



doi: <https://doi.org/10.20546/ijcrar.2020.811.010>

## Review on Estrous Cycle and Reproductive Problems in Bitch in Ethiopia

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### Abstract

The period in which bitch stays in heat is very short, between ten days and, on occasions, up to three or four weeks. After the heat period bitches secrete the pregnancy hormone progesterone. Measurement of plasma progesterone concentration can be very useful in predicting the fertile period of the bitch. Pheromones are secreted by the bitch under the influence of oestradiol and are detected by the dog's olfactory or vomeronasal organs. The first stage of estrous cycle is controlled by follicle stimulating hormone (FSH) when the ovarian follicles mature in preparation for the release of eggs, the estrogen levels increase and the uterus enlarges. The estrous cycle of the bitch has been shown to be controlled by the same hormonal interactions as those demonstrated in other animals. The most significant influence cycling fluctuations in estrogen and progesterone have on female dog behavior is pregnancy related behaviors. While estrogen increases in the dog's body for a short length of time, progesterone remains in the circulation. Increased plasma progesterone concentration before ovulation in bitches is unusual in comparison with other domestic animals, particularly in ruminants. The development of the ovarian follicle is initiated by the production of gonadotrophin releasing hormone (GnRH) which induces the release of FSH and LH. Mating of disproportional parents, breed peculiarities such as brachiocephalic breeds, litter size are cause of dystocia with subsequent delivery of weak or dead fetus. The most common reason for failure of conception is inappropriate timing of mating. Early embryonic death and abortion account for all conceptus loss between conception and birth. *Brucella canis* is the only bacterial organism proven to cause infertility in the bitch.

### Article Info

Accepted: 08 October 2020

Available Online: 20 November 2020

### Keywords

Bitch, Estrous cycle, Progesterone, Reproductive problems

### Introduction

Estrous is derived from the Latin for gadfly, and literally refers to frenzied behavior, i.e. the transition from the attractive but unreceptive behavioral characteristics of proestrus; to posturally inviting and receptive behavior (lordosis). The estrous cycle is a co-ordinated sequence of ovarian, uterovaginal and behavioral changes which has evolved in mammals to ensure production and fertilization of female gonads and intrauterine

development of the conceptus (Jeffcoate and Lindsay, 2004).

The stages of canine estrous cycle can be defined by sexual behavior, physical signs (vulvar swelling, vaginal bleeding) or by vaginal cytology. The period receptivity to a male varies considerably among bitches; some bitches are receptive before and after the period of potential fertility (Bowen, 1998). In the healthy bitch the

onset of puberty occurs at six to eighteen months of age (Rogers *et al.*, 2000).

Pseudocycsis is considered to be an excessive physiologic syndrome observed in non pregnant bitches at the end of diestrus (Buergelt, 2012).

Prolonged proestrus or estrus occurs when a bitch displays vaginal bleeding (of uterine origin) for more than twenty one to twenty eight consecutive days, accompanied by attractiveness to males. Bitches exhibiting prolonged interestrus intervals may have prolongation of either anestrus or diestrus (Davidson and Feldman, 2005). Pseudocycsis is an exaggeration of the normal physiologic phenomena experienced by any non pregnant bitch completing the luteal portion of an estrus cycle (Allen and England, 2004). During estrus plasma progesterone concentration can be used to determine the optimal time for mating in the dog (Van Klaveren *et al.*, 2001).

Endocrine glands may be injured or destroyed by autoimmune disorders or by neoplasia and theoretically also by infection or hemorrhage, and the resulting hypofunction is said to be primary (Rijnberk *et al.*, 2009). The most frequent causes of hormone excess syndromes are hyper secretion of hormone by a tumor of the endocrine gland (primary hyper secretion) and hyper secretion due to hyper stimulation of the endocrine gland of which there may be several causes (secondary hyper secretion) (Kooistra *et al.*, 2009).

