Establishing Criteria for a Method to Automatically Detect the Onset of Parturition and Dystocia in Breeding Pigs

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Establishing Criteria for a Method to Automatically Detect the Onset of Parturition and Dystocia in Breeding Pigs

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The aims of the present study were to characterize the farrowing process in gilts and multiparous sows in terms of duration of farrowing, birth intervals, birth weight, piglets born alive, stillbirth, mummified and dystocia by comparing means in terms of parities, and to establish criteria for a method to automatically detect the first birth and dystocia in breeding pigs for a selected farm in South Korea. One hundred nine Yorkshire x Landrace; YL, Landrace x Yorkshire; LY which were mainly raised in South Korea were used for this study (31 breeding pigs for parity 1; 48 breeding pigs for parity 2 to 6; 30 breeding pigs for parity 7 to 12). Though the results varied from one another, we didn't find any statistical significant differences within the observed parameters from the different parities studied. Given that our findings were still within the range values of the previously published works therefore our results can be a useful tool to establish a criterion to characterize the process of parturition. In this present study, we were able to established a criteria about the onset of birth by the observation that if a first discharged object is detected from a sow that weighs more than 400 g, it can be confirm that she is already been undergoing the process of farrowing and the good criterion to consider that a sow is undergoing dystocia is an interval of more than 30 min. Moreover, we believe that the parity of breeding pigs is not necessarily required in establishing criterion in detecting the onset of farrowing and dystocia because we found no significant difference results among the different parities studied. In this paper we just aimed to establish a criteria for a method to automatically detect the onset of parturition and dystocia in breeding pigs with an specific breed, location and season, therefore, we acknowledge that our findings may not be considered as the general criteria to a method to detect the onset of birth and dystocia in breeding pigs, to all type of parturition and to all breeds however we believed that it can be a useful tool to evaluate our newly developed automatic parturition detecting device which is now currently on progress and which will be tested on the same experimental farm and during the specified seasons.

INTRODUCTION

The process of giving birth is a stressful event for the sow as well as for the newborn piglets. On this process, the sow will undergo a cascade of hormonal changes associated with cervical ripening and dilatation, uterine contractions, fetal positioning and expulsions, detachment and expulsion of placentae, and care and nutrition of the piglets (First and Bosc, 1979; Taverne, 1992). For the newborns, the birth process can be a struggle for life and death. Approximately 8% of the newborn piglets are stillborn and approximately 75% dies during parturition, which predominantly a result of prenatal asphyxiation experienced in utero or during delivery (Van der Lende *et al*., 2001).

Preweaning mortality rates are often >10% in countries where the level of supervision at farrowing is low. Knowledge of factors, traits and processes influencing the duration and ease of farrowing is therefore important. It is well known that animals such as cows, mares, pigs, etc. often needs assistance during parturition in order to assure safe birth. However, in most cases, the attendant cannot be continuously present for assistance in the proximity of a pre–parturient animal or upon delivery, particularly during the night when he sleeps and when most of the births occur, therefore, the onset of parturition should be automatically detected and an alert system that is remotely given to the attendant is a great help so that he can assist delivery of the pregnant animal. For this reasons, there is a considerable demand for a method and for a device for a reliable monitoring of parturition in animals for the reduction in the loss of animals through death, through wounding or through any other devaluation and to decrease the manpower required for the subjective monitoring.

This study is an attempt to establish a criterion for a method to automatically detect the onset of parturition and dystocia in breeding pigs. The aims of the present study were to characterize the farrowing process in gilts and multiparous sows in terms of duration of farrowing, birth intervals, birth weight, piglets born alive, stillbirth, mummified and dystocia by comparing means in terms parities and to establish criteria for the evaluation of our newly developed automatic parturition detecting device that can detect the onset of parturition and dystocia in breeding pigs in South Korea.

