

Serum iron concentration as a marker of inflammation in young cows that underwent dehorning surgery

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Introduction

The systemic reaction to proinflammatory cytokines is the production and secretion of acute phase proteins (APPs) by the liver. The common APPs measured in cattle are haptoglobin (Hp), serum amyloid A (SAA), lipopolysaccharide binding protein, alpha(1)-acid glycoprotein, and transferrin. Iron (Fe) plays important roles in many enzymatic activities, and is an essential trace element for the host and pathogen. Previous studies have demonstrated that the serum Fe concentration decreases in acute traumatic reticuloperitonitis and mastitis in cows. Therefore, the relationship between inflammation and the serum Fe concentration may be useful for the evaluation of the host response to inflammation during surgery because measurement of the serum Fe concentration is cheap and easy to perform. However, comparative studies have not been conducted regarding the serum Fe concentration in cattle that underwent surgery. Therefore, the aim of the present study was to measure changes in the serum Fe concentration in cows that underwent dehorning surgery in order to assess the usefulness of the serum Fe concentration as a marker of inflammation.

Materials and Methods

Three male and 2 female Holstein cows, aged 205.0 ± 10.7 days and weighing 456.8 ± 53.1 lb (207.2 ± 24.1 kg), were enrolled in this study. These cows were patients at the animal medical teaching hospital of Rakuno Gakuen University, and were scheduled to undergo dehorning. The time at which 0.45 mg/lb (1 mg/kg) of xylazine was intravenously administered was defined as $t=0$ min. Two min after xylazine administration, the cows were injected with 5 ml of 2% lidocaine hydrochloride (Xylocaine Injection 2%, Aspen Japan, Tokyo, Japan) on both sides as a local anesthetic block of the cornual branch of the zygomaticotemporal (lacrimal) nerve. Dehorning and hemostasis at the horn base were carried out using the Barnes dehorner and electric dehorner, respectively. As all surgical procedures were completed within 15 min, $22.7 \mu\text{g/lb}$ ($50 \mu\text{g/kg}$) of atipamezole (Antisedan, Nihon Zenyaku Kogyo Co., Ltd., Fukushima, Japan) was intravenously administered at $t=15$ min as an antagonist of the sedative. All cows stood up immediately after the atipamezole injection. Blood samples (10 ml each) were withdrawn from the contralateral jugular vein before sedation (pre) and at $t=0.5, 2, 4, 6, 8, 12, 24$, and

48 hr, and the serum samples were stored in separate tubes. The SAA and Fe concentrations were measured using an automated latex agglutination turbidimetric immunoassay (LAT: SAA-1, Eiken Chemical Co., Tokyo, Japan) and 2-nitroso-5-[N-n-propyl-N-(3-sulfopropyl)amino] phenol (Nitroso-PSAP) methods, respectively. Pearson's rank correlation test was also used to evaluate the correlation between SAA and serum Fe concentrations. P-values less than 0.05 were considered significant.

Results

The initial value of SAA was $3.2 \pm 2.9 \mu\text{g/ml}$. The SAA value after dehorning reached $36.9 \pm 30.3 \mu\text{g/ml}$ at $t=48$ hr. This value was significantly higher than the initial value ($p < 0.01$). The initial serum Fe concentration was $143.8 \pm 4.1 \mu\text{g/dl}$. The Fe concentration in serum significantly decreased, and reached $90.0 \pm 36.4 \mu\text{g/dl}$ at $t=24$ hr ($p < 0.001$). Significantly low serum Fe concentrations in cows that underwent dehorning were maintained at $t=12$ ($p < 0.05$), 24 ($p < 0.01$), and 48 hr ($p < 0.01$) when compared with the initial value. The serum Fe concentration had a significant and negative correlation with the SAA concentration ($r^2=0.500$, $p < 0.01$).

Significance

A significant increase in SAA and significant decrease in serum Fe concentrations due to inflammation associated with the dehorning procedure were confirmed in this study. In cattle, the most sensitive acute phase proteins are SAA and Hp, which exhibit a significant increase in response to acute inflammation. In the present study, the SAA level increased in cows with non-infectious inflammation. However, measurement of the SAA concentration is too expensive to be performed routinely in veterinary diagnostic laboratories. Our study demonstrated that the serum Fe concentration is a useful marker of inflammation in young cows that have undergone dehorning. Measurement of serum Fe concentration is cheap and easy to perform, and can therefore be used in clinical cases by veterinary practitioners. Further studies are needed to investigate the relationship between inflammation and hepcidin expression in cows.