Pictorial guide to Veterinary Obstetrics and Gynaecology

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Dear Students/Users

The present compilation is an attempt to bring forth the basic points of Veterinary Gynecology and Obstetrics course for students so as to recollect all what they read from standard texts. All the photographs included in this presentation have been not my own and have been used from different sources only for demonstration. Many of the photographs might be copyrighted hence cannot be replicated in any form. The presentation is only for teaching purpose and not commercial sale. The inclusion of some commercial products is purely for teaching demonstration and does not endorse these products or criticizes others. Suggestions to improve this presentation or include others are welcome.
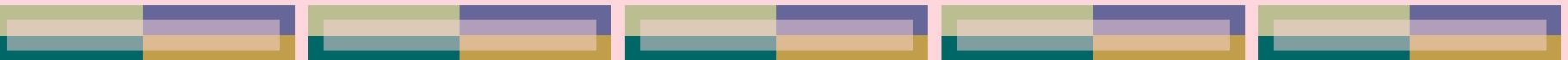
Thanks

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🔵 Disclaimer

This lecture note series is for understanding of students the subject of Veterinary Gynecology and Obstetrics and not for sale or propagation. Inclusion of pictures is for pure academic reasons and not for any commercial gains.

- Some terms

- **Obsterics**: Branch of medicine dealing with the care of the female during pregnancy, at parturition and during post-partum period also known as midwifery.
- **Gynaecology**: Branch of medicine dealing with the physiopathology of the female
- **Theriogenology**: Branch of medicine dealing with all aspects of reproduction including gynaecology, obstetrics artificial insemination.
- **Estrus**: period of sexual receptivity of the female animal towards a male.
- **Gestation:** The period of intra uterine development in mammals or the period from conception till parturition in mammals is known as gestation.

- **Embryo:** from fertilization to the differentiation stage (45 days in cattle)
- Fetus: from differentiation till parturition
- **Conceptus**: Fetus with its fetal membranes.
- **Nullipara**: An animal which has not become pregnant and parturated.
- **Primipara:** An animal which has become pregnant and would parturate for the first time
- **Monotocous**(Uniparous): Animals giving birth to single young ones
- **Polytocous** : Animals giving birth to many young ones
- **Embryology: Science of physiological development of the fetus**
- Teratology: Embryology + pathology dealing with abnormal fetal development
-

Bandl's rings: prolonged dystocia results into uterine fatigue and formation of retraction rings called Bandl's rings

Barking foals: respiratory distress and convulsion syndrome in new born foals.

Urachus: Vestige of yolke sac seen on histology.

Whartons jelly: semisolid jelly surrounding the urachus and also present in amniotic membrane

Whipples operation: submucus resection of vagina in bitches to remove parts of prolapsed vagina

Reefing operation (Farquharsons technique): sub mucus resection of vagina in prolapse of vagina in a cow for repair.

Gonadocrinin: GnRH like substances in the gonads of some species.

Puberty: age of sexual maturity

Sterility: Complete loss of fertility

C-reactive proteins: Proteins that increase during mid-gestation in the bitch in response to tissue damage due to implantation

Carazol: a beta-blocker given to sows to reduce the expulsive time of labor in sows.

Clenbuterol: A beta-adrenergic that quietens the uterus and inhibits labor.

Psuedopregnancy: False pregnancy occurs in the bitch and the goat and in many other species like mare.

Luteolysis: Process of regression of a corpus luteum.

Gonadostat theory: Lowering of the pituitary threshold for positive feedback by estrogen at puberty results in extrus expression in ewes. Before puberty although pituitary and gonads are working but there is a high threshold for estradiol positive feedback and hence estrus is not expressed. This is called the gonadostat theory.
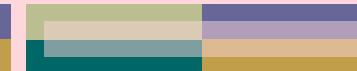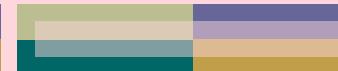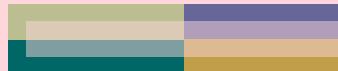
Androgen: Male sex hormone secreted by the Leydig cells of the testis.

Anestrus: Absence of estrus

Estrus: Period of sexual receptivity of a female animal towards a male

Nymphomania Increased sexual desire in a female animal

Phytoestrogens: Plants that contain compounds with estrogenic activity

Sex steroids: Steroids dervied from the gonads estrogen, progesterone and testosterone

Tenesmus: Excessive rectal straining efforts by an animal

Lochia: The uterine discharges from a parturated animal during involution period

Uteroverdin: A bile like pigment present in the zonary placenta of dogs.

Metestrus bleeding: post estrus bleeding in crossbred cows that occurs due to withdrawl of estrogen hormone

Feathering: Tapping of the vagina of a whelping bitch with finger leads to oxytocin release and delivery of a pup.

Single pup syndrome: The presence of a single pup in a bitch leading to problem in initiation of parturition and dvelopment of an extra large puppy.

Spalding sign: Overlapping of the fetal skull bones seen on radiography of a bitch with dead fetuses.

Fergusons reflex: The release of huge quantities of oxytocin in cows when the fetal legs touches thee pelvis during parturition.

Theilers disease: Infectious hepatitis in mare developing due to injection of an eCG.

REPRODUCTIVE ANATOMY

The reproductive organs of a female animal comprise of the tubular genitalia (consisting of the vulva, vagina, cervix, uterus and the fallopian tubes) and the generative organs the ovaries. Subtle differences does exist in the structure of genital organs, their loaction and size in different farm animals
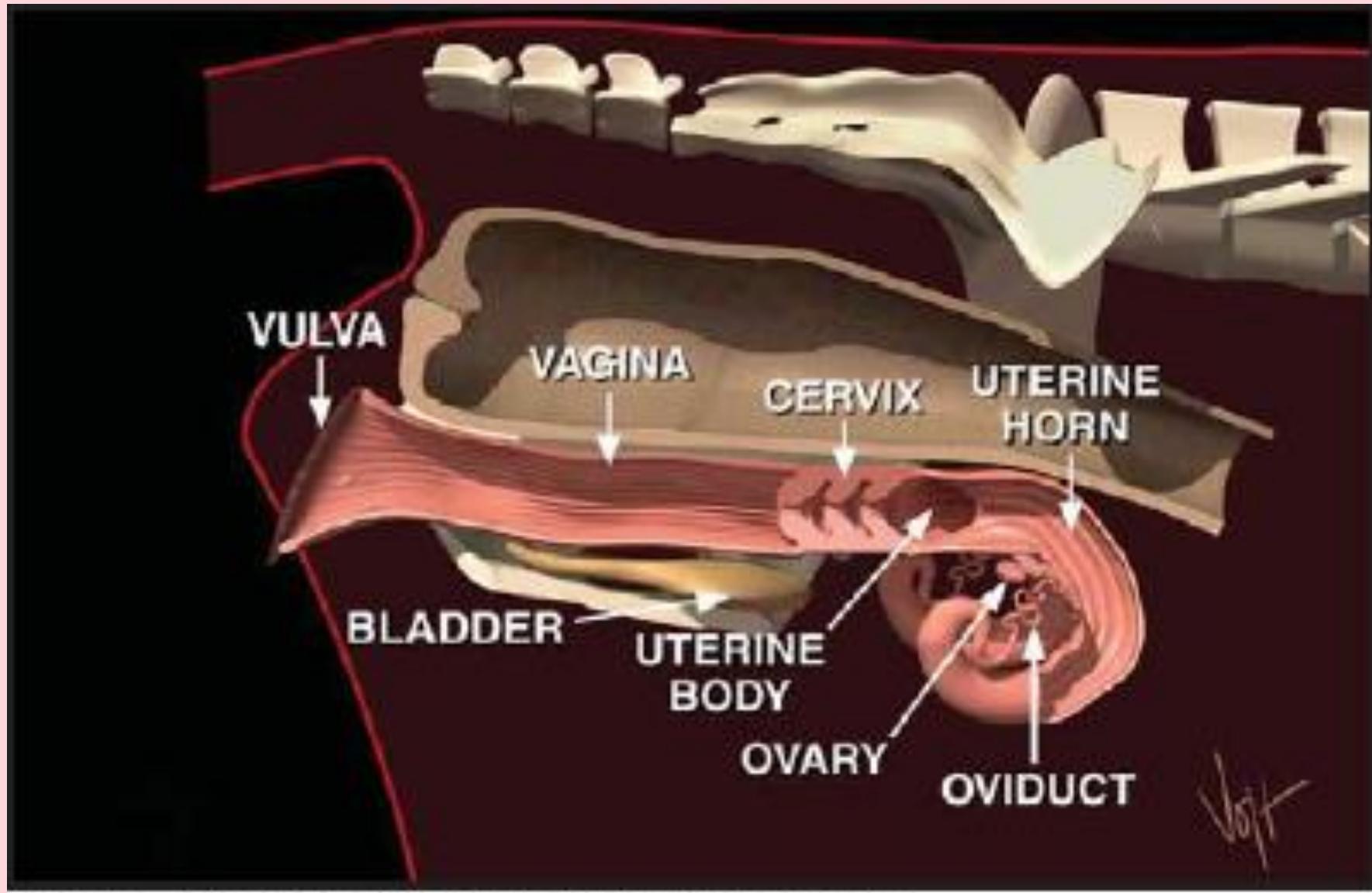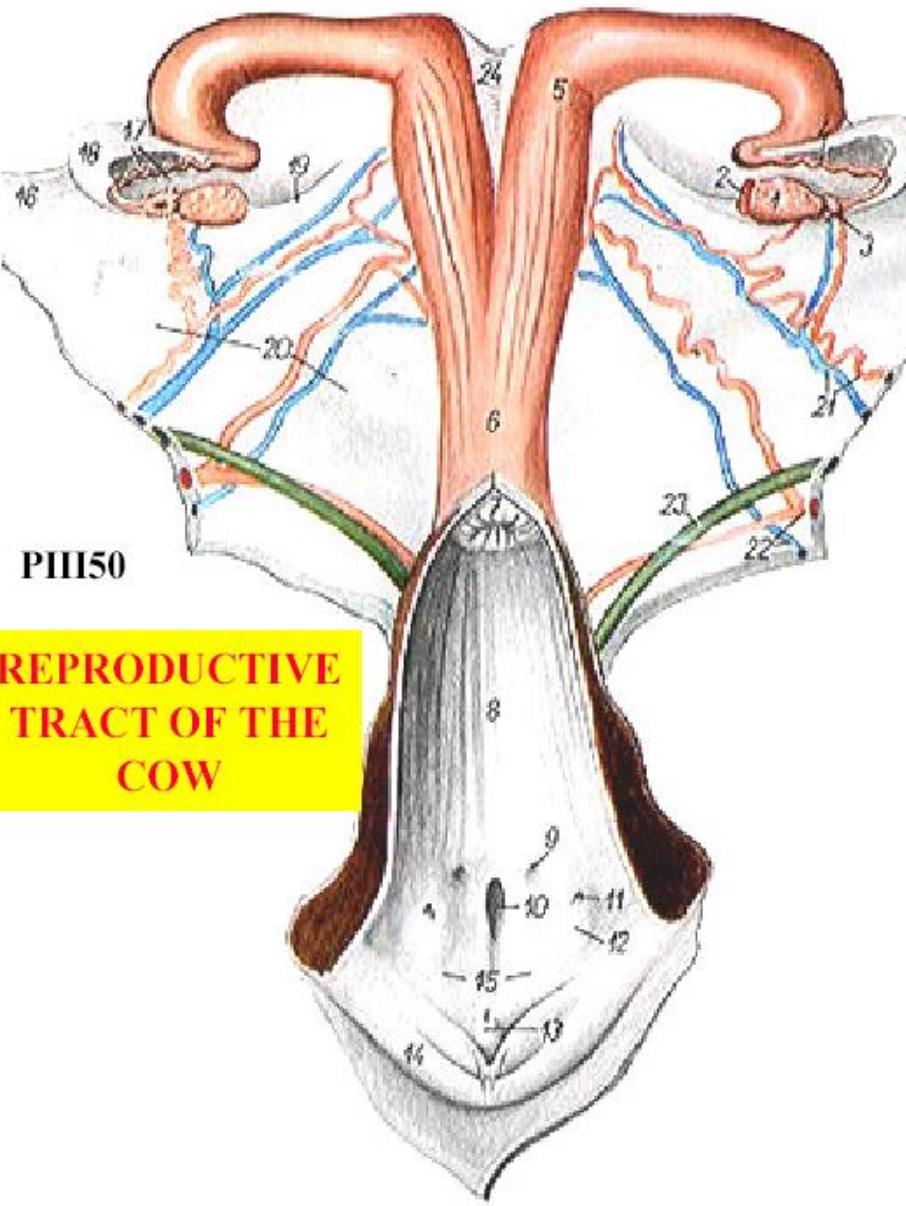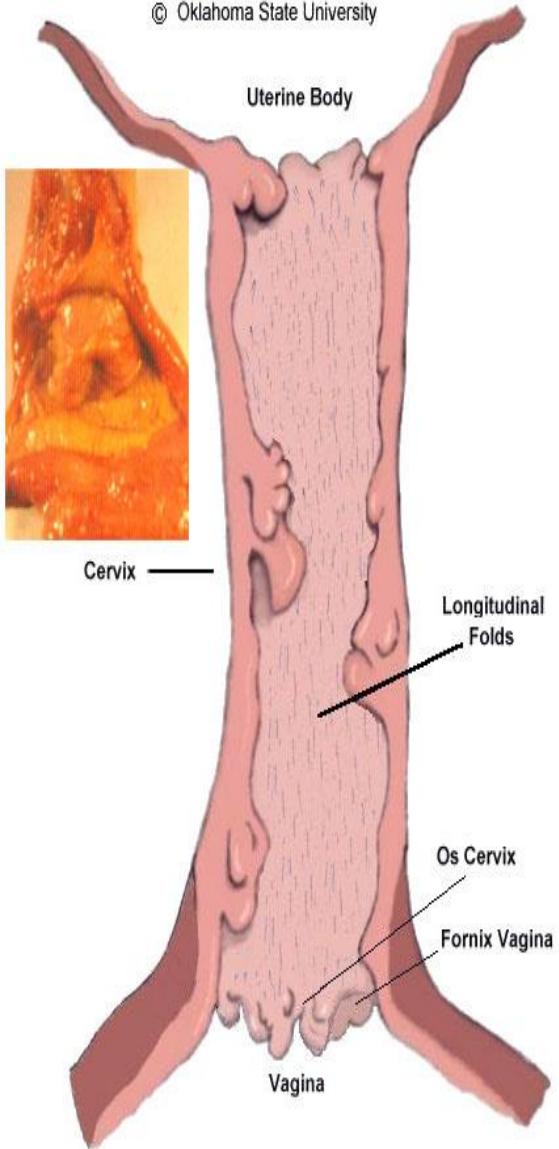
Figure 1. Side view of the cow's reproductive system.
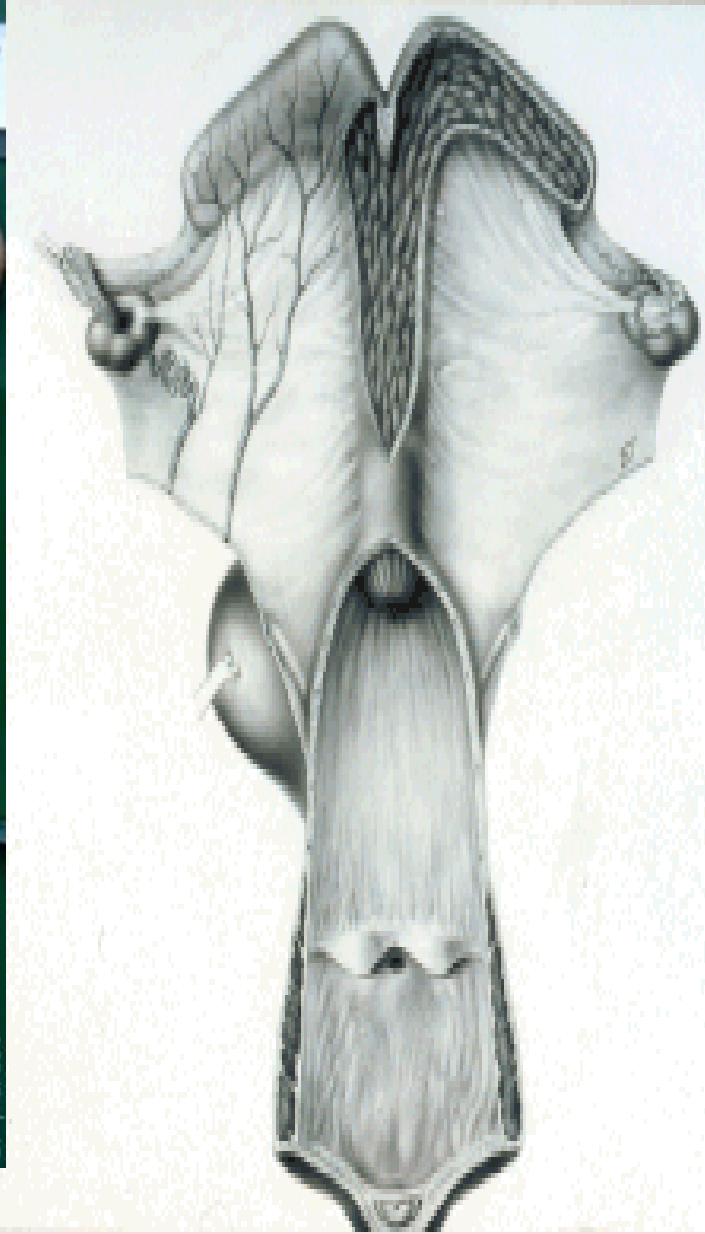
REPRODUCTIVE TRACT OF THE COW

- 1: Ovary
- 2: Corpus Luteum
- 3: Infundibulum
- 4: Uterine Tube
- 5: Horn of Uterus
- 6: Body of Uterus
- 7: Vaginal Portion of Cervix
- 8: Vagina
- 9: Longitudinal Duct of Epoophoron
- 10: Ext Urethral Opening and Suburethral Diverticulum
- 11: Maj. Vest. Gland Opening
- 12: Eminence of Maj. V. Gld.
- 13: Clitoris
- 14: Lips (labia) of Vulva
- 15: Vestibule
- 16: Mesovarium
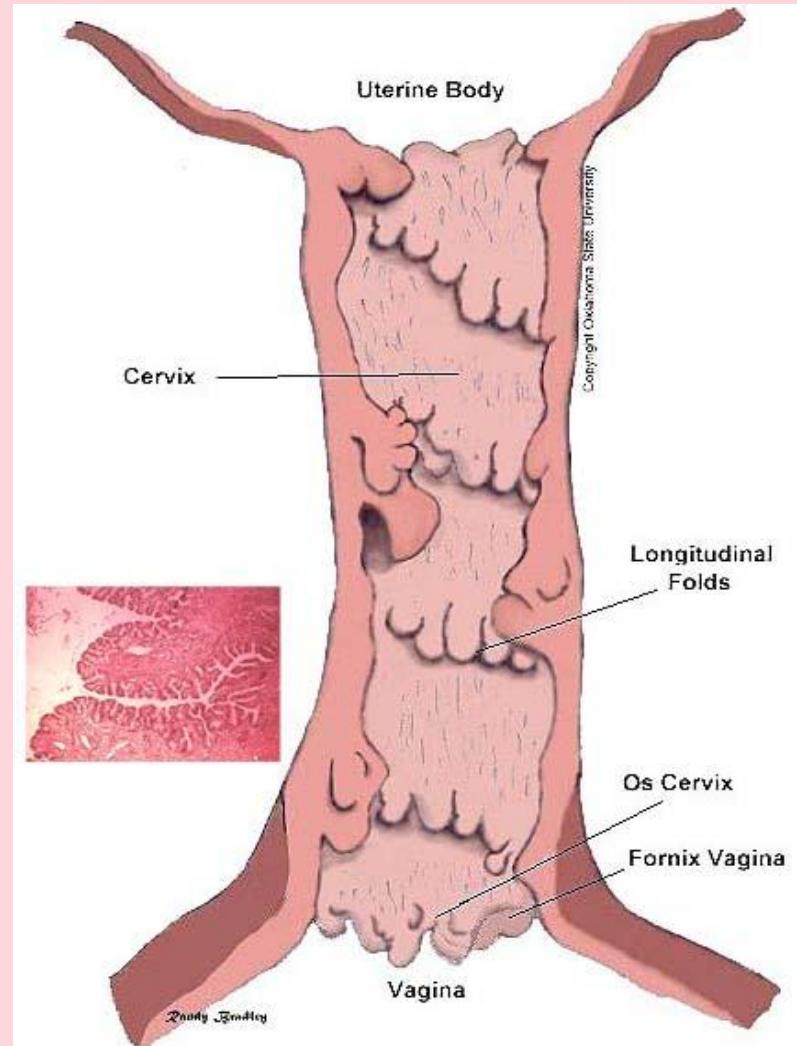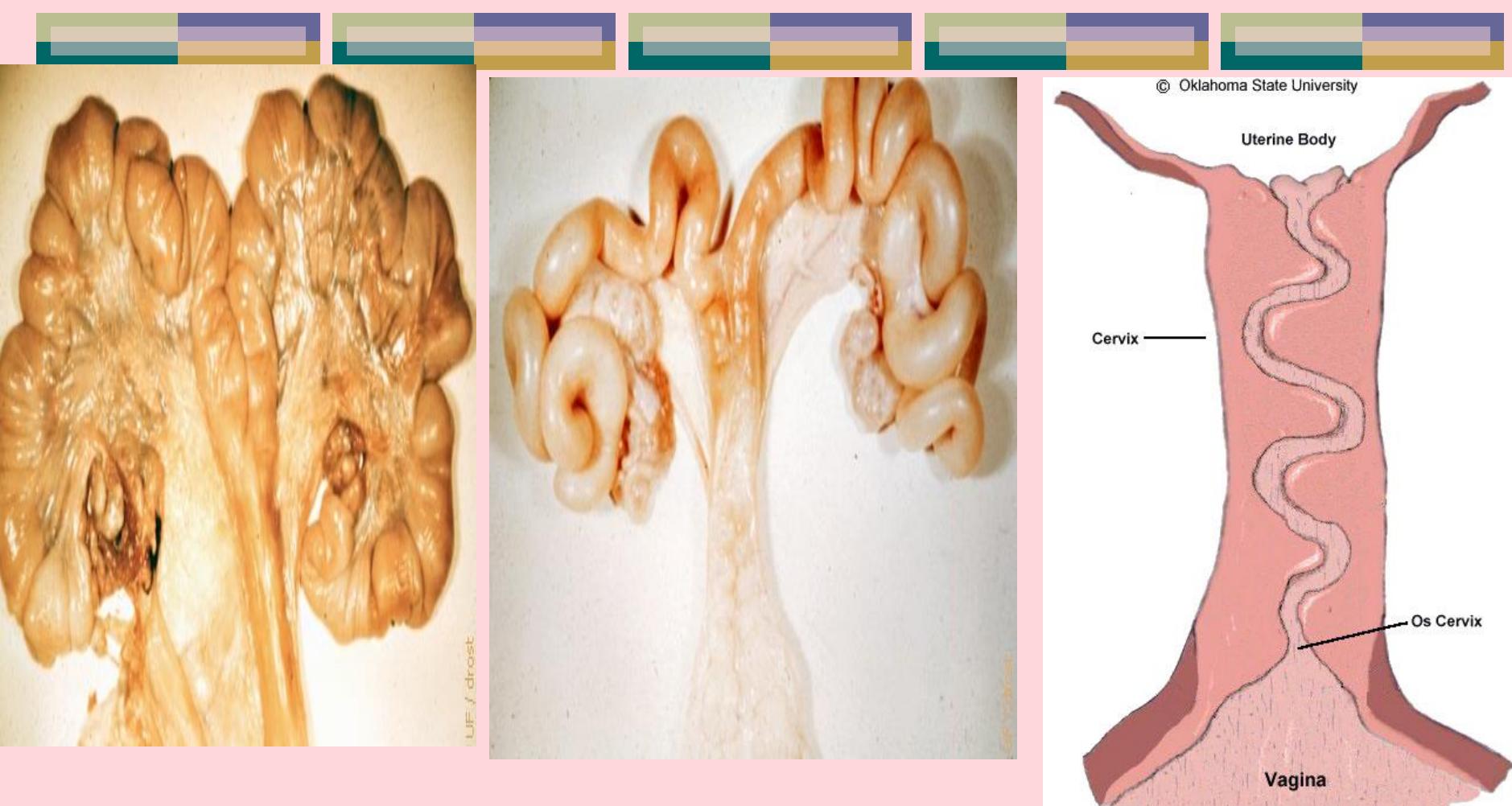- 17: Mesosalpinx

Cervix of a mare   Buffalo genitalia   Genitalia Mare

The Bovine genitalia and cervix

© Oklahoma State University

Uterine Body

Cervix

Os Cervix

Vagina

Genitalia of Adult and primiparous Sow and the cervix of a sow

REPRODUCTIVE PHYSIOLOGY

When a female animal attains sexual maturity it starts expressing rythymic sexual desire (estrus) at fixed intervals at a certain time of the year (seasonal breeder) or year round (polyestrous) at fixed time intervals. This sexual cycle is termed the estrous cycle. The reproductive cycle is dependent on the breed, age, nutrition, daylight and management in the animals. At the animals level the sexual cycle is dependent on the secretion of various endocrine, paracrine and autocrine hormones and growth factors.

The basic hormone of reproduction are governed by the hypothalamus, pituitary and the ovaries in the female. The hormones of reproduction are the peptide hormones (GnRH and oxytocin), protein (pituitary FSH and LH or the placental eCG and hCG all known as gonadotropins as they stimulate the gonads in some or other way) and steroids (progesterone and estrogen secreted masinly from the ovaries and also from the placenta). There are some other substances like prolactin and prostaglandins which affect the reproductive cycle of farm animals. When an animal comes into estrus and is bred or mated by a male there is formation of zygote which develops sequentially and result in the birth of a young one (parturition) after a fixed period. If the animal does not become pregnant there is release of prostaglandin from the endometrium of the uterus and this causes the lysis of the corpus luteum and the animal returns back to estrus usually 21 days after the previous estrus. After parturition the animal returns back to estrus and when mated becomes pregnant again. This sequence of events continue in the animal till it becomes old. There is a complex chain of events that occur during the reproductive cycle of animals. Recently it has been identified as an follicular growth wave that occurs one or more time between two estrus cycles in farm animals. There are many intricately intertwined mechanisms that are in operation during the reproductive cycle in most farm animals many of which are yet to be understood.

REPRODUCTIVE HORMONES

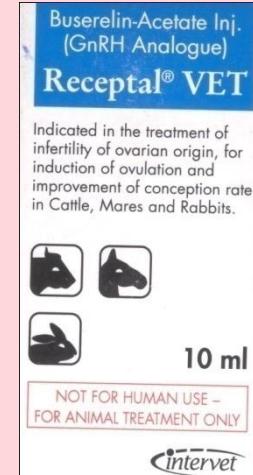Neurohormones of hypothalamus (Hypothalmic hormones or peptide hormones):

GnRH :A peptide hormone secreted by the hypothalamus. The GnRH secreted from the ventromedial nucleas, arcuate nucleas and median eminence is responsible for the tonic release of Pituitary gonadotropins(FSH and LH) whereas, the GnRH secreted from the Anterior hypothalamic area and the preoptic nuclei is responsible for the Surge-like release of pituitary FSH and LH. Clinically GnRH can be used for all clinical conditions where a action of FSH or LH is desired. It reaches the pituitary via the hypothalamic hypophyseal portal system.

Prolactin releasing or inhibiting hormone (PRH or PIH):This is secreted from the neurons containing dopamine in the arcuate nucleas of hypothalamus. It stimulate or inhibit prolactin secretion. Prolactin secretion is important for milk production and CL maintenance in the bitch. It is also reponsible for alterations in LH secretion.

Oxytocin: Secreted from the paraventricular nuclei and supraoptic nuclei of hypothalamus and stored in the posterior pituitary. It induces uterine contractions and is responsible for milk let down and gamete transport. Its main clinical use would be inducing uterine contractions during uterine inertia (lack of contractions) during parturition and is used to control uterine bleeding.

Nuerohormones of the pineal gland

Melatonin: A methoxy-indole secreted by the pineal gland and its secretion is dependent on the daylight falling on the eyes. Its secretion increases during darkness. It is responsible for the seasonality of reproduction by stimulating or inhibiting GnRH secretions.

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Hormones of the pituitary (Gonadotropins: substances which favour gonad activity)

Follicle stimulating hormone (FSH): A glycoprotein secreted by the gonadotrophes in the anterior lobe of pituitary. It stimulates follicular growth in female and spermatogenesis in the male. Clinically it is used for anestrus, out of the season breeding and for superovulation.

Lutenizing hormone (LH): Secreted from the pituitary and protein in nature. It stimulate ovulation and formation of corpus luteum in the female and testosterone secretion in the male. Clinically it is used for ovulation induction in delayed ovulation, an-ovulation, cystic ovary and for CL development. The surge like release is responsible for ovulation and is dependent on the positive feedback by estrogen hormone from the ovary. Surge like release is absent in the male.
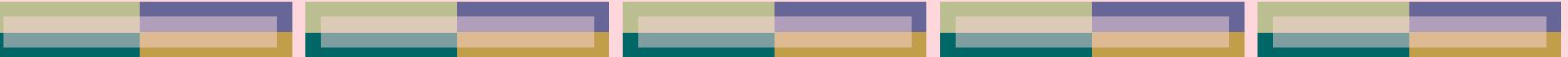
Other pituitary hormones

Prolactin: Produced by the mammotrophes in anterior lobe of the pituitary and is responsible for lactation and maternal behaviour. It is also responsible for CL maintenance during early pregnancy in the bitch and also affects LH secretion.
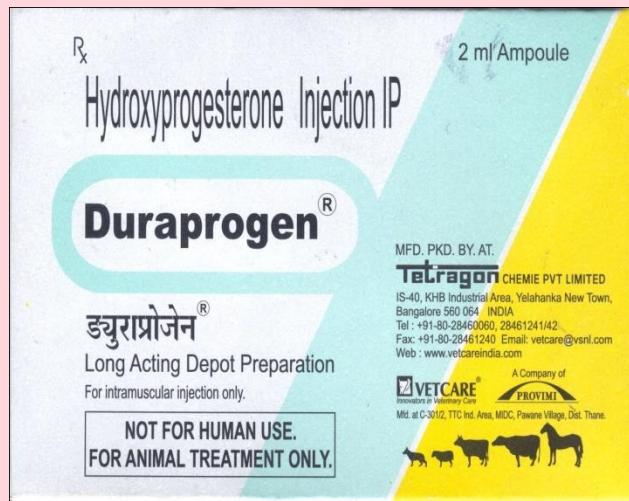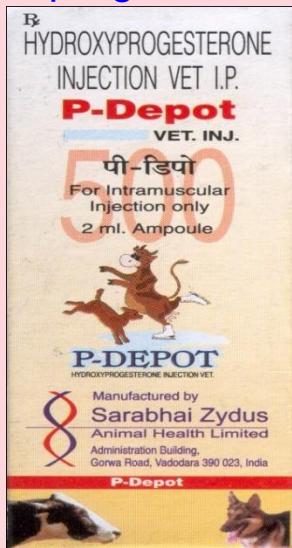
Hormones secreted by the gonads and uterus:

Steroids: (Estrogen, progesterone and testosterone)

Estrogen: Steroid secreted by theca interna of the ovarian follicle. It promotes sexual behaviour, secondary sexual characters and also has anabolic effects. It causes luteolysis in most species except the pig in which it is luteotrophic. It causes a negative feed back effect on FSH secretion and positive feed back on LH secretion.

Progesterone: Steroid secreted by the corpus luteum of the ovary. It acts with estrogen in promoting estrus behaviour and in preparing uterus for implantation. It also maintains pregnancy by quietening the uterus. It is required for the entire gestation from the CL in species like cow, buffalo, goat and pig(CL dependant species). However in other species (mare, sheep and possibly dog) the placenta may produce sufficient quantities of progesterone for pregnancy maintenance. The steroid is also produced by the adrenals.
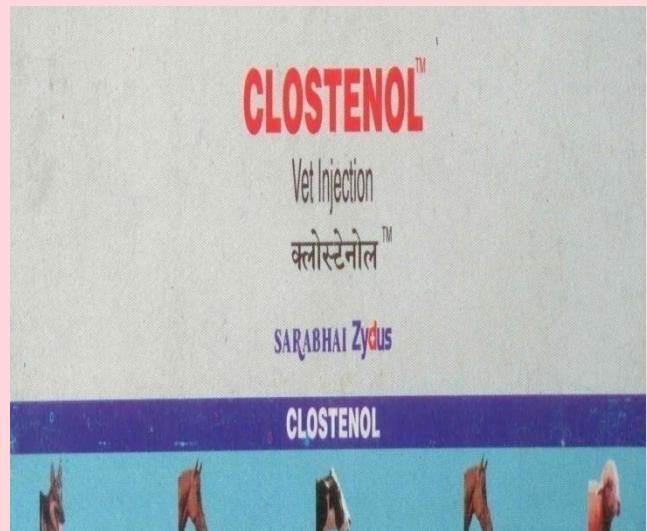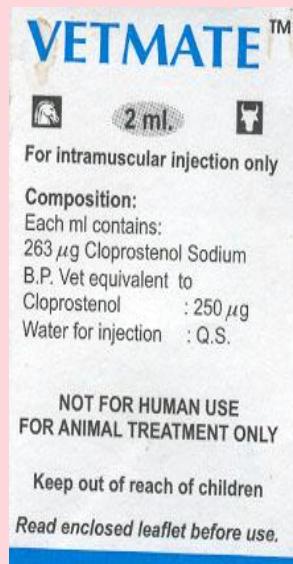

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Testosterone: Steroid secreted by the Leydig cells of the testis of male animals. It is responsible for the secondary sexual characters and the sex libido. It also has anabolic effects.

Other hormones

Relaxin: Polypeptide secreted by the CL of the ovary. It dilates the birth canal at parturition specially cervix and helps in pregnancy maintenance in the dog.

Prostaglandins :Eicosanoids (Unsaturated fatty acids) secreted by the uterus and many other tisuues which cause the lysis of the CL on the ovary in absence of pregnancy and on completion of pregnancy and also favours uterine contractions at parturition

Activins and Inhibins: Proteins found in the follicular fluid and granulosa cells of ovary which stimulate or inhibit FSH release from the pituitary.
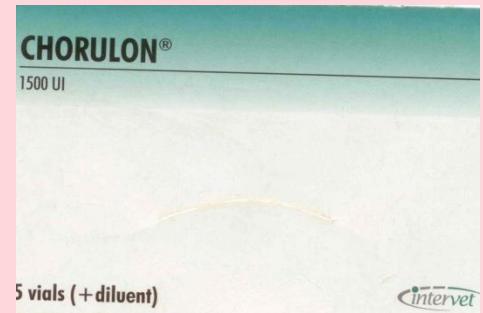
Follistatin: Protein found in the follicular fluid of ovary which regulate FSH release.

Hormones of placenta: Placenta secretes some gonadotropins hCG (humans) and eCG (equine), steroids and placental lactogen.

Placental gonadotropins:

Human chorionic gonadotropin (hCG):Glycoprotein secreted from the synctio-trophoblasctic cells of human and monkey placenta. It has LH like activity and maintains CL in primates. Clinically it is the principally used for ovulation problems like delayed ovulation, anovulation, ovarian cysts and is the most commonly available drug of human origin used in animal therapy as LH is largely unavailable and costly.

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Equine chorionic gonadotropin (eCG): Glycoprotein secreted from endometrial cups formed in the placenta of equine species. It has FSH like activity and hence used as a cheap source of FSH in therapy of anestrus, out of season breeding and superovulation.

Steroids:

Estrogens are secreted from the placental unit in sheep cattle and many species. They maintain pregnancy. Progesterone is also secreted by the placenta.

Other hormones

Placental lactogen are proteins secreted by placental tissues in sheep and cattle. It regulates transport of nutrients from the dam to fetus.

Hormone secretion, mechanism of action and metabolism:

The secretion of peptide and protein hormones depends upon the feedback mechanism and many precursor molecules. These hormones are stored in the cells of origin and hence sharp rises as occurs in surge-like release can occur. A basal level of hormone is always present but surge like pulses occur in response to some feedback or stimulation by their precursors. Steroids are not stored but their stimulation is rapid.

The mechanism of hormone action is dependent on the presence of receptors on the target organ. The peptide and protein hormones bind to specific receptors and stimulate adenylate cyclase which convert ATP to cyclic AMP which are considered as second messengers of hormone action. The cAMP activate protein kinase system and phosphorylate other enzymes in the cell with an end result of increase in the cellular products for example estrogen release in response to FSH stimulation (But some LH is required for estrogen production). The protein or peptide hormones are secreted in a episodic or pulsatile pattern.

The steroids when produced diffuse into the cytoplasm of the cell and are carried by carrier proteins. The mechanism of action of steroids in the cell include binding to the receptor site and enter the nucleas of cell where they stimulate the synthesis of mRNA. This RNA diffuses into the cytoplasm and stimulates protein synthesis.
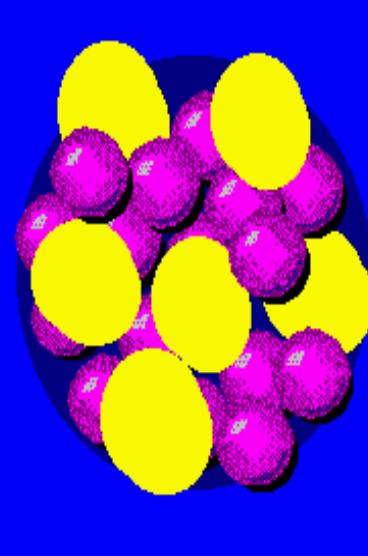
The protein and peptide hormones are broken to amino acids in the liver, kidneys and target tissues. Steroids are converted to less active soluble compounds by liver, kidneys and other tissues and excreted with feces or urine.
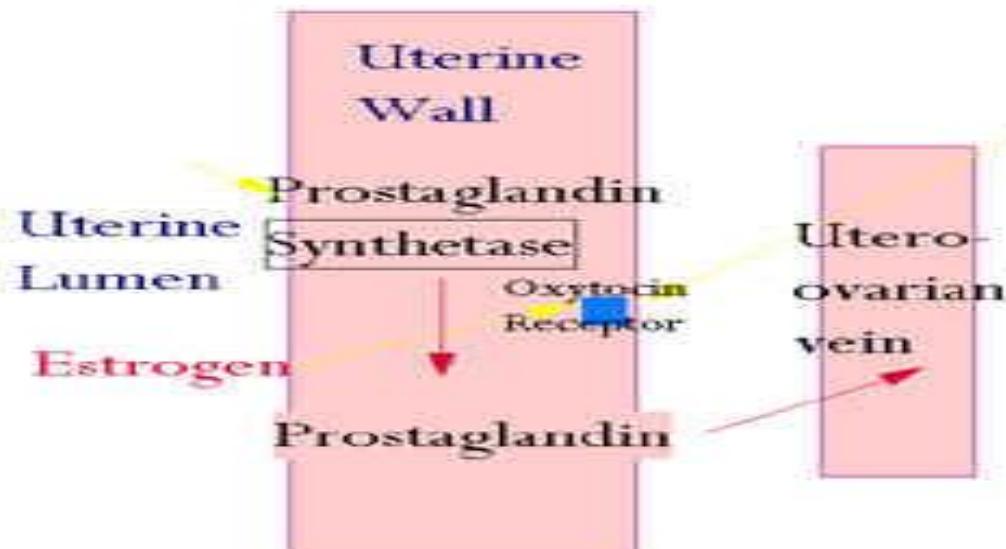
Corpus Luteum

In ruminants, testosterone and oestradiol-17β are rapidly converted to their epimers, biologically much less active, epitestosterone and oestradiol-17α. Progesterone is partially converted to androgens before excretion. In the pig, epimerization of testo sterone and oestradiol-17β does not appear to take place to a significant degree. The faecal route of elimination dominates in ruminants, while in the pig urinary excretion is more important.

The prostaglandins are inactivated at the site of action or cleared by the lungs and liver.

- **Large luteal cells**
  - (Granulosa cells)
  - PGF receptors
  - 85 % of progesterone
  - Not LH responsive
- **Small Luteal cells**
  - (Thecal cells)
  - No PGF receptors
  - 15% of progesterone
  - LH responsive

Luteolysis

Uterine Wall

Uterine Lumen

Prostaglandin Synthetase

Oxytocin Receptor

Estrogen

Prostaglandin

Utero-ovarian vein

Corpus Luteum

Ovary

Prostaglandin:
Binds large luteal cells
Releases oxytocin
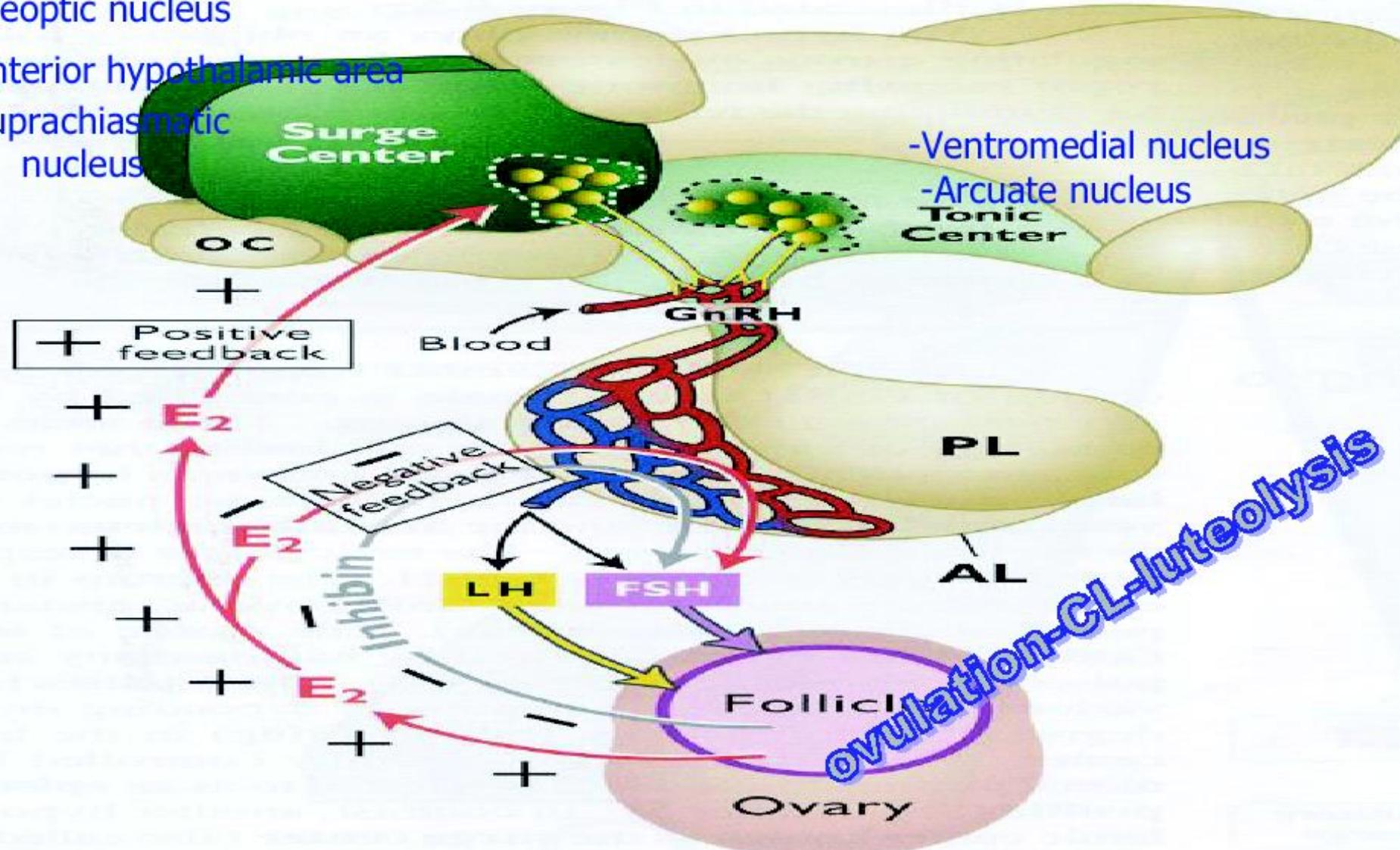
-Preoptic nucleus

-Anterior hypothalamic area
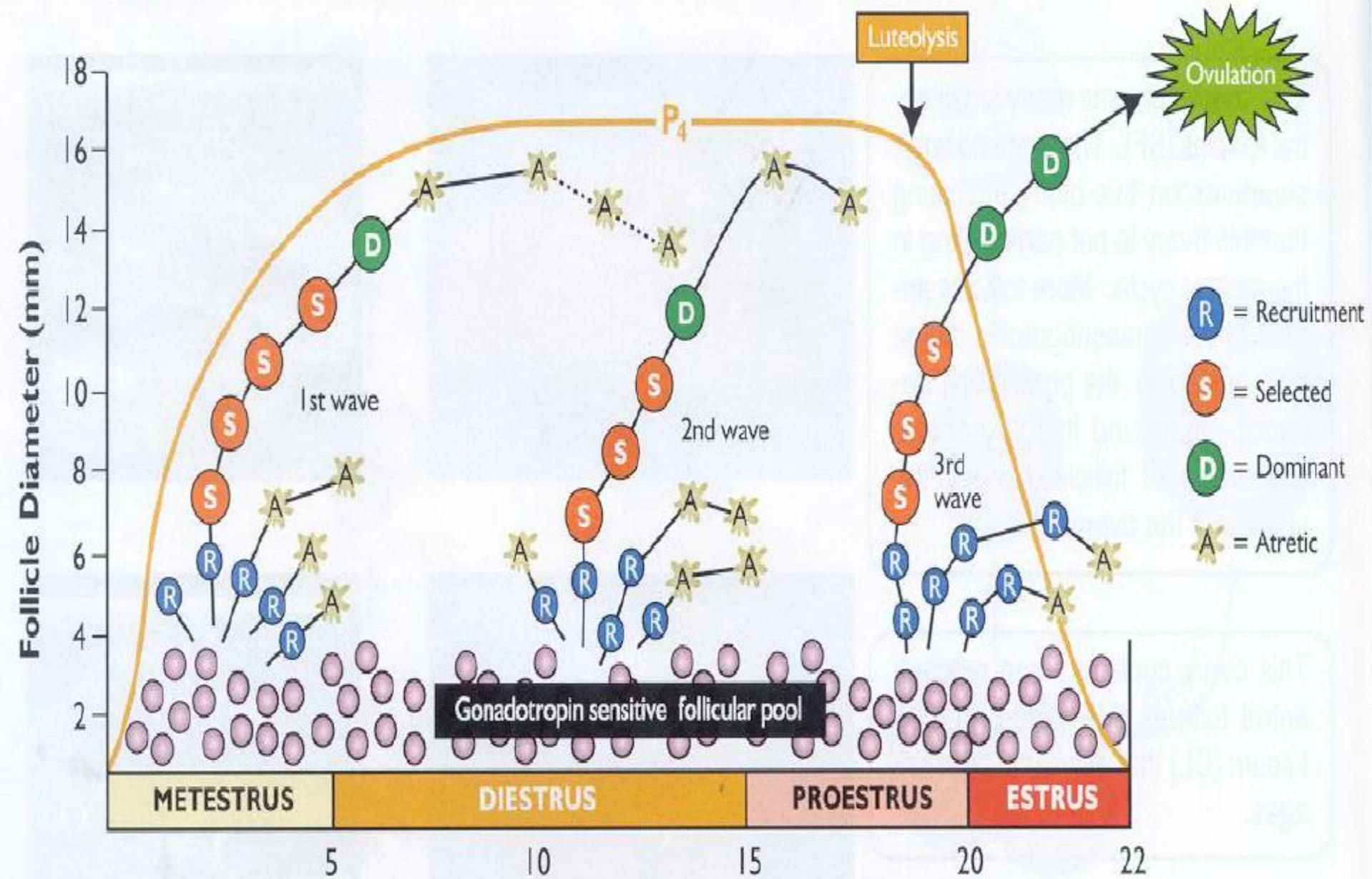
-Suprachiasmatic nucleus
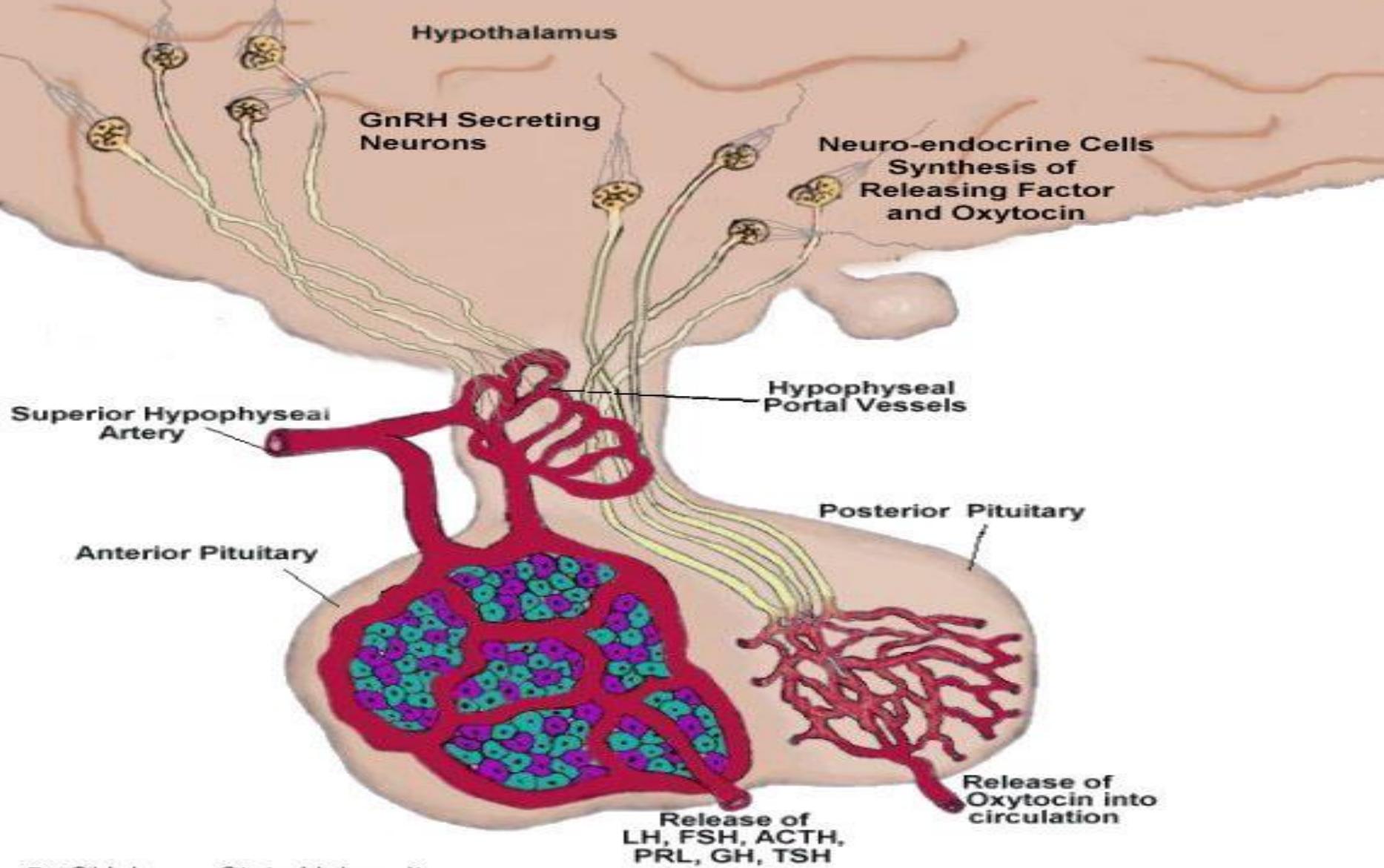
-Ventromedial nucleus
-Arcuate nucleus

Surge Center

Tonic Center

OC

GnRH

Blood

+ Positive feedback

+ E₂

Negative feedback

+ E₂

Inhibin

+

LH   FSH

PL

AL

+ E₂

Follicl

Ovary

ovulation-CL-luteolysis

Ovarian Follicular Waves During One Cycle – Bovine

The hypothalamus and pituitary secreting hormones

The mechanism of release and reaching of prostaglandin to the ovary

Figure 10. The bovine estrous cycle.

