Response of the Lactating and Postweaning Sow to Gonadotropin Releasing Hormone (GnRH)

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ABSTRACT. Clinical and endocrinological responses to administration of gonadotropin releasing hormone analog (LH-RH-A) during the lactation period and postweaning in the sow were investigated. Plasma LH concentrations in lactating sows rose immediately after administration of LH-RH-A. However, in postweaning sows the increase of LH level was more slowly. Three of 5 postweaning sows came into estrus and ovulated after LH-RH-A treatment. One sow exhibited a distinct LH response, but her ovaries remained quiescent. The remaining one with feeble estrus for a short period became cystic ovaries. Thus, LH response to GnRH in the sow seems to be higher during early lactation than at 2 days postweaning.—KEY WORDS: GnRH, lactating sow, LH, postweaning.


The major reproductive disorders encountered in commercial swine herds in Japan are postweaning anestrus, delayed return to estrus after infertile matings, feeble estrus and low fertility. Prolonged anestrus after weaning may be due to lower feed intake during late gestation and lactation, weight loss, heat stress, suckling intensity and confinement. The pathogenesis of postweaning anestrus in summer is not yet well understood. During lactation sows usually show anestrus by suppression of ovarian activity, however, the pituitary can respond to gonadotropin releasing hormone (GnRH) administered during lactation by releasing LH into the blood stream [3]. When the sow was challenged with estradiol benzoate on Day 5 of lactation, there was no evidence of a preovulatory surge of LH, however, treatment with estradiol benzoate on Day 35 of lactation resulted in a significant increase in LH [6].

These facts also seem to reflect a difference in function of the hypothalamus, hypophysis and ovaries during different stages of lactation. LH concentrations in serum and anterior pituitary tissues as well as hypothalamic levels of GnRH are also low during lactation [4].

It has been demonstrated that induction of estrus during lactation may be capable by means of partial weaning or administration of gonadotropic hormones and GnRH [7, 14]. The purpose of this study is to investigate clinical and endocrine responses to an LH releasing hormone analog (fertirelin acetate, LH-RH-A: Takeda Pharmaceutical Co., Ltd.) treatment at different stages of lactation and postweaning in sows.

MATERIALS AND METHODS

Thirteen Large White multiparous sows with average body weight, 170±10 (SD) kg, which farrowed during April in 1986 and 1988, were used in this study. During lactation the sows having 8–11 piglets were allowed for energy intake ad libitum. Indwelling cannulas were inserted into the jugular veins of these sows 2 days before LH-RH-A treatment.

Experiment 1: Two groups (3 sows per group) received 100 μg of LH-RH-A intramuscularly on Day 2 (Nos. 108, 146 and 3256) or Day 15 of lactation (Nos. 87, 476 and 2716), respectively.

Experiment 2: Four sows (Nos. 1, 2, 4 and 8) were administered with 100 μg of LH-RH-A and one sow (No. 5) was administered with 200 μg 2 days postweaning, 29–35 days postpartum. Sow No. 4 received the second injection of 200 μg LH-RH-A on Day 6 after the first hormone treatment, and the third injection of 50 μg was given on Day 20 after the second injection. Another two sows (Nos. 10 and 11) were given with 50 μg of LH-RH-A during the luteal phase of the estrous cycle.

Plasma concentrations of LH, estradiol-17β and progesterone were measured by RIA [10] in a series of samples collected at 15–60 min intervals during 12 hr after the injection of LH-RH-A.
Rectal examination of the ovaries was performed 3 days before and 7–10 days after LH-RH-A administration.

RESULTS

Experiment 1: In the three lactating sows treated with 100 μg of LH-RH-A on Day 2 of lactation, plasma LH concentration increased promptly from 0.4–2.1 ng/ml at 0 hr to a peak of 8.4–15.6 ng/ml at 2.5 hr after LH-RH-A administration. Then the concentration decreased suddenly to the basal level at 7–8 hr after the initiation of LH surge (Fig. 1). However, in the other three sows received the same dose of LH-RH-A on Day 15 of lactation, a smaller LH peak, 6.5–12 ng/ml, appeared in a shorter period, at 1.5–2.5 hr after treatment (Fig. 2).

Experiment 2: In four sows received 100 μg of LH-RH-A 2 days after weaning, plasma LH levels increased somewhat slowly compared with those in Experiment 1, and reached a peak of 9–14 ng/ml at 2.5–3 hr after treatment, excepting one sow (No. 8) in which no peak was observed. In a sow (No. 4) a higher LH level than the basal continued even for 12 hr after treatment (Fig. 3). The only one sow (No. 5) treated with a double dose of LH-RH-A, showed a similar LH response to that of No. 4.

