ORIGINAL RESEARCH

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Increasing the predictability of cloprostenol-induced farrowing in sows

Roy N. Kirkwood DVM, PhD; Frank X. Aherne, PhD

Summary

Objective: To determine the effect of a second injection of either cloprostenol or oxytocin after initial cloprostenol induction on the farrowing response of sows.

Methods: Two experiments were conducted. In experiment 1, sows received one of two treatments: either a single IM injection of 175 μg cloprostenol at day 113 of gestation (n=49) or an IM injection of 175 μg cloprostenol at day 113 of gestation followed by second IM injection of 175 μg cloprostenol 6 hours later (n=54). In experiment 2, sows received either a single (n=59) or a double (n=48) cloprostenol injection, as above, or a third treatment in which an IM injection of 30 IU oxytocin (n=56) replaced the second cloprostenol injection.

Results: After a single cloprostenol injection, 61% of sows farrowed during the following working day. When a second cloprostenol or oxytocin injection was administered 6 hours later, 86% of sows farrowed during the next working day.

Implications: A regime of cloprostenol administered twice or cloprostenol plus oxytocin markedly improved the predictability of induced parturition. This level of predictability should encourage more producers to employ induction technology.

Keywords: sows, parturition, cloprostenol, oxytocin

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The objective of induced farrowing is to allow increased supervision of piglet delivery to improve neonatal survival.[1] Inducing parturition also allows batch farrowing to be used to reduce the variation in piglet age. However, inducing with prostaglandin $F_{2\alpha}$ (PGF) does not guarantee that the sow will farrow the next working day. The response to PGF may vary across herds, but usually only 50%–60% of sows will farrow during the next working day.[2] We have shown that the poor response rate is at least partially because PGF fails to induce terminal luteolysis in some sows.[3] This relative lack of predictability is a major barrier to the widespread use of farrowing induction technology in the swine industry despite the potential economic benefit.

To induce parturition, manufacturers recommend that a single intramuscular (IM) injection of 175 μg cloprostenol or 10 mg lutalyse be administered, although we have previously shown that lower doses of either product are adequate if injected perianally or into the vulvar-vestibular mucosa.[2] To improve the synchronization of farrowing, some producers administer an injection of oxytocin 20–24 hours after PGF injection. This procedure often results in a more rapid delivery of the first pig. However, injecting oxytocin 20–24 hours after PGF injection, but before the delivery of the first piglet, often increases the need for intervention because it is associated with a higher incidence of interrupted farrowings.[4] Therefore, we believe oxytocin used as described above is contraindicated in parturition-induction programs unless sows can be continuously supervised. Injecting PGF will evoke an endogenous release of oxytocin,[5] and injecting oxytocin will evoke an endogenous release of PGF[6] in diestrus sows. Also, exogenous oxytocin has been shown to cause an endogenous release of PGF in early pregnant sows.[7,8] The role of oxytocin in luteolysis at the end of gestation remains to be determined.

In this study, we investigated the effect of injecting sows with a second injection of cloprostenol or oxytocin on subsequent farrowing.

Materials and methods

Two experiments were performed using 267 mixed-parity sows of Yorkshire and Landrace breeding on a commercial unit in Alberta. The average gestation length on this farm was 115 days. Cloprostenol (Mallinckrodt Veterinary Inc., Ajax, Ontario) injections were initiated at 9:00 am on day 113 of gestation. The working day on this farm was 10 hours (7:00 am to 5:00 pm). All injection doses were given according to manufacturer's recommendations.

Experiment 1

Sows were assigned randomly to receive:

- a single IM injection of 175 μg cloprostenol (n=49), or
- two injections of 175 μg cloprostenol administered 6 hours apart (n=54).

