


Slide 1

To Kush or Not to Kush: Camelid Reproduction

Katelyn Waters, DVM, MS, DACT
Assistant Clinical Professor
kmw0030@auburn.edu




AUBURN UNIVERSITY
COLLEGE OF
VETERINARY MEDICINE

Slide 2

Outline


- Llama and Alpaca
- Female
 - Anatomy
 - Estrous cycle
 - Pregnancy Diagnosis
 - Pregnancy Termination
- Male
 - Anatomy
 - Reproductive evaluation
 - Semen evaluation and characteristics

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 3

Hembra: Anatomy review


- Ovaries
- Cervix
- Uterus

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 4

Hembra: Ovaries


- 2 ovaries
 - Round/oval to globular in shape
 - 1-2.5 cm on average
- Completely surrounded by ovarian bursa
- Follicles and CL can be trans-rectally palpated
 - Follicles > 4 mm Transrectal palpation
 - Follicles > 2 mm Transrectal ultrasound

 AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 5

Hembra: Uterus


- Bicornuate
 - Left horn greater in size than right
 - 98% pregnancies occur in left horn (Fernandez-Baca, 1973)
- Cervix:
 - 2-3 rings/spiral mucosa
- Uterine body: 3 cm long and 3 diameter
- Uterine horns: 8 cm
- Uterine tubes
 - Oviductal papilla

 AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 6

Hembra: Estrous cycle

- Puberty
 - Nutritional status
 - Environmental conditions
 - ~ 6 months of age
- Non-seasonal breeders
 - In US & adequate nutritional settings
 - In SA there is a potential for seasonal breeding

 AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 7

Hembra: Estrous cycle

- Induced ovulators
 - First ovulation=Age at first mating
 - Goal: 1st mating at 2 years of age
 - β -Nerve growth factor
 - Seminal plasma
 - 90% ovulate after 1 mating
- Spontaneous ovulation
 - Llama: 9-15%
 - Alpaca: 5%

Slide 8

Hembra: Estrous cycle

- Equal rate of dominant follicles from each ovary
 - Previously thought left was predominant
- Uterine tone
 - Follicular
 - Increase in tone and edema
 - Luteal
 - Relaxed tone

Slide 9

Hembra: Estro

- Estrous cycle length
 - Alpaca: 9-17 days
 - Llama: 19-20 days
- Continuous follicular wave
 - Even in pregnancy

Slide 10

Hembra: Estrous Cycle

- Open and unmated
- Mated and fail to conceive
- Pregnant


Vaughn and Tibary, 2005

 AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 11

Semen deposition


- Copulation length
 - 10-50 minutes
- Cartilaginous process of glans penis
- Intrauterine semen deposition
 - Deposited in both horns
- Endometrial stimulation/irritation
 - β -nerve growth factor from seminal plasma
- Spike in Luteinizing hormone minutes following mating
- Ovulation ~ 30 hours post mating

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 12


Maintenance of pregnancy

- CL dependent entire pregnancy
- P4 remains elevated until gradual decline at approximately 15 days pre-parturition
- Gestation length
 - Average: 340 +/-5 days
 - Llama: 335-360 days
 - Alpaca: 327-346 days

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 13


	New World Camelid
Estrous cycle length	**Induced ovulators** Llama: 19-20 days Alpaca: 9-17 days
Gestation length	Llama: 335-360 days Alpaca: 327-346 days
Maintenance of pregnancy	CL dependent entire pregnancy
Placentation	Diffuse, microcotyledonary, epitheliochorial

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 14

Pregnancy Diagnosis

- Spitting off male
- Ultrasonography
- Transrectal palpation
- Hormone assays




AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 15

Spitting-off the male

- Test at day 7 and 14 post breeding
- Non-receptive to male→ Spit
 - If pregnant→ spit at male
 - Confirm with ultrasound
 - P4: ≥ 2 ng/mL
- Receptive to male→ Kush position
 - Sternal recumbency
 - Does not spit at male




AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 16

Hembra: Pregnancy Diagnosis

- Adequate restraint
- Sedation
 - Butorphanol 0.05 - 0.1 mg/kg
 - Llama lullaby (BKK)
 - Butorphanol: 1 ml (10 mg/ml)
 - Ketamine: 10 ml (100mg/ml)
 - Xylazine: 1 ml (100 mg/ml)
- Standing sedation
 - Alpaca & Llama: 1 ml/45 kg IM
- General anesthesia
 - Llama: 1ml/23 kg IM
 - Alpaca: 1ml/18 kg IM




AUBURN UNIVERSITY
College of Veterinary Medicine

Farm Animal Anesthesia: Cattle, Small Ruminants, Camelids, and Pigs, 2022

Slide 17

Hembra: Pregnancy Diagnosis

- Transrectal U/S
 - Early as 14 days, late as 60-80 days
- Transabdominal U/S
 - 85 days uterus extends ventral into the abdomen




AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 18

Trans-rectal palpation

- Must have proper restraint
 - Sedation usually required
- Llama: pregnancy diagnosis possible after 35 days
 - 45-50 more accurate
- Alpaca: pregnancy diagnosis possible after 60 days
 - Left horn is double the size of the right horn
- 90 days: fetus is palpable
- 120: Uterus is over pelvic brim and in ventral abdomen
- 300 days: fetal limbs usually palpable in pelvis
- Abdominal ballottement: 7-9 months gestation




AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 19

Progesterone

- CL dependent throughout pregnancy
 - >2 ng/mL
- 11-13 days post mating
 - >2 ng/mL suggest pregnancy
- False positives
 - ~ 15 % as spontaneous ovulation does occur or reproductive pathologies present




AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 20

Estrone sulfate

- Plasma or urine
- 2 peaks during gestation
 - 21-27 days
 - Trophoblast
 - Last 30 days of gestation
 - Feto-maternal unit
- Can confirm fetal viability
- False negative if breeding dates incorrect
 - As the peaks are short windows




AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 21

Hembra: Fetal aging

- Fetal aging
 - Biparietal distance
 - There is a strong positive correlation between gestational age and the biparietal distance
- $GA = 18.8 + 3.79 \text{ BPD}$
 - GA = gestational age
 - BPD = is the biparietal distance




AUBURN UNIVERSITY
College of Veterinary Medicine

*Medicine and Surgery of Camels, Chapter 17

Slide 22

Parturition and per-parturient period

- Impending parturition: Signs are minimal and often difficult to detect
- Dams do not often clean the offspring
- Epidermal membrane
- Involution and rebreeding
 - Involution complete by ~day 15
 - Delay mating until 20 days post parturition



AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 23

Termination of Pregnancy

- Estrumate (cloprostenol): (250 mcg/ml)
 - 0.75 cc/100 lb* once
 - 1 ml intramuscularly once q 24 for 2 doses
- Lutalyse (Dinoprost tromethamine)
 - Contraindicated
 - Anaphylactic reactions reported

AUBURN UNIVERSITY
College of Veterinary Medicine

*Cotton, NAVC, 2008

Slide 24

Macho: Puberty

- SA: 3 years
- US: Early as 2 years
- Spermatozoa in the ejaculate
- Detachment of the penis and preputial attachment

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 25

Macho: Anatomy

- Prepuce
- Penis
- Testes

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 26

Macho: Prepuce

- Inguinal region
- Flat, triangular shape
- Directed caudally
 - Cranial direction during mating
- Protractor preputial muscular apparatus
 - Cranial, lateral, caudal preputial muscles
 - Responsible for the cranial movement of the prepuce during copulation

Slide 27

Macho: Penis

- Fibroelastic
 - 35-45 cm in length
- Pre-scrotal sigmoid flexure
- Glans penis
- Cartilaginous process
 - Clockwise curvature
- Urethra
 - Located on the glans penis at the base of the cartilaginous process

Slide 28


Macho: Testes

- Testicular palpation
 - Testicles difficult to palpate at birth
 - Scrotal location
 - Small
 - 6 months
 - Large enough to palpate but difficult to identify from epididymis
 - 12 months
 - Testes vs. epididymis
 - Should be easy to palpate and differentiate
- Spermatogenesis
 - 55-58 days

Slide 29

Macho: Breeding soundness exam


- Physical exam
- Reproductive examination
- Semen collection and evaluation

 AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 30

Macho: Physical exam


- Systemically well
- FAMACHA
- BCS
- Conformation

 AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 31

Macho: Reproductive exam


- External genitalia
- Palpation and ultrasonographic evaluation
 - Scrotum
 - Dermatitis, scars, etc.
 - Disrupt thermoregulation

 AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 32

Macho: Reproductive exam

- Testes
 - Symmetrical
 - Freely moveable in scrotum
- Abnormalities
 - Hydrocele
 - Heat
- U/S
 - Homogenous parenchyma with hyperechoic mediastinum testis
 - Evaluate for any cystic structure or fibrosis
- Size
 - Caliper or ultrasound
 - Length x width
 - Llama: 5.4 cm x 3.3 cm
 - Alpaca: 3.7 cm x 2.4 cm




AUBURN UNIVERSITY
College of Veterinary Medicine

Breeding Soundness Examination of the Llama and Alpaca, December 2014

Slide 33

Macho: Reproductive exam

- Prepuce
 - Examine for any dermatitis or lesions
- Penis
 - Manual stimulation within prepuce
 - Straighten sigmoid flexure
 - Reflection of prepuce
 - Exteriorize penis for evaluation




AUBURN UNIVERSITY
College of Veterinary Medicine

Breeding Soundness Examination of the Llama and Alpaca, December 2014

Slide 34

Semen collection

- Post mating collection
 - Most common method
 - Allow mating to occur
 - Samples collected from:
 - Penis
 - Vaginal canal
 - Vaginal speculum can be placed
 - Collection of sample from cranial vagina
 - Blood contamination very likely
 - Vulva
 - Make slides for motility and morphology




AUBURN UNIVERSITY
College of Veterinary Medicine

Breeding Soundness Examination of the Llama and Alpaca, December 2014

Slide 35

Semen collection

- Artificial vagina
 - Can be trained to AV
 - AV inside camelid phantom
- Electroejaculation
 - Heavy sedation or general anesthesia
 - Pattern of stimulation for 4 seconds then rest for several cycles
 - Should be on low setting


AUBURN UNIVERSITY
College of Veterinary Medicine

Breeding Soundness Examination of the Llama and Alpaca, Descants, 2014

Slide 36

Ejaculate characteristics


- "Dribble" ejaculators
- Viscous ejaculate
- Ejaculate volume: 2-3 ml
 - Llama: 1-3 ml
 - Alpaca: 0.5-2 ml
- Ejaculate concentration:
 - 1-80,000,000 spermatozoa/ml
 - 2-240 million/ ejaculate
- Daily sperm output 1-3 billion
- Color: cloudy white

AUBURN UNIVERSITY
College of Veterinary Medicine

Slide 37

Ejaculate evaluation

- Motility
 - Coverslip over sample
 - Progressive motility not often recorded
 - Collagenase can be utilized to decrease the viscosity
 - Oscillatory motility
 - >3 years of age: ≥ 30 %
- Morphology
 - ≥50% live sperm
 - 100 sperm evaluated
 - ≥50% normal morphology

AUBURN UNIVERSITY
College of Veterinary Medicine
