

SURGICAL DISEASES OF THE UTERUS IN FOOD/FIBER ANIMALS

A.M. Trent, DVM, MVSc, DACVS

Principles of Surgery, Anesthesiology & Critical Care

Elective Caesarean Surgery

Surgical Management of Dystocia

Uterine Torsion

Hydrops

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I. OBJECTIVES

When you finish this section, you should be able to do the following for cattle, sheep, goats, llamas and pigs:

1. select a reasonable approach for management of a dystocia given a specific scenario.
2. select an appropriate surgical approach for C-section given a specific scenario.
3. coordinate the entire process of Caesarean surgery from decision to proceed to departure from the farm/clinic in a manner that minimizes wasted time and expense and optimizes chances for survival of dam and fetus.
4. understand and be able to describe the surgical procedure for a Caesarean surgery to a novice veterinarian, including common errors and their affect on prognosis.
5. be able to identify errors in planning and procedure in a described or observed Caesarean surgery and describe/explain more appropriate options
6. be able to counsel an owner on options, prognoses and economics for management of dystocia, using language which is accurate but understandable to a layman.
7. list species affected by uterine torsion and describe typical timing, presenting signs, diagnostic steps, and treatment options
8. list species affected by hydrops and describe its pathophysiology, typical timing, presenting signs, diagnostic steps, treatment options, and prognosis for life and future reproduction
9. describe the role of surgery in treatment of uterine rupture and uterine prolapse.
10. explain the indication for ovariohysterectomy in food and fiber animals.

II. CAESAREAN SURGERY

A. MANAGEMENT OPTIONS FOR DYSTOCIA

Options for Dystocia	Goal
Manipulation	Save dam, fetus, or both
C-Section	Save dam, fetus, or both
Fetotomy	Save dam
Slaughter	Salvage cost
Euthanasia	Cut losses

<u>Approaches</u>	<u>Indications</u>	<u>Contraindications</u>
Elective Caesarean	Value fetus \geq dam + delivery risk Obstructed tract (Known fetal anomaly + delivery risk) (Specific pathogen free progeny)	Value dam \geq fetus + no delivery risk Open tract
Emergency Caesarean	Live fetus + dystocia Fetus and dam of value or fetal value > dam Dead fetus, fetotomy not possible* Fetus(es) out of reach and uterine atony (sow) (Experience important)	Live fetus + manipulation easy No value fetus or dam Dead fetus, fetotomy OK* (Experience important)
Fetotomy	Dead fetus, fetotomy possible* (Experience important)	Live fetus + valuable (Experience important)
Manipulation	Easily corrected fetal malposition with adequate pelvic room Sow with one blocking piglet & some uterine some uterine motility evident	No room for manipulation or vaginal delivery Manipulation required exceeds tissue tolerance (spp. variation) or clinician skill Sow with prolonged uterine atony & retained piglets
Slaughter	Fetus & dam of limited value; dam standing; no drugs on board; dam not toxic	Dam toxic, non-ambulatory, or Abx -treated Slaughter facilities not available or won't accept with exposed fetus (rules vague) Not acceptable to owner
Euthanasia	Not worth treatment & slaughter not option	Potential salvage of dam, calf, or slaughter value.

* Acceptability of fetotomy based on access to fetus, species, and veterinarian's experience.

Considerations in Selection of Fetotomy (or extensive manipulation)

1. Access to fetus

- ◆ Limited if small dam, narrow pelvis, dry or adhered uterus
- ◆ Fetus must be able to curve through pelvic canal

2. Species

Small ruminants and camelids

- ◆ Limited (partial often possible)
- ◆ Risk of traumatizing uterus high (& C-section easy)

Cattle

- ◆ Fairly tolerant if access OK
- ◆ Prolonged (>60 minutes) procedure can be expected to result in increased uterine trauma over C-section given equivalent situations and experience (undocumented)

3. Veterinarian's experience

Probably most critical (and overlooked) factor in selection of C-Section vs fetotomy.

- ◆ Procedure time for either procedure can vary 10-fold based strictly on experience (30 min. vs 5 hours or more)
- ◆ Time is trauma for either procedure
- ◆ Trauma results in decreased survival and fertility
 - a) C-Section - peritonitis, adhesions. uterine wall fibrosis
 - b) Fetotomy - uterine perforation with peritonitis & adhesions, mucosal and wall fibrosis, increased toxin absorption.

Effect on Future Fertility

- C-sections/fetotomies are generally performed due to complications during parturition.
- The complications themselves result in some decreased fertility due to their effects on the uterus and surrounding tissues.
- Comparisons of post-C-section and post-fetotomy conception rates vary widely but overall center around 60% - 80% in cattle (odds worse in horse).
- Comparisons of equivalent populations treated by personnel with equivalent experience are limited but suggest similar conception rates and delays to conception with variations reflecting the severity of the initial indication for therapy in cattle more than the method chosen.

B. CAESAREAN SURGERY

GENERAL CONSIDERATIONS with the cow as a model (*Exceptions for other species in italics*)

PREPARATION

1. Prevent infection

- ◆ Consider the uterine contents to be potentially contaminated if the cervix is open and definitely contaminated if any vaginal manipulation of the fetus has been performed.
- ◆ Preop antibiotics are more effective than a postop course in preventing infection.
- ◆ A single preop dose of a drug with short withdrawal time has little effect on income from milk production for cattle since colostrum is withheld anyway.
Ceftiofur (naxcel) has a very short milk and no meat withdrawal and has good spectrum against probable contaminants but may be less effective in vivo than in vitro
- ◆ Preop antibiotics are not indicated if slaughter is an option after delivery (eg. recipient cull cow for dairy breed).
- ◆ *Tetanus/Clostridium prophylaxis critical in small ruminants and probably camelids! vaccinate if needed. Procaine penicillin pre-op good activity vs clostridia*

2. Control straining

a) Indicated for procedures under local

- ◆ almost all C-sections in cattle & *sheep* use sedation and local block
- ◆ *not usually needed for surgery in goats, llamas and sows since usually under general (injectable or inhalant), but may use for initial exam/manipulation*

b) Epidural most common method

- ◆ no guarantees!
- ◆ dose critical to avoid recumbency, ataxia (standing) or respiratory compromise (all)

Cattle

1.5" 18g needle for cattle

10-30° angle at sacro-coccygeal space

3-4 cc usually adequate over 8 cc will likely go down

may still strain from cervical/vaginal stimulation

Small ruminants

1-1.5" 20g needle

same site as for cow

max of 0.5 ml 2% solution if expect to stand (mainly a concern for initial exam)

max of 2 ml 2% solution if down to avoid respiratory compromise

consider in total lidocaine dose used to avoid toxicity!

