EQUINE REPRODUCTION التكاثر في الخيول

Puberty and Sexual Maturity

Puberty in females is marked by the first estrus or the first ovulation. In fillies, puberty usually occurs between 12 and 18 months of age (on average 15 months), and can be influenced by several factors such as birth season, body weight, breed, and lineage.

Reproduction in the equine species is strongly influenced by the photoperiod, and the reproductive season occurs in the months of long days (spring and summer).

Between the reproductive season, or cyclic phase, and the anestrous or acyclic phase, there are two transitional periods (spring and autumn transition), which are marked by important peculiarities in the physiology of the mare.

Puberty in males can be defined as the moment at which the animal has the ability to reproduce successfully. Some researchers use the definition of puberty as the first moment in which the ejaculate contains 50 million spermatozoa with at least 10% motility.

In foals, up to 8 months of age, the concentrations of gonadotropins are low and the gonadal activity is minimal (infant period).

Blood testosterone shows a large increase between 18 and 20 months of age, with puberty being reaching between the 20th and 21st months. Age of puberty is (14 months) or late (over 24 months).

Seasonality:

The mating season occurs in the months of long days (spring and summer). In the months of negative photoperiod (autumn and winter) the vast majority of mares do not have ovulatory cycles and stallions have lower fertility.

There is a reduction in size and testicular activity, with a consequent decrease in the release of testosterone, sperm production and libido.

The pineal gland is the organ responsible for the production of melatonin in mammals. The light, detected by the retina, controls its rhythmic secretion, which occurs at high levels during the night and low during the day.

Thus, the photoperiod exerts influence on the secretory pattern of melatonin, a hormone responsible for regulating the hypothalamic production of gonadotropins (GnRH). In equines, during the months of negative photoperiod (short days) the increase in melatonin levels leads to a reduction in GnRH secretion.

In addition to environmental factors, such as photoperiod and ambient temperature, age, nutrition, and body condition also exert influences on reproductive activity.

Reproductive Endocrine Control (Hypothalamic-Pituitary-Gonad Axis (HPG)

The major hormones involved in the HPG axis include gonadotropin releasing hormone (GnRH), follicle stimulating hormone (FSH), luteinizing hormone (LH), testosterone, estrogen, inhibin, and progesterone.

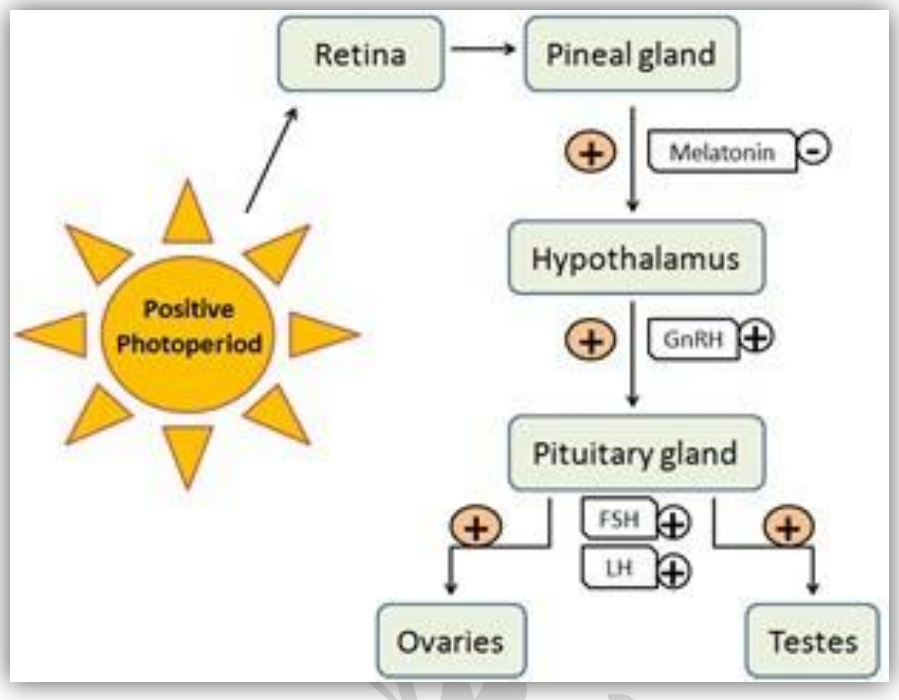

Figure 1 Influence of the photoperiod on the hypothalamic-pituitary-gonad axis in horses

Endocrine Control of Estrous Cycle and Initial Gestation in Mare

The main stimulus for the initiation of cyclicity in the mare is the increase in the hours of daily light. In this species, the decrease of melatonin secretion by the pineal gland (positive photoperiod) represents a stimulus for the hypothalamic release of GnRH, which is suppressed in the short-day months.