Reproductive problems are common in bitches. *Brucella canis* causes brucellosis in dogs and dogs are the reservoir hosts for this organism (Shaer, 2010). Therefore, the objective of this paper is to make review literature on: Patterns of onset, hormonal regulation, behavioral and physical signs of estrus and patterns of abnormal estrus cycle, the currently employed approaches of estrus detection, the reproductive problems in the bitch and the infectious diseases of reproduction in bitch

## Physiological features of canine estrus

### Patterns of onset

In the healthy bitch the onset of puberty occurs at six to eighteen months of age. Each estrus cycle, which lasts about three months, is followed by an anestrus of variable duration. The mean interval between estrus cycles is about seven months with average of four to

twelve months. The interestrus interval may be regular or variable in individual bitches (Rogers *et al.*, 2000). On average, the estrus (the period of acceptance of the male) has a duration of nine days, with a range of three to twenty one days.

The time of onset of anestrus depends on which criteria are being used to define the end of luteal phase. In any case, transition from the luteal phase into anestrus is gradual and varies considerably among bitches, the transition from anestrus to follicular phase begins at any time throughout the year and there appears to be little, if any, seasonal influence (Ettinger and Feldman, 2005).

The onset of estrus in the bitch occurs at the end of the follicular phase, nearly coincident with the preovulatory surge of LH, at or shortly after the time circulating estrogen reaches maximum levels (Concannon *et al.*, 2000).

### Endocrine control

Measurement of plasma progesterone concentration can be very useful in predicting fertile periods of the bitch. Progesterone concentration should be basal (quite detectable) during the late anestrus and will rise to low but detectable concentrations by late proestrus. LH and oestradiol would be equally or more predictive but sample collection and assay of these hormones is not currently practical. In both pregnant and non pregnant bitches, progesterone is secreted exclusively by the corpora lutea; since there is no placental contribution to circulating progesterone (Jeffcoate and Lindsay, 2004). Luteinization is essential to the success of early gestation. It is the process by which elements of the ovarian follicles, usually including theca interna and granulosa cells are provoked by the ovulatory stimulus to develop into the corpus luteum (Concannon *et al.*, 2000).

Oestradiol promotes various processes in the reproductive tract, stimulating growth and activity of the glandular epithelium and promoting mucosal vascularity and oedema. The surge in plasma LH concentration will, therefore, always occur automatically after a certain level of follicular activity and oestradiol output has been attained and since ovulation follows the LH peak, it is said to be spontaneous. A facilitatory level of FSH is also required to stimulate follicle development and oestradiol secretion, but circulating FSH does not increase as noticeably as LH because the follicles secrete 'inhibin', a selective inhibitor of FSH secretion (Jeff coat and Lindsay, 2004).

## Phases of the cycle

The estrous cycle in the dog has four stages: proestrus, estrus, diestrus and anestrus. During the proestrus, the hypophysis (pituitary gland) causes the growing ovarian follicles to secrete hormones known as estrogens that are responsible for behavioral modifications and physical changes in the bitches. However, the bitch will not yet allow mating to take place (Anderson and Wroten, 2004). During estrus, the vaginal discharge becomes clear and changes into mucus, which facilitates mating. During this phase, the still immature ova are released during oocyte phase. They usually do not become fertile for another 48 hours. Unlike those of many species the ovaries of a bitch begin secreting progesterone several days before ovulation. Progesterone levels in blood thus increase gradually, whether or not the ova are fertilized. Thus in dogs, progesterone levels are an indicator of ovulation but not pregnancy (Colby, 1986). As diestrus starts, the fertile portion of the canine estrous cycle comes to an end and the female dog is less receptive towards the male dogs. During this time, most of the swelling disappears but the vulva still remains slightly enlarged. Anestrus is the resting period that lasts for 5-6 months in which the female dog undergoes no hormonal changes and prepares herself for the next heat cycle (Olson *et al.*, 2000).

## Behavioral and physical signs of estrus

The stages of canine estrous cycle can be defined by sexual behavior, physical signs (vulvar swelling, vaginal bleeding) or by vaginal cytology. The period of receptivity to a male varies considerably among bitches; some bitches are receptive well before and after the period of potential fertility (Bowen, 1998). During this time, the dog has small amounts of bloody discharges around her vagina, as well as swollen vulvar lips. A female dog in heat often shows signs of restlessness and anxiety. Another behavior a dog in heat might show is frequent urination. The increased urination is the dog's way of marking her territory with her scent so male dogs can find her (Vet Info, 2012).

