Stillbirth and preweaning mortality in litters of sows induced to farrow with supervision compared to litters of naturally farrowing sows with minimal supervision

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Summary

Objective: To evaluate the benefits of induced farrowing with supervision on rates of stillbirths and preweaning mortality.

Materials and methods: A total of 159 multiparous sows were assigned in approximately equal numbers to two groups. Group One sows (n = 75) were induced to farrow using two intravulvar injections of 5 mg prostaglandin $F_{2\alpha}$ administered 6 hours apart on day 114 of gestation (Day 0). Farrowing was supervised, with assistance given as required. Group Two sows (n = 84) were allowed to farrow naturally, with supervision and neonatal care standard for the production facility. All live piglets were weighed at 3 days and 21 days of lactation.

Results: Of the Group One sows, 56 farrowed during working hours on Day 1. There were fewer stillbirths per litter in Group One than in Group Two sows (0.4 ± 0.09 versus 1.0 ± 0.17, respectively). There was no effect of treatment on overall preweaning mortality. Weights were greater for Group One than for Group Two piglets at both 3 days of age (1.9 ± 0.04 kg versus 1.7 ± 0.02 kg, respectively; $P < .01$) and 21 days of age (5.7 ± 0.06 kg versus 5.5 ± 0.05 kg, respectively; $P < .01$).

Implications: Inducing farrowing and providing supervision on the day of farrowing can reduce stillbirths. However, reducing overall preweaning mortality requires more than 1 day of supervision.

Keywords: swine, farrowing supervision, piglets, stillbirths, preweaning mortality

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Resumen - Nacidos muertos y la mortalidad predestete en camadas de hembras inducidas a parir con supervisión, comparados con camadas de hembras que paren naturalmente con mínima supervisión

Objetivo: Evaluar los beneficios de partos inducidos con supervisión en los porcentajes de nacidos muertos y mortalidad predestete.

Materiales y métodos: Se asignaron un total de 159 hembras multíparas en números a dos grupos, de aproximadamente el mismo tamaño. Las hembras del Grupo Uno (n = 75) fueron inducidas a parir utilizando dos inyecciones intravulvares de prostaglandina $F_{2\alpha}$ de 5 mg, administradas con 6 horas de separación en el día 114 de la gestación (Día 0). Los partos fueron supervisados, dándose ayuda conforme fue requerida. Se permitió a las hembras del Grupo Dos (n = 84) parir naturalmente, con la supervisión y el cuidado neonatal estándar en las instalaciones de producción. Se pesaron todos los lechones vivos a los 3 días y a los 21 días de lactancia.

Resultados: De las hembras del Grupo Uno, 56 parieron en horas laborales en el Día 1. Hubo menos nacidos muertos por camada en el Grupo Uno que en las hembras del Grupo Dos (0.4 ± 0.09 contra 1.0 ± 0.17, respectivamente; $P < .001$). No hubo efecto del tratamiento en la mortalidad predestete total. Los pesos fueron mayores en los lechones del Grupo Uno que en los del Grupo Dos tanto a los 3 días de edad (1.9 ± 0.04 kg contra 1.7 ± 0.02 kg, respectivamente; $P < .01$) como a los 21 días de edad (5.7 ± 0.06 kg contra 5.5 ± 0.05 kg, respectivamente; $P < .01$).

Implicaciones: El inducir el parto y proveer supervisión en el día del mismo puede reducir los nacidos muertos. Sin embargo, el reducir la mortalidad predestete total requiere más de un día de supervisión.

Résumé - Mortinatalité et mortalité présevrage dans les portées de truies induites à mettre-bas sous supervision comparativement aux portées de truies mettant bas naturellement et sous supervision minimale

Objectif: Évaluer les bénéfices de mise-bas induite sous supervision sur les taux de mortinatalité et de mortalité pré-sevrage.

Matériels et méthodes: Un total de 159 truies multipares ont été réparties en nombre approximativement égal à deux groupes. Les truies du Groupe Un (n = 75) ont été induites à mettre bas suite à deux injections intravulvaires de 5 mg de prostaglandine $F_{2\alpha}$ administrées à 6h d'intervalle au jour 114 de gestation (Jour 0). La mise-bas était supervisée, et de l'aide donnée au besoin. Les truies du Groupe Deux (n = 84) ont mis bas naturellement, sous supervision et soins néonataux standards pour ce type de production. Tous les porcelets vivants ont été pesés aux jours 3 et 21 de lactation.

