Abstract

Effects of intravaginal progesterone on follicular dynamics and FSH, LH and progesterone concentrations in transitional mares

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1. Introduction

The imposed start of the breeding season commences when most non-pregnant mares are still in the transitional phase from winter anestrus, to normal, regular estrous cycles. Transition is characterized by erratic estrous behavior and the growth and regression of ovarian follicles that fail to ovulate; it lasts between 60 and 80 days (Ginther et al., 2004b). The off-label use in mares of progesterone-containing intravaginal devices designed for cattle (CIDR, PRID) to advance the transition period has been described (Newcombe, 2002). Generally, these devices have not gained widespread acceptance because clinically they are associated with discomfort and marked vaginitis. However, these devices are effective in stimulating follicle growth in transitional mares (Foglia et al., 1999). The mechanisms whereby intravaginal progesterone stimulates follicular growth in transitional mares are not fully understood. The aims of this study were to investigate the effects of intravaginal progesterone on follicular development and FSH, LH and progesterone profiles in transitional mares.

2. Materials and methods

Ten non-lactating Thoroughbred mares (aged 5–13 years), maintained outside on pasture under natural light, were used for this study performed in the Waikato region of New Zealand where the official Thoroughbred breeding season commences on 1st September. Approval for this study was granted by the Massey University Animal Ethics Committee. Mares were selected for the study, beginning on 9th September, if they had been exhibiting estrous behavior continuously for at least 10 days prior to treatment and the diameter of the largest follicle at any examination during this period was between 20 and 25 mm, consistent with the transitional phase of the anovulatory period (Ginther et al., 2004a).

Each mare was treated with an intravaginal progesterone-releasing device (Cue-Mare\textsuperscript{®}, 1.72 g progesterone, 10%, w/w) for 10 days. Mares were examined by transrectal ultrasonography daily from day \(-10\) (day 0 = day of device insertion) until ovulation after device removal. After device removal, hCG (1667 iu IV, Chorulon\textsuperscript{®}) was administered when a follicle >35 mm was detected in conjunction with estrous behavior. Each mare was bred by natural service 24–36 h after hCG administration by one of eight different Thoroughbred stallions of proven fertility, and examined for pregnancy 14 days after ovulation.

A jugular venous blood sample was collected daily and EDTA plasma was stored at \(-20^\circ\)C. Concentrations of FSH were determined by radioimmunoassay (RIA) as previously described (Evans et al., 2002). LH was similarly measured using an antiserum (AFP-240580) against equine LH, and progesterone by kit RIA (DSL Laboratories, Inc.).

Data were analyzed by repeated measures ANOVA to account for the within-mare and between-mare effects of day on hormone profiles and follicle growth. All post hoc pair-wise comparisons were performed using Tukey’s test. Significance was considered at \(P<0.05\). Data are presented as mean \(\pm\) S.E.M. Analyses were performed using R Version 2.9.0 (2009, http://www.r-project.org).

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Fig. 1. Follicle development in transitional mares (n = 10) treated with an intravaginal progesterone-releasing device for 10 days and hCG after removal when a follicle >35 mm was detected. * indicates the first significant (P < 0.05) increase in follicle diameter when compared to the previous day.

3. Results

The mean diameter of the largest follicle on the day of device insertion was 21.3 ± 0.3 mm. The first significant increase in the diameter of the largest follicle when compared to the previous day occurred on day 6 (26.2 ± 0.4 mm vs 22.5 ± 0.5 mm; Fig. 1). At device removal the mean diameter of the largest follicle was 37.2 ± 1.1 mm. On the day after device removal (day 11), 7 mares had a follicle >35 mm in diameter and were administered hCG. The three remaining mares had follicles >35 mm on day 12 and were then given hCG. All dominant follicles ovulated within 48 h of hCG administration. The mean time to ovulation after device removal was 3.3 ± 0.2 days. Five of the 10 mares conceived.

Progestosterone concentrations peaked at 3.3 ± 0.7 ng/ml the day after device insertion (Fig. 2). Plasma FSH concentrations declined significantly the day after device insertion (8.6 ± 1.1 ng/ml vs 7.2 ± 1.3 ng/ml for day 0 and day 1 respectively; Fig. 2), then significantly increased to plateau on days 3, 4 and 5 (peak concentration of 9.4 ± 0.8 ng/ml on day 3) before significantly declining during the period from day 5 to 9.

LH concentrations tended to decrease the day after device insertion (1.1 ± 0.2 ng/ml vs 0.8 ± 0.1 ng/ml for day 0 and day 1 respectively; P = 0.07; Fig. 2). LH concentrations were significantly elevated on days 6 and 7 compared to day 1.

4. Discussion

In this study, treatment of transitional Thoroughbred mares with an intravaginal progesterone-releasing device for 10 days resulted in follicle growth and ovulation within 4 days of device removal in all mares. The growth rate from the first significant increase in follicle diameter (day 6) until removal was 2.8 mm/day, which is similar to the growth rate of dominant follicles in mares expressing estrous cycles at typical intervals (Ginther et al., 2008).

The decrease in FSH concentrations within 1 day of device insertion coincided with peak progesterone concentrations. The fact that the first significant increase in follicle diameter occurred on day 6, 3 days after the greatest FSH concentrations were first attained on day 3, is in agreement with the findings of Gastal et al. (1997) who showed that deviation (defined as a distinctive change in growth rates among follicles of a wave) occurs 3 days after the FSH peak. In addition, follicle deviation has been shown to occur when the largest follicle is between 21 and 23 mm in diameter in mares having typical estrous cycles (Ginther et al., 2004a). In the present study, the mean diameter of the largest follicle on day 5 (the day before a significant increase in follicle diameter) was 22.5 ± 0.5 mm. The decline in FSH concentrations observed from day 6 to 9 presumably occurred as a result of inhibin production by the dominant follicles (Donadeu and Ginther, 2002).

The period of significantly increased LH concentrations on days 6 and 7 during treatment corresponded to the time of the first detectable increase in follicle diameter. A close temporal relationship exists between FSH, LH and follicle growth whereby once FSH concentrations decline, LH concentrations increase and are vital for continued growth of the dominant follicle (Gastal et al., 1999).

In conclusion, intravaginal delivery of progesterone in the present study resulted in follicle growth leading to ovulation in transitional mares. Follicle development occurs in close association with increasing FSH concentrations during the initial treatment period and a significant increase in the diameter of the largest follicle on day 6 of treatment. Declining progesterone concentrations, decreased FSH concentrations, and an increase in LH concentrations on days 6 and 7 support continued growth of the dominant follicle. Within 2 days of device removal mares are in estrus and ovulate in response to hCG.

Conflict of interest

None.
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References


