Global Veterinaria 11 (4): 372-376, 2013
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2013.11.4.7683

# Prenatal Morphological Development of the Ovary in Dromedary Camel (*Camelus dromedaries*)

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**Abstract:** The knowledge of ovarian morphology and morphometry is useful in understanding reproductive cycles and/or malformations of external genitalia. Most of the published studies on prenatal ovarian morphology and morphometry are on small samples and limited to specific ages. The present study was planned to establish a base-line data on the normal prenatal morphology of ovary of dromedarian camel in Egypt. A total number of eighty one female embryos and fetuses of the one humped camel were collected from Cairo slaughter house. The collected specimens were classified into groups representing the progressive stages of development from the 3rd to the 13th month of gestation. The position of the fetal ovaries was abdominal during the third, fourth and fifth months and became pelvic during the sixth up to the thirteenth month of gestation. The shape of the gonads and ovaries varied from oval, circular or bean shaped during the 3rd month, to circular or kidney shaped at later stages (fourth to 13th month). Irregular shape ovaries could be found in camel fetuses during the last 3th months of the gestation period (11th, 12th and 13th months). The two ovarian surfaces showed shallow grooves at the 5th month of fetal age. These grooves gradually increased in number and depth with fetal age and might involve the whole thickness of the cortex during the tenth month. Vesicular follicles, less than 5 mm diameter were first observed during the eleventh month. The largest follicular diameter was 6.5mm, in ovaries of camel fetuses with 120cm C.V.R. length (thirteen months aged fetuses). Corpora lutea were never demonstrated in the examined specimens. Ovarian weight and dimensions were recorded. It was concluded that this study form an initial database for camel which may be helpful in the subsequent studies.

**Key words:** Dromedary · Ovary · Prenatal · Anatomy

## INTRODUCTION

Camel is an important component of the desert ecosystem from time immemorial and is recognized as the "Ship of the desert". Humans depend on this animal not just for meat, milk and hide, but also as one of the most important mode of transport in the desert. The genus Camelus has two species, one humped camel found in Africa, Arabia, Iran, Afghanistan and India and two-humped camel found in Central Asia reaching up to Mongolia and Western part of China. Investigations have been carried out to reveal some aspects of the physiological and anatomical mystery of camels in attempt to improve their productive efficiency [1].

Infertility was attributed to embryonic mortality and anatomical abnormalities of reproductive system of dromedary [2,3]. The biometric study of the anatomical structure of the female reproductive tract provides a very useful tool in the understanding of several physiological and reproductive phenomena in an animal. Such a study provides the scientific basis for the proper understanding and identification of any abnormality in the reproductive tract of the camel [4-6]. Congenital abnormalities can also be easily recognized with the aid of the knowledge of the biometry of these organs.

Research work on the morphology, gross and developmental anatomy of ovary of dromedarian camel [7-9] has been reported in different countries by many

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researchers. Despite the importance of the ovary for reproduction through the production of oocytes and the secretion of female sex hormones, its development during embryogenesis remains poorly understood. Moreover, information on prenatal morphological development of camel ovary is lacking [10-12].

The present study was planned to establish a base-line data on the anatomy and normal dimensions of fetal ovary of dromedarian camel in Egypt.

## MATERIALS AND METHODS

**The Collected Specimens:** A total number of eighty one female embryos and fetuses of the one humped camel were collected from Cairo slaughter house. Breeding history was not available. The sex was determined from the external genitalia and the specimens of the early stages of development could not be differentiated grossly. The collected specimens covered most of the de-velopmental stages (5-120 cm Crown Vertebral Rump, C.V.R.). The C.V.R. was measured from the start point of the fore-head up to the base of the tail along the dorsum of the fetus. Fetal age was determined according to the formula given by El-Wishy *et al*. [13]:

$$\text{Fetal age in days} = \frac{\text{C.V.R. (cm)} + 23.99}{0.366}$$

**Ovarian Measurements:** As soon as the uteri were removed from the carcasses, the embryos and fetuses were freed from their fetal membranes. The abdominal cavity of each fetus was evacuated, the two ovaries were examined *in situ*, the site and relation were recorded. The ovaries were removed and freed from extraneous tissue. The weight of each ovary was recorded by using an electric sensitive balance to the nearest 0.001 g. The shape of the ovary was recorded. A Varnier caliber was used for recording the following measurements to the nearest 0.001 cm.

