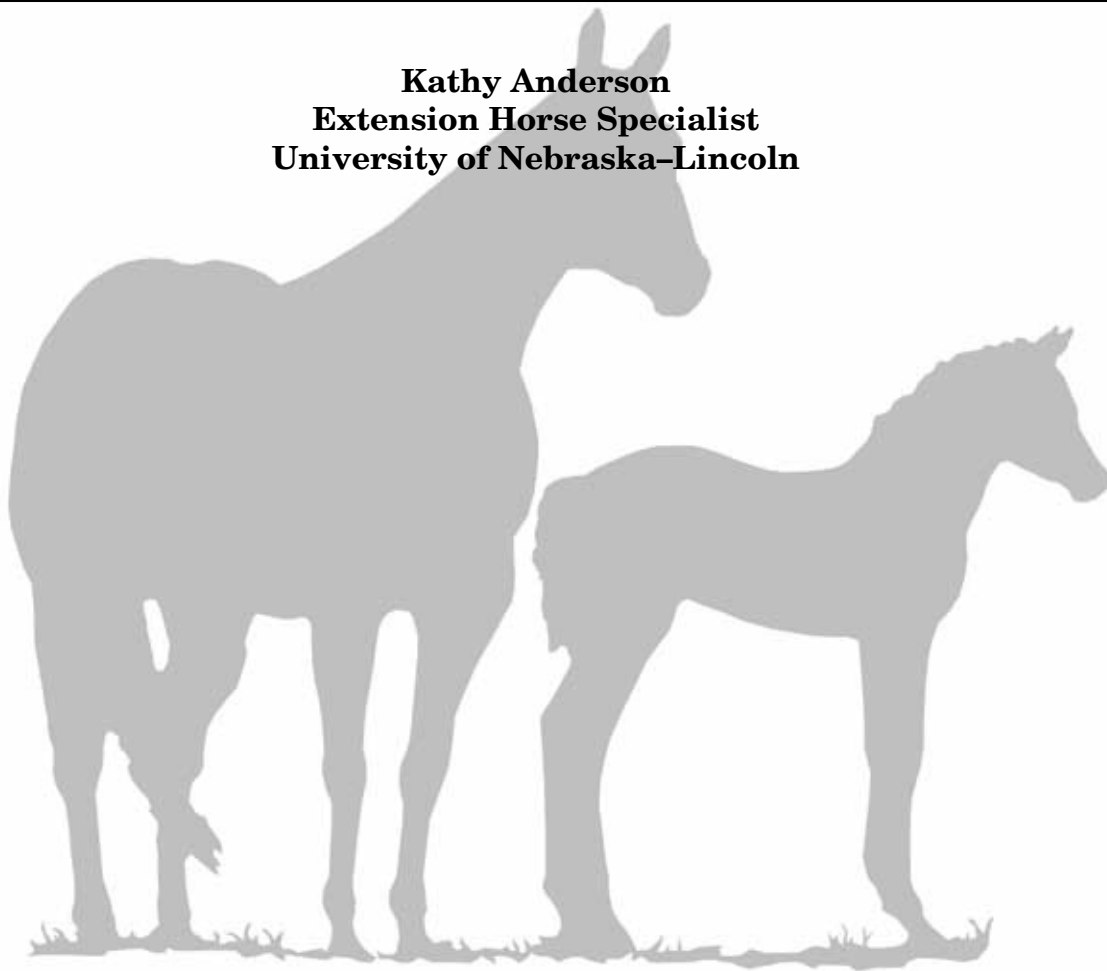


UNDERSTANDING MARE REPRODUCTION

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INTRODUCTION

Many producers who raise horses find breeding mares rewarding, yet frustrating. Mares and stallions are traditionally placed in the breeding herd due to successful performance records, with little consideration for their reproductive capabilities. Horses are difficult breeders with an estimated foaling rate of below 60 percent. Various factors contribute to this, including long-erratic estrous cycles and an imposed breeding season that does not coincide with the mare's natural breeding season. Basic understanding of the mare's reproductive physiology can improve reproductive efficiency and foaling rates. A mare manager's goal should be to get the maximum number of mares pregnant, in the shortest amount of time, and to deliver a live, healthy foal each year.

TYPICAL CYCLE

People who have bred many mares soon realize that each mare is an individual, and there may be many variations in the reproductive cycle length between mares. There is, however, a **basic** cyclic pattern that most mares will follow.

