CAUSES OF DIARRHEA IN THE FOAL

By Pat Kenney, '85

"Doc, my foal has diarrhea. What do you think caused it?" Few people realize how difficult a question this is to answer. Diarrhea is seen in specific infectious diseases of the gastrointestinal tract, secondary to generalized diseases and in non-infectious conditions as well. Diarrhea in the foal can be very serious. It can result in dehydration, weight loss, impaired growth and even death. The causes of diarrhea must be understood so the veterinarian can treat the foal promptly and the owner can take steps to prevent its spread to other foals.

In general, infectious (bacterial or viral) diarrhea makes the foal very sick. He is depressed, stops eating and runs a fever. The foal with a non-infectious type of diarrhea is usually alert, has a normal temperature and appetite.

A commonly seen non-infectious diarrhea is "foal heat" diarrhea. Most foals develop loose stools between 6 and 14 days of age and this time frequently corresponds with the dam's first postpartum estrus, also called the "foal heat", thus "foal heat diarrhea". The exact cause of this type of diarrhea is unknown although there are several theories related to changes in hormonal and nutritional levels in milk around this time. The greatest concentration of total solids, fats and milk proteins occur approximately 10 days postpartum and, consequently, excessive nutrition may be a contributing factor in "foal heat" scours. Coprophagy (ingestion of manure) and ingestion of the vaginal discharge caked on the udder have also been suggested as causes. There is also a possibility that this diarrhea is physiologic in nature, relating to changes in the normal intestinal bacterial population of the foal, or increased quantities of fiber in the large intestine which the foal is not yet able to digest properly.

The feces of the foal with "foal heat" diarrhea are soft to watery and the condition is usually self-limiting in 2-3 days, even without specific treatment. However, there is a possibility that a case of "foal heat" diarrhea will predispose the foal to more severe and prolonged cases of diarrhea.

The ingestion of too much milk can also cause diarrhea. This happens when the mare and foal are reunited following a separation usually longer than 4 hours, or when the mare reaches peak milk production, or when the foal is force-fed large quantities of feed. Normally, the milk in the foal's stomach forms a curd and the whey goes on to the small intestine, but over-ingestion of milk results in whole milk or too...
much whey reaching the intestine. The intestine is then overwhelmed and cannot digest properly. The result is watery feces.

Milk clots are diluted and more easily digested with the natural addition of saliva, introduced by the activity of nursing or drinking. Foals that drink too fast or are fed by stomach tube may miss this phase of digestion and are more prone to diarrhea.

Sudden changes in feed are also associated with indigestion and diarrhea. A high fiber diet such as grain, forages and feces, which require digestion in the foal's immature large intestine, may also cause diarrhea.

Carbohydrate intolerance may be a problem as well. Lactose is the principle sugar of milk and a foal may be unable to digest this sugar because he was born without the ability to synthesize the necessary digestive enzyme, lactase. Viral infections may damage the wall of the intestine so much that the foal may be unable to synthesize lactase, or a carbohydrate intolerance may develop in the foal fed table sugar (sucrose). Most foals have very little sucrase (the enzyme necessary to digest sucrose) in their intestinal wall so diarrhea frequently results.

Foals may develop diarrhea during or following antibiotic therapy when the antibiotics kill the bacteria needed for normal digestion in the gastrointestinal tract. These "good" bacteria may be replaced by pathogenic bacteria which actually cause diarrhea. For this reason, antibiotics should always be used with caution in the foal.

The infectious type of diarrhea is caused by several different viruses and bacteria. The most common viral diarrheas of foals are caused by rotaviruses, coronavirus and adenoviruses. Bacterial diarrheas may be caused by Escherichia coli and Salmonella. Infectious diarrhea is spread directly from foal to foal usually by contact with feces from an infected foal.

Rotavirus, the most common of the three viral diarrheas, causes moderate to severe destruction of the first one-third of the small intestine. This is the primary area where digestion and absorption occur and its destruction allows poorly or partially digested food to pass through the tract without the proper absorption of nutrients. Diarrhea and the gradual debilitation of the foal follows.

