

# Practical Alpaca Reproduction



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## Learning Objectives:

- To describe the ***normal anatomy*** of the male and female alpaca and llama.
- To describe the ***physiology*** associated with alpaca and llama reproduction.
- To describe reproductive ***behavior*** in camelids.
- To introduce ***ultrasound pregnancy detection*** in camelids



# Female Reproductive Tract Anatomy

- ***Ovaries***
  - produce ***gametes and hormones*** that act on other parts of the reproductive tract
- ***Uterus***
  - receives the ***semen*** during breeding, and protects and nourishes the ***developing embryo and fetus*** during pregnancy



- ***Cervix***

- a ***barrier*** that secretes mucus during receptivity and produces a ***mucus*** plug seal during pregnancy

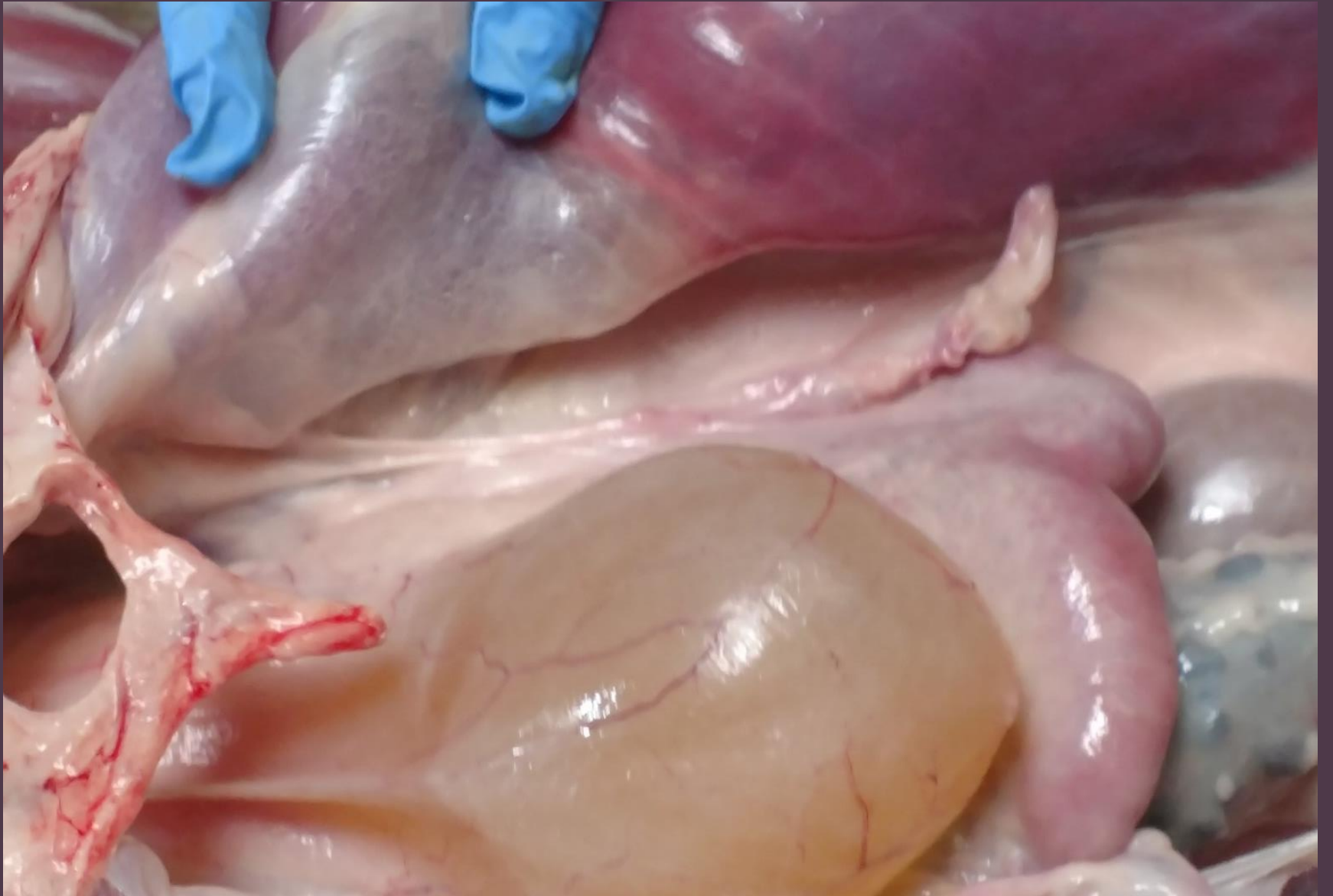
- ***Vagina***

- the copulatory organ and produces lubricating ***mucus*** during receptivity

- ***Oviducts***

- provide optimum environment for ***fertilization*** and pre-attachment development of the ***embryo***







# Cervix

- External os protrudes slightly into the vagina
- 2 - 3 non continuous *rings* within
- *Dilation = abnormal*