Typically, during the breeding season, a mare will have a 21-day estrous cycle (the interval from one ovulation to the next). This length will vary between mares and time of the year. The estrous cycle is divided into two periods, estrus and diestrus. Estrus ("heat") is the period (usually four to seven days) when the mare is receptive to the stallion. During this period, ovarian follicles grow and develop to between 30 and 50 mm in diameter with ovulation occurring 24 to 48 hours before the end of estrus. Thus, the mare is still showing "heat" when she ovulates.

During diestrus, the period between successive estrus (typically 14 to 18 days), the mare is unreceptive to the stallion.

FUNCTIONAL ANATOMY

A correctly functioning reproductive tract is essential to the potential fertility of a broodmare. The tract goes through various changes as a mare exhibits its estrous cycles. A good working knowledge of a mare's anatomy and these changes will aid in early identification of potential abnormalities. These changes can easily be monitored through rectal palpation or ultrasound by a veterinarian.

The rectum is located above the reproductive tract allowing for a noninvasive examination of the cervix, uterus, and ovaries. A diagram of a mare's reproductive tract is shown in *Figure 1*.

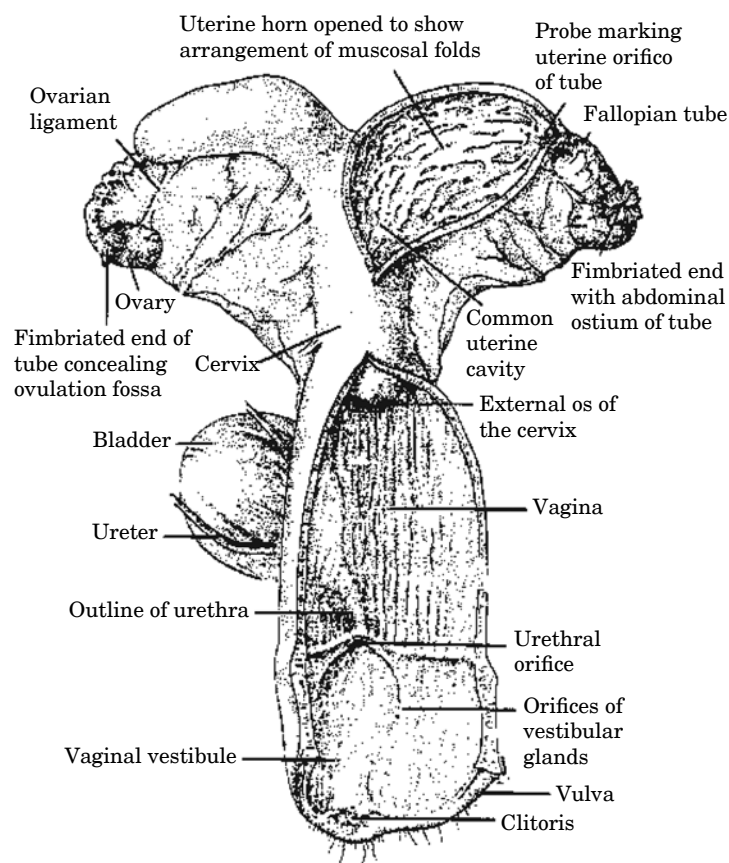


Figure 1. Reproductive organs of the mare. (From: Evans, The Horse 1990)