Coronavirus also destroys the major site of absorption and digestion in the small intestine. This destruction is usually more severe than that occurring with a rotavirus infection, and so the diarrhea is more severe.

The adenoviruses have only been associated with severe clinical diarrhea in Arabian and part-Arabian foals with combined immunodeficiency. Horses of Arabian breeding may carry the gene for the condition but be healthy themselves. Their foals, however, may be born with an inability to mount an immune response. The chances of such a foal living beyond 6 months are extremely poor.

Bacteria are a common cause of infectious diarrhea in foals. E. coli is the most common cause of diarrhea in many species. It can produce a toxin which makes the intestinal wall secrete fluid which results in a watery diarrhea. The incidence of E. coli diarrhea in foals is not known for certain, but it is less than in other species due to good husbandry practices including separate foaling quarters, assured colostrum ingestion, and individual health care and stabling.

Salmonella is another bacteria which can cause the watery diarrhea with the characteristic fetid smell. Foals are frequently predisposed to salmonellosis by stress associated with shipping, weaning, illness, surgery and poor management practices.

Parasite-induced diarrhea is commonly seen in foals and three kinds of parasites may cause the problem. Strongyloides westeri infection.
occur when the foal ingests larvae through the dam's milk. The largest number of larvae are present in the milk two to three weeks after parturition, a time which corresponds to foal heat diarrhea. The effects of this parasite are not well understood; some foals with severe infections may not have diarrhea while those with light parasite loads may have severe diarrhea.

The larvae of the large strongyles, S. vulgaris and S. edentatus cause severe inflammation of the intestine. This enteritis usually lasts for a week or more. The clinical signs of S. vulgaris infection are fever, inappetance, depression, diarrhea or constipation, and colic. If the foal survives the acute state of the infection, the diarrhea will subside but there may be ulcerations of the cecum and colon as well as tiny clots in the blood vessels of the gastrointestinal tract. This may cause colic in the future.

Parascaris equorum can cause diarrhea if present in massive numbers in the foal. These ascarid eggs are very hardy, able to live on pastures for years, and successive foal crops may be infected through ingestion of the eggs. As the eggs mature to larvae and begin migrating in the gastrointestinal tract, they produce an enteritis and diarrhea.

Diarrhea has many causes, both infectious and non-infectious. For it to be treated effectively, the underlying causes must be identified and in severe cases, prompt treatment or support therapy may be necessary to prevent the debilitation or death of the foal. Of course, prevention is highly desirable and good horse husbandry practices, including a clean, quiet stall, adequate nutrition for both the mare and foal, and a complete vaccination and worming program are essential.

Pat Kenney, student editor of this issue, is a 4th year veterinary student looking forward to becoming an equine practitioner.

OUR GUEST EDITOR: Equine Rounds is pleased to have Gordon Woods, DVM, PhD, as this issue's guest editor. Dr. Woods has been at Cornell for a little more than one year. In that time, he has begun a research and teaching program in the areas of embryo transfer and early pregnancy loss. These programs are centered at a newly renovated facility housing over 60 mares, where third and fourth year veterinary students are able to develop their rectal palpation skills in a special early morning palpation program developed by Dr. Woods.
PATENT URACHUS IN THE FOAL

By Terry Dewey, '85

The foaling season is a happy but busy time of the year for horseowners and veterinarians. Newborn foals may experience a number of problems and they require a lot of attention in those first few days. Umbilical problems are especially common in young animals. Foals developing umbilical swelling or a fluid discharge from the umbilicus should be seen by a veterinarian.

The main causes of swelling in the area of the umbilicus in foals are umbilical hernia, umbilical infection or abscess and patent urachus. The urachus is the embryonic connection between the bladder and the opening of the umbilicus. In most foals the urachus closes at or soon after birth. When the urachus remains patent (fails to close) urine can pass from the bladder out the umbilicus. Some foals will have a continual dribble of urine from the umbilicus which leaves the hair on the ventral abdomen soaked with urine.

