Inducing Farrowing in Sows by PGF$_2$ alpha and Its Analogues

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Abstract

Prostaglandins F2alpha (PGF$_{2\alpha}$) or its analogues (e.g. cloprostenols and D cloprostenol) have been used to induce farrowing worldwide in pig farms, including in Thailand. However, the dose, route of administration and timing of injection of these hormones are still controversy. Therefore, the aim of this review is to provide information based on literature search and some experiments which are performed by the authors. The crucial topics are as follows: stillbirth, leading reasons for inducing farrowing, prostaglandins and its analogue, dose and route of administration and how to shorten the duration of farrowing. The dose, route of administration and timing of injection for each hormone will also be mentioned.

Keywords: cloprostenol, inducing farrowing, prostaglandins, sow

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Introduction

The use of prostaglandins F2alpha (PGF2α) or its analogues (e.g. cloprostenols and D (R) cloprostenol) for the induction of farrowing has been successfully and widely used worldwide in pig farms, including in Thailand. The advantages are to improve batch farrowing and also induce farrowing on daytime in which the farmers are convenient to supervise farrowing of sows; rapid assistance may be given to sows which may have difficulty or dystocia. This results in safer delivery of piglets and thereby reduces piglet mortality or stillbirth. Pre-weaning piglet mortality rates 10-15% on average and may touch 30% in some herds (Vaillancourt et al., 1992; Straw et al., 1998). Most of this piglet loss occurs during the first 3 days postpartum, which primarily occur during the first few hours of life (Straw et al., 1998). Stillbirths (Fig 1) remain a primary problem in intensive pig farming and may account for 5-10% (Tantasuparuk et al., 2000; van der Lende et al., 2001; Lucia Jr et al., 2002; Leenhouwers et al., 2003; Tummaruk et al., 2004; van Dijk et al., 2005).

Asphyxia during delivery is one of the most important causes for piglet intra-partum mortality (Randall, 1972; Edwards, 1977 and Hughes, 1992). Although the piglet is considered a relatively mature neonate at birth, it seems to be more sensitive to anoxia than other neonates (puppies and kittens) that are considered immature (Stanton and Carroll, 1974). Piglet fetuses have a very little tolerance to anoxia due to asphyxia and irreversible brain damage that occurs during the first 5 min after the rupture of the umbilical cord which obstructs blood flow, and interrupts communication to its mother (Curtis, 1974). With regard to Sprecher et al. (1974), stillbirths can be classified into two types: type I or deaths which includes fetuses that die before the end of gestation (before the farrowing process begins), usually of infectious causes, and are pre-partum deaths. Type II, also referred to as intrapartum stillbirth (IPS), are animals that die during parturition and are intra-partum deaths. Type II deaths are usually from non-infectious causes. Prolonged farrowing is the most common cause of type II stillbirths (Sprecher et al., 1974). The cause of intrauterine fetal death can be explained by the following schematic (Fig 2).

![Figure 1 Stillborn piglet with meconium stained on its skin](image1)

![Figure 2 Pathogenesis of intrauterine fetal death and intrapartum death (stillborn piglet)](image2)
Taken together, the leading reasons for inducing farrowing in intensive pig farming are as follows:
- To reduce number of stillborn piglets,
- To diminish the case of prolonged farrowing process,
- To reduce the variation in the day of farrowing among sows within the house,
- To reduce age variation in weaned piglets
- To enhance cross-fostering (if need)
- To facilitate all in/all out farrowing house management.

Prostaglandins and its analogue

Prostaglandins, e.g. dinoprost, luprostiol, cloprostenols and D (R)-cloprostenol have been used in pig industry for many years. However, in the present review we only focus on dinoprost, cloprostenol and D (R)-cloprostenol (Fig 3).

