Sow and litter performance following farrowing induction with prostaglandin: Effect of adjunct treatments with dexamethasone or oxytocin

Glen Cassar, DVM, PhD; Roy N. Kirkwood, DVM, PhD, Diplomate ECAR; Robert Friendship, DVM, MSc, Diplomate ABVP; Zvonimir Poljak, DVM, MSc

Summary
Objective: To evaluate effects of dexamethasone (DEX) and oxytocin in prostaglandin F2α (PGF) farrowing-induction protocols.

Materials and methods: In Experiment One, 144 sows were induced with two injections of PGF 6 hours apart (split dose) with or without injection of 20 mg DEX with the second PGF. Interval from initial PGF to farrowing, duration of farrowing, litter size born alive, number of stillbirths, and piglet weight gain to 10 days of age were recorded. In Experiment Two, 106 sows were induced with single or split-dose injections of PGF with or without injection of 20 IU oxytocin 24 hours after initial PGF. Time to onset and duration of farrowing were recorded, as were requirement for manual intervention, total litter size born, and incidence of stillbirths.

Results: For sows farrowing 24 to 32 hours after initial PGF injection in Experiment One, there was no effect of DEX treatment on the PGF-to-farrowing interval, duration of farrowing, or piglet growth and survival to 10 days of age. In Experiment Two, more sows farrowed by 32 hours after the split dose of PGF than after a single dose (P < .05). The PGF injection protocol did not influence the farrowing response to oxytocin. Oxytocin injection was associated with higher stillbirth rates when cervical dilation was incomplete.

Implications: These data do not support a role for corticosteroid in farrowing induction protocols. Oxytocin administered 24 hours after PGF (single or split dose) was associated with farrowing problems, suggesting that routine use of oxytocin in periparturient sows is contraindicated.

Key words: swine, farrowing, prostaglandin F2α, dexamethasone, oxytocin

Received: March 4, 2004
Accepted: September 14, 2004

Resumen – Efectos del tipo de aparato y su cubierta en la recuperación de virus y microorganismos del polvo en los aparatos de ultrasonido utilizados en granjas de cerdos de Alemania

Objetivos: Investigar si el polvo del interior de los aparatos de ultrasonido, utilizados para exámenes ginecológicos en las granjas de cerdos de Alemania, contenían virus y microorganismos, y si el tipo de aparato y su cubierta afectaban la contaminación interna viral y microbiana.

Métodos: Con hisopos e recolectaron muestras de 18 aparatos de ultrasonido de tres tipos comunes. Cinco estaban completamente cubiertos (con bolsas de plástico cerradas o plástico adhesivo de de uso casero), cuatro estaban cubiertos de forma incompleta (con bolsas de plástico abiertas o perforadas), y nueve estaban descubiertos. Los hisopos fueron examinadas en busca del circovirus porcino tipo 2; (PCV-2 por sus siglas en inglés), mediante la reacción en cadena de la polimerasa (PCR por sus siglas en inglés), del virus del síndrome reproductivo y respiratorio porcino (PRRSV por sus siglas en inglés) a través del PCR de transcripción reversa anidado y de bacterias, hongos y levaduras a través de cultivo. Ocho aparatos nuevos y sin usar (dos o tres de cada tipo) sirvieron como controles negativos.

Resultados: Ni el DNA del PCV-2 ni de las bacterias se recuperaron de ninguna máquina. Nueve aparatos fueron positivos al RNA del PRRSV, sin embargo, ningún aparato nuevo fue positivo. Todos los aparatos usados y dos de los aparatos nuevos tenían bacterias y hongos. Dentro de la categoría de aparatos usados, el tipo de aparato no afectó la contaminación. El cubrir a los aparatos completamente fue el tratamiento más efectivo para reducir la contaminación interna con bacterias y hongos.

Implicaciones: Las máquinas de ultrasonido de diferentes tipos pueden contaminarse internamente con el PRRSV y con numerosos microorganismos durante su uso en las granjas de cerdos. Una cubierta que elimine completamente el contacto con el aire podría ser efectiva para prevenir la contaminación con PRRSV de estos aparatos. Se deben establecer procedimientos de bioseguridad para el uso de aparatos de ultrasonido en granjas de cerdos, incluyendo su cubierta total con bolsas de plástico intactas.

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This article is available online at http://www.aasv.org/shap.html.

