Hepatic Trace-mineral Concentrations in the Bovine Fetus and Neonate

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Introduction

Mineral deficiencies affect a variety of physiologic functions, including immunity, fetal development and metabolism. Understanding the role of mineral nutrition in animal health has prompted a need for accurate assessment and interpretation of mineral status relative to disease potential. Newer analytical technologies allow rapid measurement of multiple mineral concentrations in blood or tissue samples. Diagnostic interpretation of adult animal tissue mineral concentrations has been well defined. In contrast, diagnostic criteria for fetal and neonatal hepatic mineral concentrations are not well established. The objective of this study was to generate preliminary criteria for assessing bovine fetal and neonatal hepatic mineral concentrations.

Materials and Methods

Liver samples were collected from 106 bovine fetuses and 64 bovine neonates submitted to the Veterinary Diagnostic Laboratory at Oregon State University. Inductively coupled plasma atomic emission spectroscopy (ICP/AES) was used to assay 22 minerals in all liver samples. Mineral concentrations were determined on a wet weight basis and converted to a dry weight basis. Liver dry matter (DM) concentration was determined by drying an aliquot sample in a convection oven. Fetal gestational age was estimated from crown-rump length. Information pertaining to reported cause of death or necropsy findings was recorded for all cases.

Results and Conclusions

Fetal specimens had a mean gestational age of 8.4 months (range: 3 to 9.5 months). Neonatal specimens had a mean age of 14.2 days (range: 0.5 hr-90 days). Mean fetal liver DM ratio (0.22) was less ($P<.0001$) than neonatal liver DM (0.24) and both means were lower ($P<.0001$) than established maternal values (0.32). Pre- and postnatal age influenced ($P<.0001$) liver DM content, both increasing with age. These data suggest differing DM content of fetal, neonatal and adult liver tissue may confound diagnostic interpretation of mineral concentrations, when expressed on a wet weight basis. Also within fetus or neonate, wet weight-based criteria may not be appropriate given changing liver DM with age. Raw data for mineral concentrations (wet weight basis) in fetal and neonatal samples span from very low to very high values. There was no histological evidence of mineral toxicity in any sample. When concentrations were converted to a DM basis, fetal concentrations for most minerals exceeded current adult concentrations and neonatal concentrations were somewhere between these values. These data are in agreement with previous studies suggesting greater mineral concentrations in fetal liver dry matter, compared to adults. On a dry matter basis, fetal liver Cu, Fe, Mg, P, Zn and Na concentrations increased with age, whereas Ca, Co and Na decreased and Se and Mn were not different. In contrast, nearly all mineral concentrations declined with age in neonatal samples.

These data support the concept that the liver plays an important role in perinatal mineral metabolism. Our ability to make diagnostic interpretations from fetal and neonatal liver mineral concentrations may be improved if evaluations are based on age and hepatic dry matter content.