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Nest-building in sows: Effects of farrowing housing on hormonal modulation of maternal characteristics

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ABSTRACT

Prepartum nesting opportunities may improve maternal characteristics and welfare of sows during parturition and lactation. We investigated the effects of provision of space and nesting material prior to parturition on circulating oxytocin concentrations, maternal characteristics and their interrelation in early lactating sows. A total of 33 sows were kept in: 1) CRATE: the farrowing crate closed (210 × 80 cm) with provision of a bucketful of sawdust, 2) PEN: the farrowing crate opened with provision of a bucketful of sawdust, 3) NEST: the farrowing crate opened with provision of abundant nest-building materials. Sow blood samples were collected for hormonal assays via indwelling ear vein catheters on days −3, −2, −1, +1, +2, +4, and +7 from parturition, twice a day. Pigs were video-recorded for 24 h on days 3 and 6 of lactation to assess nursing and maternal behaviour. During the periods from days −3 to −1 and from days −3 to +7, NEST brought about an increase in sow oxytocin concentrations compared with CRATE and PEN ($P < 0.05$), and prolactin concentrations in NEST sows were also greater than for CRATE sows during those periods ($P < 0.05$). From days 1 to 7 of lactation, prolactin concentrations were positively correlated with oxytocin concentrations ($r = 0.39$, $P < 0.0001$). The average duration of all nursings ($P < 0.05$) and of successful nursings only ($P < 0.01$) were longer for CRATE than for PEN and NEST sows. The incidence of carefulness behaviour towards offspring for NEST sows was greater than for sows from the other treatments for the mean of days 3 and 6 of lactation ($P < 0.001$), and was correlated with oxytocin concentrations during the 7 days after parturition ($r_s = 0.26$, $P < 0.01$). In conclusion, provision of abundant nesting materials to sows prior to parturition could increase plasma oxytocin concentrations. This would result in improved nursing performance and maternal behaviour during early lactation.

1. Introduction

Farrowing crates have been designed and widely used in commercial pig husbandry, in order to reduce the number of piglets crushed and labour and space requirements, and thus better meet requirements for productivity improvement. This controversial practice, however, has caused inhibition in nursing behaviour (Herskin et al., 1999) and

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maternal reaction towards offspring (Thodberg et al., 1999, 2002b; Jarvis et al., 2004), an increase in the stress level of sows (Thodberg et al., 2002a; Jarvis et al., 2004) and has thus raised welfare concerns (Wiepkema and Koolhaas, 1993).

Prepartum sows display a natural pattern of nest-building behaviour such as foraging, rooting and pawing, expressing the desire to build a shelter for protecting their offspring against predators and cold (Wischner et al., 2009). However, there is little possibility to perform these natural activities in farrowing crates due to the lack of space, material or both. In order to understand the effects of nest-building possibilities on sow performance, several studies on perinatal environmental enrichment materials in pigs attempted to demonstrate a connection between nest-building behaviour of the sow and farrowing and lactating success (Herskin et al., 1999; Jarvis et al., 2004; Chaloupkova et al., 2010). Nevertheless, it is still unclear why the presence of prepartum nesting materials improves nursing and maternal behaviour during the early lactation period in sows.

Oxytocin, a pituitary hormone that is well-known for its effect on maternal characteristics of mammals, might be one potential explanation for the link between nest-building materials and maternal traits. In pigs, oxytocin release increases significantly during the late pre-farrowing stage and especially during farrowing, peaking after the birth of each individual piglet (Gilbert et al., 1994; Castrén et al., 1993; Oliviero et al., 2008). The role of oxytocin in modulation of maternal behaviour, parturition and lactation has been broadly demonstrated in a wide range of species, including the pig (Algers and Uvnäs-Moberg, 2007). It is also known that oxytocin is related to the stress reaction, and that it reduces anxiety and plays a part in emotional reactions in social situations (Uvnäs-Moberg, 1998; Heinrichs et al., 2003).

Although the onset of prepartum nest-building behaviour has been reported not to be directly related to plasma oxytocin concentrations in the sow (Boulton et al., 1997; Gilbert et al., 2000), the commencement of nest-building was suggested to be associated with changes in prolactin concentrations (Widowski and Curtis, 1990), and controlled by the availability of nesting materials (Arey et al., 1991).

The role of the environment during parturition and lactation periods was shown to have a considerable impact on maternal responsiveness towards offspring (Thodberg et al., 2002b; Pedersen et al., 2003), and on circulating oxytocin concentrations (Oliviero et al., 2008) in sows. The aim of the present study was to investigate the effect of nest-building materials and farrowing housing on circulating oxytocin concentrations and maternal characteristics. We focused on looking at the effect of the nest-building phase and farrowing environment, and hypothesized that providing abundant nest-building materials and space prior to parturition could 1) increase circulating plasma oxytocin and prolactin concentrations, and 2) improve nursing and maternal behaviour in sows. We also hypothesized that concentrations of oxytocin, as a modulator of maternal characteristics, are related to improved nursing and maternal behaviour.

2. Materials and methods

The experimental protocols were approved by the Ethical Committee for Institutional Animal Use and Care of the University of Helsinki. The experiment was conducted from March to May 2011 at a commercial pig farm registered as an experimental research station in Hyvinkää, Southern Finland.

2.1. Animals and housing

A total of 33 crossbred sows (Finnish Yorkshire × Finnish Landrace; 11 gilts, 12 parity 2, 10 parity 3 or 4) were allocated to three separate farrowing environments (standardizing for heart girth and back-fat thickness for gilts, and past parity performance for multiparous sows) approximately 7 days before the expected parturition date according to a randomised complete block design with four replicates. Piglet body weight was recorded within 12 h on the day of the last piglet birth and 7 days later.

Sows and gilts were housed in a temperature-controlled room, where they were allowed ad libitum access to water from a nipple drinker, and were fed three times a day (08:30 h, 14:30 h and 19:30 h) via an automatic liquid feeding system. A barley–wheat–protein concentrate diet (NE 11.07 MJ/kg dry matter (DM); crude protein 17%) was provided (NE 43.4 MJ/d and 35.1 MJ/d, respectively, for sows and gilts) three days before the expected parturition date, and it was gradually reduced until parturition (NE 23.4 MJ/d and 17.6 MJ/d, respectively, for sows and gilts). From two days after parturition, the amount of feed was gradually increased until 7 days after parturition (NE 93 – 140 MJ/d, depending on litter size). Each room consisted of six individual pens (210 × 335 cm) that contained conventional steel farrowing crates and piglet shelters situated in one corner with a heat lamp on the concrete floor (Fig. 1). During the period of the experiment, all sows were housed in the farrowing and lactating area (210 × 230 cm) on the concrete floor, without the possibility to reach a dung area, which was closed by a gate.

2.2. Experimental design

The sows were allocated to three treatments: 1) CRATE: Sows were kept in the farrowing crate (210 × 80 cm) without a possibility to turn around, with a bucketful of sawdust on the ground, 2) PEN: Sows were housed in a pen with the farrowing crate opened, and a bucketful of sawdust on the ground, 3) NEST: Sows were housed in a pen with the farrowing crate opened, and were provided with two bucketfuls of sawdust, a shredded newspaper, three bucketfuls of chopped straw, seven branches of a tree, and three natural sisal ropes of 50 cm length. All the nest-building materials were replaced if they were soiled prior to parturition. Otherwise, they were left in the pen for 7 days after parturition without any additional materials being provided, except a supplementary shovelful of sawdust per day. All the sows included in the experiment were confined in the farrowing crates after the first piglet was delivered until 7 days after parturition. This procedure is used on the