Table 17. The Reproductive Cycle of Domestic Animals*

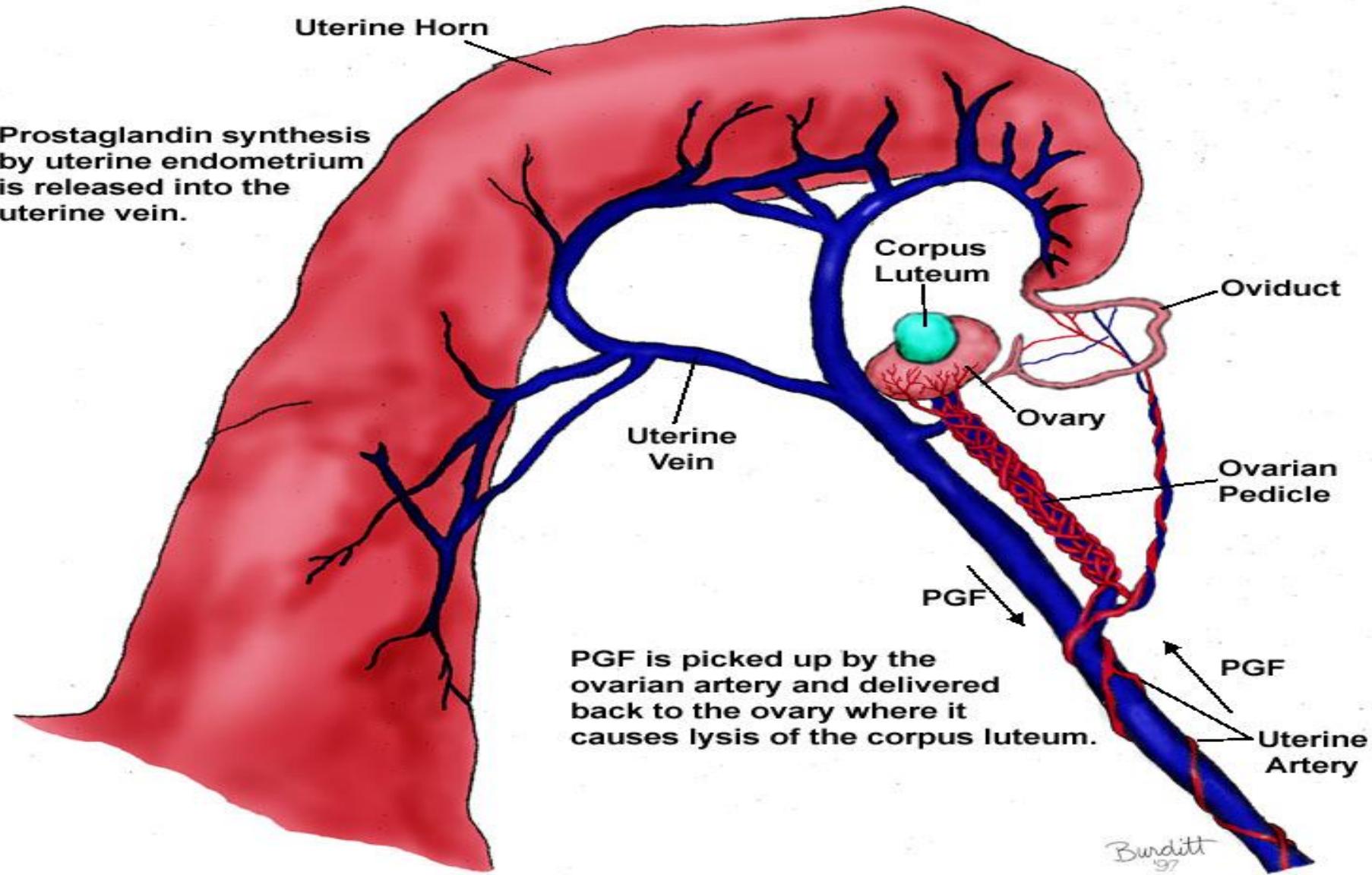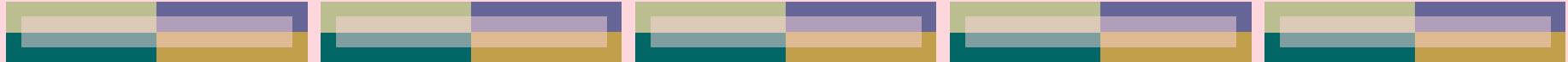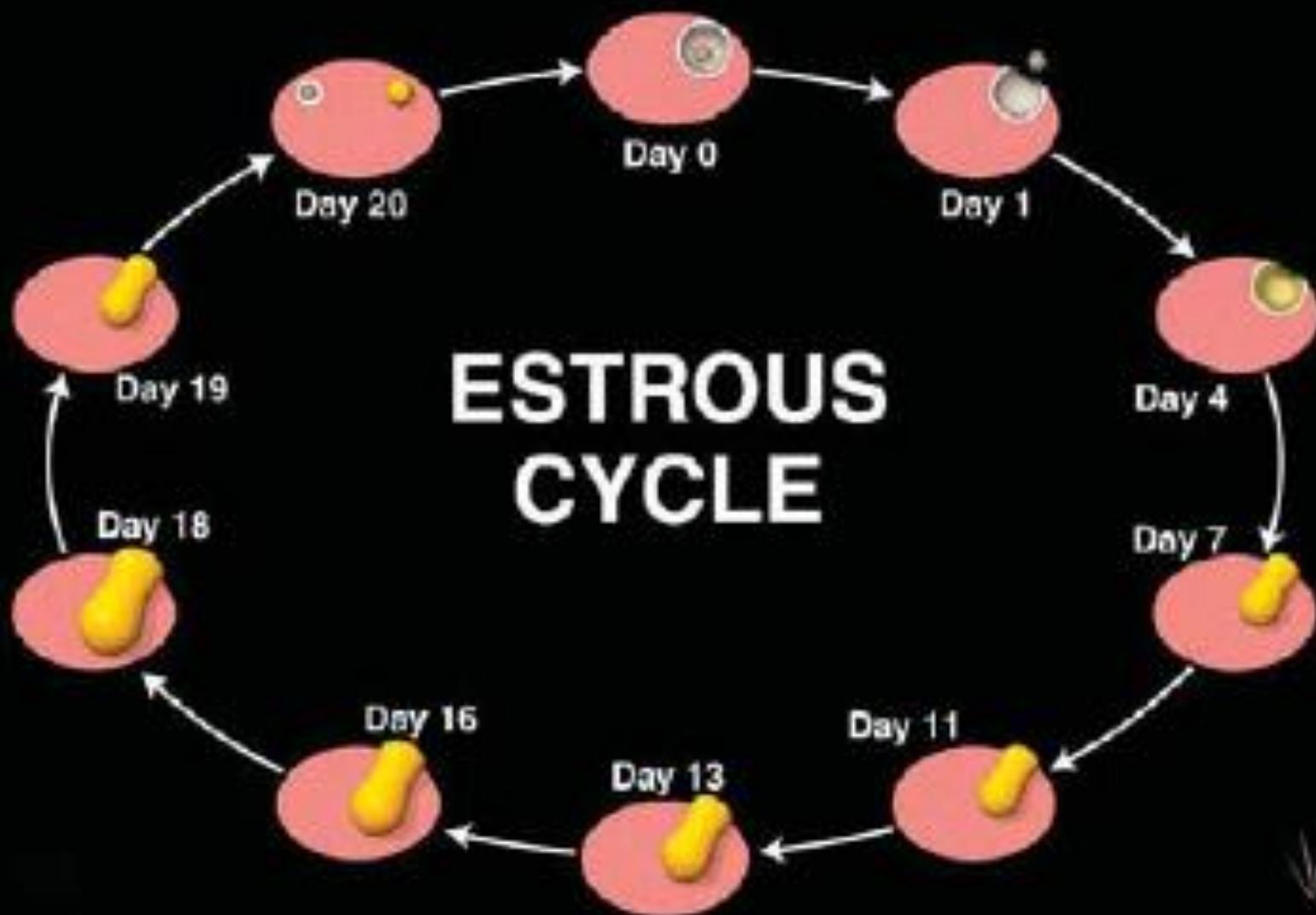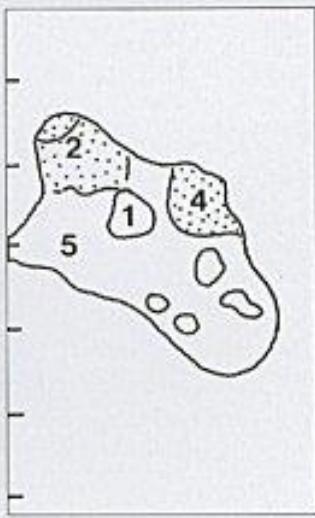| Animal	Onset of Puberty	Average Recommended Age for First Service	Length of Estrous Cycle	Follicle Diameter (mm)	Length of Estrum	Time of Ovulation	Optimum Time for Service	Ovum Transport Time	Advisable Time to Breed After Parturition
Mare	10–24 m. (18 m.)	2–3 yr.	19–23 d. (21 d.)	35–55+	2.0–13 d (7.2±2.9 d) (5.7 d)	1–2 d. before the end of estrum	2–4 d. before end of estrum or the 2nd–3rd d. of estrum	4–6 d.	About 25–35 d. or 2nd estrum; about 9 d. or 1st estrum only if normal in every way
Cow	4–24 m. (6–18 m.)	14–22 m.	18–24 d. (21 d.)	10–20	12–28 h. (18 h.) (Temperate Zone)	10–15 h. after the end of estrum	Just before the middle of estrum to the end of estrum	3–4 d.	60–90 d.
Ewe	4–12 m. (first fall)	12–18 m.	14–20 d. (16.5 d.)	15–19	24–48 h. (30–36 h.)	12–24 h. before the end of estrum	18–24 h. after the onset of estrum	3–4 d.	Usually the following fall
Goat	4–12 m. (first fall)	12–18 m.	15–24 d. (20 d.)		30–60 h. (36–48 h.)	About the last day of estrum	24–36 h. after the onset of estrum	3–4 d.	Usually the following fall
Sow	5–8 m.	8–9 m.	18–24 d. (21 d.)	7–10	1–4 d. (2–3 d.)	30–40 h. after the onset of estrum	12–30 h. after the onset of estrum	2–3 d.	First estrum 4–9 d. after weaning pigs
Dog	6–12 m. (7–10 m.)	12–18 m.	1–3 cycles per year (1.6 cycles per year) aver. every 7 months	6–8	4–12 d. (9 d.)	1–2 d. after the onset of true estrum	2–3 d. after onset of true estrum or 10–14 d. after onset of estrous bleeding	6–8 d.	Usually the first estrum or 3–4 weeks after weaning pups
Cat	6–15 m. (8–10 m.)	12–18 m.	15–21 d.[1] 4 d.[2]		9–10 d.[1] 4 d.[2]	24–30 h. after coitus (27 h.)[2]	—[2]	4–8 d.	Usually the 1st estrum or 3–4 weeks after weaning kittens

Roberts 31

Ovaries on Day 2 of the Estrous Cycle.
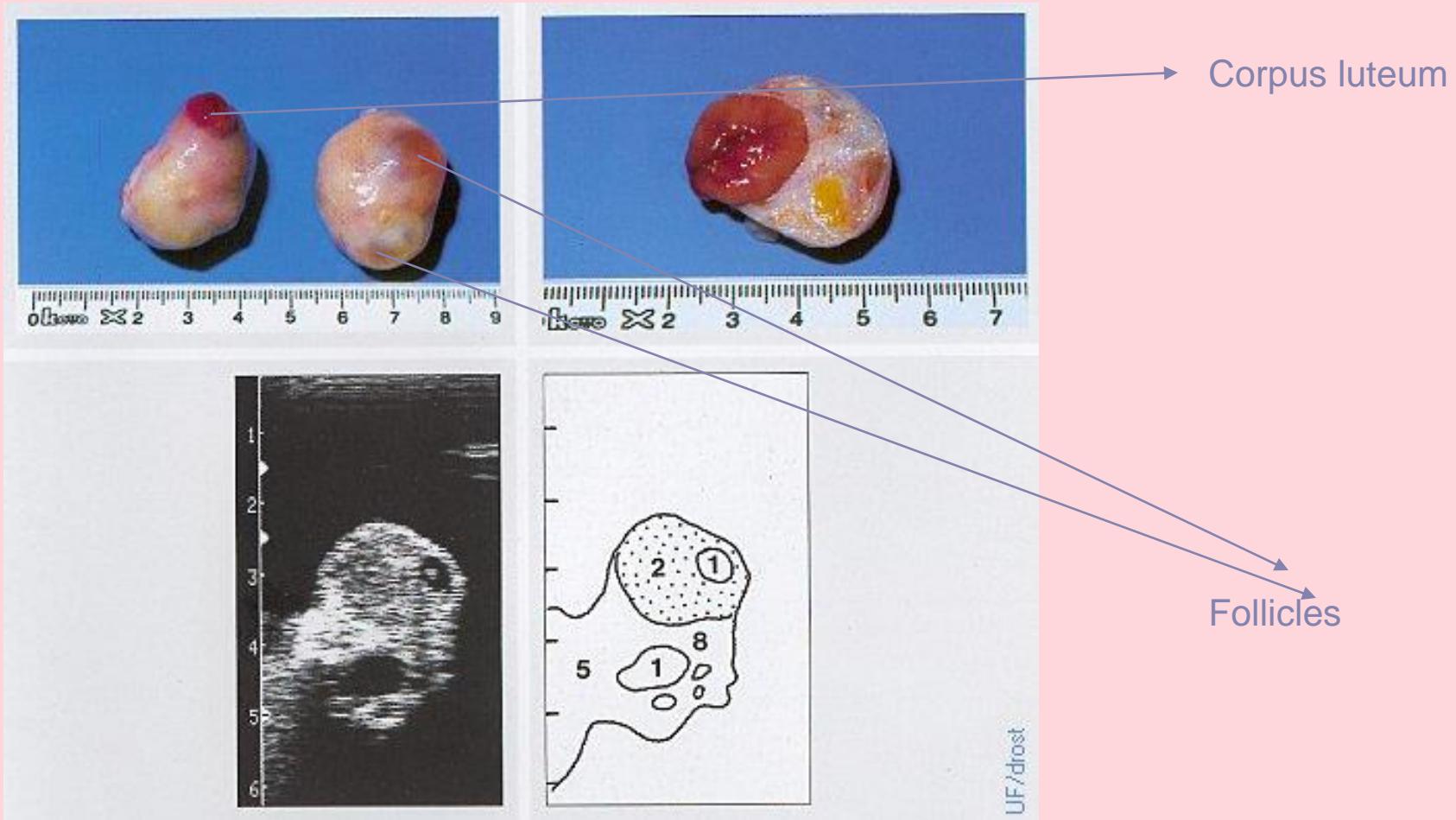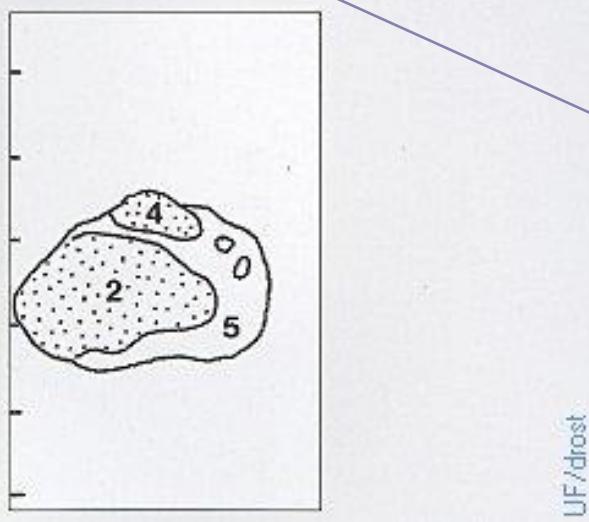
Corpus haemorrhagicum

Corpus albicans

Ovaries on Day 5 of the Estrous Cycle

Corpus luteum

Follicles

UF/drost

Ovaries on Day 9 of the Estrous Cycle
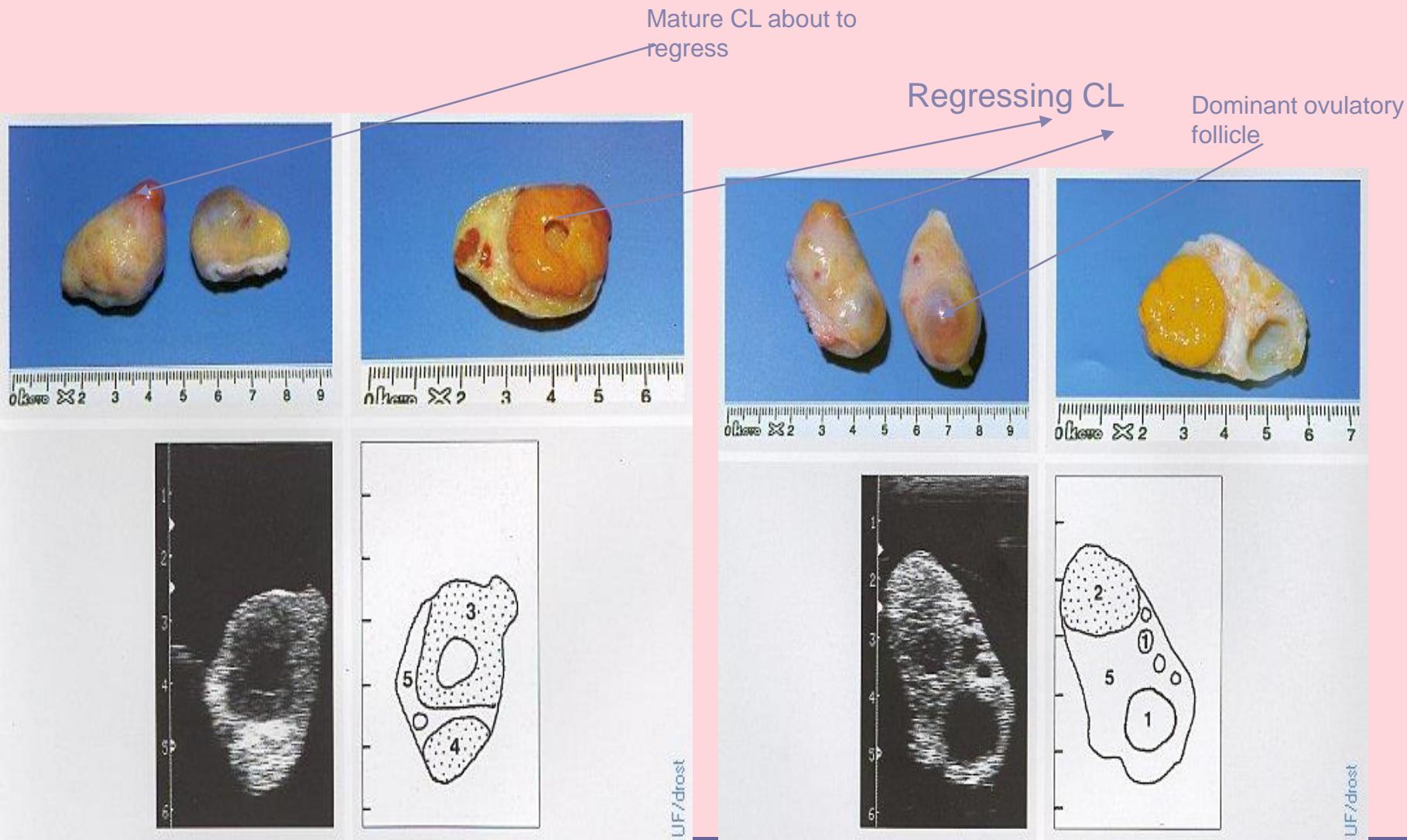
Mature CL

Fully grown dominant follicle

UF/drost

Ovaries on Day 16 and 17 of the Estrous Cycle

Mature CL about to regress

Regressing CL

Dominant ovulatory follicle
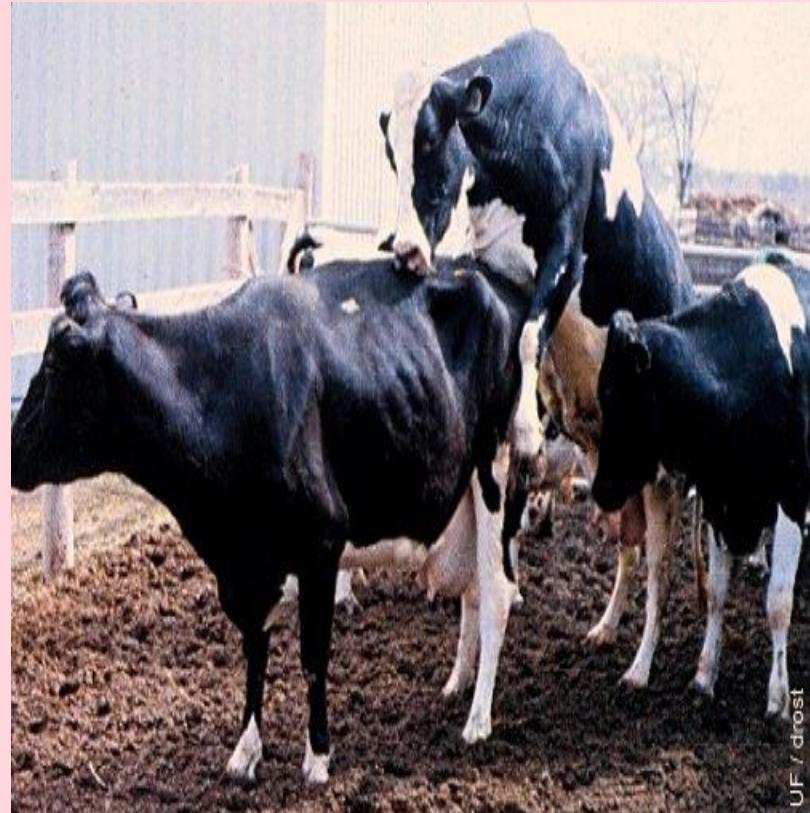
Signs of estrus cow
when a animal is in estrus it shows some visible changes in behaviour. Some of the changes in cows are shown below

- Proestrus cow mounting other cow   Cow in standing heat stands to be mounted

External signs of estrus

Vaginal Mucus

Blood post estrual

Signs of estrus in cows

External visual signs:

Frequent urination

Drop in milk yield

Vulvar edema and discharge of cervico-vaginal mucus, vaginal congestion

Mounting other cows in proestrus and standing to be mounted at estrus

Increased physical activity
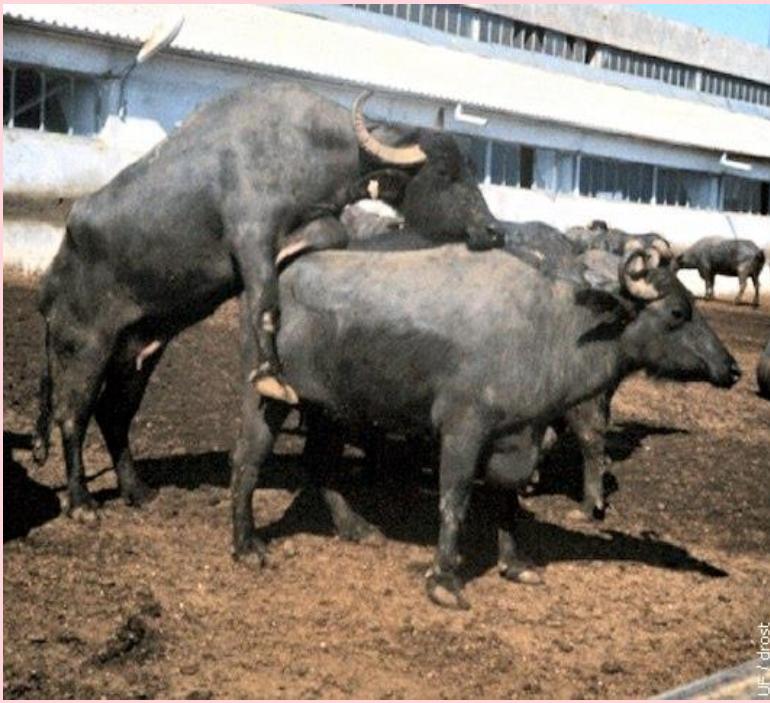
Bellowing

Internal signs:
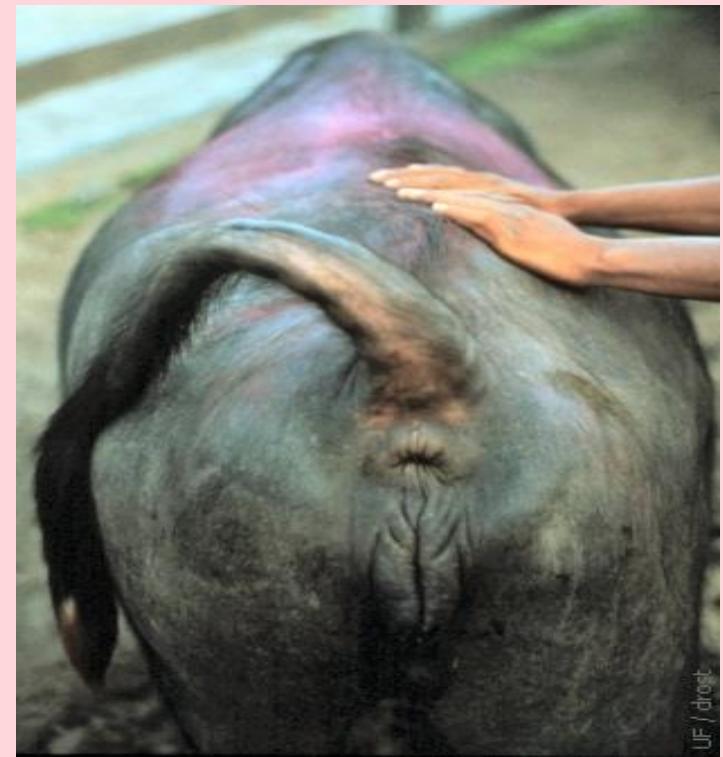
Tone in the uterus, opening of the cervix and presence of a follicle on the ovary

Buffaloes show no mounting, a slight discharge usually seen when the animal sits, many buffaloes are in silent estrus without bellowing and temporary teat engorgement(sudden let down of milk in teats 1-3 days before estrus onset, called doki) is shown by buffaloes. Estrus signs are marked during late evening and early morning. Tail switching is seen

Estrus in a buffalo

Standing estrus
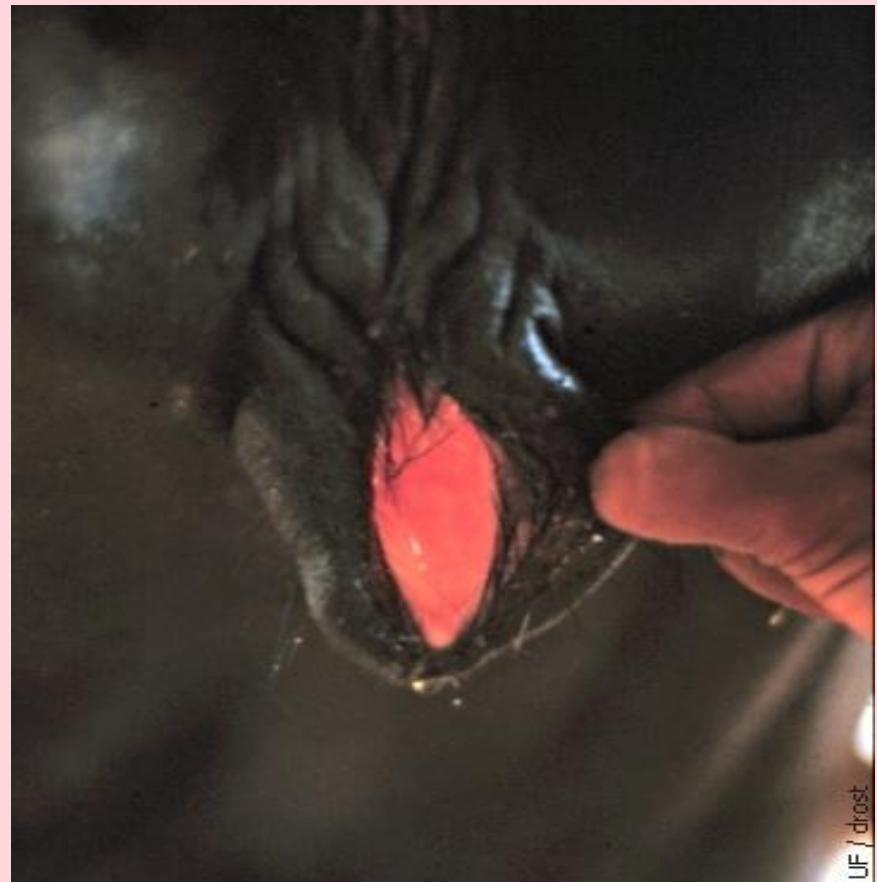
Switching tail to one side

External signs of estrus buffalo

Vulvar lip edema

Vaginal congestion

External signs of estrus buffalo
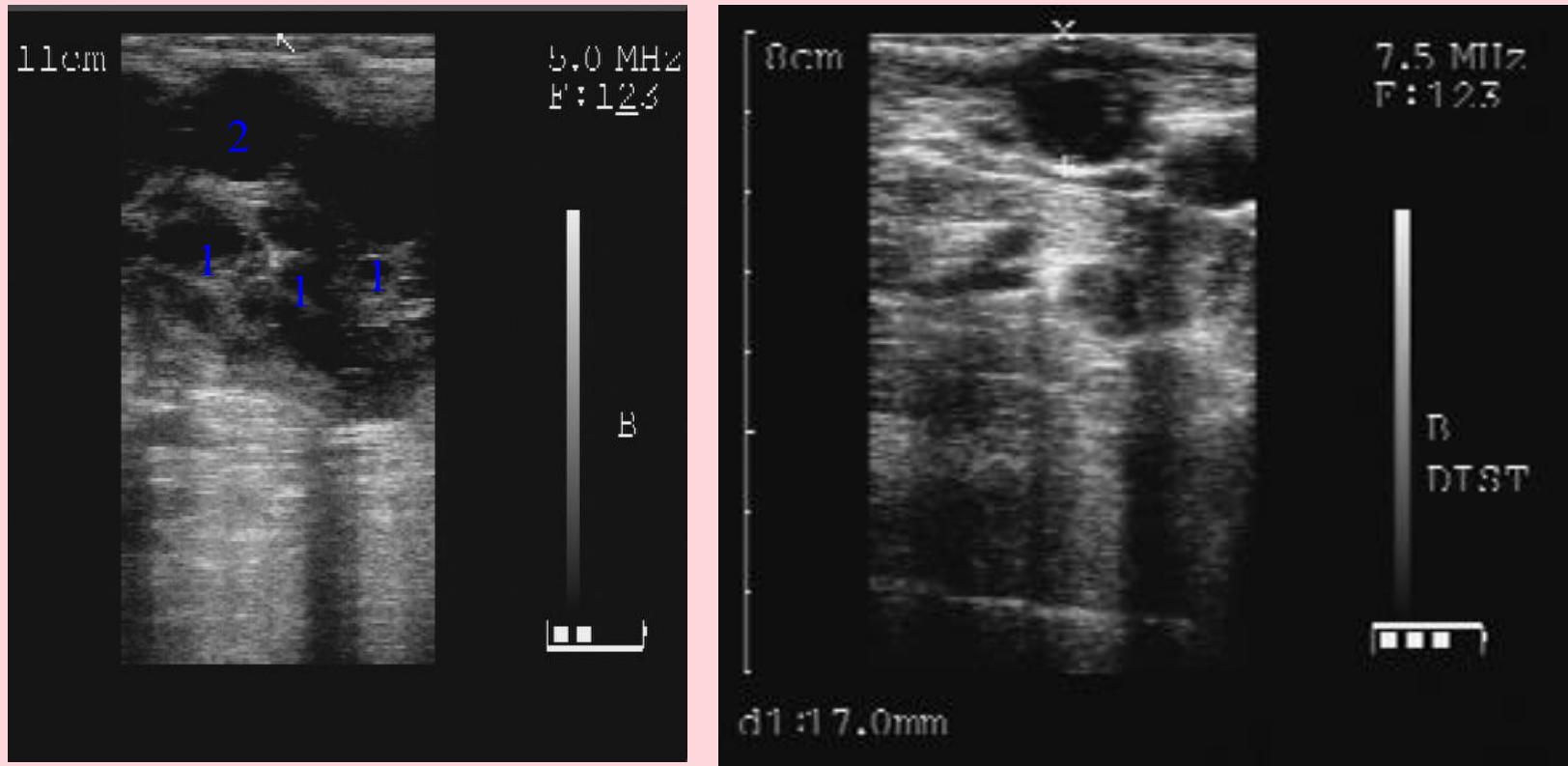
Cervicovaginal mucus discharge estrus

African wild buffalo remains in estrus for 5-6 days and cycles every 23 days

Ultrasonography at Estrus

Ultrasonography of the ovaries in cattle and buffaloes at estrus can reveal several small follicles (1) and a large ovulatory follicle (2)

Estrus in a bitch
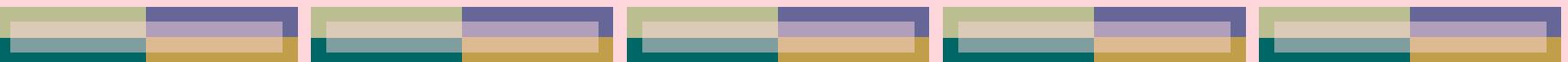
- Dogs are monoestrus with interestrus intervals ranging
  from 4.5 – 13 months Av. 7 months

  PROESTRUS BLEEDING -Av. 9 days
    Attracts Male but no mating vulvar edema

  ESTRUS - Av. 9 days Sexual receptivity
            Bitch Deviate tail and the vulvar edema disappears
            Estrogen ↑ and Progesterone
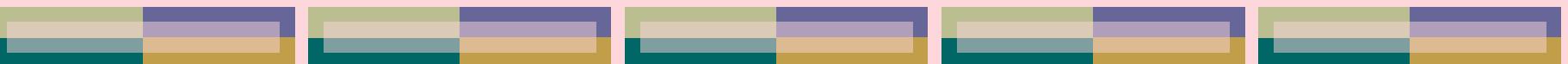
- Reproductive Physiology of bitch
- A Bitch ovulates primary oocytes that mature in 48 h after ovulation
- Ovulation 2 days after LH surge
- Transition from proestrus occurs 1 day after LH surge but can occur 3days before to 5 days after LH surge.
- The Fertilization Period

  The fertilization period of the bitch is the time when viable oocytes are available in the uterine tubes and are sufficiently mature as secondary oocytes to be fertilized by spermatozoa. Under typical circumstances in the majority of bitches it extends from four days after the preovulatory surge of LH until about seven days after the LH surge (i.e. from two days after ovulation until about five days after ovulation). Fertility usually declines very rapidly beginning 7 days after the LH surge, as oocytes undergo degeneration and the cervix closes over a 1 to 2 day period

- The Fertile Period

  The fertile period can be considered to extend from three days before the preovulatory LH surge until 7 days after the pre-ovulatory LH surge, and may be even longer when using stud dogs with exceptional semen quality or bitches in which the oocytes may survive another day or two beyond the norm.

  Importantly, for many stud dogs, their sperm may survive no longer than 1 or 2 days in the female tract. Matings earlier than the day of the LH surge have reduced pregnancy rates, suggesting that in most cases sperm are not capable of penetrating oocytes after 2 days in the female tract.

Breeding management of the bitch

Peak Fertility from day of LH surge to 6 days post LH surge

    ie 2 days before ovulation to 4 days after ovulation

2 breedings 2 days apart suggested

Optimal time to breed can be determined by LH surge/clinical methods

Average bitch may ovulate 12 days of proestrus and hence should be mated on day 14 and 16 however, a bitch may ovulate as early as day 5 of proestrus to day 30 of proestrus hence mating on a predetermined day may fail to result in conception

A poor correlation exists between behavioural events and endocrine events

Some bitches may refuse to accept particular males.

Breeding should thus be done on the basis of a vaginal

cytology and disappearance of vaginal tugor or assay of LH
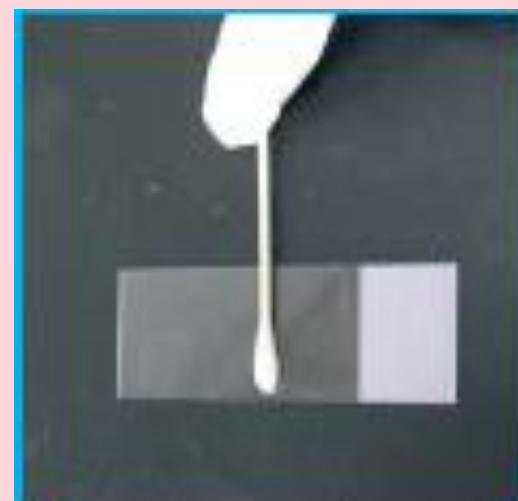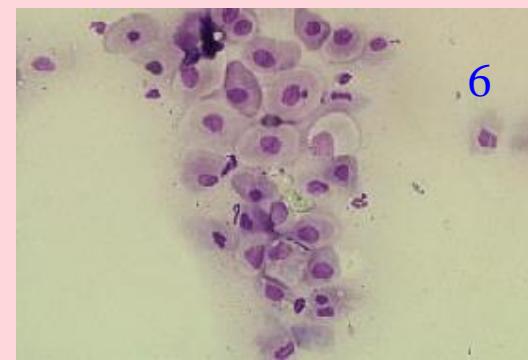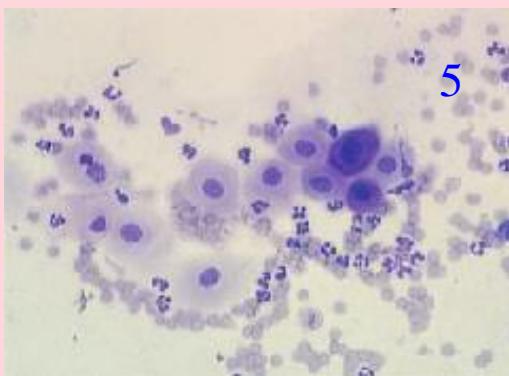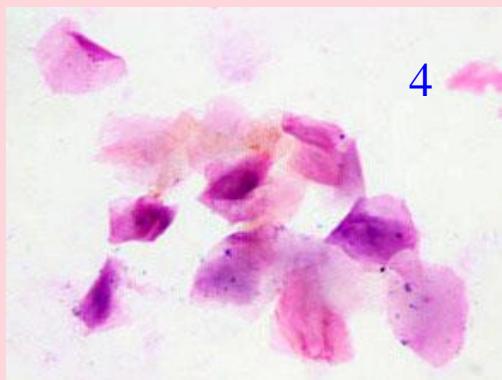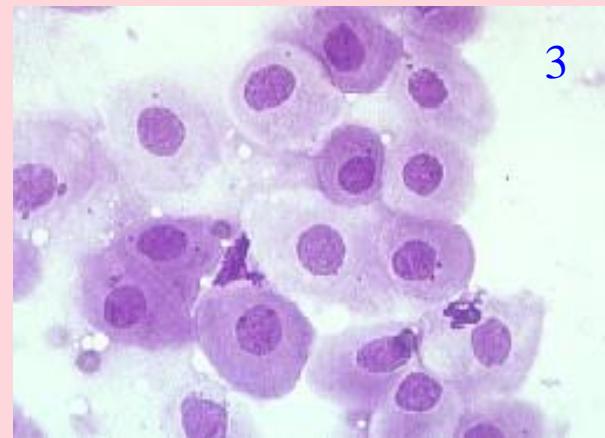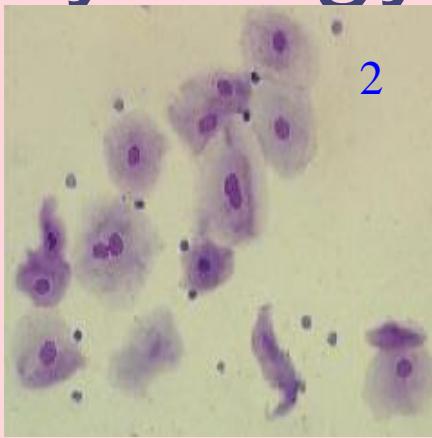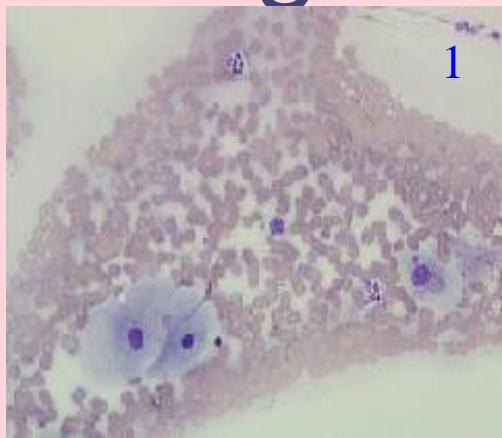
Figure 2 demonstrates the process of spreading the cells on a glass slide.

Vaginal cytology in the bitch

1. RBCs during early proestrus 2. Small parabasal cells during mid proestrus with few RBCs 3. Parabasal cells during mid to late proestrus 4. Cornified (epithelial cells) during estrus 5. A few parabasal cells neutrophils and RBCs during late estrus/diestrsus 6. Anestrus
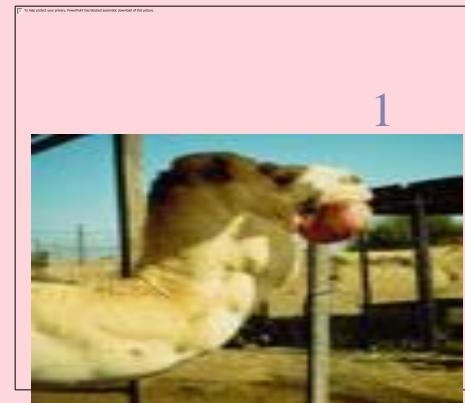
Mating in a bitch

Mating
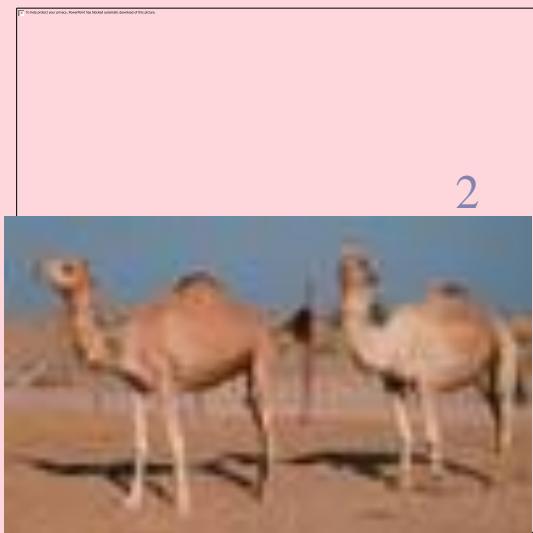
Mating and lock tie in a bitch

Estrus in camels
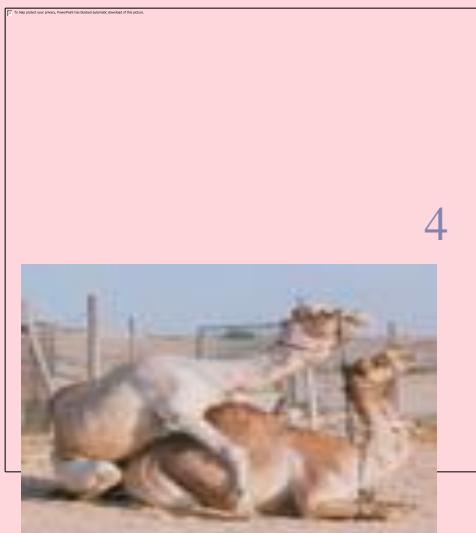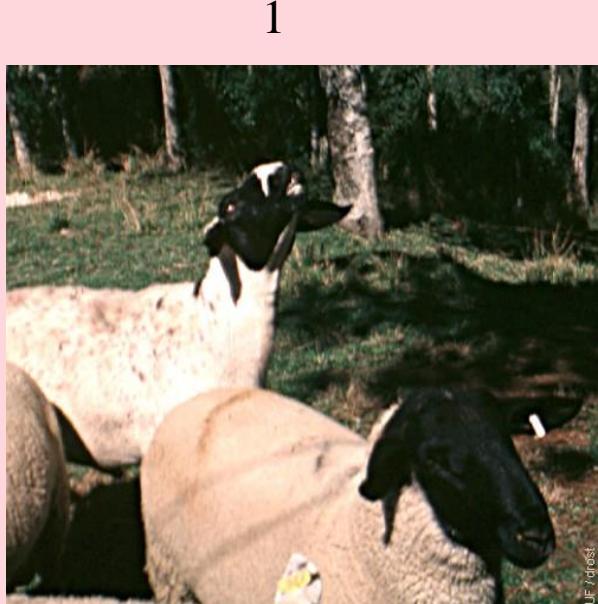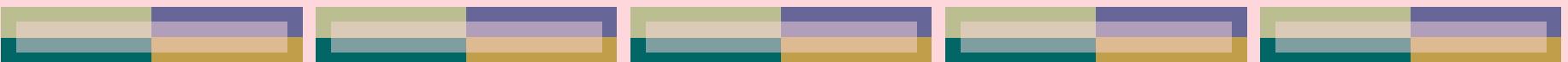
Estrus behaviour in the male (extrusion of the soft palate 1) and female camel (2 and 3) and the mating stance (4)

Estrus in sheep

- Estrus is detected by a teaser marker Ram. Fig 1 shows the Flehmen response shown by the teaser and Fig 2 shows a marker Ram with grease applied over its brisket. Fig 3 shows a ewe in estrus marked by a teaser

1

2

3

Signs of estrus in goats

Vocalization

Wagging of the tail (Up and down movement of the tail)

Slight discharge

Pawing the ground with the legs

Vulvar edema and vaginal congestion

A goat in estrus may sometimes develop the udder

Sheep and goat reproductive peculiarities

Puberty: 8-9 months depending on season of birth

Seasonality of reproduction depending on the daylight (melatonin) short day breeders The breeding season varies at various places the usual season is August-September and a minor season is during March in India.

Estrus cycle length 17 (14-19) days in sheep and 21(15-24) days in goat Estrus period 24-48 h in sheep and 24-96 h in goat

Ovulation 20-32 h after estrus onset. First ovulation of the season not accompanied by behavioural estrus. Ovulaton rate can be increased (upto 20%) by extra feeding (flushing)3-5 weeks before the breeding season.

Twinning is desirable
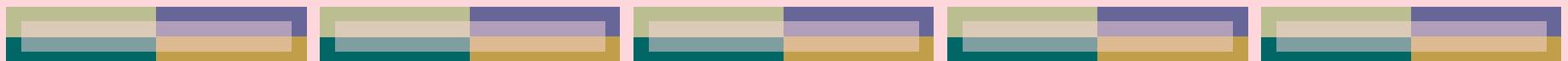
Conception rates high (90%)

Mating also called tupping in sheep.

Estrus in Equids

Signs of estrus in equids

Signs of estrus in equids are generally shown on teasing:

Urinating in front of a stallion

Lip synchrony towards a stallion

Winking of clitoris

Squatting

Cervical relaxation

Estrous cycle
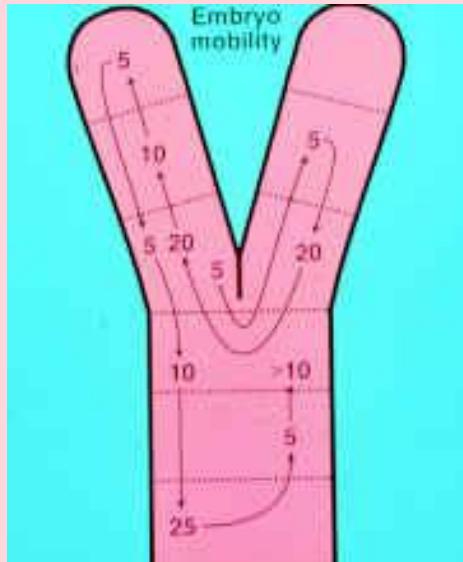
Mare Av. 21 days cycle length 5-7 days
Donkey mares cycle length 5 to 7 days

- Some peculiarities of reproduction

- Seasonality
  Uterus
  Cervix
  Fallopian tubes
  Embryonic signals and mobility
  Ovulation & CL
  Teasing program

- Sperm survival and capacitation 48 h max 6 days
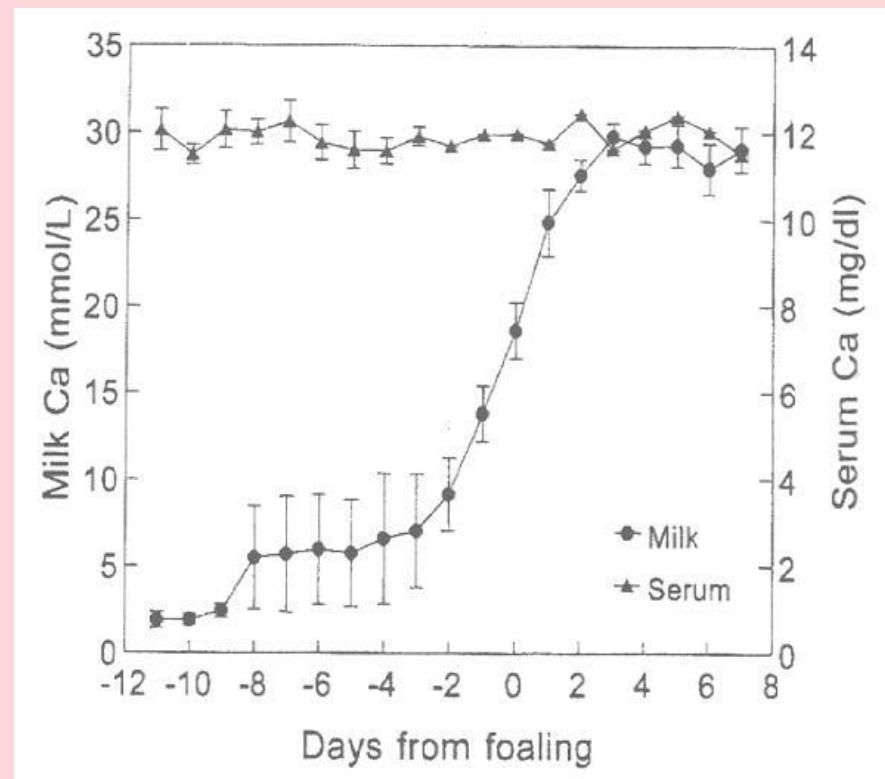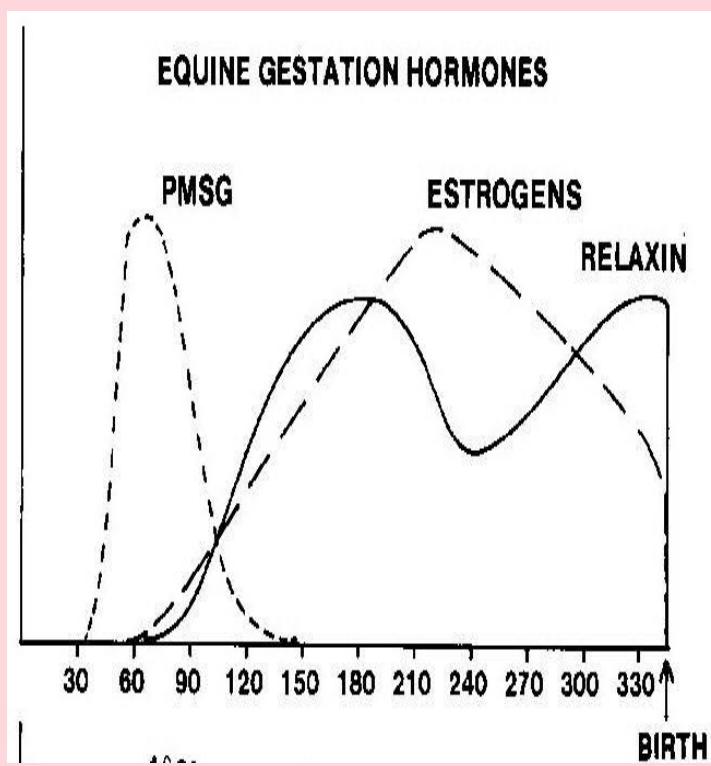
- Gestational length in mares   Range from 320 to 360   (mean - 340) days

eCG from endometrial cups 35-90 days forming accessory CL

P4 from CL low from 120-300 days of gestation

Placental progesterone 90 day onwards

Gestational hormones

Mammary secretion electrolytes near foaling

EQUINE GESTATION HORMONES

PMSG   ESTROGENS   RELAXIN

BIRTH

Days from foaling

Breeding season in equids

Mares in North Hemisph	15 Feb to 1st Week of July
Mares in South Hemisph	August to December
African wild ass	All year (Sp Apr and May)
Grevys mountain zebra	April to September
Burchells zebra	April - May

Estrus in a cat

The lordosis response shown by a female cat in estrus in the presence of a Tom cat (1) and dropping of its ears (2), besides this cats show vocalization

Estrus in a sow

The peculiar turning of the ears and the vulval edema is shown in the photographs. A sow stands to be mounted by a person when in estrus.

Pig is the litter bearing animal with high prolificacy, shorter gestation and faster growth rate

On an average there are 16 embryos 9-10 pigs born and 7.2 pigs weaned.

Puberty 6-7 months

Polyestrus all year, but no estrus during lactation and until the piglets are weaned

Senility 6-10 years.

Estrus cycle 21 days. Estrus duration 1-4 days. Older sows have a longer estrus

Signs of estrus Pacing back and forth near fences, Grunting, Allows riding by persons (lordosis), turning of ears and vulvar edema.

Ovulation 36 hours of onset Ovulation rate 10-15 in Gilts and 12-20 in sows.

Best time for AI   2nd day of estrus

Farrowing rate = Number of farrowings / number of services x 100

The minimum number of embryos in each uterine horn is 2 for pregnancy maintenance and transuterine migration of embryos thus occurs.

Gestation 115 days

Lactation 21-28 days

Weaning to estrus 5 days

Estrus detection methods

Visual

Teasers with chin ball markers or grease collars or halters soaked in a dye

Tail Painting

Plasma progesterone

Cervical mucus fern pattern

Vaginal electrical resistance

Per-oxidase concentration of vagina

Pedometers

Heat mount detectors

Sniffer dogs

Electronic chips

Figure 1. Teasing Record for Mares

Mare Record

Mare _____ Color _____ Age _____ Farm Number _____

in 19 _____ Booked to _____ Mare Owner _____

Results of last year's breeding_____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Dec.																																	
Jan.																																	
Feb.																																	
Mar.																																	
Apr.																																	
May																																	
June																																	
July																																	

Tease Code

1 – resistance

2 – indifferent

3 – interested

4 – winks vulva, urinates

5 – profuse urination and vulvular activity

Estrus synchronization

Manipulation of the estrous cycle to bring a large proportion of females in estrus at a pre-determined time

Purpose: decrease cost of labor

shorten the breeding and calving season

fixed time AI

Methods   A. Non-hormonal : Light, nutrition, weaning, male stimulation

B. Hormonal : 1. Termination of luteal phase

prostaglandins

estrogens

I/U irritants

physical enucleation

2. Maintenance of diestrus with coordinated termination

Progestagens

3. Combination of both

Progestagens + prostaglandins + gonadotropins

Pre-requisites: Animals should be normal cyclic, well fed

Termination of luteal phase

Two doses of prostaglandin 10-12 days apart

Maintenance of diestrus with coordinated termination

Progestagens   Oral: Melengesterol acetate 0.5 mg for 10-18 days

Methyl acetoxy progesterone (MAP)

Chloro acetoxy progesterone (CAP)

Injections: 30-50 mg IM daily hydroxyprogesterone for 8-10 days

Vaginal implants: CIDR, PRID for 8-12 days.

Combination of both

MGA + PG

Norgestomet (Synchromate-B) + PG
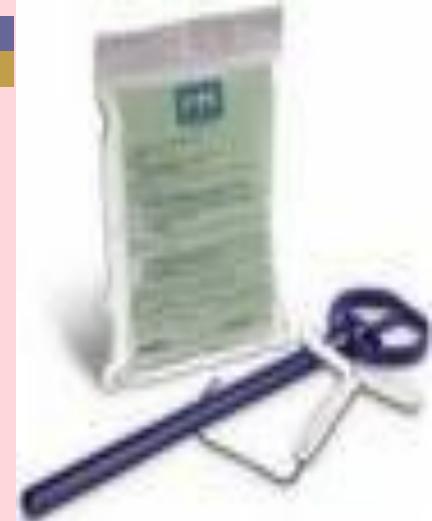
Norgestomet + estradiol

CIDR + PG

Shang Treatment   Synchromate-B + weaning

PG + 2 days weaning

CIDR + PG + GnRH   or MGA + PG + GnRH

Post Partum and other breeding strategies Cows

Voluntary waiting period (VWP) : 40-70 days post-partum

Targeted Breeding   PG - PG – AI   0 = end of VWP

                                                              -14   0

Modified Targeted Breeding   PG – GnRH – PG – AI

                                                    -24   -10   -3   0

Ov Synch Protocol   GnRH – PG – GnRH- AI

                                                       -9   -2   -0

Pre-Synch + Ov Synch   PG – PG – GnRH – PG – GnRH - AI

                                              -36   -22   -10   -3   0

Co-Synch   CIDR + Ov Synch,   MGA + Ov Synch

Heifers

                        Feed MGA 14 days – GnRH – PG – AI

                        -33   -19   -7   0

                        CIDR for 7 days - PG – AI

                              -7   0   0

Select Synch   GnRH – PG – AI

                              -7   0

Estrus control in mares

Induction of ovulation – hCG effective only after follicle is 30 mm

Single GnRH ineffective

deslorelin implants ovulation within 48 h

Termination of luteal phase (Use prostaglandins) purpose may be to

assure stallion availability

shorten 1st post-partum luteal phase

shorten diestrus

terminate unwanted pregnancy before day 40

Lengthening luteal phase (post partum or other estrus prevention)

100 mg IM daily progesterone in oil :estrus 2-7 day after end

oral altrenogest 30 mg daily for 10-15 days

oral altrenogest + PG

Transition period management

Light treatment 60 W incandescet bulb for 1 month

Deslorelin 1.5 mg IM once

Domperidone 1.1 mg/kg PO SID for 10-14 days

Sulpiride 1.0 mg/kg IM SID or BID

Estrus control in mares

Table 1. Medications and Dosage Regimens That Have Been Used in the Management of Transitional Mares

Medication	Brand Name	Dosage
Altrenogest	Regumate®	0.044 mg/kg, PO, SID
Buserelin (GnRH agonist)	Compounded	10 to 100 µg, IM or SC, BID
Deslorelin (GnRH agonist)	Compounded	1.5 mg, IM, once
Deslorelin (GnRH agonist)	Compounded	125 µg, IM, BID
Domperidone	Equidone®	1.1 mg/kg, PO, SID
Equine FSH	eFSH	6.25 to 12.5 mg, IM, BID
GnRH (native)	LHRH	a) 2 to 50 µg/hr, SC, pulsatile or continuous infusion
		b) 50 to 500 µg, IM, BID to TID
Goserelin (GnRH agonist)	Zoladex®	One-third to one-half of a 3.6 mg implant, SC, once
hCG	Chorulon®	2,500 units, IV, once
Progesterone	Generic or Compounded	150 mg, IM, SID
Sulpiride	Compounded	[−] sulpiride 0.5 mg/kg, IM, SID or BID
		[±] sulpiride 1.0 mg/kg, IM, SID or BID

The symbols [−] and [±] refer to stereoisomers of sulpiride.