**Length:** The distance between the 2 poles.

**Breadth:** The distance from the mesovarium border to the free one.

**Thickness:** Measured from medial to lateral surface.

The sum of the 3 measurements was divided by 3 and was taken as the average diameter of the ovary [2,3]. The available specimens were classified, macroscopically, into groups taking in consideration the position of the gonad and the appearance of the different structures. These groups are:

**Group I:** 25 specimens ranged from 9.5 cm to 29 cm C.V.R.
**Group II:** 25 ranged from 29.5 cm to 49 cm C.V.R.
**Group III:** 11 ranged from 49.5 to 69 cm C.V.R.
**Group IV:** 9 ranged from 69.5 cm to 89 cm C.V.R.
**Group V:** 8 ranged from 89.5 cm to 109 cm C.V.R.
**Group VI:** 3 specimens were obtained with 120 cm C.V.R.

The mathematical mean and standard deviation were calculated for each measurement [14].

## RESULTS AND DISCUSSIONS

Three forms of the gonad were grossly observed in the camel embryos which could not be sexually determined. These forms were oval, circular or bean shaped. The last two forms were usually met with in older ages, El-Ghannam and El-Naggar [15] described the ovaries of buffalo fetus during the third month of ges-tation, as oval, or spindle shaped symmetrical thickening, cranial to the anterior end of the differentiating Mullerian ducts and attached to the caudolateral border of the kidney.

The ovaries of camel fetuses during the fourth and fifth month of gestation (9.5-29.5 cm C.V.R.L.) were circular or bean shaped with two convex smooth surfaces, rounded free border and nearly straight attached one. These findings are in partial agreement with those men-tioned by Abdin [7] and El-Tayeb [8] who recorded the discoid shaped ovaries of camel fetuses with 8.3 to 35 cm C.V.R.L. changed to pyriform or kidney shaped in those with C.V.R.L. more than 35 cm up to 117 cm.

The ovaries of camel fetuses during the end of fifth months (29.5 cm C.V.R.L.) were noticed to the marked by fine shallow grooves. These grooves became prominent and increased in number and depth as development proceeded.

Some grooves were very deep involving the whole thickness of the cortex of the ovary during the ninth and tenth months (69.5-89.5 cm C.V.R.L.). At late stage of development (120 cm C.V.R.L.), the deep invaginations were also noticed. These findings were in accordance with those reported by George and Fahmy [16], Abdin [7] and El-Tayeb [8]. They observed these grooves on the ovarian surfaces of camel fetuses to be increased in

number and depth with the age. However the first authors added that these grooves, at late stage of development (32-36 weeks) are shallower and some of them disappeared. The appearance of these grooves, on the ovarian surfaces of camel fetuses which increased in number and depth with increasing age might be attributed to the unequal rate of growth of the cortex and medulla by different degrees at different ages.

The ovaries of camel fetuses with 89.5 to 120 cm C.V.R.L. (fifth and sixth stages), were circular or kidney shaped. These forms were subjected to much irregularities due to the presence of vesicular follicles on the ovarian surfaces and borders giving the ovary its irregular shape. Follicles with less than 5 mm diameter were usually noticed at these stages of development. The largest follicular diameter was 6.5 mm in ovaries of fetuses with 120 cm C.V.R.L. Follicles with follicular cavities were reported in ovaries of camel fetuses at late stages of development regardless the methods used for estimation of age [16,7,8]. The latter author reported the presence of follicles with less than 5 mm diameter in ovaries of camel fetuses with 94 cm C.V.R.L. Abdin [7] added that these follicles were noticed at an earlier fetal age. The present findings were in accordance with the result reported by George & Fahmy [16], Abdin [7] and El-Tayeb [8], that the antral follicles are observed in ovaries of camel fetuses at late stages of pregnancy. Although species differences in the timing of specific events are found in the formation of ovarian follicles [17-19], the overall chronology of developmental events that culminate in the formation of primordial follicles appears to be similar in all mammals.

In bovine fetal ovaries, Erickson [20] observed the presence of vesicular follicles in fetuses aged 250 days, the same author added that by 270 days postcoitum, the ovary in one instance becomes a mass of vesicular follicles. Vesicular follicles were met with in ovaries of buffalo fetuses with 60 to 90 cm C.R.L. [21] and with eight to tenth month [15]. Corpora lutea were not demonstrated in any of the examined specimens. The previous authors also reported the absence of corpora lutea in fetal ovaries of the aforementioned species of animals.