GnRH is responsible for regulating the synthesis and secretion of pituitary gonadotropins: follicle stimulating hormone (FSH) and luteinizing hormone (LH). FSH, as its name implies, is responsible for stimulating follicular growth.

This growth occurs in the form of follicular waves, which are detected during trans-rectal ultrasonography by the simultaneous development of multiple follicles. The mares may present one or two follicular waves per estrous cycle, being more common the occurrence of a single wave.

The waves can be classified as major and minor. Major waves are those in which follicular divergence occurs, with the formation of dominant and subordinate follicles.

The follicles under development produce two hormones, estradiol, and inhibin, which give negative feedback on the release of FSH.

Estradiol, produced mainly by the dominant follicle, presents increasing levels during estrus, reaching the peak two days before ovulation.

Behavioral changes:

1. Raised tail.
2. Rhythmic clitoris exposure.
3. Frequent and passive urination.
4. Abduction of the pelvic limbs.
5. "Squatting", vocalization).
6. Changes in the reproductive tract (uterine edema, cervix rose, moist, relaxed and open cervix).
7. Sexual receptivity of the mare during the characteristic estrus.

In addition, estradiol exerts positive feedback on LH release when circulating concentrations of progesterone are low. Thus, a drop in FSH levels and an increase in LH, which acts on the final growth and maturation of the dominant follicle, culminating in ovulation, mark the pre-ovulatory period.

The dominant follicle reaches about 40 mm in the pre-ovulatory period. Ovulation consists of rupture of the dominant follicle in the ovulation fossa, resulting in the release of oocyte and cumulus cells, granulosa cells, and follicular fluid.

The cells, of the granulosa remaining at the ovulation site, undergo a process of luteinization by the action of LH and begin to compose the primary CL.

Luteinization modifies the secretory activity of granulosa cells, which cease to secrete estradiol and secrete progesterone (P4).

The estrus phase of the mare where there is an active CL is called the luteal or diestrus phase and is marked by the action of P4 on the reproductive tract (absence of uterine edema, pale, dry and tightly closed cervix) and behavior, extinguishing the sexual.

P4 realizes negative feedback on the release of LH, causing the levels of this hormone to remain low during the diestrus.

When there is no gestation subsequent to ovulation, the uterus produces prostaglandin F2α (PGF), a potent luteolytic substance.

The PGF reaches the ovary via systemic circulation and triggers the lysis of CL around the D14 of the estrous cycle.

After luteolysis, P4 levels drop, allowing the onset of a new follicular phase.

When oocyte fertilization occurs in the oviduct ampulla, there is the formation of an embryo that enters the uterine horn, in the initial morula or blastocyst stage, between D5 and D6.

Once in the lumen, the embryonic intrauterine mobility phase is initiated, an essential phenomenon for the maternal recognition of pregnancy to occur.

The equine embryo is coated with a capsule that, in addition to presenting anti-adhesive properties, maintains its turgidity and spherical shape, preventing its early fixation and favoring mobility promoted by uterine contractions.

The presence of the embryo in contact with the endometrium, migrating throughout the uterine lumen, is necessary to block the release of PGF and, consequently, luteolysis.

This blockade needs to be effective for the primary CL to remain functional and to remain secreting P4, the hormone responsible for the maintenance of gestation.

Between days, 15 and 17, mobility is terminated, with embryonic fixation occurring, usually at the bifurcation of one of the uterine horns.

Between days 28 and 35 of gestation, the formation of endometrial cups occurs, consisting of mixed structures of placental origin (related to conception) and maternal (related to the uterus).

The endometrial cups are responsible for the production of equine chorionic gonadotropin (eCG), a hormone present in the blood of mares from 40 days of pregnancy, reaching maximum levels at 80 days and disappearing at 150 days.