Swine

- *don't suppress contractions until sure manipulation is not going to work*
 - *epidurals at L-S space (1ml 2% lidocaine/7.5-10 kg with a maximum of 20ml using a 3-6 inch 18g needle) have been used for flank analgesia*
 - ◆ preop clip even if don't give preop will avoid hassle if need in surgery
 - ◆ **administer with animal standing or in sternal recumbency**
if administer while on side, will block down side nerves and extend further cranially
- c) Remove vaginal / cervical stimulation
- 1) If possible, replace feet from cervix into the uterus
 - ◆ avoid excess pressure
 - ◆ don't try if tight or fragile uterus (*more risky in small ruminants/camelids*)
 - 2) Topical lidocaine in vagina
 - ◆ may help
 - ◆ may anesthetize fetal nose! (sneeze reflex, bonding?)
 - ◆ gel form (in lube) probably best
 - ◆ probably rapidly absorbed through inflamed mucosa so use low dose
< 15-20 ml 2% in 1,000 lb dam
< 4-5 ml 2% in small ruminants
consider in total lidocaine dose in small ruminants to avoid toxicity!
- d) Clenbuterol (where approved!) may relax uterus and aid surgical manipulation
Not approved in U.S.

3. Enhance surgical access

- ◆ Most animals go off feed just before parturition and rumen often small
- ◆ Rumen decompression may occasionally be necessary to relieve excessive gas or fluid
Makes easier to expose uterus
Most important if planning a recumbent procedure
 - decreases risk of aspiration
 - makes easier to close incision
 - if use xylazine for recumbent sedation, rumen will distend with gas throughout surgery!**
may need to decompress intra-op with needle and attached needle
- ◆ Supplement animal with calcium and fluids if necessary to maintain a standing position

Cows

Hypocalcemia is common with prolonged dystocia, particularly in multiparous cows

Muscle fasciculations indicate marked hypocalcemia

Cool ear tips and slow pupillary responses are early signs of hypocalcemia

500 ml 50% calcium solution IV pre-op may help keep standing

500 ml 50% calcium solution SQ provides lower/longer effect

avoid solutions containing dextrose! --->severe abscessation

all solutions can produce abscesses

give in small volumes (<200 ml/site) in "safe" sites

- SQ cranial or caudal to scapula most common

Sheep

- *Pregnancy toxemia is associated with hypocalcemia*
- *See Small Ruminant notes for treatment*
- ◆ Do this fast!

4. Decide if chemical restraint will be needed for the preparation phase (see spp)

- ◆ Decide how pre-op tranquilizers will interact with operative restraint
- ◆ Consider effect of pre-op tranquilizers on fetus(es)
- ◆ **Avoid tranquilizers unless absolutely necessary in standing procedures**

Cows

- **Avoid in standing procedures!!**
 - Tranquilizer + hypocalcemia + exhaustion + pain add together to increase risk of recumbency, even with very low doses
 - Commonly used tranquilizers (eg., xylazine, torbugesic, acepromazine) cross to fetus
- **Use with caution in recumbent procedures!**
 - Don't need as much as would use in healthy cow
 - Xylazine increases rumen bloat
 - Use at last possible minute to minimize negative effects

Sheep

- *Often so depressed that don't need*
- *Use lowest dose possible*
- *Same disadvantages as in cow*

Goats and Camelids

- *Usually move directly to general anesthesia*

Swine

- *Azaperone (2-4 mg/kg IM), telazol, xylazine (2-3 mg/kg), acepromazine (0.5 mg/kg IM) and others have been used for pre-anesthetic restraint*

5. Prepare for neonate

- a) Identify specific people to be responsible for the neonate and make expectations clear
- b) Clean dry cart or bedding area for neonate (avoid areas exposed to other animals)
- c) Resuscitation equipment available
 - ◆ doxapram most common but of questionable value
 - ◆ oxygen and ventilator if available (critical for horse/llama)
 - ◆ suction and appropriate sized catheters or tubes
- d) Towels available to dry neonate
- e) Heat lamp available in case needed
 - ◆ *mandatory for piglets regardless of condition*
 - ◆ *highly recommended for lambs, kids and camelids*
- f) Iodine or Chlorhexidine **solution** available for navel
 - ◆ be absolutely sure that have solution, not scrub (soap)
 - ◆ ideally 1% iodine; 0.05% chlorhexidine
 - ◆ **povidone iodine solution (betadyne)** only 0.1% active iodine - **not adequate**
 - ◆ traditional use of more concentrated iodine (5% or Lugol's) very tissue toxic and should not be used.
- g) **Adequate colostrum available or obtainable**
 - ◆ Check udder for colostrum **before surgery**
First calf heifers may not have bagged up
First calf heifers and beef cows may be difficult to strip
older cows may have mastitis
 - ◆ Check availability of frozen colostrum
Farmers may prefer using colostrum from older cows with better antibodies to farm pathogens
Use of frozen colostrum from BLV and Johnes free cattle is a sound control measure

- Pasteurized colostrum can avoid BLV, Johne's risk
- Frozen colostrum is best option if cow does not have it or you can't strip it
 - start thawing before surgery
- Colostrum substitutes available and are effective
- Goat owners and some camelid owners also may have stored frozen colostrum*
- Sheep colostrum is less commonly stored*
- ◆ Plan for plasma transfusion if good quality colostrum or substitute is not available.