There are four stages in the canine heat cycle or estrus in dogs based on the dog's behavioral and physical signs:

Proestrus is the time when a bitch's reproductive tract is preparing for the possibility of breeding with a male dog. Females usually have a blood tinged vagina discharge and a swollen firm vulva. Also the bitch will usually have an increase in the need for urination and her coat

can become soft with the increase hormones. Her temperaments can also change, becoming scatty and resistance to human direction.

Estrus is the actual fertile phase and is when the female dog will accept the male and stand for breeding. The vaginal discharge decreases and has usually gone from bright red to pink almost clear (some dogs will continue to have a bloody discharge throughout) and the vulva, although still swollen, is softer. The bitches display the behavior called 'flagging' where she holds her tail off to the side when any male approaches.

Diestrus starts when the female will no longer allow breeding. She will either snap at the males or lay down when they try to mount her. It ends when the ovaries stop producing the hormone progesterone and is the period when progesterone dominates the hormone scene. Progesterone may cause many false signs of pregnancy like nesting behavior and milk production even if the dog is not pregnant.

Anestrus is the period between heat cycles when the uterus becomes smaller and inactive. During this time the sex hormones are at very low levels, although they do continue to have small rises and declines throughout this stage (Watford GSD Help & Information, n.d.).

A summary of observations through the canine estrous cycle are given in table 1.

## Patterns of abnormal estrous cycles

### Silent estrus

Some bitches have normal cyclical activity, including follicular growth and ovulation, without any external proestrus or estrus. Certain breeds for example the greyhound may have only slight serosanguineous discharge and minimal vulval swelling during oestrus. Ovulation may be confirmed by examination of plasma progesterone concentration (England, 2004).

### Split estrus

This occurs most frequently at the first estrus, but can occur at any stage in the reproductive life of the bitch. An initial phase of follicular growth and oestrogen secretion occurs, resulting in the clinical signs of proestrus. However, ovulation does not follow; follicles regress and the signs of proestrus disappear. Subsequently a second follicular phase appears (two to

twelve weeks later) and the bitch develops proestrous, estrous and then ovulates normally. This syndrome is confusing since it may be thought that the bitch has failed to ovulate or that fertilization with subsequent fetal resorption or absorption has occurred (England, 2004).

### **Prolonged proestrous or estrous**

Prolonged proestrous or estrous occurs when a bitch displays vaginal bleeding (of uterine origin) for more than 21-28 consecutive days accompanied by attractiveness to males. Prolonged proestrous or estrous most likely results from persistent secretion of estrogens with or without small elevations in progesterone secretion. If secreted, progesterone enhances the presence of sexual receptivity (Davidson and Feldman, 2005). The normal interval to ovulation from the onset of vulval bleeding is between 6 and 20 days (England *et al.*, 2004).

### **Prolonged interestrous intervals**

Bitches exhibiting prolonged interestrous intervals may have prolongation of either anestrus or diestrus. Prolonged anestrus occurs when no ovarian activity occurs for longer than 16-20 months in a bitch having previously experienced estrus cycles (secondary anoestrus). A bitch examined for evaluation of prolonged intervals between heat cycles may be under the influence of increased plasma progesterone concentration (>2-5ng/ml) (Davidson, and Feldman, 2005)

### **Hypoluteoidism**

Hypoluteoidism, primary luteal failure occurring before term gestation is a potential but not documented cause of abortion in dogs. Plasma progesterone concentrations diminish in response to fetal death, thus documentation of a low value after an abortion does not establish the diagnosis of Hypoluteoidism as the cause of reproductive failure. It is also decline of serum progesterone levels to less than five ng/ml due to insufficient production and secretion by corpora lutea can cause pregnancy loss due to placental insufficiency in bitches (Buergelt, 2012).

### **Exaggerated pseudocyesis (pseudo pregnancy)**

Pseudocyesis is an exaggeration of the normal physiologic phenomena experienced by any non pregnant bitch completing the luteal portion of an estrous cycle. Symptoms exhibited during overt pseudocyesis include weight gain, mammary gland hyperplasia and

lactation, mucoid vaginal discharge, in appetite, restlessness, nesting and mothering of inanimate objects. This signs are the result of progesterone concentrations declining and prolactin increasing. The mechanism of development of clinical false pregnancy was thought previously to have been due either to an overproduction of progesterone or abnormal persistence of the corpora lutea (Mallo, 2000). False pregnancy can be initiated by removal of corpora lutea (ovariohysterectomy) during the luteal phase. Progesterone, androgens, estrogens and combinations of these may be used for treatment (Allen and England, 2004).

