Effects of Vitamin E and Selenium on Periparturient Diseases and Fertility in Dairy Cattle

David Morrow, *D.V.M., PhD.*
Department of Large Animal Surgery & Medicine
J. W. Thomas, *PhD.*
Department of Animal Sciences
Michigan State University
East Lansing, Michigan 48824 and
R. James Main, *D.V.M., Private Practitioner,*
Lowell, Michigan

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Vitamin E and selenium are essential nutrients for cattle. Deficiencies of these two nutrients in cattle are reported to cause white muscle disease, weakness, scours, pneumonia, and unthriftiness in calves and abortions, stillbirths, retained placentas and reduced fertility in cows.

The functions of vitamin E and selenium are interrelated. Vitamin E reduces *in vivo* formation of lipoperoxidases which damage membranes. Selenium is a component of glutathione peroxidase which detoxifies lipoperoxides formed when vitamin E is deficient.

Review of the Literature

The first study to show a relationship between vitamin E-selenium supplementation and retained placenta in dairy cattle was conducted in England.[9] Treatments of 0 or 15 mg of selenium and 680 IU of vitamin E with 15 mg of selenium were injected intramuscularly 28 days prior to the projected calving date. The percent of cows calving in which the placenta had to be manually removed was 27, 0 and 7% respectively, suggesting that the injections of vitamin E and selenium were beneficial in preventing the occurrence of retained placenta.

The first studies in the United States to show a relationship between vitamin E-selenium supplementation and retained placenta in dairy cattle were conducted in Ohio which is a selenium deficient area. The injection of 50 mg selenium and 680 units of vitamin E approximately 21 days prepartum reduced the incidence of retained placentas from 38% in 26 control cows to 0% in 27 treated cows.[5] The plasma selenium values in the treated cows approached 0.1 ppm concentration at parturition. The injection of 50mg selenium and 680 units of vitamin E 20 days prepartum reduced the occurrence of retained placenta from 51% in 80 control cows to 9% in 133 treated cows in a subsequent Ohio field study.[6] Vitamin E-selenium therapy was also effective in reducing the occurrence of retained placenta in a Kentucky study[4] but ineffective in Maryland,[11] Virginia,[3] and New York[2] studies.

An examination of 243 aborted bovine fetuses from British columbia and the State of Washington found that 28% were selenium deficient based on the fluorometric assay of fetal liver.[8] This study suggested that a relationship may exist between selenium deficiency and bovine abortions. By extrapolation, stillbirths, weak calves and other reproductive problems may result from a selenium deficiency in cattle.

In another study, the serum selenium concentration at 14 to 21 days postpartum in 115 Holstein cows was positively correlated with services per conception and days open ($P < 0.05$).[7]

The objective of the study reported was to determine the effects of vitamin E and selenium injections during the dry period on periparturient disease and fertility in high producing dairy cattle.

Material and Methods

All cows due to calve during a 12-month period in the Michigan State University dairy herd were allocated at random to a treatment or control group. All animals in the treated group were injected with 50 mg selenium and 680 IU of vitamin E[a] at 21 days prior to the anticipated parturition. Conventional feeding and management practices were followed. The cows were maintained on a selenium deficient diet and no supplemental vitamin E or selenium was provided. Blood samples were collected to monitor serum selenium values by the fluorometric method.[10]

Criteria evaluated included the following: dystocia (%), milk fever (%), retained placenta (%), metritis (%), displaced abomasum (%), inactive ovaries (%), cystic follicles (%), corpora lutea (%), interval to first estrus (days), interval to first breeding (days), and cows culled or died (%).

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[a] *Mu-Se provided by Burns-Biotec, Oakland, California 94621*

Results and Discussion

There were 42 control and 40 treated cows. The mean serum selenium values were 0.018 ug/ml in both control and treated groups. Concentrations below 0.05 ug/ml are generally considered to be deficient by the clinical nutrition laboratory at Michigan State University.

The occurrence of dystocia was decreased only 2% by treatment while the occurrence of milk fever increased 6% (Table 1). There was essentially no change from treatment in the occurrence of displaced abomasum.

