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NORMAL, INDUCED AND DIFFICULT PARTURITIONS IN EQUINES – A REVIEW

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ABSTRACT

Parturition is a process of giving birth to young ones. This process can be naturally occurring or induced and maintained by hormonal changes. The process can also be abnormal, termed as dystocia, in which several complications are expected. Equines are long day breeders. Pre and post-parturient care is required, which is mandatory to have a beneficial, stable, and safe process of parturition. The animals in which the process of parturition is not normal, or the time has exceeded the gestation period, the chances of mortality and harm to the animal as well as the fetus increase, and the process of parturition is induced by hormones. The aims of this review include covering the process of parturition in horses and donkeys, care, complications, hormonal maintenance and safety.

Keywords: Parturition, Induced Parturition, Pregnancy, Equines, Breeding, Dystocia

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1. INTRODUCTION

The mare is a yearly breeder who works long hours. Summer, fall, and late spring are her most prolific seasons. In the winter, the majority of mares stop ovulating. Stallions can breed all year round. A mare's estrus cycle is divided into the follicular phase (estrus) and the luteal phase (diestrus) (Gee 2022). The time should be checked carefully. Sometimes it is described as 21 days; the complete estrus cycle is typically about three weeks, with 5 to 7 days of estrus and approximately two weeks of diestrus (Crowell 2007).

In mares, the diestrus lasts for around two weeks and the estrus period lasts for about five days. Receptive mares hold a steady position with their hind legs open, waiting for the stallion to mount. With an erection, the stallion will mount, setting his front limbs in front of the mare's hips. Pelvic thrusts provide for quick intromission. Usually, after the foal's hips have passed through the mother's pelvis, the mare rests for 15 to 20 minutes (Brinsko et al. 2010).

The mare's forelimbs can now be lightly prodded if assistance is required. The hormonal signal that initiates parturition in horses is fetal cortisol (Giguère et al. 2017). During the final three to four days of pregnancy, maternal progestogens such as 5-dihydroprogesterone and its hydroxylated metabolites decline. Only from a clinical perspective may horse breeders and veterinarians assess the mare's condition in relation to the fetus' preparedness for birth (Nagel et al. 2020).

A mare's normal gestation period lasts between 320 and 360 days. Even after 360 days of pregnancy, foals can still be born with developmental delays. The recommended way for inducing parturition in mares is exogenous oxytocin (El-Sheikh Ali et al. 2019). In a therapeutic setting, exogenous glucocorticoids are useless for causing labor. Healthy, mature foals were produced by administering dexamethasone (100mg daily) repeatedly starting on day 315 or 320 of pregnancy (Peaker et al. 1979).

Pregnant mares receiving alternative remedies for labor extension, such as analogs of PGF2 are less effective at ending the pregnancy. Although progestogens cannot be used to induce conception, their use in mares that are past their due date merits thought (Wessel 2005). The neutrophil/lymphocyte ratio was reduced in the offspring born to these mares, which was the most obvious abnormality. The generation of placental progesterone is unaffected by PGF2 and its analogs, although they may have direct uterotonic effects or cause the release of oxytocin from the mare's posterior pituitary when parturition is imminent (Cheong et al. 2019).

The foal experiences intense uterine contractions for a noticeably longer time (Ley et al. 1989). Even at levels as low as 0.1IU, oxytocin administration induces the release of PGF2α (Chavatte et al. 2002). Term stimulation of parturition alters progesterone, estrogen and prolactin levels similarly to spontaneously foaling mares. Treatment with oxytocin at a safe dose can help with the problems associated with carefully monitoring mares prior to delivery. In addition to enabling quick veterinarian to help in the case of dystocia, close observation of periparturient mares also enables monitoring and aiding the newborn's adaption phase (Ousey and Fowden 2012).

2. Reproduction and Breeding Season

The mare is a seasonal, long-day breeder. Winter anestrus, a protracted time during which the mare does not come in heat (release an ovum or egg), renders her incapable of becoming pregnant. Temperature, nutrition, latitude, and the length of daylight all affect how long anestrus lasts. A little over 20 to 25% of mares continue cycling during the winter, particularly those who are in good health and did not give birth to foal in the previous breeding season. Due to the lengthening of the day, there is a change in mare from anestrus into transitional period also known as spring transition. While follicles, which are structures that hold the developing ovum (egg), grow and regress on the ovaries without ovulation (release of the egg), the transition is characterized by irregular periods of estrus behavior for two to three months. Mares cannot conceive during the spring transition phase since ovulation does not take place during this time, despite the fact that they could express considerable interest in a stallion. Mares are only able to ovulate and become pregnant at the very end of the spring transition phase. Stallions are also seasonal and long-day breeders but to a lesser extent than mares (Gee 2022). The spermatozoa numbers and testicular size show some reduction in winter. Stallions, however, can reproduce and get the mares pregnant at any time of the year. The mare enters the breeding season after ovulating at the conclusion of the spring transition phase, continuing to have regular cycles unless she gets pregnant. Since breeding happens primarily in the summer, most foals are born the following summer after a gestation length of around 340 days on average (Gee 2022). When compared to wild asses, feral and domestic donkeys are relatively less seasonal in ovarian activity, pregnancy, and parturition (Ginther et al. 1987). In domestic jennies, the short-day anovulatory season lasts roughly 165 days, and there is a high incidence of brief and frequent anovulatory estrus (Henry et al. 1987). The length of the long-day ovulatory season is then about 200 days. The interovulatory period lasts roughly 24 to 25 days. The average length of estrus is 6 days and ovulation occur during the last 1 to 2 days of estrus (Ginther et al. 1987). The gestation period lasts 12 months.