### **Methods of estrous detection in bitch**

#### **Visual observation of behavioral and physical signs estrous**

To optimize visual observation of heat detection a number of signs of heat both primary and secondary must be clearly understood. The primary sign of heat, standing to be mounted by the dog is the most definite and accurate sign that a bitch is in heat. The secondary signs of heat include the vulva becoming progressively enlarged throughout proestrus, and frequently becoming distinctly softened and less swollen following surge in plasma luteinizing hormone, restlessness and anxiety (Rogers *et al.*, 2000).

#### **Measurement of the electric resistance of the vaginal mucus**

Heat detection is critical importance for the maintenance of fertility on reproduction and thus it has reduced the opportunity for observing animals for the signs of heat. A probe containing two electrodes and an ohmmeter to measure resistance of electric current can be used. Very high ohm values were observed in the bitch during estrus, probably because of the mixture of blood in the mucus. The intravaginal measurement of resistance of vaginal or cervical secretions seems to be as useful method for objectively determining estrus. The determination of the optimal time for conception in individual animals still remains difficult due to the need for repeated measurements with the presently available instrument (Leide and Storla, 2006).

#### **Vaginal cytology**

Vaginal cytology relies on the principle that cells of the vaginal mucosa change in shape, size and staining

characteristics in relation to the endocrine environment (England, 2004).

Increasing plasma oestradiol concentration during proestrus stimulates cell division in the basal layers of the vagina epithelium, but then as plasma oestradiol concentration falls, endocrine support of this new highly stratified epithelium diminishes and there is a marked increase in number of dead cornified cells, some of which are easily sloughed off. Cells can be obtained using a cotton bud inserted into the vagina, preferably using a small speculum to scrape the mucosa gently; or by flushing with saline. Towards the end of oestrus, the vaginal smear reveals characteristic changes which include the return of nucleated epithelial cells and the appearance of large number of cells (Jeffcoate and Lindsay, 2004). Neutrophils in low numbers are seen normally in vaginal cytology at any time except during the peak of the estrogenic phase of the cycle (middle to late proestrus and all of the estrous). Large number of neutrophils are seen in the early diestrus; this influx of neutrophils is not associated with any disease process and is considered normal phenomena (Ettinger and Feldman, 2005).

### **Determination of hormones in blood**

Measurements of plasma progesterone concentration can be very useful in predicting the fertile period of the bitch. Progesterone concentration should be basal during late anestrus and will rise to low but detectable concentrations by late proestrus. Progesterone is the only hormone currently of value in predicting the fertile period. LH and oestradiol would be equally or more predictive but sample collection and assay of these hormones is not currently practical (Jeffcoate and Lindsay, 2004). During estrous the plasma progesterone concentration can be used to determine the optimal time for mating in the dog (Van Klaveren, *et al.*, 2001). The fluctuations of hormones during a physiological estrous cycle in bitches is shown in figure 1.

### **Reproductive problems in bitch**

#### **Abnormal endocrinological events**

##### **Delayed puberty**

Bitches that do not demonstrate estrous behavior at anticipated age are considered to have delayed puberty. However, investigation of such cases should not

commence until the bitch has reached twenty four months of age, and has been carefully observed for signs of estrous and if possible has been housed with another bitch in estrous (Johnston, 2004).

The investigation of delayed puberty involves collection of information on housing and diet since poor environmental conditions and nutrition may be associated with failure to cycle (Christiansen, 1984). Plasma progesterone concentration should be measured to ensure the bitch has not recently ovulated at an unobserved estrous. There has been in the relationship between thyroid hormone insufficiency and abnormalities of estrous cycle (Manning, 2004). Hypothyroidism has been associated with prolonged anoestrus and infertility.

Low concentration of plasma thyroid hormones and failure to respond to a stimulation test may be used to confirm the condition, although clinically these animals usually have classical clinical signs associated with hypothyroidism.