APPROACH SELECTION

General

1. Consider all possible approaches for the species in question
2. Make an initial decision based on
 - ◆ position that allows best restraint and access
 - ◆ side that allows best access
3. Pick a specific approach that
 - ◆ provides good access to the uterus
 - ◆ can be performed with available personnel and facilities
 - ◆ allows quick access to a live fetus
 - ◆ allows safe access with minimal trauma if the uterus is fragile

Cow

1. Approach options

Position	Approach	Side		
		Left	Right	Ventral
Standing	PLF/flank (mid-vertical)	Yes ^{1,2}	Yes	
	PLF/flank (45° Caudodorsal to Cranioventral)	Yes		
Lateral Recumbency	Low PLF/flank (vertical)	Yes ²	(Yes)	
	Caudal flank (45° Caudodorsal to Cranioventral)	Yes ²	(Yes)	
	Ventrolateral (45-60° Caudodors to Craniovent)	Yes ²	Yes	
	Marcenac (45° Craniodors to Craniovent)	Yes		
	Paramammary (lateral to milk vein and udder)	Yes ^{2,3}	(Yes)	
Dorsal Recumbency	Paramedian (medial to milk vein)	Yes ⁴	(Yes)	
	Caudal midline			Yes ⁴

¹ This is the standard approach for all cattle and should be used unless there is a significant reason to choose another position or access!

² Use of left side preferred to right to minimize interference by small and large intestine

³ This is the preferred approach for cattle with an emphysematous or fluid distended (hydrops) uterus

⁴ Primarily used in first calf beef cattle with poorly developed udders

2. Factors in selection

Standing vs Recumbent

- ◆ **Standing procedures are generally preferred given adequate conditions:**
 - a) limited preparation and facilities needed
 - b) no risk of bloat or aspiration
 - c) easy closure
- ◆ **Recumbent positions are indicated** in the following circumstances:
 - a) Down cow
 - b) Cow likely to go down
 - if going down, start down

- c) Friable uterus
tight torsion with vascular compromise
emphysematous fetus
- d) Cosmetic incision

◆ **Recumbent positions are contraindicated in:**

- a) Cows with pulmonary or musculoskeletal disease
- b) Cows with distended abdomens
GI distention
Uterine distention (Hydrops) (debatable since tend to go down anyway)

Right vs Left

◆ **Left side is the preferred side for most approaches, regardless of the location of the calf in the uterus.**

- a) **Rumen helps keep intestines in**
- b) Intestines tend to escape from right-side incision unless omental sling used well.
- c) Even if extenuating circumstances present, the **left side approach is preferred if cow may go down!!**

◆ The **right side** may be indicated in a few specific situations

- a) Uterus adhered to right (ex. old incision)
- b) Breach or posterior presentation (optional)
generally forces head and forelimbs to right and craniad more difficult to apply traction to forelimbs without traumatizing uterus easier to do from right if can **use omental sling**
- c) Distended rumen and large cow or short arms (optional)
rumen will force calf to right and may interfere with retraction unless small cow
- d) Uterine torsion - clockwise (debatable!)
easier to push top away and pull bottom up than vice versa
may need to expose, incise, and deliver before correcting twist

****Conflicting factors may be present - weigh relative importance****

3. Specific approaches

◆ **Standing approaches**

- PLF/flank - angle mainly personal preference
- Vertical most common
- 45 may provide better access to "shrunken" uterus

◆ **Recumbent approaches**

- a) **PLF/flank**
 - Pros - good option if start standard incision and cow goes down
 - Cons - poor choice if plan to do down
(unless extend far ventrally = difficult and long lift of fetus)
- b) **Caudal flank**
 - Pros - easier to close than more ventral, non-median incisions
- good exposure to healthy uterus
 - Cons - not optimum for friable uterus
- resistance to hernia suspect
- c) **Ventrolateral (paramammary)**
 - Pros - **optimum exposure for heavily contaminated or friable uterus**
- incision and fetal delivery can be performed by single person
- less vascular than paramedian
 - Cons - can be very difficult to close (especially caudal aspect)
- resistance to hernia suspect (but not observed)

- d) Marcenac - seldom used in cattle (45° craniodorsal to caudoventral)
- e) Paramedian
 - Pros - good exposure for contaminated or friable uterus
 - can be performed by single person
 - Cons - may be difficult to close
 - tends to be very vascular (especially dairy cows)
 - resistance to hernia suspect
- f) Ventral midline
 - Pros - cosmetic
 - good exposure for friable uterus if in lateral
 - works well in **beef cattle**
 - Cons - positioning more difficult if in dorsal
 - exposure limited for friable uterus if dorsal
 - intestines tend to spill out if in lateral

Sheep and Goats

- ◆ ***Recumbent (right lateral) left PLF/flank or caudal flank is standard approach***
 - *the omentum and rumen interfere less with uterine exposure than in the cow*
 - *the uterus of small ruminants is much more mobile than that of the cow and both horns can generally be exteriorized*
 - *a right PLF/flank approach would only be indicated if there are adhesions or other pathology in the left flank or if access to GI structures distal to the pylorus is required*
- ◆ *Ventral midline or paramedian approaches in dorsal recumbency are used by some*

Camelids

- ◆ *Ventral midline approach in dorsal recumbency is the standard approach in camelids*
 - *good access to uterus*
 - *minimal damage to coat*
- ◆ *Recumbent PLF/flank approaches provide good access but are seldom used*
 - *requires extensive clipping and loss of coat*

Swine

- ◆ *Recumbent flank, ventral midline and paramedian approaches have all been used*
 - *the uterus is highly mobile and both horns can be exteriorized by all 3 approaches*
 - *flank approaches avoid incisional irritation by suckling piglets*
 - *ventral midline and paramedian approaches are more common for SPF (specific pathogen free) pigs*
- ◆ *Standing approaches are not a viable (or comfortable) option*

