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Disclaimer

- I am NOT the expert on neonatal calf problems
- I have (unfortunately) experienced a lot of problems in neonatal calves and have learned from an expert (Dr. Allen Roussel) in bovine medicine
- I'm sharing with you what my friend, the expert, has taught me

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Most Important, Fundamental Principal of Food Animal Medicine

- Prevention is always much better than cure
- One gram of prevention is worth 5 kg of cure

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Failure of Passive Transfer (FPT)

- Newborn calves have almost no circulating IgG
- Calves absorb whole immunoglobulins from the mother's first milk (successful passive transfer)
- Failure to absorb these immunoglobulins is called "Failure of Passive Transfer" -- FPT
- Anything that causes FPT increases the risk of infection and death by 5X in a particular herd

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Failure of Passive Transfer (FPT)

- Actual mortality rate depends upon FPT plus everything else going on in herd (e.g., environment, nutrition, pathogen load, etc)
- Herd A normally has a 2% mortality of calves
 - FPT increases this 5 times to 10%
- Herd B normally has a 15% mortality of calves
 - FPT increases this 5 times to 75%

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Failure of Passive Transfer (FPT)

- Factors decreasing quantity (amount) of colostrum:
 - Heifers have less colostrum than older cows
 - Poor nutrition of cow before birth
- Factors decreasing quality of colostrum:
 - Breed dependent: dairy breeds generally have poorer quality colostrum than beef breeds
 - Milking the cow near the time of parturition

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Failure of Passive Transfer (FPT)

- Factors decreasing intake of colostrum by calf:
 - Weak, unthrifty calf
 - Poor footing for calf (muddy pen, on a hill, etc)
 - Poor udder conformation of cow (large teats, low udder)
- Factors decreasing absorption of colostrum by calf:
 - Corticosteroids
 - Respiratory alkalosis
 - Stress

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Administration of Colostrum

- The antibodies in colostrum are only absorbed intact from the intestines in the first 24 hours after birth
- **Sooner is better**
- At 6 hours after birth, the calf only absorbs 66% as much IgG as it could immediately after birth
- At 24 hours after birth, the calf only absorbs 11% as much IgG as it could immediately after birth

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Administration of Colostrum

- Give at least 100 grams IgG (150 grams is much better)
- Best if you give colostrum within first 1-2 hours of life
 - Volume administered is dependent upon calf's size and amount of IgG in the colostrum
 - Calf > 35 kg can usually accept 4 liters of colostrum in one dose
 - Calf < 30 kg can only accept 2 liters at a time (can give another 2 liters 12 hr after the first administration)

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Administration of Colostrum

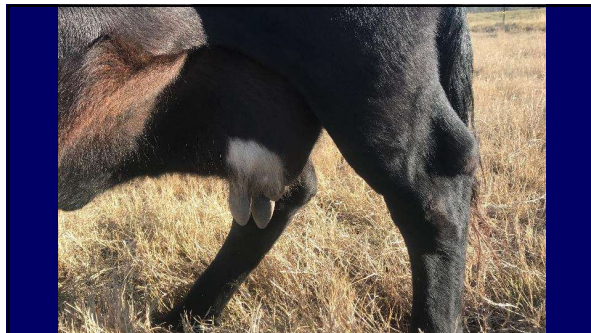
- **Dairy** cattle:
 - Give 3-4 Liters of colostrum as soon after birth as you possibly can
 - If giving colostrum that you harvested from your own cows, use the first milking colostrum

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Administration of Colostrum

- **IF YOU ARE LETTING THE CALF NURSE THE COW TO GET COLOSTRUM:**
 - Reasons to give colostrum immediately
 - Any problems at birth (pulling calf or C-section)
 - Cow has problems with udder that will make nursing difficult or impossible

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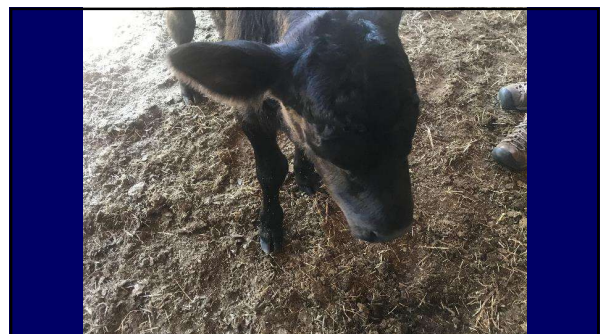