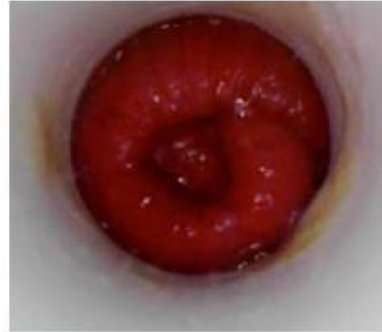




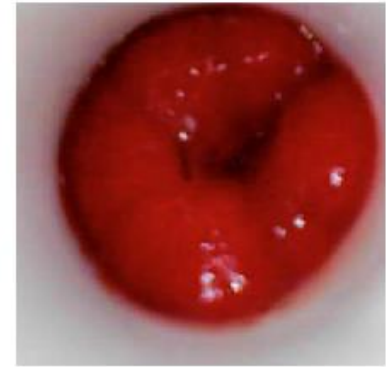
# Cervical appearance

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**Corkscrew/Spiral**



**Donut**



**Flap**



**Papilla**



**Multiple Papilla**



**Slit**

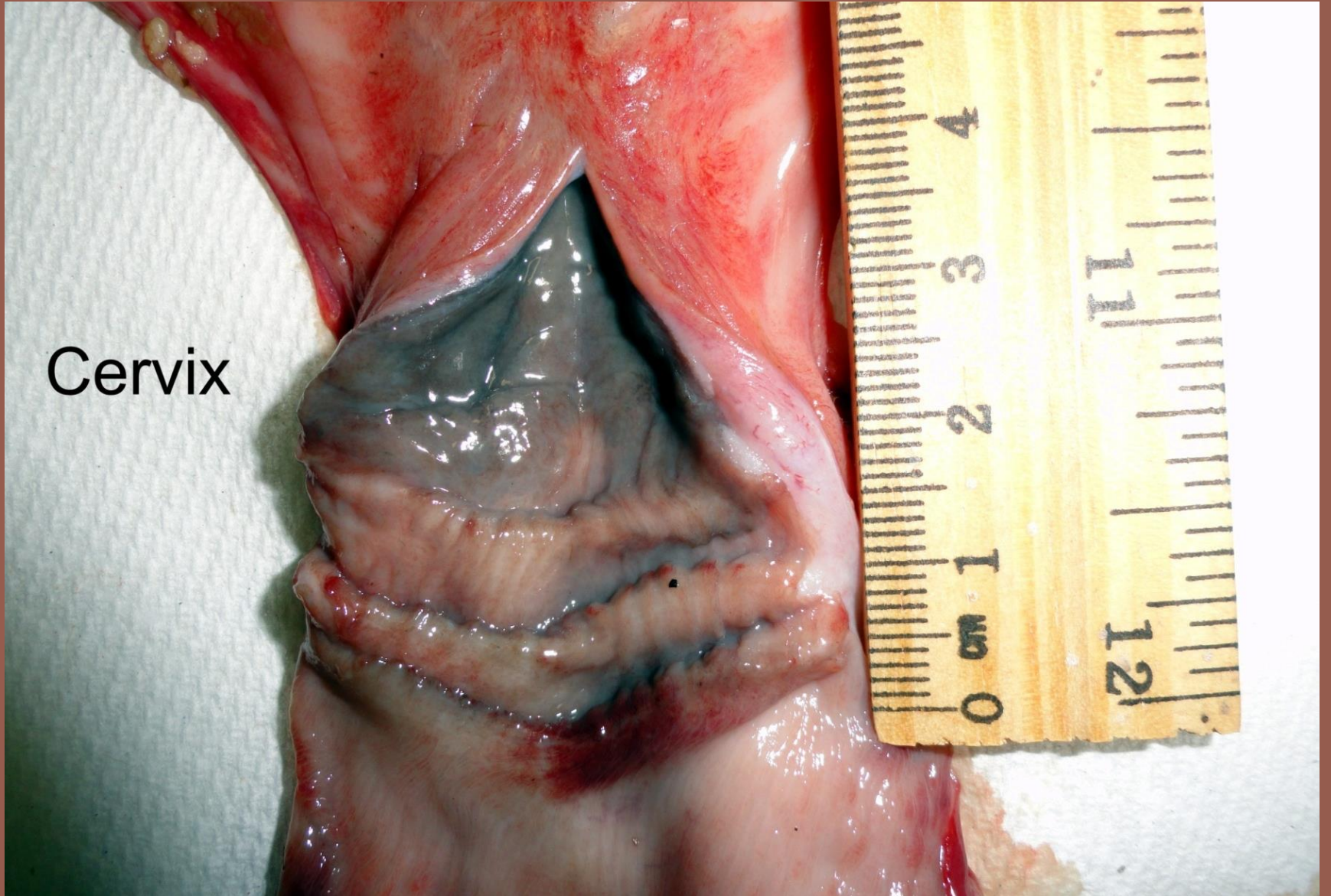




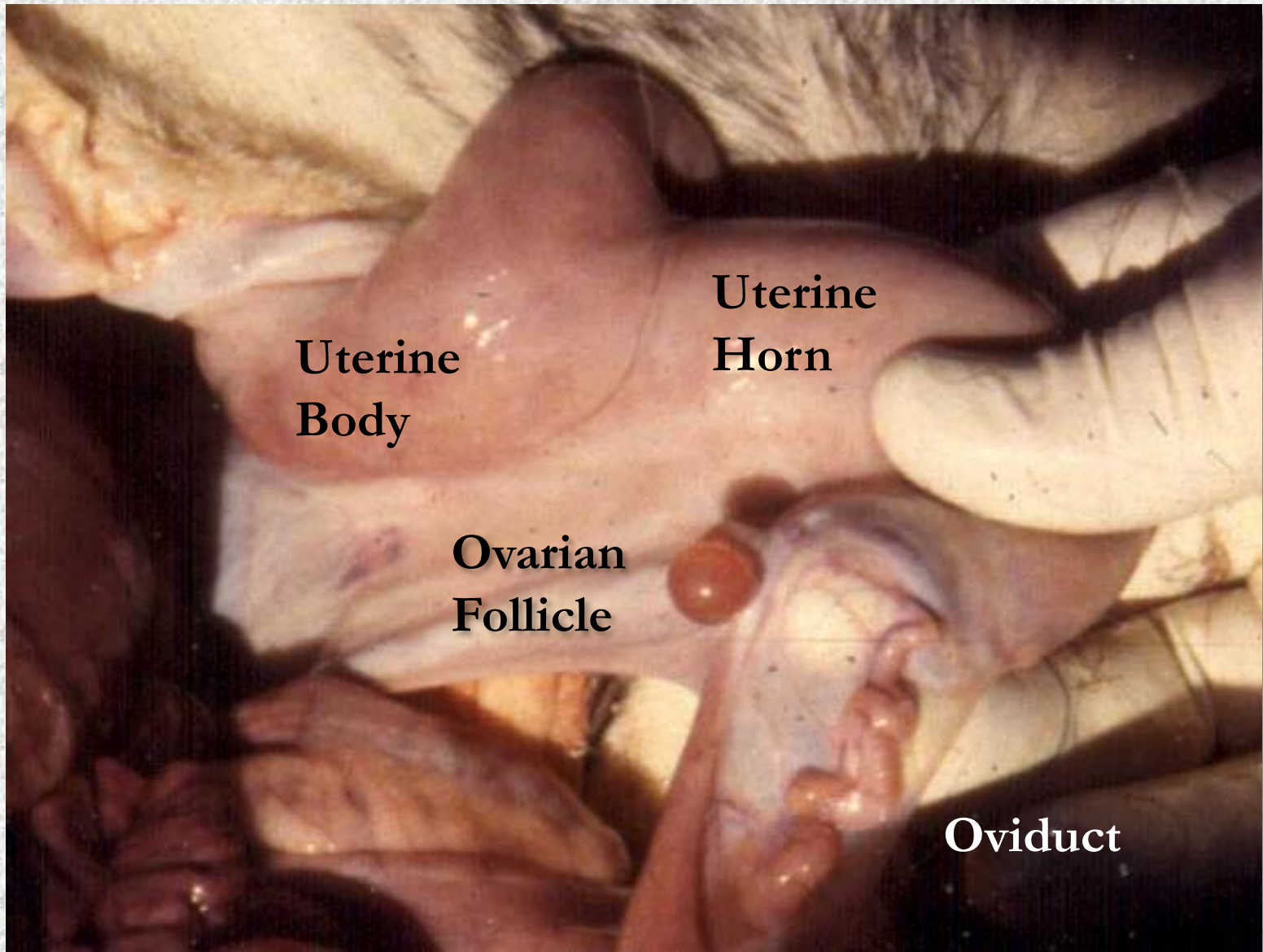




Cervix

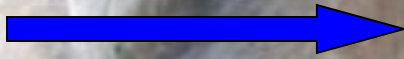


# Uterus and Ovary with Follicle



# Vulva

Anus



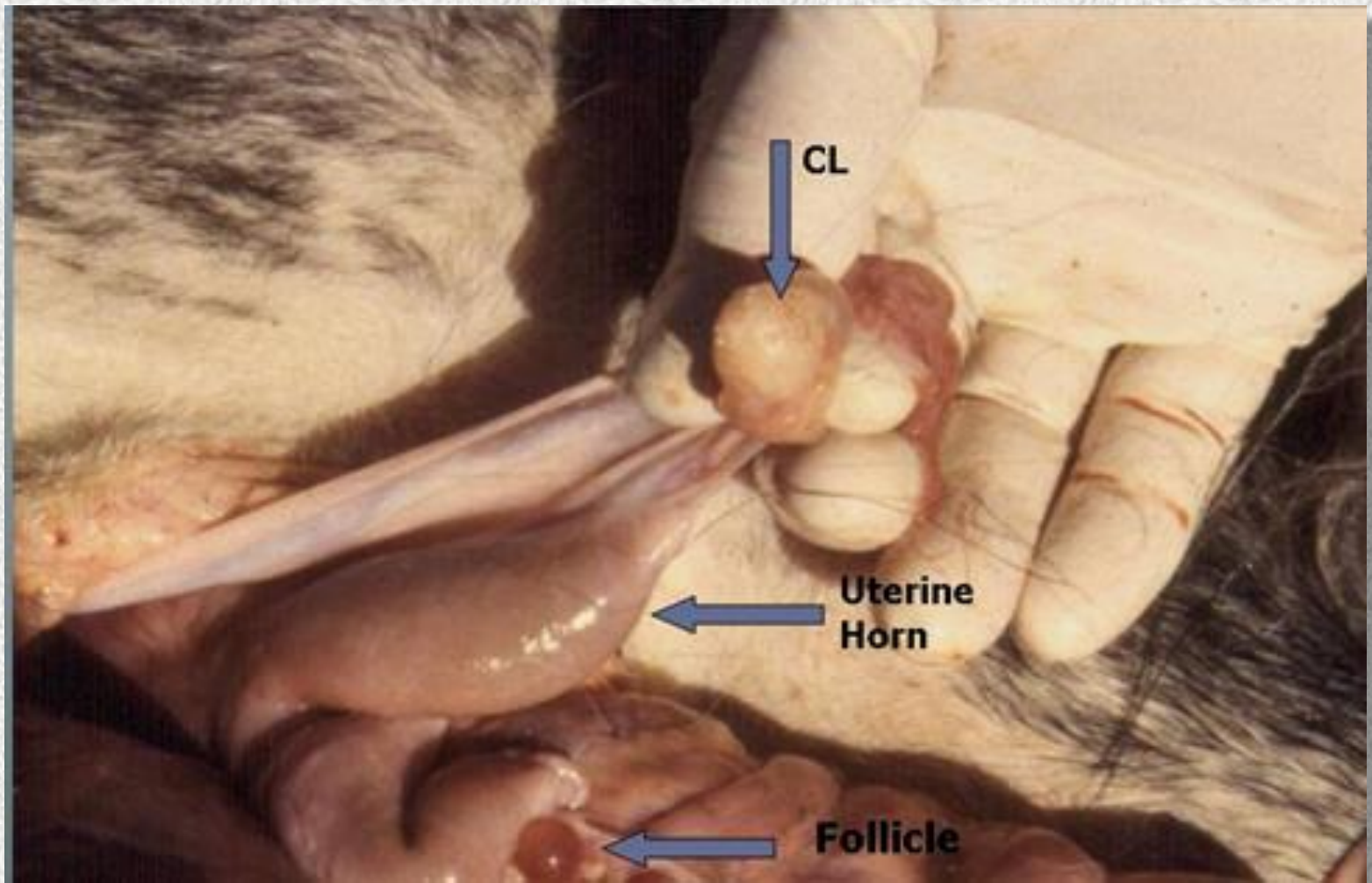
Vulva



## Major effects of estrogen on the camelid reproductive tract

- Increased blood flow
- Relaxation of the cervix
- Increased white blood cells to counteract the contamination which occurs at breeding
- Increased secretion of mucus
- uterine gland growth
- Increased uterine muscular tone
- ***Behavioral receptivity***





- All types (maturation levels) of follicles are present in the ovary at all times.
- Corpora lutea (CLs) may or may not be present depending on whether an ovulation has occurred.

