Research Journal of Biological Sciences 8 (5): 119-123, 2013
ISSN: 1815-8846

Study of Relationship Between Selenium-Dependent Glutathione Peroxidase and Retained Placenta in Dairy Cows

[1]S. Mosaferi, [2]P. Khatamino, [3]Z. Ostadi, [4]T. Jalili, [1]A. Davasaztabrizi and [1]A. Kaveh
[1]Department of Clinical Sciences, Faculty of Veterinary Medicine,
[2]Faculty of Veterinary Medicine, Islamic Azad University, Tabriz Branch, Tabriz, Iran
[3]Department of Anesthesiology, Faculty of Medicine,
Tabriz University of Medical Science, Tabriz, Iran
[4]Islamic Azad University, Tabriz Branch, Tabriz, Iran

Abstract: Retained placenta (after birth of calves) in cattle (especially dairy) is seen in comparison with other animals. Typically, placenta of cows should be expelled within 24 h after delivery. If whole or some part of the placenta remained after birth for a longer time, it is considered a pathological or abnormal condition. Remaining part of the placenta is more common and most commonly involved parts are the pregnant ovaries. The frequency of retained placenta in cattle herds is 7-10% in normal condition. The purpose of this study is to inspect a metabolic parameter with the retained placenta rate. Researchers measured activity of glutathione peroxidase enzyme dependent to selenium in blood samples of healthy cows and remained placenta cows. After statistical analyzing, it was seen that difference between activity levels mean of GPX enzyme dependent to selenium in healthy cows is significantly more than placenta remained cows ($p<0.0001$). The average level of selenium-dependent GPX in healthy cows is 73/78 u/g Hb and its in placenta remained cows is 58/25 u/g Hb. According to the lack of other pathogenic and mechanical factors that cause placental retention in this study and absence of other disease and consider to providing enough proteins in these cows, researchers can suppose that the activity level of GPX enzyme in blood samples in direct relation to selenium amount. Although, researchers can say in the absence of pathogen factors, increasing placenta retention rate shows metabolic deficit and here vitamin E and selenium has the main role.

Key words: Placenta, GPX, dairy cows, diseases, selenium, Iran

INTRODUCTION

Retained placenta is referring to the failure of detachment the fetal part of placenta from the maternal part of placenta. Placental retention occurs in about 10% of dairy cows parturition (Eger *et al*., 1985); although the incidence 2-3 times greater has been reported by Callahan (1969).

Placental retention increased incidence of uterine infection to 54% in affected animals as compared to 10% for cows which expelled their fetal membrane normally (Muller and Owens, 1974). Since, nearly 25% of important diseases of dairy cattle are associated with genital infections (Roberts, 1986), the economic significance of retained placenta should not be underestimated.

Fetal membrane retention has not been related to a specific syndrome but rather to a number of physiological, pathological, environmental and nutritional factors. The general etiology of retained placenta has been reviewed (Roberts, 1986), Wetherhill (Wooding and Flint, 1994; Muller and Owems, 1974).

The importance of puerperal nutrition as it affects in the incidence of retained placenta has been suggested by several researchers (Harrison *et al*., 1981; Robert, 1986; Wooding and Flint, 1994). It has increased in avitaminosis A (Nicholasan and Cunningham, 1965; Roberts, 1986; Radostitis *et al*., 2000) and iodine deficiency (Julien *et al*., 1976; Moberg, 1981). Pelissier (1972) and Noorsdsy *et al*. (1973) indicated that retention rate was correlated positively with imbalances in calcium and phosphorus metabolism. Trinder *et al*. (1969, 1973) observed higher retention rates in herds with correspondingly greater problems of nutritional muscular dystrophy and were able to reduce incidence through the supplementation of selenium and vitamin E. An abnormal high incidence of retained placenta observed in an area with a history of

Corresponding Author: S. Mosaferi, Department of Clinical Sciences, Faculty of Veterinary Medicine, Islamic Azad University, Tabriz Branch, Tabriz, Iran

white muscle disease, Trinder *et al*. (1973) suggested that retention may be related to a deficiency of vitamin E but implicated the element selenium as well, white muscle disease being responsive to both. In a series of experiments, these researches found that injection of vitamin E and/or selenium significantly reduced retention rate and that injection of vitamin E and selenium together was more effective than either substance injected alone in its prevention.

In a later study (Trinder *et al*., 1969), dry cows fed a ration containing 0.025-0.047 mg g^{-1} of dry matter of selenium still had a high incidence of retention, although in another group of dry cows a combined injection of vitamin E and 15 mg of selenium 1 month before calving date was effective in reducing this incidence. About 15 mg of selenium injected as potassium selenite were slightly less effective. Selenium in blood in herds with high retention rates was significantly lower than in herds with no history of retained placenta.