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MATERIALS AND METHODS

Animals and treatment

The breeding pigs were raised from the selected commercial farm in South Korea. They were housed in four groups with similar body weights. The animals were checked once a day (16:00) for estrus by back pressure test in presence of an adult boar. When the animals showed their fourth estrus, they were artificially inseminated twice with an interval 24 h with semen of Duroc boars. The gilts were carefully selected from the herds were artificially inseminated at average age of 240 days. All pregnant pigs were fed 1.3 to 1.5 kg commercial ration (12.56 MJ metabolizable energy kg^{-1}, crude protein 144 g kg^{-1}, ideal digestible lysine 7.5 g kg^{-1}) twice daily at 07:30 and 16:30. The animals were moved to the farrowing units 7 days prior to farrowing. They were not fed on the day of farrowing, but had ad libitum access to water.

Housing and environment

During gestation period, the animals were housed in an individual gestation stalls. They were transferred to the individual farrowing pens approximately 7 days prior to estimated farrowing day. The size of the farrowing pens was 240 × 160 cm in a windowless farrowing house with the slatted floor pens. The size of the farrowing crates was 210 × 160 cm. The farrowing house was mechanically ventilated by fans. An infrared lamp (250 W) was also installed above each creep area. It was turned on when room temperature was observed below 30 °C from the estimated farrowing day until weaning.

Data collection

All the data were collected from April to September 2009 (during spring, summer, and fall). One hundred nine breeding pigs (Yorkshire x Landrace; YL, Landrace x Yorkshire; LY) were used for this study (31 breeding pigs for parity 1; 48 breeding pigs for parity 2 to 6; 30 breeding pigs for parity 7 to 12). In order to collect farrowing data in terms of the first birth time, duration of farrowing, birth intervals, birth weight, piglets born alive, stillbirth, mummified and hard labor, many observers were located at the rear of the animals around 5 a.m. of the estimated farrowing day. They visually confirmed the farrowing process and recorded birth time by using watches and birth weight by using scales. A veteran caretaker, who has been working for ten years in the experimental farm injected oxytocin via intramuscular (20 IU) when he observed that the interval was already over 30 min after the first birth had occurred without giving birth to another pig or without expelling membranes that indicate farrowing is completed (England *et al*., 2001) and also regarded some farrowing process as dystocia based on other reasons. The dystocia were determined based on he's judgment and according to the sow's previous records.

Statistical analysis

Piglets born alive, piglets weighed less than 800 g, stillborns, mummys, birth weight, duration, and birth interval were statistically analyzed using the ANOVA procedure of SAS (SAS Institute Inc., Cary, NC, 1999) including the effect of parity. The arrangement, sorting, and getting proportion were conducted using Microsoft Office Excel 2007 (Microsoft, USA).

RESULTS AND DISCUSSION

The descriptive statistics were presented in Table 1. Of the total of 1,245 piglets born, 1,197 piglets were born alive (96.2%; 10.9 ± 2.49 head $litter^{-1}$), 3 piglets born weighed less than 800 g (0.2%; 0.0 ± 0.21 head $litter^{-1}$), 27 were stillborn (2.2%; 0.2 ± 0.49 head $litter^{-1}$), and 18 were mummified (1.4%; 0.2 ± 0.44 head $litter^{-1}$) from the total of 109 farrowings of the 31 primiparous sows (parity 1) and 78 multiparous sows (48 from parity 2–6 and 30 from parity 7–12).

The rate of piglets born alive in this study is relatively high compared to the result in the previous literature that range from 9.8 to 10.3 head $litter^{-1}$ (Jeon *et al*., 2006). The stillbirth rate (2.2% of the total number of piglets born) is also relatively low compared to findings in previous literature that range from 7.6 to 12.6% (Leenhouwers *et al*., 2003 and Lucia *et al*., 2002) and from the review of Van Der Lende *et al*., 2001 (3–8%). It appears that this low overall mortality rate at birth is mainly caused by the extremely low percentage of mummified and stillborn piglets per litter from all parities studied. These positive results may due to the breed that we used in this study which is the Yorkshire x Landrace; YL, Landrace x Yorkshire; LY. Van Dijk *et al*. (2005), found significant differences between litters derived from different breeds, housed in the same farm (for example, Large White and Dutch Landrace litters), which underlines the presence of breed effect. However, the variable breed has to be interpreted with care because, next to the genetic background, factors like farm management and environment can be involved indirectly as there may be different approach among herd managers.