Estrus synchronization Goat / Sheep

Non Breeding season   PG ineffective

changing photoperiod or melatonin implants

progestagens + eCG

Transition period   Buck effect

Breeding season FGA, MAP oral   or CIDR-G and PGs

Sows:

Pre-pubertal Gilts Puberty 170-220 days : Boar effect

PG 600 (400 IU eCG + 200 IU hCG)

Cycling Gilts: Oral progestagens 17-L- hydroxyprogesterone

Altrenogest 10-15 mg/gilt/day for 18-20 days

PG (Estrogens not to be used as they extend life of CL)
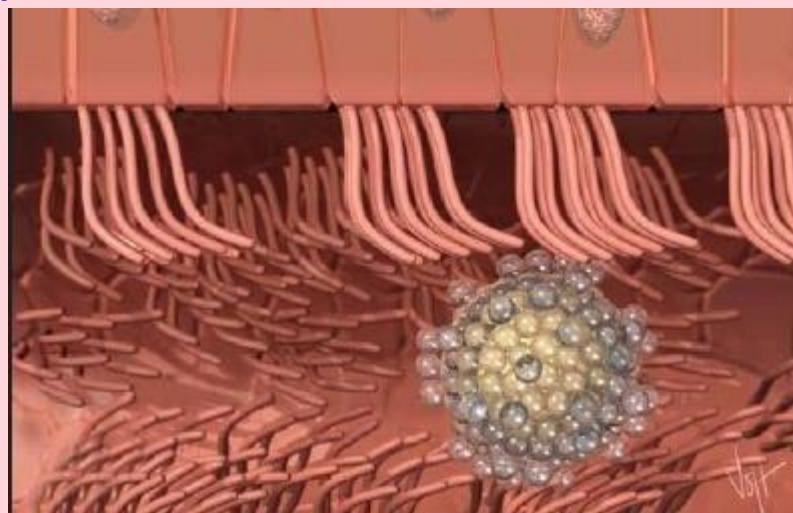
Methallibure 5mL (Non progestogenic pituitary inhibiting
substance)
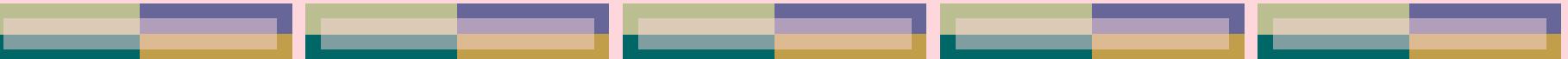
Fertilization

When an animal is in estrus it is either inseminated with semen or is mated with a male. The male deposits the male gamete (sperm) and female discharges the female gamete (ovum) which meet together to form the zygote. The zygote then develops sequentially for the complete gestation if the pregnancy is established and is delivered on completion of the gestation. The sequence of events that follow are described

An egg in the oviduct→

Gamete Transport : Fertilization depends upon the two gametes bumping into one another. In species with internal fertilization, which includes all mammals and birds, both sperm and egg must be transported into the oviduct, which serves as the site of fertilization.

Sperm Transport Semen is ejaculated and deposited initially into one of two sites:

the vagina (e.g. humans, cattle, rabbits) or the uterus (e.g. horses, pigs, rodents).

In species such as dogs, semen is probably deposited largely into the vagina, but

also forced into the uterus. Despite these differences in deposition site and significant differences in the number of sperm ejacuated, there is remarkably little variation among species in the total number of sperm that reach the oviducts. Typically, a few hundred to a few thousand sperm reach the oviducts following a single mating, which usually represents far less than one percent of the sperm in the ejaculate.

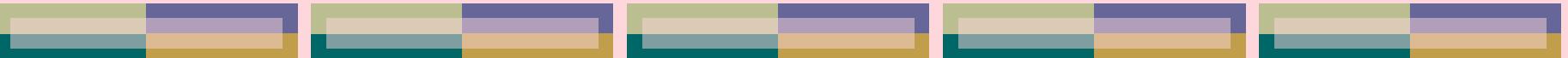The vagina represents a hostile environment for sperm, and their continued survival depends on getting into more hospitable regions of the female tract. In their journey from vagina to oviduct, sperm must overcome a series of barriers, each of which eliminates a substantial proportion of the original population of sperm. The sperm enters the cervical mucus.

The cervix connects the vagina to the uterus. The cervical canal follows an irregular, tortuous route, and the epithelium contains many deep crypts. The cervical epithelium is richly endowed with mucus-secreting cells, and, as a consequence, the lumen is filled with mucus. Interestingly, the consistency and viscosity of cervical mucus is under endocrine control. When estrogen levels are high and progesterone levels low, as occurs prior to ovulation, cervical mucus becomes watery and its mucin strands assume a parallel orientation. This state apparently greatly facilitates passage of sperm through the cervical canal. Conversely, when progesterone concentrations are high, as in the luteal phase of the cycle, cervical mucus becomes exceptionally viscous and disorganized, which largely precludes entry of sperm into the uterus.

The uterus does not present an active barrier, but sperm must somehow be transported directionally along its length.

Studies in several species have shown that sperm are able to get from the distal uterus to the oviducts in times as short as a few minutes, which is much too fast to be explained by sperm motility. Moreover, dead sperm and inanimate sperm-sized particles are rather efficiently transported upward through the uterine lumen. The conclusion from these types of studies is that sperm transport in the uterus is largely a result of uterine contractions, and that sperm motility plays a minor if any role in the process.

In most, but not all species, the uterus is also a site hostile to sperm. In many animals, sperm within the uterus are rapidly phagocytosed. In other cases, sperm can remain viable in the uterus for several days, but their fertility rapidly declines. There are some dramatic exceptions to these general observations.

The uterotubal junction is the region joining the tip of the uterine horn to the oviduct. The morphology of this region varies considerably among species, and and this structure appears to be a significant barrier to sperm especially in animals like rodents and pigs where huge numbers of sperm are deposited directly in the lumen of the uterus.

In summary, the vast majority of ejaculated sperm are lost at various points between the cervix and oviduct. A few exhausted semifinalists make it to the site of fertilization. Of those, of course, there can be only one "winner" for each egg. A few sperms may be lost in the peritoneum and some lost by retrograde movement outside the vagina.

Egg Transport

Mammalian eggs are ovulated from ovarian follicles as cumulus-oocyte complexes, which consist of the oocyte embedded in a cluster of follicle (cumulus) cells. The image to the right shows such a structure from a cow - the oocyte is encased in its zona pellucida, which is somewhat obscured by a cloud of follicle cells.
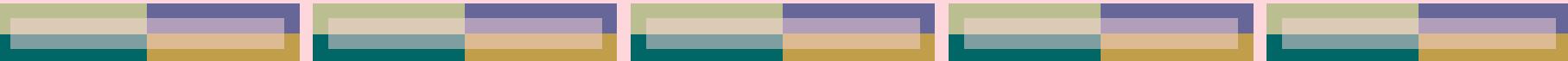
In order to reach the site of fertilization, the ovulated egg must be picked up and transported into oviduct through an opening called the ostium. In most mammals the ovarian end of the oviduct flares into a funnel-shaped structure called the fimbria, which is positioned to partially cover the ovary. The fimbria is densely covered with ciliated epithelial cells, which beat toward the ostium and propel the cumulus-oocyte complex into the oviduct.

In species such as the rodents and dogs, the ovary is enclosed completely or nearly completely in a thin membrane called the bursa. Because the ostium of the oviduct is inside the bursa, the eggs are essentially trapped after ovulation with no where to go except into the oviduct.

Once an oocyte enters the oviduct, it is propelled by ciliary motion down into the ampulla, where fertilization takes place. The oviduct provides the appropriate environment not only for fertilization, but for early embryonic development, and it is important that the embryo remain there for a period of about three days.
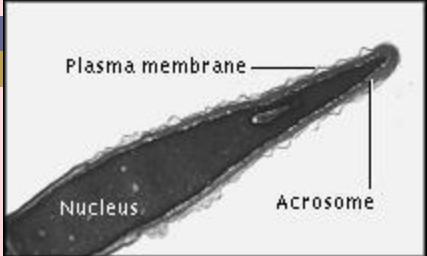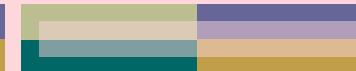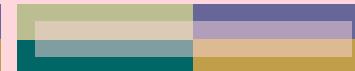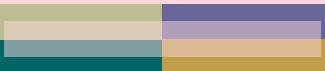
The Fertilizable Lifespan of Gametes

In most species, both sperm and egg have a short fertilizable lifespan, and once they are delivered into the female tract, the clock starts ticking. What this means, of course, if that mating or insemination must coincide closely with ovulation. If sperm are deposited many days before the egg reaches the oviduct, there is little chance that they will survive to fertilize. Conversely, if sperm reach the oviduct several days after ovulation, they will certainly find an egg that has long since degenerated.

Table 1 Fertile life of sperm and ova and embryonic development in farm animals

Species	Fertile life sperm hrs	Fertile life ovum hrs	Day of entry of embryo in uterus	Blastocyst formation
Cattle	30-48	20-24	3-3.5	7-8
Horse	72-120	6-8	4-5	6
Sheep	30-48	16-24	3	6-7
Swine	24-72	8-10	2	5-6

Structure of the Gametes Before Fertilization

Fertilization presents some major challenges to both sperm and egg:

- The fertilizing sperm must somehow recognize, bind to and ultimately traverse the zona pellucida surrounding the egg. It then must bind to the plasma membrane of the egg.

- The egg must not only respond to the fertilizing sperm in a number of ways, but actively prevent more than one sperm from fertilizing it. Fertilization by more than one sperm is bad.

In their mature form, both sperm and egg possess structures that allow them to fulfill these mission objectives.

Structure of the Sperm

Mature sperm, known formally as spermatozoa, have a morphology that most people over the age of ten would recognize immediately. The nucleus is contained within the head, which, for most mammals, has a flattened, oval shape. During spermiogenesis, the haploid sperm cell develops a tail or flagellum, and all of its mitochondria become aligned in a helix around the first part of the tail, forming the midpiece. The entire cell is, of course, enveloped by a plasma membrane. The images above to the right shows these structures at the light microscopic level with a bull sperm.

The other structure in the mature sperm that plays a critical role in fertilization is the **acrosome**. The acrosome is, in essence, a gigantic lysosome that forms around the anterior portion of the nucleus. It is bounded by a membrane that is considered to have two faces - the *inner acrosomal membrane* faces the nucleus, while the *outer acrosomal membrane* is in close contact with the plasma membrane.
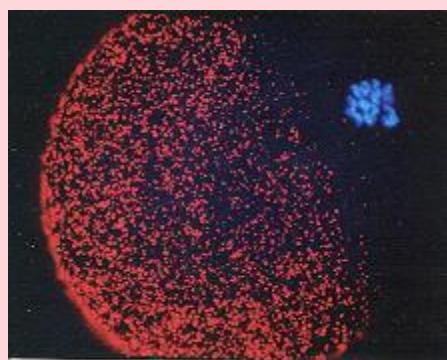
Structure of the Egg
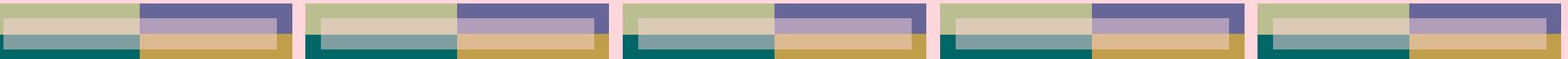
Most mammals ovulate an "egg" that has matured into a secondary oocyte; it is always the secondary oocyte that is fertilized. The secondary oocyte is produced along with the first *polar body* as a result of the first meiotic division. Both of these cells are encased in a thick glycoprotein shell called the zona pellucida. The images below shows a secondary oocyte from a mouse; residual follicle cells have been stripped away.

Genetically, the secondary oocyte that arrives in the oviduct is in metaphase of the second meiotic division. The *metaphase plate* is located inside the oocyte immediately below the first polar body.

The final structural feature of the egg that serves a critical function during fertilization is a set of *cortical granules*. During oogenesis, the oocyte develops thousands of small membrane-bound granules that accumulate in the cortical cytoplasm, just beneath the plasma membrane.

Normal secondary oocytes and a oocyte showing cortical granules (red dots)

Fertilization Successful fertilization requires not only that a sperm and egg fuse, but that not more than one sperm fuses with the egg. Fertilization by more than one sperm - polyspermy - almost inevitably leads to early embryonic death In overview, fertilization can be described as the following steps:

Sperm Capacitation

Freshly ejaculated sperm are unable or poorly able to fertilize. Rather, they must first undergo a series of changes known collectively as capacitation. Capacitation is associated with removal of adherent seminal plasma proteins, reorganization of plasma membrane lipids and proteins. It also seems to involve an influx of extracellular calcium, increase in cyclic AMP, depletion of sperm cholesterol and decrease in intracellular pH. The molecular details of capacitation appear to vary somewhat among species.
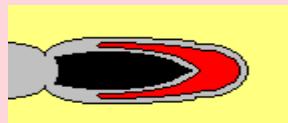
Capacitation occurs while sperm reside in the female reproductive tract for a period of time, as they normally do during gamete transport. The length of time required varies with species, but usually requires several hours. The sperm of many mammals, including humans, can also be capacitated by incubation in certain fertilization media. Sperm that have undergone capacitation are said to become hyperactiviated, and among other things, display hyperactivated motility. Most importantly however, capacitation appears to destabilize the sperm's membrane to prepare it for the acrosome reaction, as described below.

Sperm-Zona Pellucida Binding

Binding of sperm to the zona pellucida is a receptor-ligand interaction with a high degree of species specificity. The carbohydrate groups on the zona pellucida

glycoproteins function as sperm receptors. The sperm molecule that binds

 this receptor is not known with certainty, and indeed, there may be several

proteins that can serve this function.

The acrosome reaction are changes that provide the sperm with an enzymatic drill to get throught the zona pellucida. The same zona pellucida protein that serves as a sperm receptor also stimulates a series of events that lead to many areas of fusion between the plasma membrane and outer acrosomal membrane. Membrane fusion (actually an exocytosis) and vesiculation expose the acrosomal contents, leading to leakage of acrosomal enzymes from the sperm's head. As the acrosome reaction progresses and the sperm passes through the zona pellucida, more and more of the plasma membrane and acrosomal contents are lost. By the time the sperm traverses the zona pellucida, the entire anterior surface of its head, down to the inner acrosomal membrane, is denuded. Sperm that lose their acrosomes before encountering the oocyte are unable to bind to the zona pellucida and thereby unable to fertilize. Assessment of acrosomal integrity of ejaculated sperm is commonly used in semen analysis.
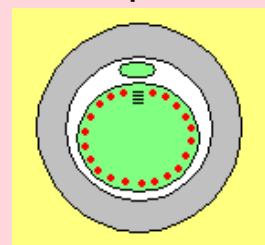
Penetration of the Zona Pellucida
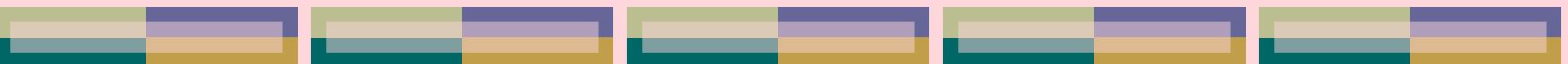
The constant propulsive force from the sperm's flagellating tail, in combination with acrosomal enzymes, allow the sperm to create a tract through the zona pellucida. These two factors - motility and zona-digesting enzymes- allow the sperm to traverse the zona pellucida. Some investigators believe that sperm motility is of overriding importance to zona penetration, allowing the knife-shaped mammalian sperm to basically cut its way through the zona pellucida.

Sperm-Oocyte Binding

Once a sperm penetrates the zona pellucida, it binds to and fuses with the plasma membrane of the oocyte. Binding occurs at the posterior (post-acrosomal) region of the sperm head.

The molecular nature of sperm-oocyte binding is not completely resolved. A leading candidate in some species is a dimeric sperm glycoprotein called **fertilin**, which binds to a protein in the oocyte plasma membrane and may also induce fusion.

Egg Activation and the Cortical Reaction

Prior to fertilization, the egg is in a quiescent state, arrested in metaphase of the second meiotic division. Upon binding of a sperm, the egg rapidly undergoes a number of metabolic and physical changes that collectively are called *egg activation*. Prominent effects include a rise in the intracellular concentration of calcium, completion of the second meiotic division and the so-called cortical reaction.

The cortical reaction refers to a massive exocytosis of cortical granules seen shortly after sperm-oocyte fusion. Cortical granules contain a mixture of enzymes, including several proteases, which diffuse into the zona pellucida following exocytosis from the egg. These proteases alter the structure of the zona pellucida, inducing what is known as the zona reaction. Components of cortical granules may also interact with the oocyte plasma membrane.

The Zona Reaction

The zona reaction refers to an alteration in the structure of the zona pellucida catalyzed by proteases from cortical granules. *The critical importance of the zona reaction is that it represents the major block to polyspermy* in most mammals. This effect is the result of two measurable changes induced in the zona pellucida:

1. *The zona pellucida hardens.* Crudely put, this is analogous to the setting of concrete. Runner-up sperm that have not finished traversing the zona pellucida by the time the hardening occurs are stopped in their tracks.

2. *Sperm receptors in the zona pellucida are destroyed.* Therefore, any sperm that have not yet bound to the zona pellucida will no longer be able to bind, let alone fertilize the egg.

Post-fertilization Events

Following fusion of the fertilizing sperm with the oocyte, the sperm head is incorporated into the egg cytoplasm. The nuclear envelope of the sperm disperses, and the chromatin rapidly loosens from its tightly packed state in a process called decondensation. In vertebrates, other sperm components, including mitochondria, are degraded rather than incorporated into the embryo.

Chromatin from both the sperm and egg are soon encapsulated in a nuclear membrane, forming pronuclei. The image below shows a one-cell rabbit embryo shortly after fertilization - this embryo was fertilized by two sperm, leading to formation of three pronuclei, and would likely die within a few days.

Each pronucleus contains a haploid genome. They migrate together, their membranes break down, and the two genomes condense into chromosomes, thereby reconstituting a diploid organism.
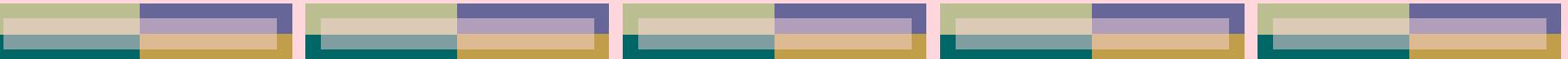

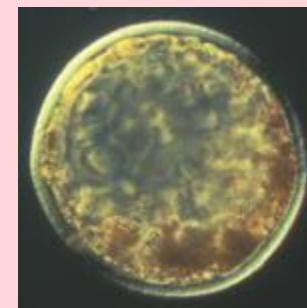← A fertilized egg showing male and female pronuclei

Cleavage and Blastocyst Formation

The product of fertilization is a one-cell embryo with a diploid complement of chromosomes. Over the next few days, the mammalian embryo undergoes a series of cell divisions, ultimately leading to formation of a hollow sphere of cells

known as a blastocyst. The one cell embryo undergoes a series of **cleavage divisions**, progressing through 2-cell, 4-cell, 8-cell and 16 cell stages. A four cell embryo is shown above. The cells in cleavage stage embryos are known as **blastomeres**. Early on, cleavage divisions occur quite synchronously. In other words, both blastomeres in a two-cell undergo mitosis and cytokinesis almost simultaneously. For this reason, recovered embryos are most commonly observed at the two, four or, eight-cell stage. Embryos with an odd number of cells (e.g. 3, 5, 7) are less commonly observed, simply because those states last for a relatively short time. Soon after development of the 8-cell or 16-cell embryo (depending on the species), the blastomeres begin to form tight junctions with one another, leading to deformation of their round shape and formation of a mulberry-shaped mass of cells called a **morula**. This change in shape of the embryo is called **compaction**. It is difficult to count the cells in a morula. At some point between fertilization and blastocyst formation, the embryo moves out of the oviduct, into the lumen of the uterus. Formation of junctional complexes between blastomeres gives the embryo an outside and an inside. The outer cells of the embryo also begin to express a variety of membrane transport molecules, including sodium pumps. One result of these changes is an accumulation of fluid inside the embryo, which signals formation of the **blastocyst**.

As the blastocyst continues to accumulate blastocoelic fluid, it expands to form - an **expanded blastocyst**. The blastocyst stage is also a landmark in that this is the first time that two distinctive tissues are present. A blastocyst is composed of a hollow sphere of **trophoblast cells**, inside of which is a small cluster of cells called the **inner cell mass**. Trophoblast goes on to contribute to fetal membrane systems, while the inner cell mass is destined largely to become the embryo and fetus. In the expanded blastocyst shown here, the inner cell mass is the dense-looking area at the botton of the embryo. Eventually, the stretched zona pellucida develops a crack and the blastocyst escapes by a process called **hatching**. This leaves an empty zona pellucida and a **zona-free or hatched blastocyst** lying in the lumen of the uterus. Depending on the species, the blastocyst then undergoes implantation or elongates rapidly to fill the uterine lumen.
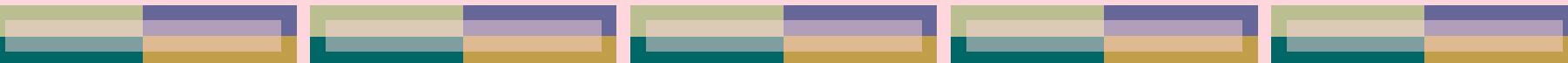
Morula and blastocyst →→→

The length of time required for preimplantation development varies somewhat, but not drastically, among species.

In addition to the morphological changes in the embryo, preimplantation development is associated with that might be called an awakening of the embryonic genome. There is, for instance, little transcription in the embryos of most species prior to the 8 cell stage, but as embryos develops into morulae, then blastocysts, a large number of genes become transcritionally active and the total level of transcription increases dramatically.

Attachment and Implantation Implantation is the first stage in development of the placenta. In most cases, implantation is preceeded by a close interaction of embryonic trophoblast and endometrial epithelial cells that is known as **adhesion** or **attachment**.

Among other things, attachment involves a tight intertwining of microvilli on the maternal and embryonic cells. Following attachment, the blastocyst is no longer easily flushed from the lumen of the uterus. In species that carry multiple offspring, attachment is preceeded by a remarkably even spacing of embryos through the uterus. This process appears to result from uterine contractions and in some cases involves migration of embryos from one uterine horn to another (transuterine migration).

The effect of implantation in all cases is to obtain very close apposition between embryonic and maternal tissues. There are, however, substantial differences among species in the process of implantation, particularly with regard to "invasiveness," or how 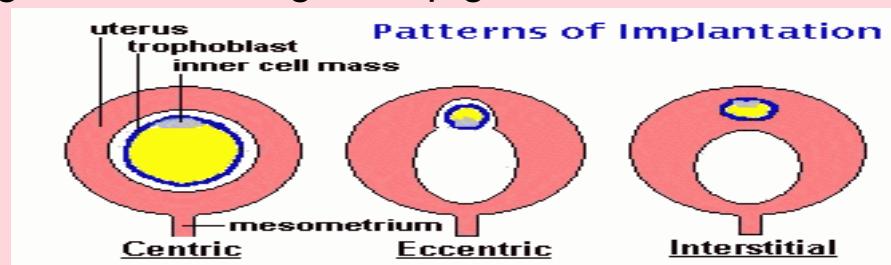much the embryo erodes into maternal tissue. In species like horses and pigs, attachment and implantation are essentially equivalent. In contrast, implantation in humans involves the embryo eroding deeply into the substance of the uterus. Many years ago, three fundamental patterns of implantation were described, based on the position the blastocyst assumes in the uterus:

- **Centric:** the embryo expands to a large size before implantation, then remains in the center of the uterus. *Examples include carnivores, ruminants, horses, and pigs.*
- **Eccentric:** The blastocyst is small and implants within the endometrium on the side of the uterus, usually opposite to the mesometrium. *Examples include rats and mice.*
- **Interstitial:** The blastocyst is small and erodes through endometrial epithelium into subepithelial connective tissue. Such implantation is often called nidation ("nest making"). *Examples include primates, including humans, and guinea pigs.*

Patterns of Implantation — uterus, trophoblast, inner cell mass, mesometrium — Centric, Eccentric, Interstitial

It has been difficult to attribute any particular advantage to the degree of invasiveness seen during implantation. One possible exception is that most species having highly invasive embryos have systems for prenatal transfer of a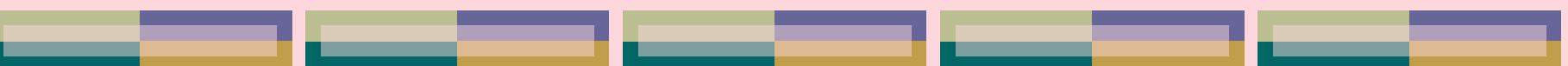ntibodies from the mother to the fetus. For eccentric and interstitial implantations, what allows the embryo to invade the uterine substance? In some species it appears that the blastocyst is a passive participant, and the underlying endometrium degenerates. In other cases, including carnivores and probably humans, the embryo seems to be the aggressor and trophoblast actively invades into the endometrium. It's likely that both tissues participate to some degree.

In species that undergo interstitial implantation, an interesting phenomenon called the decidual cell reaction occurs. This involves transformation of uterine stromal and endothelial cells into a tissue called the decidua, which becomes a substantial portion of the placenta and is expelled with the remainder of the placenta at the time of birth. The decidua is a prominent feature of the human placenta.

It is clear that steroid hormones from the ovary are necessary to prepare the endometrium for implantation and for the process of implantation itself. In some species, progesterone alone appears to be adequate, while in others, estrogen and progesterone are required for implantation.

In addition to the differences among species in the implantation process per se, there are also situations in which the timing of implantation varies. The usual case is for attachment and implantation to occur within a few days after the blastocyst reaches the uterus. In many animals, however, implantation can be delayed for substantial periods of time, during which the blastocyst enters a quiescent state called embryonic diapause. Delayed implantation seems to be a strategy used to regulate time of birth so that it occurs when environmental conditions are favorable.

Implantation : Attachment of the embryo with the uterus occurs at 18-20 days in cow, 37-42 days in mares and on day 15 in sheep and day 18 in sow. Muc-1 the antiadhesive factor decrease at implantation and the adhesive factors like integrins increase. The blastocyst penetrate the uterine mucosa in rodents and primates. It is superficial and non-invasive in farm animals.

Spacing: Even distribution of embryos in the uterus in the multiparous species

Maternal recognition of pregnancy: identification by the dam the presence of viable embryos in the uterus and involves the secretion of certain proteins like interferon-tau (INF-t), pregnancy associated glycoproteins (bPAG) or trophoblastic proteins (oTP-1, c-TP) in the ruminants and estradiol in the sow which block the prostaglandin synthesis. In the mare the estradiol by the developing feto-maternal axis and the embryo mobility in the uterus are signals for pregnancy maintenance.

Gestation (Pregnancy)

Gestation is the intrauterine period of development of the fertilized gamete from fertilization to parturition in mammals.

Reproductive organ changes during gestation

The vulva is tight and small sized during pregnancy but near parturition its size increases and it relaxes

The vagina is pale during gestation but congested near parturition

The cervix remains tightly closed during pregnancy by cervical seal

The uterus is relaxed and grows in size sequentially synchronous to the growth of the fetus and its fluids. The uterus enters the abdominal cavity in cows due to growth. In the cow and mare the uterus rests on thee abdominal floor beneath the intestines after the 4th month of pregnancy. The growth is first downward, then forward and subsequently upwards

The CL on the ovary persists for entire gestation in cows, buffaloes, goats and sow. This CL is known as CL verum. In mares accessory CL develop by day 35 and endometrial cups are formed in the uterus.

Species	Gestation Period
Cow	280 ±
Sheep	146 ±
Horse	360
Pig	116 ±
Cat	60
Dog	60
Human	270
Mouse	20

Placenta: Specialised Structure that connects the fetus with the mother and is responsible for physiologic exchange between the mother and the fetus

Umbilical cord: The structure that connects the fetus with the placenta

Classification of Placenta
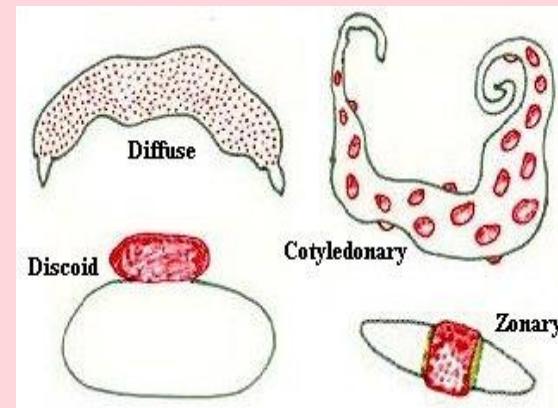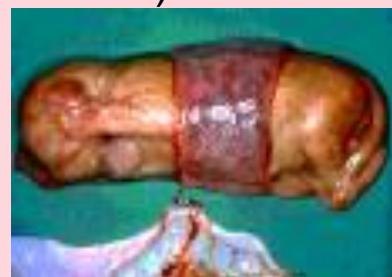
Based on gross shape the placenta is

                Cotyledonary (cattle, buffalo, sheep, goat)

                Diffuse (mare sow and camel)

                Zonary (bitch, cat)

                Discoidal (man)

Based on microscopic structure

        Epitheliochorial (horse, pig)

        Synepitheliochorial (ruminants: cow, buffalo, sheep, goat)

        Endotheliochorial (dog and cat)

        Haemochorial (man, rodents)

Based on loss of tissue at birth

        Deciduate (maternal tissue lost at birth: man and rodents)

        Partially deciduate (dog, cat)

        Non-deciduate (no loss of maternal tissue at birth: pigs, horses, ruminants)

Chorioallantois, Chorionic villi, Umbilical blood vessels (fetal), Uterine vein and artery, Endometrium

Functions of placenta
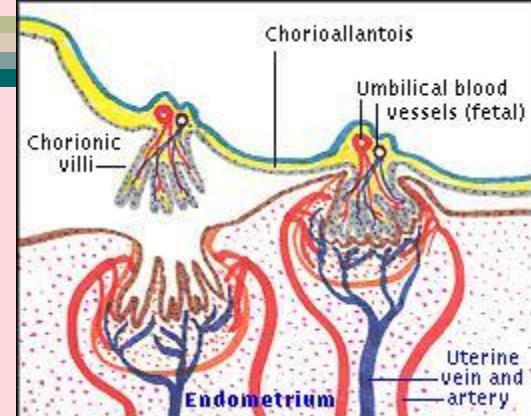
Gaseous exchange   Equine placental attachments→

Nutrient exchange

Endocrine:→production of progesterone, estrogen and placental lactogen
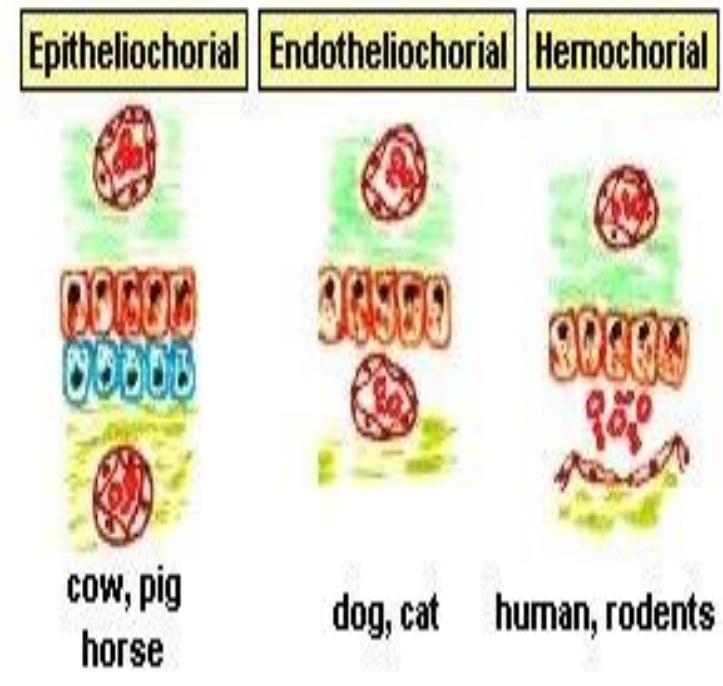
Fetal growth
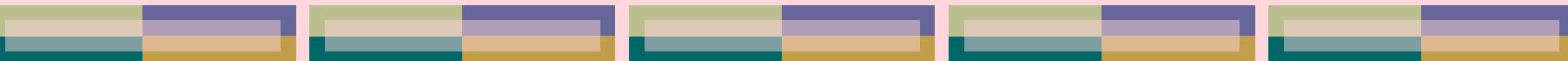
Rapid during early stages, then declines and maximum fetal growth during the last 1-2 months of gestation.

Placental Layers

Interposing tissues	Epithelio-chorial	Endothelio-chorial	Hemo-chorial
Maternal: Endothelium, Connective tissue, Epithelium (endometrium)			Intervillous space
Fetal: Epithelium (trophoblast), Connective tissue, Endothelium			
	Horse, Cow, Pig, Sheep	Dog, Cat	Man, Rodents

3rd ed. Fig 22

Epitheliochorial	Endotheliochorial	Hemochorial
cow, pig horse	dog, cat	human, rodents

Transport Across the Placenta The primary function of the placenta in all species is to promote selective trans port of nutrients and waste products between mother and fetus. Such transport is facilitated by the close approximation of maternal and fetal vascular systems within the placenta.

It is important to recognize that there normally is no mixing of fetal and maternal blood within the placenta. Entry of small amounts of fetal blood into the maternal circulation does occasionally occur, and can evoke an immune response in the mother that affects that fetus after birth or fetuses in subsequent pregnancies that are sired by the same father.

The placenta is a complex tissue and should not be envisioned as simple permeable membrane. In addition to transporting some molecules unaltered between fetal and maternal blood, it also con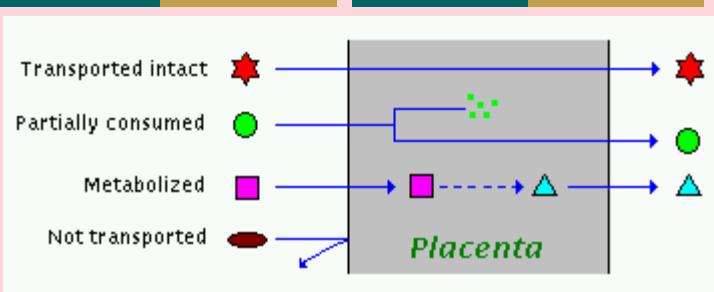sumes a large fraction of certain types of cargo - glucose and oxygen being good examples. Additionally, a number of molecules that cross the placenta are metabolized to other things during passage. There are a number of differences among species in the characteristics of transport across the placenta, which should not be a big surprise considering the differences in structure of the placental interface. The following discussions reflect general principles of placental transport.

Transport of Gases

Gases like oxygen and carbon dioxide diffuse through and across tissues in response to differences in partial pressure.

In late pregnancy, the mean partial pressure of oxygen (P_{02}) in maternal blood is considerably higher than in fetal blood. As a consequence, oxygen readily diffuses across the placenta from maternal to fetal blood.

Despite its low P_{O2}, fetal blood is able to transport essentially the same quantity of oxygen to tissues as maternal blood. This is because the hemoglobin concentration in fetal blood is about 50% higher than in maternal blood, and the majority of hemoglobin in the fetus is fetal hemoglobin, which has a higher oxygen carrying capacity than adult hemoglobin.

Carbon dioxide is produced abundantly in the fetus, and the P_{CO2} of fetal blood is higher than maternal blood. Carbon dioxide therefore diffuses from fetal blood, through the placenta, into the maternal circulation, and is disposed of by expiration from the mother's lungs.
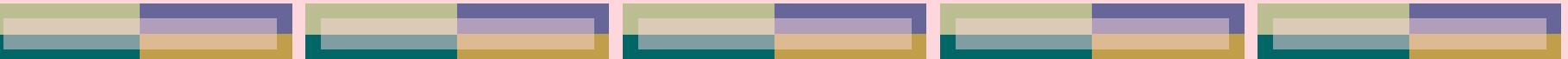
Nutrients

Glucose is the major energy substrate provided to the placenta and fetus. It is transported across the placenta by facilitated diffusion via hexose transporters that are not dependent on insulin (GLUT3 and GLUT1). Although the fetus receives large amounts of intact glucose, a large amount is oxidized within the placenta to lactate, which is used for fetal energy production.

Amino acid concentrations in fetal blood are higher than in maternal blood. Amino acids are therefore transported to the fetus by active transport. A family of at least 10 sodium-dependent amino acid transporters have been identified in placenta that serve this function. There is substantial metabolism of some amino acids as they cross the placenta - for example, much of the serine taken up by the placenta is converted to glycine prior to delivery to the fetus.

There is much more variability among species in placental permiability to fatty acids than to glucose or amino acids. In some animals, there is little transport of fatty acids from mother to fetus, while in others a significant amount of transport takes place.

Antibodies

There are marked differences among species in whether immunoglobulins are transported across the placenta. In primates and rodents, there is substantial transfer of immunoglobulin G from maternal to fetal circulations prior to birth. This process requires immunoglobulin-binding proteins in the placenta.

In contrast, there is no transplacental transfer of immunoglobulins in animals like cattle, sheep, horses and pigs. In those species, the neonate is essentially devoid of circulating antibodies until it absorbs them from colostrum (first milk).

Other Molecules

Bilirubin is a waste product derived from the heme in hemoglobin. This lipophilic molecule is conjugated in the liver to make it water-soluble, and eliminated by excretion into bile. The fetus also produces bilirubin, but conjugates only a small fraction. This is good because conjugated bilirubin is transported across the placenta very poorly. In contrast, unconjugated fetal bilirubin is readily transported from the fetal circulation, across the placenta, for elimination by the mother.

Many drugs are eliminated in bile through pathways similar to bilirubin. The relative inability of the fetal liver to metabolize and conjugate means that it is impaired for eliminating such molecules compared to adults.

Placental Hormones In addition to its role in transporting molecules between mother and fetus, the placenta is a major endocine organ. It turns out that the placenta synthesizes a huge and diverse number of hormones and cytokines that have major influences on ovarian, uterine, mammary and fetal physiology, not to mention other endocrine systems of the mother.

Steroid Hormones

Sex steroids are the best known examples of placental hormones. Two major groups are produced by all mammals:

Progestins: Progestins are molecules that bind to the progesterone receptor. Progesterone itself is often called the hormone of pregnancy because of the critical role it plays in supporting the endometrium and hence on survival of the conceptus.

The placentae of all mammals examined produce progestins, although the quantity varies significantly. In some species (women, horses, sheep, cats), sufficient progestin is secreted by the placenta that the ovaries or corpora lutea can be removed after establishment of the placenta and the pregnancy will continue. In other animals (cattle, pigs, goats, dogs), luteal progesterone is necessary throughout gestation because the placenta does not produce sufficient amounts.
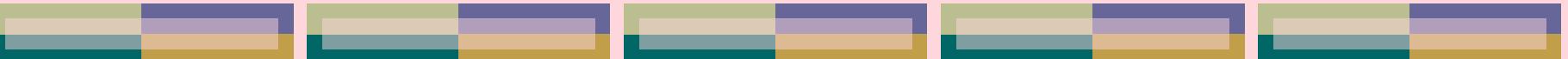
Progestins, including progesterone, have two major roles during pregnancy:

- *Support of the endometrium* to provide an environment conducive to fetal survival. If the endometrium is deprived of progestins, the pregnancy will inevitably be terminated.

Suppression of contractility in uterine smooth muscle, which, if unchecked, would clearly be a disaster. This is often called the "progesterone block" on the myometrium. Toward the end of gestation, this myometrial-quieting effect is antagonized by rising levels of estrogens, thereby facilitating parturition.

Progesterone and other progestins also potently inhibit secretion of the pituitary gonadotropins luteinizing hormone and follicle stimulating hormone. This effect almost always prevents ovulation from occuring during pregnancy.

Estrogens: The placenta produces several distinct estrogens. In women, the major estrogen produced by the placenta is estriol, and the equine placenta synthesizes a unique group of estrogens not seen in other animals. Depending on the species, placental estrogens are derived from either fetal androgens, placental progestins, or other steroid precursors.
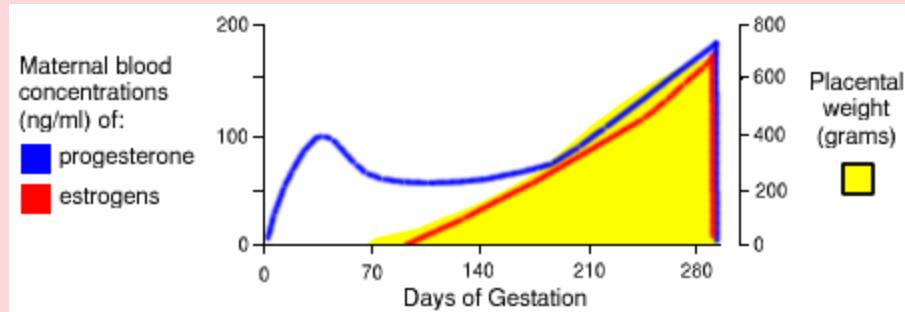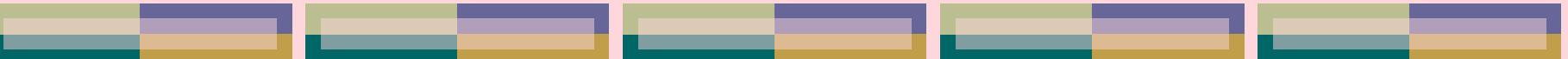
With few exceptions, the concentration of estrogens in maternal blood rises to maximal toward the end of gestation. Two of the principle effects of placental estrogens are:

- *Stimulate growth of the myometrium and antagonize the myometrial-suppressing activity of progesterone.* In many species, the high levels of estrogen in late gestation induces myometrial oxytocin receptors, thereby preparing the uterus for parturition.

- *Stimulate mammary gland development.* Estrogens are one in a battery of hormones necessary for both ductal and alveolar growth in the mammary gland.

Like progestins, estrogens suppress gonadotropin secretion from the pituitary gland. In species like humans and horses, where placental estrogens are synthesized from androgens produced by the fetus, maternal estrogen levels are often a useful indicator of fetal well being.

The image below depicts changes in concentrations of progesterone and estrogens in the maternal serum of humans through gestation.

Protein Hormones

Several protein and peptide hormones are synthesized in placentae of various species. They have effects on the mother's endocrine system, fetal metabolism and preparation of the mother for postpartum support of her offspring.

Chorionic gonadotropins: As the name implies, these hormones have the effect of stimulating the gonads, similar to the pituitary gonadotropins. The only species known to produce a placental gonadotropin are primates and equids.

The human hormone is called **human chorionic gonadotropin** or simply hCG. This hormone is produced by fetal trophoblast cells. It binds to the luteinizing hormone receptor on cells of the corpus luteum, which prevents luteal regression. Thus, hCG serves as the signal for maternal recognition of pregnancy. The first hormone you produced was hCG!
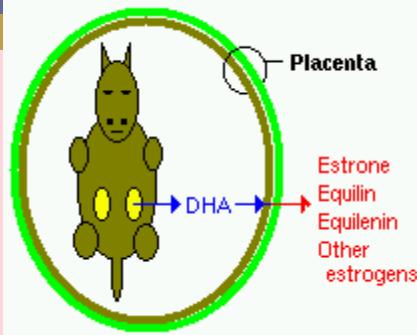
Equine chorionic gonadotropin is also produced by fetal trophoblast cells. It is actually the same molecule as equine luteinizing hormone but basically has FSH like activity.

Placental lactogens: These hormones are molecular relatives of prolactin and growth hormone. These hormones have been identified in primates, ruminants and rodents, but not in other species.

The functions of placental lactogens are not well understood. They are thought to modulate fetal and maternal metabolism, perhaps mobilizing energy substrates for fetal use. In some species they have been shown to stimulate function of the corpus luteum, and to participate in development of the mammary gland prior to parturition.

Relaxin: Relaxin is a hormone thought to act synergistically with progesterone to maintain pregancy. It also causes relaxation of pelvic ligaments at the end of gestation and may therefore aid in parturation. In some of the species in which relaxin is known to be produced, it is produced by the placenta, while in others, the major source is the corpus luteum. In some species, relaxin is produced by both the corpus luteum and placenta.

Placenta

Estrone
Equilin
Equilenin
Other
estrogens

DHA

The Equine placental hormones

Progestins: The equine placenta appears not to synthesize progesterone. However, it secretes copious quantities of progestins (5-alpha-pregnanes), which serve the same function for maintainance of pregnancy. Toward the end of gestation, blood levels of these progestins are typically 100 times the maximal level of progesterone.

Estrogens: In has been known for many decades that mare urine contains high concentrations of estrogens during the second and third trimesters of pregnancy. Indeed, a large industry has developed for collection of pregnant mare urine, which is used to produce *Premarin*, an estrogen replacement therapy used widely by post-menopausal women.

The equine embryo begins to synthesize estrogens at roughly 12-14 days of gestation, well before development of the placenta. This early estrogen apparently does not escape the uterus and probably has only local effects. Estrogen levels in the serum and urine of pregnant mares begins to rise around day 60 of gestation, peaks at about day 200 and, in contrast to other species, declines during the remainder of gestation.

Estrogens are synthesized in the equine placenta from androgens that are produced by the fetal gonads. The gonads of both male and female fetuses synthesize and secrete into umbilical blood large quantities of the androgen dehydroepiandrosterone (DHA). Within the placenta, DHA is metabolized to a number of different estrogens, most prominently **estrone, equilin and equilenin**. Equilin and equilenin are estrogens that are apparently unique to pregnant equids.

HORMONES IN PREGNANT MARES

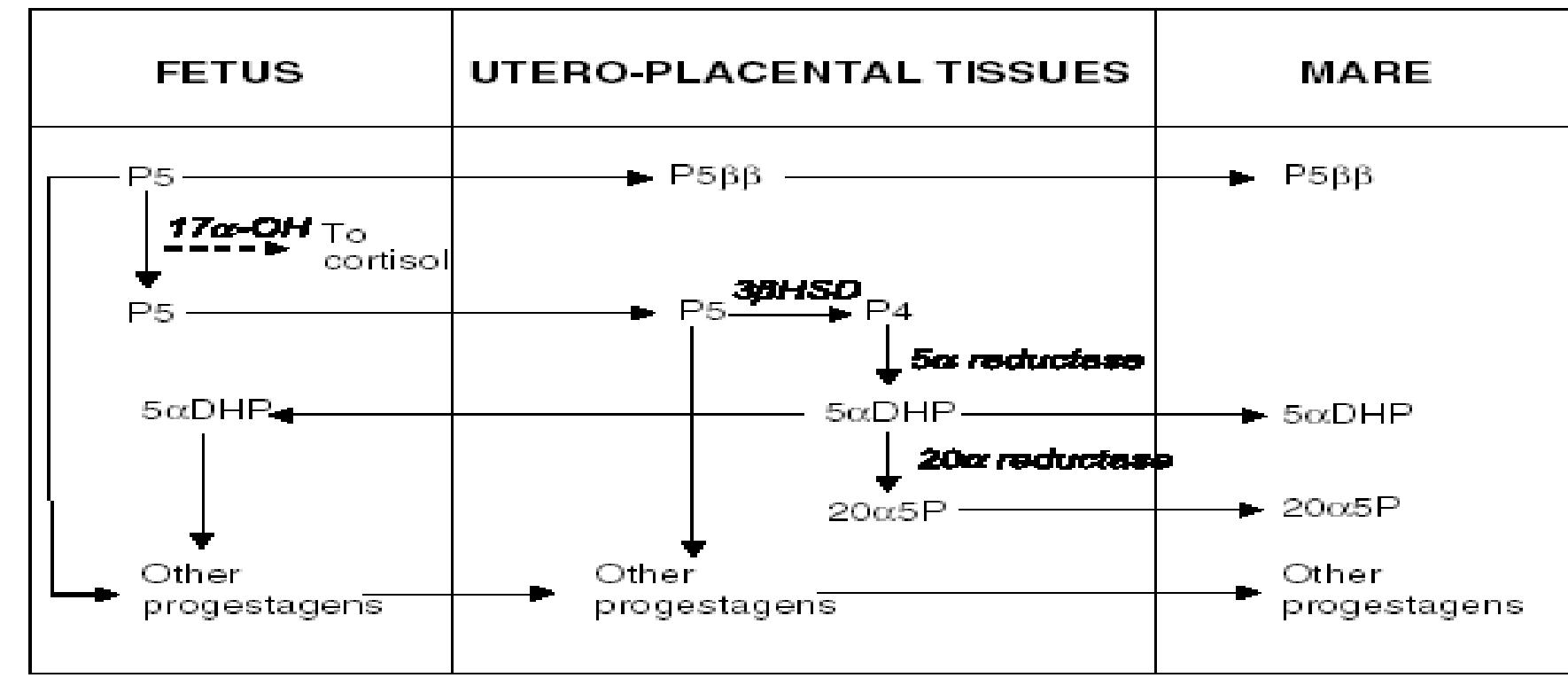| FETUS	UTERO-PLACENTAL TISSUES	MARE
P5	P5ββ	P5ββ
17α-OH To cortisol		
P5	P5 *3βHSD* P4	
	5α reductase	
5αDHP	5αDHP	5αDHP
	20α reductase	
	20α5P	20α5P
Other progestagens	Other progestagens	Other progestagens
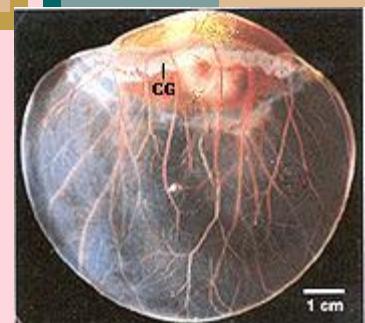
Fig. 1. Simplified diagram showing the progestagen biosynthetic pathway in the fetus, UP tissues, and mare in late gestation. The pathway to cortisol is also shown. 5α-DHP, 5α-pregnane,3,20-dione; P5ββ, pregnanediol; 20α-5P, 20α-hydroxy-5α-pregnan-3-one. Other progestagens include 3β-hydroxy-5α-pregnan-20-one, 5α-pregnane-3β, 20β-diol, 5α-pregnane-3β, 20a-diol, 20α-hydroxyprogesterone, and 20β-hydroxyprogesterone. Enzymes include *3β-hydroxysteroid dehydrogenase (3β-HSD)* and *17α-hydroxylase (17α-OH)*. (*Adapted from* Ousey JC, Forhead AJ, Rossdale PD, et al. Ontogeny of uteroplacental progestagen production in pregnant mares during the second half of gestation. Biol Reprod 2003;69(2):540–8.)

Endometrial Cups and Secretion of Equine Chorionic Gonadotropin

Shortly after establishment of pregnancy in equids, high concentrations of the hormone equine chorionic gonadotropin (eCG) appear in the mare's serum. This hormone is also called pregnant mare's serum gonadotropin

and is actually equine luteinizing hormone. The source of eCG is a placenta-associated structure called an endometrial cup, which is derived from the fetus, forms several weeks into gestation, and is immunologically destroyed 2 to 3 months later.

Endometrial cups develop from cells of the chorionic girdle, which can first be detected histologically at roughly 25 days of gestation. Initially, this structure is a narrow band of thicked trophoblast that develops circumferentially around the conceptus at a point where the membranes of the allantois and yolk sac meet.

Trophoblastic epithelial cells of the girdle proliferate to form ridges, and later glands, that abut against and are flattened by the surface of the endometrium. A mucoid material secreted into the glands adheres to the endometrium and tends to hold the girdle in place. In the image above, the chorionic girdle (CG) can be seen encircling the upper portion of the embryo

Beginning on days 36 to 38 of gestation, hyperplastic girdle cells begin to rapidly invade and destroy underlying endometrium. In this process they denude surface endometrial epithelial cells and migrate down into endometrial glands, eventually breaking through the basement membrane and invading into the underlying stroma. Within 2 to 3 days after entering the uterine stroma, they round up and differentiate into mature eCG-secreting endometrial cup cells. .

Girdle cell invasion and proliferation result in formation of tightly packed mass of trophoblast-derived cells containing little stroma - these are the endometrial cups. Invasion of endometrial glands leads to destruction of their apical epithelium; deeper segments of those glands are spared, but their lumens are obstructed by cup cells and they become distended with secretions.

Endometrial cups reach their maximum size and eCG output about 55 to 70 days into gestation, at which time they appear as pale, circular or U-shaped plaques on the surface of the endometrium. Their size and shape varies tremendously, from approximately 1 cm circles to ribbons of tissue at least 10 cm in length. At this mature stage, the differentiated trophoblast cells are distinctive - they are round and almost always binucleate.

Development of the cups is paralleled almost from their beginning by a striking maternal cellular immune response. This response is initially seen as an accumulation of T lymphocytes at the periphery of the cups, and progresses to a massive accumulation of T cells, B cells, macrophages and other leukocytes in the stroma surrounding the cups. After day 70 to 80, these leukocytes begin to invade the destroy the base of the cup. Eventually, the entire cup is destroyed and sloughs completely from the endometrial surface; the time of this event varies significantly among mares, but usually occurs between days 100 and 140.

Immunological destruction of the endometrial cups appears to be a response to paternal class I MHC antigens, which are highly expressed on invading girdles cells. In conjunction with the cellular response is a vigorous humoral immune response to these antigens.

Several interesting observations observations on endometrial cup biology have been made in interspecific equine pregnancies. In mares carrying donkey conceptuses, the chorionic girdle fails to invade the endometrium, and endometrial cups do not develop. Most of these pregnancies are aborted between days 80 and 90, but the roughly 30% that survive and are carried to term do so in the absense of eCG. However, in donkeys carrying a hinney fetus, the cups develop to a much larger size and considerably higher concentrations of eCG are achieved than in donkeys carrying a donkey fetus.

Canine and feline Placenta

The canine placenta looks very similar to that of cats. A feature usually seen in the placentae of both species is *marginal hematomas* (hematophagus zones). These are bands of maternal hemorrhage at the margins of the zonary placenta. The products of hemoglobin breakdown give them a distinctly green coloration in dogs, whereas in cats they are brownish and usually less obvious. The canine placenta is said to produce little if any quantity of steroid hormones. As with other species, maintainance of pregnancy is dependent on continued secretion of progesterone during gestation, but corpora lutea appear to be the exclusive source of progesterone in the bitch. Luteal secretion of progesterone is, in turn, dependent on secretion of luteinizing hormone and probably prolactin from the anterior pituitary. Removal of the ovaries at any time during canine gestation leads to termination of the pregnancy. Also, progesterone profiles in pregnant and pseudopregnant bitches are indistinguishable until late in gestation or diestrus.
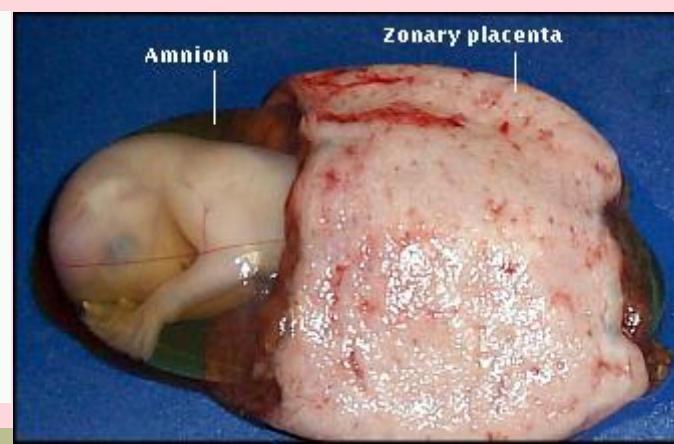
In cats, serum progesterone concentrations are similar in pregnant and pseudopregnant animals for roughly the first 3 weeks after ovulation. After that time, progesterone concentrations decline in pseudopregnant cats, but increase in pregnant cats. It is not known with certainty whether this elevation of progesterone in pregnancy reflects placental synthesis or enhanced luteal synthesis. Apparently, the ovaries can be removed after about day 45 in cats without interupting the pregnancy, which might suggest that the placenta can indeed synthesize progesterone.

