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Serum haptoglobin and C-reactive protein concentration in relation to rectal and vaginal temperature of early postpartum sows

T. Stiehler [a,b], W. Heuwieser [a,*], A. Pfützner [b], O. Burfeind [a]

[a] Clinic of Animal Reproduction, Faculty of Veterinary Medicine, Freie Universität Berlin, Berlin, Germany
[b] Tierärztliche Praxis Am Weinberg, Jessen, Germany

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ABSTRACT

Various attempts were made to improve the diagnosis of the periparturient hypogalactia syndrome in sows. A new approach was the detection of elevated concentrations of acute phase proteins. The objective of our study was to investigate the serum concentrations of haptoglobin (Hp) and C-reactive protein (CRP) in sows on Day 7 postpartum and relationship to body temperature. From Day 1 to Day 6 postpartum, 199 sows were clinically examined and a blood sample was taken for measuring Hp and CRP at Day 7. The median of Hp and CRP were 1.83 mg/mL (interquartile range: 1.42–2.13 mg/mL) and 60.0 μg/mL (interquartile range: 15.2–216.5 μg/mL). We did not find a correlation between Hp and CRP ($\rho = 0.11$, $P = 0.12$) nor a difference between sows categorized as ill and healthy sows in Hp concentration ($P = 0.1$) and CRP ($P = 0.34$). Sows with Hp $>$ 2.13 mg/mL had a higher rectal temperature than sows with Hp $\leq$ 2.13 mg/mL ($P = 0.037$), but there was no difference in vaginal temperature ($P = 0.24$). Regarding CRP, sows with CRP greater than 216.5 μg/mL had higher rectal temperature ($P = 0.017$) and vaginal temperature ($P = 0.02$) than sows with CRP $\leq$ 216.5 μg/mL. As demonstrated in this study, Hp and CRP do not support the detection of early postpartum disorders in sows.

1. Introduction

The periparturient hypogalactia syndrome (PHS) in sows is a well known and important disease in sows after farrowing. Under field conditions, the diagnosis of postpartum diseases is mainly based on clinical signs [1] such as mastitis, metritis, constipation, cystitis, anorexia, and pyrexia [2] alone or in different combinations [3].

Furniss [4] stated that the first clinical signs occurred 18 to 40 hours after parturition. In another study, sows showed clinical signs 12 to 24 hours after parturition [5]. This variation could be caused by the fact that the exact farrowing times were not recorded [4]. Various attempts were made to improve the diagnosis of this disease complex.

A promising approach was the detection of elevated concentrations of acute phase proteins (APP). Acute phase proteins are a group of blood proteins that change in concentration as reaction of external and internal challenges such as infection, inflammation, surgical trauma, or stress [6]. Acute phase proteins are mainly produced in the liver and regulated by proinflammatory cytokines [7]. Eckersall et al. [8] used a turpentine injection (dose: 8.0 mL) to stimulate a sterile inflammatory lesion in pigs. Serum C-reactive protein (CRP) concentration increased more than eight-fold and serum haptoglobin (Hp) concentration increased more than two-fold after turpentine injection. They concluded that these APPs are the best markers for the identification of inflammatory lesions in pigs. Besides a sterile noninfectious inflammatory lesion, there is evidence

* Corresponding author. Tel.: +49 30 838 62100; fax: +49 30 838-62620.
E-mail address: w.heuwieser@fu-berlin.de (W. Heuwieser).

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that physiologic processes in the puerperium potentially influence the concentration of APPs in animals [9]. Serum Hp concentration increased significantly from the day of farrowing (0.78 mg/mL) to 3.84 mg/mL at 7 ± 2 days of lactation ($P < 0.001$) [10]. In another study, the highest average concentrations of Hp (2.17 ± 0.93 mg/mL) and CRP (42.52 ± 44.34 ng/mL) were also recorded 7 days after farrowing in comparison to 1 week before and 4 weeks after farrowing [11]. The high serum concentrations of APP could be explained by physiologic events during the puerperium [10]. Some of these processes are tissue damage occurring because of the increase of myometrial activity, subsequent relaxation, and dilatation of the cervix and the caudal part of the birth canal during expulsion [11].

Up to date, several studies about APP and relationships to infectious diseases such as swine influenza virus [12,13], porcine reproductive and respiratory syndrome virus [14], or porcine circovirus [15] were conducted. However, there is a lack of knowledge about the association of APP and postpartum diseases in sows.

Therefore, the objective of this study was to investigate the serum concentration of Hp and CRP in sows on Day 7 postpartum. Specifically, we set out (1) to study if diseased sows have higher concentrations of Hp and CRP compared to healthy sows and (2) to determine plausible associations between Hp and CRP and vaginal temperature (VT) and rectal temperature (RT) in the first week after farrowing, respectively.