RESTRAINT DECISIONS

General Considerations

1. Ensure adequate **physical restraint**
 - ◆ Confirm that the necessary facilities for the planned form of restraint are available
 - ◆ Set up hoist/block and tackle for species with heavy fetuses
2. Ensure adequate **assistance** available
 - ◆ Call for help if needed
 - ◆ Instruct all untrained personnel in what to do and not to do
3. Consider **chemical restraint** that will facilitate procedure
 - ◆ use minimal tranquilizers for standing approaches
 - ◆ choose agents that have minimal effect on the fetus or can be reversed
 - ◆ decide between sedation and general anesthesia for recumbent procedures
4. Determine method of **analgesia**
 - ◆ if local analgesia is selected, select specific method
 - ◆ consider possible interactions between sedatives and analgesia

Cows

- a. Standing approaches
 1. Restraint
 - ◆ Minimal restraint requirements include head gait and side bars/ropes (one side can be a wall) to limit lateral movement
 - ◆ A head gait and chute with a side that can be opened are optimal
 - ◆ Use a halter to improve safety
 - turn head away for block (decreases kicking)
 - turn head to surgery side during surgery (if goes down incision side is more likely to stay up)
 - ◆ Place ropes on far legs in case falls (to help reposition with non-sterile assistants)
 - ◆ Tape or tie tail to keep projectiles out of the surgical field
 2. Personnel
 - ◆ Size of dam and calf requires more people than other species
 - ideally 1 scrubbed assistant and 2 non-scrubbed
 - 1 non-scrubbed assistant assigned to calf - pick least skilled
 - 1 non-scrubbed assistant as lifter and general aid if cow goes down or need something
 - can manage with one assistant if knowledgeable (or trainable) and strong
 - use all mechanical and restraint options available if short of help
 - ◆ **Explain responsibilities well** - things happen fast and may have attention split between cow and calf
 3. Chemical restraint
 - ◆ Epidural or tranquilizers as previously described for preparation
 - avoid tranquilizers unless absolutely needed (& rarely is)**
 4. Analgesia
 - ◆ Local block
 - a) Line block – least valuable
 - b) Inverted "L" block
 - c) **Paravertebral block - preferred**

b. Recumbent Approaches

Lateral Recumbency

1. Physical restraint

- ◆ Casting rope
- ◆ Cast on padding or place inner tubes under shoulders and hips
- ◆ Heavy straw bedding or deep sand are alternatives to pads/inner tubes
 - Avoid shavings (too loose)
 - Avoid manure packs (good padding but high bacteria level)
- ◆ Extend legs and tie head
- ◆ Tie tail and cover feet

2. Personnel

- ◆ Can do with one other person if strong and follows directions well
- ◆ If only one person choose paramammary approach
 - uterus will stay out once exposed
 - surgeon can incise uterus and remove calf and close the uterus without contaminating the peritoneal cavity

3. Chemical restraint

- ◆ Tranquilize and epidural as previously described
 - Be sure to give epidural while still standing or in sternal
 - Xylazine is most commonly used (40-60 mg) but have to work fast
 - will bloat
 - calf will be depressed so prepare to reverse

4. Analgesia

- ◆ Line or inverted L block

Dorsal recumbency

As for lateral plus:

- ◆ casting in well bedded gutter or ditch helps stabilize
- ◆ if ditch not available can try against wall but should probably reconsider approach
- ◆ line block or double inverted L block (watch for vessels!)
- ◆ need one extra scrubbed person until calf out

Sheep

Standing (Rarely used)

1. *Physical restraint*

- ◆ *Milking stand helps*
- ◆ *Same head positioning as cow*

2. *Personnel*

One additional person adequate

3. *Chemical restraint*

- ◆ *Avoid tranquilizers and epidurals (will go down)*

4. *Analgesia*

- ◆ *Same blocks as cow (beware lidocaine toxicity)*

Lateral (preferred)

1. *Physical restraint*

- ◆ *Minimum tranquilizer needed*
- ◆ *Tie, pad and block as cow*

2. *Personnel*

One additional person adequate

3. *Chemical restraint*

- ◆ Depressed sheep often require little or no sedation
 - ◆ Alert sheep can tolerate low (0.02-0.04 mg/lb IV or 0.04-0.08 mg/lb IM)
 - ◆ Goats may be done with sedation but **general anesthesia** is preferable
4. Analgesia
- ◆ Same as cow
 - **Beware lidocaine toxicity in small ruminants !**
 - do not exceed 4-5 mg/kg total dose
 - (= 10 cc of 2% solution in 50 kg doe)
 - can dilute in larger volume (to 1% solution)

Ventral midline or paramedian

1. Restraint
 - ◆ Sheep tolerate well with light sedation, goats require more sedation
 - ◆ V-trough or small animal table works well (tie legs well)
2. Personnel - One additional person adequate
3. Chemical restraint similar to lateral recumbency
4. Analgesia as for lateral recumbency
 - ◆ **Beware lidocaine toxicity**

Swine & Camelids

General anesthesia preferred

SURGICAL PROCEDURE

Surgery of the Dam

1. Prepare Surgical Field

Asepsis is critical for future fertility of dam (infection or secondary adhesions highly undesirable)

a) Prepare surgical site

Clip liberally (or clip smaller area and plan to use drapes)

Consider post-operative location when deciding between big clip or drapes

(Low temperatures outside may support smaller clip)

Be prepared for change in site if animal goes down (i.e., clip for lower flank incase goes down)

Maximum amount of preparation while standing (if up) important to minimize down time.