Any sex or breed of horse can be affected with either congenital or acquired patent urachus. Foals with the congenital form are born with the defect while foals with the acquired form are born normal but develop the condition when the urachus or umbilical vessels become infected. The infection can cause the urachus to lose its seal and dribble urine. A congenital patent urachus may become secondarily infected making it difficult to tell which came first - the patent urachus or the infection.

If the urachus has become infected or abscessed the affected foal may have infections in other body systems as well. In newborn animals, the umbilicus is a favorite pathway for bacteria to enter the body. Foals with a patent urachus may also have a bacterial infection of the bloodstream (septicemia) or infection of joints (septic arthritis). Diarrhea and pneumonia are also occasionally seen in septicemic foals.

Treatment of patent urachus can be medical or surgical depending upon the condition of the foal. Most cases show a small patent urachus with no associated infection and these foals can be treated medically. Medical treatment consists of keeping the foal and surrounding area as clean as possible, systemic antibiotics and chemical cautery of the urachus with silver nitrate or an iodine solution. When the cautery agents are applied to the urachus, the tissues become irritated, swell and seal. This process may have to be repeated every day for a few days in order for the seal to become complete. Antibiotics are given to prevent secondary infection.

Sometimes chemical cautery does not work and the urachus remains open, or patent. In these cases, the surgery will help prevent further spread of infection. Surgery is generally recommended if, after four days of medical treatment, the urachus still hasn't closed. Surgery is also recommended if there is a hernia, abscess or related infection such as septicemia or septic arthritis.

The surgery removes the urachus and all the infected tissue at the umbilicus. If infection has spread to the bladder, the tip of the bladder also needs to be removed. Post-operatively, these foals should be kept confined and on antibiotics. If no complications, such as septic arthritis or septicemia, were present before surgery, the foals usually do quite well afterwards. However, foals with these infections seldom do well. For that reason, the veterinarian should recognize and treat complications early and aggressively and it is important that surgery not be delayed when it is clear that the foal is not responding to medical treatment. It is equally important that newborn foals with umbilical swelling or a fluid discharge from the umbilicus receive prompt veterinary care. Early care and proper treatment will minimize, if not prevent, any complications.

Terry Dewey, a 4th year student, presented her senior seminar on patent urachus in the foal.
The use of ultrasonography in the evaluation of the mare's reproductive tract has been a revolutionary breakthrough in equine theriogenology. Ultrasonography's most practical and widespread use is for the early diagnosis of pregnancy. Early diagnosis of pregnancy or the absence of pregnancy is extremely important in the Thoroughbred and Standardbred industries where the traditional January 1st birthdate assigned to the year's crop of foals brings pressure for earlier foals and the advantage of additional months for growth and development.

Ultrasonography is the location, measurement, or delineation of deep structures by measuring the reflection or transmission of ultrasonic waves. Ultrasound is defined as sound with a frequency beyond the range of human hearing and an ultrasound image is produced by the number and strength of sound waves reflected from body tissues. Changes in tissue density reflect nearly all the sound waves, especially where soft tissue and air or soft tissue and bone meet.

The ultrasound waves are both transmitted and received by a small transducer that can be easily inserted rectally. Images are displayed on a scope, usually a small television monitor or oscilloscope. The type of scanner typically used in the examination of a mare's reproductive tract, produces gray scale imaging. The reflected ultrasound waves are translated into varying shades of gray for a two-dimensional anatomical cross section of the tract on the scope. Liquids like the yolk sac of an early equine embryonic vesicle do not reflect any sound waves and result in a black image on the screen. Body tissues like the uterus cause part of the ultrasound waves to be reflected so a gray image is seen. The ultrasound beam can produce a freeze-frame picture of a thin slice of the uterus or a changing image can be constantly displayed as the probe is moved over the reproductive tract.