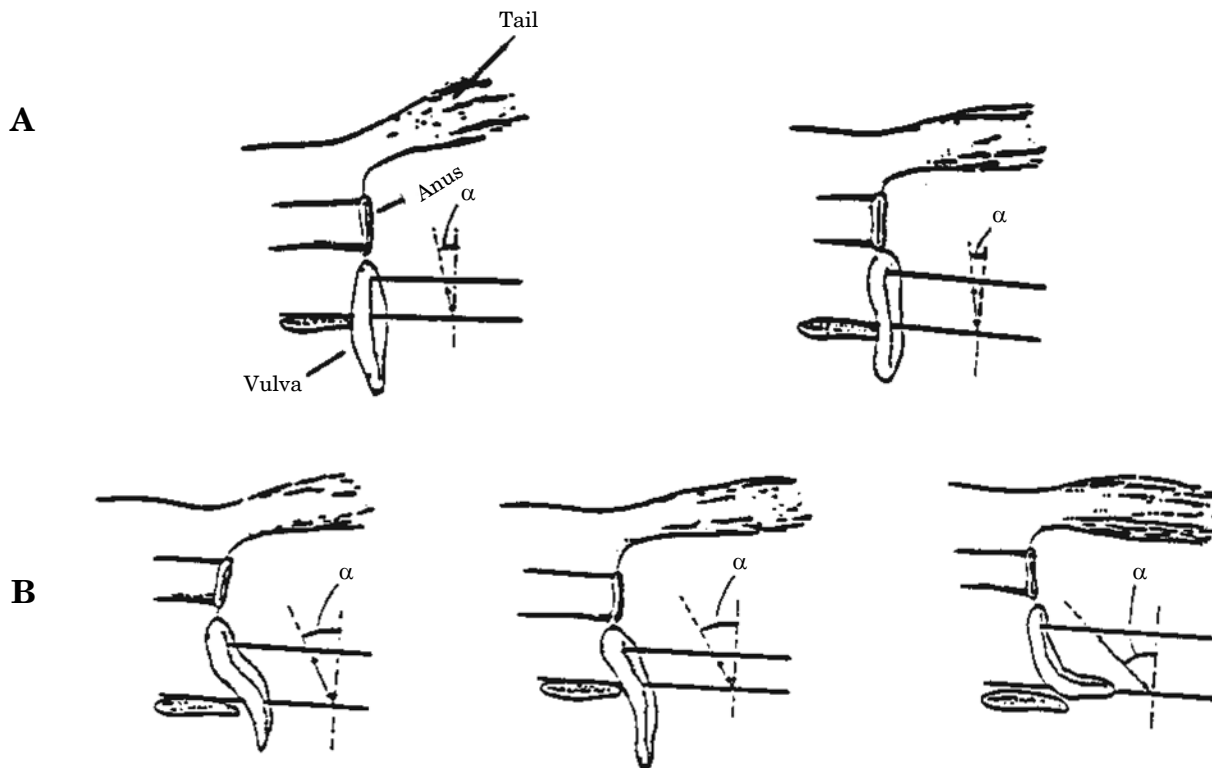


Figure 2. Desirable (A) and Undesirable (B) vulva conformation in mares. (From: Evans, The Horse, 1990).

Vulva

The vulva is the external portion of the mare's reproductive tract. The lips of the vulva contain muscles to help keep the opening closed, preventing feces or other foreign matter from entering. When the mare is in "heat," the lips swell and become moist and relaxed. In some mares the vulva's muscle tone is greatly reduced, becoming very loose and pliable. During diestrus, the muscle tone increases, keeping the lips of the vulva "closed."

The conformation of the mares' vulva is frequently overlooked by producers. Desirable vulva conformation (*Figure 2A*) is characterized by a vulva vertical to the pelvic floor, parallel with the anus, and the lips meet to form a seal. Undesirable conformation (*Figure 2B*) is a vulva lying more horizontal with the pelvic floor, or having a "tipped inward" appearance. The anus will appear sunken and in a position predisposing the mare to collecting fecal material in her vagina.

Additionally, poor conformation of the vulva predisposes mares to wind sucking (pneumovagina) and urine pooling. This undesirable vulva conformation can be due to genetics, aging, and/or poor body condition. Regardless of the cause, poor vulva anatomy is an important component of subfertility in mares due to the ease in which the mare's tract can become contaminated and infected.

Caslick's operation

A simple surgical procedure, known as Caslick's operation, can be performed on mares that have undesirable vulva anatomy to reduce the chances of uterine contamination. The skin on the outer portion of the lips is removed, then sutured together, leaving a small opening for breeding and urination (*Figure 3*). Mares with a sutured vulva can easily be bred through artificial insemination. Mares that need their vulva sutured and bred by natural service would have to be sutured after determined pregnant, or reopened if not pregnant. **It is essential to record this procedure on the mare's permanent records so the vulva is reopened approximately four weeks (30 days) before her expected foaling date!** Failure to do so could lead to serious tearing and damage to the reproductive tract.

Vagina

The vagina is a tubular structure about 6 to 8 inches in length connecting the cervix and vulva. There are no glands within the vagina. Its lining is highly elastic and permits dilation during parturition. During estrus, the vagina has a more reddish color and increased moisture. In diestrus, the vagina is typically pale and dry.