Exceptions in complete prep only if

Terminal dam

Impending fetal death (virtually impossible to judge reliably - hyper or hypomotility of fetus suggestive)

b) Prepare surgical field

Standard aseptic surgical scrub

May require several washes to remove gross debris before begin surgical scrub

Open all required instruments before scrubbing (unless trained technician available)

○ include OB chains and handles

○ include two sets of needle holders, needles, thumb forceps and scissors

○ include all necessary suture material

▪ Open sterile gown (yes, in the field) and sleeves for cattle

c) Prepare the surgeon

2. Approach

**** Consider emergency if fetus potentially alive ****

- ◆ **Proceed safely but rapidly**
- ◆ **Speed critical until calf removed**
- ◆ Don't waste time with small bleeders (come back for later)
 - grid approaches generally minimize bleeding if OK size
 - *grid more useful for small ruminants*
- ◆ Make incision big enough for fetus + 2 sides of uterine wall
 - if too small will waste time enlarging
 - if too large will take longer to close, but better to expend extra time here than early
- ◆ May grid incision but lose easy opportunity for enlargement
- ◆ **Once peritoneum open, all instruments and sponges off animal!!**

3. Expose the fetus

**** Consider uterine contents contaminated if cervix open****

**** Adequate exposure of the uterus is critical ****

- ◆ Uterine manipulation
 - **use palms and arms, no fingers**
 - pull with **gentle but steady (or slow rocking) motion**
- ** Painful to conscious animals so watch for fall ****
- ◆ Handholds for anterior presentation
 - **hocks and back feet** will be in the end of one horn
 - hook hock and feet with palms or wrists and pull
 - hock and back feet will lock in incision, allowing uterine incision with minimal contamination of the peritoneal cavity
- ◆ If posterior presentation, front feet or head will be in horn
 - may be able to hook head like hock but more difficult
 - can try whole hands around leg in horn (keep fingers together)
 - can use one arm beneath neck and one hand around leg to lever out (easier if right side approach in cow)

Cows

Standing Approach

- ◆ Left side approach: rumen helps retain intestines
- ◆ Use handholds to expose uterus
- ◆ Right side approach requires skilled and rapid action
 - use omental sling to scoop intestine cranially around horn
 - in same motion bring free horn to incision
 - if you delay, intestine will slide out of incision before the uterine horn blocks it!

Lateral Recumbent Approaches

- ◆ Left side PLF/flank approach
 - use the gas in the rumen to elevate the uterus to the incision
 - make take 2nd person to push rumen under uterus while surgeon lifts horn
 - extending the incision ventrally greatly improves access (uterus not so far away)
- ◆ Left side paramammary approach
 - can usually roll uterus out of incision and will stay in place once exposed
 - requires minimal tension on uterus of all incisions (best for fragile uteri)

Dorsal Recumbent Approaches

- ◆ Long lift to expose uterus at incision
- ◆ If people available and cow adequately restrained, can roll cow to help expose uterus

Sheep, Goats, Camelids, Swine

- ◆ *Uterus is fairly fragile and requires careful handling*
- ◆ *Uterus is more mobile and much lighter than that of cow and good exposure is possible by all common approaches*
- ◆ *Multiple feti may obscure handholds, but entire uterine horn can be lifted*
- ◆ *Gentle handling particularly critical in camelids to minimize adhesions*

4. Incise the Uterus

- ◆ **on greater curvature, longitudinal**
- ◆ **avoid tip of horn near ovary**
- ◆ **limiting to small area over feet until calving chains can be placed over feet will prevent uterus slipping back into abdomen while trying to manipulate fetus**
- ◆ *once chains in place and ready to pull, extend incision to fit fetus size*
**** coordinate pulling with incision to avoid tearing ****
- ◆ *extend incision rather than allow tear*

Sheep, Goats and Swine

- ◆ *may be able to extract fetuses from both horns through incision in one horn in some cases*
- ◆ *if multiple fetuses and fragile uterus, may need to make an incision in each horn to remove multiple fetuses safely*
- ◆ *may need to make multiple incision in swine to get all fetuses without tearing*

5. Minimize Contamination

- ◆ *one person concentrate on maintaining exteriorization of uterus while second incises uterus and extracts calf*
- ◆ **do not let uterus fall back into abdomen as fetus is removed!!**
- ◆ *with more ventral incisions and animals in lateral, uterus often remains out without help*
- ◆ *direct all fluids and lavage material out of the abdomen*

Camelids

- ◆ *camelids are particularly prone to adhesions that can impair future fertility*
- ◆ *avoid any fluid spillage that can promote adhesions*

6. Close the Uterus

**** Check for twins and tears first ****

- ◆ *Lavage surface debris and blood off of the uterus and **out of the abdomen** with sterile isotonic solution*
****avoid letting lavage fluid drain into peritoneal cavity****
- ◆ **Placenta - remove if loose, if not trim tags and fold into uterus**
- ◆ **Material – absorbable (usually chromic gut since uterine wall regains strength quickly)**
- ◆ **Pattern - inverting continuous** (Cushing, Lembert, Utrecht)
 - *bury knots and suture*
 - *start at cervical end (or loose exposure as uterus contracts)*
 - *special pattern for hemostasis if diffuse placentation (equine, llama)*

◆ Layers

- Two layers is standard
- Get first layer in fast if standing
 - cows often go down after fetus removed (pain relieved and tired)
 - allows surgeon to "toss" uterus back in if cow goes down
- If first layer has a good seal, may not need second layer

Camelids

Camelids have diffuse placentation (like horse and man)

Risk of hemorrhage from uterine edges higher than for ruminants or swine

Standard recommendation for a whip stitch of incision edge to control hemorrhage before closure

Swine

- ◆ *Be sure all piglets out*
- ◆ *Be sure uterus straight when returned to abdomen*

7. Close the Incision

routine for species and site

- ◆ leave simple interrupted sutures at ventral-most part of incision for drainage if needed

Care of the Neonate

1. **They are slick - don't drop them.**

- Be sure assistants are aware and careful!
- **Slinging neonates** with head down probably of **no benefit** and **potentially detrimental** due to:
 - high risk of dropping (heavy and slick)
 - risk of cerebral vascular damage (true in infants)
 - back pain on "slinger's" part

2. **Confirm respiration** first

a) **Tactile stimulus generally sufficient**

- **straw in nose** best clean out mucus in nose and mouth
- rubbing chest helps stimulate

b) If heart beating but no respiration try dopram under tongue

c) If heart beating but weak respiratory response or cyanosis consider ventilator

d) Suction with catheter may help clear fluid

e) Neonatal resuscitation can require extensive therapy (refer to medicine notes)

