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Anatomy and histology of the female reproductive tract of the Arabian camel

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Abstract: One hundred and twenty normal non-pregnant and eight pregnant female camel reproductive tracts from the abattoir were examined during the months of November and December 2000. All the histological slides were stained with H & E. The camel has a bipartite uterus, which is shaped more like the letter T than the classical Y shaped bipartite uterus seen in other ruminants. The left horn was significantly ($p < 0.05$) longer (77.75 mm ± 5.58: mean ± sem) than the right horn (59.37 mm ± 2.95). The length of the uterine body was 67.56 mm ± 5.68.In all eight early pregnant tracts, the fetus were exclusively implanted in the left uterine horn. The cervix was very short (3.62 mm ± 1.32) with 4 to 5 rows of outgrowth ridges and the vagina was relatively very long (322.6 mm ± 4.21). The endometrial lining consists of a single layer of columnar epithelium supported by a broad, highly cellular connective tissue stroma with simple tubular glands. A thick layer of myometrium surrounds this endometrial tissue. The oviducts were 140-300 mm long, larger at the uterine end and opens up into the uterine horn with a distinct circular papillae like projection. The oviductal epithelium consists of a single layer of ciliated and non-ciliated columnar cells. The camel is a seasonally polyestrus induced type of ovulating animal. Decreasing length of daylight appears to be the stimulus to seasonality in camels. This can account for various ovarian structures that were seen in the ovaries that were collected during the shorter day length months of November and December. The ovaries are flattened, lobulated and each ovary is enclosed in an ovarian bursa. In the mature follicles, the zona granulosa layer is made up of several layers of cells of different sizes followed by a vascular theca interna and externa layer of cells. The histological appearances of atretic follicles vary enormously, depending on the stage of development and the progress of atresia. Large follicles (> 10mm) and small follicles (5-10 mm) were seen on 96% of the ovaries examined. The Graafian follicles were 13.55 mm ± 2.74 and the corpora lutea were 8.92 mm ± 0.54 in diameter.

Key words: camel, reproduction, anatomy, histology, ovary, and follicle.

Introduction

The Arabian camel or the Camelus dromedary is a primary inhabitant of the Middle East, along with cattle, sheep and goats. The camel is most probably a better source of food provider than cows that are severely affected by scarcity of water, poor quality feed and severe heat stress during the long summer months of the year (ElWishy, 1988). However, the exploitation of the camel's productive capability is only possible if the reproductive potential can be improved. To exploit the recent advances in techniques such as superovulation and embryo transfer (Skidmore et al., 1998), a sound understanding of the reproductive biology of the camel is essential, including an in-depth appreciation of normal anatomy and histology of the reproductive tract of this species.

Materials and Methods

In the present study, 120 normal non-pregnant and 8 early pregnant female camel reproductive tracts from the abattoir were examined for the dimensions of the reproductive tracts and the associated structures in the ovaries. All the measurements were made using a vernier caliper to the nearest mm. The length of the left and the right uterine horns were measured from the uterine bification to the tip of the uterine horn. The length of the uterine body was measured from uterine bification to the posterior end of the cervix. Also, the diameter of uterine horns and the body were measured at the mid point of each of these structures. The length of the cervix was measured from the posterior to the anterior end and the length of the vagina from the anterior end of the cervix to the tip of the vulva. The cervix was cut open to

count the number of cervical folds. The length of the oviduct was measured from the tip of the left and the right uterine horn to the ovarian end of the oviduct. In the ovaries, the number, the diameter of follicles, corpora hemorrhagicum, corpora lutea and corpora albicans were recorded. Each part of the reproductive was randomly selected, sectioned, and stained with H & E for histology. Data were analyzed through the analysis of variance using the statistical analysis system (SAS, 1993).

Results and Discussion

The gross anatomy of the reproductive tract is shown in figure 1. In contrast to the description of Arthur et al., (1986) who described a camel bicornuate uterus, the uteri in the present study were all classified as bipartite.

