Although oxytocin has been shown to encourage social behavior, piglets given oxytocin were involved in more aggressive behaviors and exhibited long-term dysregulation of the stress axis.

By CHRISTOPHER SCHUMACHER*

In the pig world, social interactions are a double-edged sword. While socialization can be positive for their overall well-being, these interactions also can become violent and potentially damaging when unaccompanied pigs are establishing a hierarchy.

Since pigs are social animals, an area of interest among researchers is allowing pigs to be housed together while minimizing these negative interactions to pigs' rearing areas.

To tackle the problem, researchers have proposed a method to influence the oxytocin system, a hormone associated with the stress axis, to reduce cortisol levels via the hypothalamic-pituitary-adrenal axis (stress axis), a series of glands that play a major role in the response to stress.

Oxytocin, a neurohormone that influences social behavior and maternal behavior, was administered with the hopes of minimizing aggressive responses to stress by reducing stress activity. Oxytocin's suppressive action on the stress axis stimulated the idea that oxytocin may be the basis for the beneficial effects derived from positive social interactions among pigs.

Trial design

Research trials conducted in West Lafayette, Ind., were headed by Drs. Jean-Lois Rault and Don Lay with the Livestock Behavior Research Unit of the U.S. Department of Agriculture's Agricultural Research Service, with co-investigators from Purdue University and the University of Illinois-Chicago.

Six litters of pigs were used for the experiment. On days 1, 2 and 3 of age, two piglets from each litter were given 50 μg of oxytocin intranasally, while two additional piglets from each litter were given saline to serve as a control.

After one week, teat hierarchy was recorded for the week using a grid by labeling each piglet as being in the anterior, middle or posterior position during nursing.

The pigs were weaned after 17 days and mixed in pens with four similar-sized non-litter mates, totaling three males and two females per pen. This was done again at 7.5 weeks of age.

Behavior data and blood were collected for each pig. To quantify aggressiveness, resident-intruder tests were conducted, with the experimenter recording the amount of time each piglet spent in the anterior pen and an unfamiliar pig as the intruder.

Cortisol concentrations — a hormone released in response to stress — and all other blood components measured did not differ between the control and treated pigs at weaning (P > 0.1), but were higher 24 hours after the repeated mixing at 7.5 weeks of age (P = 0.004).

Treated pigs also continued to exhibit more head pushing behavior at that age (P = 0.06) but did not show any other behavioral differences (P = 0.1).

Finally, oxytocin-treated pigs did not respond to dexamethasone, as measured by their cortisol levels (P > 0.01), which pointed to deficient regulation of the stress axis (Rault et al., 2013).

Discussion

When piglets were administered oxytocin, behavioral and physiological changes were evident. However, the changes were not what the researchers had expected. Oxytocin administration has been widely shown to encourage social behavior, but very few studies in any species have investigated the effects in early life or the long-term effects of oxytocin in general.

In this experiment, the treated pigs were involved in more aggressive behaviors and exhibited long-term dysregulation of the stress axis, as opposed to more positive social interactions and lower stress.

The oxytocin-treated pigs were involved in more aggressive interactions, but it was not clear whether or not the treated pig was the aggressor. Due to the way the behaviors were measured, many of the subtle passive-aggressive behaviors piglets use to communicate, such as threats, could not be observed.

The researchers hypothesized that the oxytocin-treated pigs may have failed to read these cues from their penmates.

In ham, oxytocin has been shown to reduce the importance of threatening behaviors; hence, the treated piglets may have been socially altered (Guastella et al., 2009).

The oxytocin system develops after birth, so the physiological manipulation used in this study may have shut down the normal development of the pig's stress axis. Since oxytocin plays a role in social memory, it is possible that administering treatment in the early stages of development has adverse effects on the pig's ability to learn from social experiences. The pigs may not have been able to recall subtle passive-aggressive signs and associated behaviors.

This also would lead to a potential explanation as to why the treated pigs were more active. The inability to learn from past experiences could have caused the pigs to take longer to adjust to a new environment, and thus, they could have been the source of the observed restlesslessness and lessened peer interaction (Rault et al., 2013).

This is unusual due to prior research evidence supporting the use of oxytocin to lubricate social interaction in the short term (Bown et al., 2011).

Responses to the dexamethasone-suppression test and corticotropin-releasing hormone injection showed a dysfunction of the negative feedback loop of the stress axis.

The implications of this need to be clarified. While no immunological effects were observed, further consideration of the subject may be warranted due to oxytocin's properties as an anti-inflammatory and the effects of the stress axis on immunology (Rault et al., 2013).

Intrastral oxytocin is currently being explored as a potential method to help with social difficulties in autistic children (Guastella et al., 2010). Research by others has confirmed that short-term intrastral oxytocin use has no side effects (MacDonald et al., 2011), but in light of oxytocin's effects on piglets, more research on the potential effects of long-term usage should be considered since pigs are emerging as an important and valid model for biomedical research.

References


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