A Comparative Study of the Effectiveness of Calcium Propionate and Calcium Chloride for the Prevention of Parturient Paresis in Dairy Cows

B. PEHRSON, C. SVENSSON, and M. JONSSON
Department of Animal Environment and Health,
Section of Field Research, Swedish University
of Agricultural Sciences, PO Box 234, SE-532 23 Skara, Sweden

ABSTRACT

The efficacy of calcium propionate for the prevention of parturient paresis (milk fever) was compared with that of calcium chloride using 194 cows that had experienced milk fever during the previous calving. The cows were mainly of the Swedish Red and White and Swedish Friesian breeds and were divided randomly into an experimental group (n = 99) and a control group (n = 95). The cows in the experimental group received up to six boluses of 20 g of calcium as calcium propionate between 36 h before and 24 h after calving; the cows in the control group received up to four doses of 54 g of calcium as a commercially available oily solution of calcium chloride during the same period. Incidence of milk fever was recorded as the percentage of cows that were treated by a veterinarian because they showed clinical signs of the disease and had a blood calcium concentration less than 8.0 mg/dl. Twenty-five (25.3%) cows in the experimental group and 22 cows (23.2%) in the control group developed milk fever. The incidence of milk fever for cows in both groups was significantly lower than the 36.0% found in 713 cows that had experienced milk fever during their previous calving but received no prophylactic treatment. Therefore, calcium propionate was considered to have had a significant preventive effect, comparable with that of calcium chloride.

(**Key words**: parturient paresis, milk fever, calcium propionate, calcium chloride)

Abbreviation key: **SASAT** = serum activity of aspartate aminotransferase, **SCa** = serum concentration of calcium, **SMg** = serum concentration of magnesium.

INTRODUCTION

Parturient paresis (milk fever) is a metabolic disorder of cows that is associated with parturition and the initiation of lactation. Milk fever is characterized by hypocalcaemia, general muscular weakness, circulatory collapse, and depressed consciousness (17). In 1995, the incidence of the disease in Swedish dairy cows was 4.4% (20) but probably would have been significantly higher if effective preventive treatments had not been widely used.

In the US, adjustment of the acid-base balance in the diet during the last weeks of pregnancy is a method often used to prevent milk fever (1, 12). This method is not used in Sweden where the most common method is oral administration of calcium chloride during the peripartal period. Since the early 1970s, many Swedish farmers have treated their cows with three to four doses of 150 g of calcium chloride mixed to a gel with hydroxycellulose between 24 h before and 48 h after calving. The method is a modification of a procedure introduced by Ringarp et al. (18) and has been shown to reduce the incidence of milk fever by about 50% (10). This method, sometimes in a modified form, has also been used in other countries. One modification uses an oily solution of calcium chloride, which reduces the bitter taste of the salt. Schültken (19) considered calcium chloride in soybean oil to be as effective as calcium chloride in gel, although Goff and Horst (7) found that calcium chloride in soybean oil was poorly absorbed. The bitter taste may also be overcome by the administration of calcium chloride in a capsule, a method that also helps to reduce the risk of aspiration pneumonia and has been shown to be at least as effective as the gel (15).

Jørgensen et al. (11) reported that calcium chloride, administered as a gel, caused focal inflammation of the mucosa of the forestomachs; similar findings were recorded by Wentink and van den Ingh (22) who also observed extensive necrotic lesions in the abomasum, probably the result of elicitation of the esophageal groove reflex by the salt. Pehrson and Jönsson (14) also found inflammatory reactions in the rumen after the administration of capsules of calcium chloride, although the reactions did not apparently yield any clinical signs. No increase in the

Received October 14, 1997.
Accepted March 16, 1998.

concentration of protein fibrinogen in the blood was observed during the acute phase, and no decrease in milk yield occurred. In contrast, the administration of oily solutions of calcium chloride caused only mild reactions in the forestomachs (11, 22).

