

Think Quick

BY AMANDA DUCKWORTH
PHOTOS BY ANNE M. EBERHARDT

BY THE TIME a Thoroughbred foal is born, a significant amount of effort has been dedicated to its arrival. From the carefully planned mating to tending to its dam for 11 months, future racehorses arrive on the scene surrounded by people who have done their best to ensure a good outcome. Even so, there is risk with any birth, and even after a seemingly safe delivery, things can still go wrong.

Neonatal maladjustment syndrome (NMS), colloquially referred to as dummy foal syndrome, occurs in approximately 3-5% of live equine births.

Unlike many other issues that can occur with a newborn foal, neonatal maladjustment syndrome is not a disease. It is a catchall for foals that begin exhibiting abnormal, often neurologic, behavior not long after birth. Although the foal might physically appear normal, if it does not behave normally, it is a significant cause for concern.

Typically a healthy foal will be responsive to its surroundings and active

shortly after being born. According to the American Association of Equine Practitioners, the 1-2-3 RULE is often applied to newborn foals. That means following birth a healthy foal should stand within one hour, nurse within two hours, and

Timing is of the essence in evaluating foal problems, especially neonatal maladjustment syndrome

pass its meconium (first feces) within three hours.

“A healthy newborn foal is strong, responsive, and very active,” explained Dr. Luis Costa in ‘Evaluation and Care of Newborn Foals’ for the AAEP. “A number of things should be noted when you observe the newborn from a distance, including the foal’s attitude, willingness to nurse, awareness of the surroundings, the relationship with the mare, the ability to move around, and the respiratory pattern.

“The suckle reflex begins at approxi-

mately 20 minutes after birth and becomes stronger and stronger with time. Normal foals nurse every 30 minutes, and failure to suckle is the first sign of a neonatal problem. It is advisable to have a routine evaluation of a newborn foal by your veterinarian within 12 to 24 hours of birth.”

Nursing is a key component for newborn foals, from both a health standpoint and a behavioral standpoint. They need the mare’s all-important colostrum, but also, a lack of nursing indicates a looming problem.

“Normal nursing behavior is the most important indicator of good health,” explained Dr. Madison Seamans in the paper ‘Recognizing Critical Illness in Foals: Is He Sick, or Just Napping?’ for the AAEP. “Failure to stand and nurse normally within two hours after birth and wandering around the stall ‘nursing’ foreign objects are clear indicators that the foal is in trouble.”

In addition to being called dummy foals, newborns suffering from neonatal maladjustment syndrome have also commonly been called barkers, sleepers, and wanderers due to their odd behaviors. As the colorful names imply, foals can exhibit signs of maladjustment by appearing to wander aimlessly, by struggling to identify their mothers, by failing to nurse properly, by having seizures, and/or by making strange barking sounds.

Symptoms can range from mild to severe, and they vary from case to case. Foals can be treated with glucose and oxygen as well as oral and intravenous nutrition. Supplemental nutrition is obviously important as failure to nurse leads to an entirely new set of complications.

The most pressing nutritional issue is that, as with all other foals, it is critical a dummy foal receives colostrum soon after birth.



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MESSAGE FROM THE GRAYSON-JOCKEY CLUB RESEARCH FOUNDATION

DOES MAGNITUDE OF AIRBORNE EXPOSURE PREDICT DISEASE DEVELOPMENT



Grayson-Jockey Club
Research Foundation

This Q&A discusses one of five research projects on *Rhodococcus equi* funded by Grayson-Jockey Club Research Foundation and conducted by Dr. Noah Cohen in recent years. Cohen is a professor and associate department head at Texas A&M University.

Pneumonia is a leading cause of death among foals, and the most common form of foal pneumonia is caused by *R. equi*. Dr. Cohen's most recent ongoing work on foal pneumonia is seeking a vaccine.

Q: What first sparked your curiosity to explore this area of equine research?

There were many sparks. First, Dr. Ronald Martens included me in his *Rhodococcus equi* research program. His passion for solving this problematic disease was inspirational and motivational. Second, I've always been a fan of puzzles, and trying to elucidate the complex relationships involving the bacterial organism, the environment in which both the bacterial and mammalian (foal) organisms live, and the mammalian host (foal) is quite a tough nut to crack. Third, Dr. Gary Muscatello and his colleagues from Australia did pioneering work on quantifying airborne *R. equi* in horse environments. Their good work was clearly the most proximate spark.

Have you studied this area of equine research before?

We have been studying the epidemiology of *R. equi* for some time. From the standpoint of the environment, we had been looking at concentrations of *R. equi* in feces and soil (as well as management practices), but the work from Muscatello and his colleagues made it clear that studying airborne concentrations was important.

What was the most significant finding from this research?

