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Changes in the ovarian dynamics and endocrine profiles in goats treated with a progesterone antagonist during the early luteal phase of the estrous cycle

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Abstract

The aim of the present study was to determine the physiological role of endogenous progesterone in the regulation of ovarian dynamics, gonadotropin and progesterone secretion during the early luteal phase in the goat. Cycling Shiba goats received subcutaneously a vehicle (control group, $n = 5$) or 50 mg of RU486 (RU486 group, $n = 4$) daily from 1 to 7 days after ovulation (day 0) determined by transrectal ultrasonography. Ovarian dynamics were monitored by the ultrasonography and blood samples were collected daily until the subsequent ovulation for analysis of progesterone, luteinizing hormone (LH) and follicle stimulating hormone (FSH) secretion. Blood samples were also collected at 10 min intervals for 6 h on day 3 and day 7 for the analysis of pulsatile patterns of LH and FSH. The LH pulse frequency was significantly ($P < 0.05$) higher in the RU486 group than in the control group on day 7 (4.8 ± 1.1 pulses/6 h versus 1.2 ± 0.4 pulses/6 h). The shape of the FSH pulses was unclear on day 3 and day 7 in both groups and the overall means of FSH concentration for 6 h on day 3 and day 7 were not significantly different between the RU486 and the control groups. The pattern of daily FSH concentrations showed a wave-like fluctuation in both groups. There was no significant difference in the inter-peak intervals of the wave-like pattern of daily FSH secretion between the RU486 and the control groups (4.1 ± 0.6 days versus 4.5 ± 0.6 days). The maximum diameter of the largest follicle that grew from day 1 to day 7 in the RU486 group tended to be greater than that in control goats (6.4 ± 0.8 mm versus 5.0 ± 0.8 mm, $P = 0.050$), whereas no significant difference was detected in the size of the corpus luteum and progesterone concentrations between the control and RU486 groups on almost all days during the treatment period. These results indicate that the rise of the progesterone concentration suppresses the

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pulsatile LH secretion and follicular growth, whereas progesterone has no physiological role in the regulation of FSH secretion and luteal function during the early luteal phase of the estrous cycle in goats.

Keywords: Progesterone; LH; FSH; Ovarian dynamics; Goats

1. Introduction

The adequate secretion of progesterone plays an important role in the achievement of a successful pregnancy and in the regulation of the estrous cyclicity in females. Several lines of evidence have revealed that changes in the circulating progesterone level influence endocrine function during the estrous cycle. For example, the rise in the peripheral level of progesterone inhibits gonadotropin secretion by suppressing the hypothalamic gonadotropin-releasing hormone (GnRH) release through the negative feedback system in cows (Walters et al., 1984; Imakawa et al., 1986) and ewes (Karsch et al., 1987; Skinner et al., 1998).

Previous studies have indicated that progesterone action during the early luteal phase modulates the life-span of the corpus luteum in ruminant species. In cows (Burke et al., 1994) and ewes (Ottobre et al., 1980), exogenous progesterone treatment in the early luteal phase shortened the inter-estrous intervals by activating the uterine release of prostaglandin $F_{2\alpha}$ from the endometrium. On the other hand, the treatment with the progesterone antagonist during the early luteal phase after estrus prolonged the length of the estrous cycle in the ewe (Morgan et al., 1993; Paslay et al., 2003). However, the physiological role of progesterone in the regulation of the endocrine system as a circulating and a local regulator remains to be clarified. There was no positive correlation between the number of the pulse frequency of follicle stimulating hormone (FSH) and the plasma concentrations of progesterone during the luteal phase in ewes (Bartlewski et al., 2000) and cows (Walters et al., 1984). In contrast, a previous study has demonstrated that the pattern of daily FSH secretion is wave-like in ewes (Ginther et al., 1995) and goats (Medan et al., 2003), and the mean values of daily FSH tended to increase in the early luteal phase (0–5 days after ovulation), but not thereafter in ewes (Ginther et al., 1995). *In vitro* studies (Skarzynski and Okuda, 1999) and a review (Skarzynski et al., 2001) reported that the secretion of progesterone from the bovine early luteal cell cultures was reduced after treatment with a specific progesterone antagonist, indicating the possibility that progesterone itself stimulates progesterone release from the early corpus luteum in an autocrine and paracrine fashion in cows.

The purpose of the present study was to determine the involvement of endogenous progesterone in the peripheral concentration of gonadotropins, ovarian steroids and their associations with follicular and luteal dynamics during the early luteal phase of the estrous cycle. Our approach was to examine hormonal profiles (luteinizing hormone (LH), FSH and progesterone) and ovarian responses monitored by ultrasonography in goats treated with the progesterone antagonist, RU486 (mifepristone), from 1 to 7 days after ovulation.

2. Materials and methods

2.1. Animals

Long-term ovariectomized Shiba goats and female Shiba goats with regular estrous cycles were used for the preliminary study and the main experiment, respectively. Shiba goats are non-seasonal