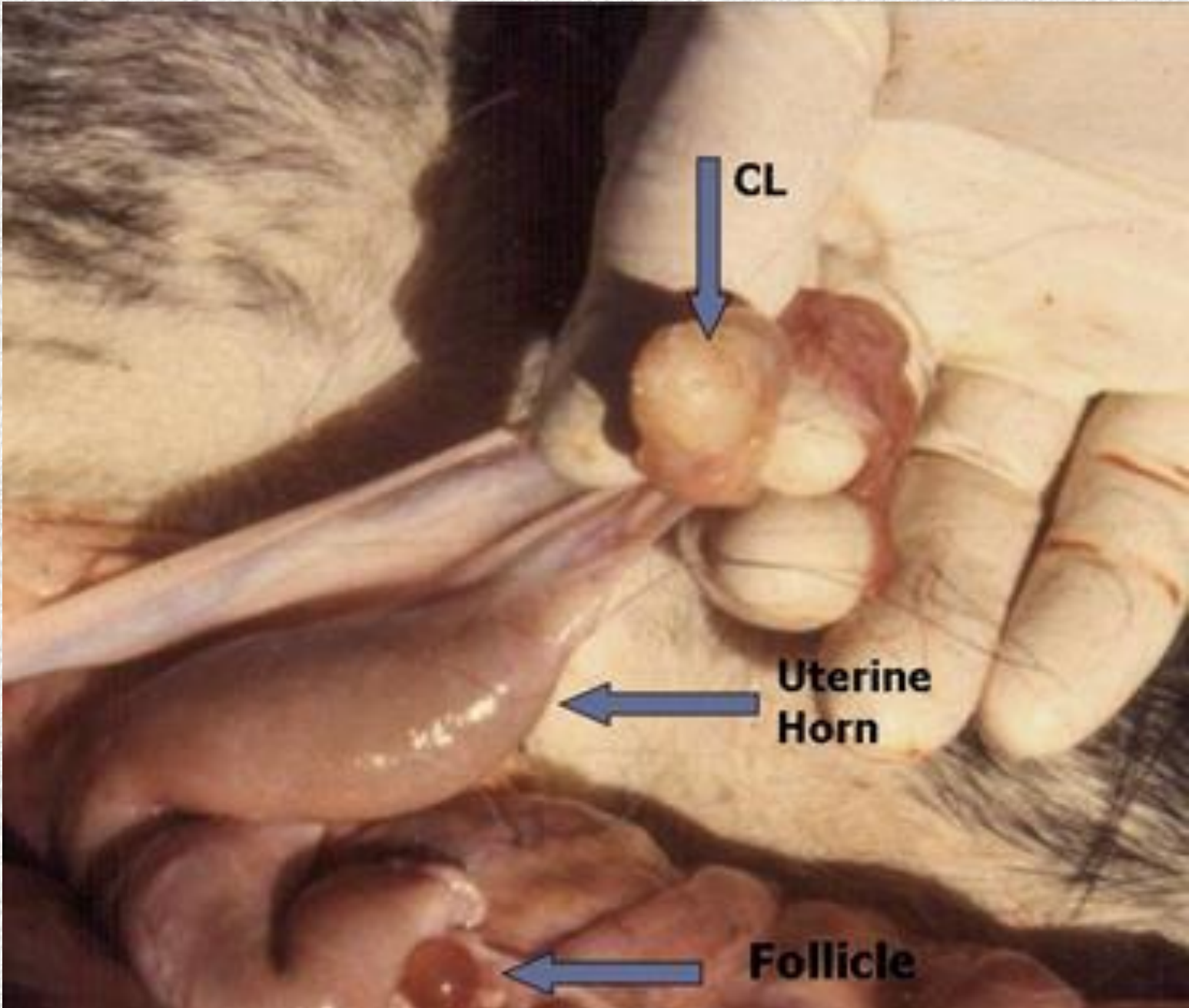
# Ovarian Physiology

- **Follicular Phase**
  - Follicles are fluid filled structures within the ovaries that contain the eggs (ova)
  - Camelids do not have estrous cycles as in other mammals
  - ***Camelids are termed “induced ovulators”***
    - breeding causes ovulation= rupture of the follicle and release of the egg
    - does not mean always receptive!



# Follicular Growth

- Several small ( $< 3\text{mm}$ ) follicles are present at all times
- Some follicles grow and regress
- Interrupted by ovulation after copulation or exogenous hormone stimulation
- follicles are capable of ovulation at **6 mm** diameter.
- If no ovulation occurs the follicle regresses, shrinking back down in size, or disappears within 2 days (unpublished, 2011)
- **Follicular sizes do not necessarily correlate with sexual receptivity**



**CL**

**Uterine  
Horn**

**Follicle**

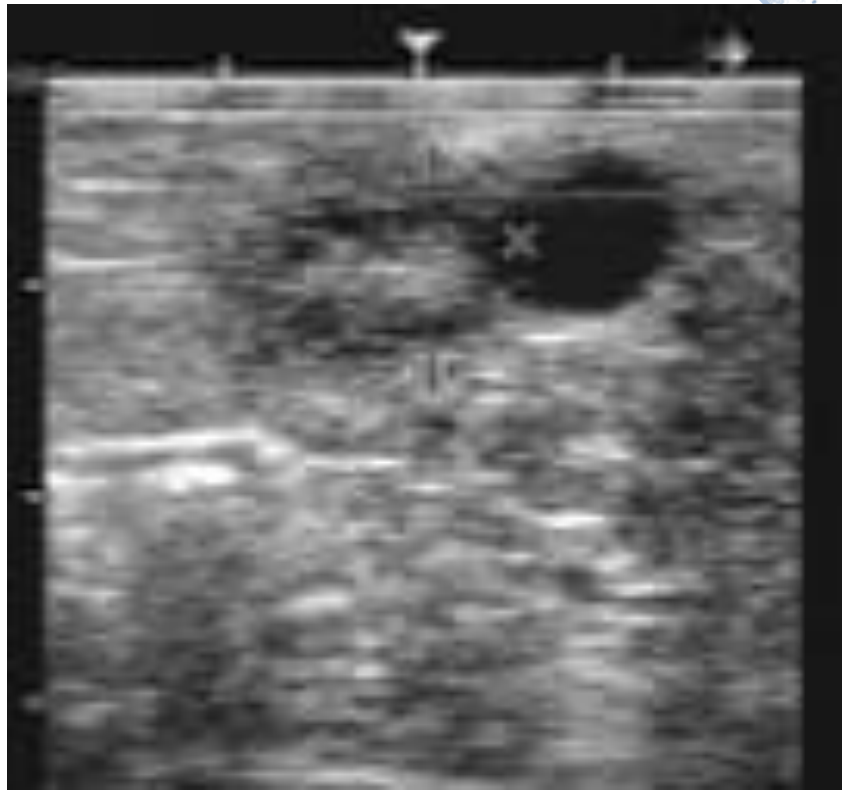
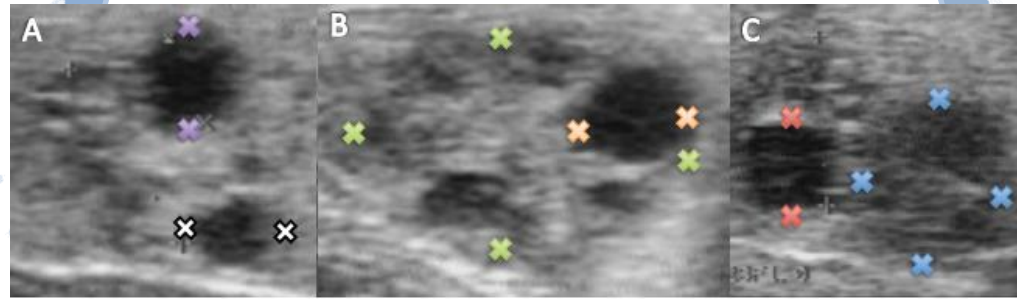
# Ovarian Follicles

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# Ovarian Follicles

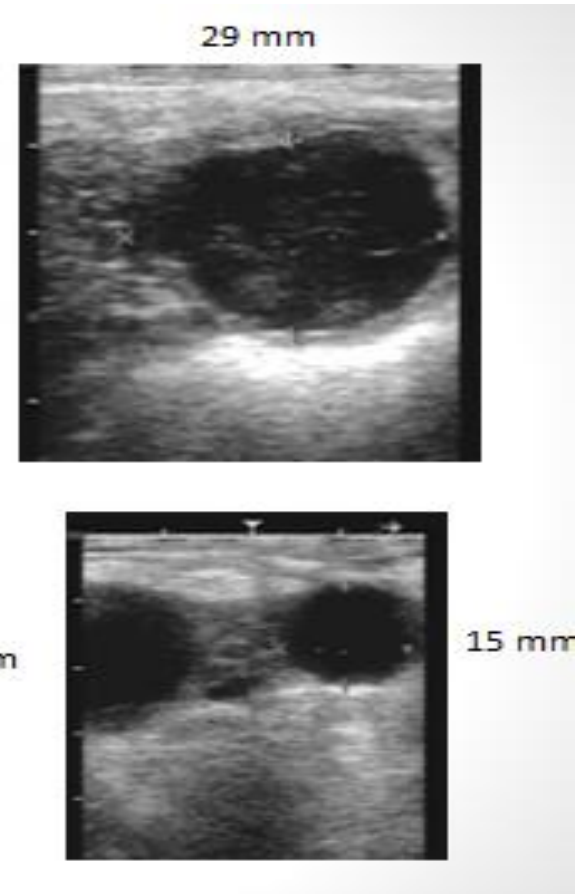




Ovarian Follicles

# Anovulatory Follicles

- > 15 mm diameter are abnormal
- Grow up to 30 mm in diameter.
- No effect on sexual receptivity
- Resolve without treatment through rupture



