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Plasma Cortisol Response after Intra-Vaginal Insertion of CIDR and DIB in Beef and Dairy Cattle

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Abstract

The aim of this study was to compare the plasma cortisol response between the cows after intravaginal insertion of DIB (Dispositivo Intravaginal Bovino) and those after the insertion of CIDR (Controlled Internal Drug Release). Nine ovariectomized cows (four beef and five dairy) were divided into two groups; four cows were inserted with CIDR for 12 days and five cows were treated with DIB for the same period. All the cows did not have any abnormality in the vagina before insertion of the devices. Blood samples were collected via the tail venipuncture once a day at 8:30 to 9:00 for 7 days before treatment and once at 5-10 minutes before insertion, every two hours for 24 hours after the insertion and once daily thereafter until 3 days after removal of the devices. Plasma cortisol concentrations were estimated by an enzyme immunoassay. Mean plasma cortisol concentrations in nine cows for seven days before treatment remained stable. Immediately before the insertion mean of plasma cortisol concentrations in cows treated with CIDR was 3.6 ± 0.6 ng/ml and 2.9 ± 0.7 ng/ml in those treated with DIB. After the insertion, plasma cortisol concentrations increased rapidly ($P<0.05$), reaching the peak with 8.5 ± 2.5 ng/ml at 4 h (DIB) or 6.4 ± 1.0 ng/ml at 6 h (CIDR) and then gradually decreased to basal levels at 12 h and remained stable thereafter. There was no significant difference in plasma cortisol responses which were marginal and temporal between DIB treated and CIDR treated cows.

Keywords: CIDR • Dispositivo intravaginal bovino • Cortisol • Cattle • Stress

Introduction

Intra-vaginal progesterone devices such as PRID, CIDR, DIB and PRID-Delta have been widely used for synchronization of estrus in cattle [1,2]. Upon the insertion of an intravaginal device such as CIDR, cattle often show discomfort and strain. When the CIDR was removed from the vagina after 7 to 14 days, pus or purulent discharge often appeared on the surface of CIDR. It was reported that the treatment with CIDR caused irritation in the vaginal mucosal membrane [3]. These findings indicated that the CIDR insertion into vagina results in a kind of stress associated with irritating and inflammatory response of the vaginal mucosa. DIB is V shaped silicon elastomer insert, which has more flexible shape with soft tips. It was reported that there was a significant difference in an incidence of straining and defecation between cows treated with CIDR and those with DIB, the latter showing a lower incidence [4]. In addition, less pas was observed on DIB when removed compared with CIDR [5]. It is assumed that DIB causes less stress than CIDR in cattle after intravaginal insertion.

Blood concentrations of cortisol are considered to be an indirect measurement of a degree of stress [6]. Stress levels can be estimated by response of plasma cortisol concentrations. Many acute stress situations are inevitable in livestock management such as rectal palpation at oestrus and AI, which causes significant increase in plasma cortisol and may be potential stressors for cows [7]. The authors reported a significant increase of plasma cortisol concentrations in cattle after insertion of CIDR [8].

The objective of the present study was to show plasma cortisol response in cattle after DIB treatment in comparison to CIDR insertion.

Materials and Methods

This experiment was carried out at Yamaguchi University Experiment Farm, Yamaguchi Prefecture, and the south-western region of Japan.

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Animals and housing system

The study was undertaken in nine ovariectomized cows (five dry Holstein Friesian cows and four non-suckling Japanese black beef cows) were used for the experiment. Cows were kept in a tie-stall, using sawdust for bedding. The ages of the cows ranged from 4 to 16 years old. The body condition score was 2.25 to 3.25 in dairy cows [9]. And 3 to 6 in beef cows [10]. The experiment protocols and animal care during the experiment followed the International Guide Principles for Biomedical Research Involving Animals (Council for International Organizations of Medical Sciences).

Experimental design

Five cows (two beef and three dairy) were used for the experiment using DIB. Other four cows (two beef and two dairy) in group two were used for the experiment with CIDR. The CIDR or DIB were inserted into the vagina of the cows by using standard CIDR and DIB applicators and were removed 12 days later.

CIDR and DIB treatment

CIDR is a T shaped intra-vaginal device containing 1.38 g progesterone and DIB is a Y shaped insert containing 1.0 g progesterone.

Examination of the vagina before the experiment

The vagina of the cows was examined by using a vaginoscope for the presence of inflammatory and purulent discharge, urovagina and any other vaginal abnormalities before insertion of CIDR or DIB devices. All cows had normal vagina.