2.1. Puberty, Estrous and Sexual Behavior

Mares usually attain puberty between the ages of 12 and 15 months. The average age of stallion at puberty is also around 15 months. Well-grown mares could breed when they are 2 years old but most of the time mares could not breed until they are 3 years old. The estrus cycle of a mare consists of two phases, the follicular phase (estrus), during which the mare is sexually receptive to the stallion and the genital tract is ready to accept and transport sperm to the oviducts for fertilization, and the luteal phase (diestrus), which involves the process of ovulation (in which the mare is not receptive to the stallion, and the genital tract is prepared to accept and nourish the zygote) (Brinsko et al. 2010). The length of the estrus cycle is about 3 weeks. The estrus period is 5-7 days long in mare and diestrus is about 2 weeks (Crowell 2007). Estrus is characterized by a mare continually approaching the stallion, frequent urine, standing stationary with the hind limbs spread, and diverting the tail away from the perineum. Diestrus is characterized by avoidance of an approaching stallion and hostility toward the stallion if he continues trying to court the diestrus mare, including striking, kicking, and squealing. The jenny exhibits specific signs of estrus, such as a lowered head with a forward-extended neck, ears pressed up against the neck, closing and opening of the mouth, splayed hind legs, one foreleg angled slightly backward, the other slightly forward, a tail raised from the perineum, and presentation of the perineum to the jack (Henry et al. 1991). Diestrus includes turning away and continuing as opposed to abruptly stopping, avoid the jack by running away, angling the hips away from the jack and side to side, swinging the distal end of the tail while clamping the head of the tail on the perineum, kicking out with fully extended both hind legs, biting the jack, and a grunting vocalization (McDonnell 1998). In terms of sexual behavior, jacks tend to groups or individuals of estrous jennies who are actively engaged in sexual activity as well as defend their territorial boundaries, investigate, and cover jennies' waste with urine. The jack pays little continuing attention to jennies outside of estrus, besides investigating and covering feces. The jack often spends most of his time caring for the group of sexually active jennies in a small, confined resting and grooming area (McDonnell 1998). Long-term social partnerships allow mares and stallions to rest together, graze together, and groom one another without engaging in sexual activity. Estradiol, which is secreted by the follicle, triggers estrous behavior in mares, whereas progesterone, which is secreted by the corpus luteum, suppresses estrous behavior. In contrast to other ungulates, mares occasionally display estrous activity during the anovulatory stage. This is most likely caused by the adrenal cortex's secretion of estrogenic hormones. When compared to most ungulates, where males and females only interact during mating season, the horse's social structure is thought to benefit from the mare's year-round display of sexual behavior. This is because the male stays with a group of females year-round (Crowell 2007).

3. Mating

Mares in estrus move more often generally, sometimes with relaxed facial expressions, their ears moved to the side, and their heads slightly dropped (Crowell 2007). When the mare is ready to mate, she allows the stallion to examine her hindquarters and frequently turns her head to face him while doing so (McDonnell 2016). The stallion

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can lick and nibble the estrus mare's coat across her flanks, hindlimbs, withers, and buttocks when she displays her hindquarters to him. The mare will lift or raise her tail to the side, pass a small amount of urine, and then wink her clitoral region. The stallion will respond by exhibiting flehmen, possibly to enhance the olfactory signs of estrus. Mares who are receptive to breeding stand steadily with their hind legs spread apart, ready for the stallion to mount. Prior to mounting, the stallion typically snuggles or nips the mare's hocks and flank, and she may bend her head back to facilitate muzzle-to-muzzle contact (McDonnell 2016). The stallion will mount with an erection and position his front limbs in front of the mare's hips once he is certain that the mare will stand for breeding. He might use his teeth to grab the mare's neck and mane. The mare positions herself and shifts during breeding to provide room for the stallion to thrust and penetrate. Fast intromission is made possible by pelvic thrusts, and additional pelvic thrusts immediately result in ejaculation and tail flagging (the stallion's tail moving up and down). Following ejaculation, the stallion usually lies on the mare before the mare advances and ends the mating (Gee 2022).

Nose to nose contact, nibbling and/or smelling of the neck, head, back of the knee, flank, body, tail, and perineum, olfactory examination of discharged feces or pee, and flehmen are all examples of jack's pre-copulatory activity. The jack usually has brief interactions with the jennies, separated by returns to his resting location. In a research on donkeys that breed in pastures (Henry et al. 1991), it was observed that the intercopulatory cycle included approach to the sexually active group, vocalization in the resting area, severe teasing of one or more jennies, step back to the rest area, watchful eye contact with the sexually active group, single or multiple abrupt approaches to the group of a sexually active group of jennies, a rapid approach to a jenny, a brief mounting without an erection or tease, a retreat to the resting place, and an unexpected erection while still in the resting area. The cycle took about 90 minutes. Each jack appears to have a favorite part of his domain where these actions took place, as well as a favorite resting spot where no other donkeys were allowed. Similar to other equids, one episode of spontaneous erection and masturbation happens every 90 minutes or so (McDonnell et al. 1991).

4. Normal Parturition

Parturition is a continuous process, but it is divided into three stages for descriptive purposes. The first stage of parturition in the mare is the preparatory phase which usually requires 30 minutes to 4 hours. The first stage is characterized by the restlessness and colic-like symptoms of the mares (e.g., the mare may look back toward her flank, raise and switch her tail, perspire, urinate small quantities frequently, and lie down and get up frequently). Cervical dilatation and stronger, more frequent uterine contractions are linked to this time. Additionally, the foal's cranium moves from a dorso-pubic to a dorso-sacral posture during this period. Strong uterine contractions push the foal's forelimbs and muzzle into the dilating cervix along with the chorioallantoic membrane that surrounds them. The process of cervical dilatation continues until the chorioallantois ruptures and many gallons of allantoic fluid escape from the vaginal tract (i.e., the "water breaks") as the fetus and fetal fluids (kept within the placenta) are pressed against the cervix.