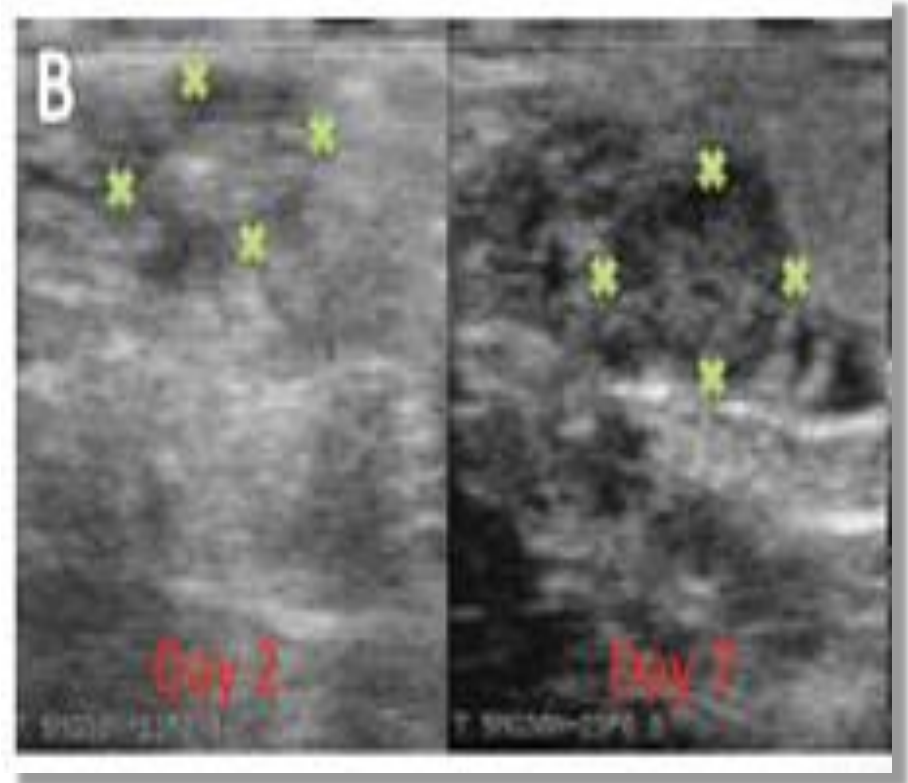


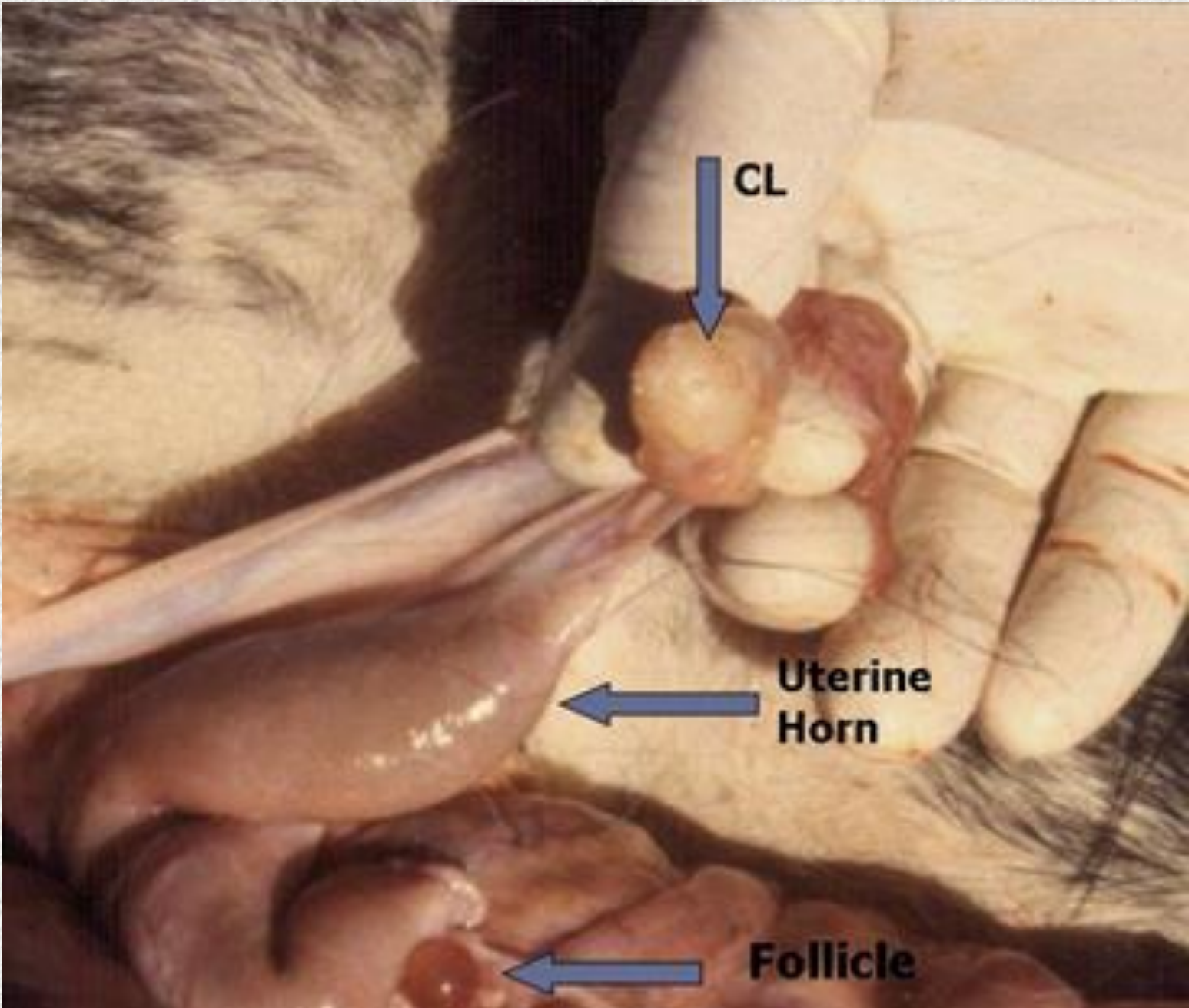
# Luteal phase of the ovarian cycle

- Occurs after ovulation
- Lasts for months if the female is pregnant
- Ovulatory **Corpus Luteum (CL)** is responsible for *progesterone* production throughout pregnancy
- 6-15 mm follicles burst releasing the ovum or egg approximately 24 hours after breeding
- Follicles develop during pregnancy

# Corpus Hemorrhagicum

- Transitory blood filled structure for  $\sim 48 - 96$  hrs. after ovulation
- Can be visualized with transrectal ultrasound at approximately 48 hours after breeding
- Replaced by the “corpus luteum” (CL) which grows and secretes progesterone.