3. **Keep warm**

a) Dry majority of body (except perianal region and head)

b) Place in warm, dry area

c) Heat lamp if debilitated or in cold area

4. Dip navel in **1% iodine or 0.5% chlorhexidine** (equine and ruminants)

5. Provide **colostrum within 2 hours** (ruminants and equine)

a) **Suckling most effective in ruminants** (bypass rumen)

- **preferably standing first**
- be sure alert and swallowing well
- don't allow to suckle if not swallowing well

- b) Stomach tube
 - 1) If weak suckle reflex can induce sucking while passing nasogastric tube and supply fluid to abomasum in calf
 - 2) If no suckle reflex, giving colostrum by stomach tube still better than not giving at all or giving intratracheally
 - should allow to suckle more colostrum once up
 - 3) Keep in sternal recumbency while tubing to decrease risk of aspiration

6. Maternal bonding

- a) Important in beef cattle, sheep, goats, llamas and pigs
- b) Especially important in primiparous dams
- c) Leaving placental fluid on face and perineum for dam to lick off helps
- d) Can put calf in front of cow while closing but may make dam move around more
- e) Save placenta if dam under general or prolonged surgery expected and rub on neonate before introducing to dam

Post-Operative Care of the Dam

1. **Oxytocin used** (controversial) in most species to
 - speed uterine involution and placental expulsion
 - also aids milk let-down for stripping
 - **most effective within first 2 hours after procedure**
2. Antibiotics
 - base on intra-op contamination
 - **generally not necessary to continue unless excessive contamination**
3. Monitor for placental expulsion and uterine involution
 - retained placenta common with dystocia, regardless of management method
 - uterine involution often delayed; metritis may develop
4. Monitor incision for seroma/infection
 - stress on incision high during surgery and minor complications common
 - be prepared to open ventral part of incision if fluctuant swelling occurs
5. Monitor for signs of peritonitis (anorexia, fever, decreased GI motility)
 - expect slight (24 hour) delay in return of motility due to manipulation, pain, hypocalcemia, etc.
6. Monitor for common postparturient disorders based on species

SPECIAL CONSIDERATIONS - BOVINE

Restraint Decisions

Standing

1. Physical restraint
 - ◆ Head gate or stanchion
 - ◆ Side bar/rope or chute
 - ◆ Halter
 - Tie loosely with head turned;
 - away from block (impedes kicking)
 - to surgery side for surgery (so falls incision up)
 - ◆ Ropes or hobbles on far legs in case falls
 - ◆ Tape or tie tail (to keep out of surgical field)

2. Personnel

- ◆ Size of dam and calf requires more people than other species
 - ideally 1 scrubbed assistant and 2 non-scrubbed
 - 1 non-scrubbed assistant assigned to calf - pick smallest
 - 1 non-scrubbed assistant as general aid if cow goes down or need something when short, can manage with one assistant if knowledgeable and strong
 - use all mechanical and restraint options available if short

Explain responsibilities well - things happen fast and may have attention split between cow and calf

3. Chemical restraint

- ◆ Epidural or tranquilizers as previously described
 - only if needed

4. Analgesia

- ◆ Local block
 - a) Line block
 - b) Inverted "L" block
 - c) Paravertebral block

Lateral Recumbency

1. Physical restraint

- ◆ Casting rope
- ◆ Cast on padding or place inner tubes under shoulders and hips
- ◆ Heavy straw bedding or deep sand are alternatives to pads/inner tubes
 - Avoid shavings (too loose)
 - Avoid manure packs (good padding but high bacteria level)
- ◆ Extend legs and tie head
- ◆ Tie tail and cover feet

2. Personnel

Can do with one other person if strong and follows directions

If choose paramammary incision, uterus will stay out once exposed

3. Chemical restraint

- ◆ Tranquilize and epidural as previously described
 - Be sure to give epidural while still standing or in sternal
 - Xylazine is most commonly used (40-60 mg) but have to work fast
 - will bloat
 - calf will be depressed so prepare to reverse

4. Analgesia

- ◆ Line or inverted L block

Dorsal recumbency

As for lateral plus

- ◆ casting in well bedded gutter or ditch helps stabilize
- ◆ if ditch not available can try against wall but should probably reconsider approach
- ◆ line block or double inverted L block (watch for vessels!)
- ◆ need one scrubbed person until calf out

Surgical Procedure

1. **Surgical Preparation**

Clip from 12th rib caudally past the hook and from opposite side of dorsal spinous processes ventrally to ventral flank fold to minimize hair contamination

May consider small clip with drapes for cows returning to pasture in mid-winter

If coat very contaminated, will need to remove gross debris before beginning aseptic preparation

2. **Approach**

Incision must be large enough to allow calf's body and uterine wall to fit through

Make the incision large to save time

if too small will have to stop and enlarge in a less convenient and safe position

incisions heal side to side, not end to end

May be able to grid flank incision if small calf (more feasible with Angus, Jersey, Guernsey)

3. **Fetal exposure**

Standing approaches

a) Use the omental sling in right side approaches

- take caudal border of sling and push caudally against body of uterus (trapping all intestines medially)

- keeping pressure of the caudal omental border against the uterus, slide cranially around tip of horn

- as move sling around horn tip, bring back horn

**** He/she who hesitates is lost! ****

c) It is usually possible to "lock" the hock and hind feet in the incision, freeing one or both hands

d) Identify matching back feet by feel

Lateral recumbency

a) Use the rumen in right lateral recumbency low flank incision

- rumen usually gas distended so floats up in way

- if one person pushes rumen under uterus while other person elevates uterus, can use rumen to hold uterus up to incision.

b) Can usually roll uterus out of paramammary incision with minimal manipulation

c) It may be necessary to shove small intestine or omentum back in until the uterus is rolled out

Dorsal approach

a) Will have to lift uterus to incision

b) If exposure difficult and personnel available, can let cow roll partly to one side to help expose uterus