Muscatello and colleagues were first to demonstrate that airborne—but not soil—concentrations of *R. equi* were positively associated with the cumulative incidence of equine pneumonia at Thoroughbred farms in Australia: There were higher concentrations of *R. equi* in the air at farms that had

higher incidence of disease. But it wasn't clear from that seminal work whether the higher concentrations were a cause of disease (i.e., more *R. equi* in air caused more foals to get sick) or an effect of disease (more sick foals were putting out more *R. equi* into their environment). We also had no information about air concentrations of *R. equi* from farms in North America. The principal significance of our work is that we were able to show that airborne concentrations were higher in stalls of foals that went on to get *R. equi* pneumonia than in stalls of foals that did not get pneumonia. Because the higher concentrations were detected before disease, this indicates a causal relationship (because causes must precede effects). This was important evidence of the role of environment in the disease, and indicated that reducing airborne concentrations could help prevent the disease in foals, particularly in foaling stalls.

Another important finding was that concentrations of *R. equi* in the air were higher at times during the day when there was greatest activity (human or horse) in barns. This suggested that perhaps mucking out, etc. should be done when mares and foals are out of the barn so as to reduce exposure to higher concentrations of *R. equi* in the air.

What, if anything, surprised you about your findings?

We also compared concentrations between barns and paddocks/pastures and among locations in barns. I expected the airborne concentrations in the "better ventilated" stalls near entryways and

more peripheral would have lower concentrations. But this wasn't the case. Dr. Ed Robinson suggested to me that greater exposure to winds might make those stalls have more particulates in the air on which *R. equi* would be borne. I thought that was a pretty good explanation.

What did you learn about the research process through your project?

The challenges of collecting samples in Kentucky and sending them to Texas, the challenges of working with many farms, the willingness of farm managers in Central Kentucky to help with sample collection, the importance of having outstanding collaborators when research is being done in different states. In particular, Drs. Jackie Smith and Craig Carter from the University of Kentucky's veterinary diagnostic laboratory made this work possible.

How will this research improve equine health and welfare?

It will only help if it is built upon. We need to try to see whether approaches to reducing airborne concentrations of *R. equi* might be effective at reducing the incidence of disease. There is no reason to expect that this will be completely effective. But it might help. We have some ideas but haven't had the opportunity to investigate.

Has this research led to additional projects?

It has been difficult to obtain funding for the follow-up studies that need to be done. Because funding for equine research is limited, we often have success but can't follow up because there are so many competing problems and so many talented people working on other problems. The continuum grants from the Grayson-Jockey Club are an innovation in equine funding that will help, particularly if more can be offered and more foundations adopt the concept. **BH**

Colostrum, the thick yellow fluid that a mare produces before her milk, is integral for a newborn's health since it contains antibodies the foal needs while its own immune system develops. According to AAEP, a mare's highest-quality colostrum is produced within the first eight hours post-foaling, and ideally, a foal will get at least two pints of mare's milk within its first 12 hours.

Even if a foal were to recover from neonatal maladjustment syndrome, had it never received colostrum, it would have a bleak outlook.

Clinical signs can appear immediately after birth—usually if there have been complications during delivery—but it is also possible for them to occur 24-48 hours after delivery.

“Neonatal encephalopathy (NE) and neonatal maladjustment syndrome are terms used for newborn foals that develop noninfectious neurologic signs in the immediate postpartum period,” said Dr. Ramiro E. Toribio in the paper ‘Equine Neonatal Encephalopathy: Facts, Evidence, and Opinions,’ which appeared in the August 2019 edition of *Veterinary Clinics of North America: Equine Practice*.

“Cerebral ischemia, hypoxia, and inflammation leading to neuronal and glial dysfunction and excitotoxicity are considered key mechanisms behind NE/NMS. Attention has been placed on endocrine and paracrine factors that alter brain cell function. Abnormal steroid concentrations (progestogens, neurosteroids) have been measured in critically ill and NE foals.”

NMS is often associated with hypoxia, which is an inadequate oxygen supply. Hypoxia is not limited to a single time frame. It can occur in utero due to placentitis or illness in the mare leading to decreased blood flow; it can happen at birth due to events such as dystocia and red bag delivery; and it can happen after birth as the result of things such as sepsis, anemia, premature delivery, and pulmonary disease. Hence, a foal that seems perfectly normal at birth might be symptomatic the following day.

However, because as of yet there is no one single identifiable cause of neonatal maladjustment syndrome, there are multiple views on the best ways to treat it. One method that has gained traction in recent years is the Madigan Foal Squeeze Procedure, which is just what the name implies.

“This syndrome has been associated with altered events during birth and was believed to be caused exclusively by hypoxia and ischemia. However, recent findings revealed an association of the NMS syndrome with the persistence of high concentrations of in utero neuromodulating hormones (neurosteroids) in the postnatal period,” according to the



A healthy foal should stand within one hour of being born

paper “Survey of Veterinarians Using a Novel Physical Compression Squeeze Procedure in the Management of Neonatal Maladjustment Syndrome in Foals,” which appeared in the September 2017 edition of *Animals*. “Anecdotal evidence demonstrated that a novel physical compression (squeeze) method that applies 20 minutes of sustained pressure to the thorax of some neonatal foals with this syndrome might rapidly hasten recovery.”