The eCG is responsible for the resurgence of primary CL and the development of multiple secondary CLs in the maternal ovaries, which remain functional until 150 days of gestation.These CLs (primary and secondary) are responsible for the transient increase and prolongation of P4 secretion, which is necessary until placental production is sufficient to maintain pregnancy until delivery.

Transitional Periods

The cyclic or fertile season, in which there is follicular development followed by ovulation and formation of functional CL, occurs from mid-spring, extending through the summer.

The anestrous season, or ovarian quiescence, predominates during late fall and all winter.

Between the cyclic and anestrous phases, there are two periods that merit attention, termed spring transition and autumn transition.

The spring transition occurs between the end of the anestrous season and the beginning cyclic season.

The autumn transition occurs at the end of the breeding season and beginning of the anovulatory phase.

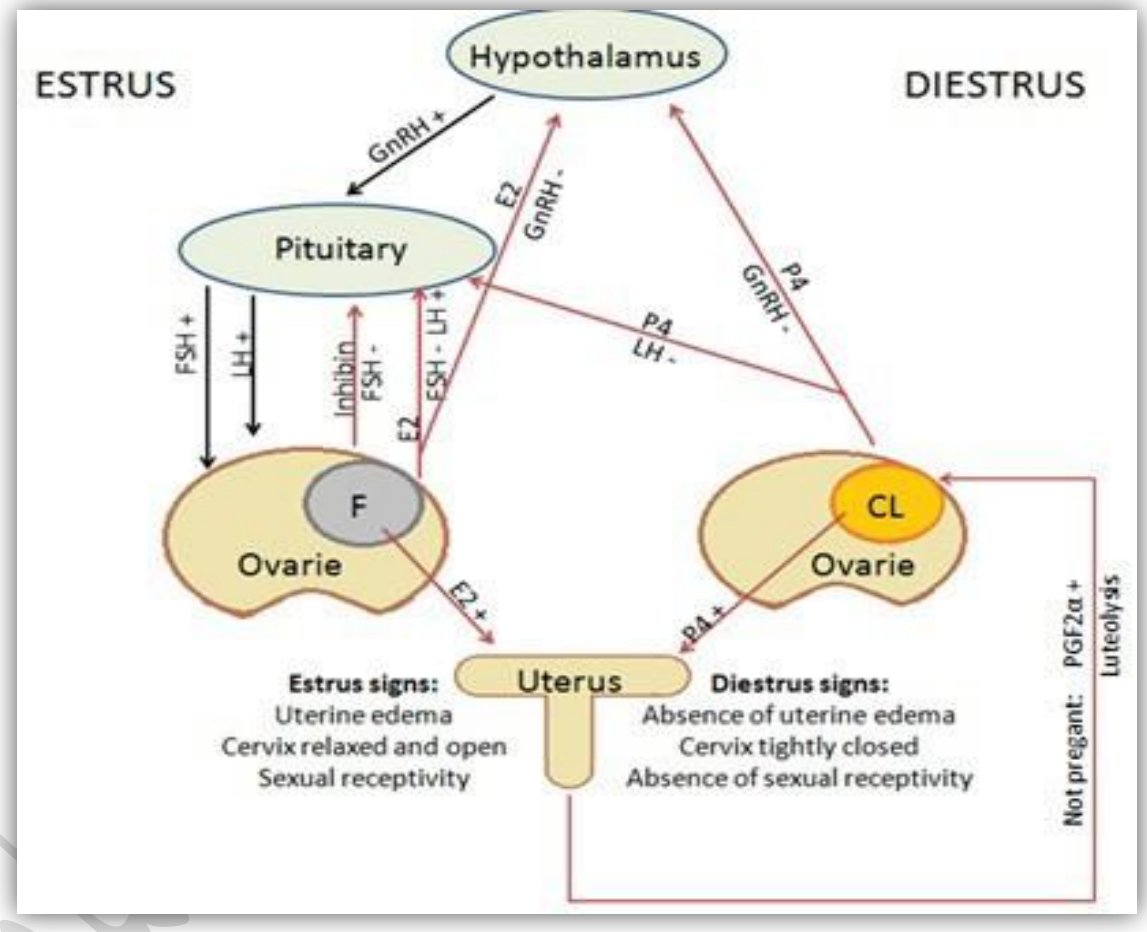

Figure 2 Hypothalamic-pituitary-ovary axis and their interactions with the uterus in the mare

