Indian Journal of Animal Sciences **79** (2): 147–150, February 2009

Efficacy of vaginal electrical resistance (VER) measurement for evaluation of follicular activity in *Camelus dromedarius*

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Received: 2 April 2008; Accepted: 6 September 2008

ABSTRACT

VER was studied in female dromedary camels (n=14) concomitant to ultrasound examination at 2 days intervals to evaluate vaginal electrical resistance (VER) as an indicator of follicular activity and pregnancy. VER was recorded using a commercially available resistance probe and scanner was used for ultrasound examination. Females were mated with virile stud camels and the diameter of the follicle at the time of mating recorded. VER and ultrasound examinations were continued till day 30 after mating. Follicles of different diameters were recorded but the follicular growth wave was difficult to define. The growth of follicles in non-mated camels continued with follicles reaching up to 3.72 cm diameter. Ovulations did occur in the mated females even when the size of follicle was 0.8 cm at mating, however, only 50% of the matings resulted into ovulation when the follicle size was <1.0 cm. The use of heat detector for measurement of vaginal electrical resistance in dromedary camel did not give significantly different values, when there was no follicle, follicles with diameter < 0.5 cm, follicle with 0.8 to 0.99 cm, follicle ≥1.0 cm, corpus luteum and pregnant uterus.

Key words: *Camelus dromedarius*, Follicles, Ultrasound, Vaginal electrical resistance

The dromedary and the Bactrian camel are both regarded as seasonal breeders (Khanna *et al.* 1990, Chen and Yuen 1984). Camel is an induced ovulator, and shows no definite period of estrus as observed in other species (Musa *et al.* 1993). The existing practice of camel breeding by farmers as well as at organised farms is based on the assumption that being induced ovulator, a mature follicle is always present over the ovaries during the breeding season (Purohit and Pareek 2000). However, such assumptions are not always correct and many times a follicle if present may not be of ovulating size (Vyas and Sahani 2000). This is one of the likely reasons for conception rate of only 68% (Khanna 1995), even in organized farms where natural service is the mode of breeding. Detection of a follicle of ovulating size over the ovary therefore, appears to be an important cue to time breeding in the dromedary females. Ultrasonographic examination of the ovaries is an accurate diagnostic modality that has been experimented in many animal species and also validated for use in the female camel (Skidmore *et al.* 1996, Vyas *et al.* 2002 and 2004), however, there appears to be still many simpler diagnostic approaches for breeding management like the measurement of the vaginal electrical resistance (VER) which has well been documented in various farm animal species like cows (Aboul-Ela *et al.* 1982a, Canfield and Butler 1989, Purohit and Gupta 2000, Meena *et al.* 2003), buffaloes (Gupta and Purohit 2001a, Gupta and Purohit 2001b) ewes (Adam *et al.* 1981) and sows (Rezac *et al.* 2002, Rezac *et al.* 2003, Rezac and Olic 2006). Leidl and Stolla (1976) conducted a series of investigations on the VER of the vaginal or cervical mucus as an indicator of the optimum time for conception during the estrous cycle in cows, sheep, pigs and bitches. The measurement of VER was advocated for use in farm animals to determine the most appropriate time of insemination for improving the conception rate and fertility index (Feldman *et al.* 1978, Foote *et al.* 1979, Fossen 1990, Purohit and Gupta 2000). In many farm animals VER has been used to monitor the follicular activity (Edward and Levin 1974, Al-Obaidi and Lasson 1975, Gupta and Purohit 2001a) and diagnosis of pregnancy (Mc Caughey 1981, Kaya *et al.* 2005). Changes in electrical resistance of the reproductive tract tissues are clearly related to changes in steroid levels and sexual receptivity (Senger 1994). To the best of our knowledge, literature on the use of VER in camel is not available. The present study was undertaken with the specific objective to evaluate VER as an indicator of follicular activity and pregnancy in dromedary camels.

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MATERIALS AND METHODS

Experimental animals: During the natural breeding season (November – March), healthy non-pregnant she camels (n=14) belonging to the herd of National Research Centre on Camel, Bikaner, aged 7–11 years and having calved at least once, were selected for the experiment. The she camels were kept in loose but under standard intensive management conditions during the period of experiment.