The 6-hour interval was chosen to represent approximately 1.5 half-lives for cloprostenol (information supplied by the manufacturer). Sows were monitored every 30 minutes for piglet delivery during the working day of induction and the following working day. Interventions were as for normal farm management, i.e., sows were manually as-

RNK,FXA: Alberta Pork Research Centre; Alberta Agriculture, Food and Rural Development, 905 O.S. Longman Building, 6909–116 Street, Edmonton, Alberta, Canada T6H 4P2, email: kirkwoo@agric.gov.ab.ca

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sisted if the interval between successive piglets exceeded 30 minutes, fetal membranes were removed as required, and small pigs were placed at a mammary gland. Since the only purpose of monitoring was to determine when the sows farrowed, piglet preweaning mortality was not monitored. Sows farrowing during the day of induction were considered to have farrowed independently of cloprostenol treatment and were not considered in the data analysis.

For the purpose of analysis, remaining sows were divided into two farrowing periods:

- early-responding sows that began farrowing between the end of the working day of induction and the end of the following working day (i.e., 8–32 hours after the first cloprostenol injection), and
- late-responding sows that began farrowing after the end of the following working day (> 32 hours after first cloprostenol injection).

Total numbers of pigs born and number born alive were recorded.

Experiment 2

Sows received one of three treatments:

- a single injection of 175 μg cloprostenol at day 113 of gestation (n=59),
- two injections of 175 μg cloprostenol administered 6 hours apart at day 113 of gestation (n=48), or
- a single injection of 175 μg cloprostenol followed 6 hours later by an IM injection of 30 IU oxytocin at day 113 of gestation (n=56).

As in experiment 1, data from sows that farrowed on the same working day as induction were not included in the analysis. Based on the time of farrowing onset, the remaining sows were categorized into the following groups for analysis:

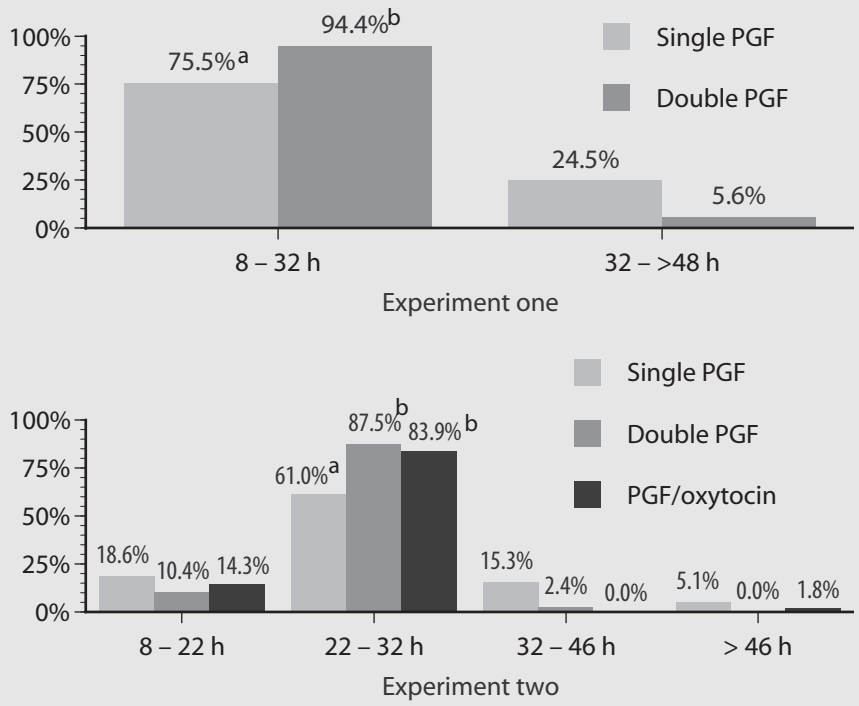
- first overnight (farrowing 8–22 hours from cloprostenol injection),
- second working day (farrowing 22–32 hours from cloprostenol injection),
- second overnight (farrowing 32–46 hours from cloprostenol injection), or
- nonresponsive to induction (farrowing > 46 hours from cloprostenol injection).

Litter sizes were recorded as for experiment 1.

Statistical analysis

All analyses were performed using SAS.[9] Effects of treatment on percentages of sows farrowing in the different time intervals were examined by χ^2. ANOVA was used to determine differences in litter sizes born (total, alive) between treatments.