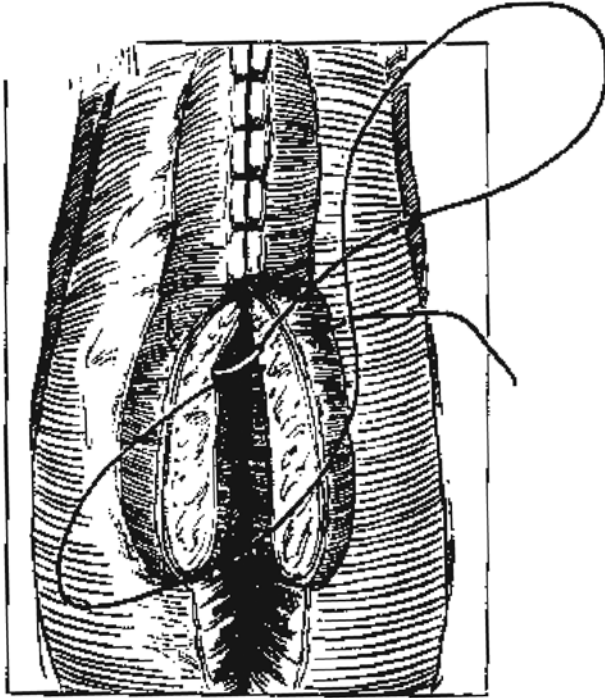
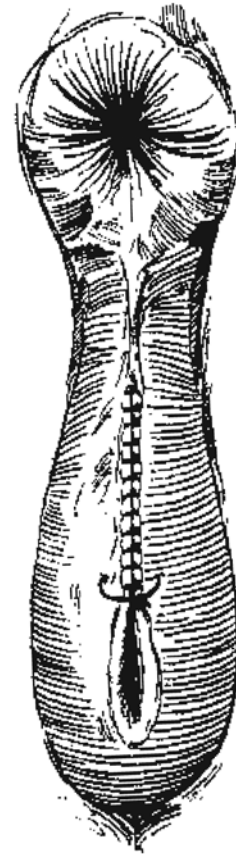
A**B**

Figure 3. Caslick's operation. A, Suturing the lips of the vulva. B, Finished Caslick's. (From: McKinnon & Voss, Equine Reproduction, 1993).

Cervix

The cervix of the mare serves as a barrier to the uterus during diestrus and pregnancy, and is also the major site of semen deposition during natural service. Visual changes of the cervix can be detected during estrus by viewing through a vaginal speculum. The vaginal speculum commonly used is a disposable, hollow cardboard tube. The mare's vulva should be washed, rinsed, and dried before passing the sterile speculum into the vagina.

Following lubrication of the rolled end, the speculum is passed through the vulva and into the vagina where it is placed adjacent to the external opening (exterior os) of the cervix. With a penlight, the cervix can be examined visually.

The cervix of a mare when in estrus ("heat") is relaxed and has a glistening red appearance when viewed through a speculum. Often, the relaxation is such that the cervix appears flattened and lying on the vaginal floor (*Figure 4A*). Penetration of the cervical lumen is very easy at this time. A large quantity of mucus is secreted and acts as a lubricant to facilitate passage of the penis or foal through the

vagina. The mucus also allows semen to enter the uterus.

The cervix of a diestrus or pregnant mare will be "whitish" in color and lack the moist appearance. A sticky mucus cervical plug, which aids in sealing the lumen during pregnancy and diestrus, is present. The cervix will also appear very "toned" (rigid) and be up off the vaginal floor (*Figure 4B*). However, with manipulation, the diestrus cervix can still be penetrated. Thus, visual evaluation of the cervix through a vagina speculum can be used along with other management practices in making breeding decisions.

Uterus

The mares' uterus is composed of two uterine horns and the body, which are connected almost perpendicularly, forming a T-shaped configuration. The uterus goes through cyclic changes similar to the other areas of the mares' reproductive tract. As a mare exhibits estrus, estrogen causes a swelling and increased folding in the endometrium. Once a mare enters diestrus or becomes pregnant, progesterone