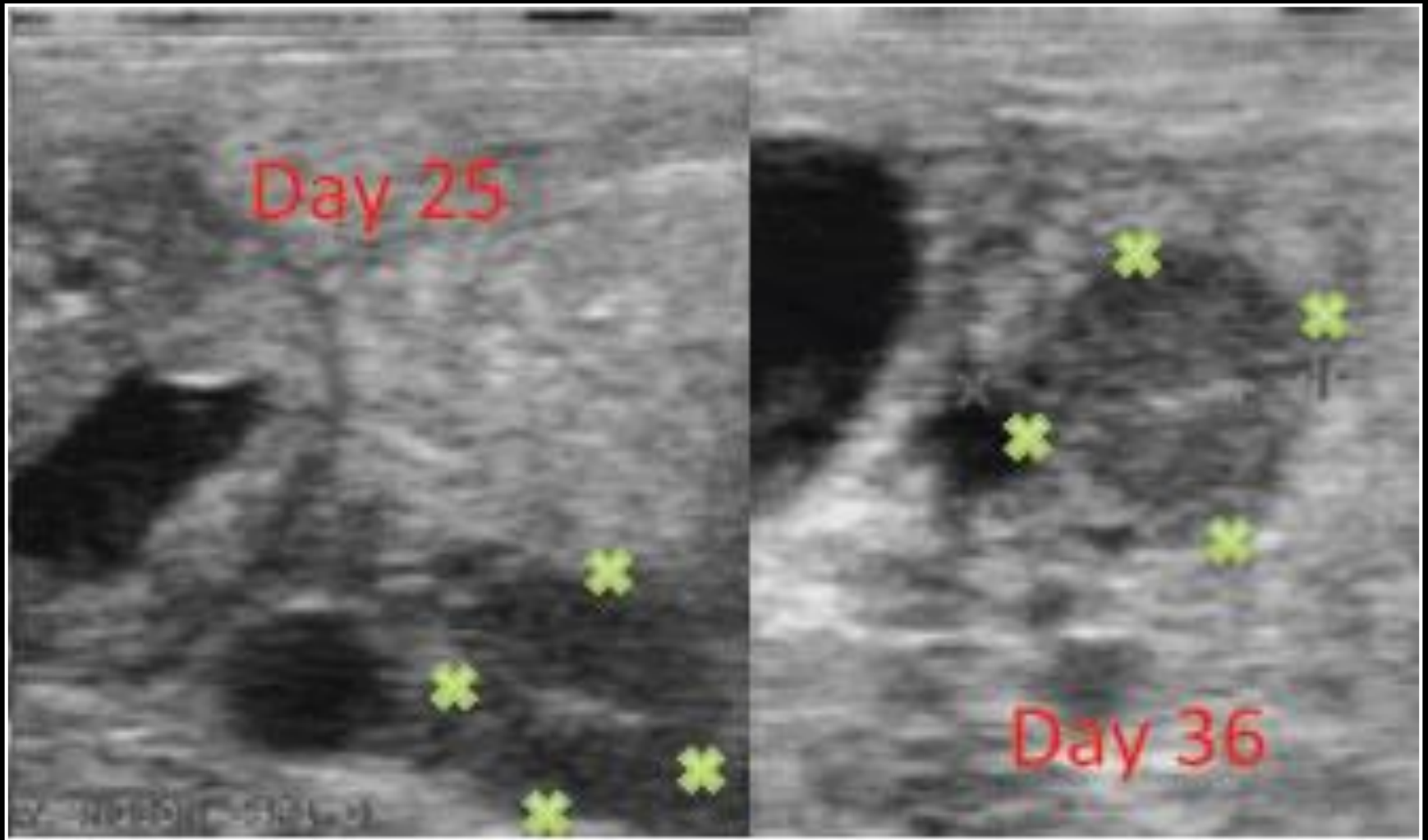




**CL**

**Uterine  
Horn**

**Follicle**



Corpus luteum, embryonic vesicle,  
ovarian follicle

## Retained CL

- CL remains functioning without a pregnancy = non-receptive behavior
- treatment with  $\text{PGF}_2\alpha$
- suggest 200  $\mu\text{g}$  of cloprostenol sodium (0.8 ml of Estrumate<sup>®</sup> for alpacas or llamas) SQ, two days in a row
- May be over diagnosed




## Return to Receptivity

- If no pregnancy is established expect in approximately 12 to 14 days
  - a longer period of time if the animal experienced **early embryonic death**
  - varies with each ovulation
  - not necessarily consistent for a specific female

# Pregnancy Termination

- Two doses of 200 µg of cloprostenol sodium (0.8 ml of Estrumate<sup>®</sup> for alpacas or llamas) SQ daily in a row is most effective after 60 days of pregnancy
- One dose may be sufficient before 60 days
- Check (behavior test) for return to receptivity within 7 days
- Recheck pregnancy status with ultrasound if animal does not become receptive.



# Male Reproductive Anatomy

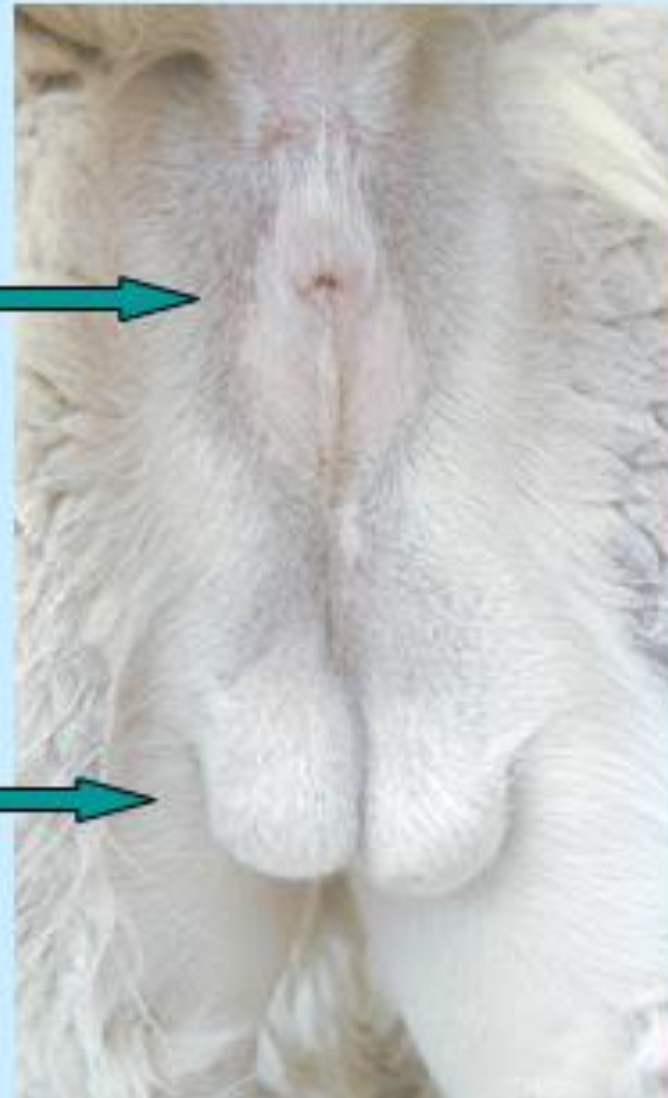
- Two testicles located in the scrotum
  - much smaller than those of other species of comparable body size
    - Alpacas
      - length 3.5 to 5.0 cm
      - thickness 2.0 to 3.0 cm
    - measure with ultrasound or calipers
  - larger testicle ? = greater sperm production
  - size does not vary with photoperiod length



