Reproduction Takeaways from the AAEP Convention

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Each year at the American Association of Equine Practitioners Convention, veterinarians share the latest in research on a number of topics. The revelations often mean a better understanding of managing horses' health. Reproduction topics at the convention, which was held Dec. 4-8, 2010, in Baltimore, Md., ran the gamut; we selected a few that should most interest breeders and owners in the Thoroughbred industry.

Manual Reduction of Twins in Mares

While a mare with twins by her side is rare, twinning in horses is actually dangerous for the mare, especially during delivery. More often than not, one of the twins, generally the smaller and weaker of the two, will die prior to birth. In fact, the chances of a mare carrying twins to term and delivering them successfully are about one in 10,000.

The manual reduction of one embryo in mares in the very early stages of carrying twins is a practice that was introduced to the breeding community in 2006 (the technique was first described in the '80s along with the increased use of the ultrasound to detect twin pregnancies), and since then it has become a common practice in managing twin cases. Dr. Pete C. Sheerin reviewed a study he conducted on manual twin reduction. Sheerin, a reproduction specialist who carried out his study at Rood & Riddle Equine Hospital in Lexington, examined whether the performance of the veterinarian, the drug treatment used, or the mare's age impacted the procedure's success rate.

In his retrospective approach Sheerin used the medical records of mares that underwent twin reduction at Rood & Riddle. The procedures were performed between Days 13-20 of gestation. Sheerin explained that mares from the same farms that had only one embryo served as controls in the study. He noted the mares' ages (which ranged from 3 to 24 years), the veterinarian that performed the procedure (14 veterinarians total), and the combination of drugs that were used on the mares (22 combinations).

Sheerin said that the mares that had undergone a twin reduction treatment had a marginally lower live foal rate (80.3%) than those mares that carried a single foal since the beginning of their pregnancy (86.7%). There was no difference in the live foal percentage of the mares that underwent a reduction from Day 13-16 of

Broodmares are known to have the ability to control the size of their foals (page 701)

gestation than those undergoing the procedure between Day 17-20.

Although the individual veterinarian's performance affected the live foal rate, Sheerin said differences were not related to veterinary experience. He also noted that "mare populations may have impacted these results, with experienced practitioners being referred difficult cases."

Mare age also impacted twin reduction procedures. Sheerin found that mares older than 15 years of age had lower live foaling rates (66.2%) after undergoing a reduction procedure than younger mares (83.2%).

Finally, the drugs used to treat the mares after they underwent a reduction procedure seemed to impact foaling rates, said Sheerin. He explained that mares treated with flunixin meglumine (Banamine) and progesterone had foaling rates of 84%. Mares treated with other drug combinations had a live foal rate of 84%, and mares not treated with drugs had a live foal rate of 77%.

With this new research on twin reduction procedures, owners can feel confident that their mare with a twin pregnancy can undergo a successful reduction procedure and give birth to a healthy foal. —*EL*


Assessing breeding records can offer plenty of clues regarding a stallion's fertility

Subfertile Breeding Stallions: Management Strategies

"Stallions do not become sires because of reproductive capability," began Dr. Dickson Varner, a reproduction specialist and professor of large animal medicine and surgery at Texas A&M University. "They're selected based on performance, pedigree, and conformation—reproductive ability is last. The equine breeding industry abounds with stallions whose level of fertility is less than optimal."

Varner discussed several cases of breeding stallion subfertility, along with semen and breeding management strategies that effectively increased those stallions' fertility. Some involved live cover programs, while others involved artificial insemination.

"Are we acting unethically when we enhance fertility in stallions?" he asked the audience. "It's not a black and white issue. It is difficult at present, except in isolated circumstances, to differentiate between heritable and nonheritable causes of reduced fertility."

The first step in improving breeding stallion fertility, he said, is to assess a stallion's breeding records to discover the circumstances that result in low fertility. The problem could be with the stallion, the mares, and/or their management. In the case of the mares, for example, he referenced one stallion that had above-average pregnancy rates per cycle for maiden and foaling mares, but lower rates for barren mares (which clearly had lower fertility). That latter group could lead you to underestimate the stallion's fertility if you didn't analyze the mares as well as the stallion.