In addition to initiating piglet delivery, peripartum endocrine changes may also affect early postnatal piglet survival. High levels of maternal corticosteroids are involved in advancing fetal visceral (ie, lung and intestinal) maturation, which are involved in advancing fetal visceral (ie, vinal. High levels of maternal corticosteroids

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Materials and methods</th>
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<td>Animals and facilities</td>
<td>These studies were approved by the animal care committees of the University of Guelph and Michigan State University and were conducted in accordance with their guidelines for the care and use of experimental animals. Experiment One was conducted on each of two facilities, one a commercial 700-sow farrow-to-feeder facility in Guelph, Ontario, Canada, and the other a 220-sow farrow-to-finish facility at Michigan State University. Experiment Two was conducted at the Guelph facility.</td>
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<td>Experimental design</td>
<td>For Experiment One, 144 mixed-parity sows were induced to farrow 2 days before their due date (day 113 of gestation) with two vulvar injections of 2.5 mg or 5.0 mg prostaglandin F₂α (PGF; Lutalyse, Pharmacia, Orangeville, Ontario) administered 6 hours apart by 12-mm, 20-gauge needle. The different dosages reflect different management protocols for each farm but, on the basis of previous data, no dose-dependent difference in farrowing response was anticipated. The initial injection was administered between 7:00 AM and 8:00 AM. At the time of the second injection, sows were assigned to receive an injection of 20 mg dexamethasone (DEX; Dexadreson, Intervet Canada, Whitby, Ontario; n = 73) or to serve as controls (n = 71). This dose of dexamethasone is at the high end of the therapeutic range and was administered intramuscularly (IM) in the neck.</td>
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The following working day (24 to 32 hours after initial PGF injection), sows were monitored continuously for piglet delivery until farrowing was complete. If an interval between piglet deliveries exceeded 45 minutes, manual intervention was employed. Sows farrowing < 24 hours after initial PGF injection were not observed, and their data were not included in the analysis. Similarly, sows farrowing > 32 hours after initial PGF injection were deemed to be nonresponsive to the induction protocol and excluded from data analysis. Piglets of sows farrowing 24 to 32 hours after PGF injection were individually identified by ear notching at birth, and incidences of piglet mortality were recorded. For sows farrowing 24 to 32 hours after initial PGF injection, records were maintained for the interval from initial PGF injection to onset of farrowing, duration of farrowing, litter size born (alive and stillborn), and piglet weights and survival at birth and at 3 and 10 days of age.

For Experiment Two, 106 mixed-parity sows were assigned, 2 days before their due-to-farrow date, to injection of 5 mg PGF (PG1; n = 29); injection of 5 mg PGF followed 24 hours later by 20 IU oxytocin (Bimeda-MTC Pharmaceuticals, Cambridge, Ontario) (PG1-OT; n = 28); injection of 2.5 mg PGF followed in 6 hours by a second injection of 2.5 mg PGF (PG2; n = 24); or injection of 2.5 mg PGF followed in 6 hours by a second injection of 2.5 mg PGF and then 20 IU oxytocin 24 hours after the initial PGF injection (PG2-OT; n = 25).

The dose of oxytocin was based on literature evidence indicating effective doses of between 10 and 30 IU8,9,11 and anecdotal evidence of 20 IU being a commonly used dose in commercial practice. The PGF was administered into the vulva and the oxytocin was administered IM in the neck. Initial PGF injections were administered between 7:00 AM and 8:00 AM on day 113 of gestation. During the following working day, sows were monitored continuously for piglet delivery until farrowing was complete. If an interval between piglet deliveries exceeded 45 minutes, manual intervention was employed. As in Experiment One, sows farrowing < 24 hours or > 32 hours after initial PGF injection were excluded from data analysis. Where oxytocin injection was indicated, an assessment of cervical dilation was performed prior to injection. A gloved hand was inserted into the vagina and cervical dilation confirmed if at least two fingers could be inserted comfortably into the cervical canal. Records were maintained for interval from initial PGF injection to onset of farrowing, duration of farrowing, requirement for manual intervention, and litter size born (alive and stillborn).

