Camelus dromedarius*)

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ABSTRACT

The study of the reproductive female camel was focused on the structure and positioning of the uterus. The uterus, a large, thick-walled muscular organ, was found to house embryos until birth and appeared red or greyish-white in colour. Located between the pelvic and abdominal cavities, the uterus was supported by the broad ligaments, which comprised peritoneum, muscle fibres, and connective tissue. This ligament is connected cranially to the ilium and caudally to the sacrum. The uterus was divided into two parts: the cranial transverse part, consisting of the uterine horns, and the caudal longitudinal part, forming the uterus body. The uterus of camels exhibited a T-shape rather than the classical Y-shape, with the left horn being significantly longer than the right. Blood supply was provided by the middle uterine artery. The study also noted the absence of caruncles in the uterine body and horns, with the endometrial surface showing variations in colour from creamy to red depending on functional state. Detailed measurements indicated differences in length and circumference between the left and right horns, with the left being larger. The findings highlighted the complex and adaptive nature of the camel's reproductive system, essential for its survival in harsh desert environments.

Key words: Broad ligament, camel, reproductive system, uterine body, uterine horn, uterus

Animal output is mostly determined by their reproductive ability. The key to profitable large animal production is consistent and successful reproduction (Arata, 2015). Reproductive efficiency is a key factor in maximising the animal's profit (Khaton *et al*, 2015). Seasonally polyestrous and induced ovulates are found in both dromedary and Bactrian camels which normally only ovulate in response to mating (Sghiri and Driancourt, 1999). The short breeding season, the late age of puberty, the long gestation period and the long interval between births due to prolonged lactation-related anoestrus are all factors contributing to the low reproductive efficiency (Skidmore, 2003).

In mammals, the uterus is an important organ for reproduction. It is necessary for the female fertility, health and offspring. It is divided into two horns and body (Khaton *et al*, 2015, Ghazi, 1981). In camels, the uterus is bicornuate, meaning it has two distinct horns that connect to the fallopian tubes (Porjoosh *et al*, 2010).

The female genital tracts of camelids have previously been studied for reproductive purposes (Skidmore and Adams, 2003). However, present study was aimed for the macro-morphological studies on the uterus of dromedary camels.

Materials and Methods

The female reproductive tracts of six recently deceased camels, free of any reproductive system pathology, were used for the current study. They were obtained from the Veterinary Clinical Complex, RAJUVAS, Bikaner, and examined in the Department of Veterinary Anatomy, College of Veterinary and Animal Science, Bikaner. Topographical and gross examinations of the uterus of every camel was conducted immediately after death and collected uteri were fixed in 10% neutral buffered formalin. Prior to fixation, the colour and shape of seen uterus were noted. Using a weighing scale, the organs' weight was determined. Utilising a measuring scale, the length was measured. The circumference and length of uterus was measured by wrapping a thread around the organ and recorded on the measuring scale. The mean and standard error were calculated for length and circumference of uterine horns and body.

Results and Discussion

The uterus appeared red or grayish-white in colour. The uterus was a thick-walled, hollow muscular organ that was partially located in the pelvic cavity and almost in the abdominal cavity, between the bladder below and the colon and rectum above.

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The camel's uterus was situated under the 5th, 6th, and 7th lumbar vertebrae in the abdominal cavity (Fig 2, 3). It was more caudal in young females. This finding agreed with the observations of Novoa (1970) and Jarrar and Faye (2015) in camel. Whereas, Skidmore and Adams (2003) reported that in nulliparous females the uterus was very small and found entirely within the pelvic cavity, whereas in mature non-pregnant females it was located in the abdominal cavity at the level of the 5th, 6th and 7th lumbar vertebra.

The genital fold was a transverse peritoneal fold that ran between the dorsal side of the bladder and the inferior face of the rectum. Due to presence of the reproductive tract in female, the genital fold was extended to cover the uterus and a small portion of the vagina. It was formed of two large folds, the broad ligaments of uterus, which attached the organ to the sides of the pelvic cavity and upper part of the flanks below the level of tuber coxae. Hence, the recto-vesical pouch was entirely divided into the recto-genital and vesico-genital pouches, which were located in the dorsal and ventral compartments (Fig 2, 3).