Vaginal electrical resistance (VER) measurement: A commercially available 'heat detector' for cattle having a 36 cm probe with 2 rings electrode and a plastic body was used for vaginal electrical resistance measurements. VER was measured at 2 days intervals before ultrasound examination on the same days. The she-camel was restrained as described earlier for ultrasound examination (Vyas and Sahani 2000). The VER was recorded as per Gupta and Purohit (2001a).

To avoid transmission of infective agents, the probe was cleaned with lukewarm water and disinfected with 1.0% chlorhexidine solution after each investigation. Then the probe was cleaned with running tap water. After investigating many animals each day, the electrodes were finally cleaned with 70% alcohol.

Females were mated with virile stud camels when the size of follicle was observed to be ≥0.8 cm. VER was recorded up to 30 days post mating irrespective of whether or not the females became pregnant.

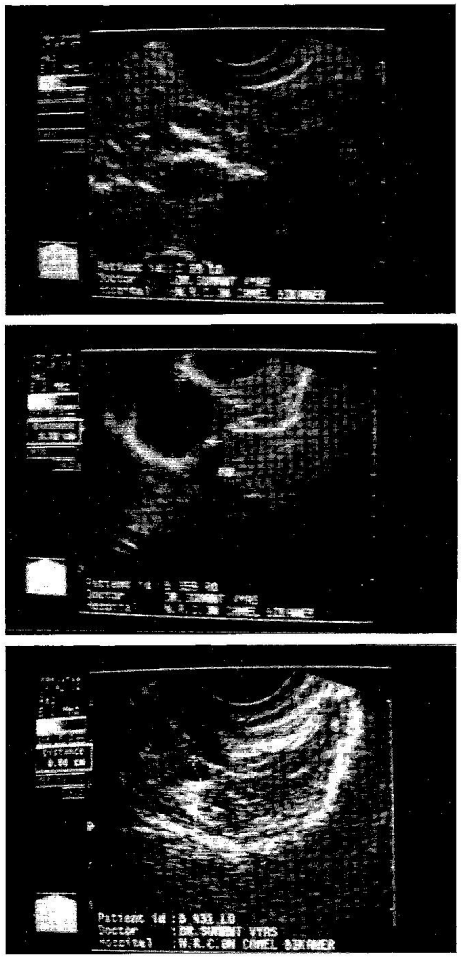
Ultrasound examination: The endo-vaginal, mechanical and annular array sector probe of dual frequency (5 MHz, 7.5 MHz) was used for ovarian examination. Ultrasound examination of internal genitalia was attempted in sitting position (Vyas and Sahani 2000). All follicles ≥0.5 cm in diameter and corpora lutea present on both ovaries were counted and measured using the internal electronic calipers. The observations were carried out by the same operator, recorded on a videotape with the help of videocassette recorder interfaced with the scanner, and were subsequently reviewed to monitor the status of ovaries and the structures present therein.

Pregnancy was assessed by evaluating ultrasonograms recorded using a transrectal probe (5.0–7.5 MHz) on day 18, 20, 23 and 30 day post mating.

Statistical analysis: The data obtained from the study undertaken were statistically analysed. The mean, standard error, and ANOVA were calculated using standard methods suggested by Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

During the present study, follicles of different diameters were seen, however, distinct follicular growth waves as seen in other farm animals were difficult to define. There was periodic increase in the number of follicles observed (Fig. 1). Growth patterns of a dominant follicle depended upon whether or not the dromedaries were mated. In non-mated animals the follicles continued to grow to reach size even up to 3.72 cm (Fig. 2). Ovulations did occur in mated females even when the size of a mature follicle was 0.8 cm on the day of mating (Fig. 3). However, only 50% of the matings resulted into ovulation when the follicle size was <1.0 cm. The life span of the corpus luteum in non-pregnant females ranged from 6–9 days (7.2±0.8 days).



