Raising Healthy Kids:
Colostrum Management and Prevention of Failure of Passive Transfer

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Introduction

- Colostrum Management
- Failure of Passive Transfer (FPT)
- Treatment of FPT
- Milk Replacers
- Weaning management

What is Colostrum?

- Defined as 1st milking after parturition
- Higher in solids, fats, proteins, vitamins, and immunoglobulins
- Lower in lactulose
- Also Contains:
  - Cytokines
  - Nonspecific immunologic substances
  - Nutritional Elements
  - Growth Factors
- Amount of solids and protein rapidly declines after day 1
- Reaches normal milk concentration by day 4
Why do neonates need colostrum?

- Agammaglobulinemic to hypogammaglobulinemic at birth
- No transfer of Antibodies in utero
- Ingestion of colostral antibodies establishes passive immunity
- 30d until innate immunity fully functional

Colostrum Management

- Management Systems
- Disease
  - Biosecurity
  - Johne’s Disease
  - BVDV

Colostrum Quality

- Large variation on colostral IgG concentration
  - Varies from 15 g/L-175g/L in dairy cattle
  - Llama 292 samples average 16,315 mg/dl (163 g/L) with range of 2000-35,000 mg/dl (20-350 g/L) using Triple J RID
  - Bravo 1997 - 220 g/L average
  - High quality cow colostrum: >50 g/L
  - Triple J claims animals with less than 7000 mg/dl had routine FPT in crias
  - Not all high IgG colostrum had adequate due to low volume

Colostrum Quality

- Specific Gravity
  - Hydrometer
  - Refractometer - Brix not validated in camelids to my knowledge
- 1st milking weight
Specific Gravity

- Associated with total protein and immunoglobulin concentration
  - >1.050 correlates to IgG conc. >50g/L in cattle
    § Sensitivity 0.32
    § 2 out of 3 low-quality samples classified as acceptable
- Low- and high-immunoglobulin concentration colostrum samples have SG that overlap
- Not assessed in camelids - no data to support use

1st Milking Weights

- Data only available for cattle
- <8.5kg (18 lbs) correlated to significantly higher colostral IgG concentration
- Discard samples weighing >8.5kg significantly increases percentage of high-immunoglobulin colostrum samples
- Insure adequate passive transfer in most calves fed 3L of colostrum in timely manner
- Higher weights correlate to lower IgG concentration due to dilution

Selecting Colostrum Donors

- Factors affecting colostral quality
  - Parity
  - Time of collection
  - Pooling
  - Health Status
  - Breed

Parity

- Research: lack of statistical difference in colostral IgG concentration between 1st and 2nd fresheners
- Common Recommendation: discard all 1st lactation colostrum
- May be higher concentration in 3rd or greater lactation cows
Timing of colostrum collection

- Milk dam within 1-2hrs after birth
- Delaying colostrum collection for 6 hours causes significant decrease in colostral IgG concentration

Health Status

- Several diseases can be transmitted through colostrum
  - Johne’s disease
  - Salmonella spp.
  - Mycoplasma
  - Listeria monocytogenes
  - Escherichia coli
- Know the health status of colostrum donors to minimize risk of disease transmission

Breed Differences

- Research has shown breed differences in dairy cattle
- Ayshire and Jersey > Holsteins
- Dairy vs Beef cattle
  - Dairy cattle < Beef cattle
  - Dairy cattle have larger volumes and lower concentrations than beef cattle

Pooling

- Logic: Minimize influence of low quality colostrum
- Cows with larger volumes tend to have lower concentrations
Example
- Cow A: 15kg colostrum w/20 g/L IgG
- Cow B: 5kg colostrum w/40 g/L IgG
- Pooled Colostrum =
  \[
  \frac{(20 \text{ g/L} \times 15 \text{ kg}) + (40 \text{ g/L} \times 5 \text{ kg})}{20 \text{ kg}} = 25 \text{ g/L IgG (not 30 g/L)}
  \]

Pooling Colostrum
- Low immunoglobulin, high volume colostrum is overrepresented
- Increases risk of disease transmission
  - Multiple dams represented in single sample
- Keep each milking of colostrum separate
- Pooling colostrum should be strongly discouraged

Colostrum Storage
- Refrigerate <24 hrs
- Freeze up to 1 year
  - Double bag in freezer bags
  - Label accordingly
    - § Animal
    - § Milking number
    - § Date
    - § Disease Status

Thawing Colostrum
- DO NOT MICROWAVE
  - Microwave or hot water destroys IgG in colostrum
- Thaw in warm water bath
Prevention of Disease Transmission