The second stage of parturition begins after the chorioallantois ruptures, cervical dilatation advances, and the fetus enters the birth canal. Abdominal contractions and the release of oxytocin from the neurohypophysis are brought on by the entry of the fetus into the pelvic inlet. These outcomes intensify already occurring uterine contractions. The white, glistening membrane known as the amnion—which ruptures five minutes after the chorioallantoic membrane—is squeezed between the vulvar lips. With the hoof bottoms pointing downward, the forefoot of each animal gradually becomes visible as labor advances. The nose comes next, with the head lying at the fetlock or carpal level on the forelimbs. When the head and shoulders pass through the mare's pelvis, the contractions become the strongest. The amnion usually ruptures at this point. If aid is required, it can be given now by gently pushing on the foal's forelimbs as the mare pushes her belly. The mare typically relaxes for 15 to 20 minutes after the foal's hips have passed through the mother's pelvis. The mare need not be disturbed if the foal has breached the amnion, passed the fetal membranes, is breathing normally, and can struggle to a sternal posture. Second-stage labor is typically quick and violent; the fetus is usually delivered in 20 to 30 minutes. The uterine involution and expulsion of the fetal membranes are included in stage 3 of parturition. Within 30 minutes to 3 hours after birth, the placenta is usually thrown out. In order to accelerate the placenta's ejection and prevent uterine damage and infection, therapy may be required if it hasn't been passed by this point (Brinsko et al. 2010).

5. Induction of Parturition

Induction of parturition in mares is not routinely used. Only pregnant mares with serious pathological abnormalities were allowed to induce parturition in this species. An opinion against inducing parturition in horses was developed in response to the frequent occurrence of non-viable and dysmature foals in experiments where foaling was primarily induced for scientific reasons (Leadon et al. 1986). Since equine gestation lengths vary widely, it is unlikely that planned inducement of parturition on a particular day of pregnancy will give birth to a live foal very often. The prevalence of dystocia in mare varies from 4 to 11% (Ginther and Williams 1996; Lanci et al. 2022). According to Lanci et al. (2022), all occurrences of dystocia were retrospectively classified into three

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categories of severity: mild, moderate, and severe dystocia. The occurrence of postpartum complications in mares and neonatal diseases and failure of passive transfer of immunity in foals was higher in the Dystocia Group. Foal venous lactatemia and serum creatine kinase were significantly higher in the Dystocia Group (median 3.9mmol/L; 262UI/L, respectively) than in the Eutocia Group (median 3.1mmol/L; 187UI/L, respectively). The APGAR score was lower in the Dystocia Group (median 8) than in the Eutocia Group (median 10) and significantly lower in severe dystocia (median 3). They further emphasized that the duration of stage II should not be considered the only parameter of dystocia in mares: even a rapid resolution of dystocia could pose health risks to the foal and the mare.

In the case of dystocia, prompt intervention is necessary, since prolonged labor quickly puts the foal's life at risk (McCue and Ferris 2012; Dascanio 2021; Lection et al. 2021). In this connection, a case of 5-year-old American Miniature horse mare (Hilliard et al. 2022) was presented for dystocia of several hours' duration with sternal recumbency and unable to stand, with both pelvic limbs splayed perpendicular to her body. Partial fetotomy was performed under general anesthesia. After resolution of the dystocia, the mare could not stand and ambulate with her hind legs hobbled. These are the complications of delayed handling of dystocia.

Keeping an eye on the mare during her periparturient period helps not only in monitoring and helping the foal in the adaption phase but also gives ample time to seek professional help in case of a difficult birth. Neonatal sepsis, which is still the main cause of foal loss (Giguère et al. 2017), will most likely arise from insufficient colostral antibody absorption by the foal (i.e., failure of passive immunity transfer). Mostly, parturition in the mare is difficult to predict and occurs at night so it is usually difficult to monitor the mare (Nagel et al. 2020). In order to solve these concerns, horse breeders and veterinarians are becoming more and more interested in novel methods to induce parturition close to the end of gestation without jeopardizing embryonic survival. The effectiveness and safety of various treatment options for the mother and her foal are described (Nagel and Aurich 2022).

5.1. Endocrine Regulation of Parturition

There are substantial differences between how the endocrine system controls pregnancy and parturition in horses. (Fig. 1). Fetal cortisol is the hormonal signal that starts parturition in horses. Along with triggering the procedures leading to the foal's delivery, this steroid hormone also begins the fetal development's final stage and prepares it for life outside the uterus (Liggins 1994). Maternal progestogens such as 5α-dihydroprogesterone (DHP) and its hydroxylated metabolites decrease during the last three to four days of pregnancy, while maternal plasma levels of cortisol considerably increase (Conley and Ball 2019). When the fetal adrenocortical response to adrenocorticotrophic hormone (ACTH) increases, fetal cortisol is also released at the same time. This increase in fetal ACTH release comes first (Cudd et al. 1995). The level of adrenocortical maturation of dysmature foals is correlated with their survival rates (Rossdale and Silver 1982). A move from pregnenolone to cortisol in the synthesis of steroid hormones is a hallmark of the fetal adrenal gland's progressing maturation (Fowden et al. 2008). Recent studies on placentitis-affected mares revealed changes in the metabolism of progestogens that resulted in both; functional and localized withdrawal of progestogens from the myometrium due to the drop in myometrial progesterone receptors, which was indicated by a reduction in the excess of myometrial progesterone receptor mRNA (El-Sheikh Ali et al. 2019). The level of cortisol in maternal plasma increases noticeably during fetal delivery (Nagel et al. 2012). A complicated balance between the components of the autonomous nervous system that are parasympathetic and sympathetic, as well as a high dominance of the parasympathetic system during fetal ejection, are linked to the beginning of parturition in horses metabolites of prostaglandin in peripheral blood fluctuate in tandem with increasing pituitary oxytocin release, indicating changes in prostaglandin F2 (PGF2) secretion, which in turn stimulates the foal's birth and finally the expulsion of the fetal membranes (Melchert et al. 2019).

