TRACE ELEMENT DEFICIENCIES IN THE PATHOGENESIS OF RESPIRATORY DISTRESS SYNDROME IN THE MATURE NEWBORN CALF

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Introduction

In Belgium, respiratory distress syndrome (RDS) is one of the leading causes of neonatal death in mature hypermuscled Belgian Blue calf (BB) but also in other cattle breeds (1). Major clinical signs (achynea, tachycardia and sometimes depression) develop in the first hours after birth and are due to insufficiency of functional surfactant (2). Males are more susceptible to RDS because of the inhibitory effect of testosterone on surfactant production (3). Necropsy findings reveal atelectasia, congestion, interstitial edema and emphysema. Often, intestinal lesions are also observed (1). Knowing that trace elements deficiencies can slow pulmonary maturation, the aim of this study was to investigate trace elements status in RDS affected herds in comparison with reference herds without any evidence of RDS.

Material and methods

Ten RDS affected BB herds (RDS morbidity = 20-40% and mortality = 6-80%) and 7 reference herds (0% morbidity and mortality due to RDS and less than 5% due to other neonatal pathologies) were considered.

In each herd, blood sample was taken from 10 calved healthy cows. In each blood sample, the plasmatic zinc (Zn) and copper (Cu) contents and erythrocytic glutathion peroxydase activity (GSH-pxe) were measured and considered normal when above 15 µmol/L, 14 µmol/L and 250 IU/gHb, respectively.

Milk was also sampled and pooled from 10 calved cows or, when possible, bulk milk was taken. Milk iodine (I) content was considered normal when above 80 µg/L. Results were compared between groups by Chi-square test.

Results

All RDS affected herds had low Zn and Cu concentrations and low GSH-pxe activity. Eight out of 10 had low I in milk. In the non-RDS affected herds, only 1 herd was deficient in I, Zn, Cu and had low GSH-pxe activity. The thyroid of calves who died from RDS weighted 15.3-17.3 grams (normal value is 6-12 g). This increased thyroid’s size revealed I deficiency in the dams.

The χ²-test indicates significant differences between RDS affected herds and control herds for I and Se but no significant difference between RDS affected herds and control herds for Cu and Zn. Furthermore, the χ²-test also indicates that there is significant difference between RDS and control for the combined deficiency in Se and I. It means that the probability to meet RDS affected herds is higher with a combined deficiency in I and Se instead of a simple deficiency in I or in Se.

Discussion

It seems that the trace elements Se, Zn and Cu play an essential role in the development of RDS, by primary surfactant insufficiency. The same applies for I, although not deficient in all herds. The reason for this might be that milk samples were taken during lactation, when cows’ nutrition was different and, in any case, supplemented in I.

A recent study (4) in Wallonian BB herds showed that the large majority (>90%) of them are deficient in at least one trace element. It can explain how important is the impact of RDS in Belgium farms. Effectively, RDS concerns 65% of the BB herds situated in the south part of Belgium (of which 36% lose one or more calves each year).

A relation between RDS and Zn, Cu, I and Se deficiencies had been described in veterinary medicine (5,6) but also in human medicine. In mature human babies, the same RDS is observed (7) but its etiology is still unclear, although I deficiency in the mother is suspected to play a major role in its pathogenesis (8). Furthermore, it has been demonstrated that a Se-dependent deiodinase is responsible for transformation of thyroxine (T4) into triiodothyronine (T3) (9), which is essential for effective surfactant production (10). Another part of the pathogenesis of RDS concerns the secondary surfactant insufficiency which is due to septicemia-endotoxemia of intestinal origin or not (11, 12).

Conclusions

A conclusion, results suggest an association between RDS in mature newborn calves and trace elements deficiencies, especially Se and I, that can be responsible for primary surfactant insufficiency. Correction of trace elements deficiencies in these herds led to a spectacular decreasing of morbidity and mortality due to RDS.