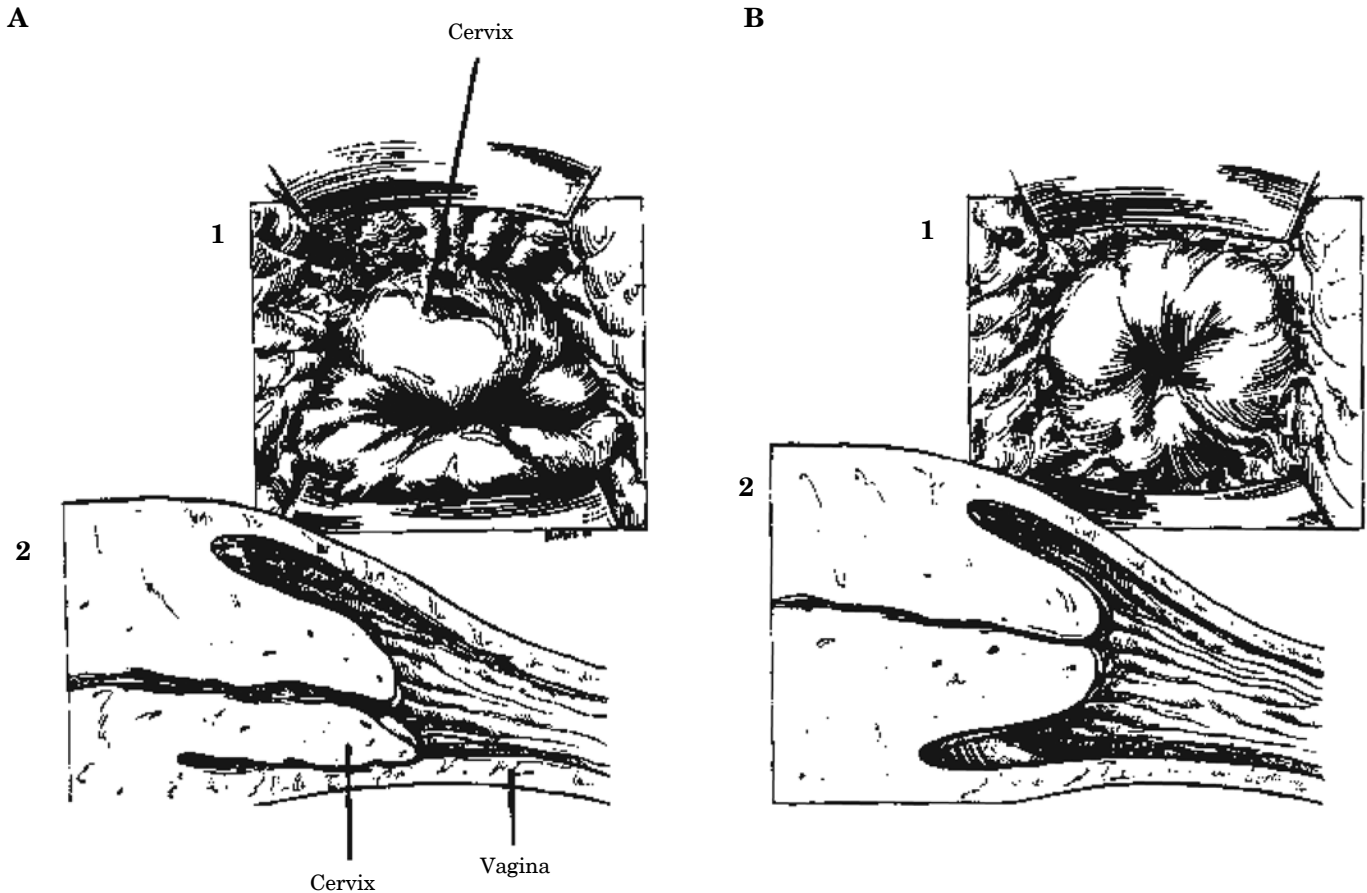


Figure 4. Vaginal portion of uterine cervix. A, during estrus and B, during diestrus. 1, Viewed through speculum in vagina; 2, side view. (From: McKinnon & Voss, Equine Reproduction, 1993).

terone secreted encourages glandular development and secretion in the endometrium. It also encourages greater muscular tone within the myometrium. If a mare has some type of uterine infection or is not exhibiting normal estrous cycles, her uterine tone may be compromised and be more flaccid.

A small sample of the uterine lining (endometrium) is obtained during a uterine biopsy for histological examination. A healthy endometrium is critical for high fertility. Infection or damage to the endometrium often results in failure to conceive, abortion, or reduced fetal growth.

Oviduct

The oviducts, also known as Fallopian tubes in humans, connect the uterine horns and ovaries. The oviducts are about 7 to 12 inches in length. During ovulation, the unfertilized ovum enters the oviduct at the infundibulum. The ovum travels to the widened ampulla segment of the oviduct for fertilization to occur. The isthmus is a narrow, coiled portion of the oviduct that joins the oviduct to the uterus and propels semen to the ampulla and the

fertilized embryo to the uterus. The fertilized embryo remains within the oviduct for approximately 144 hours before entering the uterine horn.

Ovaries

The mare has a unique kidney bean-shaped ovary from which ovulation only occurs at the ovulation fossa (indented area of the ovary). As with most species, the ovaries have a dual role, being not only responsible for production of hormones that regulate reproductive function, but also the production of oocytes (eggs).

When a mare is in estrus (heat), an oocyte (egg) develops in a follicle or fluid-filled blister on the ovary. A mature follicle in mares is typically 40 mm (2 inches) in diameter and the egg is released from the follicle toward the end of estrus. Initially, the follicle is firm, but before ovulation it becomes softer as the oocyte migrates to the ovulation fossa. The ovulation fossa is a wedged-shaped area on the concave side of the mare's ovary and is the only portion of the ovary from which the egg may ovulate.

Ovulation can be detected by a veterinarian through rectal palpation or ultrasonic evaluation.