##### **Acromegaly**

Acromegaly is a syndrome that results when the anterior pituitary gland produces excess growth hormone (GH) after epiphyseal plate closure at puberty.

Chronic hypersecretion of growth hormone in the adult results in acromegaly, an insidious condition associated with connective tissue and bone overgrowth. In the dog, acromegaly is caused by progestogen therapy or by endogenous progesterone produced during the metoestrous phase of the estrous cycle. The progesterone induced growth hormone excess originates from hyperplastic ductular epithelium in the mammary gland and not from the pituitary. Clinical signs of acromegaly develop slowly in middle aged to older intact bitches, which are either cycling normally or being given regular treatment with progestogens to prevent estrous (Selman *et al.*, 2004).

##### **Resistance to hormone action**

Hormone resistance is defined as a defect in the capacity of normal target tissues to respond to the hormone. It may be an inherited disorder involving one or more molecular abnormalities, including defects in receptors and in post receptor mechanisms. A common feature of hormone resistance is an elevated concentration of the

hormone in the circulation in the presence of diminished or absent hormone action (Kooistra *et al.*, 2009).

**Diseases of the ovary**

**Ovarian cysts**

Cysts that exist on or around the ovary can be normal (vesicular follicles & cavitated corpora lutea) or abnormal. Abnormal cysts are functional or non functional (inclusion cysts, embryonic remnants, and rete ovarii cysts). Follicular and luteal cysts have also been identified (Dow, 2000). Estrogen secreting follicular cysts may produce persistent estrous (Burke, 2000). Functional ovarian cysts are the only disease entity. They may be follicular or luteinized and may produce sex steroids. In bitches, functional cysts can be induced with exogenous equine chorionic gonadotrophin (eCG) intended for estrus induction.

**Intersexuality**

An intersex animal is one possessing the characteristics of both sexes. They are classified as either true hermaphrodites or pseudo hermaphrodites and as either male or female on the basis of their gonads (Howard and Bjorling, 1989).

Intersexuality is usually recognized because of abnormal phenotypic sex appearance. Intersex animals may be

classified into those with abnormalities of chromosomal, gonadal or phenotypic sex. Generally these animals are phenotypic females or males with underdeveloped genitalia. In the dog, abnormalities in chromosomal number (XXY, XXX, XO), chimeras and mosaics have been reported (Meyers-Wallen and Patterson, 1986).

**Ovarian tumors**

These are not common in the bitch, accounting for approximately 1% of all neoplasm's (Cotchin, 2000; Hayers and Harvey, 2004); the mean age of occurrence is 8 years (Withrow and Susaneck, 1986). Tumors may be germ cell, epithelial or sex-cord stromal in origin. Ovarian tumors do not commonly metastasize and are frequently endocrinologically inactive.

**Diseases of uterus**

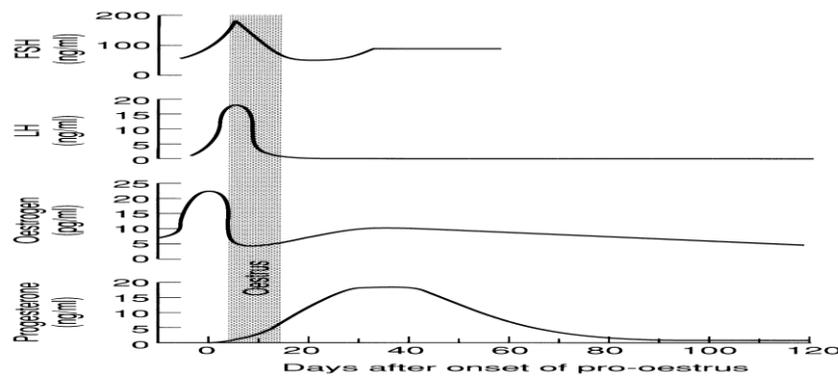
**Cystic endometrial hyperplasia (CEH) or pyometra**

During metoestrous (diestrous) plasma progesterone concentrations are high promoting endometrial growth and glandular secretion; changes which regress at the end of the luteal phase. However, with continuing cycles, the endometrium becomes thickened due to an increase in size and number of endometrial glands, this is referred to as CEH.

