Real Time RT-PCR Analysis of Glucose Utilization Enzymes in Skeletal Muscle of Preterm vs. Full-term Neonates

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Preterm birth is a serious and costly health problem, which affects nearly 1 in 8 births in the United States. Intravenous, or parenteral, nutrition is often required in very preterm neonates (<33 weeks gestational age), whose digestive tracts are too immature to receive enteral nutrition. Unfortunately, current parenteral feeding methods are also associated with metabolic complications including hyperglycemia, which is a primary factor in postnatal morbidity and mortality. The underlying causes of hyperglycemia in preterm neonates receiving parenteral nutrition are unknown, but attenuated glucose uptake and usage by peripheral tissues has been implicated. We hypothesized that compared to neonates born full-term, preterm neonates possess a diminished capacity for glucose uptake and usage in skeletal muscle. To test this, mRNA transcript amounts were measured in skeletal muscle tissue of preterm and term pigs (delivered on days 114 and 106 of gestation, respectively). Tissue was collected after 6 d of parenteral feeding and transcript amounts for enzymes involved in glucose transport (GLUT 1 and GLUT 4), glycogen synthesis (glycogen synthase), glycogen degradation (glycogen phosphorylase), and fatty-acid oxidation (carnitine palmitoyltransferase I [CPT I]) were determined. Preterm pigs displayed increased ($P < 0.05$) expression of GLUT 4, CPT I, and glycogen phosphorylase transcripts relative to term pigs. This suggests that mechanisms for glucose uptake in the preterm neonate are immaturely developed and that muscle cells derive energy more heavily from fatty acids and glycogen stored prenatally as alternatives to circulating glucose. Further investigation of the activity and protein quantities of these enzymes is necessary to validate these conclusions.