Short Communication

Prevalence of subclinical hypocalcemia in dairy herds

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\textbf{Abstract}

The prevalence of subclinical hypocalcemia in the transition cow is unknown. Cows with subclinical hypocalcemia have no clinical signs of hypocalcemia but may be more susceptible to other diseases. The objective of this study was to determine the prevalence of subclinical hypocalcemia in the US dairy herds. As a part of the United States Department of Agriculture’s National Animal Health Monitoring System 2002 Dairy study, serum samples were collected from 1462 cows within 48 h of parturition. The samples were sorted by lactation number: 1st (\(n = 454\)), 2nd (\(n = 447\)), 3rd (\(n = 291\)), 4th (\(n = 166\)), 5th (\(n = 72\)), and 6th (\(n = 32\)). Subclinical hypocalcemia (<2.0 mM) increased with age and was present in 25\%, 41\%, 49\%, 51\%, 54\%, and 42\% of 1st–6th lactation cows, respectively. Cows with serum calcium concentrations >2.0 mM had significantly lower serum non-esterified fatty acids indicating better energy balance than those with subclinical hypocalcemia. Subclinical hypocalcemia may make cows more susceptible to secondary diseases but more research will be required to determine if this is true.

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Clinical hypocalcemia (milk fever) in dairy cows is an economically important disease and significantly increases a cow’s susceptibility to mastitis, retained fetal membranes, displaced abomasum, dystocia and ketosis, which can reduce a cow’s productivity life (Curtis et al., 1983, 1985). Hypocalcemia reduces the ability of immune cells to respond to stimuli (Kimura et al., 2006) thus contributing to infections, such as mastitis. Hypocalcemia reduces smooth muscle contraction, which results in reduced rumen and abomasal motility leading to displaced abomasum and reduced feed intake (Goff, 2008). Its effects on muscle contraction prevent efficient teat closure, which contributes to mastitis (Goff, 2008).

The objective of this survey was to determine the prevalence of subclinical hypocalcemia in dairy herds. As a part of the United States Department of Agriculture’s (USDA) National Animal Health Monitoring System 2002 Dairy study, serum samples were collected from 1462 cows within 48 h postpartum, representing 480 dairy herds from 21 States. The National Animal Disease Centers (NADC) Animal Care and Use Committee approved all animals. Specific management data were collected where available including whether a cow was treated for clinical milk fever. Samples were assayed for calcium, 1,25-dihydroxyvitamin D (1,25(OH)\textsubscript{2}D\textsubscript{3}), and non-esterified fatty acids (NEFA) as described elsewhere (Prapong et al., 2005; Melendez et al., 2007). Data were analyzed by ANOVA using a factorial design in the JMP statistical package (SAS Institute). The main effects were lactation number and clinical signs of milk fever. Means and SEM are reported for all data. Means separation was conducted by the method of Tukey.

The overall incidence of milk fever found from the NAHMS 2002 Dairy study was 5\%, which aligns with the 5–7\% incidence of clinical hypocalcemia reported by others (DeGaris and Lean, 2008; Goff, 2008; Mulligan and Doherty, 2008). Fig. 1 shows the incidence of subclinical and clinical hypocalcemia by lactation number. The Merck Veterinary Manual defines normal blood calcium in the cow as 2.1–2.8 mM\textsuperscript{1} and subclinical hypocalcemia was defined as serum calcium <2.0 mM as this is below the normal reference range. Subclinical hypocalcemia increased with age and was present in 25\%, 41\%, 49\%, 51\%, 54\%, and 42\% of 1st–6th lactation cows, respectively. Furthermore, 47\% of all cows in their second lactation or greater had varying degrees of subclinical hypocalcemia that in some cases is severe enough to alter physiological and immune functions (Kimura et al., 2006).

Figs. 2A–C show the mean serum calcium, 1,25(OH)\textsubscript{2}D and NEFA concentrations by age/lactation number. There was a significant decline in serum calcium concentrations as the lactation number increased from 1st to 4th. This reflects the effects of age, and the increased number of cows which had subclinical hypocalcemia (Fig. 2A). The serum calcium concentrations in 5th–6th lactation cows were not significantly different from 3rd to 2nd.
lactation cows, respectively. This was most likely due to the low cow numbers in these two age groups. Mean serum 1,25(OH)2D concentrations rose significantly as calcium declined (Fig. 2B) but this rise plateaued beyond 3rd lactation cows. These data suggest that this normal homeostatic response to hypocalcemia may have limits with the animal’s age and may therefore contribute to greater or prolonged hypocalcemia in older animals.

Fig. 3 shows that cows with serum calcium >2.0 mM had lower serum NEFA concentrations postpartum than cows with serum calcium <2.0 mM (P < 0.001), which indicates that normocalcemic cows are in better energy balance than in subclinical hypocalcemic cows. This link between subclinical hypocalcemia and higher serum NEFA provides further evidence as to why both clinical and subclinical hypocalcemic cows are probably at greater risk for diseases and why we should therefore be concerned about the prevalence of subclinical hypocalcemia in dairy herds.

The take home message with the data available is simply that postpartum blood calcium is below the normal range in many more cows than we have previously appreciated. We speculate that this may have some health effects (Curtis et al., 1983, 1985) due to calcium’s central role in many cellular functions (Kimura et al., 2006; Goff, 2008). The high prevalence of subclinical hypocalcemia should be viewed as a potential health risk to the transition cow that requires further research.

Conflict of interest statement

None of the authors of this paper has a financial or personal relationship with other people or organizations that could inappropriately influence or bias the content of this paper.

References


Fig. 1. Serum calcium concentrations were plotted for 1462 cows. All serum samples were collected within 48 h postpartum by lactation number: 1st lactation cows (n = 454), 2nd lactation cows (n = 447), 3rd lactation cows (n = 291), 4th lactation cows (n = 166), 5th lactation cows (n = 72), and 6th lactation cows (n = 32). The percent of cows by lactation number that experienced a clinical milk fever episode which was treated or were subclinically hypocalcemic are shown in the graph.

Fig. 2. Mean serum calcium concentrations by lactation number (A), Mean serum 1,25(OH)2D concentrations by lactation number (B). Mean serum NEFA concentrations by lactation number (C). 1st lactation cows (n = 454), 2nd lactation cows (n = 447), 3rd lactation cows (n = 291), 4th lactation cows (n = 166), 5th lactation cows (n = 72), and 6th lactation cows (n = 32). All data are means ± SEM. a,b,c,d Lactation number not connected by same letter are significantly different. (P < 0.01.)

Fig. 3. Mean postpartum NEFA concentrations for normal calcemic cows, serum Ca > 2.0 mM with subclinical hypocalcemic cows which had serum Ca > 2.0 mM (mean ± SEM, Ca < 2.0 mM, n = 630 and Ca > 2.0 mM, n = 832), ** P < 0.001.
yield in Holstein cows dried-off with low body condition score. Research in Veterinary Science 82, 349–357.