Blood sampling

Blood samples were collected once a day at 8:30 to 9:30 into heparinized vacuum tubes from cows via the tail venipuncture during a period of seven days before the first day of the experiment. At the first day of the treatment, blood samples were collected 5 to 10 minutes before CIDR or DIB insertion, and every two hours for 24 hours after the insertion. From the second day of the treatment blood was sampled once a day at the time 8:30 to 9:30 until 3 d after removal of the devices.

Blood samples were immediately stored at 4oC and centrifuged (1,500 x g for 15 min) within 30 min after collection. The plasma obtained was stored at-20oC until analyzed for cortisol concentrations.

Cortisol assay

Plasma cortisol concentrations were analyzed by an enzyme immunoassay established and validated by [9]. The intra-assay and inter-assay coefficients of variation in high and low cortisol pooled plasma samples were 6.0 ± 1.5% (n=6) and 11.4 ± 0.6% (n=6) and 4.2 ± 1.2% (n=5) and 8.4 ± 0.1% (n=5), respectively.

Statistical analysis

The results were presented as the mean ± standard error (SE). Difference in the mean values of plasma cortisol concentrations during insertion of CIDR or DIB were analyzed by one-way ANOVA (Microsoft Office Professional Edition 2003, Excel 2003). A probability of $P<0.05$ was considered as statistically difference.

Results

Mean plasma cortisol concentrations in nine cows for seven days before insertion of the intravaginal devices remained stable. Immediately before the treatment mean of plasma cortisol concentrations in cows treated with CIDR was 3.6 ± 0.6 ng/ml and 2.9 ± 0.7 ng/ml in those treated with DIB. After the insertion, plasma cortisol concentrations increased rapidly ($P<0.05$), reaching the peak with 8.5 ± 2.5 ng/ml at 4 h after insertion of DIB or 6.4 ± 1.0 ng/ml at 6 h after CIDR treatment and then gradually decreased to basal levels at 12 h and remained stable thereafter. There was no significant difference in peak plasma cortisol values between CIDR and DIB treated groups of cows.When CIDR or DIB were removed from the vagina 12 days after insertion, the pus or purulent and /or yellowish mucus were present on the surface of the devices in both groups of cows. No device on any cows was lost until day 12 of the experimental period (Figures 1 and 2).

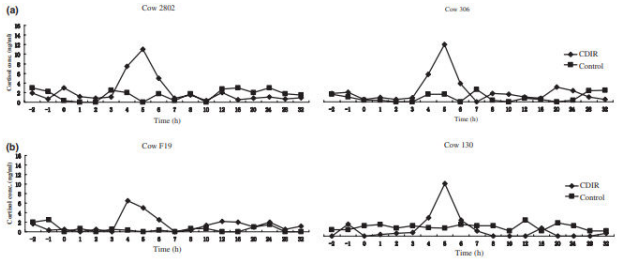

Figure 1: Plasma cortisol concentrations in four cows during insertion of CIDR for 24 h. CIDR was inserted 9 days after oestrus in two cows (a) and 13 days after oestrus in other two cows (b).

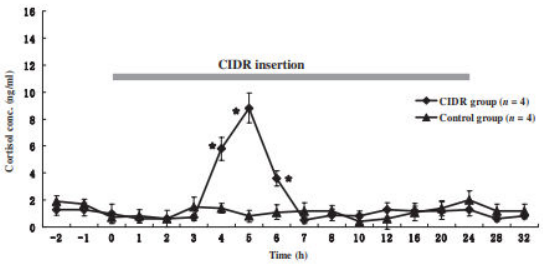

Figure 2: Mean plasma cortisol concentrations (± SEM) in four cows during insertion of CIDR for 24 h. Bold bar shows the period of CIDR insertion.

Discussion

A number of stressors including heat stress [10-13]. Caused enhancement of the pituitary-adrenal axis and secretion of cortisol in cattle [14]. Reported that 25 IU ACTH-challenge test in cows after normal calving or dystocia showed peak plasma cortisol concentrations of 18-23 ng/ml and 15-45 ng/ml. Palpation per rectum also caused an elevation of plasma cortisol up to 12-14 ng/ml [15,16]. Reported a significant increase of plasma cortisol up to 14.0-19.6 ng/ml in cows after milking. According to our previous study,

intravaginal insertion of CIDR caused a temporal elevation of plasma cortisol from 1.3+0.4 ng/ml to 8.8+1.1 ng/ml at 5h after the insertion. Plasma cortisol concentrations then returned to basal at 7h after the treatment. Results obtained in the present study were well comparable to the results of the earlier study. Moreover, no significant difference in plasma cortisol response was shown between cows treated with CIDR and those with DIB. It is indicated that stress caused by the intravaginal insertion in cattle is marginal and temporal, and may not exert any adverse effects on cattle reproduction, since plasma cortisol response after the intra-vagina treatment were lower than the response after palpation per rectum and vaginoscopic examination [17]. Indicated that the intravaginal device did not cause a pathologic response, but caused a slight alteration in the number of circulating leukocytes, neutrophils, and lymphocytes.