Following ovulation the oocyte is passed into the oviducts where fertilization occurs. In the mare, the fertilized egg remains in the oviduct approximately six days before entering the uterus. After the embryo enters the uterus, it must migrate throughout the entire uterus until it becomes fixed, generally around day 16 following ovulation. Therefore, a mare may have ovulated from the right ovary, but the pregnancy may be detected within the uterine body or left uterine horn. Two to three days following release of the ovum into the oviduct, a corpus luteum develops in the cavity where the follicle existed. The corpus luteum produces progesterins, which inhibit the mare's estrus behavior and act to maintain pregnancy.

REPRODUCTIVE HORMONES OF THE MARE

The events occurring during the estrous cycle are controlled primarily by two sets of hormones, those from the pituitary gland, and those from the ovary. The pituitary gland is located at the base of the brain and produces follicle stimulating hormone (FSH) and luteinizing hormone (LH). FSH, as the name implies, stimulates follicular growth on the ovary. LH reaches highest levels toward the end of estrus and is responsible for actual follicle ovulation and release of the oocyte. Another hormone, gonadotrophin releasing hormone (GnRH), is released from the hypothalamus of the brain to stimulate release of both FSH and LH.

Two hormones secreted from the ovary, estrogen and progesterone, are steroids, and have important roles in the control of the estrous cycle. Follicles release increasing amounts of estrogen as they grow. The general effects of estrogen include initiation of standing heat, dilation of the cervix, and changes in the oviducts in preparation for egg and sperm transport. Progesterone is produced from the mature corpus luteum following ovulation, causing the cervix to tighten and readying the uterus for pregnancy.

Prostaglandins ($\text{PGF}_{2\alpha}$) is a naturally occurring compound synthesized in most body tissues. In relation to the reproductive cycle, $\text{PGF}_{2\alpha}$ is released by the uterus of the mare toward the end of diestrus. This causes regression of the corpus luteum and thus removes the influence of progesterone. $\text{PGF}_{2\alpha}$ can also stimulate severe, smooth muscle contractions that can cause abortion in pregnant animals.