5.2. Prediction of the Mother's Readiness for Foaling

Horse breeders and veterinarians may only evaluate the mare's state relative to the fetus' readiness for birth from a clinical standpoint. The normal gestation period of a mare typically lasts between 320 and 360 days, while tiny breed horses have somewhat shorter periods (Nagel et al. 2014; Nagel et al. 2019). Despite being genetically predetermined, gestational time is highly varied and influenced by a variety of variables, including age and body size, day length, and foal sex of the mare. As a result, even within a single mare, gestation length might vary greatly between successive pregnancies. The risk of immature foals being born is reduced in large breed horses when a primary requirement for inducing parturition is a gestational age of more than 320 days (Leadon et al. 1984). Foals can still be delivered dysmature even after 360 days of pregnancy, hence gestation length is insufficient to determine when a mare will give birth. Progestogen and cortisol changes, which are linked to pregnancy and parturition, are not appropriate for predicting when a foal will be born (Nagel et al. 2020). Clinical indicators like the growth of the mammary gland are extremely inconsistent and variable (Ousey et al. 1984). Before giving birth, the secretion of the mammary glands changes in the contents of total protein, consistency, and color, lactose,

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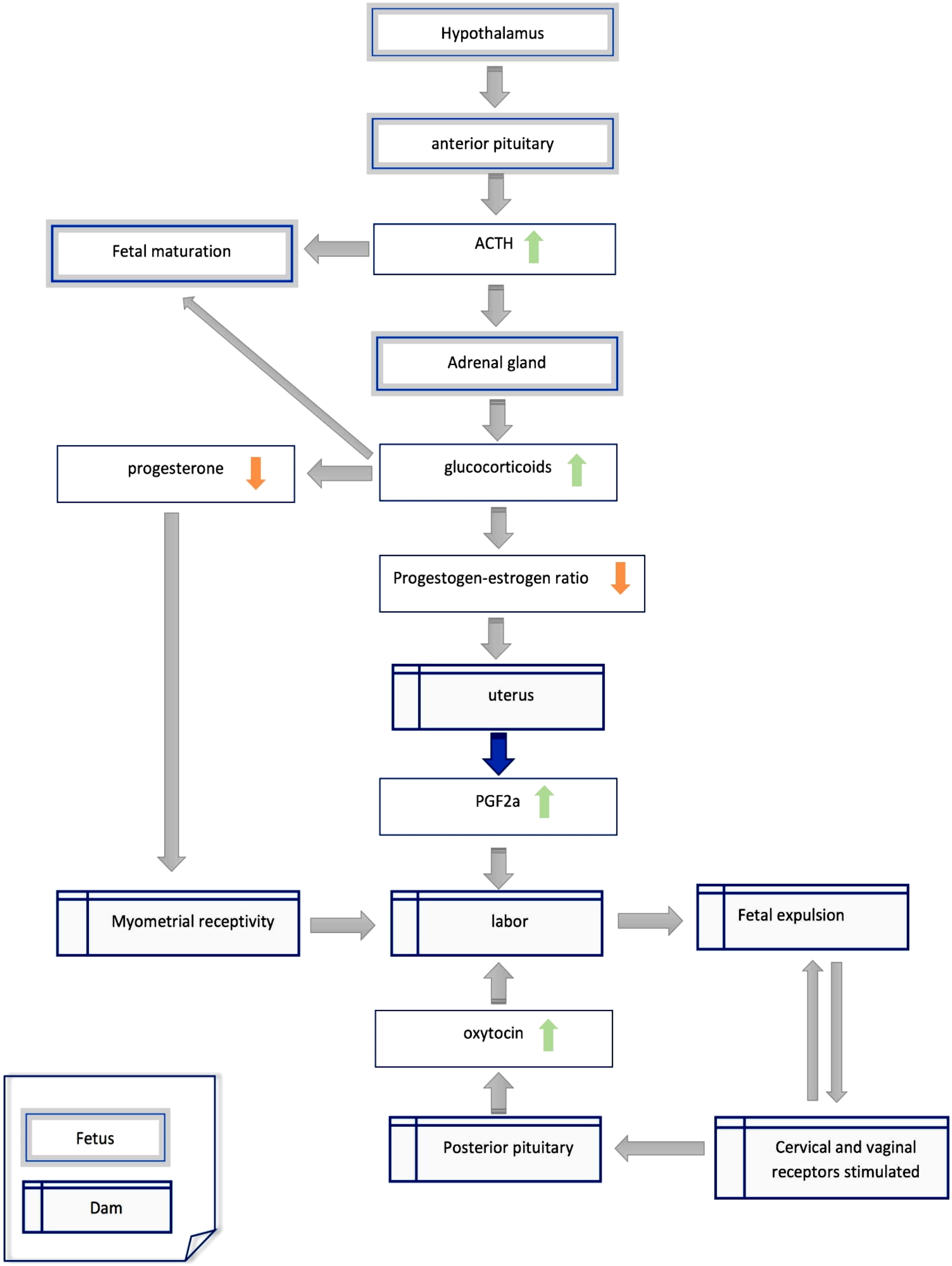

Fig. 1: Endocrine regulation of parturition in the horse (Nagel and Aurich 2022).

globulins, electrolytes (calcium, potassium, chloride, and sodium), and albumin (Peaker et al. 1979). The determination of calcium carbonate ($CaCO_3$) concentration is regarded to be the most accurate indicator for the delivery of a mature foal after induction of parturition, despite being inadequate in mares with placentitis and early lactation.

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In around 80% of mares, a declining pH can be used to forecast when parturition will occur since it relates to alterations in electrolytes in the pre-colostrum before foaling (Cheong et al. 2019). The likelihood that mares were about to give birth when the pH of t mammary gland was used as an indicator for predicting readiness for foaling. The degree of parturition preparation must be predicted using a combination of multiple factors due to the large degree of variability in gestation length, differences between maiden and multiparous mares, as well as several signs of impending parturition (Diel de Amorim et al. 2019). In conclusion, it is advised against attempting to induce parturition until the following conditions have been met: pre-colostrum pH ≥6.5, gestation length ≥330 days, $CaCO_3$ ≥250 ppm, and the existence of clinical signs that the mare is prepared to give birth to the foal (Cheong et al. 2019).

A new aspect of prediction of the mare for foaling has been put forward by Müller et al. (2022). According to them, skin temperature during the last hours before foaling where primiparous mares showed a higher mean temperature than uni- or pluriparous mares (Fig. 2) as early as from 180 min on or before parturition. They concluded that an increase in skin temperature in most mares within 90 min before birth (Fig. 3).