Figure 1



Influence of cloprostenol (PGF) injection and oxytocin on timing of farrowing of sows.

ab P <.01 within same time period and experiment

Results

Experiment 1

A second injection of cloprostenol increased ($P < .01$) the proportion of early-responding sows (Figure 1). There were no reports of any farrowing complications and there was no treatment difference in total pigs born (11.9 ± SEM 0.4 for both) or in pigs born alive (11.5 ± SEM 0.4 for single injection and 11.3 ± SEM 0.4 for double injection).

Experiment 2

Within experiment 2, no farrowing complications were reported and there was no difference between treatments in the number of sows farrowing from 8–22 hours from the cloprostenol injection (Figure 1). The total number of pigs born did not differ among the single-cloprostenol (11.4 ± SEM 0.4), the double-cloprostenol (11.7 ± SEM 0.4), and the cloprostenol-plus-oxytocin (12.5 ± SEM 0.4) groups; nor did the number of pigs born alive differ among the single-cloprostenol (11.0 ± 0.4), the double-cloprostenol (10.8 ± SEM 0.4), and cloprostenol-plus-oxytocin (11.8 ± SEM 0.4) groups.

Discussion

Data from this experiment confirmed the beneficial effect of a second cloprostenol injection and further, that an injection of oxytocin could

be substituted for the second cloprostenol injection.

This investigation indicated that oxytocin administered 6 hours after a PGF injection reduced the overall period of farrowing. Given that oxytocin did not precipitate more farrowings during the first overnight, this effect is not comparable to the known effect on uterine contraction and piglet delivery of oxytocin given 20–24 hours after PGF (i.e., stimulation of onset of piglet delivery). We do not believe that the pattern of response to the PGF/oxytocin treatment will greatly vary by herd. However, the response is likely to vary depending on when the treatment is implemented relative to natural onset of farrowing. Timing of injections should be investigated at the herd level.

A previous study with swine observed small increases in circulating oxytocin in stage one (pre-expulsion) of parturition at concentrations suggested to be sufficient to allow the final stages (delivery of piglets and placenta) of parturition to proceed, but concluded that oxytocin had no role in the initiation of parturition.[10] In contrast, the present data suggest that oxytocin is involved in terminal luteolysis in sows and so does have a role in the initiation of parturition.

It has been demonstrated in diestrous sows that PGF evokes oxytocin release,[5] and oxytocin evokes PGF release.[6] Also, oxytocin receptors have been demonstrated in the early pregnant porcine endometrium,[11] and the porcine endometrium responds in vitro to oxytocin by increasing the secretion of prostaglandin.[12] It is therefore reasonable to conclude that oxytocin is intimately involved in the endocrine events that result in luteolysis at the end of the luteal phase of the estrous cycle. Luteolysis during the estrous cycle and at the end of gestation both require the action of PGF. We suggest that the luteolytic message is the same at both times and will involve oxytocin at both times.

To our knowledge, this is the first evidence, albeit indirect, of a role for oxytocin in the endocrine events resulting in parturition in sows. Unpublished evidence from our laboratory indicated that a single injection of cloprostenol sometimes failed to initiate terminal luteolysis. It is also known from work in sheep that terminal luteolysis requires a pulsatile release of PGF.[13,14] Therefore, assuming a similar mechanism in swine, a single cloprostenol injection may occasionally fail to initiate this pulsatile endogenous PGF release. From the results of the present study, it would appear that the luteolytic signal (i.e., pulsatile PGF release) can be reinforced by either more prostaglandin or more oxytocin. Therefore, these results support the hypothesis that oxytocin promotes the pulsatile luteolytic secretion of PGF during corpus luteum regression at the end of gestation.

The dose of oxytocin administered in this study was at the lower range of the manufacturer's recommended dose for obstetric use. However, most clinicians recognize the efficacy of a dose of 10 IU for a physiological response (e.g., milk let-down) and we believe a lower dose of oxytocin would be effective in the present protocol. The minimum dose of oxytocin required to control farrowing in this protocol is under investigation.

Implications

- The regime of two doses of cloprostenol or cloprostenol plus oxytocin improved the predictability of induced parturition.
- The enhanced predictability should encourage more producers to employ induction technology.

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