The broad ligament was made up of double folds of peritoneum, muscle fibres and connective tissue. The nerves and vessels leading to the uterus were passing through it. The broad ligament was connected cranially to the shaft of the ilium and caudally to the sacrum. These findings were in agreement with Jarrar and Faye (2015). A round ligament that arose from the ventro-lateral aspect of the broad ligament fixed the uterus in camels and similar observations were reported by Ball and Peters (2004) in cattle. Mesometrium was seen as a part of the broad ligament that supports the uterus (Fig 2, 3, 4).

The mesometrium was attached at the ventro-lateral aspect of the uterus and it made the uterine surface flat ventrally and convex dorsally. The uterus was connected caudally to the cervix and cranially to the oviducts. The middle uterine artery, which was the largest of the uterine and utero-ovarian arteries, supplied blood to the reproductive tract (Fig 2, 3, 4).

The uterus was divided into two distinct parts: the cranial transverse part, which was made up of the free portion of uterine horns, and the caudal longitudinal part, which was made up of the fused part of horns and served as the uterus body (Fig 3, 4, 5) which was also noticed by Novoa (1970), Musa *et al* (1993), Tibary and Anouassi (2001), Srikanda kumar *et al* (2003) and Porjoosh *et al* (2010) in camel. A long

inter-cornual septum was responsible for dividing the uterus which was also reported by Tibary and Anouassi (2001) in camel (Fig 3, 4, 5). There were two uterine horns, i.e. the right and left. Each horn was a muscular spiral tube with a cranial tapered that connects to the oviduct which was also described by Arthur *et al* (1985) in camel. Camels had a bicornuate uterus, with the left horn being noticeably longer than the right. The uterus of a camel resembled a letter T more so than the classical Y shape (Fig 3, 4, 5). These findings resembled with those of Ghazi (1981) in camel.

The body of the uterus measured 4.93 ± 0.75 cm in length and 11.17 ± 0.98 cm in circumference whereas according to Skidmore and Adams (2003) non-gravid uterus had a short body of only 2 - 3.5 cm in length and according to Srikanda kumar *et al* (2003) body of uterus was 20-35 mm (2cm-3.5) in length in camel (Table 1). Body of uterus appeared to be longer because the caudal most portions of the horns before they fused had a shared peritoneal covering. Its upper surface was convex while its lower surface was flat. The wall of uterine body was thicker than horns. The body was continued caudally with the cervix and bifurcates cranially to form horns. The uterine body was relatively short. The caudal portions of the cornua were intimately united together. The findings were in agreement with reports of Novoa (1970) in camel that the uterus had a flat lower surface and a convex upper surface. The uterine body was relatively short. The cornua of uterus were intimately united in their caudal portions. Porjoosh *et al* (2010) also measured the length and diameter of the uterine body as 65 ± 9.4 mm ($6.5\text{cm} \pm 0.94\text{cm}$) and 65 ± 15.5 mm ($6.5\text{cm} \pm 1.55\text{cm}$), respectively. Inter-conual ligament was absent in the uterus of camel. Jarrar and Faye (2015) observed that the uterine body was relatively short 2.5 to 4 cm in length and diameter (Fig 5, 6).

The horns or cornua were varying greatly in length and the uterine body and horns were typically laid within the abdomen above the bulk of intestines. A long inter-cornual septum was formed between two horns. Horns were directed downward, forward, outward, backward, and then upward. The cranial sections diverged, forming a T-shape rather than a Y-shape with the uterine body (Fig 2, 4, 5, 6). These findings were in harmony with the findings of Novoa (1970), Tibary and Anouassi (2001) and Srikanda kumar *et al* (2003) in camel. The colour of the horn changed from light to dark purple, and the cranial free border of the horn appeared more convex than it did caudally (Fig 2, 4, 5, 6).



Fig 1. Photograph showing the oviduct entering into the uterine horn. a. ostium uterinum tubae, b. Intramural part of the oviduct, c. Uterine horn, d. Pyramid-shaped papilla, e. Oviduct and f. ovary with CL.