In another two sows (Nos. 10 and 11) treated with 50 μg LH-RH-A during the luteal phase, a rapid increase in plasma LH concentration was observed with a peak at 60–90 min after treatment (Fig. 4).

The clinical response of the sows to administration of 100 μg of LH-RH-A after weaning was monitored by means of rectal examination. In three sows exhibiting standing estrus (Nos. 1, 2 and 8), ovulation occurred during 24 to 33 hr after the onset of the estrus.

Plasma progesterone and estradiol-17β concentrations of three sows in Experiment 2 (Nos. 4, 5 and 8) were determined. Estradiol-17β concentration in No. 8 peaked at the onset of estrus, i.e., Day 3 after LH-RH-A treatment and then it decreased rapidly.

Fig. 1. Changes in plasma LH concentration in 3 sows treated with 100 μg of LH-RH-A on Day 2 of lactation.

Fig. 2. Changes in plasma LH concentration in 3 sows treated with 100 μg of LH-RH-A on Day 15 of lactation.

Fig. 3. Changes in plasma LH concentration in 4 sows treated with 100 μg of LH-RH-A on 2 days postweaning.

Fig. 4. Changes in plasma LH concentration in 2 sows treated with 50 μg of LH-RH-A during the luteal phase of the estrous cycle.
LH-RH-A treatment revealed that none of distinct follicles was palpable. After treatment, however, 6–7 small follicles up to 5 mm in diameter came out without estrus, and these small follicles disappeared within 7 days after treatment (Fig. 6). The LH response of No. 4 was similar to that of the LH-RH-A treated sows which exhibited estrus (Fig. 3). The plasma estradiol-17β and progesterone concentrations of No. 4 treated with 100 µg LH-RH-A were low (Fig. 6).

Sow No. 4 which failed to exhibit estrus after LH-RH-A administration did not develop estrus again, even though she was injected with 200 µg LH-RH-A. Her LH response showed a distinct peak 3 hr after injection, but her ovaries remained quiescent. This sow received the third injection of 50 µg LH-RH-A on Day 20 after the second hormone treatment. In spite of the small dose of LH-RH-A, the greatest LH response was detected 3 hr after treatment, however, the ovaries still exhibited the pattern of ovarian quiescence.

Sow No. 5 developed feeble estrus for a short period after LH-RH-A treatment which failed to cause ovulation. Her ovaries contained a number of cystic follicles, 16–20 mm in diameter (Fig. 7). Elevation of estradiol-17β was observed after signs of feeble estrus, but progesterone concentrations remained less than 2.0 ng/ml throughout 8 days of posttreatment period.

**DISCUSSION**

Much information indicates that hypophyseal function in the sow is less active during early lactation than during late lactation [5, 9, 13].
Likewise, Rojanasthien [11] also found that sows tended to respond to GnRH with estrus and ovulation during late than early lactation. However, there was no difference in the LH response of the pituitary gland to GnRH between early and late lactation [12]. In the present study, the response to LH-RH-A resulted in a tendency toward decrease in LH activity as duration of lactation progressed. On the other hand, in postweaning sows the pituitary response to GnRH was slow, and a pattern of rapid release of LH into the blood circulation was about 2 hr later compared with lactating sows. This finding appears to be affected by several factors including increasing suckling intensity of the litter, weight loss of the dam and swelling of the udder caused by mastitis in postweaning period [12]. It is suggested that endogenous opioid peptides may be involved in the suckling-induced suppression of LH secretion [2].

The difference in LH response to 50, 100, and 200 μg of LH-RH-A was not clearly dose-dependent. In the luteal phase of the normal estrous cycle, the sow exhibited an LH response to LH-RH-A treatment as well as during early lactation. Three of 5 sows administered LH-RH-A 2 days postweaning developed distinct estrus and ovulated, however, one of them showed feeble estrus associated with cystic ovaries. The remaining sow, No. 4, showed no evidence of estrus, although the ovaries contained small follicles 3–5 mm in diameter which later disappeared. The LH response to GnRH treatment in this case, however, was greatest. According to Armstrong et al. [1] and Kirkwood et al. [8], extensive loss in body weight and backfat and also consumption of less energy in lactating sows cause a decrease in the activity and feedback sensitivity of the hypothalamo-hypophysial axis.

Ovarian cyst occurred in sow No. 5 may be suggested to be related to a failure of positive feedback response of LH to estradiol [10].

REFERENCES