Conclusion

There was a marginal and temporal increase of plasma cortisol concentrations after the insertion of two types of intravaginal devices, DIB and CIDR, and there was no significant difference in plasma cortisol responses between DIB treated and CIDR treated cows.

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References

1. Noakes, David E, Parkinson Timothy J and England G CW. "Veterinary Reproduction and Obstetrics." (9th edn). New York: Saunders Ltd, United States, (2009).
2. Van Werven, T, Waldeck F, Souza AH and Floch S, et al. "Comparison of Two Intravaginal Progesterone Releasing Devices (PRID-Delta vs CIDR) in Dairy Cows: Blood Progesterone Profile and Field Fertility." *Anim Reprod Sci* 138 (2013): 143-149.
3. Ryan, D P, Galvin J A and O'Farrell K J. "Comparison of Oestrous Synchronization Regimens for Lactating Dairy Cows." *Anim Reprod Sci* 56 (1999): 153-168.
4. Young, Laura and Lawrence Lyndsay. "Using Quantitative Observational Research to Assess Cow Behavior During Treatment with Intravaginal Progesterone Inserts on New Zealand Dairy Farms." Proc. 28th World Buiatrics Congress 2014, Cairns, Australia, (2014): 132.
5. Young, L. "Comparing Progesterone Inserts." *Agri Health* (2015).
6. Peeters, M, Sulon J, Beckers JF and Ledoux D, et al. (2011). "Comparison between Blood Serum and Salivary Cortisol Concentrations in Horses using an Adrenocorticotropic Hormone Challenge." *Equine Vet Journal* 43 (2011): 487-493.
7. Nakao, T, Sato T, Moriyoshi M and Kawata, K. "Plasma Cortisol Response in Dairy Cows to Vaginoscopy, Genital Palpation per Rectum and Artificial Insemination." *J Vet Med A* 41(1994): 16-21.
8. Long, Thanh Su, Yoshida Chikako and Nakao Toshihiko. "Plasma Cortisol Concentrations after CIDR Insertion in Beef Cows." *Reprod Domest Anim* 46 (2011): 181-4.
9. Ferguson, J D, Galligan D T and Thomsen N. "Principal Descriptors of Body Condition Score in Holstein Cows." *J Dairy Sci* 77 (1994): 2695-2703.
10. Newman, A L and Lusby K S. "Rebreeding the Mature Cows." In: Beef Cattle, New York: John Wiley and Sons, United States, (1986): 118.
11. Yoshida, Chikako and Nakao Toshihiko. (2005). "Response of Plasma Cortisol and Progesterone after ACTH. Challenge in Ovariectomized Lactating Dairy Cows. *J Reprod Dev* 51 (2005): 99-107.
12. Alvarez, M B and Johnson H D. "Environmental Heat Exposure on Cattle Plasma Catecholamine and Glucocorticoids." *J Dairy Sci* 56 (1973): 189-194.
13. Thatcher, W W. "Effects of Season, Climate, and Temperature on Reproduction and Lactation. *J Dairy Sci* 57 (1974): 360-368.
14. Abilay, T A, Johnson H D,and Madan M. "Influence of Environmental Heat on Peripheral Plasma Progesterone and Cortisol During the Bovine Estrous Cycle." *J Dairy Sci* 58 (1975):1836-1840.
15. Nakao, T and Grunert E. "Effects of Dystocia on Postpartum Adrenocortical Function in Dairy Cows." *J Dairy Sci* 73(1990): 2801-2806.
16. Miyazawa, Kiyoshi. "Changes in the Plasma Cortisol and Glucose Level After Applying Stimulus into the Jugular Vein to Collect Blood, Stimulus on the Teat and the Stimulus of Milking in Cows." *Res Bull Obihiro Univ* 13 (1984): 229-235.
17. Walsh, Robert B, LeBlanc Stephen J, Vernooy Erin and Leslie K E. "Safety of a Progesterone-Releasing Intravaginal Device as Assessed from Vaginal Mucosal Integrity and Indicators of Systemic Inflammation in Postpartum Dairy Cows." Can *J Vet Res* 72 (2008): 43-49.

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