Résultats: Parmi les truies du Groupe Un, 56 ont mis bas durant les heures travaillées

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au Jour 1. Il y avait moins de mort-nés par portée dans le Groupe Un que dans le Groupe Deux (respectivement 0.4 ± 0.09 vs 1.0 ± 0.17, $P < .001$). Il n'y avait pas d'effet traitement sur l'ensemble de la mortalité pré-sevrage. Le poids des porcelets du Groupe Un était supérieur à celui de ceux du Groupe 2 autant à 3 jours d'âge (respectivement 1.9 ± 0.04 kg vs 1.7 ± 0.02 kg, $P < .01$) qu'à 21 jours d'âge (respectivement 5.7 ± 0.06 kg vs 5.5 ± 0.05 kg, $P < .01$).

Implications: L'effet d'induire la mise-bas et de fournir une supervision lors de la journée de la parturition peut réduire les mortinatalités. Toutefois, une réduction de la mortalité pré-sevrage globale nécessite plus qu'une seule journée de supervision.

The incidence of stillbirths on North American swine farms generally falls within the range of 5% to 15%, in addition to losses from preweaning mortality of between 10% and 15%.[1] The most common non-infectious cause of stillbirth can be attributed to intrapartum hypoxia, usually resulting from prolonged farrowing and dystocia.[2] In liveborn pigs, the degree of hypoxia is a major determining factor for the ability to thermoregulate, the time to first suckle, and pig neonatal survival. Hypoxic piglets are weaker and less active than their littermates.[3] To reduce the frequency of stillborn piglets, farrowing supervision and timely intervention as needed are recommended to reduce sow discomfort and piglet hypoxia or death during parturition. Administering prostaglandin $F_{2\alpha}$ (PGF) or a PGF analogue to induce farrowing allows for a relatively predictable onset of piglet delivery. This, in turn, allows for the allocation of resources and labor more efficiently.[4] If farrowings are attended, more attention to sows and piglets may enhance piglet survival rates and minimize sow discomfort.[5] Constant supervision allows for manual assistance of sows exhibiting difficulty during farrowing, or treatment with oxytocin to help overcome primary uterine inertia. Special treatment of newborn piglets, such as drying and warming, clearing airways, and ensuring colostrum intake, will help to improve chances for survival,[6] while separation of newborn piglets from the sow until farrowing has finished has been suggested as a way to reduce traumatic injuries.[7]

The first few days after parturition have proven to be the most challenging for piglets, as evidenced by the high percentage of mortality that occurs within 3 to 4 days after birth.[8] Neonatal assistance with uptake of colostrum, cross-fostering, and assisting piglets as needed is likely to be important in reducing piglet losses.[9] The issues of reducing perinatal losses and improving animal welfare are two topics that intersect in the pork industry. The purpose of this study was to test the hypothesis that farrowing induction and increased farrowing supervision reduce the incidence of stillbirths and preweaning mortality.

Materials and methods

This study was conducted on a 500-sow farrow-to-feeder facility near Guelph, Ontario. The experimental design was approved by the University of Guelph Animal Care Committee.

A total of 159 multiparous Yorkshire × Landrace sows were housed in a farrowing facility at 110 days of gestation. Each farrowing crate contained a creep area with a heat lamp at the front and flooring made from plastic-coated expanded metal. The rooms were mechanically ventilated and thermostatically controlled, and the farm practiced all-in, all-out management of the farrowing rooms. During gestation, sows were housed in individual gestation stalls and fed approximately 2.5 kg per day of a diet formulated to provide 14.2 MJ digestible energy per kg and 15% crude protein. During lactation, sows were fed the gestation diet to appetite twice daily. Farrowing rooms were washed and disinfected routinely after weaning (approximately 21 to 25 days of age).

At 114 days of gestation, each sow was assigned to one of two treatment groups. For sows of Group One, farrowing was induced by intravulvar injection of 5 mg of PGF (Lutalyse; Pfizer, Kirkland, Quebec, Canada) at 8:00 AM and again at 2:00 PM.[10,11] Sows farrowing during the following working day (7:00 AM to 5:00 PM) were supervised during piglet delivery and assisted as needed. Oxytocin was not routinely used, but 10 IU was administered to two Group One sows that exhibited farrowing difficulty that was not resolved through manual intervention. Group Two sows were not induced and received the supervision and neonatal care standard to the production facility. On this farm, all sows were observed at least twice during the day, at feeding time. Sows identified with problems at that time were provided with appropriate assistance, but follow-up visits during the day did not occur.

Sows were not assigned to treatment groups in a strictly random manner. In order to maximize labor availability, sows that were expected to farrow on the same day were purposely selected as Group One sows. Sows that were chosen for Group One but then farrowed during the night were removed from the study. All other sows were candidates for Group Two.

