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Calf Note #15 – Respiratory Acidosis and IgG Absorption

Introduction. During the birthing process, neonates are subject to considerable stress. This stress can be associated with a lack of oxygen common during parturition when fetal membranes are ruptured and uterine contractions begin or simply the result of the neonate's ability/inability to begin spontaneous respiration. Often this results in animals being born acidotic. The term acidosis refers to an acid-base imbalance which results in a pH that deviates from the 'norm'. Normal pH in adult mammals is considered to be 7.35 - 7.40 when arterial blood is analyzed. However, a pH range from 7.2 - 7.8 is considered to be abnormal but not life-threatening during the early post partum period. In the event that animals are born acidotic, frequently compensation occurs spontaneously.

The driving force behind the pH alteration. Acidosis at birth can be the result of a number of challenges the calf encounters during the birthing process and the early hours of life. The actual pH alteration is caused by one of two factors: the base portion of the acid-base system, which is the bicarbonate ion or the acid portion, carbon dioxide. Excessive anaerobic glycolysis, common during periods of oxygen shortage to tissue, like the birthing process, results in the production of lactic acid. Lactic acid is a strong acid that is buffered by the bicarbonate ion (HCO_3). Consequently, HCO_3 is excreted in an effort of the body compensate for increased acid in the system. This is referred to as metabolic acidosis. Respiratory acidosis, on the other hand, is caused by alteration of the carbon dioxide level resulting in an increased carbon dioxide concentration. The most common clinical measurement for carbon dioxide is expresses as a pCO_2 or partial pressure of carbon dioxide. Practitioners generally perform blood gas analysis to determine levels of both HCO_3 and pCO_2 as well as a host of other parameters to indicate the acid-base status of patients.

The importance of proper sampling techniques. Venous samples are less satisfactory than arterial samples for pCO_2 measurements and should be restricted to evaluating metabolic conditions. Results of venous sampling may be misleading due to the stagnation of venous blood and the contribution of tissue oxidation, causing the appearance of pCO_2 concentrations to be elevated and pH to be depressed.

The concern. Some researchers have determined there is correlation between respiratory acidosis and the neonate's ability to absorb colostral immunoglobulins. The importance of colostral immunoglobulin absorption cannot be adequately stressed. Without sufficient levels of plasma immunoglobulins, the incidence of calf mortality and morbidity increase dramatically. Therefore, our concern for any challenge that detracts from the animal's ability to absorb immunoglobulins is paramount.

The exact mechanism for the interference with absorption is not well understood at the present time. However, there is some conflicting data regarding the effect of increased arterial pCO_2 levels and colostral immunoglobulin absorption. Recent research at the University of Tennessee found no correlation of elevated arterial pCO_2 concentrations and the apparent efficiency of absorption (AEA) of colostral immunoglobulins. Rather than making a comparison to serum Ig levels, the actual AEA

was calculated. Calculating the AEA minimizes errors associated with varying intake of colostral Ig, resulting from colostrum with different concentrations of Ig, body weight and levels of intake. Calves with elevated arterial pCO_2 concentrations had AEA levels that were not different from calves with lower pCO_2 concentrations. It should be noted that in our study, all calves were born with pCO_2 concentrations considered to be 'normal' at birth.

On the farm application. Since data is conflicting regarding the possible interference of immunoglobulin absorption resulting from acid-base disturbances observed during parturition, we need to return to good basic calf management. Most producers don't carry a blood gas analyzer in their back pocket so we need to take a practical approach to neonatal calf health. If elevated pCO_2 levels do inhibit Ig absorption, be aware of signs indicating compromised acid-base status. Signs include prolonged second stage labor, dystocia requiring traction, and weakness or lack of responsiveness of calf at birth.

Respiratory function may be altered or improved by two means: increasing rate of respiration or increasing the depth of respiration. Commercial drugs are available to stimulate the CNS or calves may be manually ventilated to compensate for respiratory disorders. A more reasonable approach for controlling acid-base disturbances during the perinatal period is to properly manage cows during the dry period and at calving. Avoidance of obesity and adequate rearing of breeding heifers should lead to a reduction of assisted and/or difficult calvings, eliminating two risk factors. If assistance is required, care should be given before a prolonged time period. Finally, it is well established that feeding an adequate supply of high quality colostrum as early as possible is the best tool we have for ensuring proper levels of serum Ig and consequently increasing our odds for the desired health and viability of calves.