Both dogs and cats produce the hormone relaxin during pregnancy. In pregnant bitches, relaxin is first detected in serum about 4 weeks into gestation, and increases relaxin is first detected in serum about 4 weeks into gestation, and increases substantially during the remainder of gestation. The placenta is known to be the primary site of secretion of relaxin in dogs, although a smaller contribution is made by the ovaries and luteal synthesis of relaxin persists for several weeks after parturation. *Relaxin is not present in serum of pseudopregnant bitches, and thus can be reliably used as a pregnancy test.*

The cat placenta also produces copious quantities of relaxin, beginning about 20 days of gestation. As with dogs, relaxin has not been detected in the serum of cycling or pseudopregnant cats.
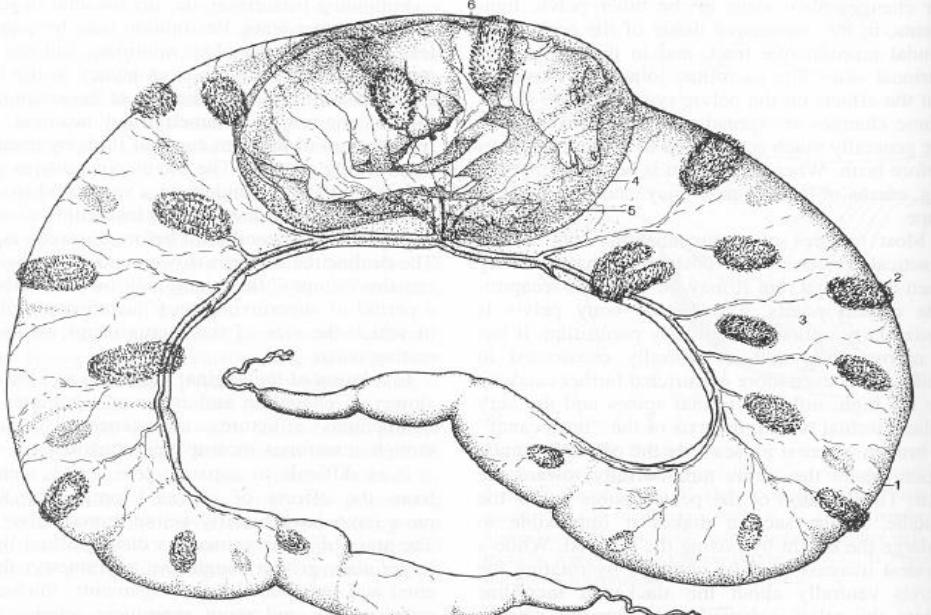

Relaxin during canine pregnancy

Serum Relaxin (ng/ml)

Weeks of Gestation
(adapted from Steinetz, et al. 1989)

Amnion   Zonary placenta

Figure 29-26. A bovine fetus within its membranes. The villi are mainly restricted to the cotyledons.
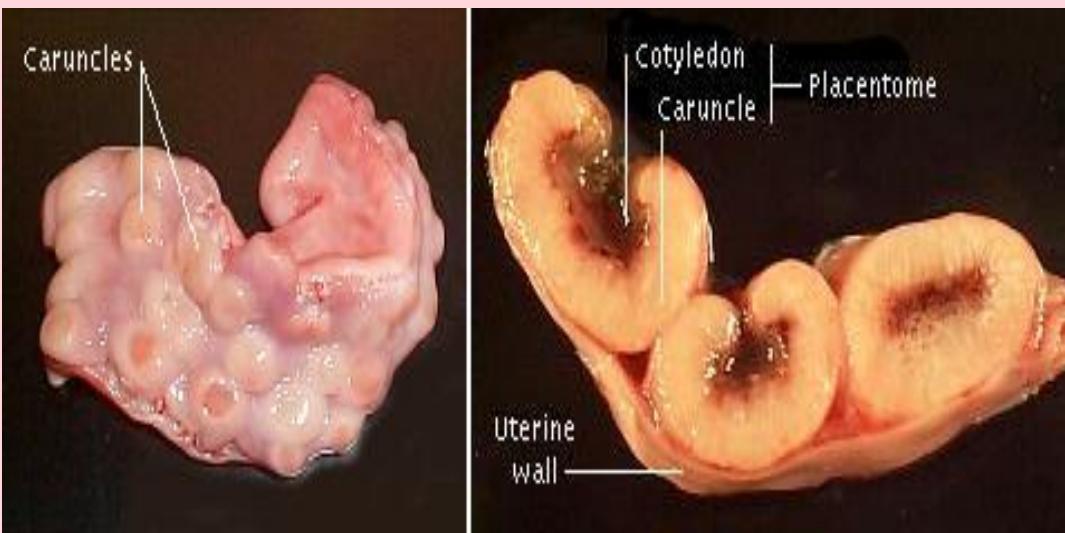
1, Chorioallantois; 2, cotyledon; 3, allantoic cavity; 4, amnion; 5, amniotic cavity; 6, chorioamnion.

DSW,

- Amniotic plaques : soft irregular white epithelial thickenings in amnion
- Hippomanes(allantoic calculi) soft free floating rubber like masses in cow, horse, sheep, goat and pig in the allantois
- Cervical star: Irregular bare spot in the chorion of mare over internal os
- Uterine sand dried granular blood clots

Cotyledon: the fetal side of the placenta
Caruncle: the maternal side of the placenta
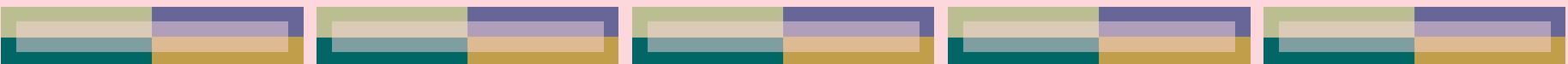**Placentome**: a cotyledon and caruncle together

Fetal Fluids during pregnancy: The urine from early fetuses produced by the mesonephros passes to the allantoic cavity through urachus till day 90 in sheep. Then it passes to the amniotic fluid. Other sources of amniotic fluid are the fetal salivary glands and lungs. There is constant swallowing of fluids by the fetus and this may maintain an equillibrium. The fetal fluids increase throughout gestation but decline at term in the pig. The allantoic fluids are higher than the amniotic fluids.

Fetal fluids in cattle The total quantity of fetal fluid of cattle increases progressively throughout pregnancy; it averages about 5 litres at 5 months and 20 litres at term. Sharp rises in the total quantity occur between 40 and 65 days, between 3 and 4 months and againbetween 6.5 and 7.5 months. The first and last of these are due to allantoic and the second to amniotic increases.

Throughout gestation the allantoic fluid is watery or urine like. In the first two thirds of pregnancy the amniotic fluid is similar but for the remainder of gestation it is mucoid fluid. This change gives it the lubricant property which is helpful at parturition for fetal delivery. At birth the allantoic sac forms the first and the amnion the second water bag. The allanto-chorion is thicker and tougher than the transparent amnion.

camel placenta→

Methods of pregnancy diagnosis

Clinical

1. Rectal palpation
2. Abdominal ballotment
3. Radiography
4. Ultrassonography

Laboratory

1.Hormones
P4, E2, eCG, relaxin
2.Pregnancy assoc proteins
bPAG, ePF

Visual

Return to estrus
increase in abdominal size
Increase in udder size (4 months)
Increased fetal movements (6 month)
Tail cocking camel
(14-15 day of mating)

Pregnancy diagnosis

Recto-genital palpation

Cows: Increase in uterine size & softening

Amniotic vesicle 35-45 days (1.5 cm)

        (65-70 days not palpable)

Fetal membrane slip 35-90 days

Placentomes 80 days to term
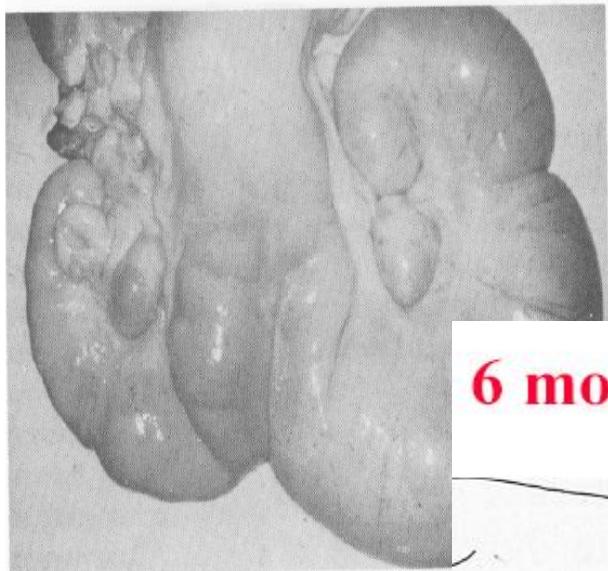
Fetus 65-70 day onward

Middle uterine artery 90 day onward
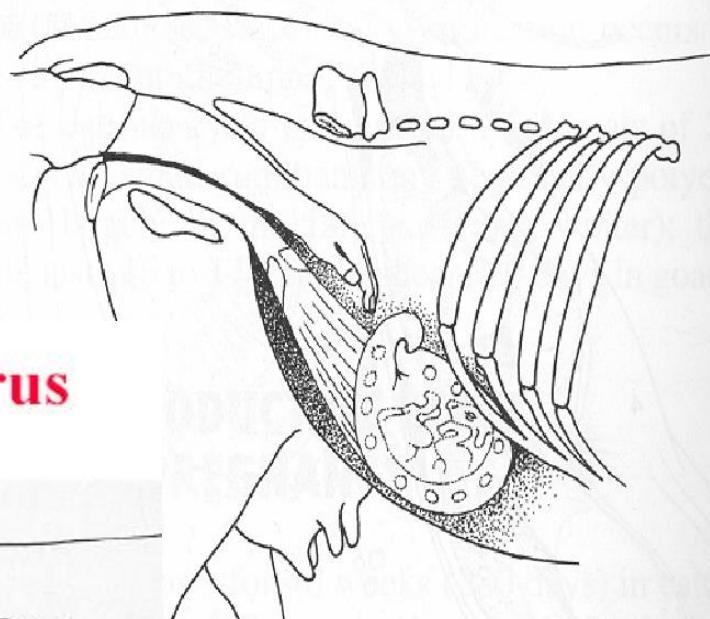
Ovaries not palpable beyond 4-5 months

Vaginal discharge beyond 5 months
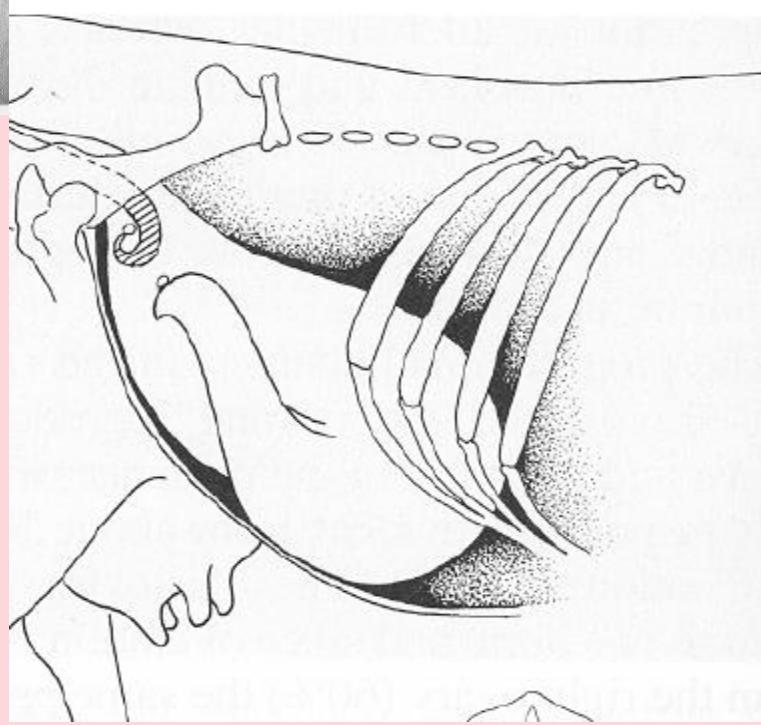
60-70 Day Pregnant Cow Uterus
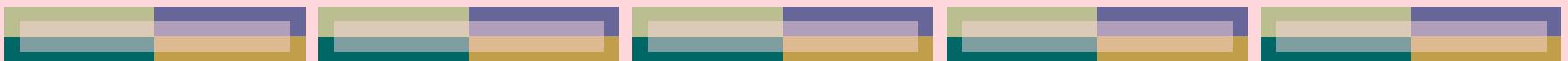
At 5 months the uterus is temporarily out of reach

6 month gravid uterus

Mare
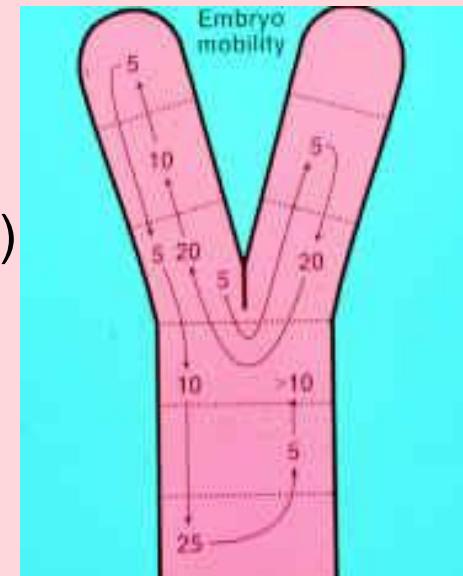
Uterine tone 16-50 days

Amniotic vesicle 25-28 days bulge (60 days football size)

Fetus palpable by day 90 (difficult 5-7 months)

Uterine descent by day 100 Ovaries descent 3-5 months

 beyond 5 months ovaries not palpable

Radiography

Sheep and goat 70 days onwards

Bitch 6 week onward

Good for counting fetal numbers

Spalding sign: Overlapping of fetal cranial

                          bones in dead fetuses

- Ultrasonography
- Uses sound frequencies beyond 20000 Hz (1 MHz to 12 MHz)
- Real time A(Amplitude mode) B(brightness) mode and M (motion) mode
- Probes Linear array, sector or curvilinear (Transrectal, transabdominal and transvaginal probes)
- Trans-rectal probes for large animals 5-10 MHz frequency
- Trans-abdominal probes for small animals 1.0 to 4.5 MHz frequency
- Coupling gel neccessary

Echotexture terminology

Echotexture terminology of a tissue structure relative to the surrounding tissue
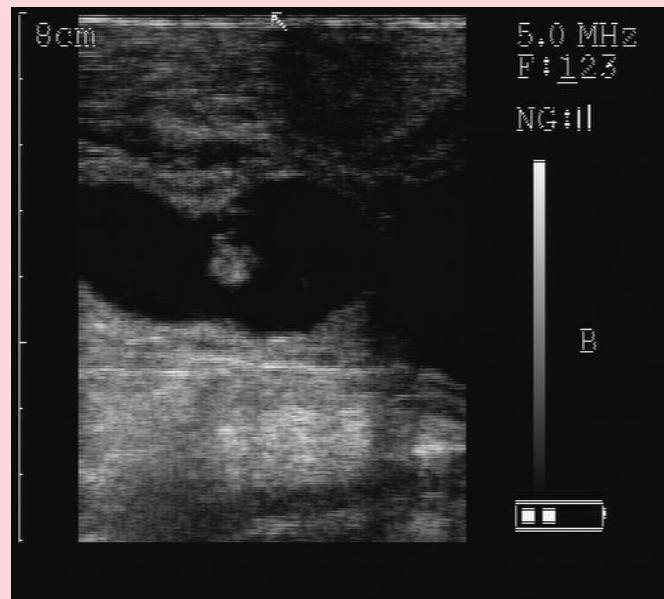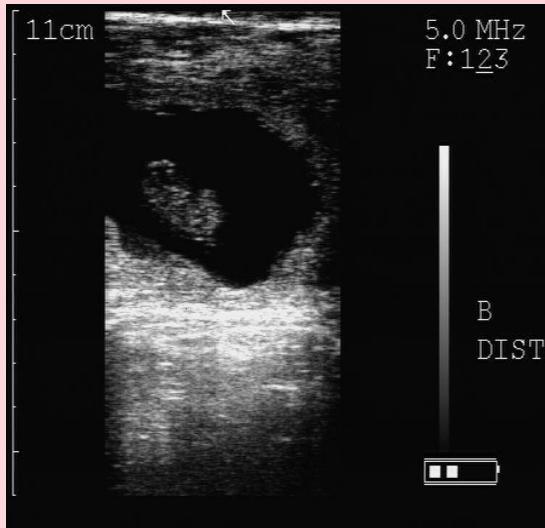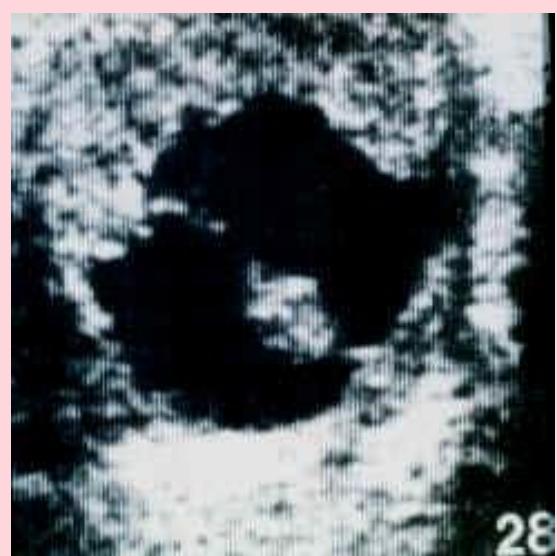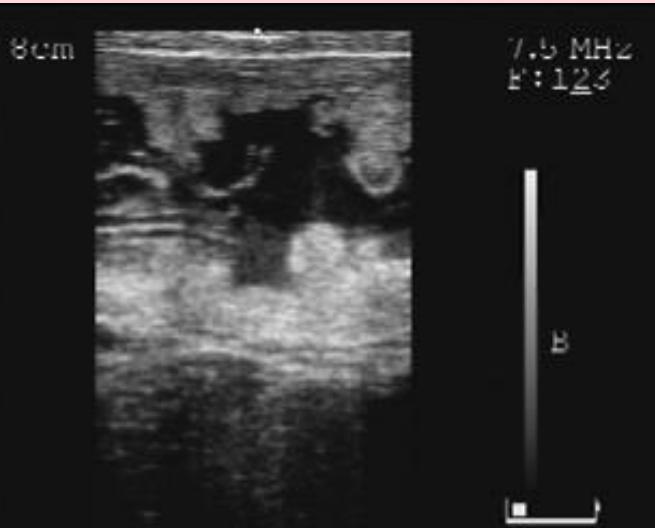
Table I. **Summary of indications and characteristics of different types of probes used in bovine reproduction**
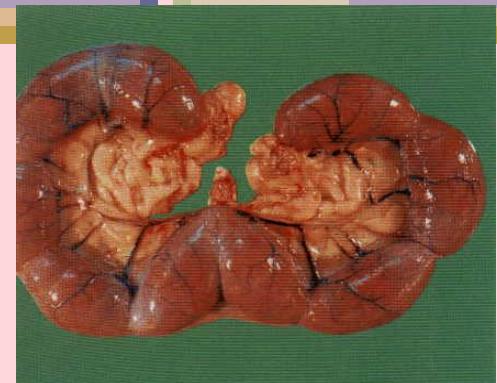
3.5 MHz (Low frequency)	5 MHz (Intermediate frequency)	7.5 MHz (High frequency)
High display depth (0-20 cm)	Intermediate display depth (0-12 cm)	Intermediate display depth (0-12 cm)
Reduced axial and lateral resolution	Reduced axial and lateral resolution	Reduced axial and lateral resolution
Advanced pregnancy Post-partum uterus	Follicles and *corpus luteum* Pregnancy diagnosis Fetal sexing	Follicles and *corpus luteum* Pregnancy diagnosis

Ultrasonography technique and sonograms showing anechoic fluid and echogenic fetus during pregnancy in cattle

Ultrasonographic appearance of different structures

Fetal heart beat   18-20 days

Fetal heart beat   25-30 days

Cotyledons   35-40 days cow   40-50 day sheep (Trans-abd)

Fetal sex   57-60 day cow   60-70 day mare

Transrectal probe 5.0 – 7.7 MHz   Cow, buffalo, mare, camel

Transrectal (Prostatic) probe 5.0 – 7.5 MHz   Sheep/Goat before day 40

Trans-abdominal probe 2.5 – 3.75 MHz   Sheep/Goat- beyond day 40

                                    Bitch, cat

Doppler ultrasound   Sow

Abdominal ballotment
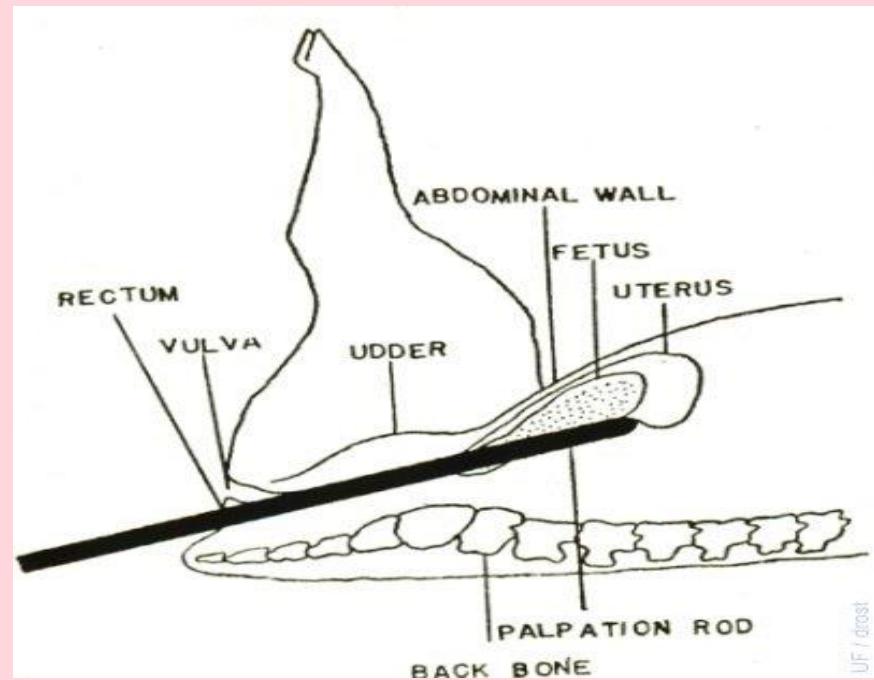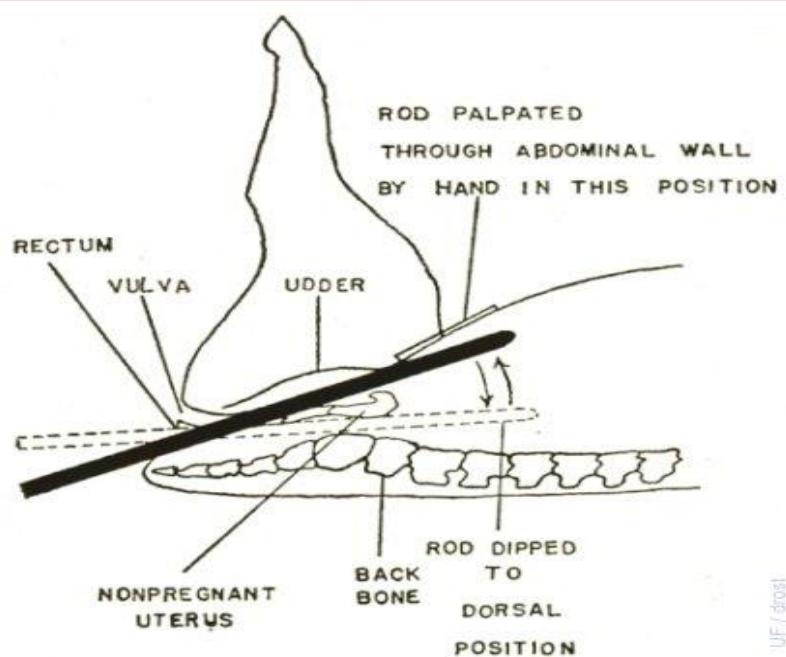
Cows   beyond 7 months
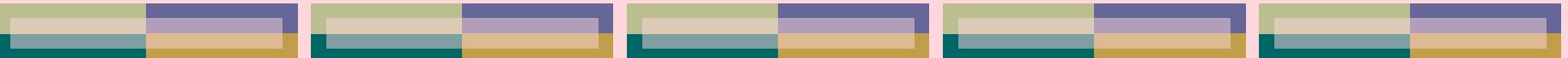
Fetal sacs sometimes palpable in the bitch
   at 30 days

Rectal abdominal method – sheep(rod method)

Digital manipulation goat

Palpation of fetus 4months goat 50 days bitch

Laboratory tests

Assay of hormones

Progesterone 18-24 days post-breeding 98-100%
      accurate for non-pregnant regularly cycling cows
      75-80% accurate for pregnant cows.
      Useless for the bitch

Estrogens

Mare	Maternal estrogens high after 60 days. Conjugated urinary estrogens high after 150 days
Cow/buffalo	Maternal estrogens high after100 days.
Goats	Maternal estrogens high after 50 days.
Sows	Rise at 20 days peak at 25-30 days, decline at 45 days and rise again at 70 – 80 days to term
Bitch	Slightly elevated at implantation and high for rest of gestation

Chemical tests to detect urinary estrogens

cows   barium chloride test→Urine + BaCl2→heat a white ppt if positive.

mares mucin test (dark staining cells on vaginal smears)

cubonis test→15 ml urine + 3 ml HCl→heat(10 min and cool) add 18 ml benzol→collect benzol layer and add 10 ml H_2SO_4 and heat(5min) a green fluorescence in a positive case

eCG   Currently Elisa, RIA have replaced older tests

Older tests (biologic tests)

Ascheim Zondek test Inject pregnant mare serum to rats

Freidmans test (Rabbit test)

Toad test

Relaxin Pregnant bitches placenta secrete relaxin

from 20-30 days of gestation

Assay of pregnancy specific proteins
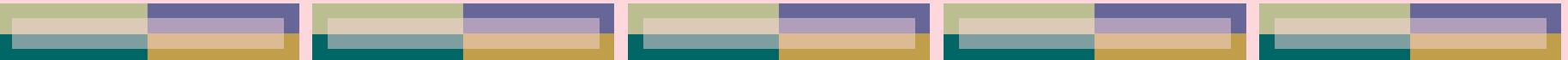
bPAG (PSPB) placenta specific 29-30 days post breeding RIA needed

EPF (RIT) 24-48 h of fertilization and these molecules disappear within

48 h of fetal death

Vaginal biopsy vaginal epithelial cells decrease from 20 layers at estrus to 3-4 layers at 18-22 days of pregnancy in sows and sheep.

Problems of pregnancy

FETAL   Fetal Death   Before day 45 EED
                              Abortion
                              Mummification
                              Maceration
      Fetal compromise   Monsters
                              Dropsical conditions: Ascites, Anasarca, Hydrocephalus
MATERNAL   Dropsy of the placental membranes Hydroallantois, Hydroamnion
            Abdominal, inguinal, umbilical hernias
            Rupture of prepubic tendon
            Ectopic pregnancy
            Rupture of vagina
            Cervico-vaginal prolapse
            Uterine torsion
            Metabolic disorders
            Prolonged gestation
            Hydrometra
            Prolapse
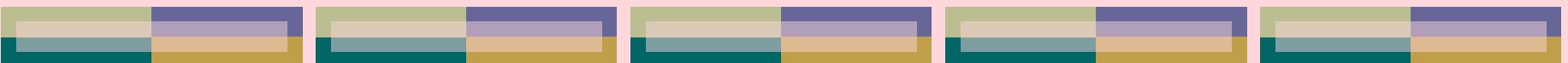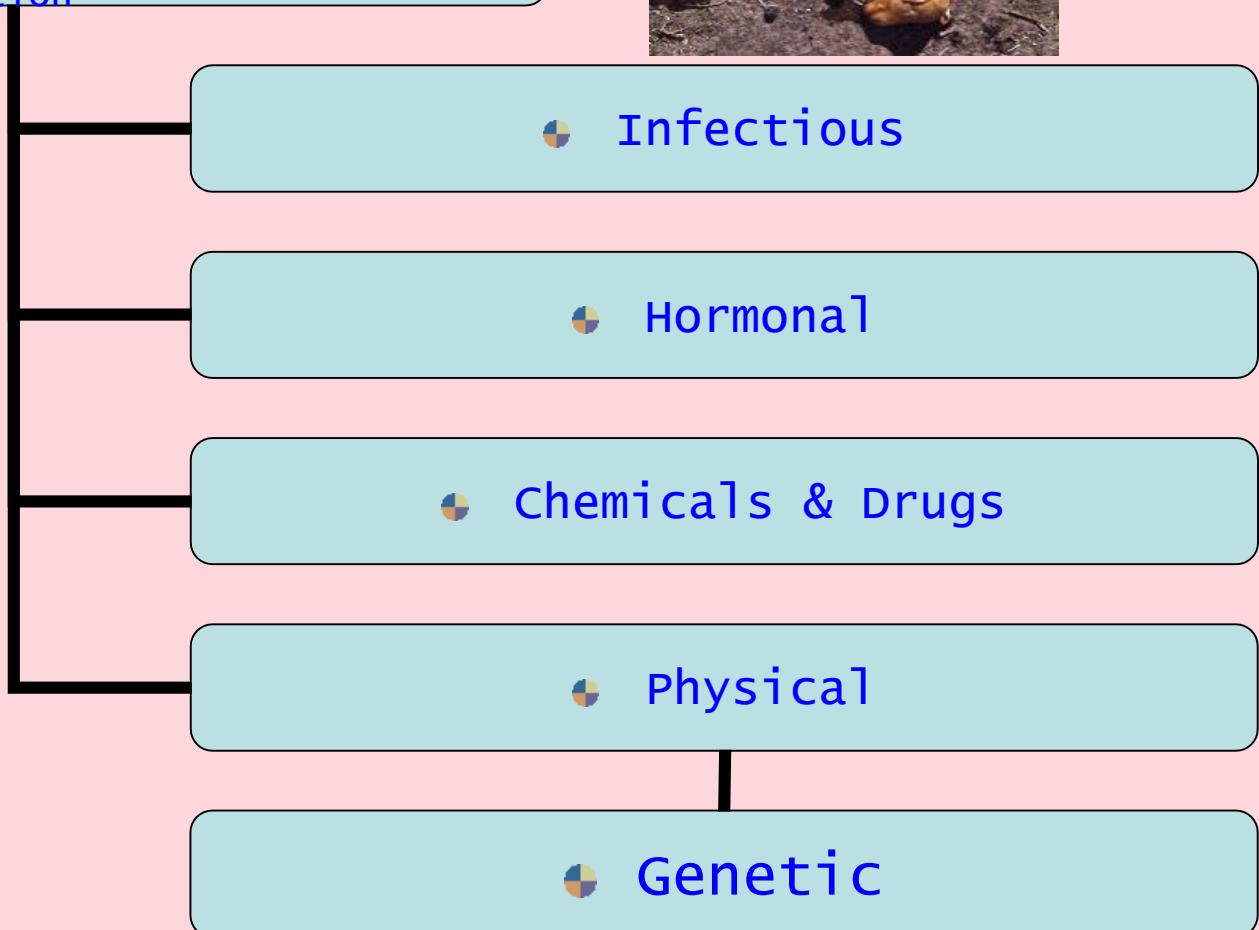
FETAL PROBLEMS EED & ABORTION

Abortion: Expulsion of a fetus that is incapable of independent life before completion of gestation

- Infectious
- Hormonal
- Chemicals & Drugs
- Physical
- Genetic

Fetal mummification: Fetal death without CL Lysis during last third of gestation
↓

Haematic (cattle,buffalo) →blood because of cotyledon involution(Fig 1 and 2)

Papyraceous (dogs, cats, swine) paper like (Fig 4)

Etiology: Campylobacter, BVD, Leptospira, Hog cholera & Aujeskeys disease in pigs
            Torsion of umbilical cord

Clinical findings anestrus or shrinkage of udder in primipara

Diagnosis Rectal palpation of a thick wall and mummy like fetus

Therapy: PG, manual removal after PG, laparohysterotomy

1

2
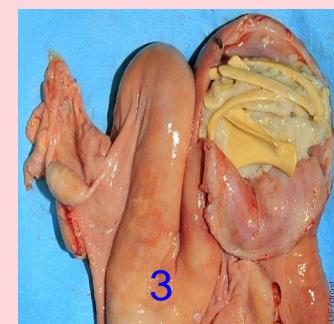
Fetal maceration(Fig 3) common in cattle and buffalo

Failure of abortion of a dead fetus (after fetal bones formation) followed by disintegration
    with a partially open cervix. Fetal death due to many reasons.
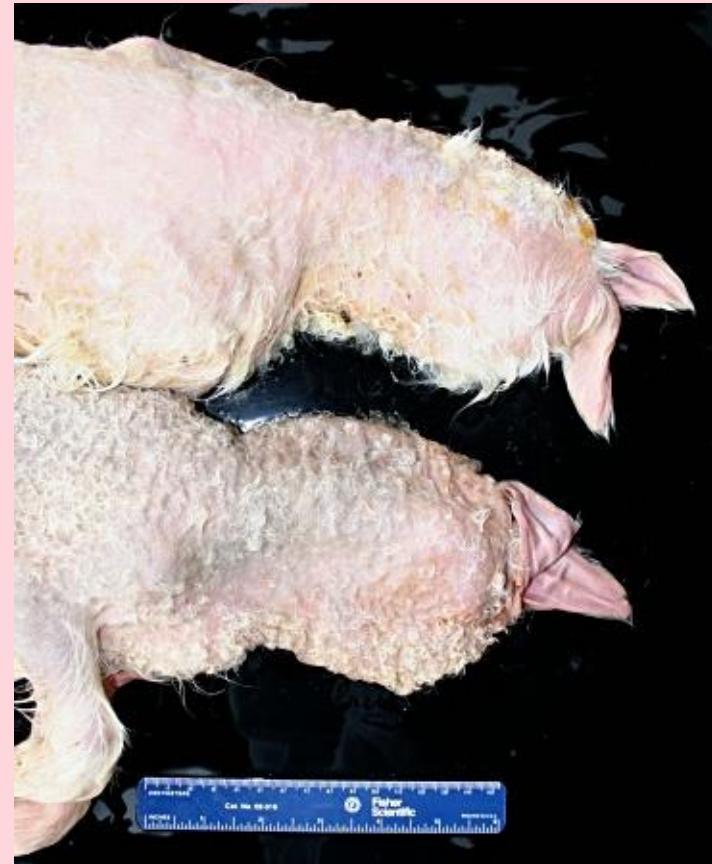
Clinical signs of discharge of pus with fetal bones
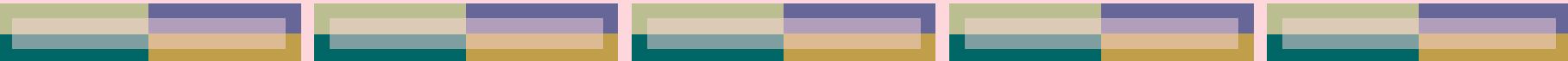
Diagnosis: rectal finding of thick walled uterus, discharge of bones and pus

Therapy: PG and manual removal of bone pieces

4

3

Fetal dropsical conditions: Fetal ascites (accumulation of fluid in abdoomen), Anasarca (generalised subsutaneous edema and Hydrocephalus (fluid in meninges of the brain) Figures below show hydrocephalus

Hernias are seen in many species
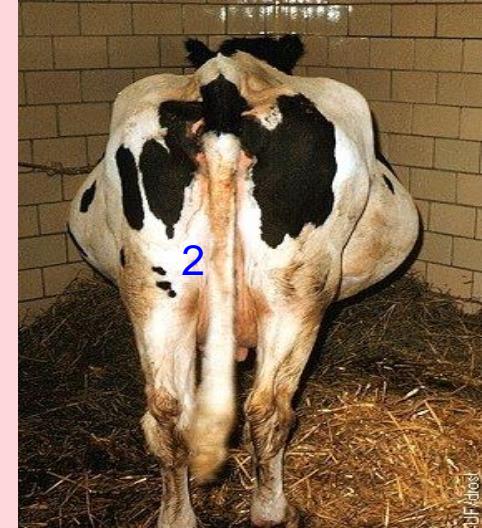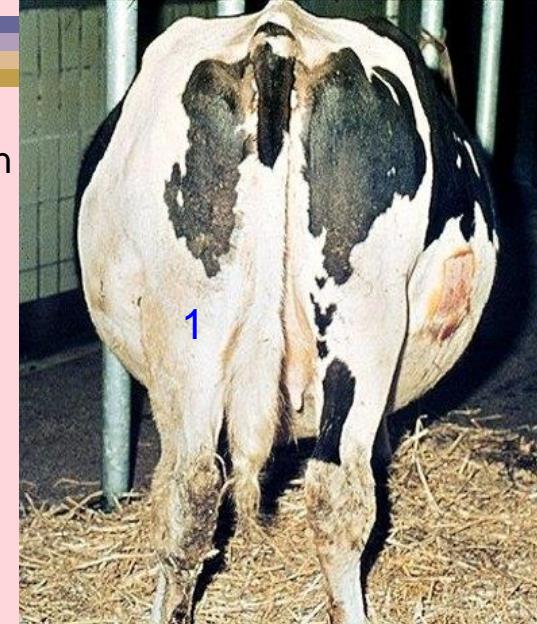
1) Ventral and 2) perineal hernia in a sheep 3) Inguinal hernia in a female camel and 4) surgical correction of inguinal hernia in camel

Dropsy of Placental membranes 1 Hydroallantois 2 Hydroamnion

	Hydrops amnion	Hydrops allantois
Incidence	n	15n
Onset	Insidous (5-6 months of gestation)	Rapid (7-8 months of gestation)
Calf	Abnormal (Cleft palate)	Normal
Placenta	Normal	Abnormal diseased
Fluid	Mucoidal (80 litres)	Watery (80-200 litres) Normal fluid 8-15 litres
Prognosis	Guarded	Poor
Abdomen	Pear shape	Apple shape

Rupture of prepubic tendon (Desmorrhexis)

Common in heavy idle mares
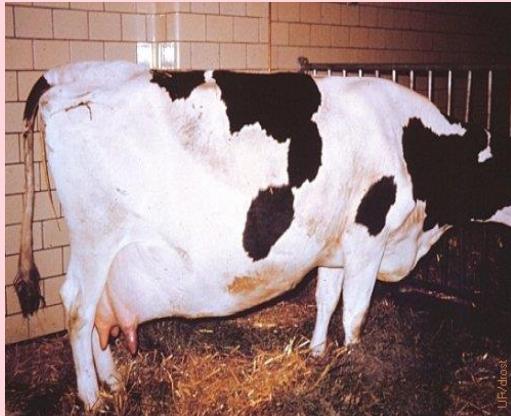
Less common in cows because of presence pf sub-pubic tendon
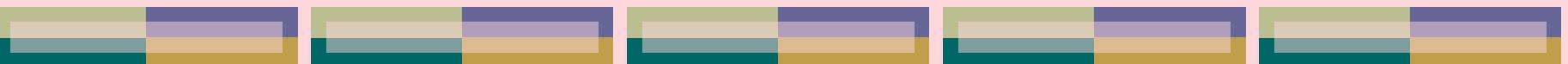
Etiology: Trauma, overweight, jumps. Common in late pregnancy

Clinical signs Pain, colic, severe ventral edema at abdomen, increased
                respiration, reluctance to lie down, in severe cases death.

Prognosis: Poor   Therapy: Canvas straps suggested

Ectopic pregnancy   Primary or secondary

Tubal ectopic pregnancy in humans   True ectopic pregnacy in animals not possible

Because:

  1. Presence of embryo in uterus not required in woman for P4 production

  2. Human embryo can survive both in oviduct and uterus

  3. Placenta is hemochorial and implantation invasive in humans

Uterine torsion (Common in buffaloes and cows, less common in goats, mares)

Twisting of a pregnant uterine horn on its own axis
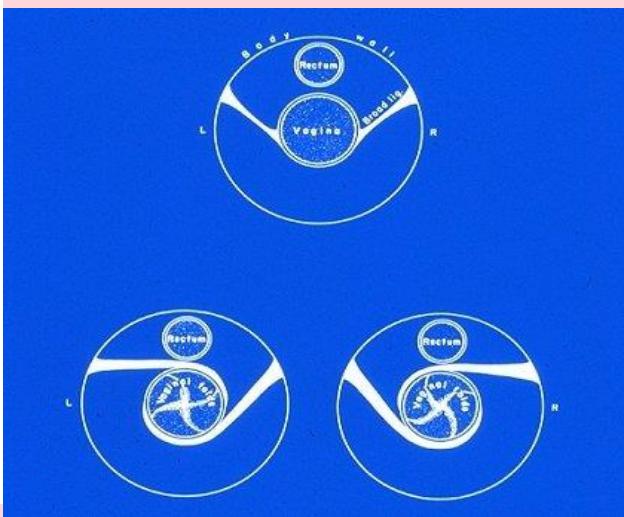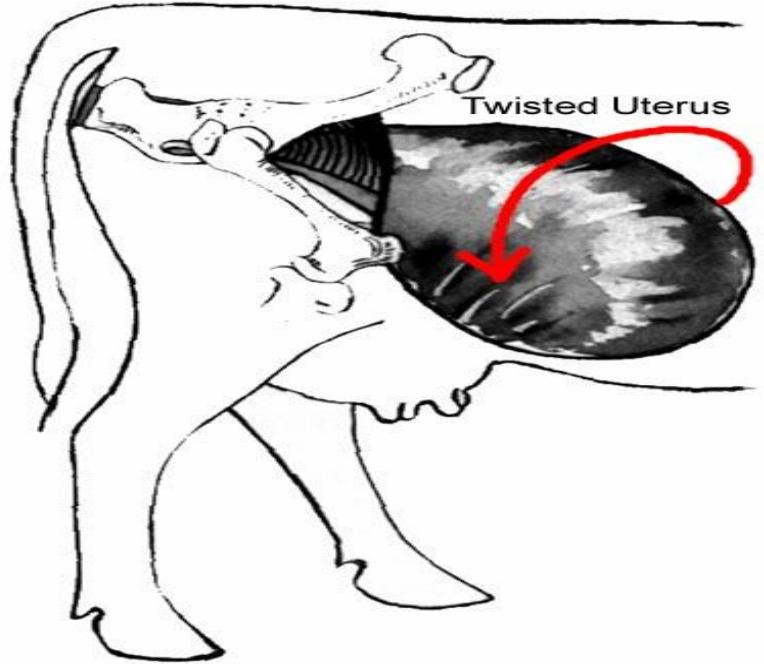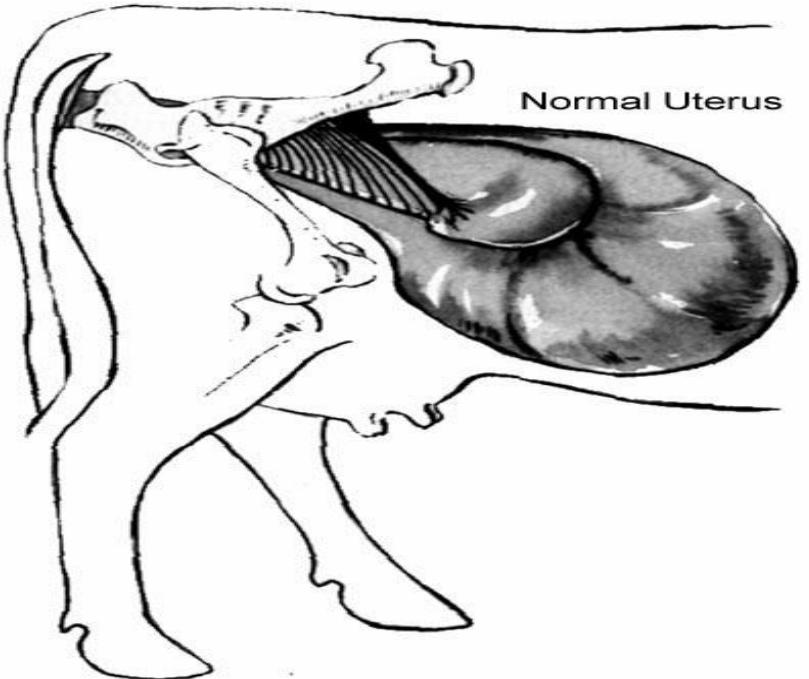
Predisposing factors – The way of attachment of broad ligament with the uterus, instability of the gravid uterus, inordinate fetal movements

Direction of torsion: Right or left (clockwise and anti-clockwise)

Location: Precervical and post cervical

Degree of torsion: 90 degree to 360 degree

Normal Uterus

Twisted Uterus

Predisposing factors: Hilly tracts, wallowing habbits

    1 Uterus has no stabilizing structures during mid to late gestation

    2 Fusion of amnion to allantois and of the allantois to the uterus

    3 Lowering of fore legs when lying down

Etiology: Inordinate fetal movements during late gestation

    In buffalo broad ligaments small and weak and the abdomen deep and capacious

Clinical signs: Colic, anorexia, twisting of vulvar lips

    Non-progressive second stage labor

Diagnosis: Rectal palpation the broad ligament on the side of torsion under the uterus and the ligament of the other side crossed to opposite side and tensed

Therapy: General condition of the patient must be monitored first

    Rotation of fetus per vaginum

    Rolling of the cow (sudden)

    Rolling of the cow (slow) with Schaeffers method using wooden plank
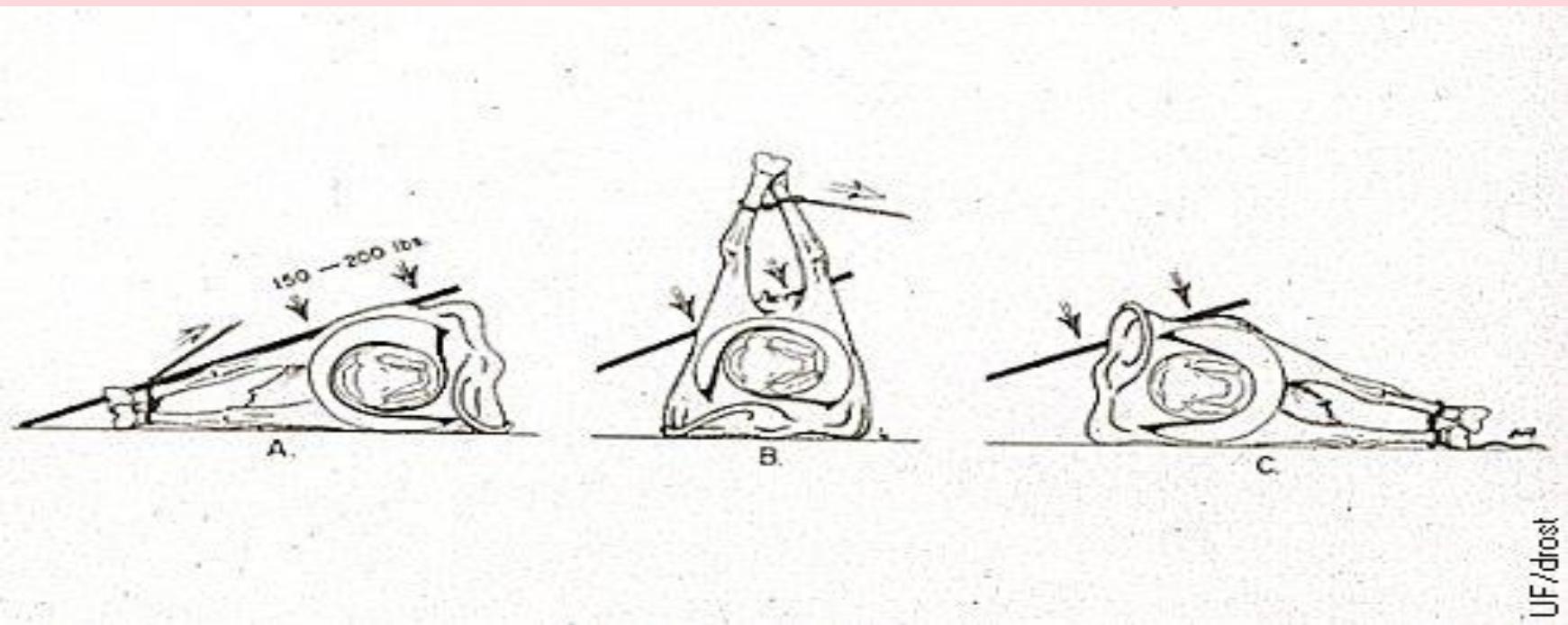
    Laparotomy with manual detorsion

    Laparohysterotomy

Torsion correction

Rolling

150 — 200 lbs

A.   B.   C.

UF/drost

- Casting cow in direction of torsion
- Rolling the cow after placing a plank over paralumbar fossa

The Schaffers method of detorsion of uterus

Cervico-vaginal prolapse
(basically because of incompetence of constrictor vestibuli and vulvar muscles also called casting of wethers)

Common in cattle, bufaloes, sheep and Boxer breed of dogs during estrus

Common in pleuriparous cows and in Hereford, Santa Gertrudis, Rathi breed

Etiology:

High estrogenic feeds during gestation

Perivaginal fat deposition

Vaginal/vulvar injury, poor conformation

Cold weather

↑intra-abdominal pressure due to high bulk diet and pregnancy

Cystic ovaries

Hormone therapy

Prolapse

Prolapse

1st degree
Vagina Protrudes Only when Animal sits

2nd degree
Vagina Constantly Prolapsed Tenesmus

3rd degree
Vagina And Cervix Exposed Pregnant Cows may abort

4th degree
Necrosis Of vagina And cervix

Consequences

Edema, inflamation, difficulty in urination, infection, tenesmus (constant straining)

Differential diagnosis

Tumors of the vulva, vagina, cervix, prolapse of the bladder

Therapy

Wash with cold water and soap use alchohol/sugar to reduce edema

Wash with antiseptics

Raise the organ to relieve pressure so that the animal urinates

Use epidural anaesthesia 2-4 ml of 2% xylocaine if straining is more
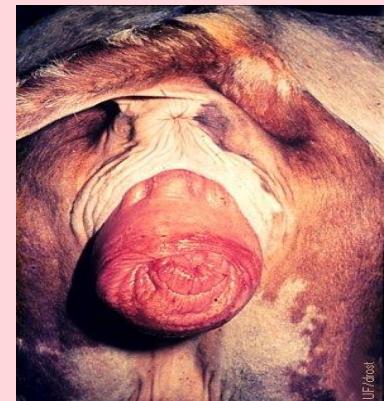
Replace back in standing animal after lubrication can use bottle for replacing

Lower fore limbs

Apply Truss in cows and retainers in sheep
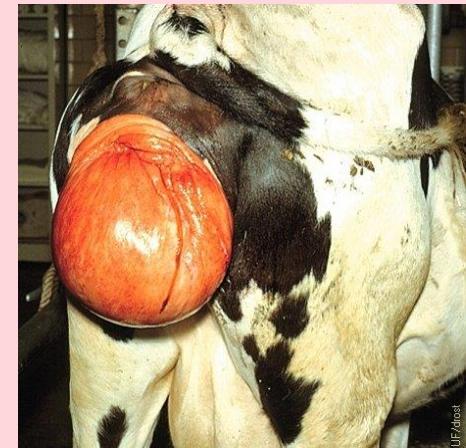
Reduce tenesmus by → Siquil injection

→Epidural anaesthesia

→Sacral paravertebral anaesthesia

→Pudendal nerve block

→Continuous caudal epidural anaesthesia

→Alchohol epidural anaesthesia

Retention sutures

        Purse string

        Buhner suture

        Button sutures

        Vertical mattress

        Interrupted horizontal mattress

        Bootlace
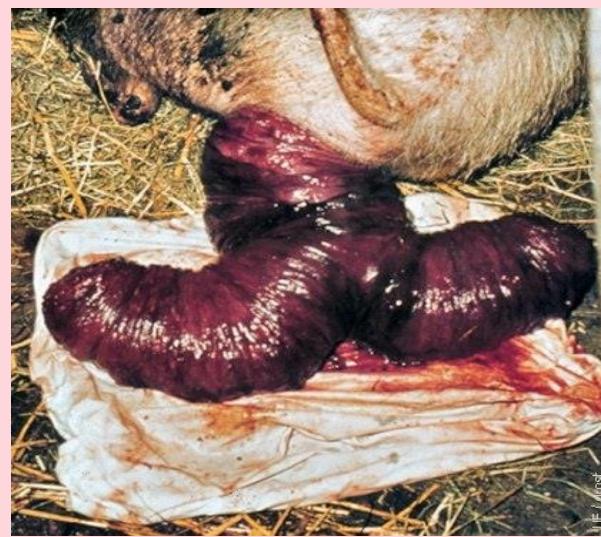
Surgical management

      Whipples operation and reefing operation→submucus resection

      Caslick operation→only in 1st degree prolapse

      Cervicopexy (Winklers operation) Fixation of cervix to the prepubic tendon through the vagina or the abdomen

      Vaginopexy (Modified Minchev method) Fixing of vagina with the hip by passing a specialised needle from the vagina to the hip

Uterine prolapse in a goat, a prolapse retainer applied to a sheep and perineal hernia in a sheep

Vaginal Prolapse in a bitch, sow, buffalo and uterine prolapse in a ewe and prolapse of intestines in a ewe with uterine rupture

Prolapse in a sow and a cow (epidural anaesthesia is being given)

Metabolic disorders of pregnancy

Pregnancy toxaemia of sheep and goat

metabolic disorder of heavily pregnant animals charachterised by hypoglycemia and ketonuria

Clinical signs Dullness, inability to stand, labored breathing, head pressing, low body temp

Diagnosis: Rotheras test, presence of twins

Therapy: Dextrose consider pregnancy termination

Hypomagnesemia/ hypocalcaemia of cows/ buffaloes   Eclampsia in bitches

Hyperlipidaemia in pony and donkey mares

Disease of overweight donkeys and Shetland ponies during late gestation

Etiology: sudden energy deficiency results in fat deposition in liver, kidneys & organ failure

Signs: Dullness, diarrhea, muscle twitches, weight loss, ventral edema, recumbency coma and death.

Prognosis: guarded   Therapy: oral glucose + insulin

Prolonged gestation: Mummification
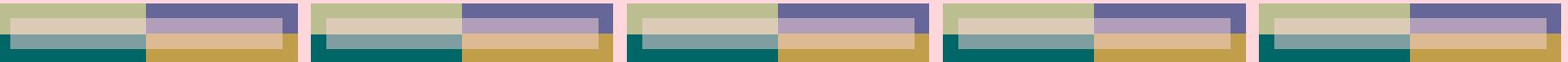
BVD (cows) Border disease and Blue tongue (sheep)

Hydrocephalus

Single pup syndrome in dogs

Feeding of toxic feeds

Congenital fetal defects

Are abnormalities of structure or function present at birth. They may affect a single anatomic structure or function, an entire system, parts of several systems or both a structure and a function.

Minor (Anamoly)

Defects may be visible → ⟨ Major (Monster)

The defects may be lethal, semilethal or non-lethal

Defects are either inherited or arise because of the environment

- Teratology: embryology + pathology
- Cytogenetics: genetics of cellular constituents related with heredity
- Karyotype: Systematized arrangement of chromosomes in pairs
- Autosomes: Paired chromosomes in mammalian somatic cells
- Sex Chromosomes: Chromosomes in gamete producing organs. Mammalian females have paired (XX homogametic) and males have unpaired (XY heterogametic) chromosomes whereas, in birds female is heterogametic (ZW) and the male is homogametic (ZZ).
- Parthenogenesis: Ovum activated by means other than the sperm.
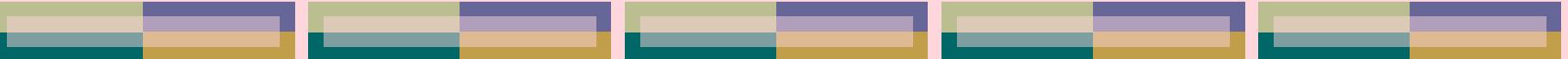
- **Agynogenesis:** Ovum activated by the sperm which do not take part in fertilization
- **Androgenesis:** Ovum activated by the sperm but the ovum do not take part in fertilization.
- **Wandering of the ovum:** Trans-uterine migration of the ovum
- **Superfecundation:** Female in estrus release many ova which are fertilized by sperms from different males
- **Superfetation:** Pregnant female comes in estrus and conceives.
- **Telegony:** Misbilief among dog owners that a bitch once conceived by a mongrel dog her subsequent pups would have the mongrel characters.
- **Chromosomal aberrations:** Abnormalities in the number and structure of the chromosomes
- **Normal Karyotype:** Cow 60, swamp buffalo 48, River buffalo 50, sheep 54, goat 60, horse 64, donkey 62, pig 38, cat 38, dog 78.
- **Numerical aberrations:**
- **Aneuploidy:** Chromosome number is diploid but one is in excess or in deficiency $2n\pm1$, $2n\pm2$ X chromosome aneuploidy (XO turners syndrome, XXX triple X syndrome)
- XXY (Kleinfelters syndrome)
- **Trisomy** ($2n+1$), monosomy ($2n-1$), nullisomy ($2n-2$)
- **Polyploidy:** Whole set of chromosomes increased (3n, 4n or 5n) because of failure in reduction of number, polyspermy or polygyny (Polar body taking part in fertilization)

- **Mosaic**: Animal with 2 or more cell populations derived from a single zygote which differ in chromosome number and/or structure

- **Chimera**: An animal or its tissues having 2 or more cell populations derived from two or more zygotes.

- **Structural aberrations** (Due to segmental break with reunion) include deletion, duplication, Inversion or translocation. And result into early embryonic deaths or monsters.