The use of a source of calcium that would have no adverse effects on the forestomach is preferable, provided that the calcium is equally available for absorption. Large amounts of propionic acid are produced in the rumen as a result of carbohydrate metabolism, and no adverse effects are obvious. Therefore, calcium propionate might be expected to be a satisfactory source of calcium. The salt has a neutral taste, and Goff and Horst (6) found that an aqueous solution of calcium propionate was at least as effective at increasing plasma calcium concentration as a calcium chloride gel but was not as effective as aqueous calcium chloride. Those researchers (6) reported promising results from the prophylactic administration of two doses of a calcium propionate paste to a herd of Jersey cows (8). Moreover, Higgins et al. (9) found increased serum concentrations of calcium (**SCa**) when calcium propionate and propylene glycol were administered to Holstein cows at parturition.

The aim of the present investigation was to evaluate further the use of calcium propionate for the prevention of milk fever in cows highly predisposed to the disease by comparing its effect with a commercially available oily solution of calcium chloride.

MATERIALS AND METHODS

Cows (n = 255) from Skaraborg in southwestern Sweden that had been treated for milk fever during their previous calving and that were expected to calve between January and June 1996 were selected from a database of the Swedish Association for Livestock, Breeding, and Production (Hållsta). The cows were allocated at random into an experimental group and a control group. The owners of the cows in the experimental group (n = 121) were instructed to administer to their cows six boluses of calcium propionate, each containing 20 g of calcium, by balling gun; the boluses were cylinders that were 15 cm long and 3.4 cm in diameter. One bolus was to be administered about 24 h before the cow was expected to calve, two boluses were administered close to calving, two were administered about 12 h after calving, and one bolus was administered about 24 h after calving. The owners of the control cows (n = 134) received four bottles of a commercially available oily calcium chloride solution (lycine oil; Paregel vet®; Pherrovet AB, Malmö, Sweden). Each bottle contained 54 g of calcium. Those owners were instructed to follow the recommendations of the manufacturer and administer one bottle about 24 h before expected calving, one bottle close to calving, one bottle about 12 h after calving, and the final bottle about 24 h after calving. Many Swedish cows that have suffered milk fever are treated prophylactically with calcium chloride at the subsequent calving, and it was not considered ethically acceptable to use a control group treated with a placebo.

For practical reasons, we preferred to administer the calcium propionate as boluses. However, it was not physically possible to incorporate more than 20 g of calcium in a bolus of a size that could be easily administered to a cow. In this trial, we wanted to compare the effect of the commercial product with that of calcium propionate in a dose that could be considered obtainable under practical circumstances. Therefore, we used a number of boluses that we considered realistic for the owners to administer. Consequently, we could not use equal doses of calcium from the two salts.

All cases of milk fever were treated by veterinarians who were requested to take blood samples and send them to our laboratory to determine SCa, the serum concentration of magnesium (**SMg**), and the serum activity of aspartate aminotransferase (**SASAT**). The SCa and SMg were measured by atomic absorption spectrophotometry, and SASAT was measured with a commercial kit (Boehringer Mannheim Diagnostica, Mannheim, Germany). The veterinarians also sent data on the time of treatment and a description of the clinical signs exhibited by each cow. The owners were provided with a form on which they were requested to record the exact time of calving, the appearance of possible signs of milk fever, and the times at which the boluses or bottles were administered.

Cows were considered to have milk fever if they showed clinical signs of the disease between 2 h after the administration of the first dose of either of the two treatments and 7 d after calving, if they had an SCa below 8.0 mg/dl, and if no other main disease could be suspected on the basis of either the description provided by the veterinarian or the results of the analyses of SMg and SASAT. Staggering and muscle twitching were accepted as signs of milk fever. Cows were recorded as not diseased only if at least three of the four treatments had been administered close to the scheduled times. The first dose was administered between 36 h before calving and 3 h after calving.

In total, 99 (82%) of the 121 cows in the experimental group and 95 (71%) of the 134 cows in the control group fulfilled the previously mentioned