Overall, mean duration of the expulsive stage among the three group parities (187.2, 162.3 and 161.0 min) and mean individual birth intervals (17.1, 14.9 and 14.5 min) from parity 1, 2–6 and 2–7 respectively, are well within the range previously reported with values, which vary from 156 to 262 min for duration of expulsive stage (Randal, 1972 and von Klocek, 1992) and from 15.2 to 22.4 min for birth intervals (von Klocek, 1992 and Hoy and Lutter, 1995). Moreover, average duration of farrowings and birth interval had been reported previously for sow of different (cross) breeds (e.g., Jones, 1966; Randall, 1972; Zaleski and Hacker, 1993; Leenhouwers *et al*., 2001, Mota–Rojas *et al*., 2002; Wulbers–Mindermann *et al*., 2002). In the present study, the average duration of farrowing and birth interval were relatively low compared to the previously published studies, that varied from 140 (Fahmy and Flipot, 1981) to 355 min (Cavalcanti *et al*., 1979) and 15.1 (Cronin *et al*., 1993) to 28.5 min (Mota–Rojas *et al*., 2002), respectively. This might be due to the fact that the experimental animals were crossbreds. Klocek *et al*., 1992, for example reported that

Table 1. Descriptive statistics of the Yorkshire x Landrace crossbred (YL) and Landrace x Yorkshire crossbred (LY) sows

Item	Dam group			
	Parity : 1	Parity : 2–6	Parity : 7–12	Overall
No. of dams (head)	31	48	30	109
Piglets born alive (head litter^{-1})	11.0 ± 2.26[2)]	10.9 ± 2.72	11.1 ± 2.40	10.9 ± 2.49 (96.2%)
Piglets weighed less than 800 g (head litter^{-1})	0.0 ± 0.00	0.0 ± 0.00	0.1 ± 0.40	0.0 ± 0.21 (0.2%)
Stillborns (head litter^{-1})	0.1 ± 0.43	0.3 ± 0.49	0.3 ± 0.55	0.2 ± 0.49 (2.2%)
Mummys (head litter^{-1})	0.2 ± 0.48	0.2 ± 0.50	0.1 ± 0.25	0.2 ± 0.44 (1.4%)
Birth weight (kg head $^{-1}$)	1.23 ± 0.218	1.33 ± 0.304	1.41 ± 0.231	1.3 ± 0.270
Farrowing time (min)	187.2 ± 75.39	162.3 ± 79.42	161.0 ± 43.20	169.0 ± 70.41
No. of dams involved in dystocia[1)] (head)	2 (6.5%)	11 (22.9%)	9 (30.0%)	22 (20.2%)
Interval between piglet births in normal parturition (min)	17.1 ± 15.36	14.9 ± 22.15	14.5 ± 13.50	15.38 ± 18.14
Interval between piglet births in hard labor (min)	45.8 ± 11.09	64.0 ± 30.91	47.1 ± 12.67	52.5 ± 32.79

[1)] Hard labor was based on the injection of oxytocin by a farmer.
[2)] Mean ± SD.
* All means in the same row are not different at α = 0.05.

crossbred sows had significantly lower birth interval (20.43 ± 0.92 min) than purebreds (23.78 ± 1.09 min). On the other hand, the lack of influence of the parity of sow on the duration of farrowing agrees with the work of Fahmy and Friend (1981). The expectation was, however, that gilts take long to farrow due to some farrowing problems and their tendency to savage (Tavern, 1992) that seems to be the case in this study.

The observation that average birth weight affected duration of farrowing agrees with the Mungate *et al.* (1999) though not statistically proven, who showed that there is a variation of litter birth weight between different parities and this subsequently affects duration of farrowing. In the present study, as the average birth weight increases, the farrowing time decreases. However, Van Rens and Van der Lende (2004), reported that neither average birth weight, litter birth weight nor within–litter standard deviation influenced the duration of farrowing.

We also observed in this study, although not statistically proven, that parity affected the birth interval, is in agreement from the previous reports that birth intervals are expected to increase with parity due to the reduction in uterine muscle tone in older sow (Gordon, 1997; Merck Veterinary Manual, 2003). The observed variations in birth intervals in this study could have been due to the fact that the data were collected over 12 parities, however, the within–parity variation could indicate sow genetic differences (Motsi *et al.*, 2006).