Inherited or genetic fetal anomalies

- **Achondroplasia**: Common in Hereford, Ayrshire, Dexter and Angus cows compressed skull, short upper jaw. Heavily muscled small calf
- **Epitheliogenesis imperfecta:** Skin fails to form commonly on legs, knees and muzzle.
- **Hypotrichosis:** Partial to complete loss of hair
- **Icthyosis congenita**: Lack of hair, thick scaly skin
- **Arthrogryposis:** Joints of all 4 legs are fixed and cleft palate is present
- **Brachygnathism** (Parrot mouth)
- **Brachyspina syndrome** (Holsteins) growth retarded, short vertebral column and limbs, multiple defects in internal organs
- **Atresia ani** Failure of anal opening
- **Cerebral hernia:** (Caltin mark) frontal and parietal bone opening
- **Cryptorchid**: Abdominal retention of testes
- **Dwarfism** Many breeds snorter and compressed dwarfism
- **Fawn calf syndrome** heritable defect of Angus cows, muscle contracture and angulation of stifle
- **Water head (hydrocephalus)** Accumulation of fluid in the meninges of the brain
- **Double muscling** seen in beef breeds Herefords, Angus, Charolais
- **Inherited congenital myoclonus** : involuntary twitching of muscles
- **Perosomus elumbis** : congenital curvature of the spine, short ankylosed limbs
- **Pulmonary hypoplasia with anasarca**: Large anasarcous calves seen in Maine-Anjou and Shorthorn cows.
- **Protoporphyria**: photosensitivity
- **Polydactyly**: (Extra toes) One or all legs may have extra toes
- **Agnathia** Absence of lower jaw seen in Jersey cows

Figure 1. Dwarfism. Notice short, blocky appearance with deformed nose causing labored breathing (snorter dwarf).

Figure 4. Hairlessness (hypotrichosis) in a calf.

Figure 5. Rigid joints (arthrogryposis) in a calf. Notice rigid front legs. These calves have a cleft palate.

Figure 6. Extra toes (polydactyly).

Figure 7. Mulefoot (syndactyly). Notice single toe as compared to the normal front foot.

Figure 8. Weaver calf (progressive bovine myeloencephalopathy)/ Notice unsteady posyure of this animal.

Figure 10. Bulldog calf (achondrodysplasia).
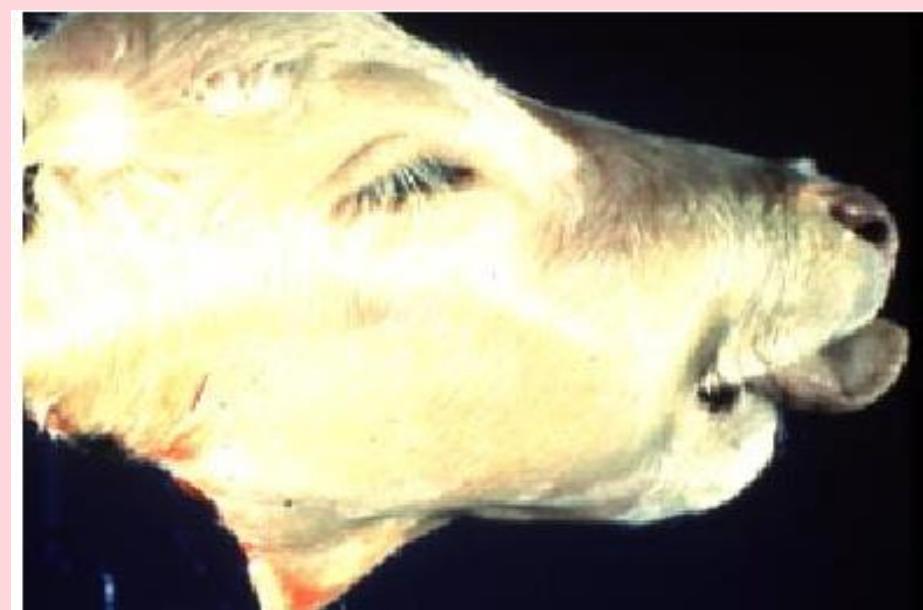
Figure 12. Parrot mouth (brachygnathia inferior). Short lower jaw in a calf.
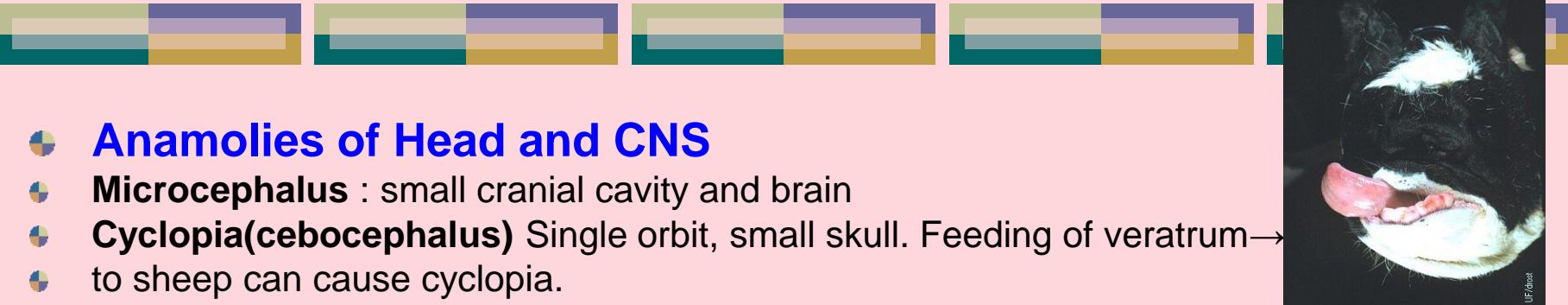
- **Dermoid cysts** : Hair like growths in the eye
- Epilepsy**:** Loss of consciousness and convulsions
- **Umbilical hernia** seen in many breeds of cows
- **Syndactyly** Mule foot in cows both parts of the hoof fused
- **Weaver calf** progressive bovine myelo-encephalopathy. Calves develop a weaving gait at 6-8 months of age
- **White eyes** : Hair coat is bleached and iris is pale blue
- **Tibial hemimelia** short or absent tibia, abdominal hernia, meningocoel common in Galloway cows.
- **Prolonged gestation** seen in many breeds

Non-Genetic defects

Sex anamolies :

- **Hermaphrodite** **True :**gonads of both sexes

   Male pseudo-hermaphrodite Testis present and external genitals of female

   Female pseudo-hermaphrodite Gonadal ducts female and external genitals virilized

- **Freemartin** A infertile female calf born cotwin to a male with which it has exchanged blood during pregnancy it has ovotestis and cul-de-sac vagina

- **Mammalian hybrids**   **Equine Mule** : Male donkey + female horse

   Hinny : Stallion + female donkey

   Zebronkey zebra + donkey

- **Anamolies of Head and CNS**
- **Microcephalus** : small cranial cavity and brain
- **Cyclopia(cebocephalus)** Single orbit, small skull. Feeding of veratrum→
- to sheep can cause cyclopia.
- **Hydrocephalus** fluid accumulated in the mininges of the brain
- **Crania bifida** : defect of skull
- **Anury** Tail-lessness
- **Anamolies of the trunk**
- **Schistosoma reflexus**: congenital curvature of spine, abdominal viscera exposed
- **Campylorrhachis scoliosa** : Lateral curvature of vertebrae and deformed limbs
- **Anamolies of the limbs**
- **Amelia(Otter calf)** Misssing or amputated extremities
- **Micromelia** Absence of distal half of limbs
- **Ectrodactyly** Absence of phalanges of the digits
- **Accessory limbs** Extra limbs attached to the neck, body→→
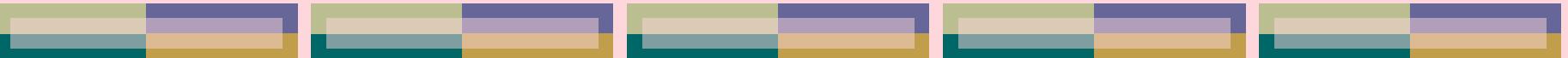
- **Twins :-   Symmetrical** →**Monozygotic (Identical) or dizygotic (Fraternal)**
         Asymmetrical → **Normal**
                          → **Monster Hemicardius** Imperfect parts identifiable
                                   Holocardius acephalus Cranial part missing
                                   Holocardius amorphous General body form not
                                           recognisable

Common fetal monsters:1)Perosomus elumbis 2)and 4) Amorphous globosus 3) Schistosoma reflexus

- **Conjoined twins (somatodidymi, Siamese twins)** generally monozygotic with incomplete to complete duplication

- **Thoracopagus** Twins joined at sternum face to face

- **Pygopagus**   Twins joined at sacrum Back to back

- **Ischiopagus**   fetuses joined at pelvis heads in opposite direction

- **Diprosopus**   double face →

- **Dicephalus**   two heads and neck

- **Dibrachius** 2 pairs of fore limbs Tribrachius 3 pairs of fore limbs

- **Dipus**   2 pairs of hind limbs Tripus 3 pairs of hind limbs

- **Syncephalus** 1 face, 4 ears and a single cerebrum

- **Janiceps**   2 faces on opposite sides

Conjoined twin monstrosities in a calf and piglet, Pipygus in a calf

Parturition delivery of fetus on completion of pregnancy

Pre-parturient Care

Shifting to calving boxes 1-2 months before calving

Mares need a quiet environment

Feeding Cows should be given a low energy high fibre diet during gestation and anionic salts should be given if they are fed fodder to which high K+ fertilizer has been added

Sheep twin fetus carrying animals should be fed high energy feed.

Bitches 1.0 to 1.8% Ca and 0.8-1.6 % P in diet of late pregnant bitches

Vaccines Tetanus vaccination of foaling mares

Symptoms of approaching parturition

Cow   Udder enlargement 4 months heifers and 1-2 weeks before parturition in cows

Vaginal discharge 7 months

Relaxed ligaments 24 - 48 h, raised tail head, anorexia,

Bitch   Vomition, drop in 1-2^0 rectal temp 24 h prepartum, nesting behaviour.

Mare   Drop in mammary secretion electrolytes

Waxing of teats

COMPLETELY SUNK DOWN

Symptoms of approaching Parturition

Theories of parturition initiation

Physical factors 1. Increase in fetal size: this increases uterine irritability

2. Uterine distension : reversal of progesterone block

3. Fatty degeneration of placenta and presence of infarcts: leads to interference in fetal nutrition

Biochemical factors: 1. Increase in CO_2 tension in maternal blood due to increased fetal activity: this ↑uterine contractility

2. Release of fetal antigens:→serotonin →release of collagenase and stoppage of blood supply to cotyledons.

Neuroendocrine factors: FETAL factors
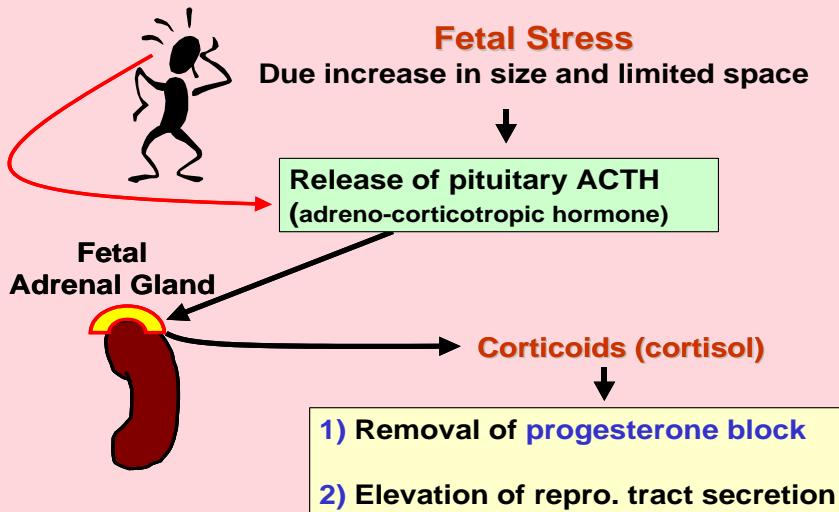
1. ↑ in cortisol in adrenals→convert P_4 to E_2 & release of PG

2. ↑ in ACTH by pituitary →stimulate cortisol release

3. ↑ in CRH in hypothalamus →stimulate ACTH

4. ↑ in endogenous opiods →stimulate ACTH

MATERNAL factors

1. Reversal of P4 block → ↑ myometrial contactility
2. Release of relaxin → dilation of the birth canal
3. Placental estrogen rise →release of PG ↑ myometrial contactility
4. Pro-inflamatory cytokines → dilation of the birth canal
5. Release of PG → softening of cervix, contractions ↑
6. Release of Oxytocin → ↑ myometrial contactions

Stage 1 (Initiation of Parturition)

Fetal Stress
Due increase in size and limited space

Release of pituitary ACTH
(adreno-corticotropic hormone)

Fetal
Adrenal Gland

Corticoids (cortisol)

1) Removal of **progesterone block**

2) Elevation of repro. tract secretion
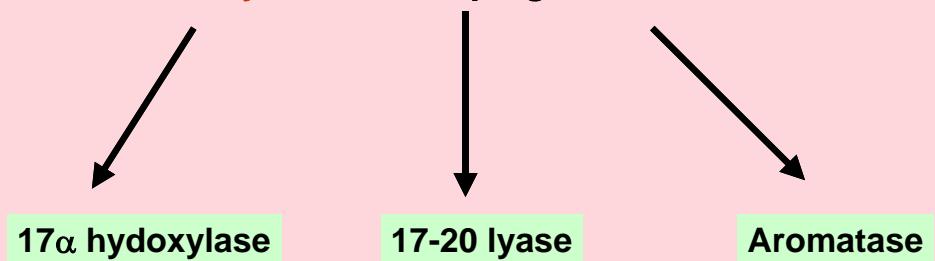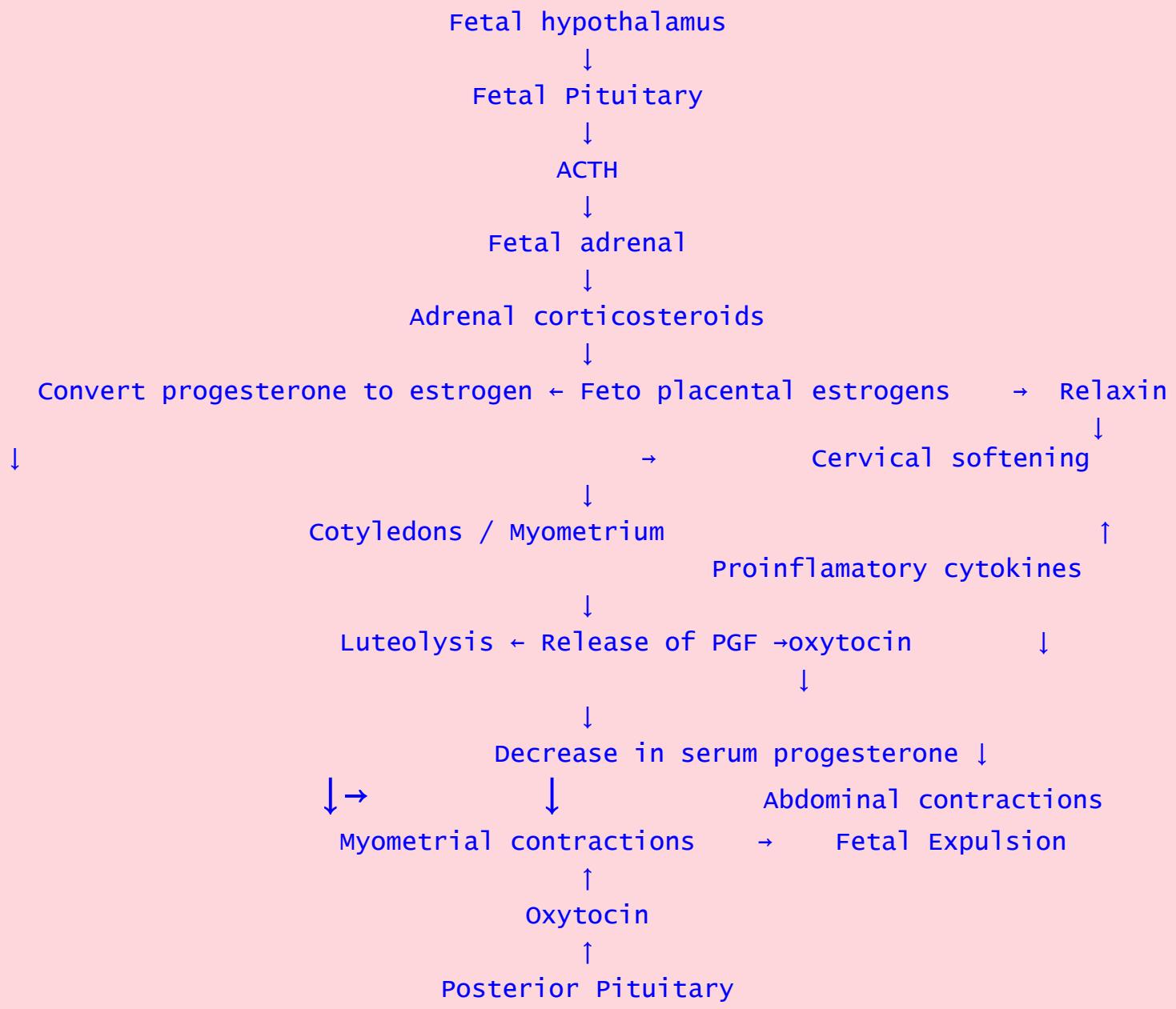
Removal of Progesterone Block

How does progesterone secretion is inhibited?

Elevated cortisol promotes the synthesis of 3 enzymes

These 3 enzymes convert progesterone to estradiol

17α hydoxylase   **17-20 lyase**   **Aromatase**

Fetal hypothalamus
↓
Fetal Pituitary
↓
ACTH
↓
Fetal adrenal
↓
Adrenal corticosteroids
↓
Convert progesterone to estrogen ← Feto placental estrogens   → Relaxin
                                                                              ↓
↓   →   Cervical softening
                                    ↓   ↑
                        Cotyledons / Myometrium
                                                    Proinflamatory cytokines
                                    ↓
                Luteolysis ← Release of PGF →oxytocin   ↓
                                                    ↓
                                    ↓
                        Decrease in serum progesterone ↓
            ↓→   ↓   Abdominal contractions
                Myometrial contractions   →   Fetal Expulsion
                                    ↑
                            Oxytocin
                                    ↑
                        Posterior Pituitary
Possible endocrine changes that occur during the periparturient period in the sow, ewe,
cow and their effects

Duration of different stages of labor in domestic animals

Species	First stage of labor	Second stage	Third stage (Placental expulsion)
Cow	4-24 h (Bluish vascular semitransparent chorio-allantois appears & ruptures	0.5 – 3 h (Amnion appears with the fetus. Fetus is delivered)	12-16 h (Placenta is expelled)
Buffalo	1-12 h	45-90 min	7-12 h
Mare	1-12 h	30 min	Within 3 h
Ewe/Doe	6-12 h	0.5-1 h	Within 3-6 h
Sow	12-24 h	0.5-4 h	After 2-3 piglets or 4 h post farrowing
Bitch	4-24 h	1st puppy within 2 h of 2nd stage of labor. 5-60 min between puppies. Total time upto 24 h	After each puppy or within 2 h of last puppy
Cat	2-12 h	1st kitten within 5-60 min of labor. Subsequent kittens every 5-60 min	Within 2 h of last kitten
Camel	3-48 h	5-80 min	Within 4 h

Prepartum fetal changes:

Changes do occur in the fetus before delivery and these are esential because the fetus has to prepare itself for the external environment outside the uterus. The changes include

Maturation of fetal lungs: The surfactants in the lungs increase which reduce the surface tension within the alveoli.

Increased output of tri-iodothyronine and catecholamines to meet the increased metabolic demands

Closure of the ductus arteriosus and the closure of the foramen ovale

Increased glycogen reserves in the liver to meet the demands on delivery by the production of glucose as a source of energy post delivery.

Table 1
Maturational effects of the pre-partum cortisol surge on various tissues in the equine fetus

Tissue	Effects
Liver	Deposition of glycogen
	Induction of glucose-6-phosphatase for gluconeogenesis
	Induction of β adrenergic receptors
	Decreased production of cortisol binding globulin
Thyroid	Increase in T3, possibly via induction of hepatic T4 deiodinase
Lung	Indirect evidence for a role in lung maturation
Gut	Indirect evidence for a role in maturation of the gastrointestinal tract
Adrenal	Increased sensitivity to corticotropin hormone (possibly via induction of corticotropin receptors)
	Induction of 17α-hydroxylase for cortisol production
Bone marrow	Increase in leucocytes, particularly neutrophils
Cardiovascular	Increase in blood pressure and plasma angiotensin converting enzyme

Sequence of parturition events in the cow
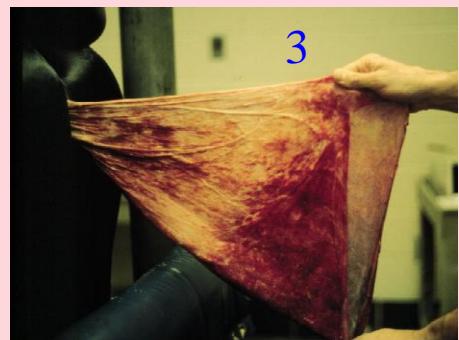
First Stage

- Appear anxious
- Sweat
- Look and kick at her sides

If disturbed the progressive stages of parturition may stop.
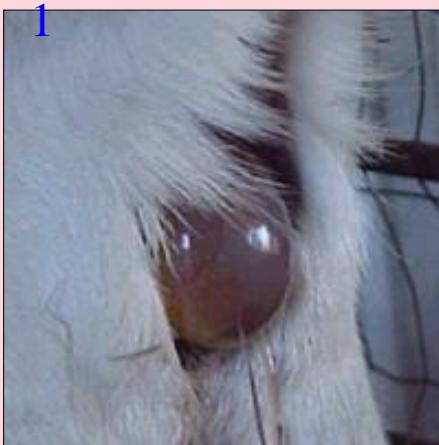
First Stage

- May lie down intermittently
- Rolling
- May look like a colic

2

2

2

3

Sequence of parturition events in the mare 2 second stage and 3 third stage

Stages of labor in a goat

1. The first water bag(allantochorion) is protruded
2. The second water bag (amnion) and the fetus are protruding through the vulvar lips.
3. The placenta is being dropped in the third stage of labor

A pregnant cat about to kitten and a sow in delivery

Maternal behaviour

Peurperium: is the period after completion of parturition including the 3rd stage of parturition when genital organs are returning to the normal non-pregnant state

Depends upon age, season, nutrition and periparturient disease

Peurperium

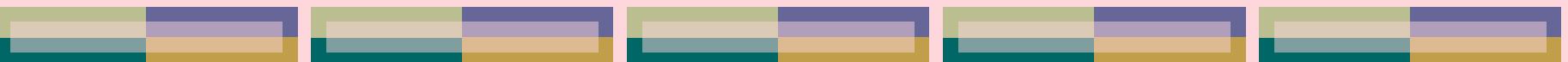### Uterine Involution
Reduction in Size and Return of Normal function

Ovarian Rebound
Resumption of Normal ovarian cyclicity

Elimination Of bacterial Contami- nation

Genital tract involution

Uterine Involution completed in 26-40 days in cattle and buffalo. Uterus within pelvic cavity within 8-10 days Cervix: involutes fast it is contracted within 10-24 hrs and at 25 days of parturition the cervical diameter is greater than the uterine diameter.

Involution involves degenerative changes, loss of fluids, caruncle shrinkage and liquefaction

There is discharge of fluids which are known as lochia. The lochial discharge is high for 2-3 days it is yellowish brown in color. The discharge is reduced at 9-10 days and is bloody (red in color). By 14-15 days the lochia disappears. Some cows do not show lochial discharges probably because of absorption. The endometrial regeneration is completed by 25 days.

Ovarian rebound:Is dependent on the season in seasonally breeding species like buffaloes, ewe and goat. There is reversal of progesterone block and reversal of pituitary responsiveness to GnRH

FSH rises transiently 15 days postpartum resulting into follicular growth, however LH rise occurs later because of lack of estrogen receptors at hypothalamus and pituitary and thus the first estrus is anovulatory. The first ovulation usually ocurrs in the contrlateral ovary.

Suckling leads to increased cortisol which decreases LH, thus cows that are suckled have a delayed first post partum estrus.

High producer cows have a high prolactin which also decrease LH and thus a delayed first post partum estrus.

The first post partum estrus occurs between 30-85 days in cows but the overt signs of estrus are less prominent or absent at this estrus.

Bacterial elimination

Since the birth canal is open at parturition and for some time post partum the uterus is continuously charged and cleared of bacterial contamination. The commonly found bacteria include *Actinomyces pyogenes, E.Coli, Psuedomonas, Streptococci* and *Staphylococci,* and many anaerobic microbes like *Fusiformis necrophorous* and *Bacteroides* species.

The Bacteria are eliminated by phagocytosis, uterine secretions and uterine contractions.

Peurperium in mares

The lochial discharge is scanty and cease by 24-48 h post foaling.

The involution is fast and foal heat within 7-10 days the ovarian rebound is very fast in fact follicles start developing during few days before parturition.

Peurperium in sows Rapid weight loss occurs during 1st 5 days post partum.

Peurperium in bitches Involution complete by 15 weeks post whelping

Uterine horns return to pregravid size by 4 weeks post whelping.

DISORDERS DURING PARTURITION

PROLONGED GESTATION

● **DYSTOCIA :-**

(Difficult birth)

MATERNAL

Uterine rupture
Uterine displacement
Uterine torsion
Uterine herniation
Uterine inertia – Primary
or Secondary
Stenosis / Obstacle in
birth canal Cervical
dilation failure

FETAL

Foetal oversize / Giantism
Malposition of foetus
Malpresentation of foetus
Malposture of foetus
Foetal death
Fetopelvic disproportion
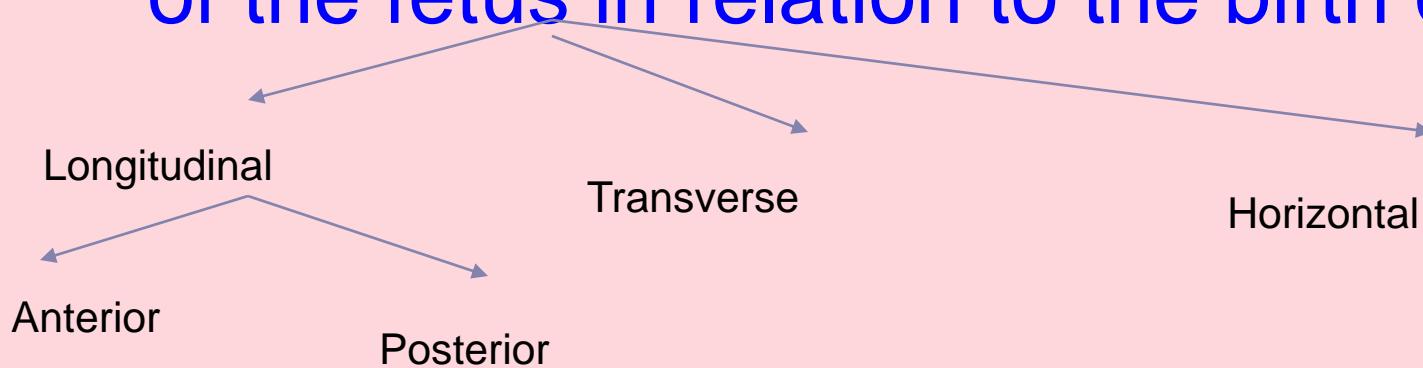
RUPTURE OF BIRTH CANAL :-
* Occurs because of extra
force &/or use of sharp
instruments
* Most common rupture is
cervical

- Presentation: Relationship of the long axis of the fetus in relation to the birth canal

Longitudinal

Transverse

Horizontal

Anterior
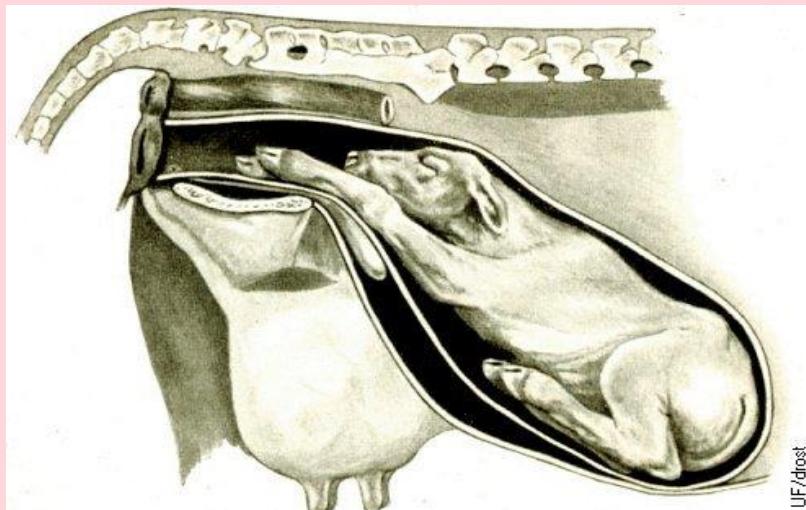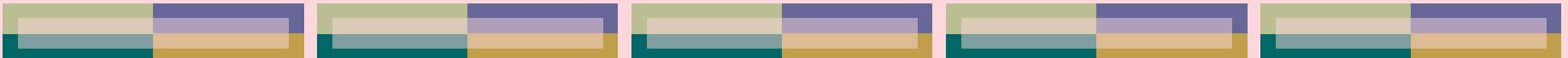
Posterior

- Position: Relationship of the dorsum of the fetus as applied to the quadrnats of the mother ;sacrum, ileum, pubis

Dorso sacral

Dorso-ilial

Dorso-pubic

- Posture: Relationship of the head and extremities of the fetus to its own body

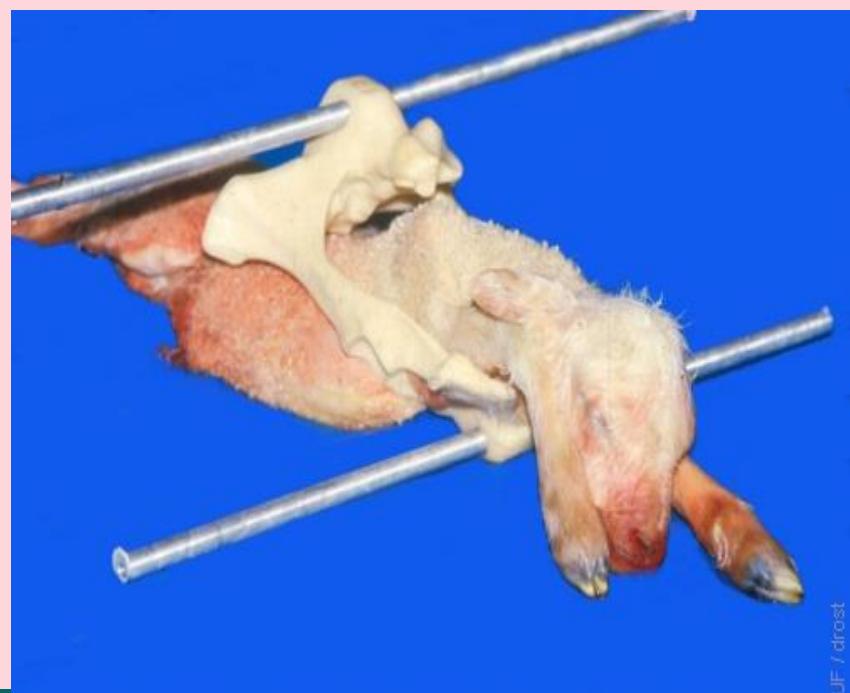Normal Birth Posture: Anterior longitudinal presentation dorso sacral position, both forelimbs extended and the head extended resting on the knees.

Common causes of Dystocia

BASIC

1. Herredity - Breeds like brown swiss, Bull dogs
   - Defects like hydrocephalus, Achondrpolasia, Perosomus
2. Nutrition & Management - Small size of the dam
   -Disproportionate matings
   -Poor or excess feeding.
3. Traumatic- Ventral hernia, rupture of prepublic tendon.
4. Miscellaneous- Calcium deficiency

IMMEDIATE

Maternal and Fetal or a combination of both

A.MATERNAL

I Expulsive forces.

1.Uterine

 a) Uterine Inertia

   i) Primary uterine inertia -Myometrial defect- overstretching, degeneration uterine infection, small letter size, heredity.

$$\text{-Biochemical deficinces – estrogen, oxytocin, PGF}_2\text{, relaxin,}$$
$$\text{calcium, glucose.}$$

   - Environmental disturbance.

   - Nervousness

   - Oligoannion- Premature birth

  ii) Secondary Uterine inertia- Subsequent to exhaustion

b) Uterine rupture

c) Uterine torsion

2 Abdominal

-    Inability to strain because of age, pain, debility, diaphragmatic hernia, abdominal hernia.

II Birth Canal

1. Inadequate pelvis

-Due to pelvic fracture, exocytosis, immaturity, breed, neoplasia

2. Insufficient dilation-

a) Uterus- torsion, deviation, herniation, adhesions
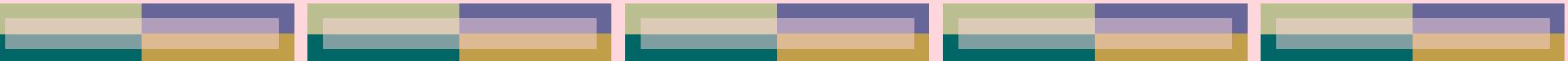
b) Cervix- dilation failure, congenital defects, fibroses.

c) Vagina- Congental defects, fibroses, prodapse, perivanginal abscess, human defects, excess fat

d) Vulva- congenital defects, fibrosis, immaturity.

B FETAL

1. Fetal death- Lack of initiation of birth process, lack of movements.

2. Fetal oversize a) Absolute Large sized fetus Monsters, disproportionate matings

b) Relative- A fetus larger relative to the pelvis

3.Fetal Maldisposition

Malpresentation -Transverse, lateral, vertical
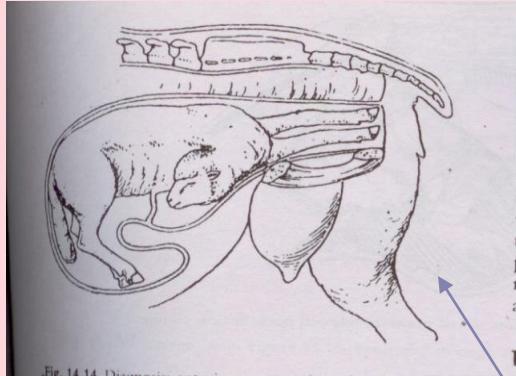
Malposition   Dorsopublic, Dorso-ilial , oblique

Malposture

-Anterior presentation – Limb flexion at carpal, elbow or shoulder

-Head deviation – lateral, upward and

downward (vertex, footnape and breast- head)

-Posterior presentation : Hock flexion and hip flexion (Breech)

Abnormal birth postures

Fig. 14-14 Diagnosis: anterior presentation

Anterior Longitudinal Presentation

Lateral Head Deviation
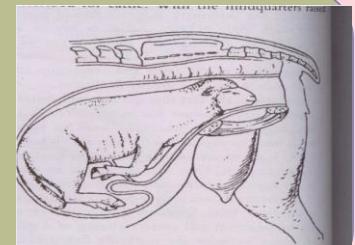
Downward Head Deviation

Vertex

Nape

Breast Head

Carpal flexion

Elbow flexion
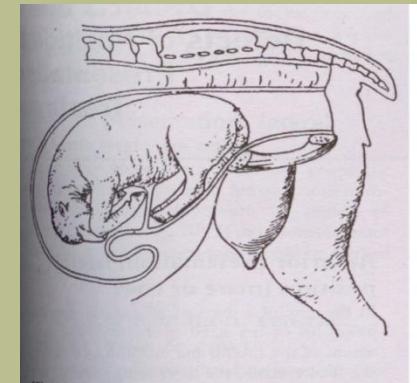
Shoulder flexion

Posterior Longitudinal presentation

Hock flexion
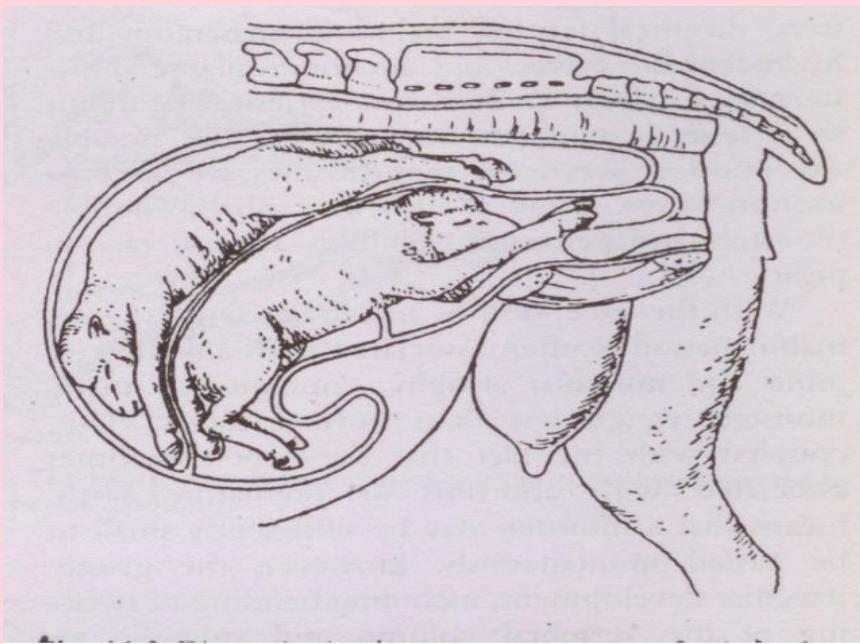
Hip flexion

Transverse Presentation

Dog sitting posture

Simultaneous presentation

CAUSES OF DYSTOCIA IN CATTLE AND BUFFALOES

The most frequent cause of dystocia in cows is fetopelvic disproportion and fetal malpresentation. Hence fetal causes are more common in cows whereas in the buffalo uterine torsion is the single largest cause of dystocia in the dairy buffalo.
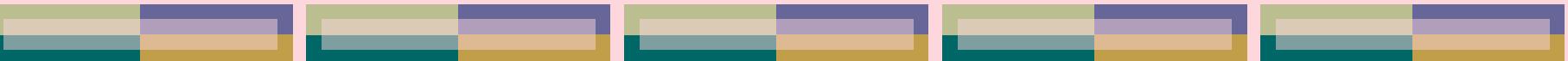
Cause of dystocia	Cattle (% frequency)	Buffalo (% frequency)
Fetopelvic disproportion	45	8
Fetal malpresentation	26	26
Cervical dilation failure	9	3
Uterine Inertia	5	2
Uterine torsion	3	55
Other maternal abnormalities	7	2
Other fetal abnormalities	5	4

CAUSES OF DYSTOCIA IN MARE

The incidence of dystocia in the mare is rare most frequent cause of dystocia in mares is lateral head deviation followed by posterior presentation problems and rarely transverse presentation..

The common causes of dystocia in sheep and goat are fetal maldispositions and birth canal obstruction. Ring womb or thee cervical dilation failure is one of the most common cause of birth canal obstruction (and thus dystocia) in sheep and goat

The most common cause of dystocia in the bitch, cat and sow is uterine inertia, followed by fetopelvic disproportion.

OBSTETRICAL OPERATIONS

Procedures used for correction of dystocia and include **mutation, forced extraction, fetotomy** and **caesarean section.**

Mutation: is defined as those operations by which a fetus is returned to its normal presentation, position and posture by *repulsion, rotation, version* and *extension or adjustment of the extremities.*
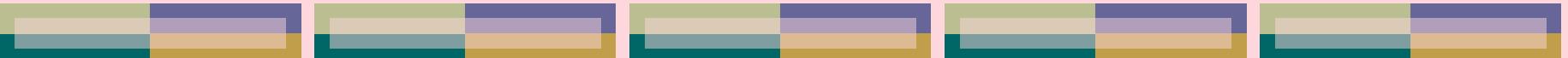
Repulsion (Retropulsion):In this the fetus is pushed back from the birth canal into the abdominal cavity where space is available for its correction. Epidural anaesthesia should be given and the operators hand or a crutch repeller can be used for repulsion

Rotation is the turning of fetus on its long axis to bring it into a dorso-sacral position from a dorso-ilial position. Rotation should be done by applying cross traction when the operators hand is used for correction. A detorsion rod or a cammerers torsion fork can be used for this purpose.

Version :is the rotation of the fetus on its transverse axis into an anterior or posterior longitudinal presentation. It should be limited to 90 degrees only and is frequently indicated for transverse equine pregnancies.

Extension and adjustment of extremities: This is required in limb flexion or head deviation. Often ropes or long obstetrical hooks are required during correction by the operators hand. Some repulsion may be required in correction of breech presentations. The ropes and hooks should be used with care in live fetuses to avoid injury. Long eye hooks should be avoided in live fetuses.

Forced Extraction is defined as the withdrawl of the fetus from the dam through the birth canal by means of application of outside force. The indications for forced extraction include

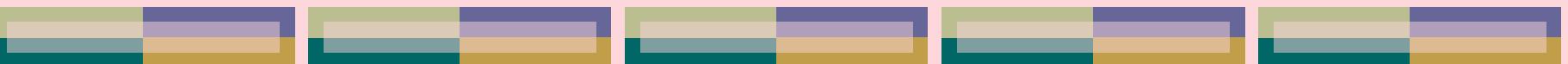1. Uterine inertia 2. Large fetuses   3. Small birth canal in primipara 4 Posterior presentation.

The force should be applied in an arc fashion first downwards and then in a straight manner. Traction (force) should only be applied when the fetus is in a normal presentation, position and posture. Traction should be steady without jerks. Traction is seldom required in thee mare if the fetus is in normal disposition. The possibility of uterine torsion should be ruled out before traction and traction should be applied with care in the dairy goat as the birth canal is very fragile. In the bitch a vectis, snare and fingers can be used for applying traction. Calf pullers can be used for applying traction.

Fetotomy: is defined as those operations performed on the fetus for the purpose of reducing its size by either division or removal of certain of its parts for its vaginal delivery. Fetotomy can be either partial (only some of the portions removed) or total (complete fetus divided into many parts). The essential requirement is the presence of a dead fetus and fetotomy shoul be avoided on a live fetus. Total fetotomy is possible only in cattle in a relaxed birth canal. In the small ruminants only partial fetotomy with removal of one of the limb or the head is common. In fetal monsters and fetal emphysema fetotomy is indicated.

Advantages of fetotomy

1 It reduces the size of the fetus 2 It avoids traumatic surgical procedures 3 It requires less assistance 4) It creates space in the birth canal for correction of a fetal maldisposition and

5 It maintains future fertility of the animal when carefully perofrmed.
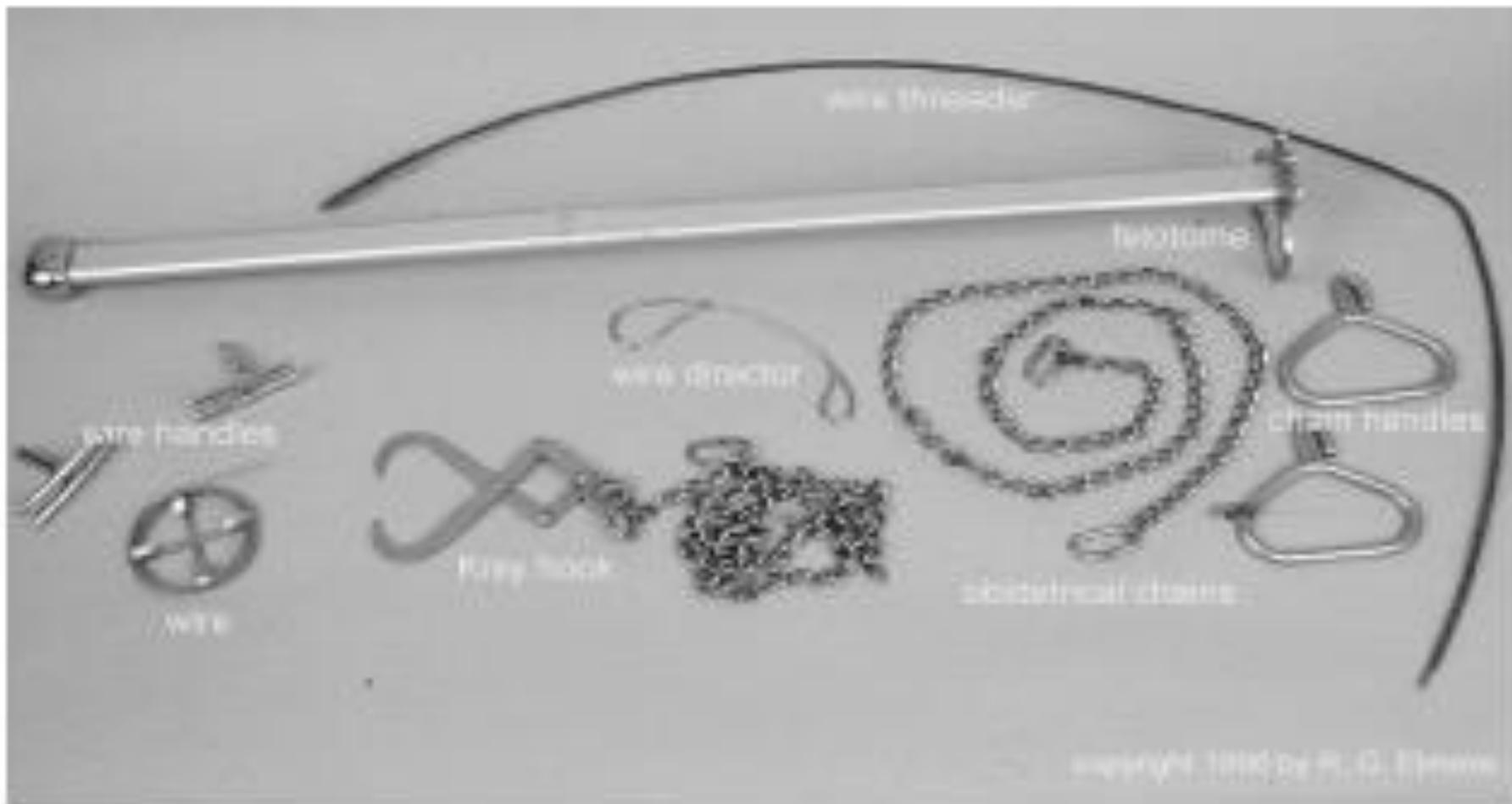
Techniques of fetotomy

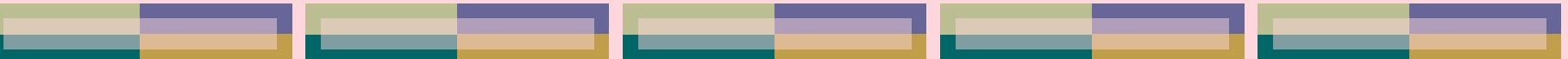Fetotomies are of two types **Percutaneous** and **Subcutaneous**

Percutaneous fetotomy:This is done using specialised instruments known as fetatomes (Thygesons, Uterecht fetatome) which are double barrel instruments. A wire saw is threaded and applied to the part to be cut and the other free ends of the wire are tied in wire saw holders and by sawing action the part is cut. Due care should be taken to avoid the tissues of the birth canal in the wire saw. The skin and the part (for ex: limb) to be cut are separated by the sawing action of the wire saw and the part is removed. If sufficient space has been created in the birth canal the maldisposition of the fetus is corrected and the fetus delivered. The birth canal should be well lubricated. Limb removal, head removal (decapitation), head and neck removal (cephalotomy), removal of the thorax (detruncation) and pelvic bisection can be done with the careful use of fetatomes in cattle. The maximum number of cuts suggested for fetotomy are six.

Subcutaneous fetotomy:This involves the cutting of certain fetal parts (usually the limbs) without the removal of the skin. It is usually used in emphysematous fetuses using different types of knives. The skin is incised from the scapular point to metacarpal bone in anterior presentation and from hip joint to metatarsal bone in posterior presentation. The skin is then separated from the muscles and other attachments by the operators fingers and or blunt instruments. The pectoral muscles or the muscles around the scapula are broked and traction is applied on the limb. The limb breaks off and is removed. Care should be taken to avoid injury to the birth canal. The advantage of subcutaneous fetotomy is that all operations are done under the skin of the dead fetus thus avoidin injury to the birth canal and the skin left can also serve as a point of traction. Also subcutaneous fetotomy can be done without specialised instruments.

Fetotomy

Methods of dystocia handling in the mare have been recently divided into assisted vaginal delivery, controlled vaginal delivery, fetotomy and cesarean section.

In assisted vaginal delivery, the mare is aware and assisted to a small or large degree for vaginal delivery of an intact foal within 10-15 minutes. If resolution takes longer than 10-15 minutes, the obstetrician should consider the alternatives for correction of the dystocia. For assisted vaginal delivery the following points must be kept in mind:

Assist when the mare is lying down. If mare is foaling in standing position, the foals umbilical cord may rupture prematurely resulting in tissue hypoxia. However, for repositioning of the foal, the mare must be standing.

Once the thorax of fetus is delivered traction should stop.
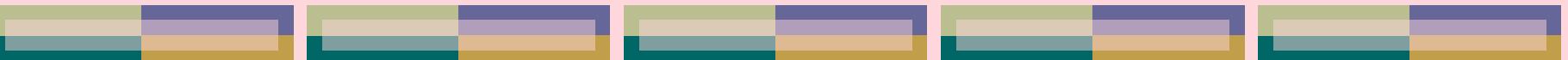
Never apply traction on a fetus with fetal maldisposition.

Pull fetus in a downward arc, one leg at a time to reduce the width of shoulders.

Controlled Vaginal Delivery:

Controlled vaginal delivery employs general anaesthesia and hoisting the mare's hindquarters upwards. The uterine relaxation and effects of gravity assist in fetal repulsion and manipulation. The position and posture of the fetus is determined, and the fetus is then repelled and repositioned to allow vaginal delivery. Manipulations must be gentle and plenty of lubrication must be used to help delivery. When the head and distal forelimbs come out in the birth canal, the mare should be lowered into lateral recumbency and traction must be applied to the foal until delivery. The umbilical cord must be clamped and cut. The mare must be placed on a thick mat for recovery. If the foal cannot be delivered within 15 minutes a fetotomy (if the foal is dead) or caesarean section (if foal is live) should be performed. Moreover, the option to perform a fetotomy may be limited if manipulations before presentation of the mare have already inflicted severe trauma.

Genital surgeries of the female animals

Genital surgeries are infrequent in animals. The three most common surgeries are cesarean section (all animals), Ovariohysterectomy (bitches and cats) and Episioplasty (Caslick operation in mares).

Surgeries of the ovaries

Ovariectomy (Unilateral or bilateral)

Indications : To prevent estrus and pregnancy in cattle, mares and bitches.

Unilateral ovariectomy for removal of ovary affected with neoplasia.

To obtain tissues for research

Approaches: The approaches suggested for ovariectomies include flank celiotomy (laparotomy), colpotomy (through the vagina using special instruments K-R Spay instrument or the Wills spay instrument in heifers) and laparoscopic ovariectomy

Surgeries of the fallopian tubes

Performed rarely in animals for embryo recovery in small ruminants or

Gamete Intra-fallopian transfer

Surgeries of the uterus

Include hysterotomy (cesarean section), hysterectomy and
ovariohysterectomy

Hysterectomy:

Hysterectomy is suggested for removal of uterine tumors when it is
performed on one horn (unilateral). Complete hysterectomies are
Rarely indicated in cattle and buffaloes in cases of chronic prolapses with necrosis
and gangrene of the uterus when it is performed vaginally whereas complete
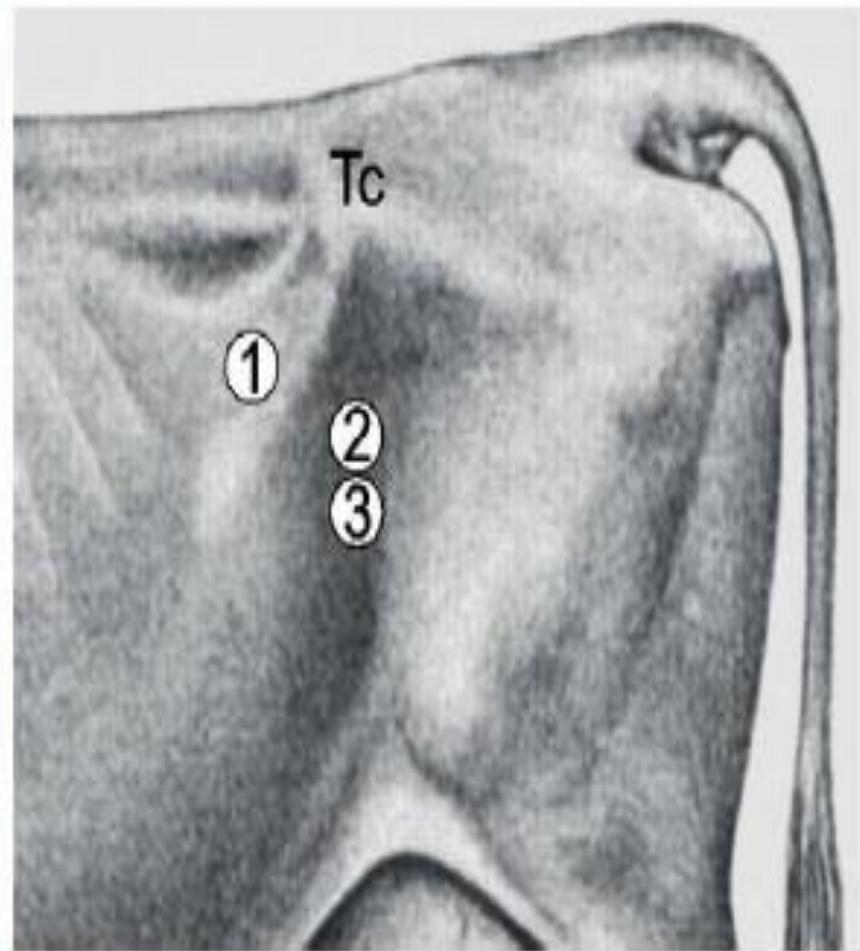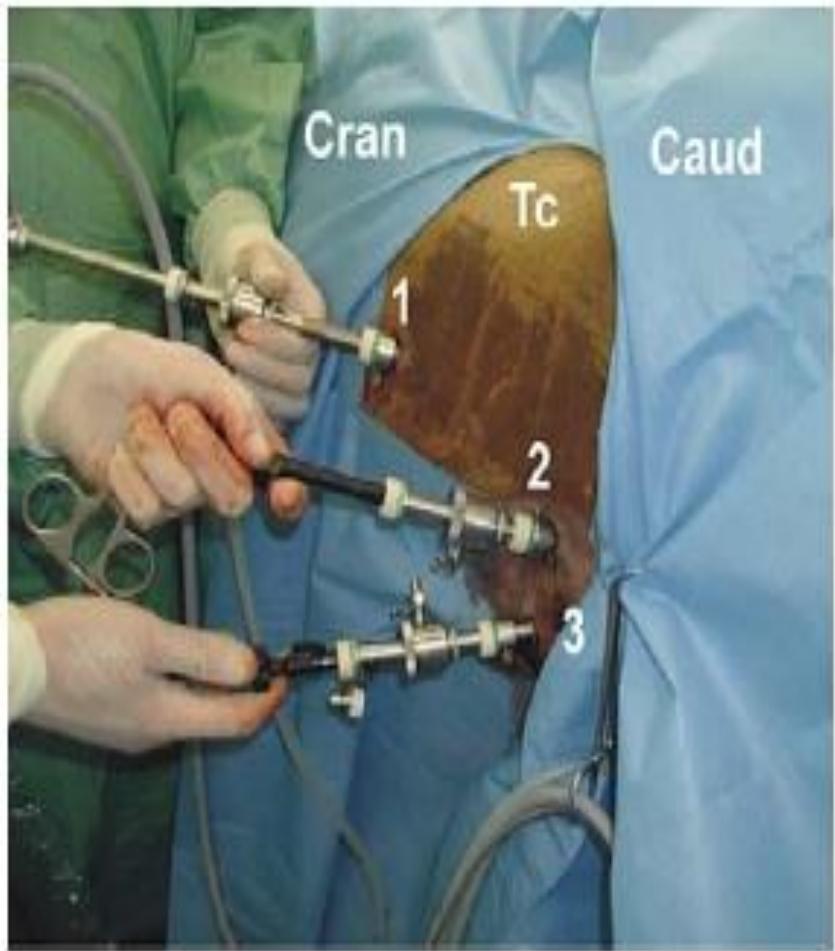hysterectomies are indicated for obtaining disease free pigs

Fig. 1. Portals for laparoscopic ovariectomy via the left flank in a standing cow. Cran = cranial, Caud = caudal, Tc = tuber coxae, 1 = endoscope portal, 2 = first instrument portal, 3 = second instrument portal.

Hysterectomy can be performed via flank laparotomy or vaginal approach. For vaginal hysterectomy epidural anaesthesia is given and a longitudinal incision is given on the dorsal surface of the uterus between the rows of caruncles, the uterine arteries and veins and broad ligaments are ligated, the vainal end is sutured and the uterus and possibly the ovaries are removed.

