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Inside the Womb

It takes one egg, millions of sperm (but only one really lucky one), 11 months, and a host of normal physiologic events to make a mare a mom. Also, on the owner's part, "there is a lot invested, both financially and emotionally, in producing a healthy foal," explains Igor Canisso, DVM, MSc, Dipl. ACT, a theriogenologist PhD candidate in the Reproduction Laboratory at the University of Kentucky's Maxwell H. Gluck Equine Research Center, in Lexington. "Yet on average throughout the horse industry, only about 60-70% of mares bred ultimately give birth to a live, viable foal. This is why it is so important to carefully manage your mare."

In this article we will detail ways to get a mare in foal and describe some of the tools and techniques veterinarians use to increase her likelihood of delivering a healthy, viable foal. The goal, even for seasoned breeders, is to be aware of potential problems and avoid unnecessary strikeouts.

Batter Up: Getting the Foal *In Utero*

Breed registry regulations sometimes dictate how a foal can be conceived. Thoroughbred foals that are destined to be registered with The Jockey Club, for example, must have been conceived via in-hand natural mating (aka "live cover"); a natural gestation must take place; and the foal must be delivered from the body of the same mare. Other breed organizations are a little less stringent, with most permitting artificial insemination, embryo transfer, oocyte transfer, and *in vitro* (in the lab) fertilization. Other foals are the product of alternate techniques such as cloning, in which the cloned embryo is placed in a recipient mare for gestation.

But regardless of how your mare was bred, what are the chances she will ultimately conceive?

"Various studies have consistently shown that the fertilization rates in mares are remarkably high, ranging from 82% to 96%," relays Canisso.

But although it might look like the game is locked up, this couldn't be further from the truth. "Approximately 30-40% of all fertilized eggs (equine embryos and fetuses) are lost between fertilization and term, and most of the conceptuses are lost within the first two weeks of gestation," Canisso says.

The best way to tell if your mare is truly in foal is via an early pregnancy test. Your veterinarian can use transrectal ultrasound (inserting the ultrasound probe into the rectum to image the underlying uterus) to diagnose pregnancy accurately in mares as early as 14-16 days after ovulation and breeding. Under experimental conditions, ultrasound can even detect pregnancy as early as 10-12 days post-mating. If an ultrasound examination is not possible, there are several affordable commercial endocrine tests, including progesterone, equine chorionic gonadotropin (eCG), and conjugated estrogens, that your veterinarian can use to assess a mare's blood or urine to confirm pregnancy. He or she must conduct these tests at very specific points during gestation (which might mean catching her while she's in the first or even well into the second trimester) to avoid misinterpreting the results.

In addition to avoiding a lost breeding season because your mare didn't take, another reason to consider the early transrectal ultrasound pregnancy test is to detect twins and triplets. The mare's uterus can generally only accommodate one placenta and one foal, which is why most twin pregnancies are ultimately lost mid- to late gestation. Even if one or both foals survive to birth, the delivery itself can be dangerous for the mare.

Because mares can ovulate more than one follicle during estrus, the chance of multiple pregnancies is high enough that ruling out twins and triplets is important very early in gestation. Several studies have confirmed that twins and triplets are relatively common (as high as 10.3-13.1% of all pregnancies) in Thoroughbreds and Standardbreds worldwide.

First Base (The First Trimester)

If a veterinarian confirms a mare pregnant at Days 14-20 of gestation, then the chances of losing the fetus up to Days 40-60 are an estimated 10-15% in young mares and 20-30% in older mares. Owners, breeders, and equine practitioners can help some problem mares stay in foal by supplementing with a hormone the ovaries produce called progesterone.

"Sufficient progesterone levels are needed to maintain pregnancy until about Day 100 of gestation, and lack of progesterone is widely thought to be a common cause of early embryonic death," says Canisso. "There is little scientific proof supporting this theory, but many owners and breeders supplement their horses with a progesterone-like product during the first 100 days, particularly mares that have a history of repeated pregnancy failure of unknown cause."

Michelle M. LeBlanc, DVM, Dipl. ACT, of Rood & Riddle Equine Hospital, in Lexington, Ky., adds, "Mares that colic chronically and mares with laminitis may also benefit from progesterone supplementation ... Studies show that mares that underwent a twin reduction and were administered altrenogest (an oral synthetic progestin, or progesterone) and a non-steroidal anti-inflammatory lost fewer remaining embryonic vesicles (the fertilized egg with its surrounding fluid and membranes) than mares not given the drugs."

Canisso says breeders might administer a daily dose of altrenogest or a double dose in cases of placentitis (inflammation of the placenta), late twin reduction, or colic surgery.

Second Base (The Second Trimester)

Akin to a good seventh inning stretch, this is the time to take a deep breath and try to relax. "Although about 12% of established pregnancies are lost after Day 40, very few of these losses occur during the middle trimester," explains Sara Lyle, DVM, PhD, Dipl. ACT, assistant professor of theriogenology in the Department of Veterinary Clinical Sciences at Louisiana State University's School of Veterinary Medicine.

Nonetheless, routine monitoring of the mare and foal can help detect problems that might affect the future health of the foal. Once again, ultrasound is a key tool for monitoring mares, particularly those considered at risk for pregnancy loss. Transrectal ultrasound allows veterinarians to examine the area of the placenta near the cervix, which is the most common site of placentitis. They can visualize the placenta's thickness, look for evidence of separation of the placenta from the uterus, and evaluate the fluids surrounding the fetus.