Table 1

Effects of Injecting 50 Mg Selenium and 680 Units of Vitamin E Three Weeks Prepartum on Periparturient Diseases and Fertility in 82 Dairy Cows

Criteria	Control	Treated	P
Number	42	40	
Dystocia (%)	17	15	N.S.
Milk Fever (%)	2	8	N.S.
Retained Placenta (%)	31	23	N.S.
Metritis (%)	38	26	N.S.
Displaced Abomasum (%)	14	13	N.S.
Inactive Ovaries (%)	12	6	N.S.
Cystic Follicles (%)	16	20	N.S.
Corpora Lutea (%)	72	74	N.S.
Interval to first estrus (days)	44	46	N.S.
Interval to first breeding (days)	66	69	N.S.
Days open	139	144	N.S.
Services/Conception	3.4	3.5	N.S.
Calf Mortality (%)	17	22	N.S.
Culled or died (%)	26	28	N.S.

Retained placenta decreased from 31 to 23% however these differences were not signigicant ($P < 0.05$).

Ovarian function, measured by the presence of inactive ovaries, cystic follicles, and corpora lutea, was not affected significantly by prepartum treatment with vitamin E and selenium ($P < 0.05$).

Fertility, measured by the intervals to first estrus and breeding, days open and services per conception, was not significantly affected by the injection of 50 mg selenium and 680 IU of vitamin E 21 days prepartum ($P < 0.05$).

The occurrence of calf losses during the first 30 days of age and cows culled or died during the subsequent lactation was not affected significantly by treatment ($P < 0.05$).

The parameters used to measure periparturient disease and fertility in this study were not affected significantly by the injection of 50 mg selenium and 680 units of vitamin E 21 days prepartum in selenium deficeint cows. These parameters are affected by many factors, such as disease, nutrition, season, sanitation, management and heredity which may partially account for the variable responses reported to vitamin E and selenium therapy. It is possible that the amount and/or length of supplementation was inadequate to influence these parameters in this study.

The daily requirement of vitamin E in a dairy cow has not been definitely established[1]: however 300 IU per day appears to be a reasonable amount. It is customary to supplement the ration daily with 50 to 100 IU of vitamin E.

The concentration of selenium in feeds is related to the content in the soil; however, acid soils tend to reduce the uptake of selenium by plants.[1] This factor likely contributes to the variable clinical signs and responses observed in cattle in selenium deficient areas.

The dietary requirement for selenium by cattle is estimated to be approximate 0.1 ppm, depending on the chemical form of selenium and the levels of interfering or enhancing factors in the diet such as vitamin E, sulfur, lipids, proteins and amino acids.[1] The maximum tolerable level of dietary selenium for dairy cattle is estimated to be 2 ppm. Increased amounts of protein and sulfur in the diet help to reduce the potential for toxicity problems. Naturally occurring organic selenium in plants appears to be more toxic than the inorganic form. The range between requirements and toxic levels is 30 to 50-fold.[1]

Recommendations for Preventing Selenium Toxicity

1. Add only *one* selenium supplemented ingredient such as a protein supplement, trace mineral salt, or mineral mix to the diet. When selenium is added from several sources, it is possible to feed more than 2 mg daily. This practice may result in potential toxicity problems.
2. Mix the selenium supplemented ingredient with the ration rather than feed free choice when possible in order to more closely monitor selenium intake.
3. Feed selenium supplements only to the species designated on the feed tag. The species requirements are highly variable.
4. Mix feed thoroughly to provide for even distribution of selenium throughout the ration.
5. Read and follow directions closely.

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Lutalyse
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For intramuscular use for estrus synchronization in beef cattle and non-lactating dairy heifers.

DESCRIPTION

This product contains the naturally occurring prostaglandin F2 alpha (dinoprost) as the tromethamine salt. Each ml contains dinoprost tromethamine equivalent to 5 mg dinoprost, also, benzyl alcohol, 9 mg, and water for injection, q.s. When necessary, pH was adjusted with sodium hydroxide and/or hydrochloric acid. Dinoprost tromethamine is a white or slightly off-white crystalline powder that is readily soluble in water at room temperature in concentrations to at least 200 mg/ml.

