*Review Article*

# Induction of Parturition in Sows

**Roy N. Kirkwood**


## *Abstract*

When levels of neonatal mortality are considered too high or there is a need for relatively high levels of cross fostering, a protocol of induced farrowing should be implemented to facilitate farrowing supervision. Before implementing an induction protocol the normal gestation length for the farm should be established and sows not induced more than 2 days in advance. Earlier injections will result in low birthweight pigs with potentially compromised lung development. For optimal induction, inject prostaglandin or an analogue into the vulva at the label or 50% dose in the morning and again 6 to 8 hours later. Do not inject oxytocin routinely (e.g. at 24 hours after initial PGF injection) as this will increase stillbirths and neonatal mortality because the strong uterine contractions will cause blood flow restriction to the uterus with consequent fetal hypoxia. Injections of up to 10 IU oxytocin can be given strategically for potential problem sows and to older slower farrowing sows after the delivery of the 7$^{th}$ pig.


**Keywords:**, dystocia, farrowing, induction, prostaglandin F2α, oxytocin, sows

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## *Introduction*

***Why induce farrowing?:*** Before considering a farrowing induction program, it is prudent to first determine that there is a good reason for doing so. Some farms employ farrowing induction for convenience such as to minimize weekend farrowings. For others, it is possible that their farm records indicate an intervention level for apparent stillbirths (>8%) or the preweaning mortality is too high (>12%)? It is easy to think that pigs are born dead or alive while, in reality, there is large gray area between these two extremes. Problems during parturition may cut-off the oxygen supply to the piglet and kill it or the lack of oxygen may be non-lethal but result in poorer neonatal viability. Further, non-lethal anoxia may result in absent or reduced suckling with consequent compromised passive immunity, or possibly hypoglycaemia and chilling leading to overlaying of piglets. In either case, increased supervision of piglet delivery is indicated. Indeed, the provision of farrowing supervision can save an overall average of 0.5 pigs per sow (Holyoake et al., 1995).

Farrowing induction may also be employed because of a consistent need to cross-foster piglets; have a written protocol in place if cross fostering is to be employed. Also, realize that cross-fostering is an intervention that should be avoided unless necessary with the best place for any baby being with its mother. So if a sow has enough functional teats for her litter then her piglets should remain with her. Note that once a litter starts suckling, both the antibody content in colostrum and the piglet's ability to absorb antibodies drop precipitously (Klobasa et al., 1987). Although it is recommended that piglets should remain with their birth sow for at least 6 hours to allow transfer of immunoglobulins, for improved passive protection piglets should remain on their birth sow for at least 12 hours to allow transfer of leucocytes because the piglets absorb these immune cells only from their own sow and this takes 12 hours (Bandrick et al., 2011). Then, if necessary, move the largest piglets to a foster sow farrowing within a few hours of the donor sow.

Perhaps the most important reason to supervise farrowing is colostrum management. Pigs that do not receive sufficient amounts of colostrum because they are born weak, become chilled, or are pigs born into a very large litter, do not receive full passive protection. Consequently, these pigs are more easily infected with potential disease organisms that they, in turn, carry into the nursery to infect others as the passive immunity of their contemporaries' declines. Control programs for PRRS, PCVAD and even Glasser's disease are examples of situations where ensuring adequate colostrum uptake is emphasized.

***How to induce farrowing:*** Part of knowing how to induce farrowing is to know when to induce farrowing. If farrowing induction is to be employed it is important to not use industry average values for gestation length but to determine the average gestation length on the individual farm (which may vary from 112 to 117 days) and then do not induce more than 2 days before the due date. The pig fetus is unusual in that its lung development is almost exponential at the end of gestation; at 100 days of gestation none of the fetuses have entered the saccular phase but by about 114 days of gestation lungs are fully developed (Olsen, 1979). Therefore, a relatively small error in timing of parturition can result in a major deficiency of lung development. Corticosteroids are important for visceral maturation (Olsen, 1979) and their incorporation in an induction regime may prove beneficial under conditions where compromised lung maturity may be encountered. However, if induction is timed accurately there will rarely be an increase in low viability piglets. The composition of the colostrum from induced sows may suffer a slight but transient alteration but immunoglobulin content is not affected (Foisnet et al., 2011). Gilts will likely have a lower quantity and quality of colostrum compared to older sows and, therefore, while induction of gilts is unlikely to cause a problem it should be avoided if possible.