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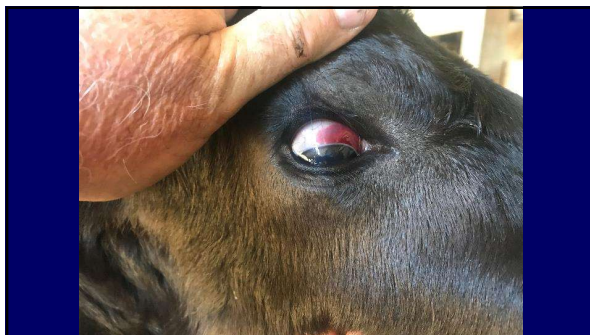
Administration of Colostrum

- Otherwise, generally wait 1-2 hours to see if calf will nurse (also allows cow and calf to bond)
- Reasons to supplement colostrum
 - Cow (especially 1st calf heifer) does not allow calf to nurse
 - Cow does not have sufficient milk (Calf is repeatedly trying to nurse)
 - Calf cannot nurse

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Administration of Colostrum

- If you supplement colostrum, it is optimal if calf sucks colostrum from a bottle with a nipple

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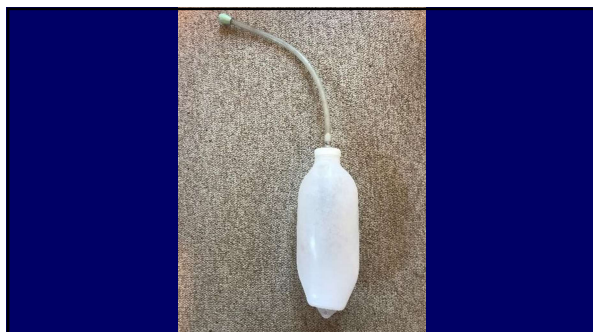


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Administration of Colostrum

- If you supplement colostrum, it is optimal if calf sucks colostrum from a bottle with a nipple
- If feeding from bottle with a nipple is not working or is doubtful or if it is a dairy calf, then give colostrum via esophageal tube

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Options For Replacing Mother Cow's Colostrum

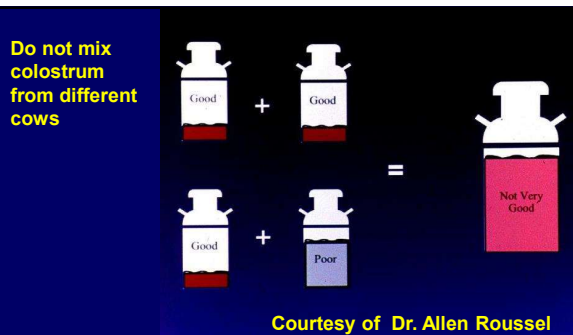
- Colostrum **collected/stored from your own cows**
 - Inexpensive but a lot of work
 - Unpredictable amounts of IgG (from < 20 g to > 150 g/2 L)
 - If you are collecting colostrum from your own cows, you need to measure the IgG by refractometer (which is rarely done on farms)
 - Poor colostrum tends to be thin or bloody or mastitic
 - Good colostrum tends to be thick and creamy, but visual assessment is not sufficient – you need to measure it

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Options For Replacing Mother Cow's Colostrum

- Colostrum collected/stored from your own cows
 - Tends to have higher bacterial counts (> 10,000 cfu coliforms/ml and 100,000 cfu total bacteria/ml) which decreases IgG absorption from the gut
 - This is the major reason why you should not mix colostrum from different cows – always keep colostrum from individual cows separate

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Options For Replacing Mother Cow's Colostrum

- Commercial colostrum replacer
 - Much easier but good products are much more expensive

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Options For Replacing Mother Cow's Colostrum

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 - Much easier but good products are much more expensive
 - Products with IgG from cows' colostrum have better bioavailability than those with IgG from cows' serum

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Options For Replacing Mother Cow's Colostrum

- Commercial colostrum replacer
 - Much easier but good products are much more expensive
 - Commercial products are sterile
 - Products with IgG from cows' colostrum have better bioavailability than those with IgG from cows' serum
 - You know how much IgG is present
 - There should be at least 100 grams/2 L (150 grams/2 L is preferred)
 - Be careful – there are lots of poor quality products available

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An old study, but the idea still holds true

Courtesy of Dr. Allen Roussel

	Immunoglobulin concentrations			
	IgG	IgA	IgM	Total
Fresh colostrum (g/L)	88.7	4.9	6.2	99.8
Frozen colostrum (g/L)	21.4	1.5	1.2	24.1
Colostrum (g/454 g bag)	13.5	2.9	1.4	17.8
Costro-Milk Replacer (g/227 g bag)	3.4	0.7	ND	4.1
Nurse-mate, First Milk (g/30 mL tube)	1.1	0.1	ND	1.2
Colostrum Bolus II (g/6 g bolus)	0.1	ND	0.2	0.3

ND = none detected

Haines, 1990

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Options For Replacing Mother Cow's Colostrum