INDICATIONS AND INSTRUCTIONS FOR USE

For Intramuscular Use for Estrus Synchronization in Beef Cattle and Non-Lactating Dairy Heifers. Lutalyse (dinoprost tromethamine) Sterile Solution is indicated for its luteolytic effects in beef cattle and in non-lactating dairy heifers. Lutalyse is used to control the timing of estrus and ovulation in estrous cycling cattle that have a corpus luteum.

WHICH COWS AND HEIFERS WILL RESPOND TO LUTALYSE

Lutalyse is effective only in those normally estrous cycling animals having a corpus luteum; i.e., those which have ovulated at least five days prior to treatment. Lutalyse programs call for two injections 10 to 12 days apart. This avoids the need to consider the animal's precise day of the estrous cycle. Animals in a group situation that are not having estrous cycles will not be harmed by Lutalyse injection.

Many factors contribute to success and failure of reproduction management, and these factors are important also when time of breeding is to be regulated with Lutalyse. Some of these factors are:

1. *Physical facilities must be adequate to allow cattle handling without being detrimental to the animal.*
2. *Nutritional status must be adequate prior to and during the breeding season as this has a direct effect on conception and the initiation of estrus in heifers or return of estrous cycles in cows following calving.*
3. *Cattle must be ready to breed—they must be estrous cycling and must be healthy.*
4. *Estrus must be detected accurately if timed AI is not employed.*
5. *Semen of high fertility must be used.*
6. *Semen must be inseminated properly.*

A successful A.I. program can employ Lutalyse effectively, but a poor A.I. program will continue to be poor when Lutalyse is employed unless other management deficiencies are remedied first.

USE PROGRAMS ARE:

Program I—Estrus Observation

1. Inject 5 ml Lutalyse intramuscularly (25 mg dinoprost).
2. Repeat the injection 10 to 12 days after the first injection, then,
3. Observe for estrus after the second injection, and
4. Inseminate at the usual time relative to detection of each estrus following the second injection.
5. If the cattle are estrous cycling estrus is expected to occur 2 to 5 days after second injection. Cattle that do not become pregnant to that breeding will be expected to return to estrus between days 21 and 27 after the second injection.

Program II—Timed AI

1. Inject 5 ml Lutalyse (25 mg dinoprost) intramuscularly.
2. Repeat the injection 10 to 12 days after the first injection, then,
3. Inseminate about 80 hours after the second Lutalyse injection without estrus detection or observation.
4. Cattle that do not become pregnant to that breeding will be expected to return to estrus between 21 to 27 days after the second injection.

Experimental data have demonstrated that pregnancy rates at 2 to 5 days after second injection in Program I and Program II, were markedly greater than pregnancy rates for contemporary controls. However, due primarily to the mechanics of Program 2 there was an increase in services per conception.

WARNINGS

Not for human use.
Women of child-bearing age, asthmatics, and persons with bronchial and other respiratory problems should exercise *extreme caution* when handling this product. In the early stages, women may be unaware of their pregnancies. Dinoprost tromethamine is readily absorbed through the skin and can cause abortion and/or bronchiospasms. Direct contact with the skin should, therefore, be avoided. Accidental spillage on the skin should be washed off *immediately* with soap and water.

PRECAUTION

Do not administer to pregnant cows, as abortion may result.

Do not administer intravenously (I.V.), as this route might potentiate adverse reactions.

ADVERSE REACTIONS

1. The most frequently observed side effect is increased rectal temperature at a 5x or 10x overdose. However, rectal temperature change has been transient in all cases observed and has not been detrimental to the animal.
2. Limited salivation has been reported in some instances.
3. Intravenous administration might increase heart rate.

DOSAGE AND ADMINISTRATION

Lutalyse (dinoprost tromethamine) is supplied at a concentration of 5 mg dinoprost per ml. Lutalyse is luteolytic in cattle at 25 mg (5 ml) administered intramuscularly. As with any multidose vial, practice aseptic techniques in withdrawing each dose. Adequately clean and disinfect the vial closure prior to entry with a sterile needle.

HOW SUPPLIED

Lutalyse (dinoprost tromethamine) Sterile Solution is available in 10 ml vials.

CAUTION

Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian.

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