2. Materials and methods

The study was carried out on a commercial pig farm with 1370 sows in Brandenburg, Germany. Sows were managed according to the guidelines set by the International Cooperation and Harmonisation of Technical Requirements for Registration of Veterinary Medical Products [16]. The sows were moved to farrowing crates approximately 7 days before expected farrowing. The front third of the farrowing crates had solid concrete floors, with a covered and heated region for the piglets and a fully slatted floor in the back region. When moved into the farrowing room, sows were fed a lactation ration (energy: 13.0 MJ/kg, raw protein: 17.5%, raw fiber: 6%, raw ash: 6%, and raw oil and fats: 5%) twice daily at 6 AM and at 1 PM with continuous access to water from a nipple drinker. Routine managment of piglets included ear notching for idendification, iron injection (1 mL Belfer 100 mg/mL, iron (III)-hydroxid-dextran-complex; Bela-pharm GmbH & Co. KG, Vechta, Germany) and castration of the male piglets during the first 6 days. Sows and piglets remained in the crates until the piglets were weaned at an age of 28 days.

Every Thursday, 12 ± 2 sows (including 2 ± 1 gilts) were enrolled in the study for the duration of 16 weeks. Only sows that finished farrowing and completely expulsed the placenta were included. They farrowed either on Wednesday or Thursday morning. After enrollment, 10 ± 2 of these sows got a microprocessor-controlled temperature logger inserted in the vagina as recently validated for cows [17,18], dogs [19], and sows [20]. The temperature logger (Minilog 8; Vemco, Ltd., Halifax, Nova Scotia, Canada, size = 92 × 20 mm, weight = 40.5 g) was attached to a modified vaginal controlled internal drug release device (CIDR-blank; InterAg, Hamilton, New Zealand). Therefore, a part of the plastic frame of the CIDR-blank was removed, and the silicon part was pulled over the logger. Before use, the logger was disinfected with a Povidon-Jod solution (Braunol; B. Braun, Melsungen AG, Melsungen, Germany) and then inserted in the vagina of the standing or lying sow with the help of a tubular speculum (tubular speculum for pigs, length: 40 cm, inner diameter: 2.5 cm, Garbsen, Germany). The logger was pushed through the speculum with the help of a CIDR-blank applicator and positioned in front of the cervix. It remained in the vaginal cavity for 6 days after parturition and measured the VT every 10 minutes. Overall, 199 sows were enrolled in the study. In 156 sows, a VT logger was inserted after parturition. The remaining 43 sows did not receive a temperature logger and served as a negative control group. A total of 15 sows were excluded from VT analysis because of logger losses (n = 10, 6.4%) or technical problems of the loggers (n = 5, 3.2%). These sows, however, were included in the analysis of RT. In total, 34 gilts and 165 pluriparous sows were used in the study. Of these, 100 and 65 sows were parity 2 to 4 and 5 to 10, respectively (mean ± SD = 3.8 ± 2.3, including gilts).

The medical treatment of sows, the birth weight of the litters, and litter weight at weaning were recorded at enrollment.

Daily observation of animals, measurement of RTs, and medical treatment of study animals were conducted by the herd manager (investigator) who had a 3-year education in veterinary medicine (i.e. comparable to a bachelor degree) and the first author, a licensed veterinarian. Before initiating the study, the investigator was intensively trained by the first author. In the first 2 weeks, the investigations were conducted together to ensure comparable measurements. In addition, clinical examinations were conducted jointly every Thursday when enrolling new sows. Every sow of the study got her own data capture form which was attached above the farrowing crate. From Day 1 to Day 6, the study animals were clinically examined by the investigators in the morning between 6 AM and 7 AM. First, feed intake was categorized by visual check on a 3-point scale (complete, partly, and none). Second, the investigators scored the general condition on a 3-point scale (healthy: sow was attentive, standing up for feeding and nursing the piglets, slightly reduced: sow seemed apathic, did not nurse the piglets; i.e. remained lying in abdominal position although the piglets are searching and crying, but stood up for feeding, severely reduced: sow was somnolent, remained lying down, did not nurse the piglets, and did not stand up for feeding). Furthermore, vaginal discharge was visually classified (purulent vaginal discharge or no purulent vaginal discharge) and the study personnel measured RT twice daily at 6 AM and at 2 PM. On Day 7 after farrowing, the loggers were removed. Piglets were weighed again at weaning on Day 28.

A sow was diagnosed as ill when 3 parameters of the clinical examination were abnormal (reduced general condition, reduced feed intake, vaginal discharge, and RT > 40.0 °C). Not all sows we categorized as ill in further analysis were medically treated. Instead, the herd manager treated these animals only when deemed necessary at her