- Selection of appropriate colostrum donors
  - Use low risk colostrum on best animals
- Disease Prevention
  - Heat treatment of colostrum
    § $56^\circ C$ for 1 hr

Heat Treatment

- Heat in double boiler to temperature and then hold at temp for 1 hr
  - Place in pre-heated thermos
  - Warm water bath
- Important to check temperature at removal

Heat Treatment

- Important to maintain correct temperature
  - Increase temp 3-4 degrees significantly increases IgG loss
- Must maintain temp for full time period
  - Always check temperature at end of 60 minutes

Colostrum Selection

- Best quality colostrum for most valuable animals
  - Donor: parity, milking number, disease status, vaccinations
  - Other factors: leakage prior to parturition
Colostrum Administration

- Timing of ingestion
- Method of administration
- Volume administered
- Presence of Dam
- Metabolic Disturbances

Timing of Administration

- First 12-24 hours
- Closure: cessation of macromolecule absorption
- IgG absorption:
  - Optimum: <4-6 hrs postpartum
  - Rapidly declines after 6-12 hrs postpartum

Method of Administration

- Nipple bottle > esophageal feeder
- Act of suckling closes esophageal groove
- Less developed in camelids

Volume Administered

- Depends on quality of colostrum
- Estimated that for a 10 kg cria we need 20 grams of IgG to achieve our goal of 1000 mg/dl
- Thus if the average colostrum was 220 g/L we would need approximately 100 ml of colostrum to achieve our goal
- Assumes good administration, good absorption, no loss of antibodies during thawing etc
- I would use this as a minimum volume and prefer 10-20% of BW in first 24 hours (1-2 Liters)
Volume Administered

- Calculating volume by Body Weight
  - 1) Determine weight in kg (1 kg = 2.2 lbs)
    - Average Alpaca cria around 7 kg
    - Average Llama cria around 9 kg
  - 2) Multiply weight (in kg) x desired percent
    - Example: 9 kg BW x 0.1 = 0.9
    - This means that 10% of a 9 kg cria is 0.9 kg
    - 1 kg is approximately 1 L
  - 3) 0.9 kg = 0.9 L = 900 mL to administer 10% of BW

Presence of Dam

- Increased IgG concentration in calves left with dam compared to calves separated from dams at birth
- But, risk of FPT much higher in naturally suckled calves that mothering effect does not provide enough benefit to advocate leaving with dam
- Not studied in camelids to my knowledge

Metabolic Disturbances

- Calves with metabolic disturbances have delayed closure
- Calves have the ability to absorb IgG but increased rate of FPT because less likely to get up and nurse in a timely fashion
- Does the cria get up and nurse appropriately etc
- Recommend that cria standing in 30-60 min
- Nursing at most 2-4 hours, prefer 30-60 minutes

What if you have no camelid colostrum?

- In absence of camelid colostrum cow or goat colostrum can be used
- Administer at same volume
- Realize the biosecurity risk
- Consider heat treatment of colostrum and pasteurization of milk
- Realize that antibody are not camelid - hence better than nothing but not the “real thing”
- Likely better than colostrum replacers
Colostrum Substitutes

- If all else fails, consider colostrum substitutes
- Will not provide additional benefit if good quality colostrum is available in a reasonable period of time
- You get what you pay for! In general the more expensive the replacer the better quality it is.

Failure of Passive Transfer

- Secondary immunodeficiency disorder that increases risk of illness and death
- Defined as plasma Ig level <800 mg/dl or <1000 mg/dl
- Incidence (lambs): 9-20.5% depending on study
- In study with 9% FPT rate (Peru)
- Overall mortality was 12%
- Mortality in FPT crias was 78%

Diagnosis of FPT

- Radial Immunodiffusion Test
- Serum Total Solid Concentration
- Sodium Sulfite Turbidity Test
- Zinc Sulfate Turbidity Test
- ELISA
- GGT Activity

Radial Immunodiffusion Test

- Traditional Gold Standard for IgG determination
- Research published in Jan 2013 suggest that this may be changing - Immunoturbidimetric new gold standard
- Downsides
  - Must be mailed to reference laboratory
  - Results are not available for at least one day
Radial Immunodiffusion Test
- One commercially available - Triple J Farms

Radial Immunodiffusion Test
- Traditional Gold Standard
- Widely used in industry
- Allows for quantitative results
- Higher variability in test results between days and technicians
- Length of incubation important
- Difficult to measure accurately
- A difference of 0.5 mm measurement equates to 2-12 g/L difference at low and high IgG
- Missed 10% of FPT cases at <1000 mg/dl
- Pinn et al 2013