# Alpaca Testicles

Anus →

Normal Scrotal Location  
with 2 Symmetrical  
Testicles →

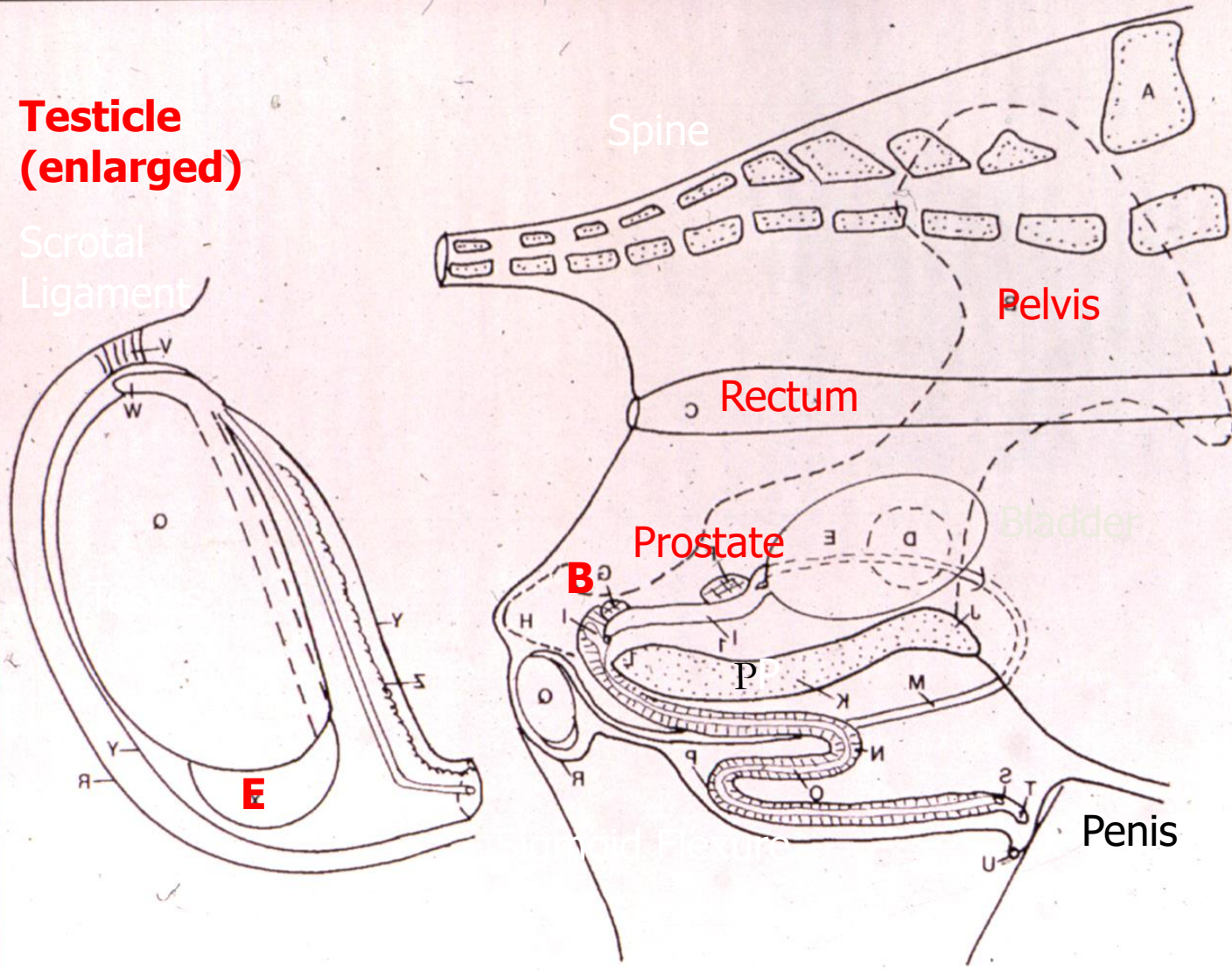


# Male Camelid Genitalia

**Testicle  
(enlarged)**

Scrotal  
Ligament

Fowler



**E = Epididymus**

**B = Bulbourethral Gland**

PG



RPM

GP

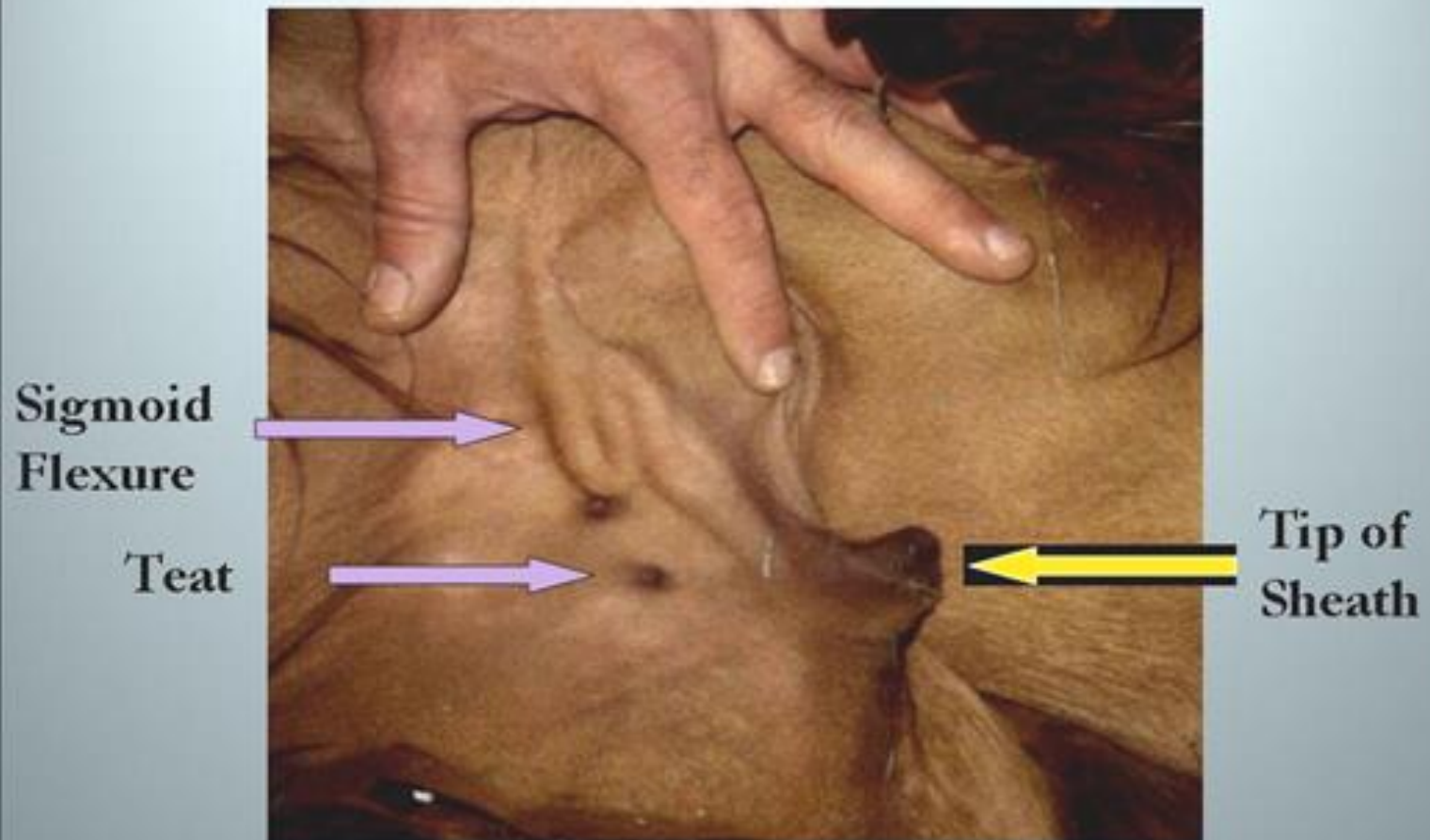
## Male Tract (ventral view)

- Retractor penis muscles (RPM)
- Prostate gland (PG)
- Glans penis (GP)

# Penis is fibroelastic with a sigmoid flexure when relaxed

- Males urinate backwards between the legs since the tip of the sheath points caudally and the penis is not extended during urination
- Mature male alpacas partially extend the penis out of its sheath in the standing position when mounting receptive females
- The penis has a **corkscrew appendage** at its tip that is used to dilate the cervix and enter the uterus during breeding
- **Cartilaginous process** on the end of the penis- function unknown

## Sigmoid Flexure of Camelid Penis

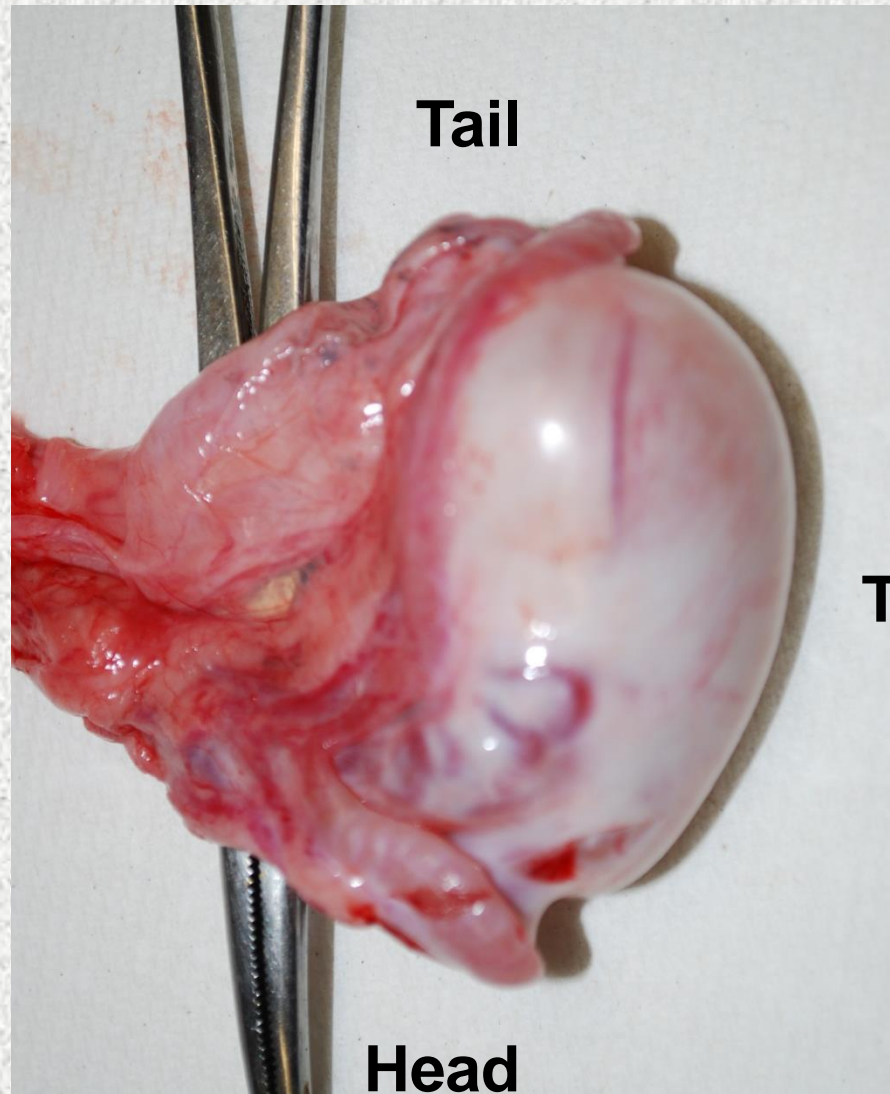


# Glans Penis

corkscrew appendage - auxiliary process



# Testis and Epididymis





# Reproductive Behavior in Alpacas



# Sexual receptivity in the female

- ***Extremely variable!***
- In the presence of the male:
  - Immediate acceptance= receptive (R)
  - Female stands when mounted by the male, but does not drop= recheck later= not receptive (NR)
  - Refusal= not receptive (NR)
- **Acceptance** = female dropping for breeding upon approach of, or mounting by, the male
- **Refusal** = standing, running away, spitting, vocalizing

# Behavior Testing





## Home Schooling








# Receptive Behavior

Some females run with others and do not show receptivity unless cornered


Females ***demonstrate preferences*** for different males on the same day

***Males and females get used to each other*** if housed in close proximity and will stop showing aggressive breeding and receptivity behavior

**Competition-** A new male may have to be brought in to stimulate female sexual receptivity and male aggressive behavior, especially in timid, young males



Females will show receptivity as early as 24 hours after birthing.