Several studies of injecting PGF$_{2\alpha}$ or one of its analogues in combination with or without oxytocin have been carried out, indicating that more than 80% of sows will farrow within 36 hours of an intramuscular (IM) injection of PGF$_{2\alpha}$ or its analogues administered at 112-114 days of gestation (1-2 days before farrowing) (Cameron et al., 2000; Keïta et al., 2002; Balogh and Bilkei, 2003). It has also been shown that inducing parturition in the sow using PGF$_{2\alpha}$ (full dose = 10 mg) or cloprostenol (Estrumate®, full dose = 175 µg) in combination with oxytocin (10-20 IU) resulted in increasing (i.e. more than 85% of sows farrowed within 36 hours of an injection, Intramuscular route) the expectedness of parturition (Chantaraprateep et al., 1986; Balogh and Bilkei, 2003).

Recently, Mota-Rojas et al. (2002, 2005) and Alonso-Spilsbury et al. (2004) reported that injecting oxytocin (i.e. 20-50 IU) during parturition not only had a significant decrease in farrowing time (i.e. shortening farrowing duration) and expulsion intervals but also had a significant higher number of stillborn piglets per litter, number of piglets with ruptured and hemorrhagic umbilical cords. Although using PGF$_{2\alpha}$ and its analogues alone or in combination with oxytocin to induce farrowing has proven efficacious, many pig farmers decline to use these hormones due to extraordinary price per dose of PGF$_{2\alpha}$ and cloprostenols.

**Figure 3** Structures of PGF2alpha and its analogue (cloprostenol)

**Dose and Route of administration**

It is now established that injecting PGF$_{2\alpha}$ at half of manufacturer’s recommended dose into the vaginal mucosa is as effective as an intramuscular injection (IM, neck region, Fig 4) at full recommended dose for inducing parturition in sows (Koh et al., 1986; Perestrelo and Perestrelo, 1986; Friendship et al., 1990). It has also been reported that injection of PGF$_{2\alpha}$ (Lutalyse®, half dose = 5 mg) or cloprostenol (Planate®, half dose = 88 µg) into the perianal region (at about 4-or 8-o’clock position) is as effective as a route of administration into vaginal mucosa (Kirkwood et al., 1996). Cloprostenol exists optically active isomers (d-cloprostenol and l-cloprostenol) and racemic mixture, dl-cloprostenol (Kral et al., 1989). Recently, it has been shown that d-cloprostenol (i.e. D(R)-cloprostenol) is approximately 10 times more potent than cloprostenol (Re et al., 1994). Regularly, when D(R)-cloprostenol is used, a lower dosage could be given than that required for dl-cloprostenol.

More recently, Kaeoket (2006) and Chanapiwat and Kaeoket (2008) reported that injecting PGF$_{2\alpha}$ or Cloprostenol, D ® cloprostenol at half of recommended dose into the vulva region

**Figure 4** Administration of PGF$_{2\alpha}$ or its analogues into the neck region (Intramuscular, IM) to induce farrowing in sows

**Figure 5** Administration of PGF$_{2\alpha}$ or its analogues into perivulva region (at about 3-or-9-o’clock position) to induce farrowing in sows (at about 9-or 15-o’clock position, Fig 5) is as effective as an intramuscular injection (IM, neck region) at full recommended dose for inducing parturition in sows. More details of this experiment are presented in
Tables 1 and 2. It is interesting, for the case of Dinoprost injection, that the restlessness (behavior such as pawing floor and chewing the crate) diminished when half the dose is applied at the vulva region, comparing with the full dose. However, such behaviors are not observed in case of cloprostenol or D (R) cloprostenol injection. The reason might be explained by the study in pig that PGF2 alpha treated female pigs had significantly higher levels of c-fos mRNA expression in hypothalamic paraventricular nucleus, neural lobe of pituitary gland and cerebellum (indicating transcriptional activity in the brain) and also in corpora lutea (Burme et al., 2002). As a result, pre-farrowing restlessness of sows found in our study may be, at least, explained by the increased level of c-fos mRNA expression in the brain. Furthermore, what we realized from this experiment is that the sows were injected with D cloprostenol at 7 am on the day before expected farrowing were more likely to start farrowing earlier (<24 hours after injection) than the sows that were injected at 7 am with dinoprost or cloprostenols.