Serum Total Solid Concentration
- Measure with a refractometer
- Camelid Data (Weaver et al 2000)
- <4.5 g of total solids/dl provided definitive evidence of FPT
- Readings > 5.5 g/dl provided definitive evidence of passive transfer
- Between more difficult to interpret

Serum Total Protein Concentration
- Requires laboratory testing
- Camelid Data (Weaver et al 2000)
- 5.0 g/dl cutpoint
- 0.71 sensitivity and 0.8 specificity
**Sodium Sulfide Turbidity Test**
- Traditional 3-step semiquantitative test.
- Uses 14%, 16%, and 18% sodium sulfite test solution.
- Selective precipitation of high mol. Wt. proteins resulting in turbidity.
- Weaver et al found this to be inadequate for routine use - Do not use this test.

**Sodium Sulfide Turbidity Test**
- Commercially available SST for llamas.
- Llama-S test from VMRD.
- The published cutpoints likely not appropriate.
- Weaver et al found:
  - An endpoint of 300 mg/dl (this is different from the listed 600-1200 suggested by kit).
  - Correctly identified 89% of the crias with adequate passive transfer.
  - All crias with FPT identified.

**Zinc Sulfate Turbidity Test**
- Major Limitations:
  - Inappropriately high endpoint.
  - Effect of hemolysis: increases estimated IgG conc.
  - Solution not stable when exposed to atmospheric CO2: yields high # false negatives.

**Immunoturbidimetric**
- Two commercially available kits.
- Midlands Bioproducts - automated chemistry units.
- Rapid Test - Value diagnostics.
**Immunoturbidimetric**

- Comparison of the two kits and RID
  - Pinn et al 2013
  - With standards supplied
  - RID missed 10% of FPT
  - Midlands missed 17% of FPT
  - However, when you use the standard from the Rapid Test in the RID and Midlands results better than Rapid Test
  - Cornell now using Midlands with standard from Value Test

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**GGT Activity**

- Confirms ingestion of colostrum
- Not predictive of FPT status

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**Treatment of FPT**

- Colostrum administration if before 24 hours
- Plasma administration (after 24 hrs)
- Oral colostrum administration after closure only provided local GI protection
- Maintain in clean environment
- Treatment decisions based on age, value, environment

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**Plasma Transfusion**

- 20-40 ml/kg IV or IP
  - IV if hospitalized
    - Jugular vein
    - Plasma administration set
  - IP administration
    - 14-16ga 1.5” needle
    - left paralumbar fossa
    - Clip and surgical prep
Milk Replacement

- Can use goat or cow milk if necessary
- Llama milk composition: 4.2% fat, 5.8% protein, 6.3% lactose, 0.7% ash, 84.8% water with an energy content of 326kJ/100g.
- Alpaca milk composition: 3.2% fat, 5.8% protein, 5.1% lactose, 1.6% ash, 83.7% water and energy was 299kJ/100g.
- Higher protein in camelid and higher lactose

Milk Replacement

- Many people use cow or goat milk fed at 10-15% of BW
- Do not overfeed
- Use of pasteurized product will decrease biosecurity risk
- Milk replacers may be used
- Some mix milk replacer with colostrum replacer to increase protein

Milk Replacement

- If using milk replacers
  - Be sure to measure by weight not volume - these compress easily
  - Be consistent in mixing well using a whisk and feed at a consistent temperature
  - Follow temperature for mixing on bag
  - Feed at slightly above body temperature
  - Pay attention to cleaning and disinfecting mixing equipment etc

Milk Replacement

- Cow milk replacers that are 20/20 are likely not as good as newer cow MR that are 25-27% protein
- Kid and lamb replacers a better choice with 25/30
- Feed every 2 hours to start with
- Consume 14% BW/day first month
- Drop to 7% and 4% respectively in 2nd and 4th month
**Weight Gain**

- Crias may lose 0.25 kg the first day.
- Should gain 0.25-0.5 kg per day thereafter.

**Creep Feed**

- Highly digestable creep feed.
- At least 20% protein.
- Digestible protein source - milk protein, soybean or alfalfa meal.
- Processed carbohydrate - rolled.
- Most commercially available starter rations for other species.

**Weaning**

- Crias should not be weaned until they are eating at least 1 lbs of creep per day.
- Generally 4-6 months of age.

**Questions?**