These data indicate that there is a possible relationship between uterine health and selenium and/or vitamin E deficiency. However, Horvath in a study of 3 years duration was unable to show a significant prophylactic effect when 15 mg of selenium and vitamin E were injected 20 days prepartum in dairy cows. Both source and concentration of selenium and vitamin E were identical to those in Trinder's study. The reason for the apparent discrepancy in results in the two studies is not known.

MATERIALS AND METHODS

This study was conducted in a commercial dairy farm with 700 milking cows. All of the cows were Holstein and held in an "open shad" system and feeding done by TMR method with feeder. Researchers selected 2 groups of post parturient cows with approximately equal milk production and nearly body condition (Eger *et al*., 1985; Harrison *et al*., 1981) and without any health problem. Forty post parturient cows that expelled their placenta 24 h after parturition were in first group and forty post parturient cows that cannot expel their placenta 24 h after parturition were in second group. Researchers indicated these cases as a pathological condition as retained placenta. Blood sampling was performed from the coccygeal vein 24 h after parturition with heparinized venoject. Researchers shake the sampling tube 8-10 times to mixing the blood sample with heparin well and then freeze them.

It is important to know that researchers visited all of the cows of study and there was not any other health problem. The body condition and ages of the cows of bath groups were approximately similar. After sampling, the samples were transferred to the clinical pathology laboratory for estimating the enzymatic activation of glutathione peroxidase affiliated with selenium. Total hemoglobin and GPX enzymatic activation were estimated. Total hemoglobin estimated by Sianomethemoglobin Method and with spectrophotometer in 540 nm wave wide and for estimating o f GPX enzymatic activation, the Paglia and Valentive Method and Randox kit were used.

RESULTS

Results of this study showed that mean glutathione peroxidase enzymatic activity affiliated with selenium in normal cows was 73.78 ug Hb^{-1} but in retained placenta cows was 58.25 ug Hb^{-1} (Fig. 1). Standard deviation in first group was 10.02 and in second group was 6.55, SEM in first group was 1.58 and in retained placental group was 1.03 (Table 1). The minimal levels of glutathione peroxidase enzymatic affiliated with selenium in healthy cows 52.3 ug Hb^{-1} but in retained placenta cows were 44.6 ug Hb^{-1} (Fig. 2).

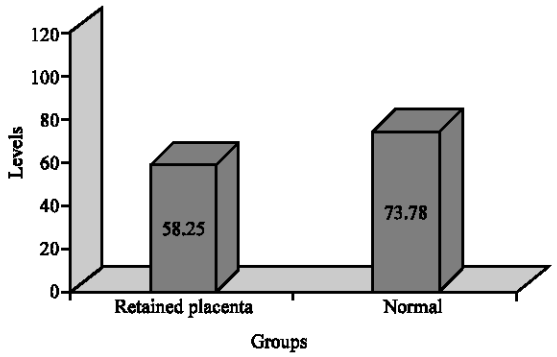

Fig. 1: The mean level of glutation peroxidase enzymatic activation affiliated with selenium in cows with retained placentum and healthy cows

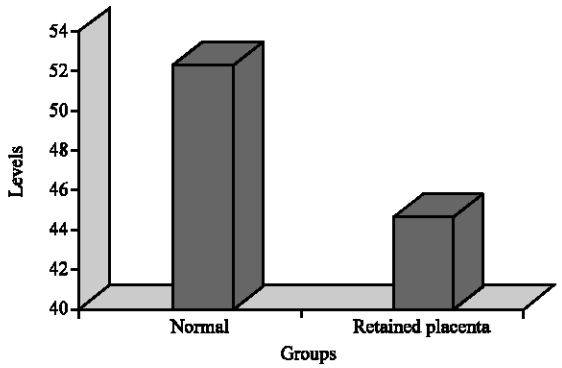

Fig. 2: The comparison of minimal level of glutation peroxidase enzymatic level affiliated with selenium in first and second groups

Table 1: Data analysis with instate statistical program and t-student statistical method showed that difference of the mean level of GPX in healthy cows is higher than retained placenta a cows significantly

Variables	Retained placenta	Normal
Sample size	40.00	40.00
Mean	58.25	73.78
SD	6.55	10.02
SEM	1.03	1.58
Min.	44.60	52.30
Max.	69.50	108.73

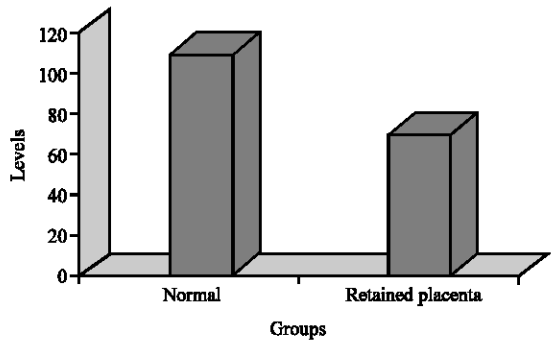

Fig. 3: The comparison of the maximum level of glutation peroxidase enzymatic level affiliated with selenium in first and second groups

The maximum level of glutathione peroxidase enzymatic activation affiliated with selenium in healthy cows was 108.73 ug Hb^{-1} but in retained placenta cows was 69.50 ug Hb^{-1} (Fig. 3). Data analysis has were done with t-student method. It showed that there is significant difference between the mean level of GPX enzymatic activation affiliated with selenium in healthy cows compare with retained placenta cows and p-value is <0.001 ($p<0.0001$).