The early embryo can be detected by a 5 mHz ultrasound machine once the yolk sac reaches 3-6 mm in diameter, displayed as a black circle in the grey uterus. The embryonic vesicle reaches this size by 9 to 11 days after ovulation. Since the embryo is so small at this age, greater accuracy in detection results from an examination at 20 ± 2 days ovulation. By this time, the embryonic vesicle should be large enough to be seen easily on the screen.

Ultrasonography is useful for diagnosing twin pregnancies. Twins are associated with high rates of fetal and newborn deaths, so most broodmare owners try to prevent their development. With ultrasonography, twins can be detected earlier and with greater success than by rectal palpation. One method of handling a twin pregnancy involves aborting both twins and then rebreeding the mare at her next heat. If this method is used, early detection of twins is important before the mare's uterus forms endometrial cups at about 35 days of gestation. Once formed, the endometrial cups produce hormones which
prevent the mare from coming back into heat for several months. Another option for handling twins is to squeeze one embryo manually. The survival rate of the second embryo is high if this is done before the 26th day of gestation. Viability of the remaining embryo can be evaluated ultrasonographically. The ultrasonic image of an embryonic vesicle can be confused with an endometrial cyst. Endometrial cysts are fluid-filled structures that develop in the inner wall of the mare’s uterus. Their ultrasonic image can be distinguished from embryonic vesicles because they will usually appear irregular in shape, instead of circular like a vesicle, and septa dividing the cysts into compartments may be visible. If there is any doubt, it is safest to recheck the mare in a few days. Repeated ultrasound examinations will also show that endometrial cysts do not grow or change locations.

Ultrasonography is also useful for diagnosing pseudopregnancy. Pseudopregnancy is a condition in mares in which they are not actually pregnant but they do not return to heat after being bred. They maintain cervical and uterine tone, and a functional corpus luteum as if they were actually pregnant. On the basis of a rectal palpation alone, it is very difficult to differentiate a pseudopregnancy from a pregnancy until 25-45 days after breeding. At that point, the fetal bulge should be large enough to easily palpate. With ultrasonography, the decision to recycle the pseudopregnant mare with prostaglandins can be made by the 18th to 20th day of gestation when scanning shows no embryonic vesicle. This saves valuable time in a short breeding season.

Ultrasonography is rapidly becoming an integral part of good veterinary care of broodmares. It allows more efficient management of mare breeding and pregnancy with decreased risk of costly errors and delay.

Wendy Kimmel spent last summer palpating and scanning mares for Dr. Woods and did her senior seminar on ultrasound in the mare.

"WHEN WILL YOUR FOAL BE BORN?"

By Pamela Livesay-Wilkins '86

With special thanks to
Dr. Robert B. Hillman DVM
and George Haluska, PhD candidate

Your mare is going to foal. Soon, you think. At least you hope she foals soon because you are sick of trekking to the barn every two hours to check on her and those video monitoring set-ups are so darned expensive! The gestation length in horses is remarkably variable, with normal foals being produced from 320 to over 365 days post-breeding; where in this wide range will your mare fall?

The mare normally delivers her foal rapidly, at night and, if at all possible, alone. The most certain sign of impending parturition (birth) is the onset of mammary gland development* beginning about one month prior to parturition with a major increase observable in the last two weeks of gestation. In the average mare, the udder will be fully distended and the teats full of colostrum 24 to 48 hours before parturition. Waxing of the teat, the appearance of small "waxy" white plugs in the openings of each teat, usually occurs 24 hours before foaling, although this can be highly variable. There are other signs to watch for. In the final days of gestation, the sacrosciatic ligaments of the pelvis relax, making the tail head appear to rise and the muscles of the croup (gluteal musculature) seem to sink. The vulva relaxes, elongates and enlarges maximally within a few hours of birth, but this change can be subtle and easily missed if the mare is not carefully observed every day.