"We can also use transabdominal (across the abdominal body wall, like in humans) ultrasonography to look at aspects of the fetus such as heart rate, activity, breathing, and swallowing," says Lyle. "These findings are taken together to develop a 'biophysical profile' for the pregnancy."

Ultrasound can also be used for fetal sexing. "Determining fetal gender by transrectal examination between 55 and 75 and 100 and 150 days of gestation can reach 100% accuracy in routine study practice," says Marco Livini, DVM, an equine practitioner in Milano, Italy.

Livini used transrectal ultrasound to correctly identify the sex of 203/232 fetuses during a 150-second exam of each mare at Days 55 to 70 gestation. From Days 90 to 150, Livini correctly identified the sex of 299/341 fetuses. In total, he only incorrectly identified the sex of 6/573 fetuses (1.05%); he could not clearly sex the remaining fetuses within his self-imposed 150-second time limit.

"In theory, (transrectal fetal sexing) is not particularly difficult if performed by an experienced ultrasonographer with a very good-quality machine and patience (for both the examiner and the mare)," Lyle notes. "There are days when the position of the fetus and other factors make getting the right plane of image difficult, especially if the mare is less than cooperative."

Experimental studies have shown that another way to determine the sex of the foal *in utero* is by performing a simple blood test on the mare. Genetic material from the foal, a specific type of DNA called circulating cell-free fetal DNA, can be detected in the mare's blood and then analyzed for the presence of the "male gene" (called sex-determining region Y gene). According to researchers from the Universidade Federal de Pelotas, Pelotas, RS, Brazil, this technique was 95% accurate in correctly determining fetal sex. In that study they collected blood samples from mares during the last three months of gestation. However, at present this technique is not yet commercially available for use in horses.

Similarly, scientists can test biopsies of embryos (recovered from mares before re-implanting them in recipient mares) for various genetic conditions. According to the University of California, Davis, Veterinary Genetics Laboratory, which performs embryo testing, veterinarians aren't yet requesting genetic screening of mares' blood, but they say this area of science will likely grow.

Third Base (The Third Trimester)

Although most pregnancies are lost during the first trimester, the "third-base blues" can and do occur.

"In the third trimester a condition called 'ascending placentitis' is the most common cause of premature foal births and foal deaths after seven months' gestation," says LeBlanc.

Ascending placentitis is caused by bacteria that enter the uterus through the cervix and vulva, and "if left untreated, placentitis leads to accelerated fetal maturation, placental failure, abortion, still births, and foal losses in the first 24 hours of life," adds LeBlanc.

Transrectal ultrasound is one of the best methods of identifying a mare with placentitis. Specifically, a combined thickness of the uterus and placenta (CTUP) measured near the cervix greater than 1.5 cm (normal thickness at 10 months of gestation is 1.2 cm or less) could indicate placentitis.

Other ways veterinarians can identify mares with ascending placentitis include:

- Ultrasonographic evaluation of the placental attachment itself;
 - Examining clarity of the fetal fluids;
 - Monitoring activity of the fetus; and
 - Measuring the mare's hormone levels (e.g., progestins and estrogen)—commonly referred to as endocrine profiling.
- Currently, veterinarians' treatment of choice for this condition is a combination of framethoprim sulfamethoxazole, pentoxifylline, and altrenogest.

Home Run! (Foaling and Inducing Parturition)

Foalings often start and end uneventfully and in their own good time, but sometimes owners/breeders want to be more involved.

"One of the most common tests used to determine 'readiness for birth' is milk electrolytes—most often calcium," says Lyle. "If a mare is more than 310 days of gestation, increases in calcium above 400 ppm (or 10 mmol/L) indicate that the likelihood of foaling with the next 24 hours is good, but not guaranteed."

If calcium rises above 400 ppm prior to Day 310, says Lyle, this usually indicates an abnormal pregnancy (e.g., twins, -placentitis).

Commercial laboratories provide the most precise measure of mammary secretion electrolyte concentrations, but a variety of test kits are also available for stall-side testing. The most common test kits involve using test strips that change color depending on the calcium levels or the owner diluting a sample of the mammary secretion with an indicator dye until the color changes (e.g., from pink to blue).

In some individual cases, such as mares with a history of poor neonatal outcomes or ventral (underside) abdominal rupture, veterinarians will induce labor.

"For inducing delivery, and I do not do this lightly, the criteria are greater than 330 days gestation and calcium levels greater than 400 ppm," Lyle says. "Foals induced to deliver when the calcium is less than 400 ppm are associated with a poor outcome."

While veterinarians can induce labor on the farm, complications can occur, and most veterinarians do not recommend it in normal mares. Owners and veterinarians need to be aware that dystocia (difficult birth), "red bag" (premature placenta separation, where the placenta comes out before the foal), and retained placenta are generally higher with induced labor than with natural deliveries.

Take-Home Message

Appropriate monitoring of the mare, foal, and the uterine environment using ultrasound, a variety of drugs, and the advice of an experienced veterinarian are essential for maximizing the chances of producing a live foal with each breeding.