This significant difference in mean level of GPX affiliated with selenium in both of groups shows that retaining of placenta is due to decrease of glutathione peroxidase enzymatic activity and there is a reversed relation between the mean level of GPX affiliated with selenium and the rate of placental retention. It means that how this means elevate, the rate of retaining of placenta decreases.

Selenium in hemopoietic centers enters in red blood cells of glutathione peroxidase and 6 weeks resist and is a lowly affected by daily selenium intake. Measurement of glutathione peroxidase is more suitable because it does not follow from daily feeding selenium.

Smith is indicating that glutathione peroxidase enzyme, degenerate the hydrogen peroxidase and lipoperoxidas and changes them to safe water or alcohol. There was not any pathological and mechanical factors for retain placenta in this study and researchers controlled two groups of cows for exist other disease (if this factors observed in any cow, it culled from the study) and sufficient protein supplied for cows in the studied herd, so researchers can say that the GPX enzymatic activation level in whole blood has direct correlation with blood selenium.

DISCUSSION

Julien and Conrad (1985) found that the oral supplementation of 0.92 mg/head/day of selenium as selenite fed throughout the dry period or an intramuscular injection of 50 mg of selenium and 680 IU of alpha tocopherol given 20 days prepartum reduced the retained placenta incidence in dairy cows.

These experiments were designed to verify the value of selenium and vitamin E supplementation for reduction of retained placenta.

In a series of field experiments in Ohio involving 193 parturient cows of the Holstein and Guernsey breeds, the prophylactic efficacy of selenium and vitamin E was tested under field conditions. Herds initially were chosen because of a chronic problem with retained placenta which could not be related to a known etiological factor. Each herd was divided into three groups. Group A received an injection of 50 mg of sodium selenite 40 days prepartum and 680 units of alpha tocopherol acetate followed by the same treatment 20 days later. Group B received a single injection of 50 mg of sodium selenite 20 days prepartum and 680 IU of vitamin E. Group C served as the control. Incidence of retained placenta was reduced from a mean of 51.2% in control cows to 8.8% for animals injected with selenium and vitamin E. No differences in efficacy were between group A, B and it appears that the single 20 days prepartum injection of 50 mg of sodium selenite and 680 IU of alpha tocopherol acetate is an effective prophylactic for prevention of retained placenta.

The intramuscular injection of 50 mg of selenium and 680 IU of alpha tocopherol acetate approximately 20 days prepartum significantly reduced the overall incidence of retained placenta from 51.2-8.84%. The reduction in incidence in the treated animals was equally significant in each herd.

The prophylactic effect of selenium and vitamin E in reducing fetal membrane retention was evident as indicated by each cooperating herd. The injection of 50 mg of selenium and 680 IU of vitamin E 20 days prepartum successfully controlled placental retention in herds in which the disease had been a serious and chronic problem. The incidence of retained placenta in the control groups was similar to the past retention rate for that

particular herd. Apart from the injection procedures employed, there were no changes in nutritional or herd health management programs that would have accounted for the sudden, significant reduction in retention incidence.

Feed analysis of the dry cow ratio of each herd showed consistently deficient selenium content (Julien *et al*., 1976). These results of field trial verify the previous conclusion of Julien and Conrad (1985). It appears that retained placenta when not mechanically or pathogenically induced might be a selenium/vitamin E responsive disease and therefore, adequate supplementation of these nutrients appears to be an indicated prophylaxis.

Trinder *et al*. (1969) observed a high incidence of retained placenta in dairy cows in herds which also had a correspondingly high incidence of nutritional muscular dystrophy. Selenium of plasma was higher in herds where retained placenta was not a problem as compared to those where the incidence was lower.

Unpublished data suggested a decrease in incidence of retained placenta in dairy cows which consumed a ratio supplemented with 0.1 ppm of selenium as selenite. Although, Trinder *et al*. (1973) reported similar responses when dairy cows received a 15 mg injection of selenium as selenite and vitamin E, although, Horvath was unable to duplicate these results.