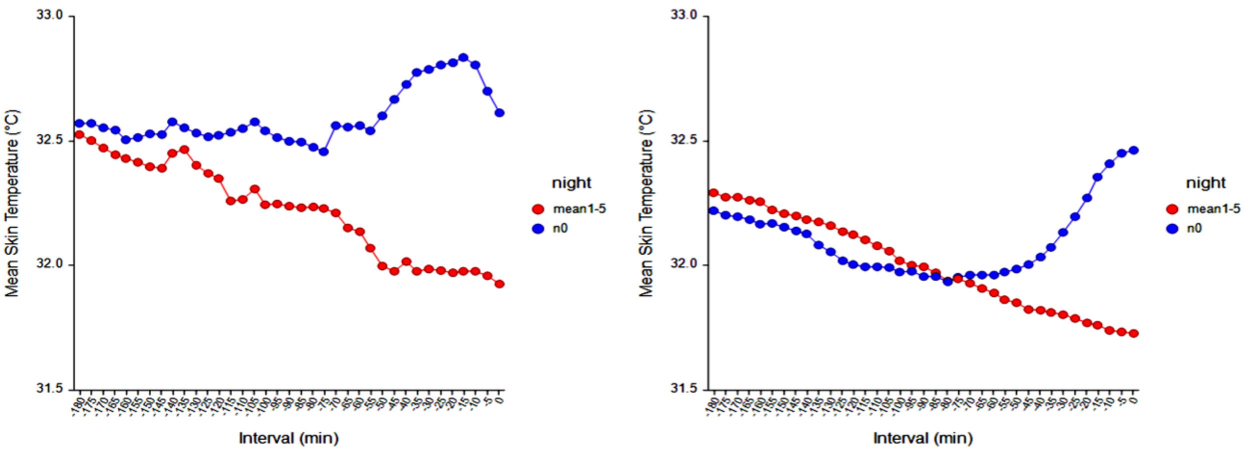

Fig. 2: Change in mean skin temperature (5 min intervals) of the last 180 min until parturition in the night of foaling (n0), compared to the mean skin temperatures in the 5 nights before (mean 1–5) at the same time set in (A) primiparous and (B) uni- or pluriparous mares. The time point of rupture of the allantochorion was set as 0 (Müller et al. 2022).

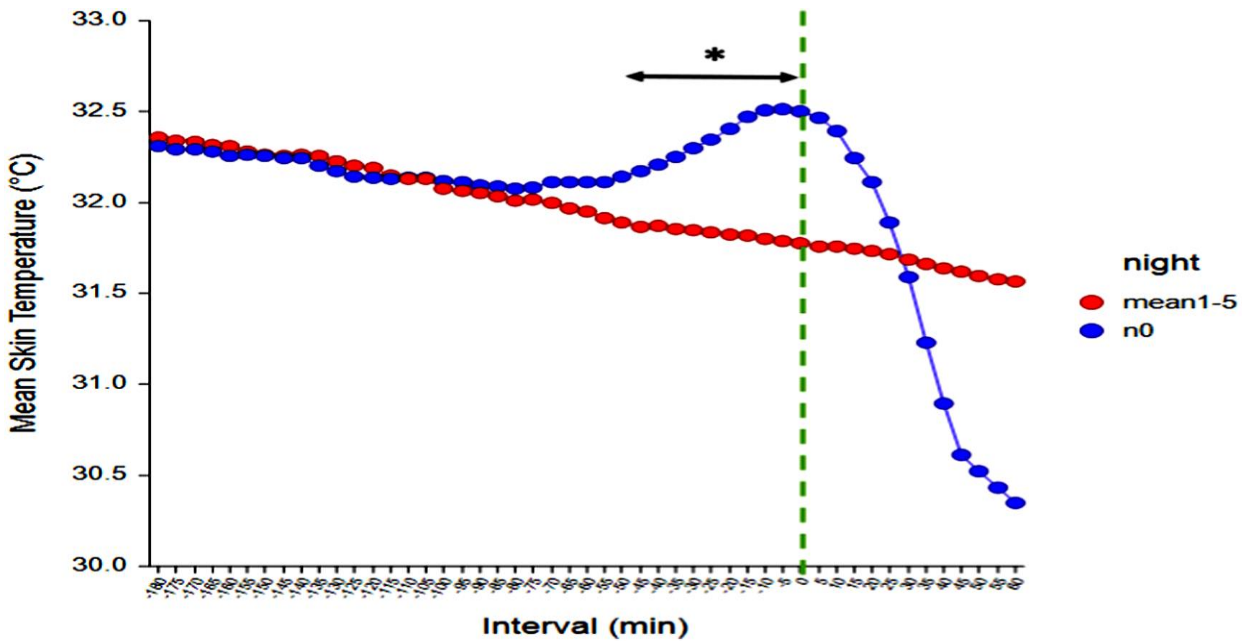

Fig. 3: Changes in mean skin temperature (5 min intervals, in °C) during the 180 min before parturition and up to 60 min after parturition in the foaling night (n0), compared to the mean skin temperatures in the five nights before (mean 1e5) at each time set. The time point of rupture of the allantochorion was set as 0 (dashed green line). Values under the arrow with the symbol * added as superscript differ significantly between the nights (Müller et al. 2022).

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5.3. Methods for Initiating Parturition

Glucocorticoids, prostaglandins, and oxytocin are the chemicals and techniques that have been used in mares to induce parturition. Glucocorticoids cannot be regularly used for induction of parturition in mares due to high doses and lengthy treatment intervals. Exogenous oxytocin is the suggested method for inducing parturition in mares (Simpson 2011). It can also be utilized in polytomous species to enhance labor when parturition has started (Schoen et al. 2017).