For Group One sows, the time of birth of each live or stillborn piglet and any requirement for manual assistance were recorded. If piglet delivery intervals exceeded 30 minutes, manual assistance was provided. When manual assistance was provided, all piglets within reach were extracted and the sow was allowed to continue delivery autonomously. Farrowing was considered to be complete after passage of the bulk of the placenta. During parturition, each piglet in Group One was assisted, including removal of placental membranes, clearing of airways, ligation of umbilical cords, towel drying, ear notching for birth order and litter identification, and placing in a crèche filled with bran under a heat source until all piglets were delivered. Once farrowing was complete, piglets were weighed and their teeth clipped. Piglets < 1 kg in weight were provided with 10 mL of colostrum obtained from the dam and fed through a syringe. When farrowing was finished, the sow was encouraged to stand, eat, and drink before the piglets were placed with her. Cross-fostering within treatment group was done as required after piglets had obtained colostrum (minimum of 6 hours). The main criterion for electing to cross-foster a pig was large litter size. When there were more piglets than available teats, the largest of the surplus piglets were moved to a newly-farrowed sow with a smaller litter. After the farrowing day (Day 0), piglets received no further special assistance.

Farrowing data recorded were numbers of total born, stillborn, and cross-fostered pigs. All piglets were weighed when they were 3 and 21 days of age. Castration was performed and iron injections were given on Day 3. Pre-weaning mortality was recorded from birth to Days 3 and 21, but cause of mortality was not investigated.

Statistical analysis

The association between treatment and the prevalence of stillbirths and preweaning mortality of liveborn pigs were determined after controlling for sow parity. Mortality was divided into two time categories: mortality at 1 to 3 days of age and at 4 to 21 days of age. The association between pig birth weight and mortality in the two time categories was determined for Group One litters using a Cochran-Mantel-Haenszel test. The association between live body weight at 3 days of

age and at 21 days of age and treatment and parity were determined using general linear models. A Poisson regression method was used to compare mortality among piglets from supervised sows (Group One) to those from the control sows (Group Two), and linear regression was applied to compare the weights of the piglets from supervised sows to those from the control sows. All statistical analyses were done with SAS 9.1 2002-2003 software (SAS Institute Inc, Cary, North Carolina). For all analyses, $P < .05$ was considered significant.

Results

There was no difference in mean parity between the experimental groups (Table 1), although parity did have an effect on both numbers of total born ($P < .05$) and born alive ($P < .001$), with litter size and born alive highest for sows between the third and sixth parities. Of the 75 Group One sows receiving PGF, 56 (75%) farrowed during working hours on the following day, 15 (20%) started farrowing before staff arrived, and 4 (5%) did not finish farrowing before 5:00 PM. The total numbers of piglets born, born alive, or stillborn per litter are shown in Table 1.

The total number of piglets born per litter and piglets born alive per litter did not differ significantly between groups (Table 1). Prevalence of stillbirths was lower in Group One sows than in Group Two (Table 1). Only 27% of Group One sows had any stillborn piglets, while 49% of Group Two sows delivered at least one stillborn pig. Group Two sows had a 2.8 times greater risk of having one or more stillborn piglets than did Group One sows.

In Group One, 11.5% of piglets weighed < 1 kg at birth. At 3 days of age, 8.4% of Group Two piglets weighed < 1 kg, compared to 11.5% for piglets in Group One ($P < .001$). Piglets weighing < 1 kg at birth or at 3 days of age had a greater likelihood of dying than piglets that weighed ≥ 1 kg (7.1% versus 5.3%; $P < .001$). As shown in Table 2, piglet mortality during 1 to 3 days of age was greater for Group One piglets than for Group Two piglets, but during 4 to 21 days of age was greater for Group Two than for Group One piglets. The number of piglets weaned and the overall preweaning mortality did not differ between Groups One and Two ($P > .05$).

Average weight was greater for Group One piglets than for Group Two piglets at 3 days and at 21 days of age (Table 2). However, weight variation was not affected by treatment: the coefficient of variation (CV) for weights at 3 days of age and at weaning for Group One piglets were 26.2% and 23.8%, respectively, while CVs for Group Two pigs were 27.3% and 24.6%, respectively. Both parity and litter size had a significant effect on weight at 3 days of age and 21 days of age ($P < .001$). As parity and litter size increased, weight at 3 days of age and 21 days of age were reduced. Piglet average daily gain to 21 days of age did not differ significantly between Group One and Two piglets ($P > .05$).

Discussion

The prevalence of stillbirths was lower for sows that were induced to farrow and provided with assistance on the day of farrowing than for sows that were not induced and provided with a minimal amount of assistance, an effect that was apparent across all parities. However, as this study further demonstrated, reducing the overall preweaning mortality requires more than 1 day of supervision, because the extra piglets that were born alive as a result of more intensive care at farrowing were lost during the following 3 days.