You step out for a cup of coffee, certain that all is quiet in the foaling stall. You return within the hour to see a foal struggling to find its legs. What happened while you were in the pursuit of caffeine? Hours before you even thought of coffee, your mare entered Stage I labor, characterized by an increase in active
contractions of the myometrium (the uterine musculature) and dilatation of the cervix. Haluska et al. recently performed electromyographic (EMG) studies of equine uterine activity and characterized this stage as demonstrating medium burst contraction activity that ends abruptly 2 to 3 hours before the commencement of Stage 2.

It is during Stage 1 that the foal actively positions itself for birth. The mare will defecate frequently, yawn, "wink", sweat, appear restless and "flehmens" (roll up her upper lip) at the very end of this stage. Stage 1 terminates with the rupture of the chorioallantoic membrane as it is forced through the cervix. Stage 2 is the actual birth of the foal, the part you didn't want to miss! It lasts, on the average, 17 to 20 minutes but can be completed in 5 minutes. Most mares will lie on their sides and expulsive abdominal contractions begin when the foal enters the birth canal, reflexly initiating oxytocin release. (Oxytocin is a hormone that causes uterine wall contractions and promotes milk release during lactation.) The actual foaling process, although rapid, is very strenuous and mares will frequently remain recumbent for more than 30 minutes following the birth of the foal.

Stage 3 begins immediately after the foal is born and results in the passage of the fetal membranes, or the placenta, rolled inside out by uterine contractions. You probably arrived in time to see this! Immediately following delivery of the foal, the uterine EMG shows continuous low level activity that lasts 8 to 16 hours, increasing in frequency and strength at the time the placenta is delivered. There are no discrete hormonal events yet associated with placental delivery in the mare.

Perhaps at your farm you have medical, surgical or management situations that arise that make the elective induction of parturition especially attractive to you. Although induction is used by many practitioners with great success, it must be considered a critical procedure with limitations. It is of utmost importance to carefully select all candidates for induction and to closely monitor the foaling.

Induction of parturition is indicated in mares with a history of dystocia (difficult birth) due to a lack of normal uterine contractions, or of premature placental separation which results in dead or oxygen-deprived (hypoxic) foals. Mares that have suffered serious perineal injury during a previous birth can be induced, as can mares that have delivered icteric foals with neonatal isoerythrolysis, a hemolytic disease of newborn foals. Mares with severe, uncontrollable colic or a ruptured prepubic tendon are also candidates. However, inducing mares purely for your convenience must be questioned, as the procedure carries risks that may not normally be present at parturition.

Before you consider inducing your mare and if you want a foal that will survive, several criteria must be met in the mare. These criteria are meant to ensure sufficient fetal maturity for survival and include: a minimum of 330 days gestation, an enlarged udder with teats distended by colostrum, relaxed
sacrosciatic ligaments and cervical relaxation. Colostrum present in fully distended teats is currently considered the most reliable sign of a fetus sufficiently mature for induction.

Once a mare is determined to be a suitable candidate, her tail is wrapped and her genital area washed. Oxytocin is the drug most commonly used for induction. The proper dose will produce a safe, quiet foaling in less than 1 hour. Less than this results in a very slow foaling, while larger doses produce more rapid, but sometimes violent foalings. Foaling induced at term by this method precisely mimics natural foaling clinically and the foals are normal and healthy in all respects.

Prostaglandin has been used in conjunction with the synthetic corticosteroid flumethasone and the estrogenic compound stilbestrol to successfully induce foaling in mares not yet at term. Fluprostenol, a synthetic prostaglandin analog, has also been used to induce mares with mammary gland development but before cervical relaxation. Most of the foals lived and eventually developed normally. While it may be convenient to be able to induce some mares at this stage, much work remains to be done before induction using Fluprostenol is clinically useful. Dexamethasone inductions have been performed but this method is impractical as it takes several days and the foals are usually born small and weak, although they eventually catch up.

So when will your foal be born? If you are going to induce her, you and your veterinarian can make an appointment, otherwise go for a cup of coffee -- the foal will be waiting when you get back!

Pamela Livesay-Wilkins is a 3rd year veterinary student who bred and raised Thoroughbreds before entering veterinary college.