5.3.1. Glucocorticoids

Exogenous glucocorticoids are used to induce parturition to imitate the fetal adrenocortical signal that initiates pregnancy and delivery. The use of ACTH or glucocorticoids to induce parturition in mares produces variable outcomes (Conley and Ball 2019). Dexamethasone and other synthetic glucocorticoids cross the placenta in horses. Although the timing of medication initiation appeared to have a major impact on the effects on foaling. Dexamethasone delivered in small doses during the 2nd or final trimester of pregnancy had no influence on the frequency of dystocia and the maturity of the foal, and they did not induce foaling. Dexamethasone (100mg daily) was administered repeatedly beginning on day 315 or 320 of pregnancy, and the outcome was the birth of fully developed foals. Despite a roughly two-week reduction in gestation, glucocorticoids are ineffective for inducing labor in a clinical setting since it takes between 3 and 11 days from the start of treatment to the birth of the foal (Ousey et al. 2011). Contrarily, when dexamethasone was administered relatively late in the course of pregnancy (between days 331 and 347), it caused severe side effects such as neonatal death and dystocia (Nagel et al. 2020).

Following preterm foaling, to improve fetal maturation and hence stimulate foal viability, ACTH has also been investigated as an alternative to glucocorticoids. There was a significant frequency of fetal death and the birth of sick foals, even if fetal development was accelerated up by repeated experimental ACTH injections into the mare or the fetus (Ousey et al. 2000).

5.3.2. Progestogens

Despite popular belief, progesterone or the synthetic progestogen (altrenogest) administered to prepartum mares accelerated rather than delayed the start of foaling (Neuhauser et al. 2008). According to some studies, this impact is brought on by either a reduction in uterine progesterone receptors or the conversion of progesterone to glucocorticoids. The most noticeable abnormalities in foals born to these mares were a decreased neutrophil/lymphocyte ratio and a drop-in respiratory rate during the first hour of life (Neuhauser et al. 2009). In addition, altrenogest treatment of pregnant mares extended labor. Altrenogest crosses the placenta in mares and accumulates in high concentrations inside the fetus (Palm et al. 2010; Müller et al. 2019). Altrenogest may therefore directly affect the fetus, which could explain how it affects the foals of pregnant mares who take it up to delivery. Progestogens cannot be used to stimulate conception, but their use in pregnant mares during late pregnancy to prevent preterm birth at least warrants consideration (Curcio et al. 2017).

5.3.3. Prostaglandins

PGF2α analogs or PGF2α are less efficient at ending the pregnancy from the point where pregnant mares no longer rely on luteal progestogens but instead on 5α-prenames generated from the fetoplacental unit just before term. Prostaglandins must typically be administered in several, high dosages for hours or even days during this time because a single PGF2α injection seldom causes preterm foaling (Ousey and Fowden 2012). The typical prostaglandin-related adverse effects, including elevated skin temperature, perspiration, and diarrhea, appeared in mares 30 minutes after PGF2α treatment (Ousey et al. 1984a). These alterations were thought to be brief clinical indicators of stage I labor, but even after the additional treatment caused the cervix to soften and widen, no mares advanced to stage II labor, this would have caused the chorioallantois to rupture, causing the foal to be expelled (Leadon et al. 1982; Fernandes et al. 2021).

However, the PGF2α analog fluprostenol can successfully induce foaling in mares that are nearly full-term and in good labor condition (Ousey et al. 1984a). In mares who aren't quite ready to give birth, the PGFM concentrations increase happens later or doesn't happen at all, although, maternal concentrations of PGFM (PGF2 metabolites) in these mares increase quickly (Rossdale et al. 1979). It seems that PGF2α and its analogs have no effect on the production of placental progesterone, nonetheless, they could directly have uterotonic effects or trigger the release of oxytocin from the mare's posterior pituitary that are near parturition (Ousey et al. 1984a). Fluprostenol, a PGF2α analog, enhanced the plasma levels of cortisol and ACTH and maternity mares, demonstrating that these mares' pituitary hormone secretion was similarly stimulated (Ousey and Fowden 2012).

There are still some differences in the health of foals born following induction of foaling with PGF2 analogues, even in mares considered to be prepared for parturition (Ousey et al. 1984b). This could be due to a relatively extended period—up to 4 hours—between the start of the medication and the foal's birth., compared to a spontaneous physiological delivery, the foal is subjected to strong contractions of uterus for a considerably longer period (Ley et al. 1989). Due to the associated danger to infant viability, PGF2 and its analogs are seldom used and categorically not recommended for parturition induction (Nagel and Aurich 2022).

5.3.4. Oxytocin

Only during the brief expulsive stage of labor, a significant endogenous oxytocin release take place in peripartum mares, and this release is linked to a surge in PGFM concentration (Melchert et al. 2019). It must be considered that at this moment, oxytocin and PGF2 cause uterine contractions to be vigorous and ensure the foal is delivered quickly (Vivrette et al. 2000).

Towards the end of pregnancy, oxytocin reliably induces foaling. A dose-dependent impact has been shown, with greater dosages causing more rapid foaling (Hillman 1975). At first, substantial dosages (up to 100IU) were administered. Overall, straightforward, with high oxytocin doses (75IU), rapid foaling resulted in higher foal viability than labored delivery). The viability of the newborn foal, based on physical inspection and behavior of the foal, was unaffected by the administration method (single injection, multiple injections spaced 15 minutes apart, continuous infusion) (Macpherson et al. 1997). However, using high doses of oxytocin to induce labor was linked to a significant frequency of dystocia (25%) and preterm placental separation (40%) that endangers the foal's life, at least if prompt veterinary care is not available. Furthermore, high oxytocin doses promote foaling at the pre-viable stage of pregnancy as well as at term., giving birth to immature and weak foals (Leadon et al. 1982).

Late-gestational mares' release of PGF2 is induced by oxytocin treatment, even at doses as low as 0.1IU, as determined by changes in PGFM concentration (Chavatte et al. 2002). Similar to spontaneously foaling mares, term stimulation of parturition by oxytocin causes alterations in progesterone, estrogen, and prolactin levels (Roser et al. 1989). Therefore, Recent study has focused on decreasing oxytocin levels to solely trigger foaling in mares Who are extremely close to the term. It has also concentrated on relocating foaling from the night to the day with improved access to obstetrical assistance if necessary. It was particularly interesting to see how the prevalence of preterm birth, dystocia, and fetal impairment decreased when compared to earlier techniques for inducing labor (Nagel and Aurich 2022).