Hysterotomy (Celiotomy or Cesarean section)

One of the oldest surgical procedures The term appears to be derived from the Greek term *caeso matris utera* meaning cutting the mothers uterus.

Cesarean in Cattle and buffaloes

Common in beef cows and two types of cesarean sections are performed elective and emergency (both on emphysematous and non emphysematous fetuses).

Indications: (Elective : For delivery of high value calf or in case of Hydrops allantois or hydrops amnion. Emergency: Performed to relieve dystocia)

Immature heifers, Beef breeds with double muscling like Charolais, Limousin, Belgian Blue

Pelvic deformities

Cervical dilation failure
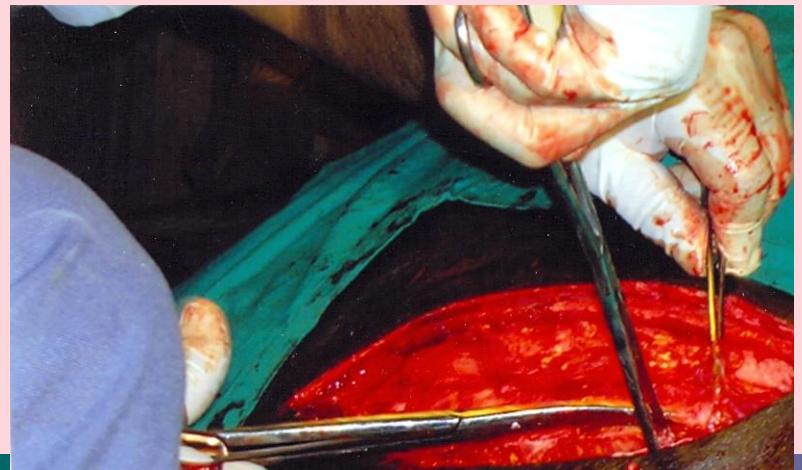
Incorrectable uterine torsion

Uterine tears

Fetal uncorrectable maldispositions

Fetal monsters

When other methods of dystocia correction fail

Operative sites

Right and Left flank or lower flank

Midline (Ventral approach at linea alba)

Paramedian (Left or right side) (Parallel to milk vein

between linea alba and S/C abdominal vein

Ventrolateral Mid abdomen just above the arcus

cruralis (preferred in dead fetus)

Restraint

Standing in a chute for flank approach

Ventral recumbency for midline approach

Dorsal recumbency for paramedian and ventrolateral approaches.

Anaesthesia

General anaesthesia if facilities available

Sedation required in vicious animals with xylazine (.03 to 0.1 mg per Kg IM) but this increases uterine contractions

Paravertebral nerve block can be used by infusing 2% xylocaine between last thoracic and 1st three lumbar vertebra.
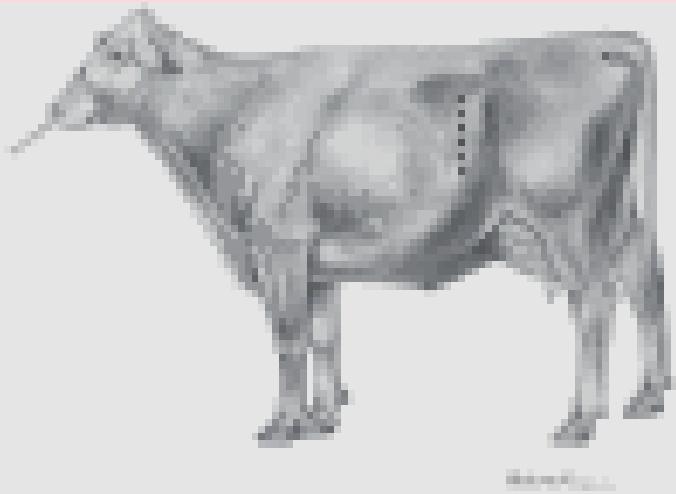
Epidural anaesthesia can also be used

Local infiltration analgesia is sufficient in animals restrained in dorsal recumbency
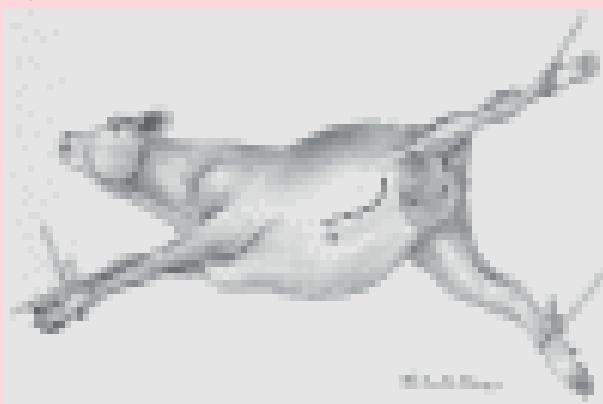
Pre-operative considerations

The general condition of the patient should be stabilized before surgery and shock, toxaemia if present should be treated by IV infusion of fluids, antibiotics and corticosteroids. Fasting is usually not possible in emergency operations

Standing left paralumbar celiotomy.
The placement of the incision is indicated
by the dashed line.

The locations for the midline (top line), right
paramedian (middle line) and right low
oblique or paramammary approaches
(bottom line)

The proper positioning of the cow
and incision site for the
ventrolateral celiotomy

The position of the oblique flank incision

Operative procedure   Exposing the uterus via flank celiotomy→

Shaving and scrubbing with soap and water and then savlon

Application of drape and Iodine or alchohol

The skin is incised and the subcutaneous tissue separated by blunt dissection

The muscles (Transverse abdominis and external oblique) are held by tissue forceps and incised. In paramedian approach care is taken not to incise the caudal deep epigastric veins

The peritoneum is visible as a smooth white layer. A nic is made in it and it is then incised by placing a finger inside the abdominal cavity

The omental fat is displaced to one side or incised. The uterus is located and braught to the operative site by pulling over a fetal extremity. It is packed with drapes or towels and incised over the greater curvature over a fetal extremity avoiding the cotyledon

The fetus is removed. The surgeon must change gloves after calf removal. The placenta can be removed if possible or separated
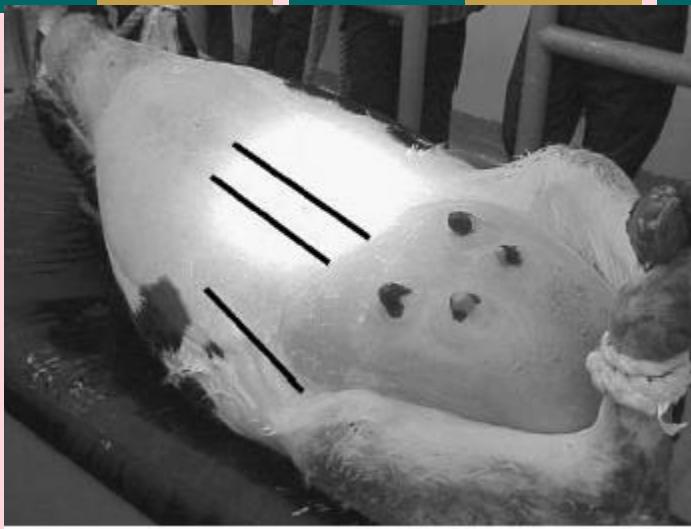
The uterus is sutured using cushing or lembert sutures using catgut or any other absorbable suture material.
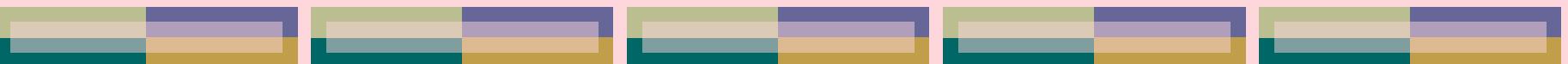
Gloves should be changed after uterine closure

The abdominal cavity is flushed with normal saline and the tissue debris is removed.
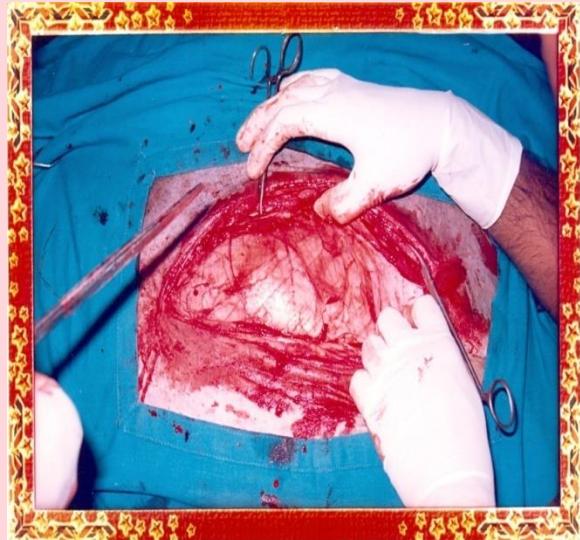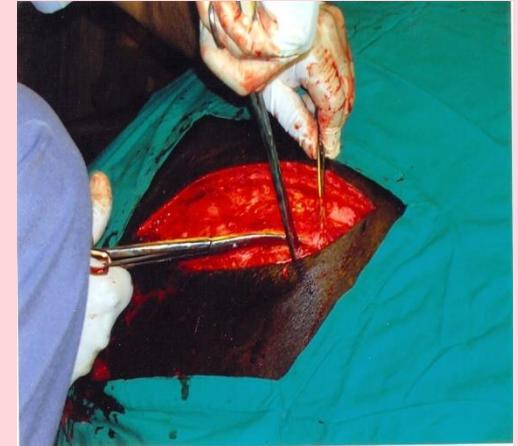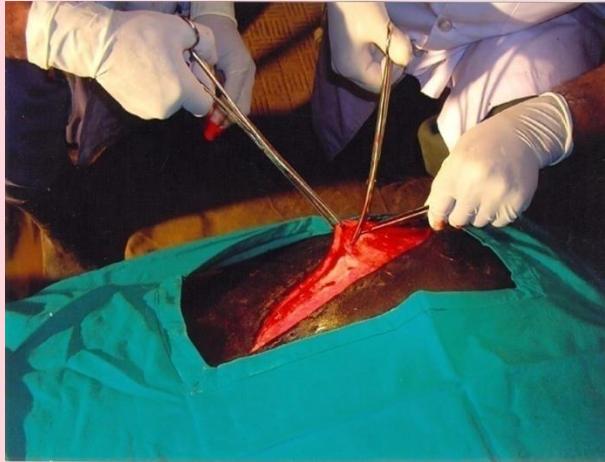
The peritoneum, muscles and other attachments are sutured using continuous or interrupted sutures sequentially avoiding any space between them and antibiotic powder can be sprinkled.
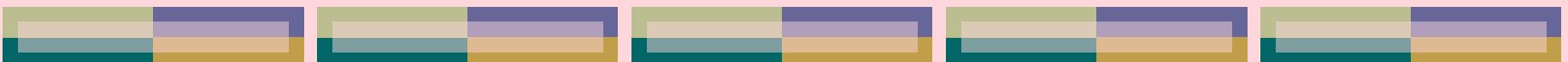
The skin is sutured using non-absorbable suture materail using interrupted simple or mattress or interlocking sutures.

Cesarean section: cattle and buffalo via oblique nentrolateral approachThe animal placed in dorsal recumbency, skin incision, subcutaneous dissection, the peritoneum is exposed, the uterus is exposed and taken out

Post operative care

Fluids, antibiotics and antiinflamatory drugs for 3-5 days and daily dressing of suture line

6-8 week sexual rest and avoiding bull mounting in ventral approaches

Operative complications

Excessive uterine bleeding and peritoneal cavity contamination

Post operative complications

Peritonitis

Seroma formation

Suture dehiscence

Subcutaneous emphysema
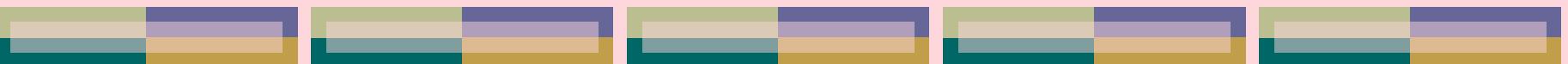
Adhesions

Prognosis

Depends on the condition of the fetus and dam before surgery. With emphysematous fetus the prognosis is poor

Mortality 8-10% when performed within 6-18 h and 10-30% when performed beyond 18 h

Cesarean section in the mare

Serious and dangerous in the absence of facility

Foal suffers anoxia within 1-2 h of second stage of labor due to dehiscence of allantochorion

Indications

Transverse presentation

When other measure have failed

Vulvo-vaginal trauma

Pelvic fracture

Anaesthesia

Methohexitone sodium 5 mg/Kg or thiopentone (10 mg/Kg) followed by inhalation anaesthesia using halothan and oxygen

Currently

xylazine 0.25 – 0.5 mg/Kg IV or 0.5-1.0 mg/Kg are used as preanaesthetic followed by guaifenesin 5-10%, ketamine 1.5-2.0 mg/Kg IV and inhalation anaesthesia using isoflurane or servoflurane gas anaesthesia at many places. 15-20 ml of bupivacaine at the site locally
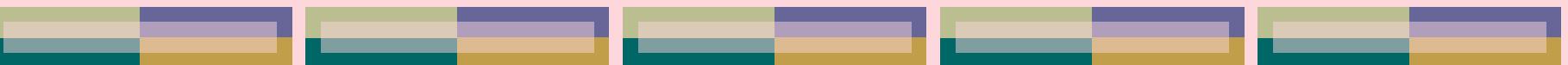
Sites   Midline (Preferred), Flank and Ventral

The uterine incision leads to profuse bleeding and hence double rows of sutures should be used. Postoperative abdominal pain and subcutaneous edema may be seen. Oxytocin can also induce colic. Oxytetracycline should be avoided as it precipitates salmonellosis. If laminitis develops uterine lavage should be considered and antiallergics should be given.

Cesarean Section

Cesarean section in sheep and goat

Similar to cattle except that only 0.5-1.0% lidocaine should be used by dilution of 2% solution as accidental infusion leads to convulsions

Cesarean section in the bitch and cat

Cesarean is either elective or emergency

Important indicator is fetal compromise

(Fetal heart rate below 150; normal is above 180)

Endotracheal intubation is suggested after induction of anaesthesia.

Anaesthesia General anaesthesia is used in both the species.

Premedication Glycopyrrolate 0.01 mg/Kg IM or SC or Atropine 0.04 mg/Kg IM or SC

Anaesthesia- Hydromorphone 0.05 mg/Kg or propofol followed by inhalation anaesthesia using mask preoxygenation and isoflurane or sevoflurane

Xylazine, ketamine and thiopentone are also used as IV anaesthetics but they cause fetal depression

Cesarean section in the sow

Approaches include ventral flank and sublumbar

Anaesthesia: Halothane (Landrace breed is susceptible so do not use in this breed) + nitrous oxide and oxygen after IV administration of thiopentone (150-200 mg/Kg IV)

Premedication

Diazepam (0.5-1.0 mg/Kg IM)
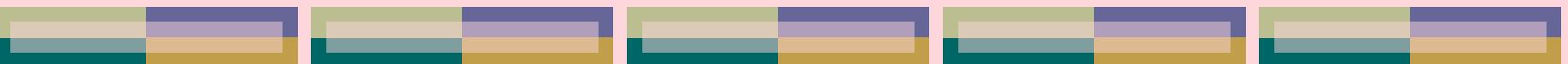
IV anaesthetics

IM azaperone (2mg/Kg) and IV metomidate (2mg/Kg) with local infiltration
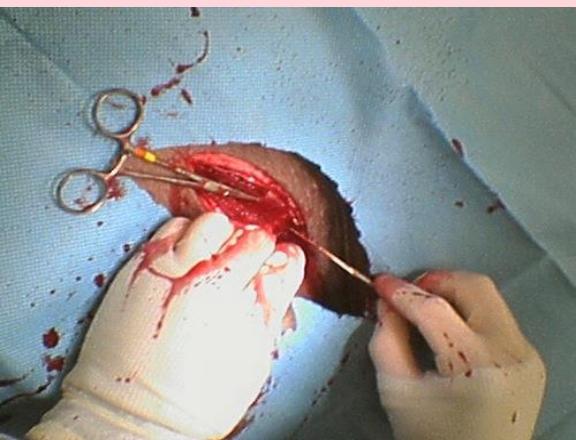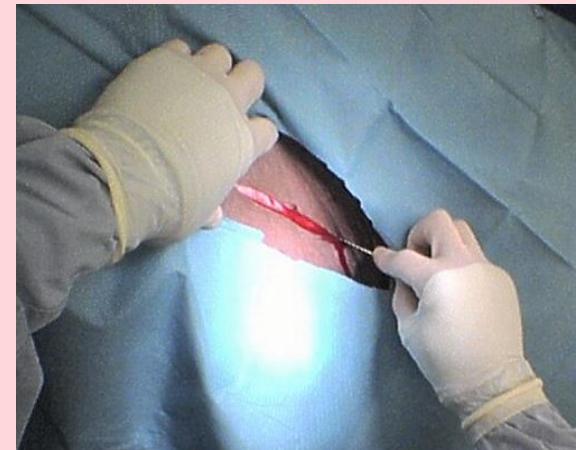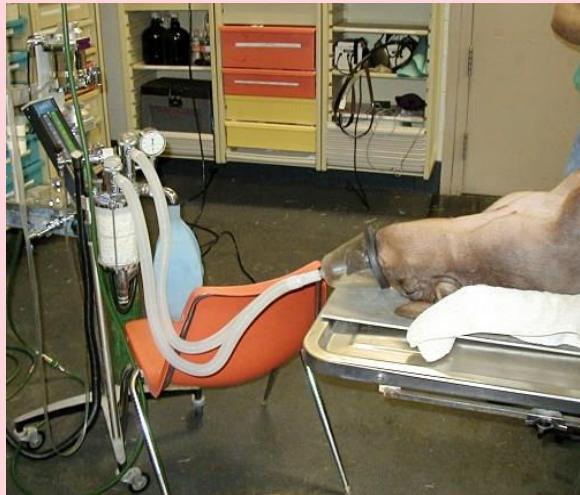
Ketamine (15-20 mg/Kg IV + diazepam (0.5-1.0 mg/Kg)
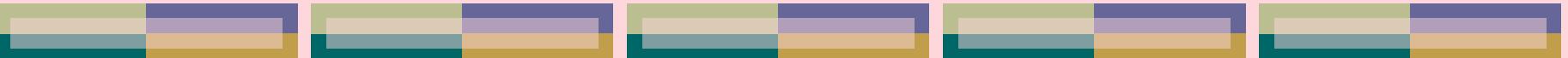
Xylazine 2.2 mg/Kg IM however, IV anaesthetics are known to cause hind limb paralysis.

Cesarean section in the sow inhalation anesthesia,skin incision, haemorrhage control, uterine incision and fetal extraction

Operative approaches

Ventral, midline and flank. The incision must be given over the uterine body and the fetuses milked slowly through the uterus. Ergonovine (10-30 μg/Kg IM) if excessive bleeding occurs post operatively.

Cesarean section in the camel

Done in sitting position

Flank and ventrolateral approaches are used. Care should be taken in flank approach when incising the peritoneum to avoid accidental cut on the spleen.

Xylazine and local infiltration anaesthesia is used.

Post-operative skin healing is delayed and hernias and seroma formation is common

Surgeries of the cervix

Cervicotomy: done for Bandl's ring dystocia, protracted cases of prolapse but only in useless invaluable animals under epidural anaesthesia and one or more incisions or complete removal of cervix is done.

Cervicorrhapy: done in cows and mare after cervical tears occur at parturition. Surgical repair needed only if more than 50% of the cervix is involved. More important in the mare and the surgery is done only 6-8 weeks after injury. General anaesthesia and specialized instruments are required for the mare. The devitalized tissue is removed and the tissues repaired in 3 layers.

Removal of Cervical tumors are uncommon but seen in cows and goats and removed under epidural anaesthesia fibroma is the most common tumor.

Cervicopexy: (Winklers operation) is a technique of fixing the cervix with the prepubic tendon for the prevention of recurrent prolapse in dairy cows.

Animals are restrained in standing position, the perineal area is prepared aseptically and the feces are removed. The animal is given epidural anaesthesia. Cathetor is placed in the urethra and a specialised needle is used to tie the tie the cervix below the the caudal vaginal floor with the prepubic tendon. Alternatively the same procedure can be done by approach through the flank celiotomy.
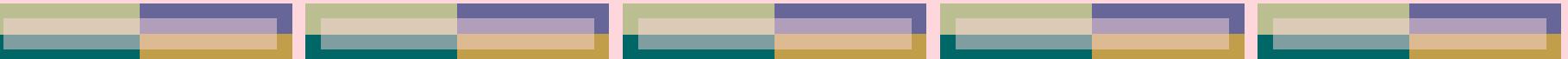
Vaginal surgeries

Vaginoplasty:vaginal reconstruction surgeries are commonly performed in mares and cows for urine pooling, whereas they are performed in the bitch and cat for repair of strictures, vaginal septum, persistent hymen. The operation is performed under general anaesthesia in the mare and bitch. Shires technique in the mare include removal of a part of vaginal floor and **urethral extension** so that the urine does not accumulate on the vaginal floor.

Some tumors of the cervix and vagina in the bitch and goat

Removal of vaginal tumors

Vaginal tumors are uncommon in animals except the dog and cat. Leiomyoma, fibroma and TVT are the common tumors in the dog. Bitches with tumors often evidence dysuria, bleeding, tenesmus and swelling. Surgical excision under general anaesthesia is suggested.

Vaginopexy (Minchevs operation): Fixation of vagina to prevent a recurrent vaginal prolapse Infiltration anaesthesia with 10 mL of 2% lidocaine injected into the gluteal region 5 cm lateral to the fourth sacral vertebra on both sides have been suggested. The gluteal region is clipped and prepared aseptically. A 1 m section of umbilical tape or No 5 polyamide is threaded through a 10 cm serpentine needle. The free ends of the suture material are threaded through a prolapse button and the ends are tied. The needle is passed through the vagina to the external skin at the gluteal region. The free end of the suture is passed through another prolapse button and after tension on the suture the ends are tied in the form of a bow. The procedure is repeated on the opposite side of the hip. The two resulting stay sutures appose the retroperitoneal surface of the vagina and the peritoneum of the pelvic cavity, inducing adhesion formation thus preventing prolapse recurrence.

Surgeries of the perineum (Perineorrhapy, perineoplasy)

Perineoplasty is performed in mares with a very loose vulvo-vaginal sphinchter alongwith a cranially positioned vulva, because episioplasty may not prevent pnuemo-vagina in such mares.

Perineorrhapy is performed usually in mares and less commonly in cows for repair of perineal lacerations that occur during dystocia. Both these surgeries are performed under general anaesthesia and require specialized retractors and other instruments and surgical skills.

Surgeries of the vulva include episiotomy, episioplasty and removal of tumors

Episiotomy: Cutting of the vulva is required infrequently in domestic animals during a dystocia. Congenital abnormalities including vulvar stenosis, vulvo-vestibular cleft and vulvar atresia in bitches may require apisiotomy. Bitches affected with vulvar stenosis often experience pain at coitus **(dyspareunia)** and are caused by imperfect joining of the genital folds.
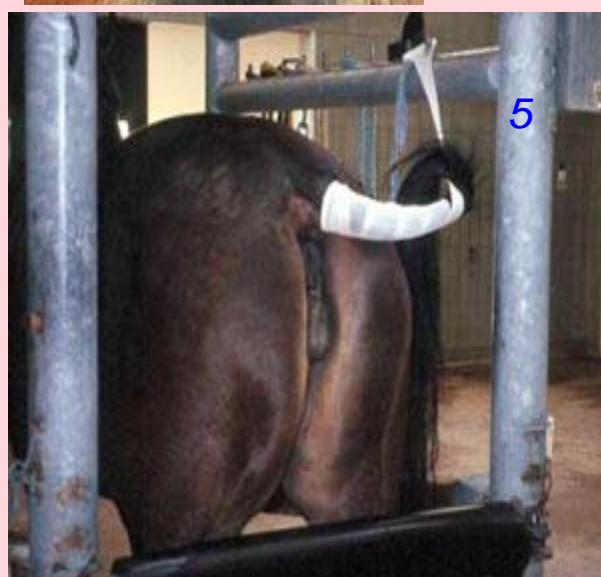
Episiotomy (Caslicks operation) means cutting of parts of the vulvar lips followed by their suturing. This is the most common surgery performed on broodmares. Ideally over 80 percent of the vulvar labia should lie in a vertical plane below the ishiatic arch of the pelvis. Dorsal positioning of vulvar lips in relation to the ischiatic arch predisposes the mare to pnuemovagina, particularly in multiparous mares. With each pregnancy, the labia are pulled further forward, predisposing to aspiration of air and fecal contaminants into the vagina. The operation can be performed easily in a standing mare restrained in a chute. Local infiltration anaesthesia is sufficient for most mares however some mares may require mild sedation. A 22 gauze needle is introduced along the planned incision line at the muco-cutaneous junction of the labia. Approximately 5-10 mL of 2% lidocaine is deposited while the needle is withdrawn. The same quantity of anaesthetic is deposited on both side labia.
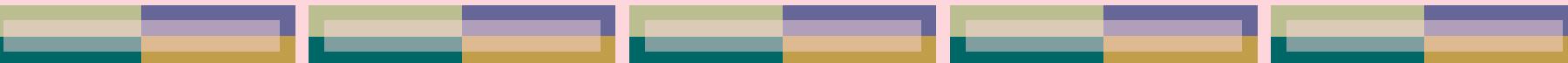
Operative procedure

After placing traction on the vulvar lips in a ventral direction, sccissors are used to remove a narrow strip of tissue at the mucocutaneous junction. No more than 1 cm of the tissue should be removed. The length of the cut may be 3-4 cm and approximately 3-4 cm should be left intact. The edges are sutured using absorbable material to avoid the need for suture removal. A continuous or interrupted suture pattern can be used to appose the tissues. Tetanus prophylaxis should be given and antibiotics may sometimes be indicate if there is an infection.

Mares with normal (1) and abnormal vulvar conformation (2-4) and the Caslick Operative procedure (5-8)

Ovario-hysterectomy

Indications: i) elective sterilization to prevent objectionable estrus and pregnancy, ii) as a *therapy for uterine, ovarian, vaginal and other genital pathologies* and iii) as a elective means for preventing diseases like those of the mammary glands and to prevent hormonal changes that interfere with medication in diseases like diabetes and epilepsy.

The customary age for elective spaying of dogs and cats is 6 months.

Preoperative considerations Fasting for 24 h, complete blood count

Anesthesia General anaesthesia

Operative procedures: Flank or midline laparotomy and Laparoscopic

Post-operative complications

Haemorrhage

Uterine stump pyometra   →→→→

Estrus following surgery due to remnants of
    ovarian tissue
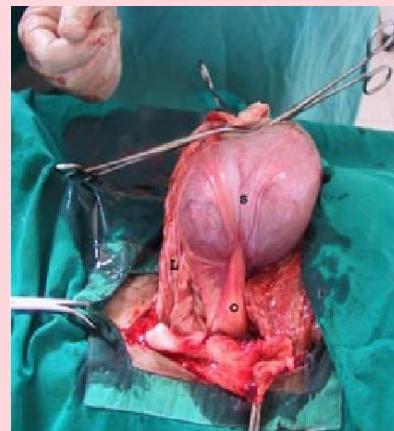
Ligation of ureters leading to hydronephrosis

Fistulous tracts

Urinary incontinence

Body weight gain

Eunuchoid syndrome (decreased agression, interest in work and decreased stamina)

Procedure of flank laparotomy for spaying in the cat
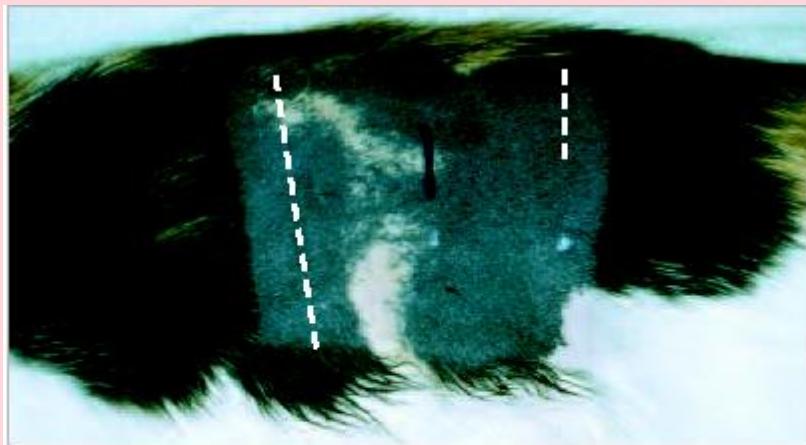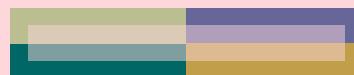
Figure 2. Prepped surgical area and proper incision location for a left lateral flank approach in a cat (*dashed line on left*: location of the last rib; *dashed line on right*: location of the iliac crest).

Figure 3. Exposure of the ipsilateral ovary in a cat.

Figure 4. Exposure of the contralateral ovary in a cat.

Figure 5. Exposure of the uterus in a cat.

Post partum complications

Retention of after birth
Post partum bleeding
Post partum prolapse
Paralysis
Post partum metritis
Lacerations of the birth canal
Sub-involution of placental sites
Metabolic disorders Milk fever, Eclampsia
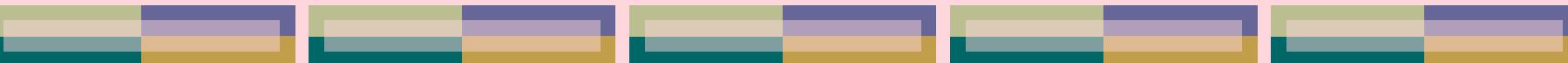
Huge uterine cyst seen in a cow immediately after parturition

Retention of after birth (Retained placenta)

A placenta should fall within 8-12 hours in cattle, buffaloes, sheep and goat and within 2 hrs in the mare if it is not expelled within this time it is considered retained. The retention is considered primary if there is lack of detachment from maternal caruncles in ruminants and secondary if there is mechanical difficulty in expelling the already detached placenta.

Incidence: from 2-50% more in summer and more in selenium and vitamin E deficient areas.

Mechanism of placental detachment in cows

↑ collagenase during postpartum causes massive breakdown of collagen during uterine involution. ↑ serotonin in fetal blood during late gestation cause ↑ collagenase by uterine cells. This also decreases blood to placenta. Uterine distension also casues separation. Increases in PG metabolites favour separation.

Etiology of RAB

Premature parturition

Failure of cotyledon caruncle detaching mechanisms

Hormonal imbalances ↑ progesterone
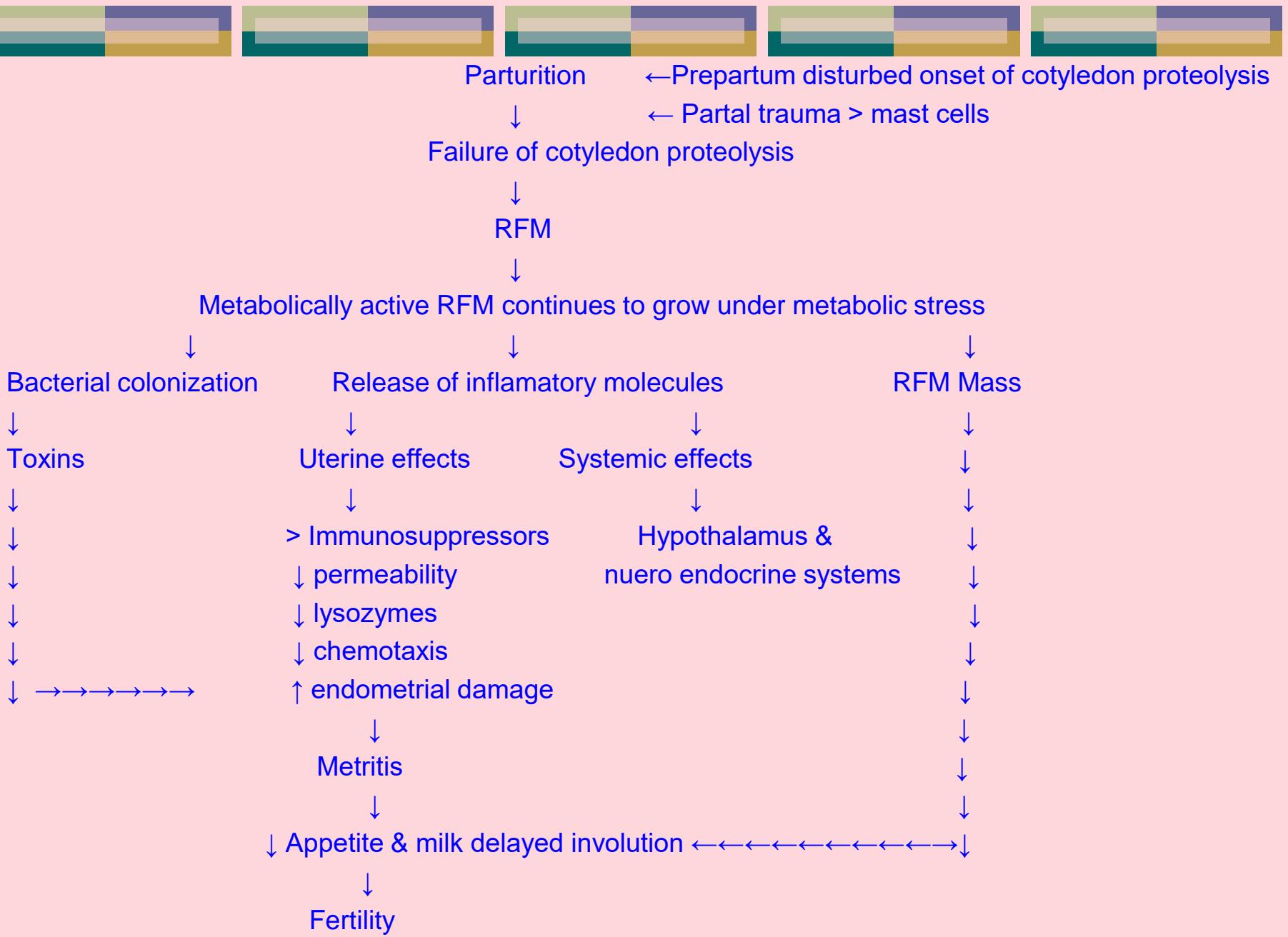
Trauma causes ↑ heparin which ↓ proteolysis

Low calcium and deficiency of Se and Vitamin E
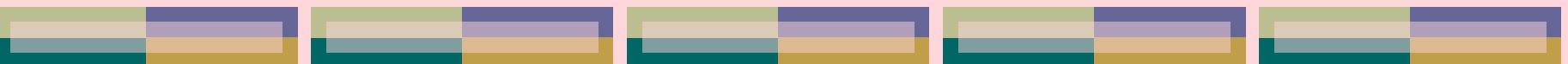
Metabolic imbalances

Post partum disease

Parturition ←Prepartum disturbed onset of cotyledon proteolysis

↓ ← Partal trauma > mast cells

Failure of cotyledon proteolysis

↓

RFM

↓

Metabolically active RFM continues to grow under metabolic stress

↓   ↓   ↓

Bacterial colonization   Release of inflamatory molecules   RFM Mass

↓   ↓   ↓   ↓

Toxins   Uterine effects   Systemic effects   ↓

↓   ↓   ↓   ↓

↓   > Immunosuppressors   Hypothalamus &   ↓

↓   ↓ permeability   nuero endocrine systems ↓

↓   ↓ lysozymes   ↓

↓   ↓ chemotaxis   ↓

↓ →→→→→→   ↑ endometrial damage   ↓

↓   ↓

Metritis   ↓

↓   ↓

↓ Appetite & milk delayed involution ←←←←←←←←←→↓

↓

Fertility

Pathophysiology of retained fetal membranes in cows

Therapies

Manual removal

Uterine motility stimulants

Collagenase injections

Effects of RFM: decreased appetite, delayed involution, Delayed post-partum estus, increased incidence of metritis. Placenta should drop in 30 min – 3h due to contractions post partum

Retained placenta mare:

More in aged draft mares and in dystocia and this can lead to laminitis because of release of vasoactive components. The peripheral blood circulation increases post partum because of decrease in uterine size and increased uterine tone. The fibrogen degradatikon products of uterus are thus carried to peripheral circulation thus causing laminitis
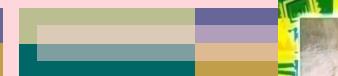
Therapy: 30-80 IU oxytocin in saline IV.

Infusion of normal saline intrauterine

Manual removal

Cold water baths, antihistaminics and antibiotics if laminits develop

Post partum haemorrhage

Due to dystocia handling or rupture of cotyledons

Subsequent to torsion correction

Vulval haemotoma common in gilts

Rupture of broad ligament, peritoneal haemorrhage common in mares

 with a copper deficiency and symptoms of vaginal pain, dysuria , colic and dificult defaecation are seen

Therapy:

Cold packs, Ligation if bleeding points accessible

NSS + 10 cc formalin, oxytocin, blood transfusion, ergonovine maleate if bleeding occurs after several days of parturition.

Rupture of uterus

Common in cow, goat and ewe.

Therapy is emergency laparotomy if diagnosed

Cervical and vaginal lacerations

Common in cow, mare and goat and repaired by suture and or surgery at a later time.

Perineal lacerations

Common in mares the term *Gill flirter* is used when the rectum and vulva become continuous

Surgeries are suggested

Prolapse of bladder

Common in mares as the urethra is large and the birth process is violent. The prolapsed bladder is replaced under epidural anaesthesia.

Prolapse of uterus (Also called casting of wethers, casting of calf bed)

More in confined cows and buffaloes with little exercise

Calcium deficiency predisposes to uterine prolapse

Dystocia handling and forced extraction can lead to prolapse

A constant sitting posture and loose genitals

Replacement should be done under epidural anesthesia after washing by pressure inwardly taking care not to rupture the cotyledons. In bitches replacement is done under general anaesthesia. In long standing cases with gangrene hysterectomy is suggested

Damage to the lumbosacral plexus
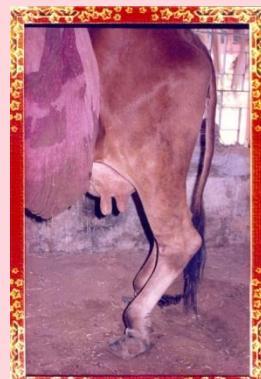
Gluteal paralysis common in mare there is difficulty in getting up and atrophy of gluteal muscles. Animals should be kep on slings
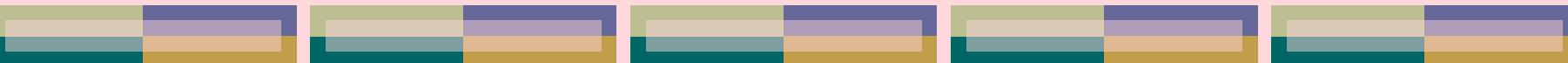
Obturator paralysis common in hiplock condition There is paralysis of adductor thigh muscles and the limbs become stiff. Nervine tonics and slings are suggested.

Peroneal paralysis Cows with dystocia and milk fever are commonly affected. There is knuckling of the fetlock and dropping of the hock joint. Bandage over the affected part and nervine tonics are suggested.

Rupture of gastrocnemius muscle There is inability to support weight and the gastrocnemius tendon is flaccid. The condition is more in selenium deficient areas.

Peroneal paralysis in a cow→

Post partum complications in dogs and cats include haemorrhage, SIPS, retained placenta, Uterine prolapse and rupture, metritis, agalactia, mastitis and eclampsia

SIPS Failure of sloughing of placental masses is the cause

Common in young dogs

bitches less than 3 years of age are more affected

chronic haemorrhagic discharge post partum upto 15 weeks

progressive weakness

pain on abdominal palpation

Anemia

Therapy   Medical PG's, ergonovine maleate, antibiotics

Laparotomy and currettage

Ovariohysterectomy

Retained Placenta Dark green vaginal discharge

Diagnosis by radiography or ultrasonography

Therapy oxytocin injections

Uterine rupture or prolapse

Replacement/ repair under general anesthesia

Metritis

Common Post whelping

Therapy Antibiotics + PG
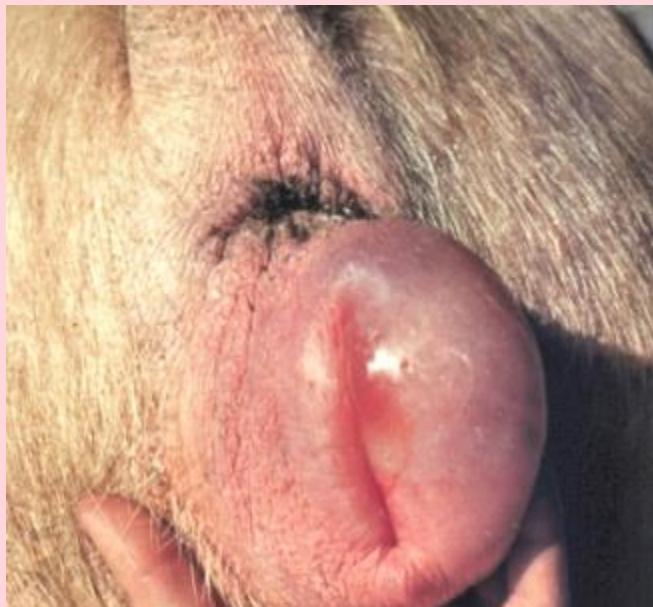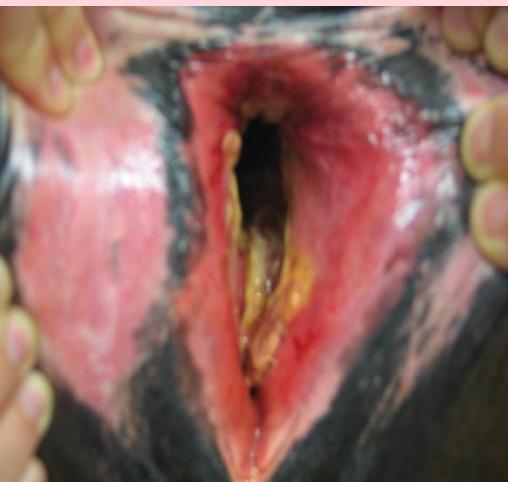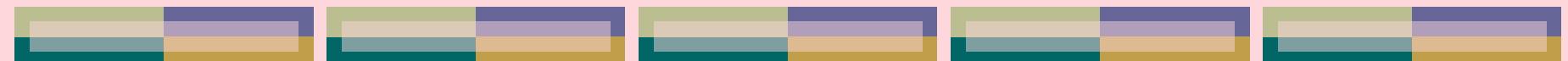
Eclampsia (Peurperal tetany) Affects small dogs with a large litter. There is hypocalcaemia and the signs of calcium deficiency appear including nervousness, excessive salivation, seizures, a stiff gait, unconsciousness and death.

5-20 ml of 10% calcium gluconate should be given IV alongwith dextrose and vitamin D supplementation. Diazepam is advocated for seizures. The pups may be fostered for a few days.

Agalactia is common in nervous and primiparous bitches and Galactostasis means swelling and edema of mammary glands
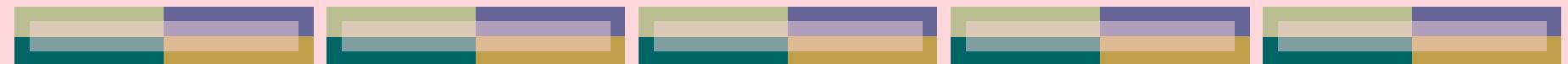
Mammitis and metritis sometimes occur simultaneously and are life threatening and hence rigorous therapy with antibiotics and antiinflamatory drugs and supplemental therapy should be done.
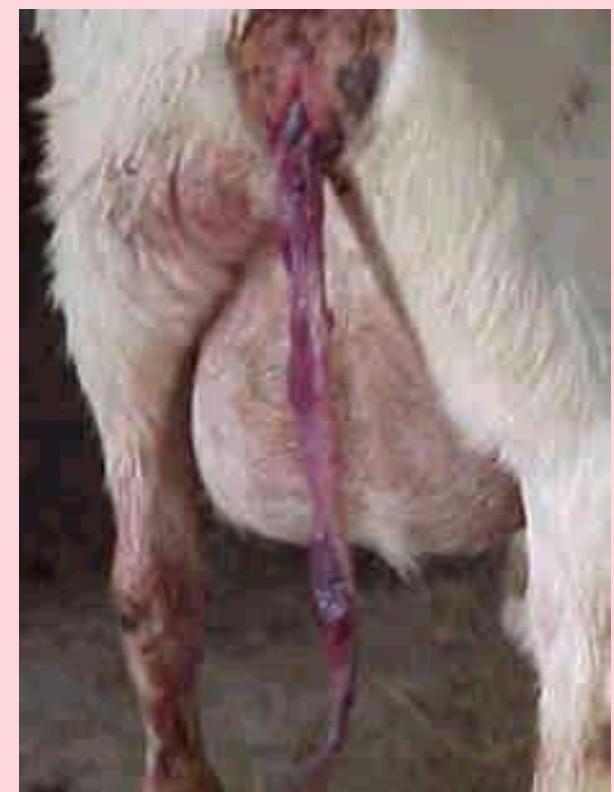
Vulvar swelling in a sow, perineal rupture in a mare and cervico-vaginal prolapse in a buffalo
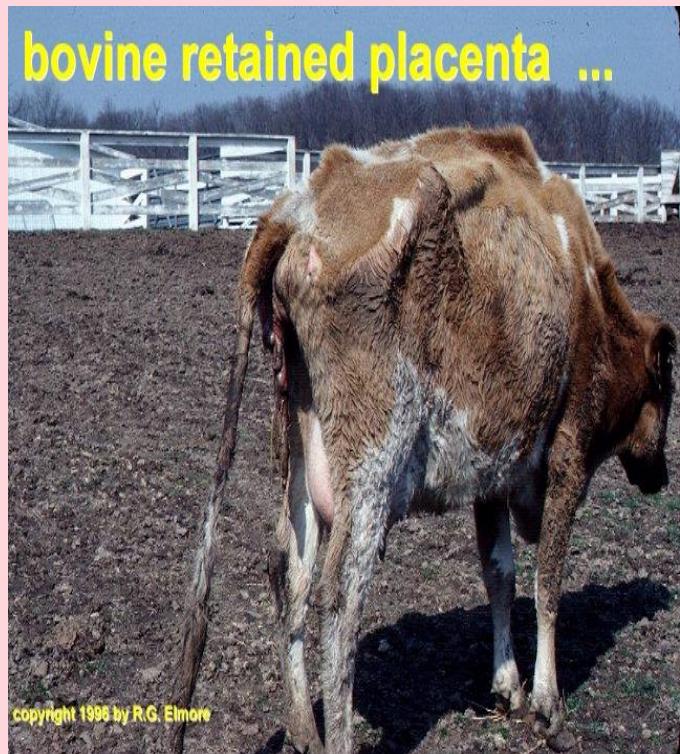
Retained placenta in a mare, sheep and goat. Skin haemorrhages in a sow suffering from swine fever

bovine retained placenta ...
copyright 1996 by R.G. Elmore
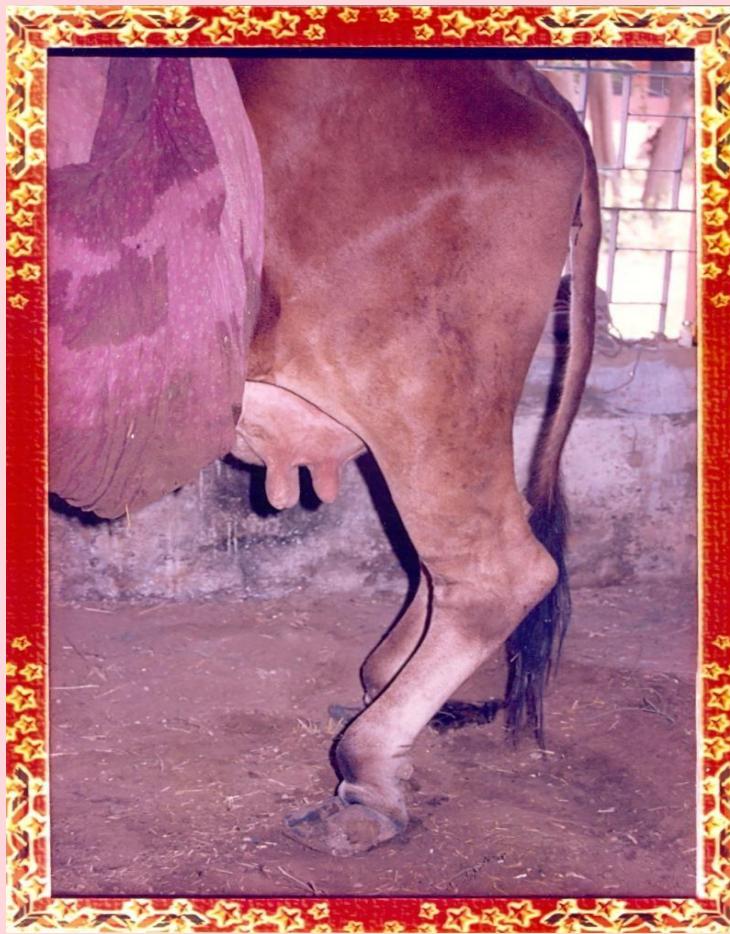
Pregnancy toxaemia in a sheep
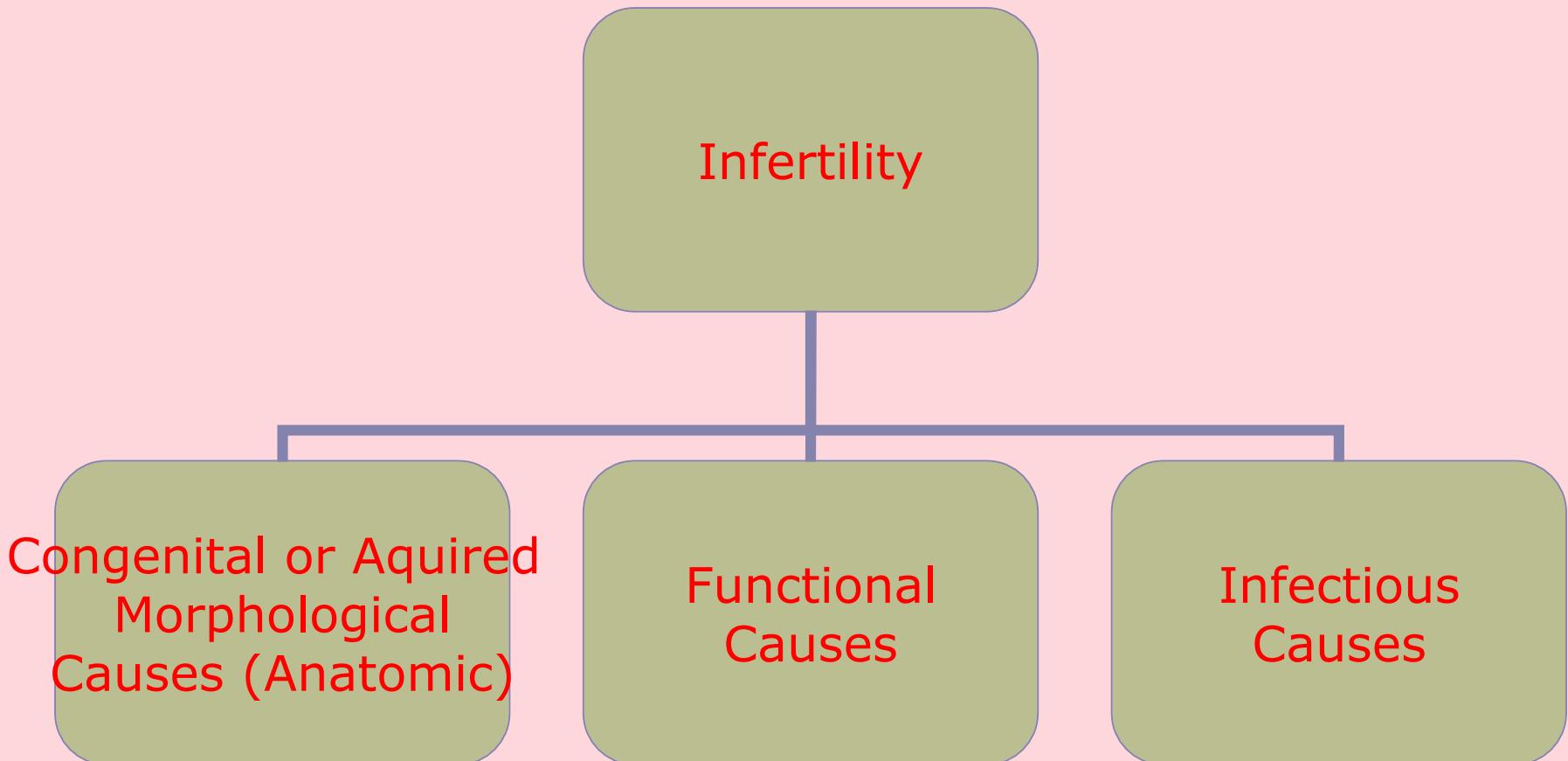
Eclampsia in a bitch, ventral hernia in a cow and peroneal paralysis in a cow
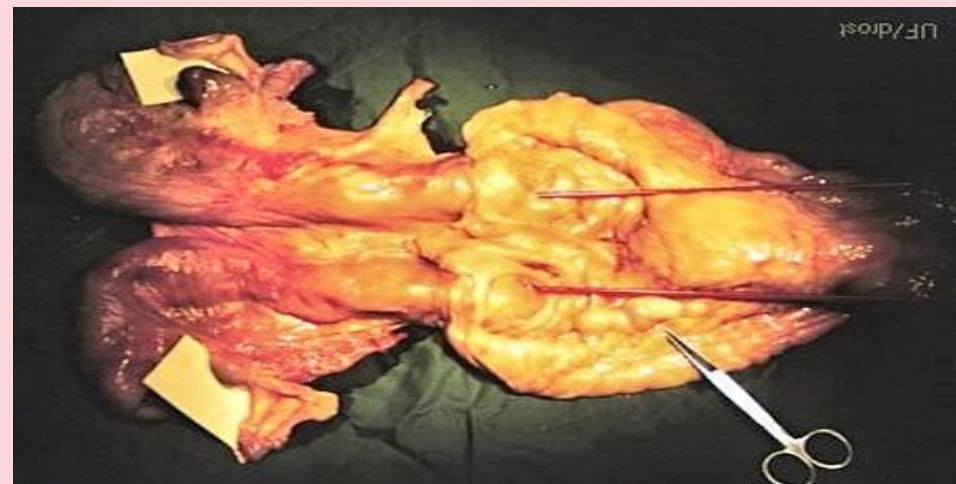
INFERTILITY Temporary Loss of fertility (Sub-fertility)

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                    ┌──────────────────────┐
                    │                      │
                    │     Infertility      │
                    │                      │
                    └──────────┬───────────┘
          ┌────────────────────┼────────────────────┐
  ┌───────┴────────┐   ┌───────┴────────┐   ┌────────┴───────┐
  │ Congenital or  │   │                │   │                │
  │   Aquired      │   │  Functional    │   │  Infectious    │
  │ Morphological  │   │   Causes       │   │   Causes       │
  │Causes (Anatomic)│  │                │   │                │
  └────────────────┘   └────────────────┘   └────────────────┘
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Congenital morphological causes
(Developmental abnormalities of genital organs)
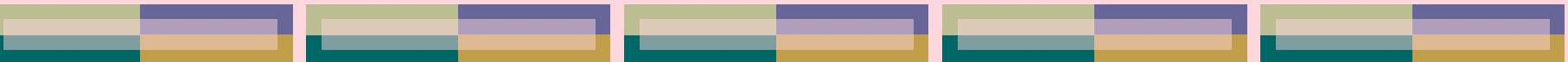
- Ovarian hypoplasia
- Freemartinism
- Hermaphrodites
- White heifer disease
- Double cervix
- Uterus unicornis
- Hymen defects
- Others

Acquired Causes

Ovarobursal adhesions

Uterine adhesions

Cervical cirrhosis

Genital tumors

Parturient lacerations

Ovarian hypoplasia An inherited disorder also called germ cell weakness

Ovaries are small narrow and functionless

Common in Swedish highland breed

Ovaries are furrowed small and shape is spindle like

Therapy is not possible and should not be done

Freemartin is an infertile female born cotwin to a male with which it has exchanged blood during the fetal life. The female will have varying degrees of abnormal development of the genitalia. The events leading to a freemartin are development of anastamosis between days 30 and 50 of gestation, which coincides with the sensitive phase of reproductive organogonesis. Anastomosis provides a physical basis for the exchange of blood all precursors and hormones between fetuses. The earlier the anastamosis occurs, the greater the degree of masculinization of the female cotwin.