***The best fertility rates (90+%) have been achieved by breeding between days 21 to 30 after birthing***





# Male Breeding Behavior

Most males will be interested in breeding at 1+ years old if allowed but it is best to ***start at 2 to 3 years of age*** to achieve the best fertility.

**Small males do not work well with large females-** organ mismatch due to requirement for cervical penetration, and breeding position

***Penile adhesions*** prevent full extension of the penis through the cervix

***May have low libido*** especially if they have not seen breedings



# Breeding Act

***Breeding - 10 to 45 minutes (average 20) in the down position and noisy.***

- The male moves forward to achieve the correct penile penetration into the uterus.

Produce a ***dribble ejaculate of small volume*** [0.5 to 7.5 ml collected (alpacas) in an artificial vagina] over the course of the breeding.

***Hot, humid weather reduces libido***



# Check angle of back





# Success!





# Semen Deposition

- Average 20 minute breeding
- Look for the hemorrhage



Males usually more aggressive in smaller pens than on pasture

Males may breed the same female ***multiple times per day***

Males may ***stop breeding to fight*** with others if they are too close together

***Lower pecking order males*** may not BT well if the dominant male is nearby

***Immature males (2-3 yrs. old)*** need time and training

***Let the males and females figure it out***

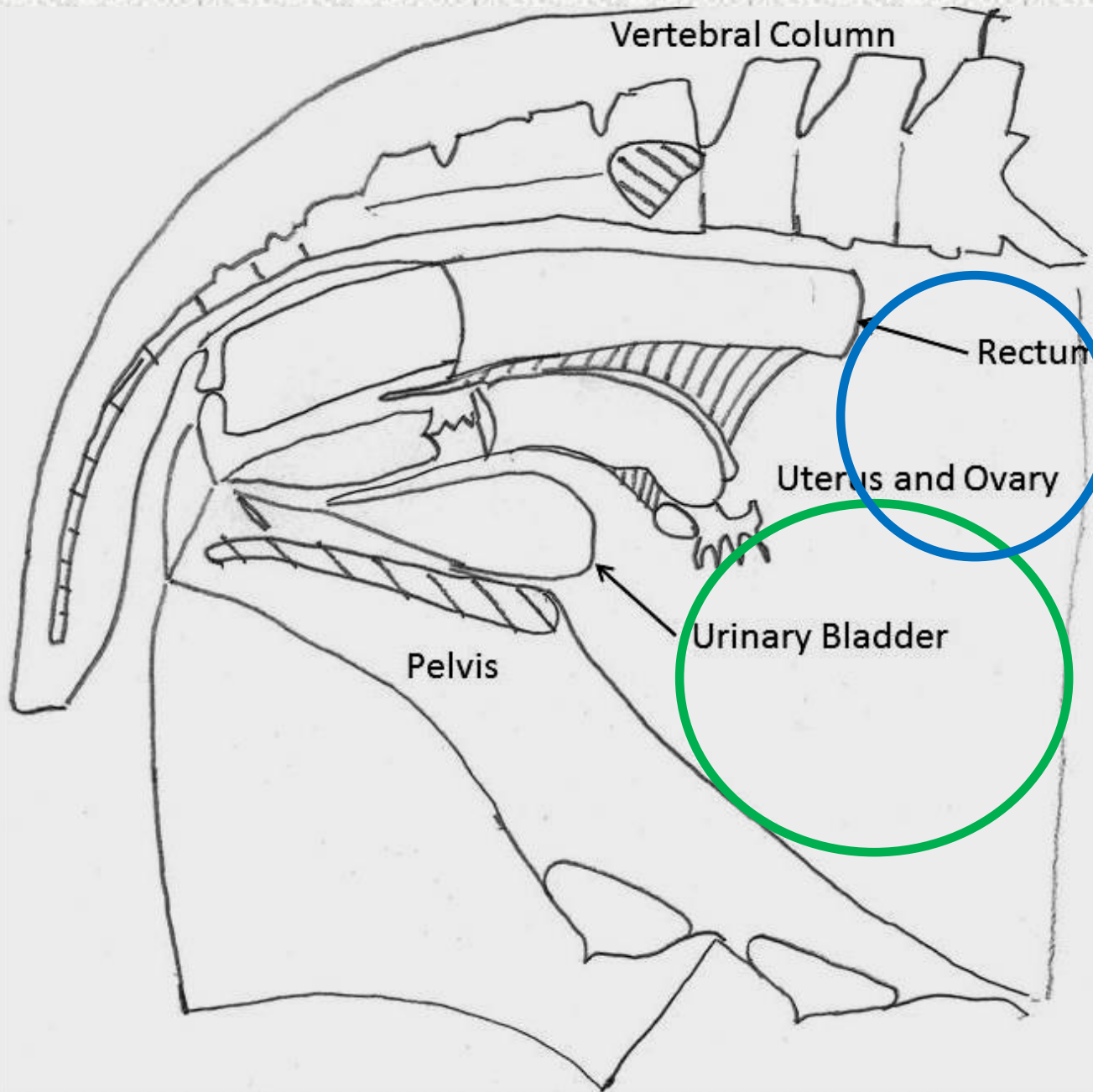


# Pregnancy Detection in Camelids

- The highest incidence of **early embryonic death (EED)** occurs in the first 30 to 50 days. ~ 20% incidence
  - Highest in first 30 days
  - A natural occurrence and a way of eliminating abnormal embryos.
  - Advantageous to lose bad embryos early and to quickly return to receptivity.
- Weekly refusal during behavior testing is *presumptive* of pregnancy.
- **Elevated progesterone** above normal baseline levels (approx. 2 ng/ml) indicate a functional CL, but are not specific for pregnancy.

# Ultrasound Pregnancy Detection

- an easy technique to master
- easily performed with a 5 MHz or 7.5 MHz linear probe
- Embryonic age and viability can be evaluated quickly by size of the pregnancy and presence of a heartbeat after 25 days
- Fetal movement is usually evident after 40 days of pregnancy
- The procedure is well tolerated by most alpacas and llamas