4. **Uterine incision**

a) Start with a 4-6 inch incision over the feet on the greater curvature along the long axis (for paramedian approaches the entire greater curvature may be incised)

b) Push or cut through the placenta and grab one foot

c) Place double half-hitch on one end of a chain over cannon bone and pastern

d) Apply slight tension on the "captured" foot while palpating for and exposing the second foot

e) Place a double half-hitch on the second foot with the other end of the chain (**be sure the feet match!!!**)

f) Have assistant place moderate dorsal tension on the center of the chain manually or with a block and tackle (preferable)

g) Extend the uterine incision along the greater curvature while tension is maintained on the chain and the calf is extracted

h) Check for twins and for uterine tears

5. **Minimizing contamination**

- a) The surgeon should maintain control of the uterus and its contents while the calf is extracted - all drainage should be directed outside of the cow
 - b) Be sure to direct any lavage fluid externally
6. **Uterine Closure**
- a) Remove the placenta only if it is loose; otherwise cut exposed placenta
 - b) Lavage the uterine surface to remove gross debris
 - c) Place an inverting layer of closure with #2 or #3 chromic gut, beginning at the tip of the horn and burying knots
 - d) The first layer should be placed quickly before the cow can go down (which often happens once the calf is out)
 - e) Place a second inverting layer unless the first was well placed and secure
 - f) Lavage the surface one more time
7. **Incisional Closure** - routine
- a) Be sure to leave several interrupted sutures at ventral aspect of flank incisions
 - b) Avoid Ford Interlocking or Simple Continuous patterns in skin of beef cattle returning immediately to brush (catch and pull out)

Neonatal Care

1. All general considerations apply
2. **VERY HEAVY AND SLICK - Do not try to sling**
3. Ensure adequate colostrum within 2 hours
4. Be particularly aggressive in allowing maternal bonding for beef calves, especially with first calf heifers

Post-Operative Care of the Dam

1. Oxytocin commonly used within first 2 hours of closure to aid uterine inversion, placental expulsion and milk let down.
2. Only continue antibiotics if gross contamination occurs.
3. Ventral incisional drainage common for flank incisions; be prepared to drain
4. Hypocalcemia and ketosis very common in multiparous cows

SPECIAL CONSIDERATIONS - SMALL RUMINANTS (Goats/Sheep)

Restraint Decisions

Standing (Rarely used)

1. Physical restraint
 - ◆ Milking stand helps
 - ◆ Same head positioning as cow
2. Personnel
 - One additional person adequate
3. Chemical restraint
 - ◆ Avoid tranquilizers and epidurals (will go down)
4. Analgesia
 - ◆ Same blocks as cow (**beware lidocaine toxicity**)

Lateral (preferred)

1. Physical restraint
 - ◆ Minimum tranquilizer needed
 - ◆ Tie, pad and block as cow
2. Personnel
 - One additional person adequate
3. Chemical restraint
 - ◆ Depressed sheep often require little or no sedation
 - ◆ Alert sheep can tolerate low (0.02-0.04 mg/lb IV or 0.04-0.08 mg/lb IM)
 - ◆ **Goats** may be done with sedation but **general anesthesia** is preferable
4. Analgesia
 - ◆ Same as cow
 - **Beware lidocaine toxicity in small ruminants !****
 - do not exceed 4-5 mg/kg total dose
 - (= 10 cc of 2% solution in 50 kg doe)
 - can dilute in larger volume

Ventral midline or paramedian

1. Restraint
 - ◆ Sheep tolerate well with light sedation, goats require more sedation
 - ◆ V-trough or small animal table works well (tie legs well)
2. Personnel
 - One additional person adequate
3. Chemical restraint similar to lateral recumbency
4. Analgesia as for lateral recumbency
 - ◆ **Beware lidocaine toxicity**

Surgical Procedures

1. Preparation - general considerations apply
2. Approach
 - a) **Right lateral recumbent left flank approach is standard**
 - b) Can usually grid approach (thin muscles and stretch easily)
3. Fetal exposure
 - a) Uterus fragile but more easily exposed than cow's
 - b) Find end of one horn and bring to incision
 - c) Once exposed, horn will rest outside of abdomen
4. Uterine incision
 - a) Usually > 1 fetus
 - b) Can often extract from both horns if incision near body on greater curvature
 - c) If can't retrieve from both horns easily, make a second incision in the other horn
 - d) **Do not tear uterus while extracting fetuses**
5. **Do not allow uterus to fall back into abdomen while extracting fetuses**
6. Uterine closure as described for general
 - Double check for extra fetuses and tears!**

Neonatal Care

General considerations apply

1. May require heat lamp
2. Maternal bonding important (but delayed if anesthetized dam)

Post-Operative Care of the Dam

General considerations apply

SPECIAL CONSIDERATIONS - SMALL RUMINANTS (Llamas)

Preparation

General considerations apply

If use ventral approach, minimal clipping required but usually can't do while standing

Approach Selection

1. Possible Approaches
 - Dorsal flank approaches limit by long rib cage
 - All ventral approaches and low flank approaches technically possible
2. Factors in Selection
 - Standing - Not practical or safe
 - Lateral or ventral approaches possible
3. Specific Approaches
 - Ventral midline in dorsal recumbency under general anesthesia is most common approach**
 - Standing is rarely possible due to llama insistence on flopping in the face of stress or pain
 - ◆ **Ventral midline preferred** although low flank possible
 - a) Ventral midline requires the least hair removal
 - Saves critical time in preparing for surgery
 - Owner compliance better
 - b) Flank musculature in llama harder to close reliably

Restraint Decisions

1. Physical restraint
 - ◆ Tie, pad and block as for small ruminants if under tranquilization
2. Personnel
 - ◆ Need someone to monitor anesthesia closely as well as scrubbed assistant if available
3. Chemical restraint
 - Heavy tranquilizer or general anesthesia
 - ◆ **General anesthesia is preferred**
 - a) Allows full control of field and fetus (see equine for fetal concerns)
 - b) Tranquilization possible but hard to achieve predictably in a llama so be prepared to repeat doses as needed
4. Analgesia
 - ◆ Same as cow if under tranquilization