This global survey had 51 respondents who resided in the U.S., Africa, Australia, Canada, and Europe. All foals exhibited abnormal behavior typical of NMS, and they were organized into non-squeezed (N = 108) and squeezed (N = 87) groups. All foals were treated within

24 hours of birth and were either Thoroughbreds or Quarter horses.

According to the survey, respondents reported using a variety of medical treatments in the non-squeezed foals, which

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included: tube or bottle feeding (89.6%), plasma administration (83.3%), intravenous fluids (81.3%), antimicrobials (79.2%), dextrose administration (52.1%), dimethylsulfoxide (43.8%), vitamin E (43.8%), intranasal oxygen (39.6%), diazepam (27.1%), corticosteroids (25%), mannitol (20.8%), and allopurinol (10.4%), and other miscellaneous treatments, including vitamin C, thiamine, caffeine, naloxone, and hyperbaric oxygen therapy (29.2%).

Of the 87 foals in the squeezed group, 21 (24.1%) did not receive any additional treatment while 42 (48.8%) and 24 (27.6%) received medical treatment prior to and after the squeeze procedure, respectively.

“This study showed that foals that were squeezed for 20 minutes had significantly faster and higher recovery rates at different time points than foals that were not squeezed.

“Further, foals that received the squeeze procedure only, without medical therapy, were 17.5 times more likely to recover within 24 hours than the group receiving only medical therapy.

“The majority of squeezed foals (N = 59/87, 68%) recovered within 24 hours post-squeeze compared to foals that were not squeezed (N = 38/108, 35%). Only 3.4% (N = 3/87) of foals in the squeeze group took more than 72 hours to recover versus 14.8% (N = 16/108) foals from the medical group. The overall recovery rate was 86% and 87% for the squeeze and non-squeeze groups, respectively. This is in agreement with the recovery rate of 80% reported previously. However, the squeeze procedure appeared to be useful in decreasing the time to full recovery.”

The Department of Medicine and Epidemiology, School of Veterinary Medicine, University of California, Davis was responsible for the study and is active in examining this issue in foals.

It is also exploring whether there is a link between NMS in foals and autism in humans via abnormal levels of naturally occurring neurosteroids.

Another recent study examined ultra-



Around 80% of foals that receive some form of treatment recover from neonatal maladjustment syndrome and go on to live normal lives

sonography of the atlanto-occipital (AO) space of foals suffering from NMS.

“Ultrasonographic assessment of the atlanto-occipital space in healthy Thoroughbred foals and Thoroughbred foals with neonatal maladjustment syndrome,” was published in the May 2017 issue of *The Veterinary Journal*.

“Ultrasonography of the atlanto-occipital space may be useful as a non-invasive diagnostic tool in neonatal foals,” according to the paper. “The aims of the study were to establish a range of values for ultrasonographic measurements of the AO space in healthy Thoroughbred foals and to compare these variables in healthy foals with foals diagnosed with neonatal maladjustment syndrome.”

For the study, 38 healthy Thoroughbred foals and 28 Thoroughbred foals with neonatal maladjustment syndrome under the age of four days had ultrasonography of the AO space performed.

“Transverse image spinal cord height (P = 0.001), width (P < 0.001) and spinal cord cross sectional area (P < 0.001), and longitudinal image dorsoventral

diameter of the ventral spinal artery, were significantly smaller in foals with NMS than in healthy foals,” the study concluded.

“Ratios of spinal canal to cord width and cross-sectional area were significantly smaller in healthy foals than in foals with NMS (P < 0.001). Spinal canal variables were not significantly different between groups. Several ultrasonographic measurements of the AO space were significantly different between healthy foals and foals with NMS. Further investigation is warranted to investigate the clinical application of this technique.”

What leads to NMS remains a highly researched and debated topic centering around the best, swiftest, and most economical means of

recovery.

Or, as Toribio concluded, “Controversies regarding the pathophysiology, diagnosis, and treatment of neonatal encephalopathy and NMS will remain until controlled mechanistic and therapeutic studies are conducted.”

The good news is that it is estimated around 80% of foals that receive some form of treatment do recover from NMS and go on to live normal lives. Of course, this is dependent on the severity of the symptoms as well as the promptness with which they are addressed.

As with almost any other medical situation, the faster the problem is noticed, the more likely the chance of a good outcome. If a foal does not respond to treatment within the first five to seven days, other issues beyond NMS need to be considered. Each case will vary, and it is important to work with a veterinarian to ensure the best possible outcome for the foal. **BH**

Amanda Duckworth is a freelance writer based in Lexington.