Birth weight has a significant influence on a pig's ability to survive and compete for a teat.[12] Small piglets have a greater surface-area-to-volume ratio, creating difficulty for thermoregulation, and also have less chance to compete against larger littermates

Table 1: Effect of farrowing induction and supervision on total and liveborn litter size (mean ± SE)*

Parameter	Group One	Group Two	*P*†
No. of sows	56	84	NA
Parity	6.4 ± 0.6	5.5 ± 0.5	> .05
Total-born litter size	11.8 ± 0.4	12.3 ± 0.4	> .05
Liveborn litter size	11.5 ± 0.4	11.4 ± 0.4	> .05
Stillborn	0.4 ± 0.09	1.0 ± 0.17	< .001

* Yorkshire × Landrace sows in a commercial farrowing facility were assigned to treatment at 114 days of gestation. Group One sows were induced by two intravulvar injections of 5 mg of prostaglandin $F_{2\alpha}$ (Lutalyse; Pfizer, Kirkland, Quebec, Canada) at 8:00 AM and 2:00 PM. Sows farrowing during the next working day (7:00 AM to 5:00 PM) were supervised and assisted as required. Group Two sows (controls) were not induced and farrowing was unsupervised.

† Poisson regression analysis.

NA = not applicable.

Table 2: Effects of farrowing supervision on piglet survival and preweaning growth (mean ± SE)*

Parameter	Group One	Group Two	*P*†
No. of litters	56	84	NA
Mortality, 1-3 days of age (%)	11.1 ± 1.8	4.1 ± 0.9	< .001
Mortality, 4-21days of age (%)	4.9 ± 1.0	7.7 ± 1.1	< .05
Weight, 3 days of age (kg)	1.9 ± 0.04	1.7 ± 0.02	< .001
Weight, 21 days of age (kg)	5.7 ± 0.06	5.5 ± 0.05	< .01

* Group One sows were induced as described in Table 1, and farrowing was supervised. Piglets were assisted as follows: placental membranes removed, airways cleared, umbilical cords ligated, dried with towels, ear notched for birth order and litter identification, and placed in a warm crèche until farrowing completed. In Group Two (controls), litters farrowed and started to nurse without assistance.

† Poisson regression analysis was conducted on mortality at 1-3 days of age and mortality at 4-21 days of age. A multi-linear regression model was used to determine differences in piglet weight at 3 and 21 days of age.

for available teats. In the present study, piglets that weighed < 1 kg either at birth or at 3 days of age were significantly more likely to die than piglets that weighed > 1 kg, even though the low-birth-weight Group One pigs were provided with nutritional support. It is clearly apparent that if low-birth-weight pigs are to survive until weaning, ongoing support will be necessary.

A concern with routine induction of farrowing is that some sows may be induced to farrow too early, resulting in underweight and immature piglets with lower viability. In this herd, sows were artificially inseminated on two consecutive days during their estrous periods, and gestation length was calculated from the day of first insemination. Ovulation and fertilization occur at variable times after breeding, resulting in possible miscalculation of the true gestational age of the fetuses. However, piglet viability did not appear to be compromised in the present study, since similar numbers of piglets were weaned in both groups and, indeed, piglets from induced sows were heavier at weaning than their non-induced contemporaries. A further potential concern, especially if farrowing is induced too early, is that fat and immunoglobulin concentrations in colostrum may be lower than in sows carrying their litters to term. However, limited evidence indicates that low levels in colostrum fat content are likely only when induction occurs more than 2 days before the due date, with no effect on immunoglobulin concentrations.[13] In contrast to the present study, others have noted no difference in stillbirth rates between induced and non-induced sows,[14] although these latter authors did not indicate provision of increased intervention and care to neonatal pigs. Others have indicated a high preweaning mortality,[15] although this is not usually observed. These latter studies highlight that there is little to be gained from inducing sows to farrow if there is no attempt to take advantage of having parturition take place during working hours and providing an increased level of supervision and assistance.

It is reasonable to believe that piglets provided with a good start through ensuring colostrum intake might grow slightly faster. Further, drying and keeping piglets warm directly after birth allows newly born piglets to maintain core body temperatures and improves teat-seeking behaviour.[6] Neonatal care is also important to ensure that all piglets receive adequate amounts of colostrum and milk. Assisting undersized, weak piglets that would normally have difficulty obtaining colostrum may help to control disease by ensuring a more even distribution of passive immunity.

Implications

- Prostaglandin $F_{2\alpha}$ given as a split dose into the vulval mucosa induces most sows to farrow by the end of the following working day, enabling provision of farrowing assistance.
- Induction of farrowing and provision of supervision on the day of farrowing can reduce stillbirths.
- Reducing overall preweaning mortality requires more than 1 day of supervision.

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