Periodic monitoring of natural (non-induced) gestation length should be performed, particularly on farms with a high staff turnover. Gestation length is often calculated from first breeding and depending on whether the sow is initially bred at the onset of estrus (and different personnel may differ in their subjective assessment of when estrus starts) or somewhat later, and appreciating that short wean-estrus intervals result in prolonged estrus to ovulation intervals (and vice versa), the initial sperm deposition may vary by more than 48 hours relative to ovulation. This will result in an apparent change in length of gestation. It would seem more rational to measure gestation length from the time of last breeding which is more likely to be closer to the time of ovulation.

The administration of prostaglandin F2α (PGF), or an analog, has long been known to be effective for the induction of parturition in sows. However, a large range in the interval between treatment and parturition can still be expected. While 80% to 90% of sows may farrow within 36 hours of injection, experience has shown that only 50% to 60% of these induced sows are likely to farrow during the working day and so be candidates for farrowing supervision (Kirkwood et al., 1996). If sows receive PGF but are not supervised during farrowing the cost of the PGF is borne by those sows that are supervised, effectively increasing the cost of treatment per supervised sow. The cost of farrowing induction can be reduced because we now know that if injected into the vulva, PGF at 50% (or even 25%) of the manufacturers recommended IM dose is equally as effective as the full IM dose (Kirkwood et al., 1996; Table 1). The reason for this has not been established but we do know that the blood vessels in this area are interconnected (Oxenreider et al. 1965) and the objective is to deposit PGF into the uterine vein which by countercurrent exchange will transfer to the ovarian artery and so arrive at the ovary to induce luteolysis. If deposition occurs into any blood vessel it is likely to be transferred to the uterine vein/ovarian artery; the net effect is a locally increased concentration of PGF compared to intramuscular injection with its 40% first-pass effect in the lung. If this route of injection is chosen, use a 12 mm, 20 g needle, or smaller. Initially, the injection site was the inside of the vulva lip but this is uncomfortable for the sow and could lead to hematomas. To avoid

these effects, the current preferred injection site is external at the vulva-cutaneous border; sows tolerate this well.

Other refinements are used in attempts to improve the predictability of parturition following PGF injection including injection of oxytocin, which has been associated with an increased myometrial contraction frequency, intensity and duration (Mota-Rojas et al., 2005). The injection of oxytocin approximately 20 to 24 hours after the injection of PGF causes a more rapid and synchronous onset of parturition but it also often causes an interrupted farrowing, ie., one piglet may be delivered but then farrowing stops, possibly for an hour or more, necessitating manual assistance (Welp et al., 1984; Table 2). The etiology of this effect has not been established but may be due to pain associated with forced delivery through an incompletely dilated cervix causing a release of adrenalin that binds to uterine adrenergic receptors and stops contractions. Interestingly, it has now been demonstrated that if oxytocin is given after delivery of the first pig when the cervix was is presumably fully dilated, an increase in dystocia may still occur although it is likely that the total duration of farrowing will be reduced. However, higher numbers of stillbirths will still be observed (Mota-Rojas et al. 2002). Further, the stillbirths were occurring among the first born pigs of the litter rather than the norm, whereby stillbirths occur in the last few pigs of the litter (Table 3). Uterine contractions transiently reduce uterine blood flow and the more frequent, longer lasting and stronger contractions induced by oxytocin cause more prolong restriction of blood flow, and hence hypoxia. The myometrial contraction-associated reduced uterine blood flow is associated fetal bradycardia and acidosis (Mota-Rojas et al., 2006), adversely impacting neonatal vitality. Also, the severe uterine contractions traumatize umbilical cords causing fetal anoxia, as evidenced by more piglets being born with meconium staining. Indeed, current measurements of neonatal vitality usually include a measure of meconium staining. Taken together, it is suggested that oxytocin not be used at farrowing except therapeutically in cases of slow farrowing. If a sow has not delivered a piglet in more than 30 min, consideration should be given to oxytocin injection. Similarly, if the farrowing is quite prolonged, especially with older sows if records indicate greater stillbirth rates, then consider oxytocin use after the 6$^{th}$ or 7$^{th}$ pig has been born. Although controlled studies have not been performed, with older sows that have a prior history of stillbirths, an injection of 20 mL calcium borogluconate to augment uterine contractions has been recommended.