Two theories have been suggested to explain freemartinism. The hormonal theory and the cellular theory. Accorrding to the hormonal theory, hormones from the male twin reach the female through vascular anastamosis between the fused placentas and cause masculinization of the female gonad.

The cellular theory for the induction of feemaritimism is based on the exchange of blood forming cells and germ cells between the fetuses.

The characteristic features of a bovine freemartin are those affecting the genital system. The external genitalia is that of a normal female with variable masculinization of the internal reproductive organs. Sometimes there is clitoromegaly and the gonads are rudimentary.

These gonads are referred to as ovotestes. Vaginal probing with a speculum reveals a short (about one third of normal length) blind ended vagina (cut – de – sac vagina) The affected animal does not show estrus, and on palpation through the rectum the reprodufive   tract is underdeveloped A definitive diagnoses is by karyotyping

White heifer disease: is a congenital disorder seen in Swedish white cattle and can be described as" segmental aplasia of the mullerian ducts". Due to segmental aplasia there is absence or one or more segments of the genital tract. There may be uterus unicornis, uterus didelphis, vulvar atresia or other defects of the genital tract. There is accumulation of fluid in the uterus or cervix if the caudal segments are absent and persistent hymen is common. This results in infertility.

Aquired causes

Ovaro-bursal adhesions: The most common aquired anatomic cause of infertility in cattle is ovaro-bursal adhesions. The formation of fibrous strands in the ovarian bursa interfere with normal ovulation and egg transport. They may be uni or bilateral. The incidence increase with increasing number of parities.

The etiology of the condition is poorly known but rough rectal palpation, manual enucleation of CL, pyometra, peurperal metritis and large volume intra-uterine infusions are considered possible contributing factors. The animal shows varying degrees of infertility.

The PSP dye test is suggested 20 ml of 0.1% PSP dye is infused in the uterus after cathetorising the bladder. The urine is collected 30-60 min later and to 10 ml of urine 0.2 ml of 10% trisodium orthophosphate is added A Pink color indicates that the fallopian tube is intact.

Cervical cirrhosis is one of the common cause of infertility in cows. The cervix becomes fibrosed and many times kinked and 'S' shape posing a difficulty in the passage of the AI gun during AI.
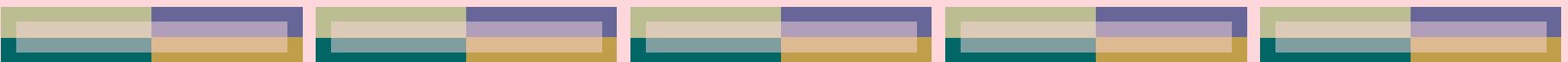
Other less frequent anatomic causes include uterine adhesions(which are common subsequent to cesarean and uterine torsion), tumors of the genital tract and perineal rupture. Fibromas are common in the uterus and cervix and granulosa cell tumor on ovary in cattle.

Functional causes

- Cystic Ovaries and retained CL

- Anestrus

- Repeat breeding

Ovarian cysts in cattle are the frequent cause of abnormal estrus behaviour and infertility in cows. The incidence varies between 5-45%. Mostly develop during the post partum period. 14% of all cows develop cysts in life.

Etiology: Exact etiology not known but endocrine dysfunction and mechanical interference are the two postulated causes. The possible mechanisms include

1) Low LH   2) Lack of LH receptors   3) Lack of response to estrogen

4) ↑ suprabasal P_4 5) ↑ ACTH   6) ↑Prolactin

7) ↓ Thyroid function   8) ↑ Endogenous opiod peptides 9) Low glucose and insulin

Predisposing factors

Common in dairy cows

Close confinement increases the incidence

Common during 2nd to 5th lactation
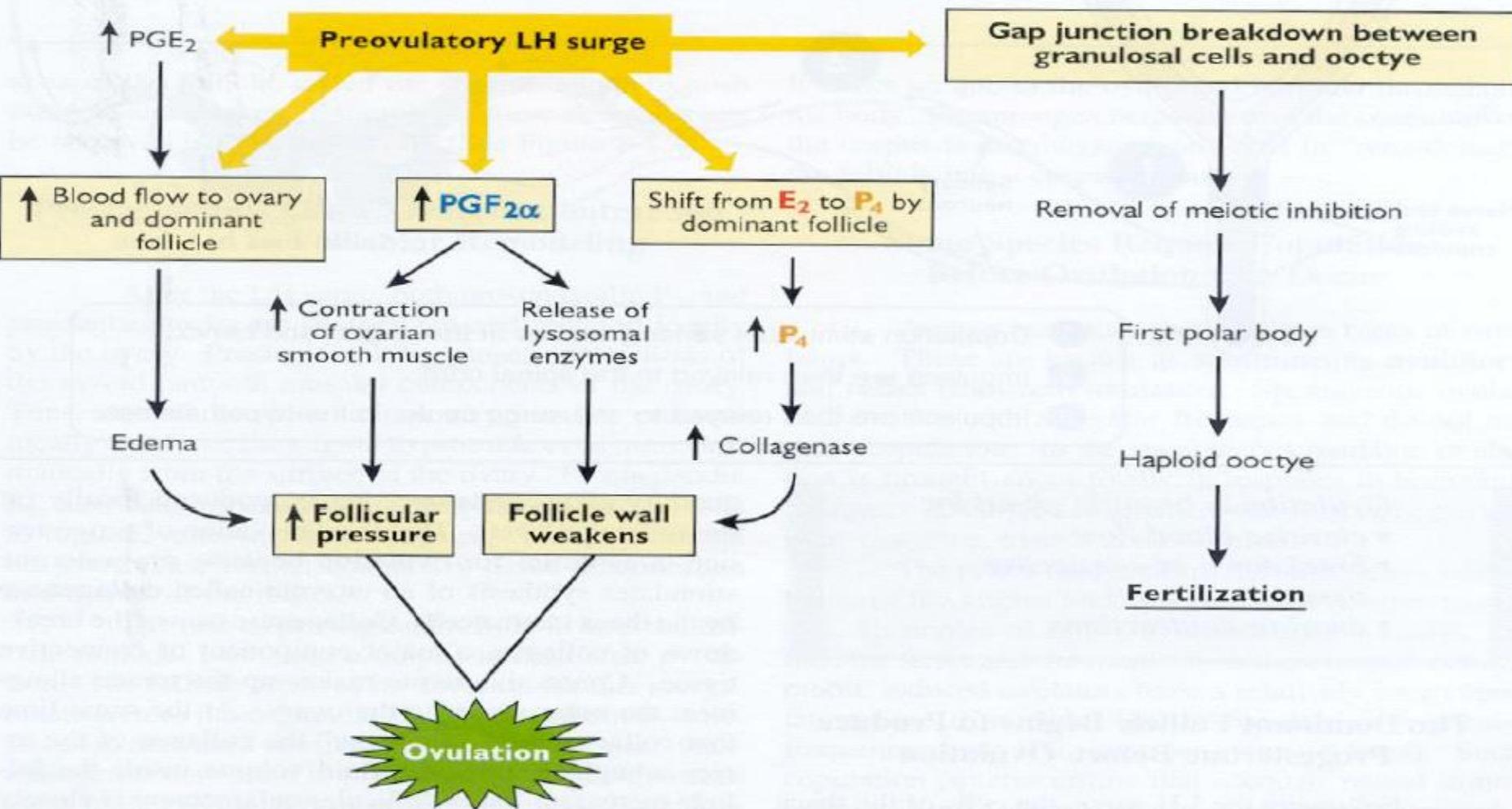
High milk production increases the incidence

High estrogenic feeds
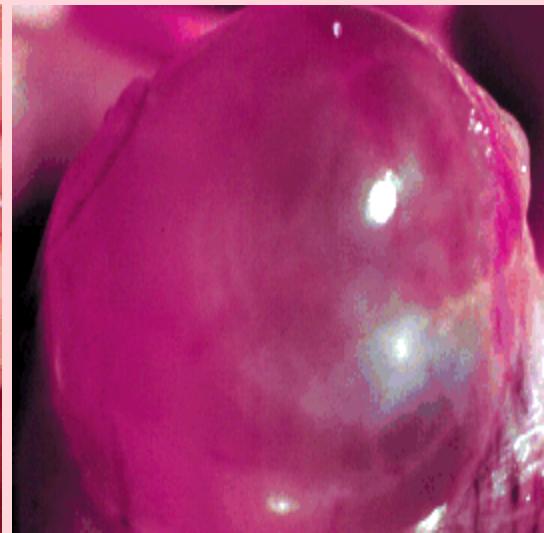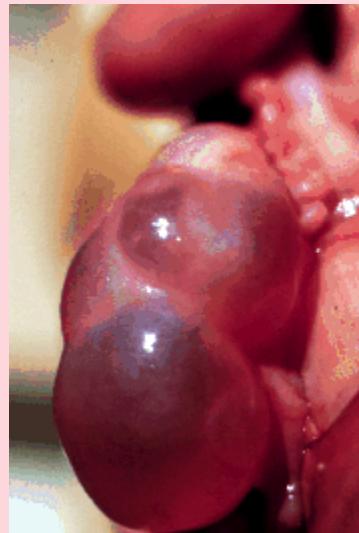
Stress at parturition

Ovarian Events caused by the Preovulatory LH Surge

Type of Cysts : Follicular and Luteal

Clinical findings

Anestrus in luteal cysts (usually single)

Nymphomania in follicular cysts (multiple)

Frequent and prolonged estrus

Masculine behavoiur

↑ 17 keyosteroids and adrenal virilism

Sterility hump

Edematous vulva

Vaginal prolapse

Mucometra

Enlarged uterus

Swiss cheese appearance of endometrium

Clitoral hypertorphy

Diagnosis: Rectal palpation finding of enlarged ovaries and fluid filled structures

Most cows develop cysts during postpartum period some may resolve spontaneously

- Persistence of cysts results in pathologies in uterus and other places like mucometra, adrenal virilism, bull like appearance, sterility hump etc.

- Diagnosis of cysts

  - Clinical signs

  - Rectal palpation

  - Ultrasonography

Possible etiopathology of follicular cysts

External factors (↑ milk, season, herredity)

↓

Anterior Pituitary

↓

High FSH ←←←←←←Altered granulosa cells →→→→→ ↑ ACTH

Low LH ↓

↓ Adrenal hypertrophy

Anovulatory Follicle ↓

↓ ↓

↑ prodn of E2 →→→→→→→→→ ↑ follicular Na ion   ↑ Aldosterone

↓ ↑ ↓ ↓

↓ ↑ Inhibition of follicular atresia ←Water retention ← ↑ salt retention

↓ ↓

Nymphomania Adrenal virilism
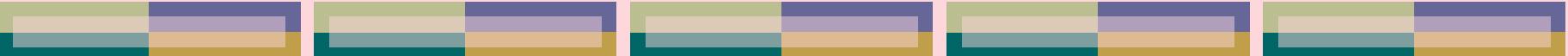
Therapy

- Spontaneous recovery
- Manual rupture
- Pottassium Iodide 10-15 gm for 5 days, Iodine Inj.(Ifer-H 2 ml SC)
- hCG Injection 1500-5000 IU IM or IV

  Chorulon, Pubergen, Profasi

- GnRH 100 Ug IM or IV :Inj.Receptal 5mL
- Prostaglandin Injection Lutalyse, Juramate, Iliren
- Progesterone 500mg IM or P4 implants
- hCG plus PG 9 days later
- GnRH plus PG 9 days later
- Ovusynch protocol: GnRH + PG 7 days + GnRH

  Day 0   Day 7   Day 9

- P4 implant + PG + GnRH
- Prophylactic GnRH 8-20 days post partum

Anestrus: Lack of estrus expression

- Prepubertal

- Post-service

- Post-partum

Predisposing Factors are

- Inadequate nutrition
- High ambient temperatures
- High parasite burdens
- Disease

Predisposing Factors are

- Inadequate nutrition

- High ambient temperatures

- High parasite burdens

- Disease

Prepubertal anestrus

- Affects heifers

Lack of estrus expression could be because of

Poor Management

Debilitating disease like BVD

Poor nutrition

Abnormal reproductive tracts

Chromosomal anomalies

Use of growth promoting implants

Postpartum Anestrus

- FSH Surges occur as early as 10-15 days post partum however cows show first post-partum estrus by day 21-30 post partum

Predisposing factors

Suckling : inhibits cyclicity by decreasing LH
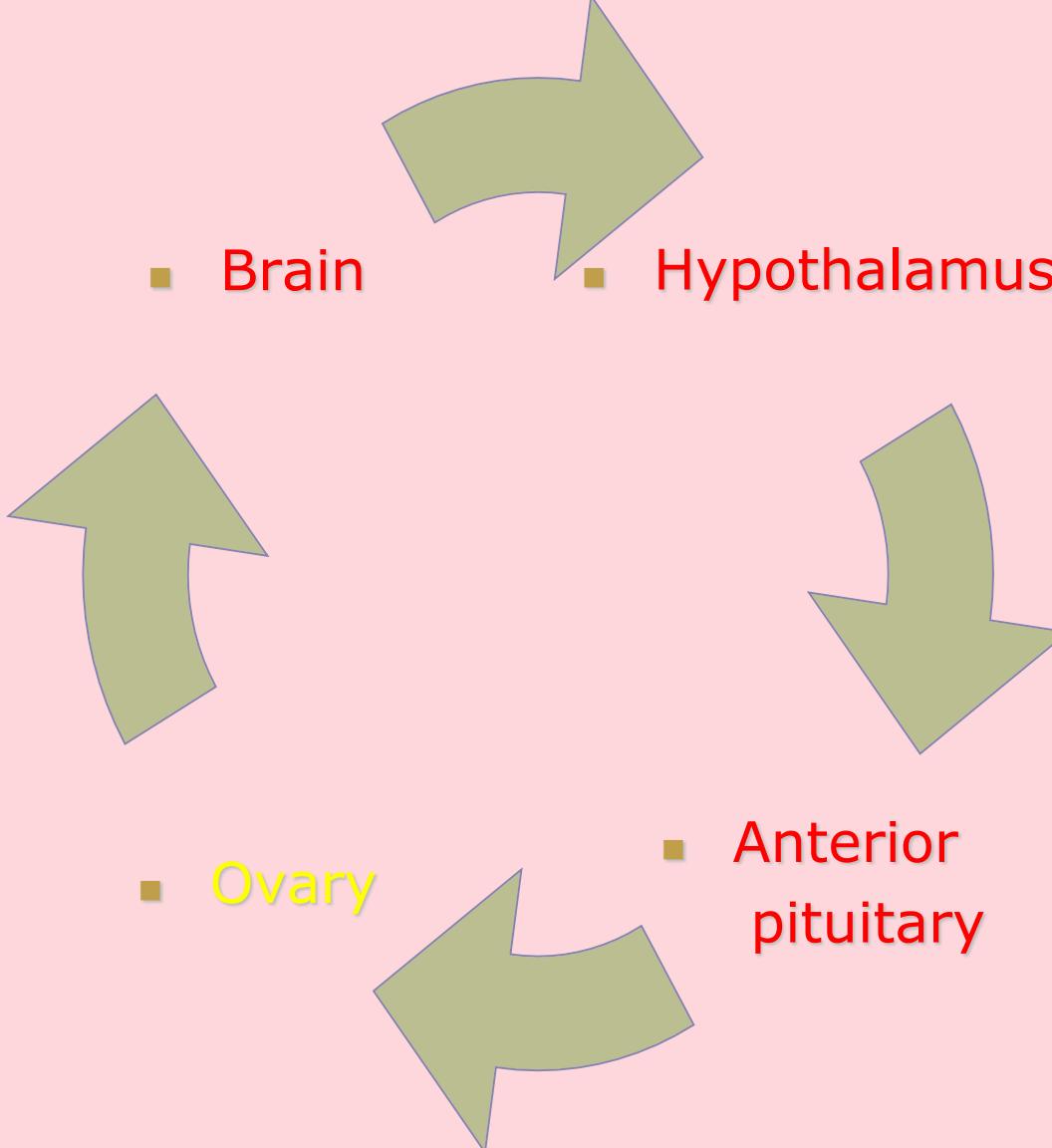
Stress: Increased corticoids decrease LH and also decrease sensitivity of pituitary to GnRH

Nutrition:

🌐 Negative energy balance and high protein both not good

🌐 Nutrition affects brain by neuropeptides, it affects liver to release IGF-1 and pancreas to secrete insulin both of which affect follicle development

- Brain
- Hypothalamus
- Anterior pituitary
- Ovary

Disease: Systemic or Uterine

Retained Placenta

Metritis

Chronic prolapse
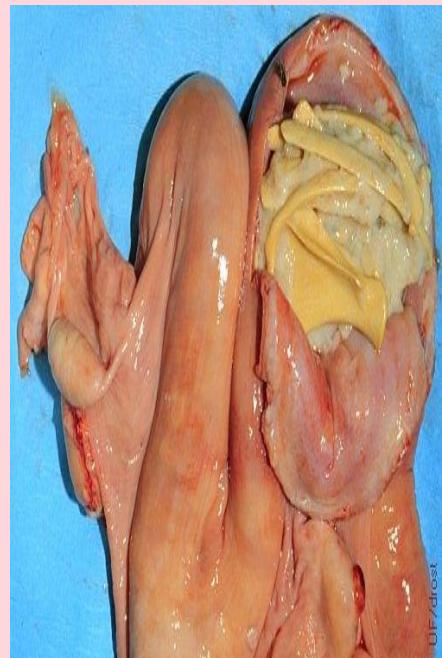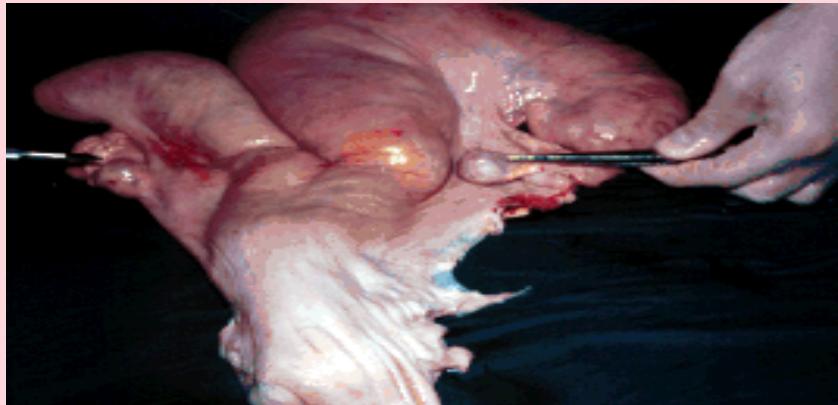
Hydrops amnii

Hydro-allantois

Post-Service Anestrus

- Pregnancy
- Luteal ovarian cysts
- Estrus Detection failure
- Pyometra
- Fetal mummification
- Granulosa cell tumor
- Fetal maceration

Summer Anestrus in buffalo

- Buffaloes have poor thermoregulation mechanism

- Seasonality of reproduction known to affected by daylight and melatonin

- Thermal stress reduces follicular activity

- High prolactin in lactating buffaloes known to affect reproductive cycles

Diagnosis: History + Rectal Exam.

Mandatory to Exclude Pregnancy first

Therapy

Improve nutrition

Mineral vitamin supplementation

Weaning

Reducing heat stress

Increasing cow comfort

Hormonal Therapy – should be attempted only when nutrition and management are optimum

- **Estrogen**   Progynon depot 2 mL IM

- **FSH**   Folligon 800-1000 IU IM

- **GnRH**   Receptal 5 mL IM

- **PG**   Only to be given when CL

is present Lutalyse 5 mL IM, Cyclix or Pragma or Juramate 2 ml IM

Repeated injection only suggested in cyclic animals

Progesterone implants or Injections safest

- Injection Duraprogen 750 mg 4mL + Vitamin A injection 14 mL
  2mL daily IM for 9 days

Progesterone + estradiol, CIDR for 9 days followed by withdrawl

Progesterone + FSH or GnRH
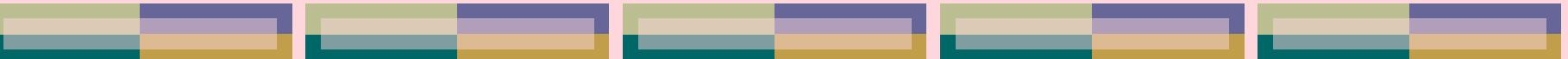
Synchromate-B ear implant (norgestomet)

Melatonin + antiprolactins for buffalo

Shang treatment = weaning + Synchromate B

Uterine motility stimulation- Lugols Iodine, manual massage

Antiestrogens: Clomiphene 300 mg orally daily
for 3 – 5 days

Anestrus mares

Management of the transition period is more important and usually light treatments are used 60 watt incandescent bulb in a stable starting in december leads to early cyclicity during January and passage of the irregular cycles before the breeding season. Other drugs suggested are the administration of domperidone 1.1 mg/Kg or sulpiride 1.0 mg/Kg orally for 10-15 days. GnRH agonists like deslorelin are being used at many places.

Terminating luteal phase with use of PG's is less successful due to idiosyncracies of its effect and the laminitis that may develop following the use of PG's.

Oral progestagens like altrenogest (0.044 mg/Kg/day) for 15 days are commonly used in foaling mares to delay the first foal heat to obtain optimum fertility.

Anestrus sheep and goats

Estrus induction during the breeding season involves the use of nearly all treatment used for cows like PG, oral or intravaginal progestagens, eCG and GnRH. During the transition period the male effect (introducing a male in a goat herd induces estrus) and melatonin and antiprolactin treatments are important however, during the non-breeding season estrus induction in goat or sheep involves the use of melatonin or light manipulations and the use of progestagens combined with eCG. PGs are ineffective during the non-breeding season.

Anestrus sows

Boar exposure brings early maturity in gilts as early as 5 months.

Estrus induction is dependent on the age of pigs for

Prepubertal gilts less than 160 days of age Boar exposure of 30 min/ day is sufficient

For Prepubertal gilts of more than 165 days of age GnRH, E2 + PG or PG 600

(contains 400 IU eCG + 200 IU hCG) is suggested

For cycling gilts oral altrenogest 15 mg/gilt/day for 18 days is suggested.

For lactating sows weaning + PG 600 are suggested

Anestrus dogs

Consider the season and nutrition

Antiprolactins (30 μg /Kg bromocryptine orally for 10-18 days) but do not give domperidone or metoclopramide if vomition occurs instead divide the dose and administer orally or give Phenergan syrup for vomition prevention.

Another therapy is 20 IU /Kg of eCG IM for 5 days followed by 500 IU hCG on day 5 IM

Repeat Breeding

A cow/ buffalo that has normal estrus & estrous cycle yet fails to conceive after 3-4 or more inseminations

A manifestation by the animal due to multifactorial etiology

Incidence : 16 to 28 %

2nd most common reproductive disorder

More common in cows vs buffaloes

Repeat Breeding

Male

AI

Poor semen quality
Cryo-preservation damages
Frozen sperm ½ life
Buffalo semen season

Natural Service
Poor Nutrition
Over-Use

Female

Nutritional Inadequacies
Lack of energy (NEBAL)
Excess of Protein
Deficiency of Minerals vitamins
Specially Vit A, C, E and Se, Ca and P

Hormonal dysfunction
Ovarian cysts
Supra-basal Progesterone
Low LH
Low luteal progesterone
Aberrant estrus

Reproductive tract abnormality
Ovaro-bursal adhesions
Kinked cervices tubal blockage

Infections Endometritis

Bacteria, viruses, protozoa, fungi

Genetic problems and Immuno-infertility

Other factors
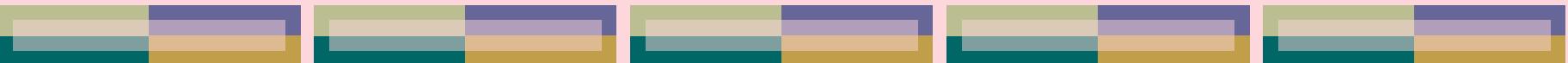
Stress like heat, cold etc

Environmental pollutants

Metabolic disorders

Peri-parturient disorders

Housing

Predisposing Factors

Nutrition   Negative energy balance

High Protein changes uterine pH & decrease P4

Micronutrients Ca, P, Mg, Cu, Zn, Vit A, E, Se

Endocrine dysfunction(suprabasal P4)

Infection/reproductive tract abnormality

Poor semen quality

Age

Genetic

Immunologic Antisperm antibody

Peri-Parturient disease

Stress Heat most important
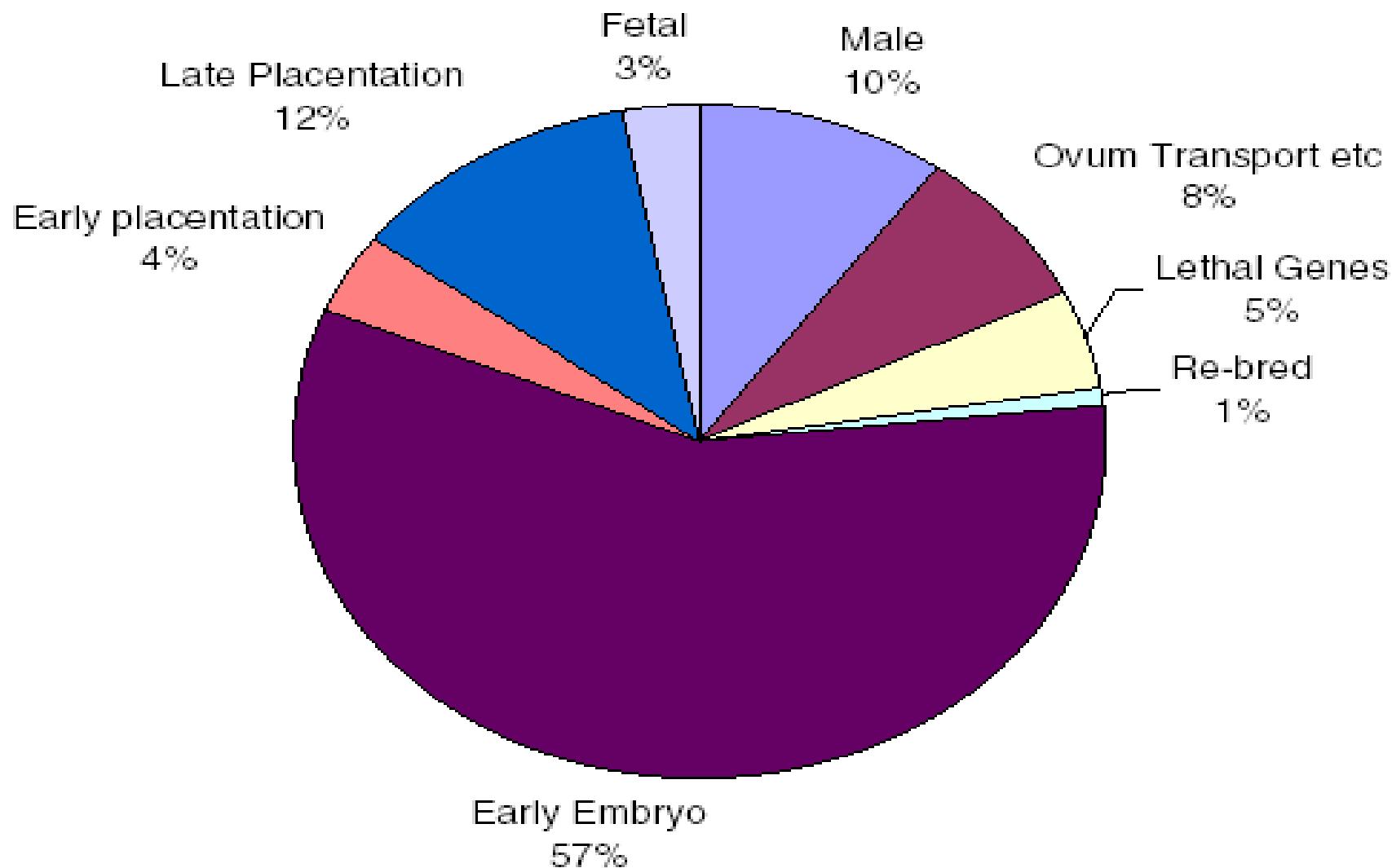
Fig. 1. Distribution of failures of pregnancy in cattle.

Therapy

Evaluate semen

Evaluate for genital infection and treat

Evaluate for anatomic defects

Evaluate for Ovulatory defects

Evaluate for nutrition and management and advice appropriate measures of correction

Evaluate reproductive hygeine and insemination procedures and adopt corrective measures

Specific corrective measures

- Genital tract infection

  Intrauterine/parentral antibiotics

  Prostaglandins

  Immunomodulators

  Oyster glycogen 500 mg in 50 mL PBS I/Ut.

  LPS 100 Ug in 30 mL PBS I/Ut

  Agents to alter Uterine environment

  Antioxidants:4mM Taurine + 50 mM fructose in

  PBS before AI

  Vitamin C Inj Ascovet 20 mL before AI

  Enzymes: Trypsin, Chymotrypsin, papain I/Ut.

  Uterine motility stimulants

  Mifepristone, clitoral massage

Hormonal therapy

- Ovulation induction agents

    hCG Injection Pubergen/Chorulon 1500-3000 IU at AI

    GnRH

    PG at AI

    Antiprolactin Bromocryptine 10 mg orally

    Dextrose   500mL IV at AI   plus Bovine insulin 0.2 IU/Kg

                           IV or Metformin orally

Luteal support

    hCG injection at 4-5 days of AI

        Progesterone injection 500 mg at 5 days of AI

        Recombinant Bovine Somatotropin 500 mg SC at AI

        Antiestrogens Tamoxifen citrate ??

Other measures

- Repeated inseminations

- Mineral vitamin supplements

- Cooling of heat stressed cows/ buffaloes

- Adequate hygeine at parturition & at AI

- Regular and frequent check of semen

- Addition of sperm motility enhancers when liquid semen is used eg. caffeine

- Prevention of natural mating with scrub bulls

Infectious causes of Infertility

Systemic
T.B

Non-Specific
Metritis, Vaginitis
Endometritis
Pyometra

Specific

Miscellaneous
Neospora, BVD, IBR-IPV, Epizootic abortion,
Granular venereal disease, Mycoplasma
Haemophilus

Venereal
Campylobacteriosis
Trichomoniasis

Others
Brucella, Leptosprira
Listeria, Corynebacteria

Bovine Venereal Diseases: Trichomonas & Campylobacteriosis

Trichomoniasis: Prevalence World over
Insidous disease causing sterility abortion and
pyometra caused by flagellate protozoan
Clinical signs Repeat breeding, abortion 1st half of gestation
Post service pyometra
Diagnosis: History of new bull introduction
Direct smear: abomasal contents of aborted fetus
Wet smear: vaginal discharge/ prepeutial washings
Org culture: Diamonds/ Tobies media transport at 4 degree C
Vaginal mucus agglutination test / FAT
Virgin heifer test mating
Prevention and control
Avoid contact of uninfected cattle to other cows & new bulls
For infected cows give Sexual rest for 8-12 weeks
Avoid renting or leasing bulls/ replace culled bulls with young bulls
Use AI for breeding
Therapy of infected animals: Imidazole derivatives, Sodium Iodide, local appl in
bulls, Vaccination
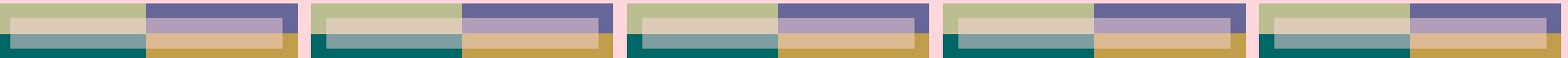
Campylobacteriosis: is caused by campylobacter fetus a gram negative bacteria affecting cattle, buffalo, sheep and goats. The disease is venereal in cattle and in cattle it is charachterised by early embryonic deatths, increased services per conception and abortions at 4-6 months.

The male is a asymptomatic carrier. Adult bulls are more affected and may carry infection for long times.

Sheep are more affected with C.intestinalis and sheep aborting one yr are resistant next year.

Diagnosis: history of increased services per conception, repeat breeding

Org identification in samples. Clarks or diamonds media must be used

Vaginal mucus agglutination test

Virgin heifer test mating

Fluorescent antibody test

Control: Widespread use of AI has limited the disease

Vaccine is available

Avoid renting or leasing bulls

Replace culled bulls with young bulls

Test all new bulls

Brucellosis: A zoonotic bacterial disease affecting cows buffaloes, goats, sheep, horses and dogs causing late gestation abortions in cattle and orchitis in bulls many times seen in the form of outbreaks.

Mode of infection: Ingestion of contaminated pasture/water/licking aborted fetuses

Organisms shed in milk & uterine discharges

After involution organisms colonize the udder

Uterus of pregnant cows get infected from blood

Organisms localize in allantochorion causing placentitis

Diagnosis: Stained smears from aborted material Koster & Zeihl Nelson method

Orgs can be cultured from fetal stomach/placenta Morrocan leather appearance

ELISA

Serological tests Rose Bengal Plate Test CFT/FAT/MRT

Control S19 vaccination calfhood vaccination 4-8 months   RB 51

Eradication: Notification, Isolation of aborting animals, disposal of aborted fetuses, placenta

Genital Mycoplasmasmosis/ Ureaplasmosis
    Cell wall deficient organisms

Mycoplasma cause vulvovaginitis andd both these organisms can cause infertility and abortion they are frequently isolated from semen and their transmision is through semen.

Genital Tuberculosis: Peritoneal - Adhesions of uterus, abscess
                        Glandular - Nodules formed on the uterus
                        Epithelial Pin head sized granular lesions

The presence of ovaro-bursal adhesions and thickened tortous fallopian tubes is diagnostic of TB

An animal showing a chronic vaginal discharge must be examined for acid fast organisms

Leptospirosis A zoonotic disease caused by parasitic spirochaetes and charachterised by fetal death, abortion and birth of weak calves.

Acute: ↑ body temp, haemoblobinuria, icterus, abortion (L.pomona, canicola, icterohaemorragia, grippityphosa

Chronic: Abortion after 6 months weak calves, mastitis, blood tinged milk (L.hardjo) Disease most common in september & october

Transmission: Mucus membrane and abraded skin

Diagnosis: antibodies in fetal sera, urine sediments

Treatment: Streptomycin + vaccine

Control: separate cattle from pigs, rodent control & drainage of water

Listeriosis (Gram positive coccobacilli) sporadic disease of ruminants charachterised by encephalitis, abortion (last trimester), neonatal septicaemia commonly occurring in winter

Transmission: By ingestion

Clinical signs: Abortion, RFM, endometritis, weight loss, transient infertility

Diagnosis: Fetal tissues

Treatment: Tetracycline

Control Remove fetal tissues, avoid spoiled feed

Salmonellar abortions:

Abortions are sporadically caused by S.dublin in cattle, S. abortus ovis in sheep and S.enteriditis in pigs however, the most important is S. abortus equi which causes abortion in mares.

Salmonella are present in the environment

Mares abort at 6-9 months and evidence slight fever.

Streptococcus zoopidemicus is another cause of abortions in poorly managed farms.

VIRAL INFECTIOUS CAUSES OF INFERTILITY AND ABORTION

Infetious Bovine Rhinotracheitis(IBR, Red Nose) and Infectious Pustular vulvovaginitis(IPV) Caused by Bovine herpes virus 1 affects cattle and buffaloes

Respiratory form causes fever congestion of nasal mucosa, nasal discharge and ulcers on nose, trachea.

Conjuctival form affects all ages of animals and usually causes conjuctivitis

Abortive form causes abortion in 2nd half of gestation. There is red colored fluid in body tissues of fetuses

Encephalitic form affects young calves less than 6 months of age

Vulvo-vaginitis (coital vesicular exanthema) has a venereal transmission and causes balano-posthitis in bulls and vulvo-vaginitis in cows with whitish discharge for 2-3 weeks

Transmission: contact with infected cattle.

Diagnosis: Organism identification from Vulvar, vaginal scrappings, nasal conjuctival swabs. Samples should be refrigerated and send on culture medium to the lab.

Histopathology of fetal liver shows multifocal necrosis.

Treatment: Palliative

Vaccines: Infected animals are life long carriers. Heifers are immunised at 6-8 months. The immunity is 3 years and live vaccines often produce latent infection

Control: Destruction of aborted material and movement restriction

Modified live vaccines (MLV's) and killed vaccines for pregnant animals.

Bovine Virus diarrhea (BVD-MD) Caused by toga virus 2 types type 1 and 2 causes gastrointestinal disease and abortions

Transmission: Aerosol and contact with persistently infected (PI) animals

Bulls excrete virus in semen following chronic infection

Calves born from infected animals are persistently infected (PI)

Clinical signs: Pyrexia, diarrhea, occulonasal discharge, ulcers and abortion at 2-4 months and mummification. The mucosal type of disease shows diarrhea and nasal discharge

Diagnosis: History of diarrhea, immuno-histochemistry on fetal tissues, PCR, ELISA

Control: Strict isolation and removal of PI animals

Vaccination of replacement heifers with MLV vaccine 2 months before 1st breeding

Killed vaccines for other animals

Equine Herpes Virus caused by herpes virus, is worldwide, affects mares. Donkeys and cattle are reserviors. There are 5 subtypes EHV-1 and EHV-4 are primarily abortigenic. May cause respiratory, encephalitic disease and neonatal mortality.

Clinical signs: Respiratory disease in young foals is followed by abortions in pregnant mares

Fever, nasal discharge, cough in foals for 2-5 days. Abortions beyond 7 months and asymptomatic. Neurologic disease may appear later.

Diagnosis: History, virus isolation from nasal swabs. Samples of fetal lung, liver, spleen and thymus should be submitted
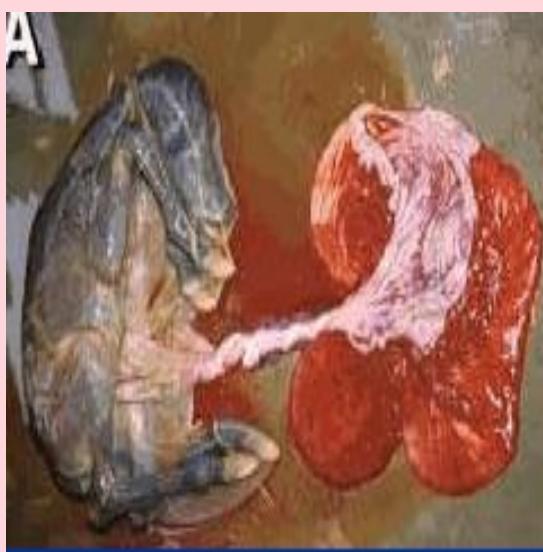
Control: Seggregation and vaccination of pregnant mares at 5, 7 and 9 months of pregnancy. The immunity is short.

Three forms of clinical disease in EHV affecting Horses

Respiratory form : fecer, cough, nasal discharge for 1-7 days

Abortive form: Late term abortion in mares exposed to EHV

Neurologic form (less common, most serious) ataxia in hind limbs, urinary incontinence, head tilt and recumbency.

Equine viral arteritis is caused by RNA virus of the Togaviridae family. It is an acute to sub-acute viral disease of horses charachterised by generalised vascular necrosis and abortion

Transmission: Aerosol transmission. Venereal transmission is also known. Infections are mostly sporadic and sub-acute.

Clinical signs: Fever, nasal discharge, keratitis, photophobia, skin rashes on neck, weight loss, abdominal pain and mild respiratory signs. Naturally infected horses recover in 3-9 days and have prolonged immunity.

Diagnosis: virus isolation from nasal swabs, lung and spleen of fetuses, semen of affected animals.

Control: Vaccination of stallions before the breeding season and vaccination of pregnant mares at 7 months of pregnancy.

Porcine Parvo Virus (PPV) DNA virus and Porcine Enterovirus(PEV) are similar

They are a common cause of fetal deaths in litters produced by gilts and immunologically compromised sows

Transmission: Fecal-oronasal route as pigs shed the virus in feces. Transplacental transmission is also present. The virus is resistant to cold, heat and disinfectants and hence infeected premises act as reservior

Primarily a Gilt disease there is mummification of many fetuses in 1st parity gilts and there is decrease in litter size and increase in the services per conception.

Diagnosis: Serological tests for diagnosis.

Control: After one infection there is life long immunity

Gilts must be vaccinated before 1st breeding.

Porcine reproductive respiratory syndrome (PRRS)

Disease of pigs caused by RNA virus transmitted by intranasal route and charachterised by systemic illnes in sows, abortions in sows and chronic respiratory problems in nursery age pigs.

Clinical signs : Anorexia, fever, abortion at 107 ro 112 days, vaginal discharge, urinary infection, increased number of still born piglets. New born piglets show coughing, sneezing and a rough hair coat. Boars show listlessness and inappetance

Diagnosis: Clinical findings and virus isolation.

Control: Remove older piglets every 10-14 days to distant places

Vaccinate 3-18 week piglets and gilts 7-10 days before breeding.

Natural herd immunity in 4 months

Hog Cholera

An important cause of fetal mummification and abortion in pigs caused by a RNA virus, transmitted by oronasal route and charachterised by multiple haemorrhages in lymph nodes, kidneys, spleen and infarction of spleen. The disease has been readicated from the USA.

Clinical signs: Aborted pigs show subcutaneous edema, hydrops and ascites

Diagnosis: Demonstration of viral antigens in tonsils and other fetal tissues.

Blue tongue: is an arthropod transmitted orbiviral disease of domestic and wild ruminants occurring seasonally in wer and warm climate in some parts of the world. Cattle are reservoir and sheep are affected.

Clinical signs: High fever, swollen ears, face and tongue, oral and nasal ulcers and lameness. Fetuses are aborted or delivered normal but show skeletal deformities

Diagnosis: Virus isolation.

Control: Vaccination and control of arthropods

Chlamydiosis: most common cause of abortion in sheep and goats and rarely cattle caused by Chlamydia psittacci is a gram –ve intracellular organism that have both DNA and RNA

Transmission: Pigeons, sparrows are reserviors, ticks and insects help in transmission. The organism persist in feces of infected animals and shed in uterine discharges for 3 weeks post abortion.

Clinical signs: Abortion during last month in primiparous ewes. Slight febrile reaction and blood tinged discharge. Placentitis is common.

Diagnosis: Necrotic changes in placenta. Microscopic examination of ZN stained smears from placenta or fetal tissue.

Treatment and control: Oral feeding of 400-500 mg/animal/day of oxytetracycline for 2 weeks during an outbreak, or long acting tetracycline 6-8 weeks before parturition.

Vaccine (Enzovac) IM or SC 8 weeks prior to breeding. The immunity lasts for 3 years.

Chlamydia can affect human beings.

Border disease: is caused by pestivirus (related to BVD) affecting sheep in America and many other places, charachterized by abortion and birth of congenitally affected weak lambs.

Clinical signs: Sheep show mild viraemia, lambs have a hairy dark wool over shoulder and evidence mild to severe tremors and hence called *"hairy shakers"* . The lambs die in the first year of life. Lambs may also be born with neurologic changes (cerebellar hypoplasia, hydranencephaly)

Control: Slaughter lambs. Separate sheep and cattle and segregate newly introduced animals.

Q fever: is a zoonotic infection caused by *Coxiella burnetti* (an obligate intracellular rickettsia) causing abortion in sheep and goats and less frequently in pigs and lambs.

Transmission: Inhalation or by ticks. Cattle, sheep, goats and wild animals shed the organism in placenta, uterine fluids and milk

Clinical signs: Asymptomatic abortions

Diagnosis: Placental tissues. Very few labs ready to handle tissue due to biosafety considerations

Protozoal Abortions

Trichomoniasis: is a venereal disease caused by a three haired single cell protozoa *Tritrichomonas fetus* and charachterised by early embryonic deaths, post service pyometra and abortions upto 5 months in cattle and buffaloes.

Clinical Signs : The male is an asymptomatic carrier (Bulls above 5 years). Abortions occur with no gross lesions. Animals may develop post service pyometra and there is increased number of services per conception.

Diagnosis: Organism can be isolated from abomasal fluid of fetus or from uterine discharges by dark field microscopy. Organism can be cultured in Diamonds medium. Uterine secretions from aborted cows 48 h after abortion shed the organism.

Therapy: sexual rest for 2-3 months after abortion. Animals with pyometra need to be given PG's and imidazole derivatives (Metro- Tinida- or Ornidazole) likewise animals with increased services per conception need therapy with imidazoles.

A vaccine is available for bulls. The org affects adult bulls and is localised in the crypts of the prepuce. Therapy of bulls also require imidazoles parentrally and locally.

Toxoplasmosis is one of the most common zoonotic parasitic infections affecting sheep and goats and rerely affecting dogs and cats caused by Toxoplasma Gondii and charachterized by abortion, mummification and birth of weak kids.

Transmission: Cats are the principal reservior. Transplacentally infected kittens can shed the organism. Goats are more susceptible and get infected by consuming water infected with cat feces.

Clinical signs: Abortions in last trimester 2-3 weeks before term.

Diagnosis: Evidence of yellow foci of necrosis and calcification in placenta. Org isolation from placenta, fetal muscles.

Control: Avoid cats near sheep and goats. A vaccine is available. Aborting sheep and goats should be handled carefully. Raw goat milk should not be consumed by human beings

Neosporosis :is a protozoal infection affecting cattle and rarely sheep and goat aquired by ingestion of feed contaminated with feces of dogs and charachterised by abortion between 4-6 months of gestation and birth of congenitally infected heifers.

Clinical signs: Abortion when animals are stressed. No other signs

Diagnosis: White foci in muscles, heart, liver of fetuses. PCR, FAT and ELISA are the tests.

Protozoal equine abortions: Two protozoal diseases affecting horses namely babesiosis and trypanosomiasis can cause equine abortions due to the generalised disease. Trypanosomiosis (Dourine) is caused by *Trypanosoma equiperdum* is known to be venereal and results into vulvar and vaginal swelling, fever, paralysis of face and limbs and appearance of dollar plaques on the skin after the disease which are pathognomonic. The organism is present in the genital secretions.

Enzootic bovine abortion is a cause of abortion and premature calving in catle grazing in California, Nevada and Oregon of USA. The disease is caused by an unnamed bacteria a gram –ve bacteria of myxobacterium family.

Transmission: By an argasid tick

Clinical signs: The abortions are sporadic or outbreaks can occur in last trimester mostly in heifers

Diagnosis: Typical lesions on the fetus include Petechiae on conjuctiva, tongue, oral mucosa. There is enlargement of pre-scapular lymph nodes and reduction of thymus with haemorrhages over it.

Control: Control the ticks in the area.

Mycotic abortions

Aspergillus fumigatus, mucor spps or candida spps are the sporadic cause of abortion and infertility in cattle, mares, sheep, goat and swine.

Abortions are common in winter after a wet summer.

Feeding of straw with fungi is the etiology. Rarely inhalation of spores can cause the infection.

Abortions occur during 6-8 months in cattle placentitis with coffee bean or cup shaped cotyledons is charachteristic lesion of mycotic abortions.

Diagnosis: Microscopic examination of placental or skin lesions after treatment with 10% KOH reveals the fungi or their hyphae.

NON-INFECTIOUS CAUSES OF ABORTION

Include 1) Ingestion of poisonous plants or adminis tration of chemicals. Plants like locoweeds, sweet clover (fatal haemorrhages due to dicoumarol), pine needle and administration of pharmaceuticals like nitrates, xylazine, anthelmintics etc. can cause abortions.

2) Hormonal deficiencies (like deficiency of progesterone) or accidental administration of hormones like estrogens, corticosteroids can result into abortion in animalss.

3) Nutritional deficiencies like Vitamin A, E, Iodine or Se can cause abortion

4) Severe stress like heat, cold, transport and trauma. Accidental AI of pregnant animals

5) Genetic defects of embryo

6) Miscellaneous like twinning in horses result in abortion because of lack of placental area for the twin fetuses which abort by 4-7 months. Hence twinning is undesirable in mares and twins are reduced by various techniques to avoid abortion

Induced abortions (Vetero-medical termination of pregnancy VMTP)

Abortions are sometimes desired to be induced in various farm animals. When they are induced nearer to parturition they are called induced parturitions.

Reasons for inducing abortions: Diseases of pregnancy like pregnancy toxaemia in sheep and goats where continuance of the pregnancy would further worsen the condition of the patient. Systemic diseases like haemoglobinuria in buffaloes often indicate the induction of abortion to reduce the load of the ailing patient.

Abnormal pregnancies like hydrops allantois, ventral hernia, rupture of the prepubic tendon, fetal mummification also indicate an induced abortion.

Termination of accidental small age pregnancies of heifers

Prevention of a mismating in bitches

Cattle and buffaloes

Prostaglanins are the most suitable drugs for inducing abortion in cows they are effective at all stages of gestation except during the 5-8 month period when they should be combined with corticosteroids to terminate the pregnancy.

Estrogens and Corticosteroids (25 mg dexamethasone) can be used to terminate bovine pregnancies.

In sheep and goat PG + corticosteroids are effective whereas in the sow PGs alone are effective in terminating pregnancies. Estrogens are ineffective in the sow as they are luteotropic in this species.

Induced abortions Mares

Inducing abortion in the mare is easy upto day 33 and can be achieved by the use of PG or a uterine lavage however from day 33 onwards when the endometrial cups are formed the induction of abortion can be achieved by the administration of PG followed by a uterine lavage however, such mares do not regain normal cyclicity for a long period because the endometrial cups continue to exist although the pregnancy was terminated. The same feature occurs when a mare aborts between day 33-120.

Termination of an equine pregnancy beyond 4 months is extremely difficult and a dangerous method. PGs are ineffective during this period because the progesterone is produced by the placenta.

Inducing parturition in the mare can only be achieved by injections of oxytocin

Induced abortion in bitches (Mismating prevention)

Prevention of a pregnancy due to an accidental mismating with a stray dog is often desired by pet owners. When this is desired early (day 2-8 of mismating) a dose of estrogens is sufficient Diethylstilboestrol 20 mg IM or estradiol cypionate 20-40 μg/Kg or estradiol benzoate or valerate 3.0 to 7.0 mg once IM is sufficient. Other derivatives include mestranol 0.5 mg orally for 2-4 days or tamoxifen citrate 0.5 – 1.0 mg/Kg for 2-5 days is sufficient

Antiprolactins like bromocryptine HCl 30 μg/Kg for 3-5 days are effective only after 15-20 days of mating.

PG's are effective only after day 30 of pregnancy 5 μg/Kg of cloprostenol or 75-125 μg IM for 2-3 days are required.

Other alternatives could be PG + aglepristone (10 mg/Kg) or mifepristone 2.5 mg/kg once or more times

Non-specific causes of infertility in cattle and buffaloes:

Include the affections of the various genital organs including ovary, fallopian tubes, uterus, cervix, vagina and vestibule.

The nonspecific ovarian reasons for infertility in farm animals include ovarian tumors, ovaritis, ovarian abscess and parovarian cysts. These conditions are infrequent. The common ovarian tumor is granulosa cell tumor and animals exhibit signs of altered reproductive cycle and infertility in such cases. Ovaritis may follow manual rupture of cysts or enucleation of a CL. Parovarian cysts are occasionally found in the broad ligament. Serosal cysts may be noted on the ovarian surface. Ocassionally the CL is black in color and called corpus nigrum.

Oviductal affections include sapingitis which usually results from passage of the uterine infection in the oviduct. This may also occur following infusion of large volumes of fluid in the uterus. Hydrosalpinx may occur in anatomic defects and pyosalpinx is less common. These problems can rarely be diagnosed by routine rectal palpation and sonographic unless the enlargements are extensive. PSP dye test is suggested for testing patency of the oviducts.

Uterine infections and affections Uterine infections are one of the most frequent cause of infertility in cattle and buffaloes. The uterine infections manifest in different ways when they occur during the post-partum period which is most frequent in cows. Clinical conditions identified during the post partum period include peurperal metritis, clinical endometritis, pyometra and sub-clinical endometritis. Other problems in the uterus include uterine abscess, tumors and mucometra or hydrometra

Metritis: Inflamation of all the layers of the uterus including endometrium and myometrium. Metritis usually occurs post partum because the genital passage is widely open during this time and bacterial accumulation and elimination occurs largely during this period. Metritis can rarely occur at other times.

Endometritis: Inflamation of the endometrium of the uterus, also frequently occurs post-partum but may occur at other times also subsequent to copulation, poor hygiene at AI and because of reinfection after recovery from metritis.

Pyometra: Accumulation of pus in the uterus with a persistent CL. This makes the animal anestrus. The condition may occur post-partum when endometritis does not resolve and an animal has ovulation resulting in formation of CL. The condition can occur post-service frequently because of Trichomaonas.

Peurperal metritis: is a bacterial complication of early peurperium which occurs during the first 2 weeks of calving and is characherised by a large amount of foul smelling reddish brown putrid watery exudate with necrotic debris, a thin uterine wall or a limited amount of malodorous purulent exudate and a thick uterine wall some days later. Systemic signs may be present including fever, anorexia and drop in the milk yield.

Pathogenesis: Bacterial invasion↓
                 Stagnating lochia → Degenerative and infiltrative processes
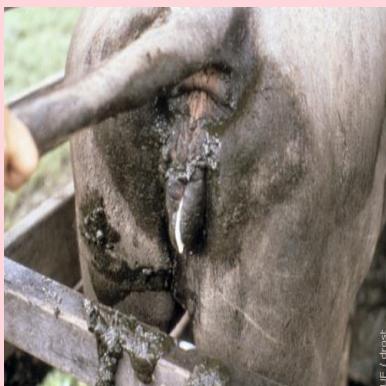
                                    ↓   ↓
                          Bacterail spread   Endotoxins

                                    ↓   ↓
                      Systemic reaction   release of Histamine & pro-
                                                   inflamatory cytokines

                                    ↓   ↓
                  Decreased appetite, milk, fever   Inactivation of PG

                                    ↓   ↓
                  Delayed post partum estrus ←systemic reaction, ↑ lochia

Predisposing factors: Dystocia, herd size, lack of grazing, retained placenta, metabolic disorders and overfeeding of pregnant cows.

Diagnosis: History, rectal palpation most insensitive method of diagnosis. Vaginoscopic examination gives evidence of the infection.

Clinical signs: Foul smelling uterine discharges, decreased appetite and milk, sometimes fever. Toxic peurperal metritis is the severe form of the disease in which symptoms of toxaemia appear

Therapy: Intrauterine infusion of antibiotics during the first 10-12 days postpartum is seldom helpful because of the presence of large quantities of tissue debris, fluid and necrotic tissue. Parentral administration is suggested along with antihistaminics and intrauterine infusion of normal saline for upto 10-12 days postpartum after which when the uterus has reduced in size the administration of intrauterine antibiotics would be helpful. The appearance of blood stained lochia is a good indication of recovery along with the disappearance of putrid smell. Fluid replacement and other treatments may be required in toxic peurperal metritis.

Clinical endometritis and pyometra: are two closely related disorders that occur from third week post-partum. **Clinical endometritis** is charachterised by presence of abnormal (muco-purulent or purulent) content in the uterine cavity and vaginal discharge through a open cervix. **Bovine pyometra** is a closely related disease that develops after first ovulation in the presence of active luteal tissue 20-21 days onwards.

Clinical signs: Is subjective. The presence of a enlarged uterus 3-5 weeks post calving suggest the presence of clinical endometritis. The cervix is open and systemic signs are absent. The diagnostic feature of pyometra is the presence of a enlarged pus filled uterus, with a closed cervix and a persistent CL.

Sub-clinical endometritis: Occurs at any time after completion of the uterine involution (on or after 8 weeks post-partum) recognised by cytological evaluation. There is no cervical discharge and no enlargement in the uterus. Cases of repeat breeding is the common clinical sign in subclinical endometritis.

Principles of therapy of uterine infections:

Regular post-partum examination at 1-3, 6-10, 14-21, 28-35 and 40-60 days post partum helpful in timely diagnosis and therapy.

Intrauterine infusion are seldom helpful during the immediate post partum period (10-12 days)

Parentral therapy with antibiotics that maintain luminal concentrations are helpful.

Administration of irritants should be minimum in the uterus

Antihistaminics useful in metritis.

Sclerotic metritis: is caussed by a severe chronic metritis that has caused the complete destruction of the endometrium and fibrotic changes in the uterine wall. The endometrium is transformed into a thick, dense layer of connective tissue. The condition often involves the cervix. The condition should be differentiated from adenocarcinoma which it closely resembles. The animal fails to show estrum and the CL is deeply embedded that does not respond to luteolytic drugs.

Uterine tumors: Uterine tumors are infrequent. A tumor may cause bleeding from the uterus during estrus due to contractions that over the tumor. Tumors may sometimes interfere with the progression of a pregnancy when they are sufficiently large.