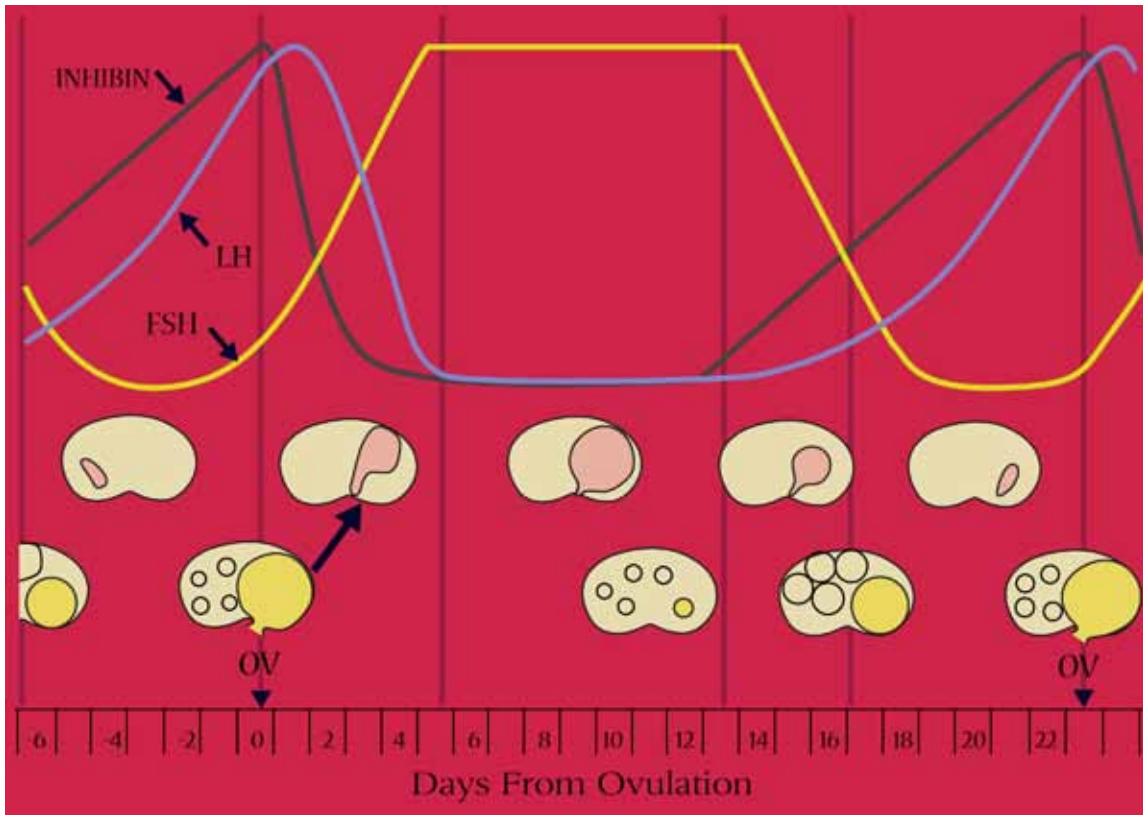
Hormonal control of estrous cycle

The sequence of hormonal changes during the estrous cycle is shown in *Figure 5*. The estrous cycle can be divided into two phases — the follicular phase and the luteal phase. The follicular phase begins when the pituitary produces FSH, which stimulates follicles. The beginning of estrus is associated with rising blood levels of estrogen secreted from the developing follicles. Shortly after the increase in estrogen levels, the concentration of LH (from the pituitary) also begins to rise. It is believed that this rise in LH is caused by a positive effect of estrogen on LH release by the pituitary gland. Levels of LH continue to increase, resulting in ovulation of the follicle. The luteal phase begins just following ovulation. The cavity remaining on the ovary following ovulation fills with blood, the cells within begin to divide, thus forming a corpus luteum (CL), which produces progesterone. This rise in progesterone can be detected in the blood within 24 hours after ovulation. Once progesterone reaches a sufficient level (about 48 hours), the mare will cease to show behavioral estrus ("go out of heat"). Progesterone continues to rise as the CL becomes more mature and is fully functional within five days. If the mare does not become pregnant, uterine cells during the latter state of diestrus secrete $\text{PGF}_{2\alpha}$, causing the CL to regress, driving the progesterone down, and allowing the mare to return to estrus. At approximately the same time (day 12 or 13 after ovulation), the pituitary will increase its release of FSH, stimulating follicle growth. Subsequently, estrogen levels will rise and the estrous cycle will be repeated. However, if the mare becomes pregnant, the effects of $\text{PGF}_{2\alpha}$ will be blocked and the CL will be maintained until approximately 180 days of pregnancy. Additional follicles will grow and develop accessory CLs, which will be maintained for the same length of time. After 180 days of pregnancy, the placenta becomes the primary source of progesterone.

SEASONALITY

The mare is a seasonal breeder with a series of estrous cycles normally occurring during the breeding season, which coincides with long day lengths (*Figure 6*). The longest day of the year is June 22 and the shortest is December 22. Therefore, mares should reach a peak in their reproductive activity around June 22 and be the least reproductively active in late December.