**Statistical analysis**
All analyses were performed by ANOVA using SAS (SAS Institute Inc, Cary, North Carolina). The treatment means for intervals from initial PGF injection to delivery of the first pig, duration of piglet delivery, and total born litter size were compared using the MIXED procedure. The proportion of sows farrowing 24 to 32 hours after initial PGF injection and proportion of stillbirths were analysed using logistic regression and tested by the Wald chi-square test. Differences in the variances around the means were tested by F-ratio test and analyses were adjusted for parity. Data from Experiment Two were analyzed as a 2 × 2 factorial.

For Experiment One, treatment effects on piglet birth weights and average daily gain to 10 days of age were compared for all piglets using the MIXED procedure with litter as a random effect and piglet birth weight as covariate. The data presented for Experiment One indicate no effect of dexamethasone on the timing or duration of farrowing. An earlier report had shown that prepartum injection of prednisolone resulted in a shorter period of piglet delivery.3 An explanation for the shorter delivery time was not provided, but it is reasonable to infer the involvement of an analgesic effect of the corticosteroid allowing for a more comfortable delivery. However, the sows used in the present study were relatively mature and so less likely to suffer a painful delivery. If true, an effect of dexamethasone on the piglet delivery process may become apparent only in young sows. Other authors have demonstrated that dexamethasone treatment of the periparturient sow resulted in enhanced neonatal piglet growth, especially of the low-birth-weight pigs.4 Also, injection of dexamethasone into newborn piglets may improve growth, although the effect has proven inconsistent with either a general or a sex-linked growth response, or no growth response being observed.12-14 In the present study, no effect of dexamethasone was observed on litter.
growth and survival regardless of birth weight. Therefore, given the unpredictable response to corticosteroid treatment, the use of dexamethasone in the farrowing induction protocol does not appear to be warranted.

In Experiment Two, the farrowing response to induction supports previous reports that the vulval route for PGF injection produces acceptable results at lower than label dosages. Further, in terms of the numbers of sows farrowing 24 to 32 hours after initial PGF injection, the split-dose PGF protocol produced a superior response compared to the single dose, also supporting earlier observations. In the present study, oxytocin-treated sows had numerically more farrowing problems requiring manual intervention (30 compared to 20 not requiring intervention), but there were too few sows to detect a significant difference. This research would suggest that there is little to be gained by routine use of oxytocin as part of an induction program. Indeed, the potential for oxytocin to cause problems if dilation of the cervix has not been performed prior to oxytocin induction can be high.

Recent research has suggested that even after delivery of the first piglet, the use of oxytocin might produce undesirable results. The latter authors described larger numbers of stillbirths per litter, with the highest incidence being among the first four piglets rather than towards the end of farrowing. This pattern of stillbirth deliveries was associated with an increased incidence of umbilical cord abnormalities, suggesting that inappropriately powerful uterine contractions may be detrimental to piglet survival even when the cervix is fully patent.

Table 1: Adjusted mean effects on the timing of farrowing and litter growth and survival (means ± SE) in sows treated prepartum with prostaglandin (PGF) alone (Control) or with prostaglandin and dexamethasone (DEX)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>DEX</th>
</tr>
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<tbody>
<tr>
<td>Number of sows</td>
<td>43</td>
<td>41</td>
</tr>
<tr>
<td>PGF-to-farrow interval (hours)</td>
<td>26.6 ± 0.3</td>
<td>27.0 ± 0.4</td>
</tr>
<tr>
<td>Duration of farrowing (hours)</td>
<td>2.7 ± 0.3</td>
<td>3.0 ± 0.3</td>
</tr>
<tr>
<td>Total born litter size</td>
<td>10.8 ± 0.4</td>
<td>11.5 ± 0.4</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.49 ± 0.06</td>
<td>1.52 ± 0.06</td>
</tr>
<tr>
<td>Average daily gain to 10 days (g)</td>
<td>215.4 ± 9.4</td>
<td>216.4 ± 9.3</td>
</tr>
<tr>
<td>Probability (%) of stillbirths</td>
<td>5.3 (3.6 - 7.9)</td>
<td>4.3 (2.8 - 6.6)</td>
</tr>
<tr>
<td>Probability (%) of piglet mortality to 10 days</td>
<td>6.8 (3.5 - 12.8)</td>
<td>8.2 (5.2 - 12.9)</td>
</tr>
</tbody>
</table>

1 Maximum likelihood estimates. Means for PGF-to-farrowing interval, duration of farrowing, and total born litter size compared using an ANOVA and the MIXED procedure of SAS (SAS Institute Inc, Cary, North Carolina). Means for birth weight and ADG to 10 days of age compared using the MIXED procedure with litter as a random effect in the model for birth weight. There were no significant differences for any effects at P < .05.