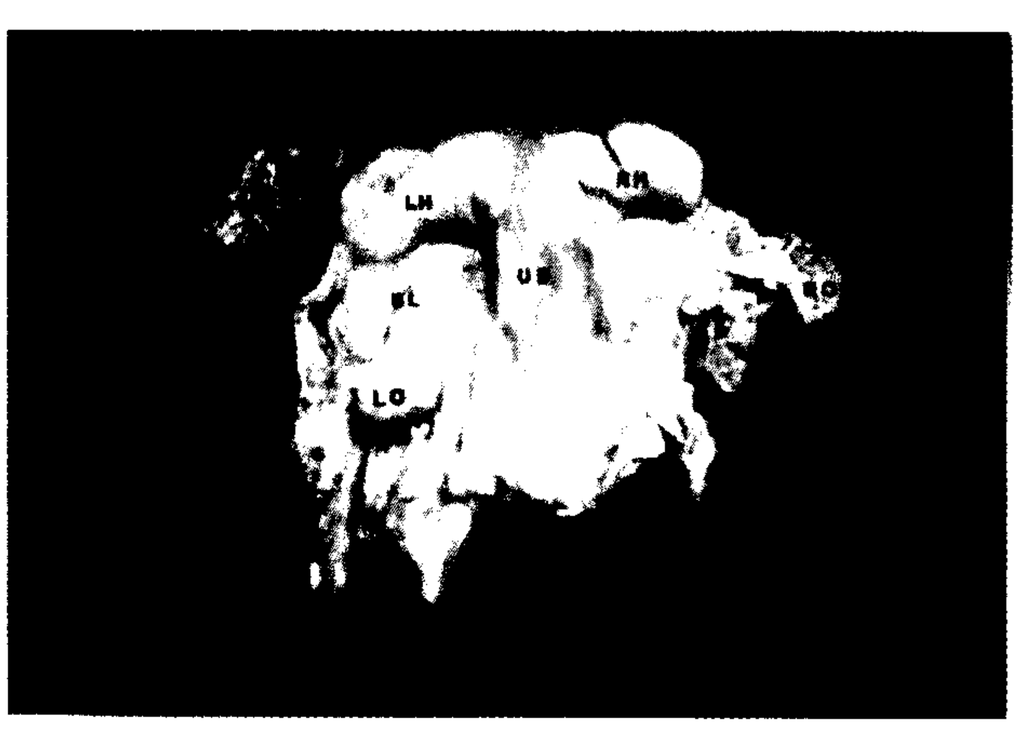

Figure 1. The gross anatomy of the non-pregnant tract of the camel.(P: papillae of the oviduct, C: uterine ridge, LH: left uterine horn, RH: right uterine horn, UB: uterine body, BL: broad ligament, LO: left ovary, RO: right ovary, F: follicle).

The camel has a bipartite uterus, which is shaped more like the letter T than the classical Y shaped bipartite uterus seen in ruminants. The left horn was significantly ($p < 0.05$) longer (77.75 mm ± 5.58) than the right horn (59.37 mm ± 2.95). The diameter of the left uterine horn (27.44 mm ± 1.79) was similar ($P > 0.05$) to the diameter of the right uterine horn (26.81 mm ± 1.72). The length of the uterine body was 67.56 mm ± 5.68 with diameter of 39.04 mm ± 2.19. From the dimensions of both the uterine horns along with the larger uterine body, it is more appropriate to call it bipartite than the classical bicornuate seen in pigs with two long uterine horns with a virtual absence of the uterine body. Arthur et al., (1986) also reported that the left uterine horn is distinctly larger than the right, even in the fetus. In all our eight early pregnant camel tracts, the fetus was solely implanted in the left uterine horn, but unlike in cattle, sheep and goats with a bipartite uterus, implantation can occur in either of the horns but not in the uterine body. ElWishy (1988) reported that 99.52 % of the pregnancy on the left horn and only 0.48 % on the right horn out of the 414 specimens examined and none in the uterine body. However, in the mare and primates, implantation occurs in the uterine body of the simplex uterus. This progressive modification of the bicornuate uterus in pigs to bipartite in cattle, sheep and goats to a simplex in mares and primates matches the reduction in the potential number of offspring's in these domestic animals (Hunter, 1982). The fact that live twin births are non-existence and the presence of a prominent uterine body in camels is further supportive of a bipartite than a bicornuate uterus. The cervix was very short (3.62 mm ± 1.32) which resembles the cervix of the cow but has 4 to 5 rows of annular mucosal folds. The vagina was very long (322.6 mm ± 4.21). The endometrial lining consists of a single layer of columnar epithelium supported by a broad, highly cellular connective tissue with simple tubular glands (figure 2).

In addition, the endometrium shows irregularly raised longitudinal uterine folds and ridges. A thick layer of myometrium surrounds this endometrial tissue.

Figure 2.Cross section of the uterine horn. (TG: simple tubular gland, CE: columnar epithelium, UF: uterine fold).

The oviducts were 140-300 mm long, larger at the uterine end and opens up into the uterine horn with a distinct circular papillae like projection (figure 1). These papillae like projection is not seen in other bipartite uterus of cattle, sheep and goats. The oviductal epithelium consists of a single layer of ciliated and non-ciliated columnar cells.