Management factors can also come into play, and they might depend on the stallion. For example, he described a comparison of two stallions, one with a pregnancy rate that increased with increasing numbers of covers in a day. The other stallion had lower pregnancy rates with increasing number of covers in a day and higher pregnancy rates after periods of sexual rest.

"For the first stallion, the more you breed him the better he gets—you'd want to have a large book of mares and keep some test mares around for him to breed if there are no commercial mares available," Varner explained. "The second would do better with a smaller book."

Other techniques to improve fertility in live cover programs include:

- Breeding stallions to test mares in the off season, as many stallions have lower fertility after extended periods of sexual rest.
- Using reinforcement breeding (collecting a dismount semen sample, filtering/extending it, and placing this in the mare immediately). Some stallions tend to dismount early, and this can help those stallions considerably (if permitted by the registering organization). This practice also helped one stallion's pregnancy rate following a kick in the groin, until he recovered from that injury. "Overall, it appears that reinforcement breeding can improve pregnancy rates in approximately 60% of Thoroughbred stallions, given the experimental figures available," Varner commented.

"Breeding and semen-manipulation strategies can be applied to maximize the fertility of these stallions and to extend their productive lives," he concluded. —*CW*

Nature vs. Nurture and Horse Health

The phrase "nature vs. nurture" is usually used to refer to the debate over which has a greater impact on a person's personality and preferences—genetics or environment/rearing. But for this article, we'll use it in the context of fetal programming, or what makes a foal develop into a physically healthy (or not so healthy) horse. Hint: Nature and nurture in this case are scientifically proven to be intertwined, with nurture (environment) affecting genetic expression even in later generations and genetics obviously controlling much of a young horse's development.

"The athletic performance of horses may be highly susceptible to fetal programming," said Dr. Carey Satterfield, assistant professor of animal science at Texas A&M University. Thus, our management of the pregnant mare and young foal could help that foal run faster, spin harder, and/or jump higher as an adult—or the opposite.

Satterfield delivered an in-depth talk on the relatively new (to horses) field of epigenetics, or the study of changes in physical characteristics occurring independently of genetic changes. To date, few epigenetic studies have focused on horses, but the bit of research that exists, plus findings in other species have opened the door to a universe of possibilities—both helpful and harmful—for manipulating the physical characteristics of our children and the animals we raise.

"The question of nature vs. nurture is unanswerable," stated Satterfield at the convention. "Nature and nurture can't be separated because nurturing can alter gene expression (nature)."

That doesn't mean that hot weather or nutrition changes alter a person's or animal's genetic code or DNA; rather, a variety of conditions can change how the organism "uses" its DNA. The genetic code is unchangeable, but various genes within it are "switched on or off" to generate appropriate proteins as needed. For example, genes that control the development of bones, manes/tails, or internal organs switch on at the right time during gestation to create those structures, then switch off once they have done their jobs.

Another way to look at DNA vs. gene expression is to consider that every cell in an organism has the exact same DNA (organ transplants aside), but hoof and heart tissue, for example, are clearly very different. Why? Because different genes within that DNA are switched on in each tissue type.

'Nature vs. nurture' is being debated by the veterinarian community

Genes switch on and off in response to a host of factors (such as injury, disease, or change in diet), in all ages of individuals. However, the younger the organism, the more flexible or "plastic" its gene expression is.

"The embryonic state is the most plastic one," explained Satterfield. "With increasing age, plasticity decreases. Adults are pretty set in stone, but the fetus is very plastic and can adapt to its environment. Plasticity continues until weaning.

"The fetus seeks cues to its environment, so it can develop to provide the phenotype (physical characteristics) it needs to maximize its survival once it's born (fetal programming)," he said. "The adaptive process is rooted in evolution and likely intended to provide an advantage to the fetus after birth. The problem is when the external environment is improperly predicted, then the offspring develops adult disease (because it developed to match an environment it doesn't live in).

"For example, a poorly nourished fetus would predict that nutrient availability will be scarce later in life and develop an extremely efficient metabolism," he said. "If, in fact, the nutrient availability is high later in life, this metabolic efficiency would result in the deposition of fat. Indeed, some horses are described as 'easy keepers'—a 'condition' that may result from the metabolic programming of the fetus in utero.

"Equine conditions such as obesity, metabolic syndrome, and laminitis could all have fetal origins," he commented.