Shortening the duration of farrowing

As mention before, it has also been shown that inducing parturition in the sow using PGF2α (full dose = 10 mg) or cloprostenol in combination with oxytocin (10-20 IU) resulted in increasing (i.e. >85% of sows farrowed within 36 h after an injection) the predictability of parturition (Balogh and Bilkei, 2003). In addition, Alonso-Spilsbury et al. (2004) reported that injecting oxytocin (i.e. 20-50 IU) during parturition not only had a significant decrease in farrowing time and expulsion intervals but also had a significant higher number of stillborn piglets per litter, number of piglets with ruptured, number of piglets with hemorrhagic umbilical cords and number of piglets with meconium staining on the skin (Figs 6, 7, 8). In contrast, Kaeoket (2006) and Chanapiwat and Kaeoket (2008) demonstrated that injecting oxytocin (i.e. 20 IU) at 24 hours after administration of PGF2α or D cloprostenol did not affect the duration of farrowing and had no negative effect on number of piglet designated as stillbirth, abnormal umbilical cord morphology and meconium staining. This might be due to the fact that the latter study used the recommended dose of oxytocin (i.e. 10-20 IU).

Table 1 Comparing all parameters after induce farrowing in sows by PGF2alpha (Dinoprost) and its analogue (R-cloprostenol and Cloprostenol) (modified from Kaeoket, 2006; Chanapiwat and Kaeoket, 2008)

Table 6 Umbilical cord of the piglets at birth designated as hemorrhage
Table 2 Numbers of sows farrowed at different durations from injection to farrowing (< 24 h; 24-30 h; >30 h) (modified from Kaeoket, 2006; Chanapiwat and Kaeoket, 2008)

<table>
<thead>
<tr>
<th>Duration from injection to farrowing</th>
<th>R - Cloprostenol</th>
<th>Dinoprost tromethamine</th>
<th>Cloprostenol</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>75 mg (IM)</td>
<td>26 μg (perivulva)</td>
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<td>36 μg (perivulva)</td>
<td>7.2 μg (IM)</td>
<td>7.2 μg</td>
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<tr>
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<td>36 μg (perivulva)</td>
<td>3.6 μg (IM)</td>
<td>3.6 μg</td>
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<tr>
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<td>10 mg (IM)</td>
<td>5 mg</td>
</tr>
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</tr>
<tr>
<td>&gt; 30 h</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Figure 7** Umbilical cord morphology of the piglets at birth designated as normal, congestion, oedema and haemorrhage

**Figure 8** Meconium staining on the body surface of the piglets at birth designated as unstained, slightly stained (25% of body surface area), moderately stained (50% of body surface area), and severely stained (more than 50% of body surface area)

**Conclusion**

The present review addressed that half recommended dose of cloprostenols or dinoprost administered into the perivulva region were effective for inducing farrowing in sows as the full recommended dose administered into the neck region (IM). Restlessness was only observed when using the full dose of dinoprost (10 mg), however this behavior is diminished when using half the dose of dinoprost (5 mg). No restlessness is observed when using D (R)-cloprostenol or cloprostenol to induce farrowing in sows.

**Implication**

In practice, the time of D-cloprostenol (Preloban®) injection need to be corrected (time of injection should be at 10 am instead of at 7 am), for Cloprostenol (Planate®) and dinoprost (Lutalyse®) the time of injection (i.e. at 7 am) is reasonable, in order to allow veterinarian or pig farmers to assist the sows that are having a difficult farrowing at day time, to supervise colostrum intake, or to perform cross fostering piglets (if need).

**Acknowledgements**

Cloprostenol (Planate®), D-cloprostenol (Preloban®) and Dinoprost tromethamine (Lutalyse®) for this study were generously provided by Intervet-Schering-Plough Animal Health (Thailand) Ltd. and Pfizer Animal Health (Thailand) Ltd., respectively.

**References**


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