**Table 1** Effect of dose and site of prostaglandin injection on time of farrowing

| | Full dose, IM | 50% dose, IM | 50% dose, vulva | 25% dose, vulva |
|---|---|---|---|---|
| Farrow 8-24 h, % | 19 | 12 | 18 | 15 |
| Farrow 24-32 h, % | 50 | 41 | 61 | 62 |
| Farrow >32 h, % | 31 | 47 | 21 | 23 |

Kirkwood et al. (1996)

**Table 2** Effect of oxytocin (OT) 20 hours after PGF on dystocia and timing of piglet delivery

| | Control | 10 IU | 20 IU | 30 IU |
|---|---|---|---|---|
| **Study 1** | | | | |
| Time to first pig, h | 2.8 | 0.8 | -- | -- |
| Delivery interval, min | 12 | 30 | -- | -- |
| **Study 2** | | | | |
| Farrowed by 42 h, % | 92 | 97 | 100 | 100 |
| Dystocia, % | 11 | 23 | 38 | 52 |

Welp et al. (1984)

**Table 3** Effect of oxytocin (OT) after delivery of the first pig on farrowing performance

| | Control | 30 IU | 40 IU |
|---|---|---|---|
| Dystocia, % | 5 | 10 | 20 |
| Liveborn | 8.3 | 8.7 | 8.7 |
| Stillborn (SB) | 0.3 | 0.6 | 0.6 |
| SB pigs 1-4, % | 0 | 70.8 | 40.0 |
| SB pigs 5-8, % | 16.6 | 8.3 | 20.0 |
| SB pigs ≥9 | 83.3 | 20.8 | 40.0 |

Alonso-spilsbury et al. (2004)

**Table 4** Effect of split-dose prostaglandin injections on timing of farrowing

| | Hours from PGF to start of farrowing | | |
|---|---|---|---|
| | 8-22 | 22-32 | >32 |
| Single dose | 17 | 56 | 19 |
| Split dose | 10 | 84 | 2 |

Kirkwood and Aherne (1998)

A further method shown to improve the predictability of farrowing is a double injection of PGF ('split dose'). With this technique, an injection of PGF is given in the morning and then a second PGF injection is given 6 to 8 hours later. When this is done, a higher proportion of sows farrowed the next day during working hours facilitating farrowing supervision (Table 4). As can be seen, the split-dose regime did not affect the proportion of earlier farrowing sows but did promote the farrowing of sows likely to have a longer treatment-to-farrowing interval (Kirkwood and Aherne, 1998). The etiology of this effect in not known for certain but what is possibly occurring is that a single PGF dose may induce a non-terminal luteolysis as indicated by an initial drop in circulating progesterone concentrations but then subsequent luteal recovery with associated increased progesterone concentrations.

## *Conclusion*

In conclusion, if levels of stillbirths or neonatal mortality are a concern then, if done correctly, farrowing induction will improve the ability to supervise piglet deliveries and potentially save an average of 0.5 pigs per litter. It is recommend to use the split dose injection (50% each time) but further recommend oxytocin be reserved for slow deliveries and/or after delivery of the 6$^{th}$ or 7$^{th}$ pig to ensure a prompt completion of farrowing.

## *References*

Bandrick M Pieters M Pijoan C Baidoo SK and Molitor TW 2011. Effect of cross-fostering on transfer of maternal immunity to Mycoplasma hyopneumoniae to piglets. Vet Rec. 168:100-105.

Foisnet A Farmer C David C and Quesnel H 2011. Farrowing induction induces transient alterations in prolactin concentratins and colostrum composition in primiparous sows. J Anim Sci. 89:3048-3059.

Holyoake PK Dial GD Trigg T and King VL 1995. Reducing pig mortality through supervision during the perinatal period. J Anim Sci. 73:3543-3551.

Kirkwood RN Thacker PA Aherne FX and Goonewardene LA 1996. The effect of route of administration of prostaglandin F2a on the parturient response of sows. Swine Health Prod. 4:123-126.

