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Short Communication

Comparison of the patterns of antral follicular development between hormonally synchronized and natural estrous cycles of non-seasonal, polyestrous goats in the tropics

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ARTICLE INFO

Article history:
Received 29 June 2011
Accepted 20 February 2012

Keywords:
Goats
CIDR
$PGF_{2\alpha}$
Ultrasonography
Follicular waves

ABSTRACT

The effects of estrus synchronization with prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) and Controlled Internal Drug Release Device (CIDR) on ensuing antral follicular development were documented and compared to natural estrous cycles of non-seasonal tropical goats. Two to six follicular waves were observed, with the three-follicular wave pattern being most frequently observed (58%), followed by four follicular waves (31.6%) per estrous cycle. There were no significant differences ($p > 0.05$) between the $PGF_{2\alpha}$- or CIDR-synchronized and natural estrous cycles nor between the synchronized and subsequent non-synchronized cycles in terms of the time of ovulation, the duration of inter-ovulatory intervals, daily numbers of antral follicles ≥3 mm in diameter, and the number of follicular waves per cycle in the goats of the present study.

1. Introduction

The application of serial transrectal ultrasonography for studying antral follicular growth and regression in goats have vastly contributed to the development of estrus synchronization protocols aimed at improving the efficiency of caprine reproduction [1,2]. Almost all ultrasonographic studies of ovarian follicular development were conducted in seasonally polyestrous goats maintained at high altitudes and in temperate climates (>35° latitude [1–5]) while 90% of the world's goat population can be found in tropical and subtropical regions [6].

Unlike in the seasonal breeders, progesterone secretion in non-seasonal, polyestrous goats is not affected by the time of the year and photoperiod [7]. In a recent study of ovarian dynamics in cyclic sheep, it was shown that progesterone was the key regulator of circulating FSH concentration and determined the number of antral follicular waves per estrous cycle [8]. However, there has been no ultrasonographic study of the wave pattern of follicular development during natural or synchronized estrous cycles in non-seasonal, polyestrous

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1642-431X/$ – see front matter
http://dx.doi.org/10.1016/j.repbio.2012.09.004

goats in the tropics. Therefore, this study was conducted to describe the effects of estrus synchronization with Controlled Internal Drug Release Device (CIDR) or prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) on the post-treatment pattern of follicular development in goats acclimatized to hot and humid tropical conditions.

2. Materials and methods

Twenty-four multiparous, Boer × feral does (3–4 years, mean body weight: 35 ± 2.7 kg) were used in the present study. A median body condition score (BCS) of the goats was three out of five [9]. The goats were raised at a goat farm in Kuang, Malaysia (latitude: 3°15′0″N; longitude: 101°32′59″E). The ambient temperature and relative humidity during the experiment (February to April 2009) ranged from 20 to 35 °C and 67 to 83%, respectively. The goats were fed spent soy bean pulp and palm leaf silage supplemented with commercial pellets to achieve a daily food intake of about 3% of their bodyweight. Water and salt licks were provided *ad libitum*. The total feed given contained 16% crude protein and 10 MJ/kg metabolizable energy.

Animals were divided equally into three groups: $PGF_{2\alpha}$-synchronized group (A), CIDR-synchronized group (B) and control group (C). In group A, estrus was synchronized with two intramuscular injections of 125 μg cloprostenol (Estrumate™, Schering-Plough, Australia) given 11 days apart [10]. In group B, the goats were synchronized with CIDR (EAZI-BREED™, New Zealand), which contained 0.3 g progesterone, and was left in place for 17 days [11]. Non-synchronized estrous cycles immediately following the $PGF_{2\alpha}$ and CIDR-synchronized estrous cycles were also studied. Goats in group C were not synchronized but their natural estrous cycles were monitored with ultrasonography. For these goats, transrectal ovarian ultrasonographic examinations were performed once daily between 0800 and 1200 h until a complete estrous cycle of normal length (19–22 days) was recorded. As for groups A and B, ultrasonographic monitoring of ovarian follicular development commenced 24 h after the second $PGF_{2\alpha}$ injection or CIDR withdrawal, respectively. Ultrasonography utilized a real-time B-mode ultrasound scanner (Aloka, 500 SSD, Japan) equipped with a transrectal 7.5-MHz linear array probe (UST-660-7.5 model). The diameter of all follicles ≥3 mm were measured using the built-in electronic callipers. Ovulation was considered as the collapse of a large pre-ovulatory follicle ≥5 mm in diameter followed by detection of a corpus luteum, while the inter-ovulatory interval was the number of days that elapsed between two successive ovulations [3]. A follicular wave was defined as two or more follicles that emerged within 48 h and grew to at least 5 mm in diameter before regression or ovulation [2,3].

Ultrasonographic data were combined for both ovaries and averaged for each goat. Data from one goat in group A was excluded from the analysis because it had a short estrous cycle of 15 days. The time from the end of the treatment to ovulation, the duration of inter-ovulatory intervals, the maximum diameter of the pre-ovulatory follicle, and the daily number of follicles were analyzed using repeated measures analysis of variance (RM-ANOVA) and Duncan's test to compare individual mean values. Chi-square analysis was used to compare the proportion of follicular waves among the synchronized, the ensuing estrous cycles, and the control group. The SPSS statistical software (SPSS Inc., version 17) was used for all analyses. The differences were considered to be statistically significant at $p < 0.05$.

3. Results and discussion

The time from the end of treatment to ovulation, the duration of inter-ovulatory intervals, mean pre-ovulatory follicle diameter and daily number of follicles recorded during the inter-ovulatory intervals studied are summarized in Table 1. None of the parameters differed ($p > 0.05$) among the groups nor between the synchronized and subsequent cycles of animals in groups A and B, except for the mean maximum diameter of the pre-ovulatory follicles which was greater in the CIDR-synchronized estrous cycles and in the estrous cycles subsequent to the $PGF_{2\alpha}$-synchronized cycles. In a previous study, it was shown that the ovulatory follicle was the largest pre-ovulatory follicle present on the ovary of goats at the time of luteolysis [4]. According to Menchaca et al. [1], the serum concentration of progesterone on the day of CIDR insertion (day 1) was 4.1 ± 1.1 ng/ml but by day 5, the concentration decreased to 1.8 ± 1.8 ng/ml. The prolonged exposure to sub-luteal progesterone concentration in the remaining 12 days of CIDR treatment prolonged the lifespan and extended the dominance of the largest follicle [12]. The latter observation may explain the larger diameter of

Table 1 – Time to ovulation and follicular characteristics (mean ± SEM) during $PGF_{2\alpha}$- (A) and CIDR-synchronized (B) estrous cycles, subsequent natural cycles and the natural estrous cycles (C) of goats.

Variables	Type of estrous cycle				
	Group A ($n = 7$)		Group B ($n = 8$)		Group C ($n = 8$)
	Synchronized	Subsequent natural	Synchronized	Subsequent natural	
Time to ovulation from the end of treatment (h)	91.2 ± 4.8	–	86.4 ± 7.2	–	–
Interovulatory interval (days)	18.7 ± 0.4	19.0 ± 0.7	18.7 ± 1.1	19.8 ± 1.1	19.5 ± 1.4
Maximum diameter of the preovulatory follicle (mm)	6.7 ± 0.2[a]	9.1 ± 0.4[b]	7.6 ± 0.5[b]	7.1 ± 0.4[a]	7.3 ± 0.5[a]
Daily number of follicles	1.8 ± 0.1	1.8 ± 0.1	1.6 ± 0.1	1.7 ± 0.1	1.6 ± 0.1

Values with different superscripts within rows denote statistical significance ($p < 0.05$).