Another aspect of fetal programming is that timing is everything, Satterfield said. "Not all organs grow at the same time or at the same rate," he explained. "The same environmental cue can have very different responses depending on the timing of administration to the fetus." —*CW*

Research in Other Species

Satterfield described several studies in humans, sheep, and rats to illustrate the impacts of fetal programming on later health. Many studies focus on undernutrition, because as he noted, "In livestock, drought during gestation is the most common cause of a mismatched prenatal and postnatal environment."

Human mothers who gave birth during the Dutch potato famine (mid-1940s) had smaller offspring than normal, and females born to those mothers also had smaller offspring than normal despite healthy diets, suggesting a heritable epigenetic alteration.

Animals' behaviors and responses to behavior modifications can be affected by the genetic results of the mother's experiences

Mothers exposed to famine (in general) have children who are predisposed to diabetes, obesity, cardiovascular disease, microalbuminuria (a kidney problem), schizophrenia, other neurologic disorders, higher cholesterol, and reduced growth (height).

Rats fed low-protein diets gave birth to pups who had increased systolic blood pressure (the first/higher number in a blood pressure reading) compared to controls. Pups of those offspring also had higher blood pressure than controls (whether one or both grandparents had had low-protein diets).

Reduced or low birth weight has been correlated with increased risk of death from adult coronary heart disease in men and women.

Fetal programming effects can vary with gender as well; one study found that ewes fed diets deficient in methionine (an amino acid) for 30 days had male lambs with higher resting blood pressure at one year of age; females did not have abnormal blood pressure.

"It is imperative that we use caution when giving nutritional supplements to pregnant mares, because using an inappropriate type, dose, or combination may have permanent consequences on the developing fetus," Satterfield commented.

Also in sheep, one study compared three groups of initially obese ewes: One with an ad libitum (unrestricted) diet during pregnancy, one on an initially unrestricted diet followed by a diet with 65% of the recommended calories (to simulate obese women losing weight during pregnancy), and one fed at 100% of recommended calories during gestation. The ewes on the heavily restricted diet lost weight quickly at the beginning, then more slowly, and had lighter offspring than the other groups.

The lambs of obese ewes on unrestricted diets weighed the same as those on the recommended diet at birth, but had 50% more lipid (fat) content in their bodies and thus less muscle. After birth they also grew more slowly.

Behavioral characteristics can be modified and inherited as well; Satterfield discussed a study in which licking/grooming (LG) behavior of mother rats towards pups in their first week of life could be modified by changing the amount of methionine in the diet or by adding stress to the environment. Changes in licking/grooming behavior were found to be passed to offspring, suggesting that an animals' behavior and response to behavior modification (i.e., training of horses) could be affected by the genetic results of the mother's experiences.

Additionally, female pups of low-LG mothers were found to have higher levels of sexual receptivity. If these findings are extended to horses, Satterfield commented, "Perhaps increased mothering could serve as a preventive treatment for later heat-related behavior that interferes with a filly's performance."

Finally, pups of rats fed high-fat diets had altered cardiovascular (heart/circulatory system) function and insulin resistance at one year of age. Satterfield notes that similar research is currently in progress on horses at Texas A&M. —*CW*

Research in Horses

Although epigenetic research in the horse is sparse, Satterfield discussed a few studies on point. First, the mare is well known for her ability to control the size of her fetus, noted Satterfield; in previous studies, Thoroughbred embryos have been implanted in pony mares and vice versa. The pony mares bore 37% smaller Thoroughbred foals than Thoroughbred mares, while Thoroughbred mares bore more than 50% larger pony foals than the pony mares. The differences in size with breed of the recipient mare continued to be apparent several months after foaling, and show the effects of recipient mare choice on fetal size/postnatal development—this is useful information to keep in mind when planning embryo transfer.

He also mentioned a study in which foals from mares on high-starch diets had lower insulin sensitivity (a factor in metabolic disease) through 160 days of age than foals from mares on low-starch diets.

"Epigenetic changes are likely to play an important role in later health and disease, and they can occur in response to transient environmental influences," he concluded. "We really don't know how long exposure has to be (to have an effect on the foal), but at different times the same factor can have different impacts. Much more work is needed.

"Now that you're aware of it, start looking for this epidemiological evidence and bring it to those of us who can test it experimentally and answer the questions," he urged the veterinarians in attendance. —*CW*

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