Vertebral Column

Rectum

Small Intestine

Uterus and Ovary

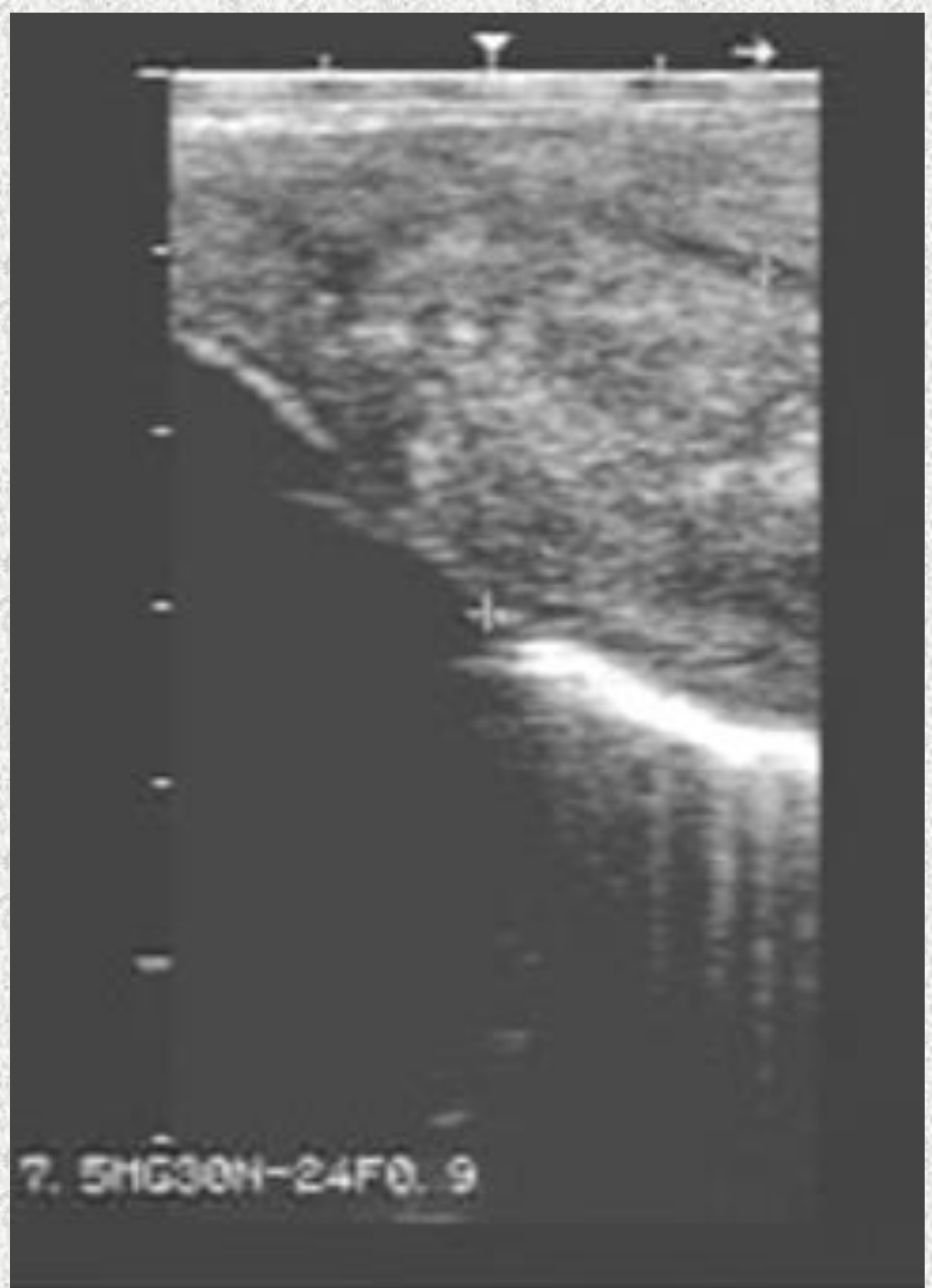
Urinary Bladder

Large Intestine

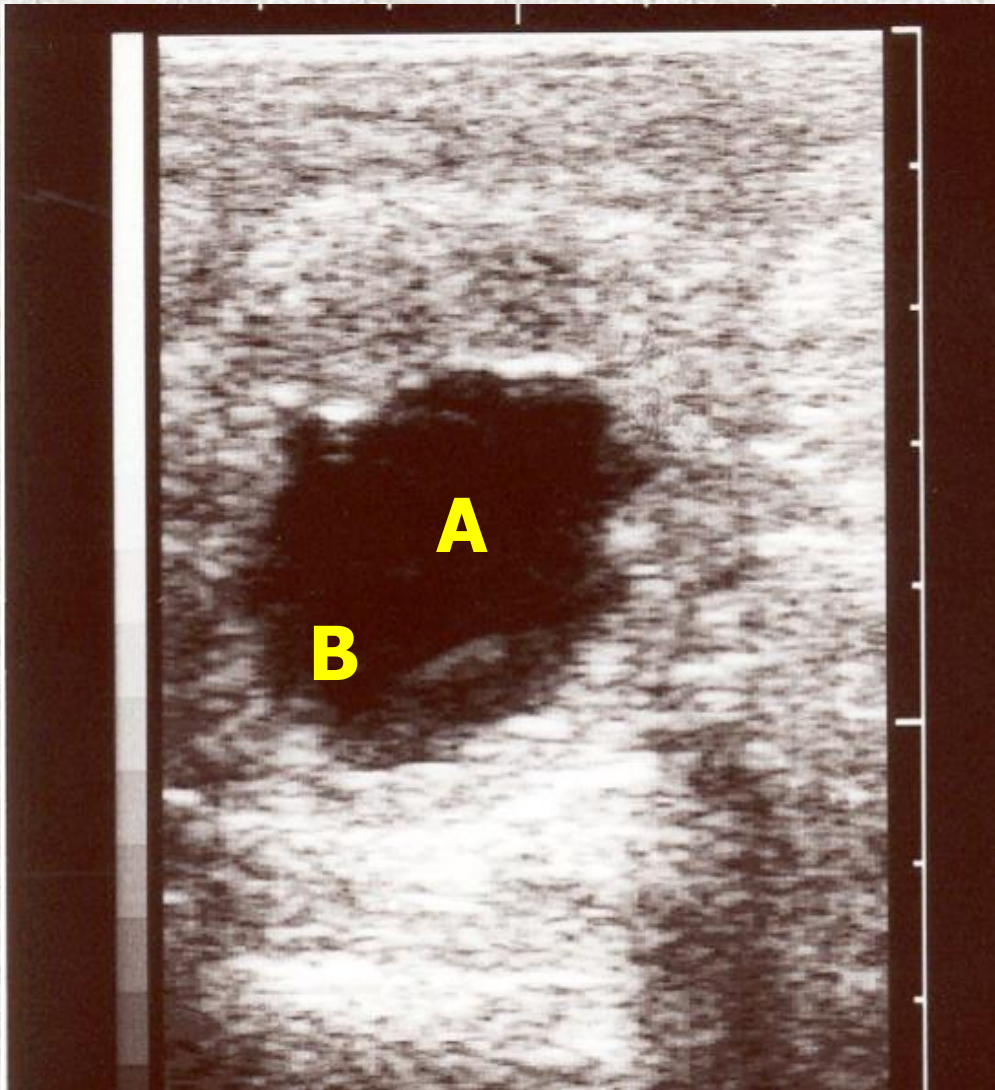
Pelvis

**Uterine horn  
(between the + signs)  
as imaged by  
transrectal ultrasound  
with a 7.5 MHz linear  
probe.**

(urinary bladder  
appears in the left  
lower corner)



# Transrectal Ultrasound of 25 day Camelid Pregnancy



**A = embryonic fluid**

**B = embryo proper**

[10 mm vertical divisions]



# Early Embryonic Death

eliminate bad embryos >> female has a chance to become pregnant again within a short time

10 pregnancies in 5 multiparous females (Brunsden, Purdy, et al, 2011)

4 EED = **40%**

1 before 12 days; the others at 30,31, and 41 days

7 pregnancies in 8 females- 7 multiparous and 1 primiparous (Purdy et al, 2013)

4 EED = **57%**

All in the first 30 days

# Embryonic and Fetal Development

- **Twin conceptions**

- Occur as the result of *double ovulations*
- *Identify at 15 to 30 days* of pregnancy
- 15% occurrence in a sample of 40 breedings; 1 set of twins persisted to 45 days (Purdy et al, 2011, 2013)
- **40 %** in our herd over 4 years

# Twin Births

- ***Twin birthing rate is very low***
  - Most often one embryo will continue to increase in size while the other decreases
  - Follow with ultrasound to monitor natural reduction to a singleton pregnancy
- 700 births in 2 northeast herds over 10-20 years
  - 1 set of live twins
  - No aborted twins
- **Should we worry about diagnosing twins?**

2 year  
results- 10  
females

3- 11 years old

Bred spring and fall  
semesters with young males

48 pregnancies

- ***EED = 19%***
- ***Twins = 40%***

# Twin Embryos

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# Internal Ultrasound

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66 days



44 days



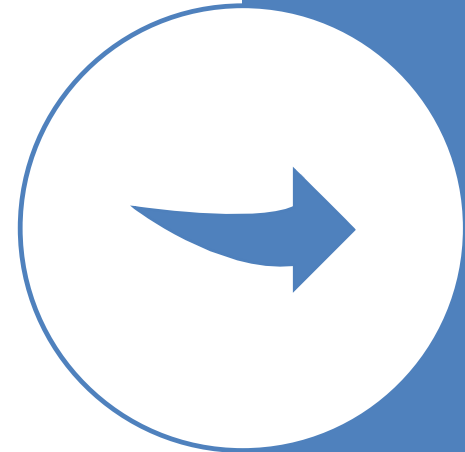
64 day  
pregnancy  
with ovary-  
fetal fluid in  
both horns

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# Transabdominal Ultrasound

- performed on left side of the caudal abdomen adjacent to the udder *between 40 - 80 days*
- on the right side *80 days until term*
  - Abdominal anatomical restrictions (stomach) are responsible for this shift in location.
- **After a negative ultrasound**
  - Transrectal ultrasound to identify both uterine horns
  - behavior test
  - vaginal exam









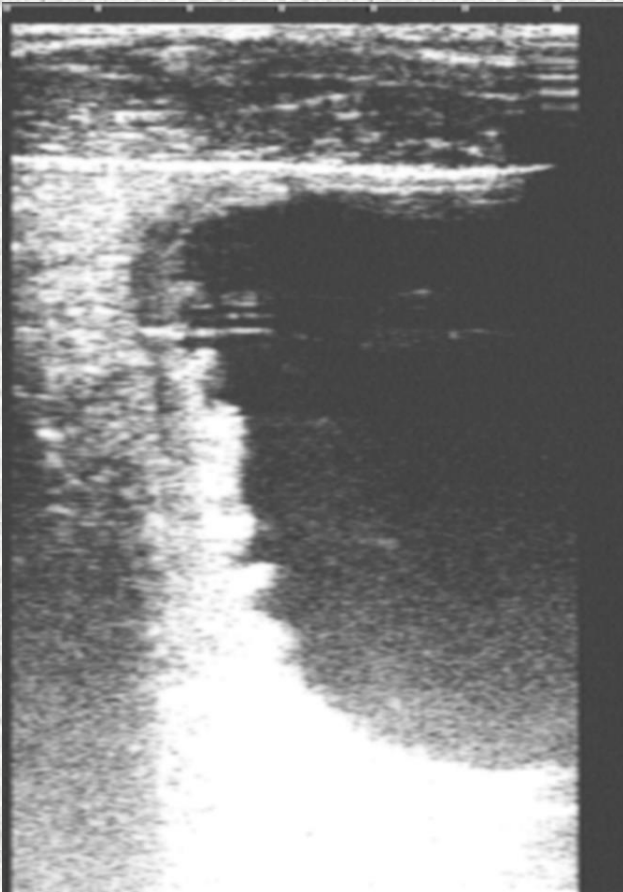
78 day fetus  
shows  
beginning of  
ossification  
of the skull

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# Advanced Pregnancies

- 130 days



- 150 days



210 days

Later



Thank You  
and  
Questions??

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