Mucometra: usually is a sequelae to long standing cases of ovarian cysts and frequently pose diagnostic problems as pregnancy to clinicians.

Cervix: common problems of cervix include cervicitis, cysts of the cervix, complete stenosis or obstruction of the cervix, mucocervix and tumors.

Cervicitis frequently follows metritis or vaginitis and abnormal parturitions, sometimes it may occur post coital. It can be diagnosed on vaginal examination with a speculum and light. The external os of the cervix is usually edematous and swollen, the mucosa is cherry red in color. Cervical stenosis may follow severe infection or trauma. Therapy usually involves the treatment of the primary cause and application of emollient antibiotic containing creams.
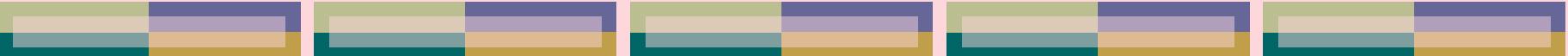
A common findiing in many cows is the presence of a kinked 'S' shaped cervix that poses difficulty in passing of the AI gun. A beta 2 adrenergic drug is suggested for such cows at the time of AI (Inj. Duvadilan 10-12 ml IM or IV) Stenosis may follow chronic infection.

Csyts of the cervix: are observed occassionally and called Nabothian cysts. They are apparently retention cysts of the cervical glands . They may be congenital but usually acquired secondary to trauma. A part of it may be seen on external os on examination. They may recover spontaneously or incised by a needle, teat bistoury or a knife.

Vaginitis: This may occur following trauma, lacerations, and bacterial, viral or protozoal infections produced at the time of dystocia, fetotomy, prolapse or postpartum metritis. Sometimes it may occur due to other reasons. The signs of vaginitis include mucopurulent, yellow-grey pus discharged from the vulva at irregular intervals and mats the hair of the vulva, tail and buttocks. Vaginitis due to IBR may recover spontaneously whereas that subsequent to metritis require therapy of metritis. Vaginal pessaries or creams may be used. Cysts and tumors of vagina are rare.

Vestibulitis and vulvitis are rare and treated in manner similar to that used for
 vaginitis. When crows sit on an inflamed vulva or when wounds remain for long
time maggots may appear that require removal and application of turpentine oil or sprays.

REPRODUCTIVE FAILURES IN MARES

I.   Shortness of the breeding season
>   ----Long day breeders
>   ----Jan 1 Birth date
>   ----During early season cycles irregular
>   ----Ovulation failures

II.   Genital infections and abnormalities
>   Genital Infections
>>   Infectious   Contagious equine metritis CEM
>>>   Coital vesicular exanthema (Gen.Pox)
>>>   Trypanosoma Equiperdum (Dourine)
>
>   Non infectious
>>   Endometritis
>>   Pnuemovagina
>>   Defects of Perineum
>>   Vaginitis, Cervicitis etc..

Genital abnormalities

Tumors of the genital tract Granulosa tumor of ovary common in mares and donkey mares

Congenital abnormalities

Cysts

Chromosomal abnormalities

III. Irregularities of the estrous cycle

Long periods of estrum

Long diestrus periods

Irregular periods of estrum

Anestrum

Delayed Ovulation

Nymphomania

Long periods of estrous cycle 75% of the irregularities specially in thin maiden mares during early season. Cycle length 10-20 days.

Long disetrus periods Infrequent estrus with prolonged periods of diestrum or anestrum. Mares may accept one stallion but refuse another

Irregular periods of estrun Psychological estrum with no ovulation

Silent estrum Common in fatty or lactating mares. Heavy drought mares exhibit silent estrus more commonly

ENDOMETRITIS

Mostly arise due to poor vulvar conformation

Poor labial muscle tone

Abnormalities of perineum

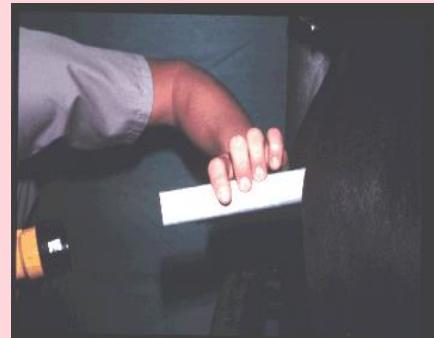Pathological parturition

Unhygeinic breeding

PMIE

Diagnosis: Physical exam- Rectal & Vaginal

Uterine Cytology

Uterine biopsy

Treatment Antibiotics after sensitivity tests,

Large volume Uterine lavage, $\rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow$

Oxytocin or PG 12 h post mating in PMIE

Episioplasty & Perineoplasty in anatomical defects

VAGINITIS/ CERVICITIS

less common, fibrosis of cervix uncommon

Cervical Incompetence Cervix fails to seal Donkey mares

CEM (Contagious Equine Metritis)

First reported in England

Caused by Tayllorella equigenitalis a gram
negative coccobacillus.

Venereal and other transmission

Infection and discharge from uterus

Infection localisation on clitoris

CANINE INFERTILITY **Most common cause of infertility poor breeding management**
Structural Abnormalities of reproductive tract

Ovarian and uterine abnormalities rare diagnosis by exploratory laparotomy

Vulva   Structural Abnormalities
Congenital vestibulo-vulvar stenosis
Common in collies surgical correction
Vulvar atresia estrogen therapy
Clitoral hypertrophy   Hermaphrodite
Hyper-adrenocorticism
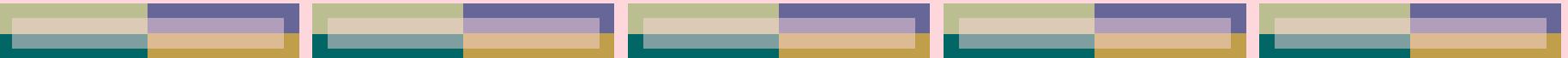Prolonged androgen therapy
Therapy: Clitoral resection + neutering

Abnormal Discharge
Abnormal Placement

Diseases of Vagina
Congenital defects
Persistent Hymen - Pain during mating
Vaginal anamoly must be suspected in urinary
incontinence.
Vaginograms radio-opaque material thru cathetor

Aquired Abnormalities

Vaginal hyperplasia

Due to high estrogen
common in 1st estrus
recurrence common
common in St Bernard, Bull dog, Boxers

Treatment

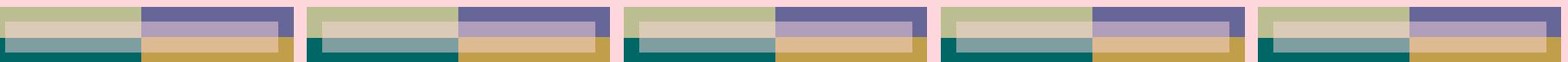Megesterol acetate 1 mg/lb for 7 days in proestrus

GnRH 50 Ug once IM

Vaginal Prolapse Entire circumference protrudes

Cause Constipation, Dystocia, Forced separation during lock tie

Therapy   Repositioning under gen anaesthesia/epsioplasty.

PYOMETRA (Pyometra CEH complex) -open or closed

Hormone mediated diestrual disorder of bitches 8-10 yrs old.

Bacterial interaction with an endometrium under prolonged progesterone exposure resulting into accumulation of uterine glandular secretion.

Symptoms

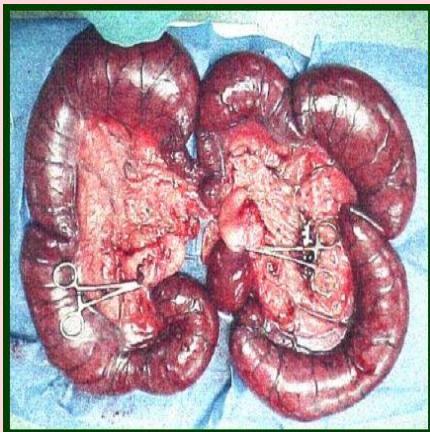 Appear in 4-10 weeks of estrus

  Depression

  Polyuria
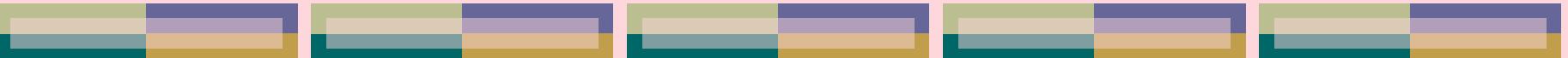
  Vomiting

  Fever

  Pus discharge

Diagnosis

Radiography/ultrasonography

Treatment: PG 125-250 Ug Sc for 3-5 days + antibiotics

          Ovariohysterectomy

Psuedopregnancy

   physiological event occuring once or more times in the life of a bitch

   false signs of whelping nesting behaviour, mammary enlargement

   exact etiology unknown possibly high prolactin levels and a

   failure of proper LH surge

Therapy: 40 Ug mibolerone PO for 5 days

                1 mg / Kg testosterone IM once
                2-5 mg/Kg bromocryptine orally

Metritis

Common Post whelping
Therapy Antibiotics + PG

SIPS (Sub Involution of placental sites)

Failure of sloughing of placental masses is the cause

Involution may take upto 12 weeks

bitches less than 3 years of age are more affected

chronic haemorrhagic discharge post partum

progressive weakness

pain on abdominal palpation

anemia

Therapy
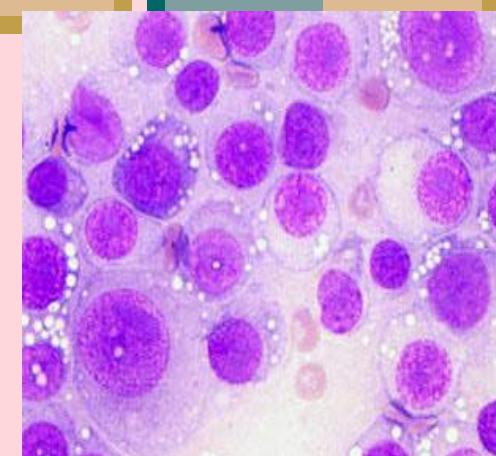
Medical PGs or ergonovine maleate + supportive therapy
Laparotomy and currettage
Ovariohysterectomy

Tumors   Ovarian and Uterine tumors uncommon
Benign tumors of vagina and vestibule
common

TVT (Transmissible Venereal tumor)
(lymphosarcoma,histiocytoma)
Coitally transmitted neoplasm affecting both sexes of dogs

Transmission cell allograft Transmission
Nodular to cauliflower like growths 5mm-10cm that ulcerate and are inflamed
Lesion on glans in male & vagina in female
Haemorrhagic discharge most common clinical finding in the bitch

Diagnosis Symptoms/biopsy/impression smear.

Therapy Inj Vincristine 0.025mg/Kg IV once weekly for 2-5 weeks
Methotrexate 0.3 mg/Kg orally daily for 10-15 days
Cyclophosphamide 1 mg/Kg orally daily for 10-15 days
Radiation therapy
Surgery or surgery + vincristine
Prognosis Good tumor is self limiting There is a growth pahse followed by regression phase.

Dystrophia adiposogenitalis

(Frolichs syndrome)

Disease of both sexes of dogs due to tumors of pituitary

Symptoms   Obesity of neck

                      Genital atrophy

                      Ulcers of extremities

                      Diabetes insipudus

Treatment   Surgical removal of pituitary

                      Administration of thyroid extracts

Hypoestrogenism

Disorder of spayed bitches

Alopecia of perineum, abdomen, thighs

Often occurs in bitches spayed before 1st strus

Treatment 1 mg DES daily for 2-3 weeks.

INFECTIOUS INFERTILITY

Brucella Canis

    Most common cause of Abortion

    Occurs 30-57 days of gestation

    Prolonged vaginal discharge for 1-6 weeks after abortion
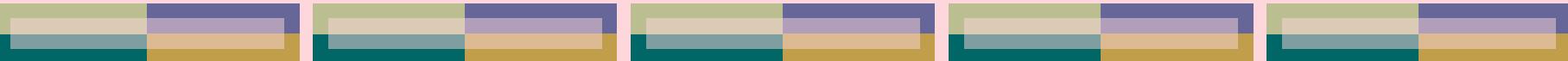
Toxoplasma Gondii

  Causes abortion, premature birth and neonatal death

Canine Herpes Virus

    Infertility, abortion, fetal mummification, premature birth

    Venereal transmission possible

    Vesicles on vestibule

Functional Abnormalities

Delayed Puberty and prolonged anestrus
- Bitches not showing estrus even after 2 yrs of age
- Unobserved estrus common in fastidious bitches
- Prolonged inter-estrus intervals 26-36 weeks
- Difficult to define prolonged anestrus.
- Basenji breed shows first estrus at 300 days and then annually.

Induction of estrus
- DES 5 mg daily for 7-9 days
- FSH/LH
- Antiprolactin Bromocryptine 2.5 to 5 mg daily for 7-12 days

Silent estrus
- 25 % of greyhound bitches show silent estrus

Split estrus
- Vulval discharge for few days without estrus

Unpredictable Ovulation time

Prolonged Pro-estrus/estrus

In bitches with longer than 30 day proestrus/estus ovulation must be induced with hCG 20 IU/Kg body wt IM or IV.

Ovarian cysts

Mostly detected in older bitches at ovariohysterectomy

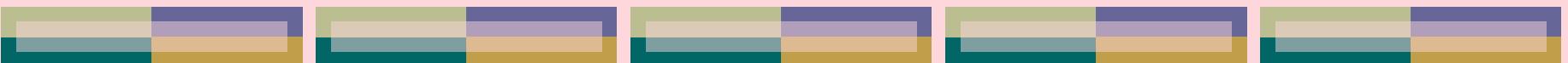Frequently of parabursal origin and less important as clinical entity

Estrogen producing cysts may sometimes produce persistent estrus with vulval discharge, flank alopecia and hyperkeratosis.

Hypoleutidism

Lack of progesterone support – abortion

Progesterone 2-5 mg/ Kg orally daily from day 20.

INFERTILITY IN PIGS

Fertility in pigs is evaluated on a herd basis and examination of records is important. The parameters in fertility evaluation include herd size, age profile, weaning to estrus interval, conception rate, farrowing rate, lactation length and total piglets born live or still born.

Fertility problems in pigs are

1) Anestrus, 2)Conception failure and 3)Pregnancy failure

ANESTRUS

Puberty, pregnancy and lactation commonest problem is lactation

Subestrus Prevalent in summer

Evaluate estrus detection   50-60% in gilts

Detect ovarian activity by P4. Detect estrus once daily in the preesence of boar from the day of weaning. Post mortem examination of ovaries in culled sows.

In large groups inadequate space, inadequate diet, photostimulation, boar stimulation or poor flooring can lead to anestrus.

CONCEPTION FAILURE

Total and Partial (reduced piglets born). Normal conception rate 90%. Returns higher than 10% are abnormal/unacceptable
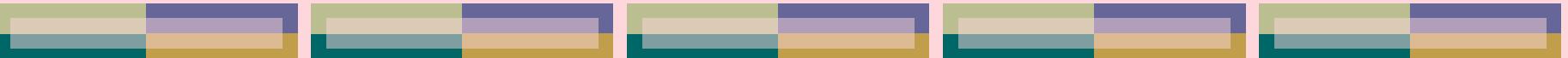
Timing of service Most important should be given on the day of standing estrus and 18-24 h later. Sperms survive for 40 h

Improper intromission

Poor semen quality: Rotate boars for optimum fertility

Poor grouping of animals.

PREGNANCY FAILURE

Failure to establish pregnancy : this is difficult to establish and it is suggested to avoid stress at day 12 of conception.

Failure of an established pregnancy

Reduction in numbers born- infectious disease

fetal death after day 35 result in mummified fetus common in viral infections like porcine parvovirus, aujeskeys disease, swine fever, PRRS

Infectious Infertility

Group1   Infection with organisms present in majority of pig population include organisms like E.Coli, Listeria, Mycoplasma, Pasteurella, Salmonella, Klebsiella and Corynebacterium these result into conception failure/abortion and still births

Group 2 Contagious microorganisms include Porcine enterovirus and porcine parvovirus result into mummification and still births

Group 3 relatively infrequent but they result into severe reproductive loss and include Leptospirosis, aujeskeys disease, PRRS

INFERTILITY IN SHEEP AND GOATS

Structural defects

Uncommon

Parovarian cysts seen sometimes

Intersexes common in polled goats and Alpine, Saanen and Toggenberg breed. They are usually sex reversed females.

Male psuedohermaphrodites seen in sheep called "wilgils".

Hydrosalphinx and rarely freemartin.

Functional factors

Anestrus uncommon except in unthrifty ewes and goats

Ovarian cysts are uncommon. Goats may sometimes evidence nymphomania

Early embryonic deaths are usually of infectious origin like Toxoplasma, Border disease or feeding of subterranean clover

Hydrometra (cloud out-burst, or psuedopregnancy) seen in goats.

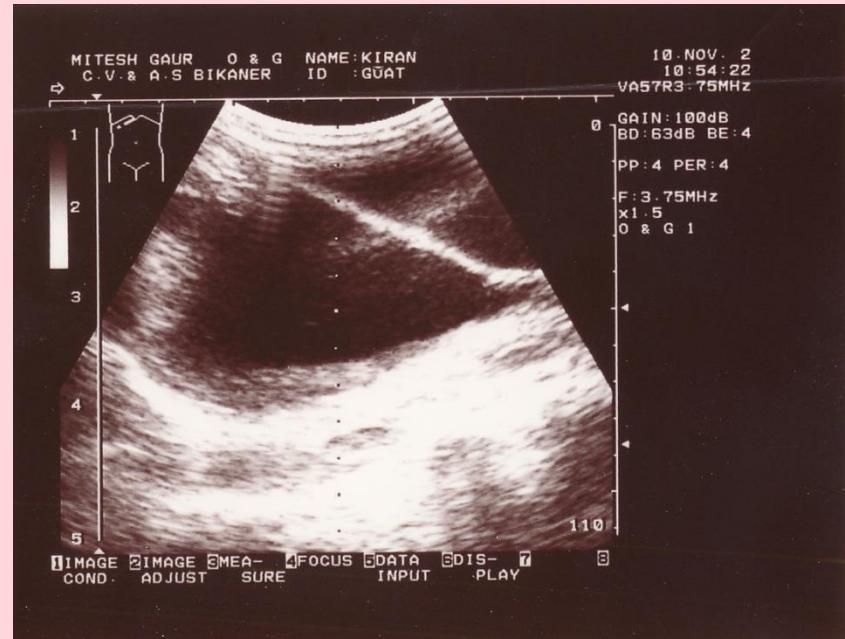Seen in goats

Incidence: 3-14%

Etiology :High prolactin levels Persistence of CL subsequent to fetal death and reabsorption is the commonly accepted cause
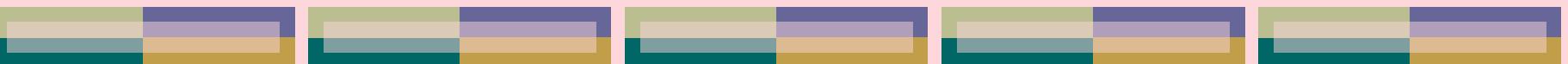
Diagnosis :Clinical cases discharge of large quantity of fluid without fetal delivery Cases referred for PD diagnosis by ultrasonography

Ultrasonography in goats with hydrometra reveals anechoic fluid, strands without fetal cotyledons or fetus/es

Therapy of hydrometra in goats:

Prostaglandin injections Inj.Lutalyse 1.5 – 2.0 mL IM or   Inj. Prostodin 125 µg IM

Anti-prolactins   Bromocryptine 1 mg SC twice daily for 6-10 days

Management factors

Estrus detection for AI

Ram:ewe ratio 1:25 to 1:40 in non estrus synchronised herds

Increasing fecundity: selction for high fertility, flushing, eCG inj on day 12 of estrus

Infectious

Campylobacter abortions last trimester

Enzootic abortion (Chlamydia)(Kebbing) abortion, polyarthritis

Toxoplasma, Listeria, Leptospira, Q fever (zoonosis caused by Coxiella burnetti)

Border disease (Hypomylinosis congenita) caused by pesti virus similar to BVD

Tick borne fever (Rickettsia).

Abortion in Angora goats

Common (upto 16% or more) two types

1) stress induced (stress aborters) occurs in poorly grown and immature does
probably because of hypoglycemia which stimulate fetal adrenal for
premature release of estrogen which then stimulate placenta and result in abortion

2) habitual aborters have genetic predispoistion because of premature hyperactivity of
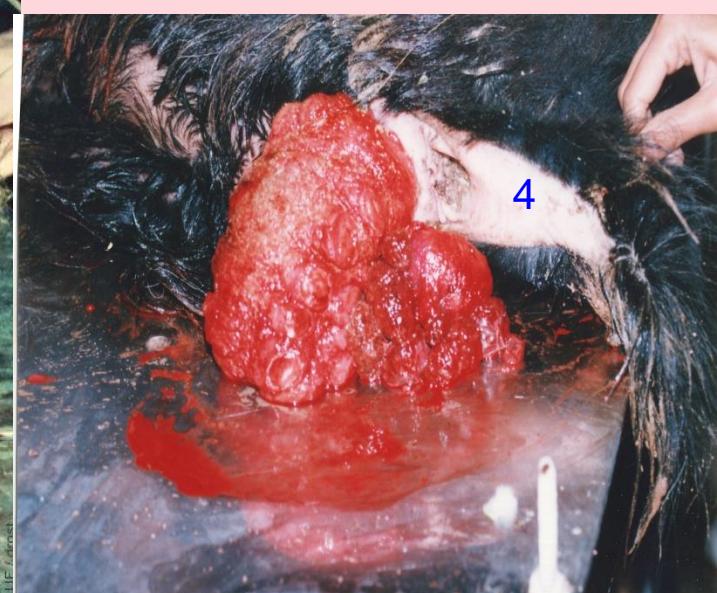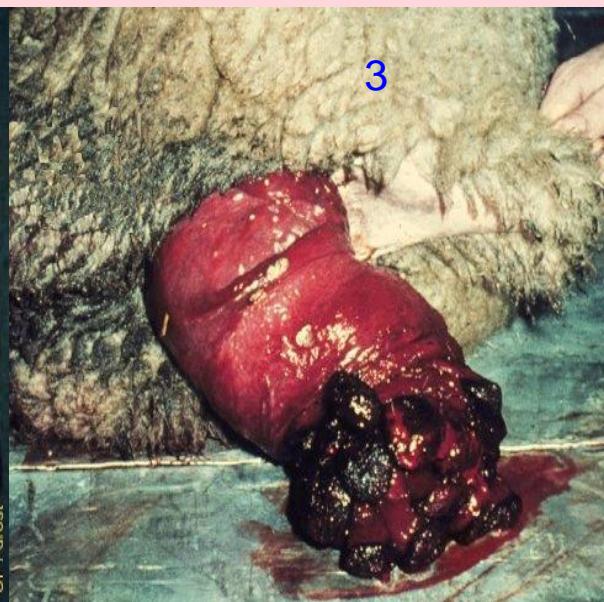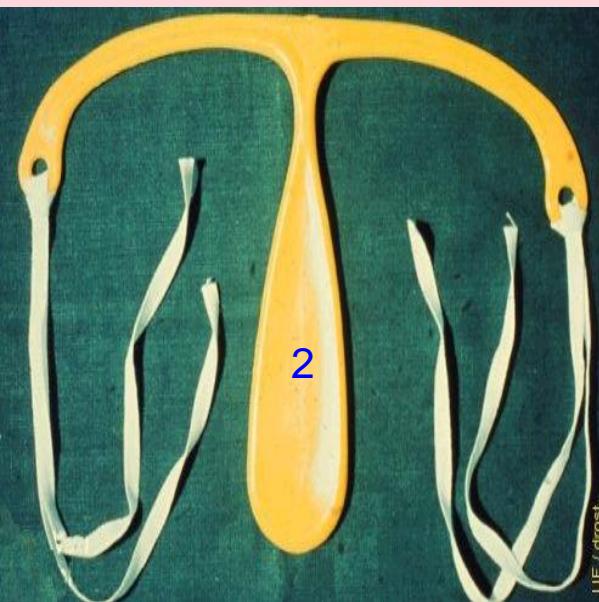maternal adrenals (hyperadrenalism).

Vaginal and Uterine prolapses in sheep and goat

◆ **Cause**   Lack of exercise
                    High estrogenic feeds
                    Herreditary

Prepartum vaginal prolapse common in sheep and a
   commercial prolapse retainer is available for therapy
Post partum- replacement calcium therapy

Fig 1 cervical and rectal prolapse in sheep Fig 2 prolapse
Retainer for sheep. Fig3 and 4 uterine prolapse in sheep
And goat.

Retained Placenta

- Known to occur both in sheep and goats
- More prevalent in young goats

ETIOLOGY

- Vitamin A deficiency
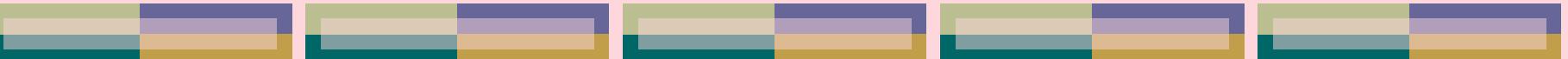- Obesity, hypocalcaemia
- Infectious disease

THERAPY

- Manual removal
- Prostaglandin Injections
- Oxytocin
- Uterine echbolics

Post Parturient metritis

Uncommon in sheep common in goats

- **Cause:** Poor hygiene at kidding/ lambing
- **Therapy:** Intrauterine/ Parentral antibiotics
      Prostaglandin injections

EMBRYO TRANSFER (Multiple ovulation and embryo transfer MOET) is a technique by which fertilized embryos are collected from a donor female and transferred to recipient females that serves as a surrogate mother for the remainder of the pregnancy.

History: The first embryo was transferred in rabbits by Walter Heape in 1890. The first sheep and goat embryos were transferred in 1949 with live births (Warwick and Berry, 1949) whereas the first embryo transfer calf was born in 1951 due to the work by Willet and his associates. The first calf from frozen embryos were born in 1973 (Wilmut and Rowson, 1973). The first embryo transfer calf in India was born in 1987 at National Institute of Immunology, New Delhi whereas the first buffalo calf by embryo transfer was born in USA (Drost and asoc 1985) and in India at SAG, Bidaj, Gujarat. The first IVF buffalo calf was born at NDRI, Karnal, Haryana. The first ET calf of Rajasthan was born at vety College, Bikaner and the first ET camel calf of India was born at NRCC, Bikaner, Rajasthan.

Applications of embryo transfer

Genetic improvement : Increasing selection intensity in elite herds

Proliferation of the desired genotypes of the female

Genetic testing of AI sires for deleterious hereditary traits

For twinning

Easier global transport of genetic material

Preservation of valuable genotype in sick animals

Disease control

Research

Preservation and propagation of endangered species

DONOR SELECTION a donor is selected on the basis of the following

Animal of high genetic merit for economic traits

Having regular estrous cycles beginning at young age

Should have calved at least once or twice

Between 3-10 years of age

Above average productive performance of offspring born from previous matings of the same sire and dam

No parturition difficulties or reproductive irregularities.

No conformational or detectable genetic defects

Calved two to three months previously

RECIPIENT SELECTION

A recipient should be a cow with high fertility, regular estrous cycle, without reproductive abnormality or parturition difficulty but genetically inferior. Usually 5 recipients per 1 donor

Methodology

Embryo transfer involves many steps including superovulation, estrus synchronization, breeding, embryo collection and evaluation and transfer to synchronised recipients.

Superovulation: is the induction of formation of multiple follicles and their ovulation in single ovulating species by the exogenous administration of follicle stimulating hormones. The hormones are administered at a specific time (day 8-12 of the estrous cycle) when growing follicles responsive to exogenous administration of FSH are present on the ovaries. When a reference estrus is not known the superovulation treatments are started on day 8-10 of the placement of a vaginal progesterone implant.

DONOR Superovulatory treatments

Superovulatory treatments of donors involve the administration of a single injection (1500-3000 IU) of eCG followed by a PG injection 48 h later. However, such treatments yield poor embryos, high degree of anovulatory follicles and more chances of ovarian cyst formation because of a longer half life of eCG (72h), hence anti eCG are sometimes suggested.

Another treatment involves the administration of purified FSH (Super-Ov, Follitropin-V, Pluset) in equal or descending divided 12 hourly doses daily for 3-4 days. A PG is given on the last day of treatment.

Recipients are usually given a PG 12-24 hrs before it is given to a donor.

The donors are inseminated with high fertility semen or bred with a high merit bull on the day of estrus. Multiple AI should be done in donors, and the recipients should be kept indoors without access to a bull The day of estrus is counted as day 0
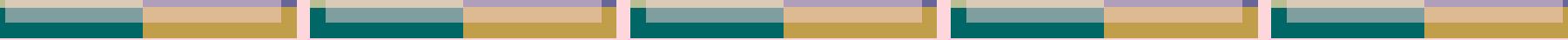
EMBRYO COLLECTION

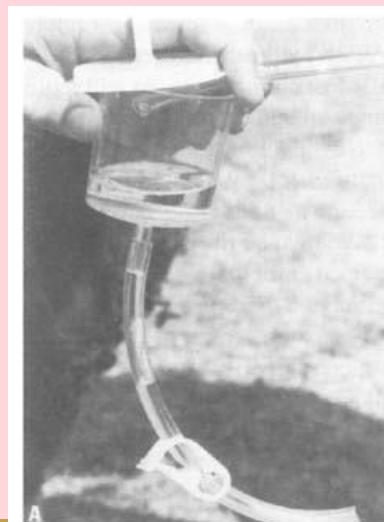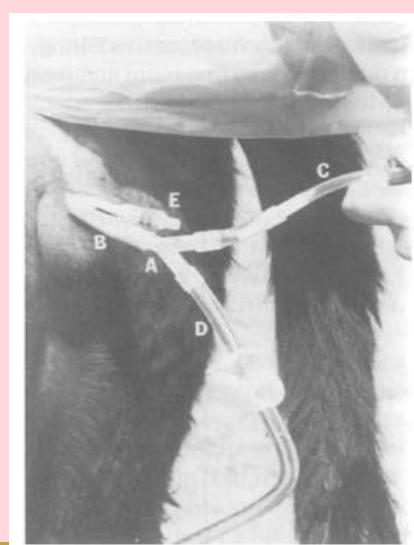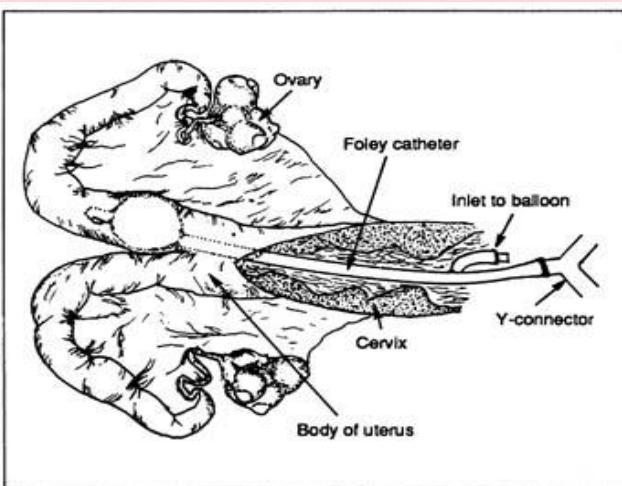Embryos are collected on day 7 of estrus in cows and day 6 in the buffalo and day 7 in mares. Usually non-surgical methods are used in these species. In the small ruminants surgical or semi-surgical (laparoscopic methods) are used for embryo collection. Before collection of embryos both ovaries are palpated to record the number of ovulations (ovulatory reponse)

Procedure: There are two methods of collection: the continuous flow (using three way embryo flushing cathetor) and the interrupted technique using a two way rusch foley cathetar. The embryos are free floating in the uterine lumen and when a uterine flushing medium (DPBS with antibiotics and BSA) is passed in the uterus and collected back the embryos are retrieved in the medium collected back from the uterus.
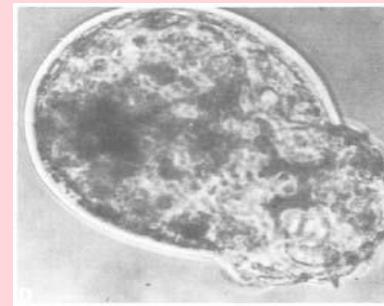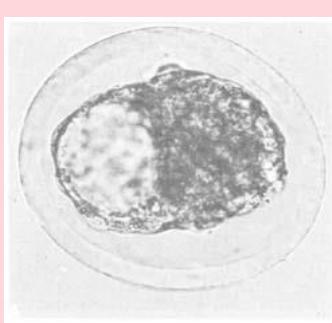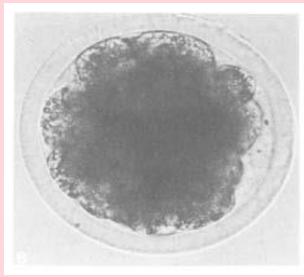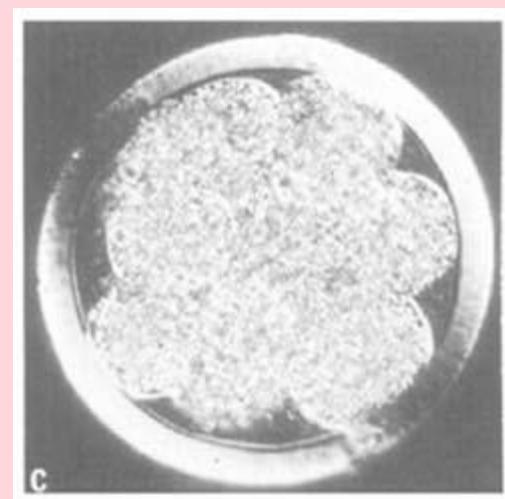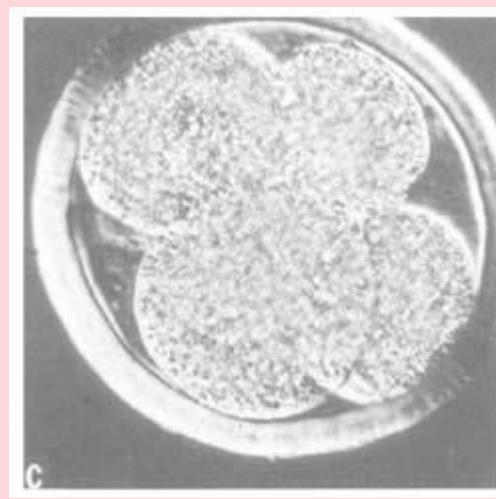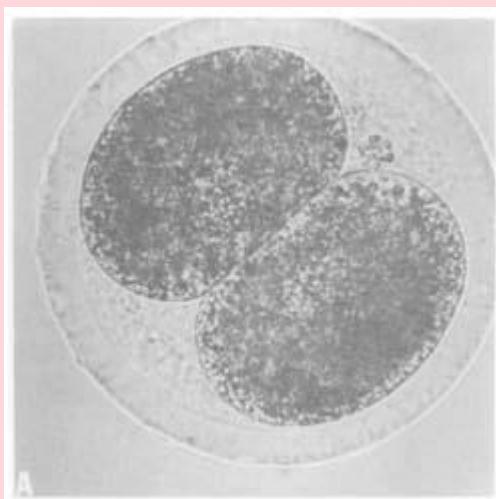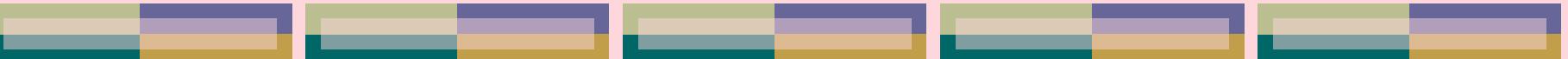
The animals are restrained in a travis and given epidural anesthesia. The perineum is washed after evacuation of the rectum. Cows with a slightly abnormal cervix may be given isoxsuprine HCl 10-15 ml IV. Cervical dilators are passed through the cervix to make space and dilate the cervix. A foley cathetor(with a stillette) or three way catheter is passed through the cervix to one one the uterine horns and the bulb is inflated with air. One hand should be in the rectum to infuse only thee desired amount of air. Once fixed the outer end of the catheter is attached to a 'Y' junction tubing or the infusion bottle. DPBS is passed through the uterine horn by opening the inlet. Care should be taken by the hand in rectum not to infuse excess fluid. Once the horn is full the outlet is opened and by gentle milking of the horn by the hand in rectum the fluid is recovered back and collected. When sufficient amount of PBS has been used (400-500 ml) the process is stopped. The catheter is deflated by withdrawing the air with a syringe and taken out. The same procedure is repeated on the other uterine horn and the recovered fluid is passed through embryo filters to minimize the volume. The filters are taken to the laboratory for evaluation of embryos.

EMBRYO EVALUATION embryos are evaluated under a stereozoom microscope. The reecovered fluid is transferred to grid dishes and seauentially evaluated for the stage of development and numbers. The overall diameter of the bovine embryos is 150 to 190 μm including a zona pellucida. Early cleavage stage embryos are commonly referred to by the number of cells present, such as one-cell and two-cell, upto 16-cell stage. In embryos beyond the 16-cell stage it is classified as morula, compact morula, blastocyst, expanded blastocyst and hatched blastocysts. A good quality embryo is spherical, symmetrical and with cells of uniform size, color and texture with no extrusion of blastomeres.

EMBRYO HANDLING AND TRANSFER

Once located the embryos are lifted using micropipettes, embryo exhauters or other appliances alongwith some medium and given washings by sequential transfer to small microdrops and then finally placed in holding medium (PBS with 0.4% BSA). They are then filled in pre-sterilized empty semen straws sequentially placing air space, an drop of medium, an air space, medium with the embryo, an air space, medium, air space. The straws are then loaded in a embryo transfer gun or AI gun with sheath. The recipient is prepared similar to the donor aseptically. The cervix is dilated by a cervical dilator and the AI gun is passed into the uterine horn ipsilateral to the CL bearing ovary upto the apex of the cornua. The gun is slightly rotated and the embryo is placed in the uterus by gently pressing the plunger of the ET or AI gun. The gun iw withdrawn.

The morula, blastocyst stages are good for fresh transfer whereas embryos arrested at different stages should be placed in culture to evaluate further development. The extra embryos are cryopreserved. Hatched blastocysts are not good either for freezing and difficult to handle.
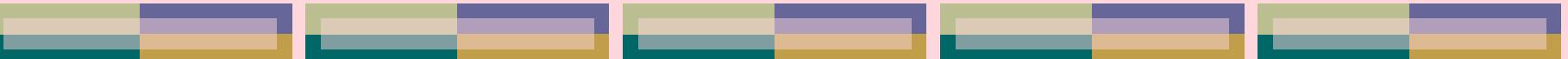
Laboratory hygiene: Strict sanitation is essential. Water used in media preparation should be pathogen free deionized and the laboratory should be properly disinfected. Proper hygiene by working personnel is also essential. Plastic ware sterilized by ethylene gas sterilization should be allowed for aeration for 1 week as the gas is toxic to embryos.

EMBRYO STORAGE

Short term: Embryos can be kept at room temperature in holding medium for 2-3 h

They can be kept in a incubator for 24-48 h and at refrigeration for 2 days

Long term storage: Two procedures are used for long term storage. Both of them involve cryostorage in liquid nitrogen. Using embryo freezers the embryos are frozen conventionally with controlled drop in temperatures. Seeding of the straws in which embryos are stored is done by touching a forceps dipped in liquid nitrogen at the point of embryo location in the straw and then the temperature is reduced fast. The frozen embryos are the placed in liquid nitrogen. For these procedures embryos have to be passed through increasing concentrations of sucrose containing media before their filling in straws which are then sealed. Effective labelling on the source of embryos and their date of collection are essential to be mentioned.

More recent methods of cryostorage involve a recent technique the vitrification. In this technique there is solidification of the liquid by extreme increase in viscocity during ultra-rapid cooling. This prevents formation of intracellular ice and damage to the embryo during cryopreservation. Embryos can be preserved rapidly using this technique and they can be directly thawed for transfer without passing through serial concentrations of sucrose as is required for embryos cryopreserved by conventional freezing. Such procedures also does not require embryo freezers.

EMBRYO TRANSFER IN MARES

First ET foal born in 1979. The problem with equine ET is superovulation. The mares ovary does not respond to most superovulatory drugs including eCG. Only Pituitary extracts have shown some promise. Synchronising ovulation is difficult in donors and recipients. Oral altrenogest are used. Embryos collected non-surgically. Unfertilized ova do not enter uterus and biologic reduction in embryos occur day 7-11 post ovulation.

Embryo transfer in sheep and goat

Superovulation started on day 11-12 of cycle in sheep and day 10-14 in goats

Ovine FSH + eCG used for superovulation

Synchronization by using vaginal progesterone implants (Florogestone or MPA)

Flushing on day 3-4 day for recovery of tubal embryos and on day 6-7 for uterine embryos

Methods of recovery: Surgical /Semi-surgical (Laparoscopic)

Embryo transfer in camel

First Llama Weipz and Chapman 1985

Luteal phase creation by progesterone treatments

Superovulation by using FSH or eCG

Ovulation induction treatments required when AI is the mthod of breeding
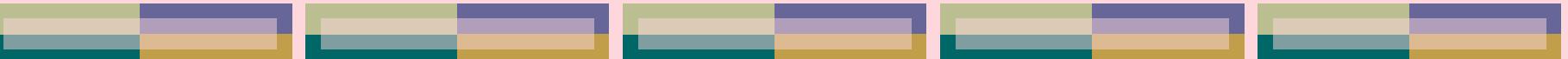
In vitro production of mammalian embryos

Embryos can be produced in vitro by in vitro maturation of oocytes, their fertilization in vitro and subsequent development in vitro (IVMFC).

Although attempts for in vitro fertilization date back to 1878 by a Viennese biologist Schneck, the use of this technology in human and animal reproduction as an assisted reproductive technique are not older than 25 yrs. The first In vitro fertilized human baby girl was born on 25n July 1978 and 8 years later the first calf produced from artificially matured oocytes was born in Japan in 1986 (Hanada and associates, 1986). The first IVF buffalo calf was born at NDRI Karnal by the efforts of Madan and associates in 1994. Over the past two decades there has been immense interest in the in vitro fertilization of oocytes from all species including endangered species. The applications of IVF produced embryos are:

Studies on the processes of oocyte maturation, fertilization and subsequent development. Large scale production of embryos for empirical studies.

Preservation of gametes (oocytes and embryos).

Besides these there can are innumerable applications of in vitro fertilization of mammalian oocytes. The mammalian oocyte is arrested at first meiotic stage when present in the follicle of the oocyte and undergoes sequential changes during its growth in the follicle to reach metaphase II and the first polar body is released before ovulation except in the dog in which the oocyte may be ovulated as a primary oocyte and may develop as a secondary oocyte with release of polar body in the oviduct. The sperm aslo undergoes sequential changes while passing through the female tract before it achieves the capacity to penetrate the oocyte. When these and the post fertilization development changes have to be braught in the oocytes collected outside the body a substantial understanding of the gamete biology is essential. The procedures adopted are described briefly.
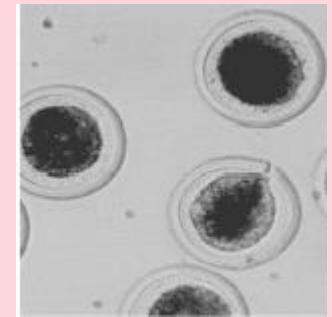
Oocyte collection: For fertilizing the oocyte in vitro it has to be collected. The oocytes are enclosed with cumulus cells and called the cumulus oocyte complexes. Various approaches used for retrieving mammalian oocytes include aspiration of ovarian follicles by:

Aspiration from slaughter house ovaries, but these are limited to studies

Aspiration by transvaginal ultrasound guided ovum pickup from live animals

Aspiration after a laparotomy

The aspiration involves suction using specialized media usually

DPBS containing BSA, a serum source and antibiotics.

Oocyte Maturation: When collected from the follicles the oocytes are arrested at the germinal vesicle stage and hence need to be matured in vitro in a laboratory. The maturation involves keeping oocytes in TCM-199 or other media supplemented with hormones (FSH, LH and estradiol), growth factors (EGF or IGF-1), antibiotics and a serum source. TCM-199 is not tailor made for oocytes and hence currently many more media have been experimented including serum free defined media (like synthetic oviductal fluid: medium SOF). The oocytes are kept in small microdrops (50-100 μL) of the media after their washing in washing media. They are usually kept in a CO2 incubator which maintains temperatures of 38.5+ 1.0 degrees, CO2 tension of 5% and a relative humidity of 95%. The microdrops are covered with paraffin oil and kept for 24-28 h for in vitro maturation. This time frame brings about maturational changes in oocytes and they reach metaphase-II and release the polar body. These changes are similar to what would appear in oocytes when they matured in the follicle.
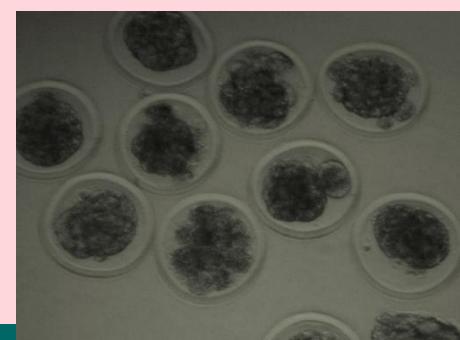
Oocyte Fertilization: Once the oocytes are matured they are kept with prepared sperms for a certain time period and the sperm penetrates the oocyte. After the desired time period, the sperm suspension is removed and the oocytes are freshly charged with medium and then cultured in vitro for development. For preapring sperms various approaches are used
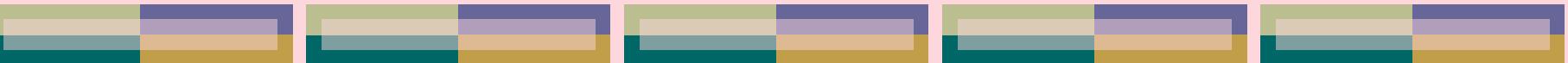
Selection of motile sperms: This is done by swim-up techniques or Percoll gradient separation. The media used for sperm preparation vary widely among species. BO(Brackett and Oliphant medium) medium or TALP(Tyrode albumin lactate pyruvate) are used. Sperms are centrifuged to separate the seminal plasma and the resultant pellet is dissolved in medium. The motile sperms are then collected by keeping in the medium for 1 h and the actively motile sperms swim up in the medium and these are collected by collecting sperm suspension from the upper layer of the media. In Percoll gradient sperms are layered over 45% and 90% layers of Percoll and the test tube is then centrifuged. The motile sperms reach the bottom of the Percoll and are collected.

Sperm capacitation: is necessary to make sperms capable of fertilizing oocytes. This is usually done by heparin treatment or treatment with calcium ionophore. Sperm motility enhancers like caffeine, theophylline or PHE (Phenylephrine, hypotaurine and epinephrine mixture).

All this is done by keeping the sperm suspension in a CO_2 incubator.

Culture of presumptive zygotes: One day after sperm oocyte co-incubation and removal of the sperm suspension the presumptive zygotes are further cultured for 5-7 days till they reach thee blastocyst stage when they are collected and used further. The culture of zygotes require the addition of a cell line like oviductal epithelial cells or granulosa cells or any other cell line. This is necessary because after the 8-cell stage there is a arrest to further development of embryos which is a culture induced phenomenon and is irreversible. The addition of the cell line prevents this block to development. The fertiliaed eggs start to cleave and reach the blastocyst stage by day 7 post culture. The medium is changed every day and there is evidence that the requirement of a growing embryo change with their growth so media may be sequentially supplemented.

The oocyte biology has been understood to a great extent by the experiments on in vitro maturation, fertilization and embryo culture. Oocyte cryopreservation has also gained popularity during recent years and has shown to have immense potential for preserving the valuable gametes from human and many species.

Other advanced assisted reproductive technologies (ART)

GIFT: Gamete Intra-fallopian transfer
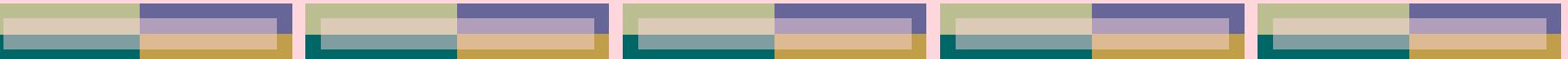
ICSI: Intra-cytoplasmic sperm injection

Clone: A group of cells tissues or molecules deriving from a common ansector. A embryo produced by somatic cell nucleas transfer (SCNT)

Transgenic: An individual carrying an extra gene introduced by intentional human intervention. Produced for production of pharmaceutical proteins secreted in natural secretions for human therapy like sickle cell anaemia.

Stem cells: Plueripotent and totipotent cells with infinite regeneration capacities like embryonal cells, marrow cells and the germ cells.

Care of the new born and common diseases

Important factors are feeding of colostrum, provision of adequate shelter and housing, application of the antiseptic to the navel, early docking and dehorning

Common calf diseases are Naval ill, Septicaemia, Calf scours and Pnuemonia. Besides this Theleriosis and neonatal hypoglycemia are common.

Signs of health in a new born foal

A healthy foal should stand within 1 hour

- Should start nursing within 2 hours
- Should pass the meconium (first feces) within 3 hours after birth

Common Abnormalities of Foals from birth to 30 Days of Age

Fractured Ribs - Fractured ribs are a very serious problem in the neonate, because death can result from a fractured rib penetrating the heart or lungs. No foal should be turned out into a paddock until its ribs have been palpated. Fractured ribs are most common after a dystocia or in very large foals.

Entropion - Entropion is the most common ophthalmic abnormality. This abnormality is best treated with a SC injection of 3 ml of procaine penicillin G (PPG) in the affected eyelid.

Umbilical Hernia - Umbilical hernias are easily palpated on the newborn examination; however, they are most obvious when the foal is a few weeks of age and the omental fat protrudes into the hernial sac. Umbilical hernias are rarely a problem in the neonate, and they are usually repaired at a later date

Meconium Impaction - Meconium is the brown, black, or greenish brown feces that is composed of glandular secretions and digested amnion. Most is passed within 24 h after birth, and it is followed by typical yellowish-colored milk feces. Meconium retention is a common source of abdominal pain in the neonate, but is more common in colts. Affected foals are initially treated with warm water and soap enemas and a low dose of flunixin meglumine (0.5 - 1.0 mg/kg) along with 12 oz of mineral oil through a nasogastric tube. Foals who refract three enemas and continue to be in pain or foals who develop abdominal distention should be referred to the hospital.

Neonatal Isoerythrolysis - Neonatal isoerythrolysis (NNI) occurs when the foal inherits different blood antigens (types) from the stallion and the mare. As a result, the mare has produced antibodies to these antigens, which are concentrated in her colostrum. How the mare is exposed to the foal's blood is uncertain, but it is thought that repeated exposure to red cell antigens after numerous foalings or placental leakage of blood is most likely. The foal nurses the colostrum, and, depending on the concentration and type of antibodies, the foal develops hemolytic anemia within 24 - 96 h of age. Affected foals become icteric, depressed, and anemic. Foals born to mares with suspect titers are muzzled, and a cross match of the mare's colostrum and the foal's RBCs are done.

Diarrhea - The diagnosis of the etiologic agent(s) of diarrhea in the foal is difficult and frustrating. Diarrhea in the foal during the first 30 days of life can be a serious problem with many adverse consequences, but it is also very common in non-life threatening situations. A common non-infectious diarrhea is milk overload diarrhea characterized by the yellowish color. This is thought to be secondary to the osmotic effect of the milk or caused by gastrointestinal floral changes. The clinical severity varies. Occasionally, using 10 cc of gentamycin sulfate orally for 2 days may help in less severe floral diarrheas but should not be used routinely in diarrheas. Foal heat diarrheas coinciding with the mare's estrus are usually not treated in any way.

Patent Urachus - The urachus is the *in utero* connection between the fetus' urinary bladder and allantoic cavity. In normal foals, this structure closes soon after delivery, and it eventually completely regresses to a group of ligaments. If the urachus does not close, urine will exit the umbilical area. A once daily treatment with silver nitrate sticks for 3 - 4 days is all that is required.

Care at farrowing

The newborn pig has three basic requirements:

- A good environment;
- Adequate and regular nutrition; and

    Safety from disease and crushing

The navel should be disinfected the day pigs are born using tincture of iodine.

Clip needle teeth

Ear-notching is a good practice There are many good sources of iron that can be used to prevent anemia. Iron-dextran injected in the muscle is an effective method. Injections in the neck or forearm are preferred to injecting in the ham. Common levels are 150-200 milligrams of iron as iron-dextran, usually given the first 2 to 3 days after birth.

Care of puppies The most critical period of a dog's life is during the first week

HEALTHY PUPPIES

1) Look and feel vibrant, vigorous and strong. Feel like a glove with a hand in it.

2) Twitch while sleeping (activated sleep)

3) Nurse with great energy and are strong enough to fight their way to a nipple.

4) Tongues are pink and warm **5)** Skin returns quickly to normal when it is pinched

6) Tummies feel full, but not bloated.**7)** Sound like a well tuned motor. **8)** Are quiet, either busy nursing or sleeping

SICK PUPPIES

1) Look and feel unthrifty, limp and flaccid feeling like a glove without a hand in it.

2) Stop twitching in their sleep

3) Rattle when breathing Sounds like it has emphysema or gurgles when it breaths

4) Cease nursing, show weak attempts at nursing or cry while nursing

5) Tongue is not pink colored and is cool to the touch (sometimes looks ruffled)

6) Cry most of the time and acts like it is colicky

7) Double up in cramps

8) Skin stays creased when pinched

9) Diarrhea and/or vomiting

Make sure the mother's breast areas are kept clean.

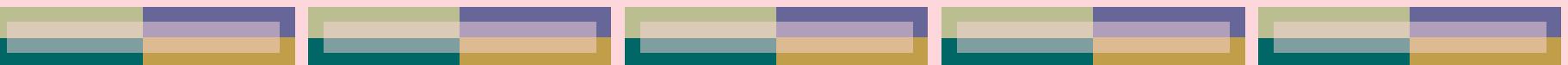**Trim the feathering and long body hair on the bitch**

Encourage puppies to nurse right away.

When the bitch has finished whelping, give her a bowl of heated (condensed) milk, with equal parts water and two egg yolks. The umbilical cord of the puppy should be tied off with thread 1 inch from the pup's body and cut off beyond the tie. Apply a drop of iodine or Betadine to the end of the cord to prevent infection. The two leading causes of puppy death after live birth are chilling, and a lack of fluids and energy. Puppies that are not nursing with enthusiasm, cold to the touch, or constantly complaining need your help. Warm them to 98-100° F rectally, and provide the necessary food.

Puppies almost always pile together in relative proximity to one another

Puppy stools are normally fairly soft, but formed and usually are yellow/brown in color.

Removal of the dew claw and tail docking

Often the pups need to have their toenails trimmed within a few days following birth using a small pair of fingernail clippers. Trim only the points and avoid the quick (that is pink) as the nails can bleed if cut too short.
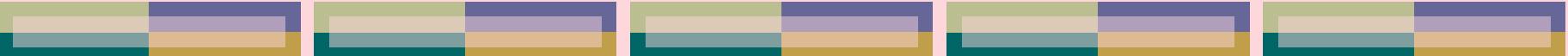
Puppy eye opening

The reason why dogs' eyes are closed at birth and humans' or other animals eyes are open at birth is a puzzle with a lot of parts. The brains of most mammals grow at a very constant rate. Eye opening is linked to brain growth, and the eyes open when the brain is at a certain maturational point, whether or not there is anything to look at. Puppies are born immature as far as the brain development is concerned hence the eyes are closed at birth.

The eyes of puppies will open sometime between ten and eighteen days.

	Puppy Vaccination Schedule
Age	**Vaccination**
5 weeks	**Parvovirus**: for puppies at high risk of exposure to parvo, some veterinarians recommend vaccinating at 5 weeks. Check with your veterinarian
6 & 9 weeks	**Combination vaccine*** without leptospirosis. Coronavirus: where coronavirus is a concern.
12 weeks or older	**Rabies**: Given by your local veterinarian (age at vaccination may vary according to local law).
12-16 weeks**	**Combination vaccine** **Leptospirosis**: include leptosporosis in the combination vaccine where leptospirosis is a concern, or if traveling to an area where it occurs. **Coronavirus**: where coronavirus is a concern. **Lyme**: where Lyme disease is a concern or if traveling to an area where it occurs
Adult (boosters)§	**Combination vaccine** **Leptospirosis**: include leptospirosis in the combination vaccine where leptospirosis is a concern, or if traveling to an area where it occurs. **Coronavirus**: where coronavirus is a concern. **Lyme**: where Lyme disease is a concern or if traveling to an area where it occurs. **Rabies**: Given by your local veterinarian (time interval between vaccinations may vary according to local law).

THANKS