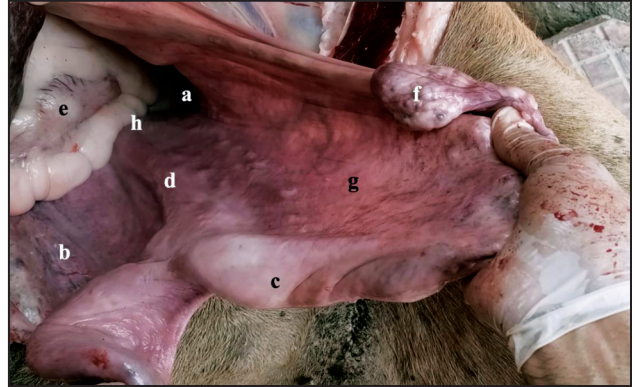


Fig 2. Photograph showing the dorsal surface of the uterus and uterine horn. a. Pelvic cavity, b. Abdominal cavity, c. Uterine horn, d. Uterine body, e. Rectum and colon, f. Left ovary, g. Broad ligament (Mesometrium) and h. Recto-genital pouch.

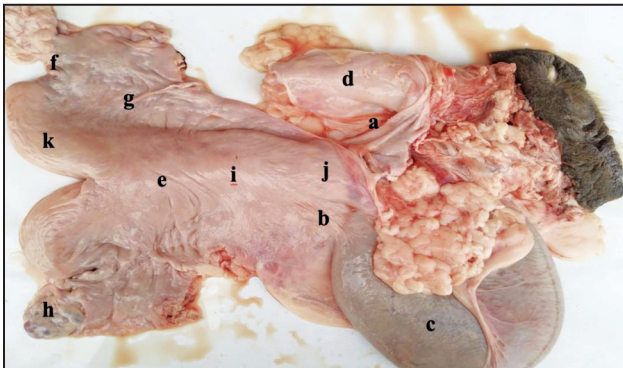


Fig 3. Photograph showing ventral surface of the uterus and uterine horn. a. Recto-genital pouch, b. Vesico-genital pouch, c. Urinary bladder, d. Rectum and colon, e. Uterine body, f. Oviduct, g. Broad ligament, h. Right ovary, i. Cervix, j. Vagina, k. Left horn and l. Right horn.

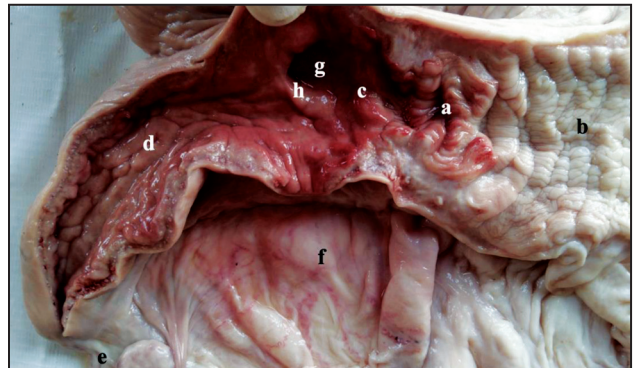


Fig 4. Photograph showing the Uterine body and horn. a. Cervix, b. Vagina, c. Body of Uterus, d. Left horn of uterus, e. Oviduct, f. Mesometrium, g. Opening of right uterine horn and h. Inter cornual septum.

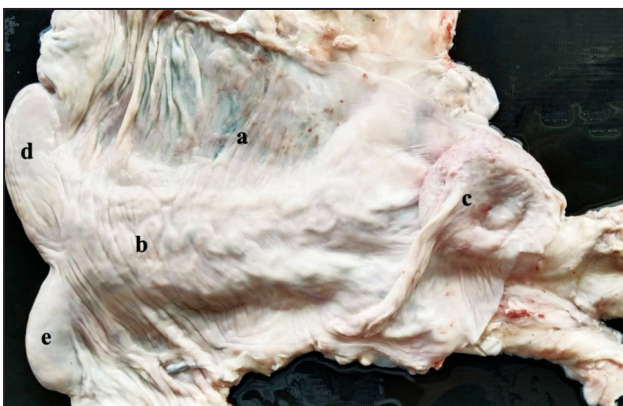


Fig 5. Photograph showing Ventral surface of the uterus. a. Mesometrium, b. Body of uterus, c. Urinary bladder, d. Left horn of uterus and e. Right horn of uterus.