A 10% chance of premature placental separation, as well as dystocia (20%), were reduced by repeated moderate oxytocin doses (2.5IU) administered at 20-minute periods until the fetal membranes burst, but impaired foals were stillborn in 50% of instances (Duggan et al. 2007). As a result, in other investigations, 2.5IU of oxytocin administered only once caused straightforward parturition in (50%) half of mares chosen based on the $CaCO_3$ concentration of mammary gland secretion. The oxytocin test was used to determine whether a mare was ready to give birth. Therefore, the first treatment was given again 24 hours later (Camillo et al. 2000). The time between treatment and foaling was shortened by just 2IU of oxytocin in comparison to controls. when the amount was further decreased to between 0.1 and 2IU, and all foals were born healthy and mature in mares with at least 330 days of gestations. (Chavatte et al. 2002).

The most dependable and secure method for inducing parturition in mares is currently treatment with modest doses of oxytocin. Only mature mares that are ready and prepared for pregnancy appear to respond to oxytocin administered at low dose once a day, which appear to encourage PGF2 production and contractions of uterine walls. Instead of calling this method "induction of parturition," it might be more accurate to call it "augmentation." Oxytocin treatment at allowed dose can address the issues related to the careful monitoring of mares before parturition, the accurate forecast of foaling, and the availability of knowledgeable veterinary help in situation of dystocia or the delivery of sick foals in conjunction with certain clinical inclusion requirements, such as 330 days during gestation., clinical indicators of impending foal birth, a drop in pH and an increased concentration of pre-colostrum $CaCO_3$ (Nagel and Aurich 2022).

6. Stages of Parturition

6.1. Stage I

Stage I of parturition might be challenging to diagnose because of its ambiguous and nonspecific symptoms. Stage I of Foaling is distinguished by the mare's agitation, sweating behind the elbows and on the flanks, and colic signs. The mare may respond with the flehmen gesture, frequently flick her tail, and squirt milk. The rotation of the foal and uterine contractions are thought to be the causes of these sporadic symptoms of discomfort. The fetus shifts from a dorso-pubic position to a dorso-sacral position with the head and front legs extended during stage I. The nose and front feet create a wedge that aids in cervical dilatation. It's crucial to monitor without disturbing the mare because she has the ability to halt pregnancy at early stages. Stage I lasts an average of 1 to 4 hours, however, in older multiparous mares, it might not be noticeable. Stage I ends when the chorioallantoic membrane ruptures and allantoic fluid is released (Wessel 2005).

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6.2. Stage II

The rupture of the chorioallantois signals the start of stage II labor. While lying down is how most mares in the second stage of labor like to labor, it is not uncommon for the mare to sit or even stand up before lying down again. Some mares even roll to try to place the foal or ease discomfort. Forceful abdominal contractions frequently result in all four legs of the mare extending, as well as frequent urination and defecation. Stage II typically is of 20 to 30 minutes and it's important to keep track of when the allantoic fluid was expelled. An issue with fetal placement may be indicated by a prolonged stage II, and the fetus may become impaired rather quickly. Within 5 to 10 minutes of the chorioallantois rupture, which denotes the involvement of the foal in the birth canal, the whitish-blue amniotic membrane at the vulva should become apparent during stage II. The Ferguson response, which causes the glottis to close and a strong contraction of the muscles of the abdomen and diaphragm, happens once the fetus engages or extends the cervix. Often, the foal is born with a complete amnion that spontaneously ruptures when the foal moves. If the amniotic membrane is still there after the foal is delivered, care should be made to remove it from the mouth and nose. During labor, a fetus' typical position is for one forelimb to extend approximately four inches cranial to the other extended forelimb, with the soles of both feet pointing toward the udder of the mare. The placenta may begin to split from the endometrium of the mare during stage II, which is probably a factor in the low rate of foals' survival born after an extended stage II (Wessel 2005).

6.3. Stage III

During stage III of parturition, the fetal membranes are discharged. This final phase is frequently characterized by myometrial contractions and minor indications of pain. After the foal is delivered, the placenta often passes in less than three hours. When fetal membranes are maintained for more than three hours, treatment should be taken right away. Fetal membranes that are exposed should be knotted to protect them. Expelled membranes should be carefully examined, taking note of any anomalies and the presence of both uterine horn endings (Wessel 2005).

7. Difficult Parturition

Difficult parturition is also termed "dystocia". Dystocia in equines is an emergency condition that put the life of both dam and fetus at risk (Haas et al. 1996; Freeman et al. 1999). It is described as any birth that necessitates medical intervention, decreases a newborn's viability, or harms the mother (Purohit and Honnappagol 2009). Although dystocia in mares is much less common than it is in other domestic animals, when it does occur, it is a serious emergency since the mother's and fetus's survival depends on every minute (Giles et al. 1993; Mc Gladdery 2001; Wilkins 2008). Dystocia must be suspected if the foal is not born within 20 to 30 minutes following the chorioallantoic membrane rupturing and the discharge of fluid. Among various breeds of horses and other equines, the incidence of dystocia varies. In thoroughbreds the incidence of dystocia is approximately 4% (Frazer 2001a). The prevalence is known to be up to 10% in some breeds, such as Shetland ponies and Belgian draught horses (Vandeplassche 1992). In female donkey (Swendsen 1989) and primiparous mares (Ginther and Williams 1996; Ball 2005), there is a high incidence of dystocia.

7.1. Causes of Dystocia

In equines, causes of dystocia are broadly divided into two main causes: fetal causes and maternal causes (Roberts 1986; Threlfall 2007).

7.1.1. Fetal Causes

Abnormalities in fetal posture are most common fetal cause of dystocia. Fetal dropsy, fetal monsters and fetal oversize are less common fetal causes of dystocia (Allen 1986; Bullard and Harrison 1995).

7.1.2. Maternal Causes

Failure of the expulsive forces and the obstruction of the birth canal are described as the maternal causes of dystocia. Prepubic tendon rupture/abnormal hernias (Auer et al. 1985; Ross et al. 2008), uterine inertia and dropsical conditions of dam (Blanchard et al. 1987; Honnas et al. 1988) are the causes of the failure of the expulsive forces. Cervical/vaginal strictures varicose veins and vaginal tumors (Jackson 2004) can cause obstruction of the birth canal. The most frequent source of obstruction is uterine torsion (Chaney et al. 2007; Lopez and Carmona 2010).