**Table.1** Physical signs and vaginal cytology during the estrous cycle of the bitch

<b>Phase</b>	<b>Proestrous</b> (mean 9days; range 2-15days)	<b>Estrous</b> (mean 10days; range 3-12days)	<b>Diestrous</b> (mean 65days; range 55-90days)	<b>Anestrous</b> (mean 120days; range 40-70days)
Physical signs	Enlargement of the vulva and bloody discharge; male is attracted to the bitch in late proestrous but is not accepted for mating.	Vulva is enlarged and swollen; reduced vaginal discharge; male is accepted for mating.	Refusal to mate; pregnancy or pseudo pregnancy	Sexual quiescence
Vaginal cytology	Number of cornified cells increases; Numerous RBC but few leukocytes.	Mostly cornified cells.	Abrupt change from superficial to basal cells; number of leukocytes increases.	Foam cells; number of leukocytes is variable.

Source: Mc Donald (2003)

**Fig.1** Trends in hormone concentration in the peripheral circulation of the bitch during estrous cycle

Source: Noakes (2003)

The endometrial gland secretion may lead to the accumulation of fluid within the uterine lumen; termed mucometra or hydrometra (Nelson and Feldman, 1986; Farstad W, 2004). Bacterial contamination may occur during estrous, when cervix is relaxed, involved in the development of pyometra during luteal phase. The bacteria commonly isolated in cases of pyometra are commensal species normally isolated from the anus or urinary tract (Sandholm *et al.*, 2004).

The clinical signs may include vaginal discharge, lethargy, in appetite, polydipsia and polyuria, vomiting, nocturia, diarrhea and abdominal enlargement. In approximately one third of cases there is no vaginal discharge and fluid is retained within the uterus (Renton and Aughey, 2000). The development of pyometra requires predisposing factors and has two requirements; a progesterone dominated uterus, and bacteria that include *Escherichia coli*, *Staphylococcus spp.*, *streptococcus spp.*, *Haemophilus spp.*, *Serratia spp.*, *Proteus spp.* and *Pasteurella species*.

### Uterine tumours

Uterine tumours are uncommon (Brodey and Roszel, 2000) although leiomyomata are seen most frequently in older bitches. This tumours are rarely associated with clinical signs and are frequently incidental findings at post mortem.

### Disease of the vagina and vestibule

#### Vaginal hypoplasia or aplasia

Segmental aplasia of the mullerian duct system may be partial and produce vaginal hypoplasia, or be complete and result in vaginal aplasia. The later will result

infertility (Wadsworth *et al.*, 2000; Hawe and Loeb, 2004), and cause the retention of uterine fluid with similar signs of pyometra.

#### Hymenal or vestibular constrictions

Strictures of the lower reproductive tract are common in bitches (Wykes and Soderberg, 2000). Vestibulovaginal strictures may be associated with signs of vulval pruritus (Holt and Syle, 2000) or chronic vaginitis (Soderberg, 2000) although they are often only noted during attempted mating.

#### Prepubertal vaginitis

A purulent vaginal discharge is sometimes seen in bitches from two months of age. Clinical signs include frequent licking, perivulval dermatitis and attractiveness to male dogs. Clinical signs usually regress after the first estrous (Burke, 2004).

#### Vaginitis

This is an inflammation of vagina and occurs in intact or desexed bitches of any age and breed. Many bacterial species are present in the vagina of clinically normal bitches (Allen and Dagnall, 2000; Baba *et al.*, 2004). The aerobic comensals commonly isolated include *E.coli*, *Staphylococci* and *Streptococci* (Olson *et al.*, 2000; Allen and Dagnall, 2000), the majority of which probably originate from the skin and the digestive tracts. The bacteria commonly isolated from bitches with vaginitis are also commensals (Hirsh and Wiger, 2000; Van Duijkeren, 2004) bitches with vaginal discharge do not necessarily have vaginitis; the differential diagnosis for vaginitis includes: proestrous and estrous, cystitis, pyometra, metritis, parturition and juvenile vaginitis.

Neutrophils are frequently present within the discharge of bitches with vaginitis.

