HORSE SPECIES: **DEVELOPMENTAL PROGRAMMING: APPLICATIONS IN THE HORSE**

0393 Developmental programming in agriculturally relevant species: An overview. K. A. Vonnahme*, *North Dakota State University, Fargo.*

Postnatal growth and development of offspring can be influenced by stressors that their parents experienced before their conception, during their gestation, or during lactation. This phenomenon is known as developmental programming. Developmental programming has been shown to influence many of our large domesticated animals and may impact livestock production. An important component to developmental programming is that placental function can be influenced by many factors impacting nutrient transport. Not only does nutritional stress, such as nutrient restriction, impact fetal and placental growth, but other stressors such as transportation, extreme temperatures, and social environments influence the offspring in utero, at birth, and after weaning. Understanding the mechanisms of how these stressors impact nutrient availability to the developing offspring will help in determining potential management strategies and therapeutics that could be implemented to reduce negative consequences. This overview of developmental programming will preface equine specific presentations on how the horse is impacted by the maternal environment and the potential impact on the equine industry.

Key Words: developmental programming, livestock, placenta

0394 Glucorticoid programming of development during early life. A. Fowden*, O. A. Valenzuela, J. K. Jellyman, N. B. Holdstock, and A. J. Forhead, *University of Cambridge, Cambridge, UK.*

Human epidemiological studies have shown that low birth weight is associated with an increased incidence of adult metabolic disease. Similarly, in experimental animals, induction of fetal growth restriction alters adult metabolic phenotype. Collectively, these studies have led to the concept that suboptimal environmental conditions during early development program later metabolic dysfunction. Glucocorticoid stress hormones may mediate many of these environmental programming effects, as they inhibit fetal growth and their maternal administration is known to alter metabolic and endocrine function of the adult offspring in several species. Normally, glucocorticoids only act as prepartum maturational signals but, earlier in development, they can also act as signals of environmental adversity. However, relatively little is known about the programming effects of neonatal glucocorticoid overexposure when tissues are particularly glucocorticoid-sensitive. In horses, unlike other species, the fetal hypothalamic-pituitary-adrenal (HPA) axis develops late in gestation, with the main cortisol increment after, not before, birth. Indeed, in preterm and dysmature foals, cortisol concentrations can be high for several days after birth. Thus, horses may be more susceptible to glucocorticoid programming in the neonatal rather than fetal period of development. Administration of synthetic glucocorticoids to pregnant mares near term ($\geq$ 300 d) causes both stillbirth and early delivery of viable foals, depending on the exact gestational age at treatment (4). In ponies in late gestation ($\geq$ 270 d), this treatment causes maternal hyperinsulinaemia and hyperglycaemia, indicative of insulin resistance, but has little effect on gestational length or foal birth weight and size, although it does have minor actions on foal HPA function in the first 2 to 3 wk after birth. In contrast, raising cortisol concentrations endogenously in the foal for 5 d after birth by ACTH administration had little effect on HPA function in the young foal ($\leq$ 15 wk), but did alter basal ACTH concentrations and hypoglycaemia-induced ACTH secretion in the adult ponies at 1 and 2 yr of age, in association with sex-linked differences in adreno-cortical growth at 2 yr. In addition, neonatal cortisol overexposure reduced glucose-stimulated insulin secretion in the young foals but not in the adults, while increasing insulin sensitivity in the young foals and yearlings but not in the 2 yr olds. However, the extent to which these changes persist, resolve, or exacerbate with increasing age remains unknown. Cortisol overexposure of equine neonates, therefore, programs their subsequent endocrine and metabolic phenotype, with implications for their adult health and potential athletic performance.

Key Words: glucocorticoid programming

0395 Nutritional programming and the impact on mare and foal performance. J. Coverdale*[1], C. J. Hammer[2], and K. W. Walter[3], *[1]Texas A&M University, College Station, TX, [2]North Dakota State University, Fargo, [3]Truman State University, Kirksville, MO.*

Many environmental factors can alter phenotype of offspring when applied during critical periods of early development. In most domestic species, maternal nutrition influences fetal development, and the fetus is sensitive to nutrition of the dam during pregnancy. Large numbers of techniques have been explored including both under- and overnutrition of the dam. Both nutritional strategies have yielded potential consequences, including: altered glucose tolerance, pancreatic endocrine function, insulin sensitivity, body composition, and colostrum quality. While the impact of maternal nutrition on fetal development in the equine has not been thoroughly investigated, overnutrition is a common occurrence in the industry. Work in our laboratory has focused on effects of

maternal overnutrition on mare and foal performance, mare intake, mare hormone concentrations, foaling parameters, colostrum quality, passive transfer of immunity, and glucose and insulin dynamics. Over several trials, mares were fed either 100 or 140% of NRC requirements for DE, and supplemental Se and arginine were added to diets in an attempt to mitigate potential intrauterine growth retardation resulting from dams overfed during the last third of pregnancy. As expected, when mares were overfed, BW, BCS, and rump fat values increased. Despite this change in mare body composition, foaling parameters such as time to stand and time to nurse were unaffected. Foal growth over 150 d was also not influenced. Maternal nutrition did not alter colostrum volume, but influenced colostrum quality. Maternal overnutrition resulted in lower colostrum IgG concentrations, but did not cause failure of passive transfer in foals. Supplemental Se and arginine were unable to mitigate this reduction in colostrum IgG. Additionally, mare and foal glucose and insulin dynamics were influenced by maternal nutrition. Mare glucose and insulin area under the curve (AUC) increased with increased concentrate supplementation, and in a subsequent trial supplemental arginine was able to decrease mare insulin AUC. Foal insulin AUC and peak insulin concentrations were increased when mares were fed concentrate during the last third of pregnancy, and in a later trial, foal peak glucose values were reduced with arginine supplementation of the mare. This influence of maternal nutrition on glucose and insulin dynamics warrants further investigation, as it may be related to athletic performance and metabolic disease in the adult. Further studies will be necessary to fully elucidate the influence of mare nutrition during pregnancy on performance of the mare and resulting foal, as well as long-term consequences of developmental programming.

Key Words: horse, nutrition, foal, developmental programming