Effect of split weaning on sow ovulatory responses to injection of gonadotrophins during lactation

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Summary

At day 18 of lactation, 21 of 42 sows had their litters reduced to five or six piglets and all sows received gonadotrophins. Remaining piglets were weaned at day 26. More split-weaned than control sows had elevated serum progesterone 2 days post weaning (47.6% versus 9.5%; $P < .05$).

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Resumen - Efecto del destete dividido en las respuestas ovulatorias de las hembras a la inyección de gonadotropinas durante la lactancia

En el día 18 de la lactancia, 21 de las 42 hembras tuvieron una reducción en sus camadas de cinco ó seis lechones y todas las hembras recibieron gonadotropinas. Los lechones restantes fueron destetados el día 26. Más hembras del grupo de destete dividido que del grupo control tuvieron suero de progesterona elevado 2 días post destete (47.6% contra 9.5%; $P < .05$).

Résumé - Effet du sevrage séparé sur les réponses ovulatoires de la truie à l'injection de gonadotrophines durant la lactation

Au jour 18 de la lactation, 21 des 42 truies ont vu leur portée réduite à cinq ou six porcelets et toutes les truies ont reçu des gonadotrophines. Les porcelets restants ont été sevrés au jour 26. Deux jours post-sevrage plus de truies avec sevrage séparé que de truies témoins avaient des taux sériques élevés de progestérone (47,6% versus 9,5%; $P < .05$).

The ability to have sows show estrus and be successfully bred during lactation would allow for later weaning ages which, with the associated increased weight and immune system maturity at weaning, could potentially benefit piglet welfare without detriment to sow productivity. Lactation estrus and ovulation have been induced by intermittent suckling, although the reproductive performance was considered too variable for practical use.[1] For sows bred during lactation, there is no apparent adverse effect of concurrent lactation and pregnancy on subsequent litter size or farrowing rate.[2] Daily boar contact from day 18 of lactation has recently been noted to induce lactation estrus in sows, with the response being improved when accompanied by split weaning.[3] However, the logistics of sow movement preclude commercial application unless group housing and reduced confinement are also employed. Gonadotrophins have also been employed to induce estrus during lactation, and the response is affected by day of lactation when treated.[4,5]

The relatively poor estrus response of sows to exogenous gonadotrophins before 20 days post partum may result from low endogenous luteinizing hormone (LH) concentrations, which would inhibit the growth of medium ovarian follicles to the preovulatory size.[6] Endogenous LH concentrations in lactating sows can be acutely increased by split weaning, ie, weaning of the heaviest piglets in the litter several days prior to full weaning,[7] which may enhance the ovarian response of lactating sows to exogenous gonadotrophins. Indeed, when coupled with intermittent suckling and boar exposure, a 90% estrus response to injection of 400 IU equine chorionic gonadotrophin (eCG) with 200 IU human chorionic gonadotrophin (hCG) at lactation day 16 or 18 was observed.[8] The logistics of this latter protocol limits its commercial utility. We hypothesize that a reduction in suckling intensity achieved through a reduction in litter size will improve the ovarian response to hormone treatment. The present pilot study was undertaken to examine whether split weaning would enhance the ovulatory response of lactating sows to gonadotrophin treatment.

Materials and methods

The study protocol was approved by the Institutional Animal Care and Use committee of Michigan State University.

During lactation, 42 mixed-parity Yorkshire sows were fed to appetite a standard lactation corn-soybean meal diet (3300 kcal metabolizable energy [ME] per kg). At 18 days of lactation, sows were assigned on the basis of parity and litter size suckled to have their largest piglets weaned, leaving either five (n = 16) or six (n = 5) piglets to suckle (Split-weaned; n = 21). Piglet selection for split weaning was subjective, based on a visual assessment of size and the manager's preference to leave six pigs in larger litters. Numbers of piglets suckled were maintained in the litters of control sows (Control; n = 21). Also at day 18 of lactation, all sows received an injection (IM) of 400 IU eCG plus 200 IU hCG (PG600; Intervet, Millsboro, Delaware). Full weaning of all

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remaining piglets was performed at 26 days of lactation. A single blood sample obtained from each sow by jugular venipuncture 2 days after full weaning was assayed for progesterone content. Sampling at 10 days after PG600 injection would be approximately 3 to 5 days after ovulation, at which time progesterone concentrations would be relatively low but increasing. A serum progesterone concentration of > 5 ng per mL was subjectively considered high and so was deemed indicative of ovulation.[9] For the purpose of this study (ovulation; yes or no), a value of 10 ng per mL was recorded for progesterone concentrations ≥ 10 ng per mL. Estrus detection involved fence-line exposure to a mature boar for 2 minutes daily on days 1 to 14 after full weaning of all sows, as per routine farm protocol. Subsequent fertility was not monitored. Data for incidence of ovulation was examined by parity (1 versus > 1) and treatment (Split-weaned versus Control) using a chi-square test, while comparisons of data for parity and litter size suckled before and after split weaning were made using ANOVA, with significance set at $P < .05$.