### **Disease of pregnancy**

#### **Conception or implantation failure**

The most common reason for failure of conception is inappropriate timing of mating. The fertile period of the bitch is between days four and eight after the surge of plasma LH, since ovulation occurs between 24 and 44 hours after the LH peak (Smith and Mc Donald, 2000; Concannon *et al.*, 2000; Wildt *et al.*, 2004) and ova are released as primary oocytes and do not mature until 2-3 days later (Anderson and Simpson, 2000; Phemister *et al.*, 2000). Problems may occur because the behavioral signs of estrous do not always correlate with the changes in peripheral plasma hormones (Mellin *et al.*, 2004) and frequently dog breeders insist on mating a set number of days from the onset of proestrus, even though the interval between this event and the LH surge is very variable (England, 2004).

#### **Abortion or resorption**

The incidence of foetal death followed by resorption is not known (Freak, 2004), although (Anderson and Simpson, 2000) suggested that the frequency resorption was 11% when number of fetuses and corpora lutea are compared. Fetal abortion and resorption may have many causes including fetal defects abnormal maternal environment, infectious agent's trauma (Feldman and Nelson, 2000).

#### **Pregnancy Hypoglycemia**

A reduction in blood glucose concentration associated with ketosis has been reported during pregnancy in the bitch (Jackson *et al.*, 2000; Hotson-Moore and Wotton, 2004); bitches are weak and may become comatose. Diagnosis is based on measurement of plasma progesterone concentration, the rapid recovery following intravenous glucose administration.

#### **Dystocia**

This is a term used to describe a difficult or abnormal birth. This encompasses any problem in the birthing process ranging from severe (uterine torsion) to mild (prolonged labor). An increased incidence of dystocia is reported in certain dog breeds, including the Bull Dog,

Chihuahua, Dachshund, Miniature Poodle, Pekingese, Pomeranian, and Yorkshire Terrier (Bennet, 2003).

Maternal factors which can cause dystocia are small pelvic size, small birth canal or uterine inertia. This can happen before any puppies are born (primary inertia) or after several puppies have been born (secondary inertia). There are certain predisposing factors that can increase the bitch's risk of developing dystocia include age, weight, previous complication, first litter and small litters. Older dogs are at greater risk of developing dystocia than younger dogs and heavy dogs are at a greater risk than dogs at healthy weight (Bennet, 2003).

Fetal factors which can cause dystocia are increased fetus size or wrongly positioned fetus. Fetal over size may be of the entire body, as with a singleton fetus, fetal monster, or anasarca fetus. Relative over size of the fetal head occurs with hydrocephalus (Bennet, 2003).

Dystocia should be considered if the following clinical signs are observed: birth does not occur within twenty four hours, body temperature below 37.7 °C, strong contractions for one to two hours with no puppies passed, resting period during the active labor of greater than four to six hours, if the bitch is in obvious pain, abnormal vaginal discharge and pregnancy lasting longer than seventy days from the first breeding (Ettinger and Feldman, 2005).

#### **Hypocalcaemia**

Eclampsia or puerperal tetany occurs most commonly during late pregnancy or early lactation in small to medium sized bitches (Austad and Bjerkas, 2004). The aetiology of hypocalcaemia is probably related to calcium loss in the milk combined with poor dietary availability. Hypocalcaemia causes loss of cell membrane bound calcium and subsequent change in the membrane potential.

#### **Infectious diseases of reproduction in the bitch**

##### **Canine brucellosis**

*Brucella canis* causes brucellosis in dogs and dogs are the reservoir hosts for this organism. It is responsible for failure of conception, early embryonic death, fetal death and abortion, and the birth of infected weak puppies (Schaer, 2010). It is the only bacterial organism proven to cause infertility in the bitch. The host range is limited compared with other aspects of *Brucella*. Only domestic

and wild canidae are susceptible; other domestic animals are experimentally resistant (Morresey, 2003).

*B. canis* is zoonotic and acquired by coitus, oronasal interactions, and by ingestion of infected material. *B. canis* is harbored in the lymph nodes, bone marrow, and reproductive tract and affected dogs may be asymptomatic shedders for a prolonged period (Schaer, 2010).

After the organisms gain entrance into the animal, they are phagocytized by macrophages and taken to lymph nodes and the spleen. Abortion occurs between thirty and fifty seven days of pregnancy. Aborted puppies appear autolysed but may show lesions of septicemia such as serosal petechiations (Wanke, 2004).