2 All 144 sows induced by two injections of prostaglandin F2α (PGF) administered 6 hours apart, with DEX administered to 73 sows at the time of the second PGF injection. Data included only for sows farrowing 24 to 32 hours after initial PGF injection.

3 Estimated (with a 95% confidence interval) using logistic regression in GENMOD procedure, with within-litter correlation for piglet mortality. There were no significant differences for stillbirths or piglet mortality (P > .05).

Table 2: Descriptive statistics of farrowing response in sows receiving prostaglandin (PGF) as a single injection (PG1) at day 113 of gestation or two injections (PG2) 6 hours apart on day 113 of gestation, with or without oxytocin (OT) 24 hours after initial PGF injection

<table>
<thead>
<tr>
<th>Variable</th>
<th>PG1</th>
<th>PG1-OT</th>
<th>PG2</th>
<th>PG2-OT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sows treated</td>
<td>29</td>
<td>28</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>Parity1</td>
<td>6.4 ± 3.0</td>
<td>8.1 ± 3.2</td>
<td>8.4 ± 2.6</td>
<td>8.4 ± 2.9</td>
</tr>
<tr>
<td>Parity &gt; 7 sows (%)</td>
<td>41</td>
<td>67</td>
<td>67</td>
<td>70</td>
</tr>
<tr>
<td>Sows farrowing in 24-32 hours2</td>
<td>17 (58.6)%</td>
<td>21 (75.0)%</td>
<td>21 (87.5)%</td>
<td>20 (80.0)%</td>
</tr>
<tr>
<td>Sows not responding (%)</td>
<td>8 (27.6)</td>
<td>5 (17.9)</td>
<td>1 (4.2)</td>
<td>3 (12.0)</td>
</tr>
<tr>
<td>Interval to farrowing1,3 (hours)</td>
<td>25.8 ± 2.3</td>
<td>24.8 ± 0.4</td>
<td>26.3 ± 3.1</td>
<td>24.8 ± 0.6</td>
</tr>
<tr>
<td>Farrowing duration1 (hours)</td>
<td>3.1 ± 1.0</td>
<td>2.7 ± 1.6</td>
<td>2.8 ± 1.2</td>
<td>2.6 ± 1.1</td>
</tr>
<tr>
<td>Litters with intervention1</td>
<td>8</td>
<td>17</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Litter size (total born)</td>
<td>11.7 ± 2.6</td>
<td>10.5 ± 2.9</td>
<td>12.0 ± 2.5</td>
<td>10.6 ± 2.8</td>
</tr>
<tr>
<td>Mean stillbirths1 (%)</td>
<td>8.1</td>
<td>7.8</td>
<td>8.5</td>
<td>7.6</td>
</tr>
<tr>
<td>Median stillbirths1 (%) (5th - 95th percentile)</td>
<td>0 (0 - 43)</td>
<td>0 (0 - 25)</td>
<td>7.1 (0 - 31)</td>
<td>0 (0 - 47)</td>
</tr>
</tbody>
</table>

1 Data included only for sows farrowing 24 to 32 hours after initial PGF injection. All analyses, including proportion of sows farrowing in 24 to 32 hours, performed by ANOVA in SAS (SAS Institute Inc, Cary, North Carolina) with statistical significance set at P < .05.

2 More sows receiving two PGF injections farrowed 24 to 32 hours after initial PGF injection (chi-square test, P < .05).

3 Variance around the means smaller for OT sows (F-ratio testing, P < .05).

ab Means in the same row with different superscripts are different (P < .05).
advanced sufficiently to allow easy passage of the piglets, and its potential to cause interrupted farrowings, suggest that the routine use of oxytocin in periparturient sows is contraindicated.

Implications
- Administration of dexamethasone to periparturient sows does not impact neonatal piglet growth or survival.
- The use of a split-dose PGF induction protocol decreases the likelihood of sows not farrowing in response to PGF.
- As some sows may have a nondilated cervix 24 hours after initial PGF injection, even with split-dose PGF induction, the use of oxytocin in periparturient sows is contraindicated.

Acknowledgment
This work was generously supported by Ontario Pork.

References

* Non-refereed references.