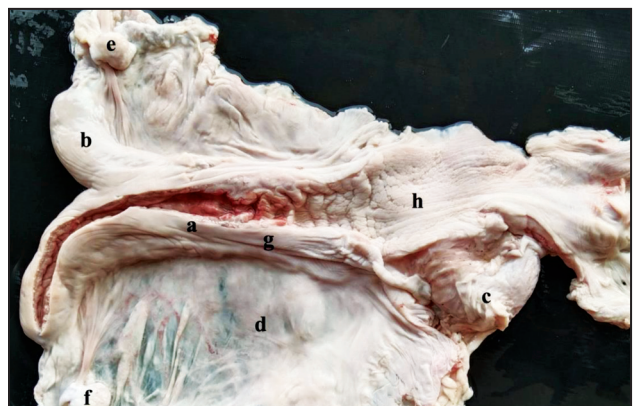


Fig 6. Photograph showing dorsal surface of the reproductive system of she-camel. a. Uterine body, b. Uterine horn, c. Urinary bladder, d. Broad ligament, e. Right ovary, f. Left Ovary, g. Cervix and h. Vagina.

The horns were likewise relatively straight, with visible utero-tubal papillae that protruded into the uterine lumen for a few millimeters and a sharp decline in breadth at their free end. Conical

or pyramidal papillae that extended into the uterine lumen appeared to represent the connections between the distal ends of the two oviduct and the uterine horns. These findings were in conformity with the

Table 1. Morphometrical measurements of the uterus of camel.

Serial no.	Left horn		Right horn		Body of Uterus	
	Length	Circumference	Length	Circumference	Length	Circumference
1.	18.50	11.00	18.50	11.00	4.00	10.00
2.	20.00	11.50	19.20	10.50	4.00	10.00
3.	18.00	8.50	13.00	7.50	5.50	12.00
4.	18.60	11.00	16.00	9.00	5.00	11.00
5.	18.00	10.00	15.00	8.00	5.50	12.00
6.	19.00	12.00	17.00	10.00	5.60	12.00
Mean	18.68	10.67	16.45	9.33	4.93	11.17
SD	0.74944424	1.251666	2.292379	1.402379	0.752773	0.983192
SE	0.30595933	0.51099	0.93586	0.572519	0.307318	0.401386

findings of Tibary and Anouassi (2001) in camel (Fig 1). The camel's uterus lacked an inter-conual ligament (Fig 1) which was favoured by the observation of Porjoosh *et al* (2010) in camel.

Comparatively, the left horn was longer than right horn. The left horn measured 18.68 ± 0.75 cm in length and 10.67 ± 1.25 cm in circumference. The right horn measured 16.45 ± 2.29 cm in length and 9.33 ± 1.40 cm in circumference. These different from those observed by Skidmore and Adams (2003) who found that the horns vary between 6 - 10 cm (right) and 8 - 15 cm (left). In Bactrian camels the right and left horns measured between 6 - 8 cm and 8 - 12 cm, respectively. These findings were in partial harmony with the Srikanda kumar *et al* (2003) that the left horn was longer than the right even in the foetus of camel. But differed in the measurements of the non-gravid uterus of a dromedary female which had horns that ranged from 60 - 100 mm (6-10cm) (right) and 80 - 150 mm (8-15cm) (left) (Table 1).

There were no caruncles in the uterine body and horn's mucous membrane (endometrium) in camels of present study which was favoured by the statement of Novoa (1970) and Ghazi (1981) in camel (Fig 4). The thickness of the uterine wall was 3 to 10 mm. The endometrium of left horn had irregularly raised longitudinal folds that were less noticeable than in right horn (Fig 4) which was also reported by Arthur *et al* (1985), Arthur *et al* (1998) and Tibary and Anouassi (2001) in camel. The inner surface was found smooth, flat, or undulating with varying degrees of endometrial fold development. It was primarily white in colour, with several prominences (endometrial folds), but in the uterine body, it was smooth. The surface showed colour variation, ranging from creamy to red, depending on its functional state. Depending on the uterus functioning state, the inner surface of the endometrium ranges in colour from

white to red and was somewhat grayish which was similar with the findings of Jarrar and Faye (2015) in camel (Fig 4).

Conclusion

The camel's uterus was a large, thick-walled, muscular organ situated at the level of the 5th, 6^h, and 7th lumbar vertebrae in the abdominal cavity, extending into the pelvic region. It exhibited a T-shaped bicornuate structure with two distinct horns, the left being longer than the right. The uterus was supported by broad ligaments composed of double folds of peritoneum, muscle fibres, and connective tissue, which also facilitated the passage of nerves and blood vessels. The uterine body, relatively short and thick-walled was connected caudally to the cervix and cranially to the oviducts, with blood supply primarily from the middle uterine artery. Notably, the uterus lacked caruncles and exhibited colour variations in the endometrial surface, ranging from white to red depending on its functional state, underscoring its specialised reproductive adaptations.

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