Table 1: Effect of split weaning* on the ovulatory response of lactating sows to injection of 400 IU eCG plus 200 IU hCG†

	Control	Split weaned
No. of sows	21	21
Parity (range)‡	3.4 ± 0.5 (1-11)	3.4 ± 0.5 (1-6)
Litter size suckled to day 18 (range)‡	9.1 ± 0.2 (7-10)	9.3 ± 0.2 (8-11)
Final litter size suckled (range)‡	9.1 ± 0.2[a] (7-10)	5.2 ± 0.4[b] (5-6)
Sows ovulating (%)§	9.5[c]	47.6[d]

* Removal of largest piglets per litter to leave five or six suckling from day 18 of a 26-day lactation.

† PG600 (Merck Animal Health, Milsboro, Delaware) injected IM on day 18 of lactation.

‡ Mean ± standard error.

§ Sows having a serum progesterone cut-off concentration > 5 ng/mL at 2 days after full weaning.

[ab] Values with different superscripts differ ($P < .001$; ANOVA).

[cd] Values with different superscripts differ ($P < .05$; chi-square).

eCG = equine chorionic gonadotrophin; hCG = human chorionic gonadotrophin.

Results

There was no difference between treatments for average sow parity or number of piglets suckled prior to split weaning on day 18 of lactation, but litter size suckled was different after split weaning ($P < .001$; Table 1). Split weaning resulted in more ($P < .05$) sows ovulating in response to PG600 injection (Table 1), with all ovulating sows exceeding the cut-off serum progesterone limit of 5 ng per mL and having serum progesterone concentrations of ≥ 10 ng per mL.

There was no difference in day 18 litter size (mean ± SE) between sows that did or did not subsequently ovulate (9.1 ± 0.3 versus 9.2 ± 0.2, respectively). In the non-ovulating Control sows, one had a serum progesterone concentration of 3 ng per mL and three remained anestrous at day 14 after full weaning. In non-ovulating Split-weaned sows, one had a serum progesterone concentration of 3 ng per mL, and all were detected as estrous by 14 days after full weaning.

Discussion

The present data support those of Downing et al[8] in that a reduction in the suckling stimulus resulted in a population of sows more responsive to hormonal stimulation of estrus onset. Although the present data are very limited, it is interesting that in the non-ovulating Control sows, one had a progesterone concentration of 3 ng per mL, indicating an ovulation occurring later than expected, while three sows remained anestrus during the post-weaning testing period. In the non-ovulating Split-weaned sows, one had a progesterone concentration of 3 ng per mL, while none were anestrus. This provides further support to the suggestion that split weaning improves sow responsiveness to exogenous stimulation. Porcine ovarian follicle growth from the medium to large category requires endogenous LH rather than follicle-stimulating hormone support.[6] The hCG component of the PG600 administered is an LH analogue and might be expected to facilitate follicle growth in lactating sows. However, it is possible that the degree of suppression of endogenous LH during lactation results in the LH-like effect of the administered hCG being inadequate in concentration, duration of effect, or both, to successfully drive ovarian follicles to the ovulatory stage. It has been shown that a reduction in litter size suckled results in an acute increase in circulating LH concentrations,[7] and although not measured in this pilot study, it is reasonable to assume that circulating LH concentrations were higher in the current split-weaned sows, although variation in levels is to be expected. We speculate that under conditions of higher endogenous LH, the LH-like effect of the hCG in PG600 would usually be sufficient in concentration, duration of effect, or both, to facilitate final development of ovarian follicles in many sows. That some sows failed to respond to hormone treatment may indicate that in these sows, endogenous LH was not elevated sufficiently. If induction of a lactation estrus is desired, a more predictable response to hormone treatment will be required. We suggest that an additional hCG supplement may have facilitated follicle development in more, or possibly all, sows. Similarly, a sufficient stimulation may have been achieved with concurrent boar exposure. Finally, it is possible that sows could be pre-screened for likely responsiveness to hormone treatment by (for example) ultrasound determination that the ovaries carried follicles of ≥ 4 mm, although this would be of limited commercial utility due to the time and technology requirements and expertise necessary to perform routine ovarian ultrasound scans.

Implications

- Hormonal induction of ovulation at 18 days of lactation in sows is possible.
- Predictability of the ovulatory response must be improved if hormonal induction of ovulation during lactation is to become an accepted management option.

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