Surgical Procedures

1. Surgical preparation - general considerations apply
2. Ventral midline approach preferred
3. Fetal exposure relatively easy
Uterus easy to manipulate to incision (although it is fragile)
 - ◆ May need help holding uterus external to incision
4. Incise uterus along greater curvature
5. Asepsis critical for future fertility
 - ◆ Llamas prone to adhesions
6. Uterus has diffuse placentation
 - ◆ Whip stitch along uterine incision edge recommended to control hemorrhage
 - ◆ Standard uterine wall closure

Neonatal Care

May require extensive support and owners usually want it

Post-Operative Care of the Dam

General considerations apply

SPECIAL CONSIDERATIONS - PIGS

Preparation

1. Prophylactic antibiotics
 - ◆ evaluate potential for slaughter
2. Straining not a problem
 - ◆ Epidurals at L -S space are used for flank analgesia 1 ml 2 % lidocaine per 7.5-10 kg (max 20 ml) via 3-6 inch 18 g needle
3. Tranquillizers
 - ◆ Not always necessary
 - ◆ Azaperone (2-4 mg / kg IM), xylazine (2-3 mg / kg), acepromazine (0.5 mg / kg IM), and others have been used for preanesthetic tranquilization or restraint
4. Uterine condition
 - ◆ Atony is common cause of dystocia
 - ◆ If atony persists despite oxytocin and piglets remain stuck or out of reach, a C-section is indicated

Approach Selection

1. Possible approaches
 - ◆ **Standing Approaches** - Not practical in a pig
 - ◆ **Recumbent Approaches**
 - a) Flank (vertical)
 - b) Ventral midline
 - c) Paramedian (lateral to mammary chain)
2. Factors in selection
 - ◆ **Right vs Left**
Left traditional but little difference

◆ **Specific approach**

- a) Flank
 - Pros
 - Good exposure
 - Incision not stressed postop
 - Easy to close
 - Minimal vascularity
 - Cons
 - carcass?
- b) Ventral Midline
 - Pros
 - Cosmetic?
 - Cons
 - Mammary gland and blood supply in way
 - Piglets traumatize incision while nursing
- c) Paramedian
 - Pros
 - Exposure to uterus ??
 - Cons
 - Still in vascular area

Restraint Decisions

1. Physical restraint
 - Physical restraint alone not adequate
2. Chemical restraint
 - ◆ Tranquilize as discussed or anesthetize (see anesthesia notes)
3. Analgesia
 - Inverted "L" block if tranquilized
 - General anesthesia, if used, provides analgesia

Surgical Procedures

1. Uterine incision
 - bilateral midhorn incision on greater curvature provides safest and best exposure to all piglets
 - can run uterine horn up arm like sleeve to get piglets at ends
 - better to make several incisions in a horn than tear or traumatize uterus at incision if long reach or big arm
2. Uterine closure
 - same principles as ruminants for each incision
 - close one incision before making next
 - ** Always check for piglets in body before final closure!! **
3. Incisional closure
 - ** Be sure uterus not torsed before closing **

Neonatal Care

1. Be sure heat lamp available
2. Refer to specific texts for specific pathogen free piglet management

Post-Operative Care of the Dam

General considerations apply

III. SURGICAL DISEASES OF THE UTERUS

A. DYSTOCIA

See C-Section

B. UTERINE TORSION

BOVINE

1. Signalment
 - a. Generally last month gestation
 - b. Suggested more common in multiparous cows
2. Direction - varies
3. Diagnosis
 - a. Rectal exam - broad ligaments (Best)
 - b. Vaginal exam - Cervical twist
4. Treatment
 - a. Conservative
 - 1) Manual detorsion (only if long arm)
 - 2) Detorsion bar (if cervix open)
 - 3) Roll cow (+plank in flank)
 - b. Surgical See dystocia
5. Prognosis
 - 1) Cow good if early and/or $< 360^\circ$
 - 2) Calf fair if early and/or $< 360^\circ$
 - if unnoticed may be dead and emphysematous

SMALL RUMINANTS

1. Signalment - similar to cows
2. Direction - varies
3. Diagnosis - vaginal palpation
4. Treatment
 - a. Conservative
 - can try rolling (cautiously)
 - b. Surgical
 - safer and simple
5. prognosis - as for cow

C. HYDROPS

BOVINE

1. Types - Allantois and Amnion
2. Diagnosis - Progressive fluid distention of uterus
3. Treatment - C-Section
 - a. Slow drainage of fluid or rapid drainage with fluid therapy and treatment for shock
 - b. Prefer standing but likely to go down
4. Prognosis
 - Life a 10 - 40% mortality (undocumented estimate)
 - Fertility - Depends on type

SMALL RUMINANTS

- similar to bovine

D. UTERINE RUPTURE

1. Treatment
 - Always indication for surgery of full-thickness intraperitoneal tears and salvage of dam required.
 - Celiotomy approach most consistent
 - Partial prolapse may be possible for some tears
2. Prognosis
 - Depends on extent of rupture and intrauterine contamination at time of tear (if cervix closed may be sterile)
 - Generally guarded to poor

E. UTERINE PROLAPSE

1. Generally not surgical problem unless:
 - necrosis necessitates amputation
 - associated with tear
2. Amputation of prolapsed uterus
 - a) Salvage procedure only
 - difficult
 - poor prognosis
 - b) Procedural considerations
 - 1) Bladder position
 - may be everted with prolapse
 - must invert bladder to normal position first!!
 - 2) Restraint/Analgesia
 - Cattle - Epidural
 - 3) Preparation - same considerations as for C-section
 - 4) Methods
 - Elastrator band
 - Heavy mattress sutures in series
 - place sutures, then amputate 4-5 cm distal to sutures
 - appose edges with continuous absorbable suture
 - Mattress sutures plus uterine artery ligation
 - difficult
 - vessels tend to snap back out of ligature after cut
 - 5) Prognosis
 - Ruminants - guarded at best

F. OVARIOHYSTERECTOMY

Seldom indicated in food animals

Appropriate if animal has emotional (pet) or performance (camelids) value, further reproduction or significant lactation is not important, and the uterus (plus or minus ovaries) present a health risk to the animal (persistent infection, neoplasia, or acute severe damage)