Selenium injections and oral vitamin E supplementation prepartum were related to incidence of retained placenta, metritis and cystic ovaries in a 2×2 factorial experiment. Groups were:

- Selenium and vitamin E
- Vitamin E
- Selenium
- Control

Incidence of retained placenta was 17.5% in cows of groups 2-4 whereas it was reduced to 0% in cows receiving both selenium and vitamin E. Incidence of metritis was 60% for cows injected with selenium and 84% for those not receiving selenium. Cystic ovaries were diagnosed in 19% of cows injected with selenium and incidence was 47% for cows not treated with selenium. Supplementation of vitamin E was required in addition to selenium for prevention of retained placenta of cows fed stored ensiled forage and prepartum selenium injections were effective for reducing the incidence of metritis and cystic ovaries during the early postpartum period (Harrison *et al*., 1981).

In a series of experiments over 3 year, relatively low doses of selenium and vitamin E were injected intramuscularly 3 weeks prepartum to pregnant Israeli-Holstein dairy cows in a high-producing herd (9000 kg milk year^{-1}) with a history of retained placenta in 17% of the primiparous and 28% of the multiparous animals, as recorded for the 12 months preceding the study.

Selenium ranged from 0.035-0.109 ppm in the prepartum diet and from 0.160-0.200 ppm in the postpartum diet. Doses of selenium ranging from 2.3-23.0 mg reduced the incidence of retained placenta in 186 primiparous and in 428 multiparous to 7 and 15% which was half of that of controls. Low doses of selenium (2.3-4.6 mg) tended to be more effective than higher ones. Selenium alone was at least as effective as a combination of selenium and vitamin E. Dosage, timing, mechanism and interactions of selenium with other factors in reducing the incidence of retained placenta need clarification (Eger *et al*., 1985).

CONCLUSION

In this study, researchers resulted that selenium deficiency can increase placenta retention in dairy cows.

REFERENCES

Callahan, C.J., 1969. Postparturient infection of dairy cattle. J. Am. Vet. Med. Assoc., 155: 1963-1967.

Eger, S., D. Drori, I. Kadoori, N. Miller and H. Schindler, 1985. Effects of selenium and vitamin E on incidence of retained placenta. J. Dairy Sci., 68: 2119-2122.

Harrison, J.H., D.D. Hancock and R. Conrad, 1981. Ensiled forages, selenium injections, cystic ovaries, retained placenta and metritis. J. Dairy Sci., 64: 150-150.

Julien, W.E. and H.R. Conrad, 1985. Dietary components affecting metabolic disorders at parturition. Ohio Agricultural Research and Development Center, Department of Dairy Science Series 19, No. 6.

Julien, W.E., H.R. Conrad, J.E. Jones and A.L. Moxon, 1976. Selenium and vitamin E and incidence of retained placenta in parturient dairy cows. J. Dairy Sci., 59: 1954-1959.

Moberg, R., 1981. Possible influence of supplementary iodine, administered by evaporation on reproductive performance in cattle. Proc. 14th Int. Cong. Anim. Reprod., 3: 682-685.

Muller, L.D. and I.J. Owens, 1974. Factors associated with the incidence of retained placenta. J. Dairy Sci., 57: 725-728.

Nicholasan, J.W. and H.M. Cunningham, 1965. Retained placenta, abortion and abnormal calves from beef cows fed all barley rations. Can. Vet. J., 6: 275-281.

Noorsdsy, J.L., H.W. Leipold, D.L. Carmahan, R.A. Frey and J. Vestweber *et al*., 1973. Metabolic disturbances in the dairy cow influenced by inanagerial practices-case reports and epidemiological studies. Proceedings of Rumen Function Conference, November 28-29, 1973, La Salle Hotel, Chicago, Illinois.

Pelissier, C.L., 1972. Herd breeding problems and their consequences. J. Dairy Sci., 55: 385-391.

Radostitis, O.M., C.C. Gay, K.W. Hinchcliff and P.D. Constable, 2000. Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 9th Edn., W. B. Saunders Company Limited, USA., ISBN-13: 9780702026041, pp: 1618-1690.

Roberts, S.J., 1986. Veterinary Obstetrics and Genital Diseases Theriogenology. 3rd Edn., David and Charles, New York, USA., ISBN-13: 978-9997670922, pp: 44-48, 373-384.

Trinder, N., C.D. Woodhouse and C.P. Retan, 1969. The effect of vitamin E and selenium on the incidence of retained placentae in dairy cows. Vet. Rec., 85: 550-553.

Trinder, N., R.J. Hall and C.P. Retan, 1973. The relationship between the intake of selenium and vitamin E on the incidence of retained placentae in dairy cows. Vet. Rec., 93: 641-643.

Wooding, E.B.P. and A.P.F. Flint, 1994. Placentation. In: Marshall's Physiology of Reproduction, Laming, G.E. (Ed.). 4th Edn., Vol. 3. Chapman and Hall, London, pp: 235-460.