Figs 1–3. **1.** (*top*) Ultrasonogram of a female camel showing small growing follicles on the right ovary. **2.** (*middle*) Ultrasonogram of a non-mated female camel showing a large dominant follicle (3.72 cm) **3.** (*bottom*) Ultrasonogram of a female camel showing a follicle (0.8 cm) on the day of mating

Table 1. Utero-ovarian observations and vaginal electrical resistance (VER) in she camels

Utero-ovarian findings	n	VER (mean±SE)
NF	67	37.36±0.18
F < 0.5 cm	6	37.0±0.54
F 0.5 to 0.79 cm	15	36.96±0.36
F 0.8 to 0.99 cm	7	37.42±0.59
F< 1.0 cm	4	37.12±0.72
CL	10	36.75±0.42
GU	7	37.14±0.54
Overall mean	116	37.11±0.19

NF, No follicle; F, follicle; CL, corpus luteum; GU, gravid uterus.

The follicular growth wave was difficult to define during the present study as has been described for cows (Gaur and Purohit 2007) although periodic increase in the number of follicles was seen but a distinct pattern was not discernible. In previous studies in camel it has been seen that there is a strong negative association between the number of follicles and the diameter of the largest follicle (Skidmore *et al.* 1996). The characteristics of the mature follicle size dimensions in the mated and non-mated females observed during the present study are nearly similar to previous findings (Skidmore *et al.* 1996, Nagy *et al.* 2005). However, spontaneous ovulations without mating as observed by Nagy *et al.* (2005) were not recorded during this study. Skidmore *et al.* (1996) had observed ovulations to occur in mated dromedaries even when the follicle size was 0.9 cm and recommended that the best time to mate females is when the follicle varies between 1.0–1.4 cm in diameter and nearly similar observations have been recorded during the present study.

The VER recorded had poor correlation with the ovarian and uterine findings. The ovarian structures and uterine observations were classified into 7 different groups and the mean±SE values of vaginal electrical resistance for that group calculated. The results are presented in Table 1.

It was revealed that the use of "Heat Detector" for measurement of VER in dromedary camel did not give significantly different values, when there was no follicle, follicles with diameter < 0.5 cm, follicle with 0.8 to 0.99 cm, follicle ≥ 1.0 cm, corpus luteum and pregnant uterus. Gupta and Purohit (2001a) noticed in buffaloes that the VER was low when a graafian follicle was developing and lowest when a mature graafian follicle was palpable, the VER was highest when smooth ovaries (no follicle) are palpable and higher when a mature corpora lutea was present. Similar correlation between a decline of VER and the presence of developing and mature follicle was established in cows (Al-Obaidi and Lasson 1975, Foote *et al.* 1979, Meena *et al.* 2003). These findings are contrary to the results of present study. However the present findings are in accordance with the results of Cavenstany and Foote (1985) who observed no major decline in the electrical resistance at the time of estrus in cow.

Feldmann *et al.* (1978) stated that the increased electrical conductivity (and hence decreased resistance) during estrus is probably due to congestion of the blood vessels and the edema, which appear in the stroma of the vestibule at that period. Whole blood has a lower specific resistance, as measured with alternating currents, than does tissue (Cole 1930). The electrical conductivity in the vestibule increased when hyperaemia was induced experimentally by heating the labia (Aizinbudas *et al.* 1972). The changes in VER have generally been attributed to the increased hydration of the mucus or the electrolytes (Aboul-Ela *et al.* 1982b). Ezov *et al.* (1990) described the changes in cell density, fluid volume, and electrolyte content of bovine vulvar tissue during estrus and diestrus. The net effect of these changes was that the vulvar mesenchymal tissue was 74% heavier during estrus than during diestrus because of tissue hydration. They speculated that the reduced vaginal impedance could be the result of tissue swelling. Since the hydration changes in the vagina of a female camel are not marked (Joshi 1972) probably therefore, there was no appreciable difference observed during the present study in the VER during different stages. In the present study also, mucus discharge was not seen and hyperaemia and swelling of vulva was also absent even when a mature follicle was present. These factors together could be attributed for the insignificant difference in the values of VER observed under various utero-ovarian conditions in the present study. It appears from the present findings that commercially available 'heat detector', which measures VER is not suitable to elicit information about presence or absence of follicles and corpus luteum over the ovaries and pregnancy in she camels.

ACKNOWLEDGEMENT

Authors would like to thank Director, National Research Centre on Camel, Bikaner for providing facility to carry out this study. The technical help rendered by Shri Nand Kishore T.O., N.R.C. on Camel is also thankfully acknowledged.

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