7.2. Clinical Signs of Dystocia

If the first stage of labor lasts longer than 45 to 90 minutes, dystocia should be suspected. This is not to be confused with the mare delaying labor deliberately because of a disturbance. Dystocia must also be suspected when 2nd stage of labor prolongs greater than 20 minutes without any advancement of the fetus into the birth canal (Frazer 2009). Dystocia is present when fore feet alone at vulva without any progress. Forceful straining and colic may accompany dystocia. In case of uterine inertia or uterine rupture, the mare may stand without any straining and quietly. If there is an abnormal vaginal discharge, it is an indication of fetal death.

7.3. Methods of Handling Dystocia

Dystocia can be handled in many different ways depending upon the condition. Methods of dystocia handling are classically divided into cesarean section, forced traction and mutation, and fetotomy (Threlfall 1997). The methods have been described most recently as cesarean section, fetotomy, controlled vaginal delivery, and assisted vaginal delivery (Embertson 1999; Lu et al. 2006; Frazer 2007; McCue and Sitters 2021). The clinical skills of the veterinarian, economics of the case, previous handling and viability of the fetus are the major considerations for the selection of dystocia handling methods. The morbidity and mortality rate for both fetus and dam increases with the increase in the duration of dystocia (Frazer 2001a).

7.3.1. Assisted Vaginal Delivery

The majority of dystocia cases at the farm level can be corrected by assisted vaginal delivery and little manipulation. If foal is not delivered in 10 to 15 minutes with assisted vaginal delivery than other methods of dystocia handling should be considered (Embertson et al. 1995). For assisted vaginal delivery always keep in mind that assist mare when she is laying down not in standing position because there are chances of rupture of the umbilical cord before parturition resulting in tissue hypoxia. For the correction of fetal mal disposition, the mare should be in standing position. Tractions should be stopped once the thorax of fetus is out of the birth canal. In case of fetal mal disposition, never apply traction on the fetus before correction.

7.3.2. Controlled Vaginal Delivery

General anesthesia is used during controlled vaginal birth, and the mare is lifted up by her hindquarters. Fetal rejection and manipulation are helped by uterine relaxation and gravitational effects (Frazer et al. 1999a; Frazer et al. 1999b). The fetus is repositioned and repositioned to allow for vaginal delivery after its position and posture are identified. Use plenty of lubricant and gentle manipulations to aid in parturition. When the foal's head and distal forelimbs emerge from the birth canal, the mare should be placed in lateral recumbency, and the foal must be given traction until parturition. The umbilical cord needs to be cut and clamped. For recovery, a thick mat must be placed out for the mare. Depending on whether the foal is alive or dead, a fetotomy or caesarean section should be performed if the foal cannot be delivered within 15 minutes (Frazer 2001a).

7.3.3. Fetotomy

Fetotomy is performed if the fetus is dead. It should be performed only by skilled obstetrician otherwise it is potentially dangerous for the dam (Higgins and Wright 1999). A dead fetus can be delivered without suffering any pain with one to two strategically placed fetotomy cuts (Nimmo et al. 2007). Due to the equine birth canal's length and softness as well as the risks posed by the fetal membranes' quick detachment, fetotomy surgery is not as easy (Stephenson 2010). The absence of fetal reflexes (no ocular reaction, no limb withdrawal, no heartbeat, no anal reflex, and no swallowing reflex) indicates that the fetus has died.

7.3.4. Cesarean Section

In cases where a suitable surgical facility is not available, a caesarean section in a mare is still regarded as a difficult and dangerous procedure. However, mare survival is high 89 to 95%) with appropriate hospital facilities and the application of current procedures for inducing and maintaining general anesthesia (Freeman et al. 1999). If the operation is undertaken after the mare has been subjected to continued vaginal manipulations, there is a poor chance for future fertility (Farman 1986; Cohen 1975). The likelihood of a foal surviving a terminal caesarean section is low (Hollis et al. 2009). Within one or two hours of the start of the second stage of labor, if the foal is still alive and still inside the mother's pelvic canal, it dies from lethal anoxia due to the dehiscence of the allantochorion (Arthur 1975). So, if the foal is still alive, the operation should be done as soon as possible. Cesarean sections in equine species are only performed in a few locations due to a shortage of equine specialized facilities and a decline in the number of equines retained worldwide. An elective caesarean is recommended when dystocia is suspected due to cervical adhesions, partially blocked pelvic canals, or other problems, or when saving the life of a foal is essential (Maaskant et al. 2010). When all other attempts at dystocia correction have failed, and there is a transverse pregnancy, or a complete fetotomy is needed, will endanger the dam's life, an emergency cesarean is recommended (Schumacher and O'Brien 2021). Other causes for an emergency cesarean section include pelvic fractures and vulvovaginal injuries.

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8. CONCLUSION

Mare is a long day breeder. Donkeys are less seasonal than wild asses. Mares usually attain puberty between the ages of 12 and 15 months. Estrus cycle is divided in estrus and diestrus phase. In estrus mare approaches the stallion while in diestrus mare avoids the stallion. Donkey differs in sexual behavior from horses. Fetal cortisol is the hormonal signal that starts parturition in horses. Neonatal sepsis, which is the main cause of foal loss, will most likely arise from insufficient colostral antibody absorption by the foal. The gestation period of a mare typically lasts between 320 and 360 days. Foals can still be delivered dysmature even after 360 days of pregnancy. Exogenous oxytocin is the suggested method for inducing parturition in mares. It mimics the adrenocortical signal that initiates pregnancy and delivery. Using high doses of oxytocin to induce labor was linked to a significant frequency of dystocia (25%) and preterm placental separation. Oxytocin treatment can address the issues related to the careful monitoring of mares before parturition. It has also concentrated on relocating foaling from night today. Dystocia is considered one of the emergency conditions in the equines. Hysterotomy or cesarean section is the best method when controlled vaginal delivery is not completed in less than 20 minutes.

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