The camel is a seasonally polyestrus induced type of ovulating animal. Decreasing length of daylight appears to be the stimulus for seasonality in camels (Sghiri and Driancourt, 1999). This can account for the various ovarian structures that were seen in the ovaries collected during the shorter day length months of November and December. The ovaries are flattened, lobulated and each ovary is enclosed in an ovarian bursa. The presence of several ovarian follicles along with corpora hemorrhagicum, corpora lutea project from the main contour of the ovary during the breeding season and resembles that of the ovary of the pig (Abdalla, 1965).

In the mature follicles, zona granulosa layer is made up of several layers of cells with different sizes followed by a vascular theca interna and externa layers of cells (figure 3).

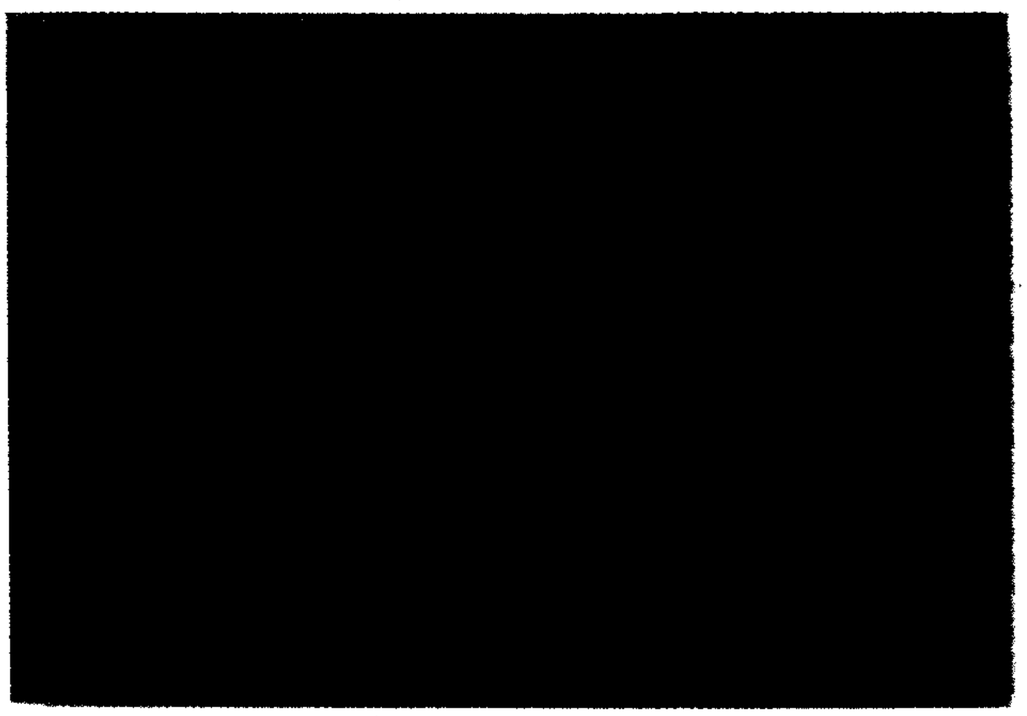

Figure 3. Cross section of a large follicle > 10 mm in diameter. (TC: thecal cells, GC: granulosa cells, CR: cumulus oophorus, SO: secondary oocyte).

The histological appearances of atretic follicles vary enormously, depending on the stage of development and the progression of atresia. Large follicles (> 10mm) and small follicles (5-10 mm) were seen on 96% of the ovaries examined. The Graafian follicles were 13.55 mm ± 2.74 and the corpora lutea were 8.92 mm ± 0.54 in diameter. In the Graafian follicle or the pre-ovulatory follicle (figure 4), the secondary oocytes was detached from the granulosa cell layers and the visibility of chromosomes in the secondary oocytes and the presence of polar body indicated that meiosis1 was completed.

Figure 4. Cross section of a pre-ovulatory follicle. (GC: granulose cell layers, TC: thecal cell layers, SO: secondary oocytes, PB: polar body).

The corpora hemorrhagicum (figure 5) was filled with blood and being infiltrated with luteal tissue and blood vessels along with a thick follicular wall.

Figure 5. Cross section of a post-ovulatory follicle > 10 mm in diameter. (CH: corpus hemorrhagicum , BV: blood vessel, FW: follicular wall).

For further information on the ovarian dynamics during various stages of the estrous cycle were well documented by Al-Eknah (2000).

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