The position of the ovaries of camel fetuses varied according to the stage of development. They were first observed in the sublumbar region, medial to the meso-ephros, 5-9.5 cm C.V.R.L. (third month of gestation). During the fourth month (14.5 cm C.V.R.L.), the fetal ovaries were noticed on the visceral surface of the permanent kidney. By the end of the fourth month, the ovaries were still abdominal in position, located lateral to the outer border of the kidney (19.5 cm C.V. R.L.). During the fifth month of gestation (24 to 29.5 cm C.V.R.L.) the ovaries were observed near the entrance of the pelvic inlet. The final pelvic position of the fetal ovaries were demonstrated in fetuses during the sixth month of gestation (32.5 cm C.V.R.L.), up to the thirteenth month of gestation (120 cm C.V.R.L.). They were located caudal to the posterior border of the kidney. These observations were nearly similar to that reported by El-Tayeb [8] who mentioned that the fetal ovaries of camel, are either abdominal, abdominopelvic or pelvic in position, in fetuses with 8.3-16 cm, 18-28.5 cm or 30.5-117 cm respectively. In this respect El-Hagri [22] stated that the fetal ovaries in domestic animals are situated like the fetal testes, in the sublumbar region, close to the kidneys but they gradually migrate caudally in some species reaching to the pelvic inlet.

The weight and different dimensions of the ovaries of camel fetuses at different stages of development are shown in tables (1 and 2). The great increase in the weight that was observed at late stages of development, may be attributed to the appearance of vesicular follicles (stages 5 & 6). Similar findings were reported by Abdin [7] in ovaries of camel fetuses, who mentioned that the great increase in the average ovarian weight and size occurs from 36 weeks up to the time of birth. On the contrary, El-Tayeb [8] stated that the ovaries of camel fetuses develop at a higher rate in early stages than at later stages. The left ovary was found to be a little heavier than the right one. This was in accordance with that reported by Abdin [7], but differ than what recorded by El-Tayeb [8] who mentioned that the right ovary is insignificantly heavier than the left one.

The ovarian weight of buffalo fetuses is proportionally correlated with the age of the fetuses [15]. The former authors pointed out that the left ovary is insignificantly heavier than the right one. Erickson [20] recorded the great increase in the bovine fetal ovaries at later stages of development; 270 days and eighth to ninth month respectively. The first author attributed this increase in the weight of bovine fetal ovaries to the development of vesicular follicles.

In conclusion, the findings of this study form an initial database for camel which may be helpful in the subsequent studies. So ovary differentiation by molecular markers to identify early ovarian genes in addition to histological and immunohistochemical study must be performed specially in camel.

Table 1: Relation between C.V.R. length of camel fetuses and ovarian weight.

| Group No. | C.V.R.range (cm) | L.ovary weight (mgm) | R.ovary weight (mgm) | Mean weight of the 2 ovaries (mgm) | No. of specimens |
|---|---|---|---|---|---|
| I | 9.5-29.5 | 37.52±9.47 | 36.56±9.84 | 37.04±9.57 | 25 |
| II | 29.5-49.5 | 66.0±12.86 | 63.64±11.42 | 64.82±11.98 | 25 |
| III | 49.5-69.5 | 119.82±13.91 | 114.55±16.78 | 117.18±15.17 | 11 |
| IV | 69.5-89.5 | 176.78±24.80 | 176.0±26.59 | 176.39±25.39 | 9 |
| V | 89.5-109.5 | 220.25±35.24 | 215.63±29.40 | 217.94±31.84 | 8 |
| VI | 120 | 640.0±158.75 | 613.33±162.58 | 626.66±152.51 | 3 |

Table 2: Relation between C.V.R. length of camel fetuses and ovarian dimensions.

| | L. ovary measurement (mm) | | | | R. ovary measurement (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| C.V.R. range (cm) | L. | Br. | Thick | L. average diameter | L. | Br. | Thick | R. average diameter | No. of specimens |
| 9.5-29.5 | 4.94± 0.95 | 3.41±0.60 | 2.83±0.62 | 3.72±0.66 | 4.82±1.02 | 3.44±0.74 | 2.8±0.56 | 3.68±0.72 | 25 |
| 29.5-49.5 | 7.25±1.03 | 5.32±0.86 | 4.20±0.66 | 5.59±0.79 | 7.02± 0.92 | 5.13±0.66 | 4.22±0.68 | 5.46±0.70 | 25 |
| 49.5-69.5 | 9.10± 0.47 | 6.66±0.51 | 4.80±0.57 | 6.85±0.40 | 8.61± 0.60 | 6.45±0.74 | 4.83±0.48 | 6.63±0.47 | 11 |
| 69.5-89.5 | 9.56± 0.33 | 7.20±0.50 | 4.61±0.77 | 7.16±0.21 | 9.36±0.39 | 7.18±0.44 | 4.91±0.61 | 7.13±0.19 | 9 |
| 89.5-109.5 | 9.46± 0.72 | 7.05±0.27 | 5.68±0.35 | 7.40±0.41 | 9.28±0.43 | 7.04±0.38 | 5.85±0.42 | 7.39±0.37 | 8 |
| 12 | 012.67±1.53 | 9.13±0.76 | 7.80±1.06 | 9.87±1.07 | 11.67±1.53 | 9.00±0.72 | 7.53±0.64 | 9.40±0.96 | 3 |

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