Kirkwood RN and Aherne FX 1998. Increasing the predictability of cloprostenol-induced farrowing in sows. Swine Health Prod. 6:51-55.

Klobassa F Werhahn E and Butler JE 1987. Composition of sow milk during lactation. J Anim Sci. 64:1458-1466.

Mota-Rojas D Martinez-Burnes J Trujillo-Ortega ME Alonso-Spilsbury ML Ramirez-Necoechea R Lopez A 2002. Effect of oxytocin treatment in sows on umbilical cord morphology, meconium staining, and neonatal mortality of piglets. Am J Vet Res. 63:1571-1574.

Mota-Rojas D Martinez-Burnes J Trujillo ME Lopez A Rosales AM Ramirez R Orozco H, Merino A and Alonso-Spilsbury M 2005. Uterine and fetal asphyxia monitoring in parturient sows treated with oxytocin. Anim Reprod Sci. 86:131-141.

Mota-Rojas D Trujillo ME Martinez J Rosales AM Orozco H Ramirez R Sumano H and Alonso-Spilsbury M 2006. Comparative routes of oxytocin administration in crated farrowing sows and its effects on fetal and postnatal asphyxia. Anim Reprod Sci. 92:123-143.

Olsen EB Jr 1979. Role of glucocorticoids in lung maturation. J Anim Sci. 49:225-238.

Oxenreider SL McClure RC Day BN 1965. Arteries and veins of the internal genitalia of female swine. J Reprod Fert. 9:19-27.

Welp C Jochle W and Holtz W 1984. Induction of parturition in swine with a prostaglandin analog and oxytocin: A trial involving dose of oxytocin and parity. Theriogenology 22:509-520.

# บทคัดย่อ

## การเหนี่ยวนำการคลอดในแม่สุกร

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เมื่ออัตราการเสียชีวิตของลูกสุกรแรกเกิดมีมากเกินไป หรือมีความจำเป็นต้องทำการย้ายฝากลูกสุกรเป็นจำนวนมาก จึงควรทำข้อกำหนดวิธีการคลอดด้วยการเหนี่ยวนำเพื่อช่วยเหลือดูแลเรื่องการคลอด ก่อนที่จะดำเนินการตามเข้อกำหนดวิธีการเหนี่ยวนำ ควรกำหนดระยะเวลาการตั้งท้องปกติของฟาร์ม และไม่ควรเหนี่ยวนำแม่สุกรล่วงหน้านานกว่าสองวัน การฉีดยาเร็วเกินไปจะส่งผลให้ได้น้ำหนักแรกเกิดของลูกสุกรน้อยลง พร้อมกับมีแนวโน้มที่การพัฒนาของปอดจะมีความบกพร่อง เพื่อให้การเหนี่ยวนำมีความเหมาะสมที่สุด ให้ฉีดพรอสตาแกลนดินหรือสารที่คล้ายกันเข้าทางอวัยวะสืบพันธุ์ด้วยขนาดยาตามที่ระบุไว้บนฉลากหรือ 50% ของขนาดดังกล่าวในตอนเช้า และฉีดซ้ำอีกครั้งใน 6 หรือ 8 ชั่วโมงถัดไป อย่าฉีดออกซิโตซินเป็นประจำ (เช่น 24 ชั่วโมง ภายหลังการฉีด PGF) เพราะจะทำให้เพิ่มการตายระหว่างคลอดและอัตราการตายของลูกสุกรแรกเกิด เนื่องจากมดลูกบีบตัวแรงเกินไปทำให้จำกัดการไหลเวียนของเลือดไปยังมดลูก จึงทำให้ลูกสุกรอยู่ในภาวะขาดออกซิเจน ออกซิโตซินสูงถึง 10 ไอยูสามารถฉีดให้แก่แม่สุกรที่มีปัญหาและแม่สุกรอายุมากที่คลอดช้าลงหลังจากลูกสุกรตัวที่เจ็ด

**คำสำคัญ:** การคลอดยาก การคลอดลูก การเหนี่ยวนำ พรอสตาแกลนดินเอฟทูแอลฟ่า ออกซิโตซิน แม่สุกร

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