A



B

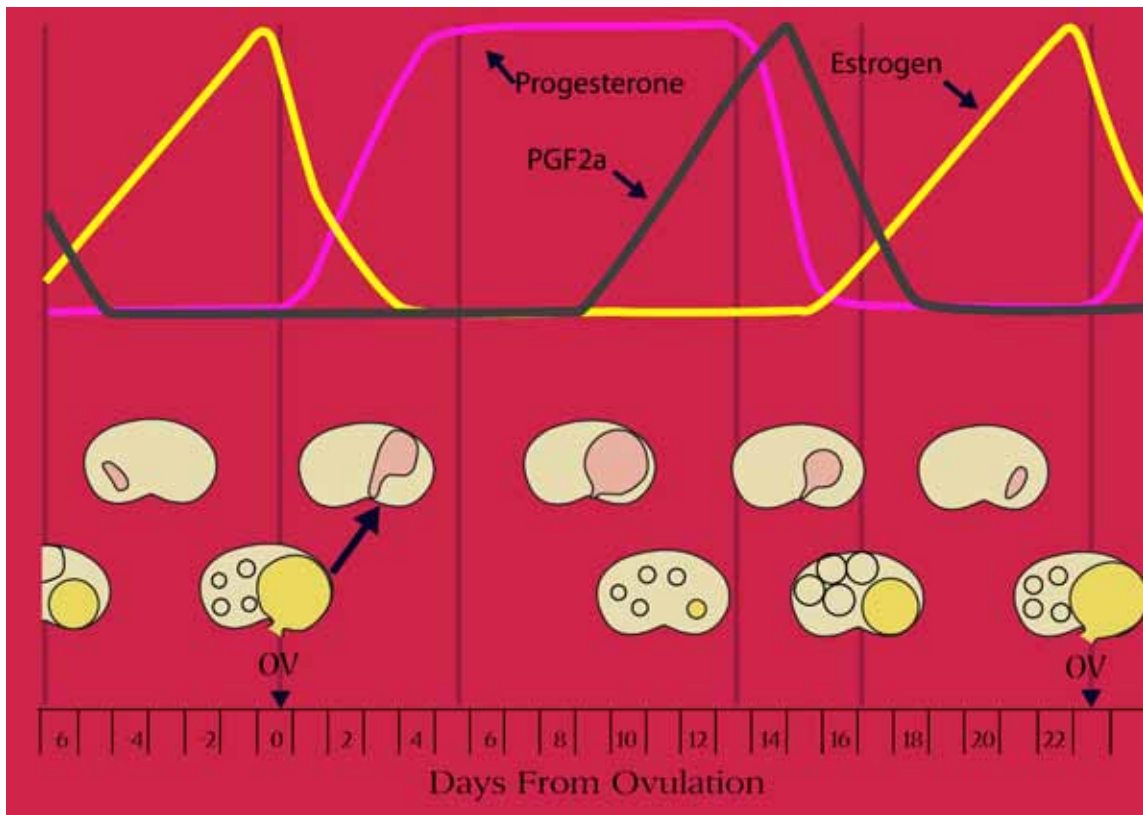


Figure 5. Endocrine and ovarian activity in mares. (A) Profile with LH and FSH. (B) Profile with estrogen, progesterone and PGF.

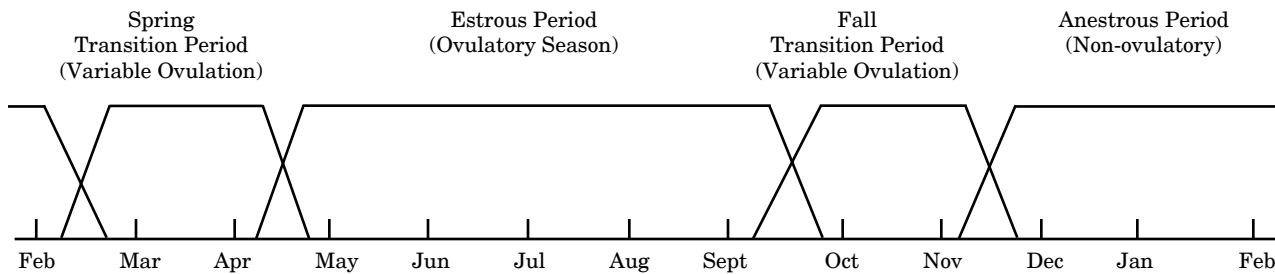


Figure 6. Mare Seasonality.

Anestrous period

The period in which the mare is the least reproductively active is termed the “anestrus” period and typically occurs during the winter months. Generally, during this period, the mare will show no signs of estrus with the ovaries being very small and inactive. Some mares will show signs of estrus, but few actually ovulate during this period.

Transitional period

As day length increases in the spring, the mare will begin to show signs of estrus around March. However, regular ovulations do not begin until about 30 days after the first period of estrus. These early heats are often erratic and unpredictable, lasting for two weeks or longer. During this period, the mare is changing from reproductive inactivity to maximal activity of the breeding season. This change is called the “transitional period.” Ovarian follicles may develop and grow, then regress (decrease in size) without ovulation. Therefore, attempts to breed mares during this transition period can be extremely frustrating and conception rates are low.

Breeding season

The natural breeding season typically begins around mid-April and is described on Page 1.

Fall transitional period

Beginning in late summer and early fall, the mare again will go into a transitional time similar to that seen in the spring. The periods of estrus and ovulations become more erratic and irregular. As winter approaches, the estrous cycle is complete as the mare once again enters into anestrus.

Hair coat and reproductive seasonality

There is a positive correlation between the shedding of hair in tufts and the first ovulation of the breeding season. The first ovulation of a mare generally occurs two months after she has begun to shed her winter hair in tufts. A smooth, “summer

type” hair coat typically does not appear until after the first ovulation. Thus, the shedding of hair can be used as an indicator that the ovulatory or breeding season is approaching. Furthermore, the horse appears to use photoperiod, or day length — not temperature — as the signal to change its hair coat from winter to summer and vice versa.

Management of transitional mares

All mares must pass through a transitional phase, and anyone breeding mares through this phase realizes how frustrating this can be. Transitional mares typically will have long, erratic periods of estrus (heat) with low conception rates. One management practice that enhances normal estrus cycles is to place mares on exogenous progesterone for 10 to 15 days. Once removed from progesterone, most mares will return to estrus within 3 to 4 days and ovulate 9 to 10 days following progesterone withdrawal. **For this practice to work, mares must have sufficient activity on their ovaries (several follicles of at least 20-25 mm or larger).** Most commonly, progesterone is given orally, marketed under the name “Regumate” (altrenogest). Oral progesterone is given at a dosage of .044 mg/kg body weight or approximately 1 ml per 110 pounds of body weight.

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