Gestation length (van Rens and van der Lende, 2004; van Dijk, 2005; Motsi *et al.*, 2006), birth order (van Rens and van der Lende, 2004; Motsi *et al.*, 2006), presentation of the piglet (anterior or posterior) (van Dijk, 2005), placental expulsion and placental traits (van Rens and van der Lende, 2004), and housing and environment (Oliviero *et al.*, 2008) which has also been reported to influence the birth intervals and duration of farrowing in sows, was, however, not examined in this study.

The distribution of birth intervals by parity and between normal parturition and dystocia is presented in Table 1. A rule of thumb, not universally recommended but widely followed, is to administer oxytocin when the first interval of 30 min after birth of the previous pigs has occurred without giving birth to another pig or without expelling membranes that indicate farrowing was completed (England *et al.*, 2001). Given that the sows in normal parturition showed so many intervals of more than 30 min from this study, we believe that the good criterion to consider that a sow is undergoing dystocia is an interval of more than 30 min. Therefore if our detecting device detects an interval of more than 30 min from the first detected piglet then it will automatically give an alarm to the caretaker that a sow is undergoing dystocia.

The frequency distribution of the first discharged object at the onset of farrowing is presented in Table 2. The rate of piglets weighed less than 800 g was 0.2% and the minimum weight of them was 400 g. Of the total of 109 sows, only one sow from parity 2–6 (0.9%) was involved to first discharge a mummy at the onset of farrowing and the rest (99.1%) first discharged were normal piglets. Based on these results, if a first discharged object detected from a sow that weighs more than 400 g, it can be confirm that she is already been undergoing the

Table 2. Frequency distribution of the first discharged object among the normal piglet, stillborn and mummys at onset of farrowing

Item	Dam group			
	Parity : 1	Parity : 2-6	Parity : 7-12	Overall
No. of dams used (hd)	31	48	30	109
No. of dams which first discharged a normal piglet (head)	31 (100%)	47 (97.9%)	30 (100%)	108 (99.1%)
No. of dams which first discharged a stillborn (head)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
No. of dams which first discharged a mummys (hd)	0 (0%)	1 (2.1%)	0 (0%)	1 (0.9%)

process of farrowing. Therefore, if our detecting device detects an object weighing more than 400 g then it will automatically give an alarm to the caretaker that the parturition already started.

Although the results varied from one another, we didn't find any statistical significant differences within the observed parameters from the different parities studied. However, we believe that our results can be useful tool to establish a criterion for a method to detect the onset of birth and dystocia during parturition process for a selected commercial farm in South Korea. Given that our findings were still within the range values of the previously published works like for example in the overall mean duration and birth intervals. Based on these results and from our observations is concern, we believed that to established a criteria for a method of an automatic detecting device to detect the onset of parturition is to consider that if a first discharged object that weighs more than 400 g is detected from a sow, it can be confirm that she is already been undergoing the process of farrowing and the good criterion to consider that a sow is undergoing dystocia is an interval of more than 30 min. Moreover, we believed that the parity of breeding pigs is not necessarily required in establishing criterion of a method to automatically detect the onset of farrowing and hard labor because we found no significant difference results among the different parities studied.

CONCLUSIONS

In this paper we just aimed to establish a criteria to detect the onset of parturition and the dystocia with an specified breed (Yorkshire x Landrace; YL, Landrace x Yorkshire; LY), location and season, therefore, we acknowledge that our findings may not be considered as the general criteria for a method to detect the onset or dystocia in breeding pigs, in all type of parturition and to all breeds however we believed that it can be a useful tool to evaluate our newly developed automatic parturition detecting device which is now currently on progress which will be tested on the same experimental farm, animals and seasons. Although, the criteria that we just established in this study may be useful only to the experimental farm where we conducted the study however the results that we had gathered here were generally observed already from the previous studies specially regarding the minimum weight of the piglet and on when to consider that a sow is undergoing dystocia. Moreover we are considering in future to conduct similar studies in a larger scale and improvised experimental design to develop more reliable criteria that can be useful on the evaluation of our newly developed automatic parturition detecting device.

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