The highest concentration of *B.canis* organisms is found in the vaginal discharge, making this the most likely source of infection after aborted material (Carmichael and Greene, 2003).

Systemic diseases may be absent in the adult or may include lymphadenopathy (often a febrile), hepatomegally and meningitis in the adult. Reproductive syndromes include abortion at 45-55 days of pregnancy, still births, weak born pups, infertility (Schaer, 2010).

### Canine herpesvirus

A species specific microorganism, canine Herpesvirus (CHV) usually causes death of neonates, but it has been implicated in fetal death and abortion (Schaer, 2010). Both humoral ( $\beta$ -cell) and cell mediated (T-cell) response occur, the latter being essential for canine herpes virus (Morresey, 2003). Canine herpesvirus host range is restricted to domestic and wild canidae (Carmichael and Greene, 2003).

At the gross level, renal cortical hemorrhages and ecchymoses are prominent in aborted, still born, or perinatal pups (turkey-egg kidney). Microscopic examination of the tissue reveals foci of necrosis with intranuclear inclusion bodies in the liver, spleen, adrenal gland, kidney and lung (Ronssev *et al.*, 2005).

CHV is a double stranded DNA virus which may be transmitted in utero or venereally, but more commonly by oronasal or aerosol routes. The organism is shed in semen and vaginal secretions; however, most infections are acquired by pups during birth or soon thereafter.

Immuno suppressed animals are particularly susceptible to infection (Schaer, 2010).

Acute hemorrhagic neonatal viremia with high mortality is the typical syndrome. Mucosal diseases occur in adults including conjunctivitis and oronasal infection.

Genital infection in older bitches is characterized by diffuse, multifocal, raised vesicular lesions on the vaginal mucosa (Schaer, 2010). Diagnosis of herpesvirus infection is made via virus isolation, molecular biology tests, or serology (Ronssev *et al.*, 2005).

In conclusion and recommendations the sexual receptivity in bitch is mainly behavioral phenomena regulated by an endocrine mechanism involving the ovarian hormone estrogen. Most mammals ovulate when the estrogen level in the blood is increasing. Dogs, however, ovulate when the estrogen level is declining and progesterone level increasing. Progesterone cannot be used to diagnose pregnancy in bitches, unlike in other animals. The intensity of estrous as well as the other aspects of estrous in bitches is variously influenced by patterns of abnormal estrous cycles. The most practical and commonly used approach of estrous detection so far is visual observation for behavioral as well as physical signs of estrous. However, this approach of detecting bitch in heat is labor intensive and time consuming process.

Reproductive activity in the bitch differs from the polycyclic patterns of other species in that there are no frequent, recurring periods of heat. All bitches have a prolonged period of anoestrus or sexual quiescence between successive heats irrespective of whether they have been pregnant or not; this pattern has been described as monocyclic. With the physiology of the bitch estrus cycle now much more clearly elucidated, the outlook for methods to induce fertile estrus and shorten metoestrus looks good, and many potential drugs and treatment protocols are already in various stages of development.

Endocrine glands are affected by abnormalities not impaired function. These include tumors, cysts, and infiltrative diseases not leading to significant impairment of hormone secretion. In line with these constraints, the efficient use of this approach particularly under large number of dog population is very difficult. It's well recognized that disease of reproduction in bitch is one of the major factors influencing reproductive performance in dogs.

In line with these conclusions the following recommendations are forwarded:-

- Attempts should be made to create an understanding about the impacts of infectious disease in reproduction and its zoonotic importance, Owners should keep clear records to the bitches previous pregnancies, breeding dates and overall health to ensure that the veterinarian as much information as possible when determining treatment and the owner should be asked to look for behavioral changes consistent with estrous.
- Authors 'contributions this work was carried out in collaboration between all authors. Author DD designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author MT managed the literature searches, analyses of the study and performed the data analysis. Author BL managed identified the species. All authors read and approved the final manuscript.

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**How to cite this article:**

Dereje Darza and Birhanu Lencha. 2020. Review on Estrous Cycle and Reproductive Problems in Bitch in Ethiopia. *Int.J.Curr.Res.Aca.Rev.* 8(11), 85-96. doi: <https://doi.org/10.20546/ijcrar.2020.811.010>