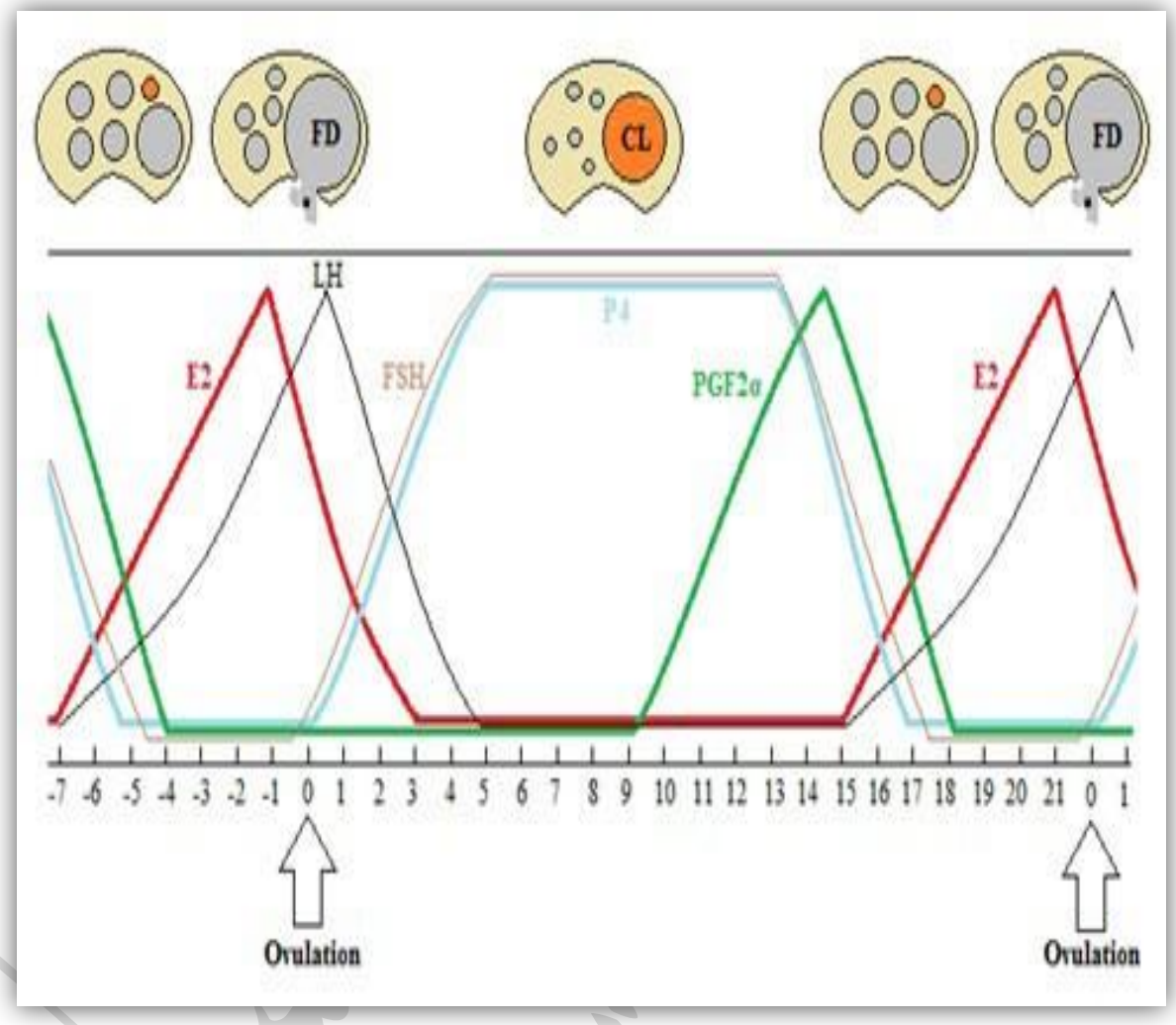

Figure3 Hormonal variations during the estrus cycle of the mare. FSH – follicle stimulating hormone; LH – luteinizing hormone; E2- estradiol; P4 – progesterone; PGF2α – prostaglandin F2α; FD – dominant follicle; CL – corpus luteu