- Commercial colostrum supplement
 - Less expensive than colostrum replacer
 - Usually has 50 grams (or less) of IgG per 2 liters
 - Will need to give twice or maybe three times as much you would if you were using a colostrum replacer

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Administration of Colostrum

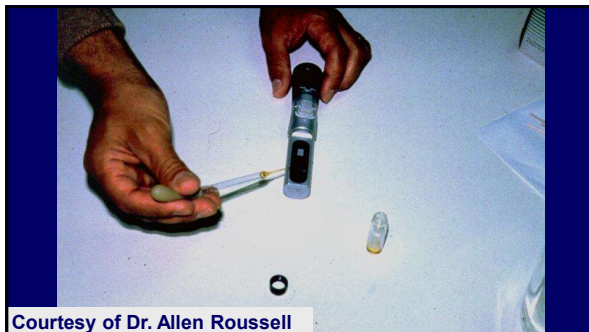
- Monitoring effectiveness
 - It is optimal to check the calf's serum at 24 hours after consumption of colostrum
 - > 10 mg IgG/ml of serum is considered successful transfer
 - Expensive to measure and requires laboratory

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Administration of Colostrum

- Monitoring effectiveness
 - Measure total SERUM (not plasma) protein with refractometer
 - Quick and easy to do
 - < 5.5 /dl is 88% sensitive for failure of passive transfer
 - > 5.2 g/dl is 89% specific for normal
 - Brix refractometer can be used (< 8.5% is 100% sensitive/89% specific)

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Courtesy of Dr. Allen Roussel

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Treatment of Calf With Known FPT

- If the calf is **very valuable**, one may administer one liter of plasma IV (via the jugular vein) over 30 minutes
 - Can repeat if necessary
- Best if use commercial product ("high immunoglobulin plasma")
- Can give whole blood instead, but this does not give as much IgG as plasma, and may cause transfusion reaction

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Treatment of Calf With Known FPT

- Keep close eye on calf and treat if the calf becomes ill and may have an infection
- Do NOT administer prophylactic antibiotics unless there is clearly an increased risk of a specific infection due to a specific condition in the herd

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Common Consequences of FPT

Most Can Also Occur Without FPT

- Navel infection
- Septicemia originating from navel infection
- Meningoencephalitis subsequent to septicemia
- Septic arthritis subsequent to septicemia
- Respiratory disease
- Diarrhea

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Omphaloplebitis

- Infection of the navel
 - May be localized (omphalitis – primarily in calves < 1 week old)
 - May travel up the umbilicus (omphalophlebitis – primarily in calves 1-4 months old)
- May or may not be associated with septicemia
- Navel may appear to be obviously infected

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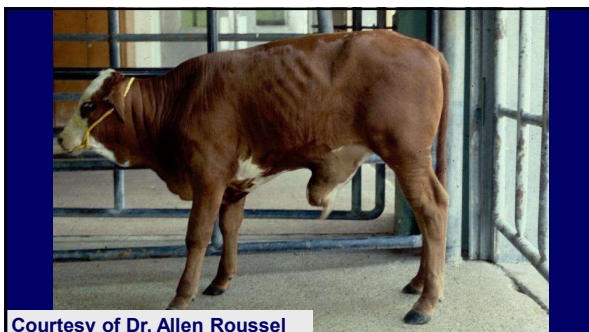


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Omphaloplebitis

- Any swelling of navel should be considered indicative of infection and treated, even if the navel is not hot or painful to the touch

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Courtesy of Dr. Allen Roussel

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Omphaloplebitis

- Any swelling of navel should be considered indicative of infection and treated, even if the navel is not hot or painful to the touch
- Treatment requires systemic antibiotics
 - Ceftiofur (3rd generation cephalosporin)
 - Florfenicol
 - Tulathromycin

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Omphaloplebitis

- **Preventing infection** is more effective than curing infection
 - Best to have calf born in clean environment
 - Best to inspect and clean navel as soon as the calf is stable after birth
 - Best to dip (not spray) navel with iodine solution
 - Best to inspect navel daily until the navel cord dries out
 - Best to prevent other calves from “nursing” the umbilicus

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Septicemia

- Definition: Bacteria and their toxins in the blood stream
- Usually acquired via oropharyngeal route, umbilicus, respiratory tract or gastrointestinal tract
- Is a life-threatening infection with high mortality rate
- Typically caused by *E. coli*, *Salmonella*, *Trueperella pyogenes*
 - (aka *Actinomyces pyogenes*, aka *Arcanobacter pyogenes*, aka *Corynebacterium pyogenes*)

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Septicemia

- Affected calves classically have some (rarely all) of the following signs:
 - Depression (head down, inactive)

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Septicemia

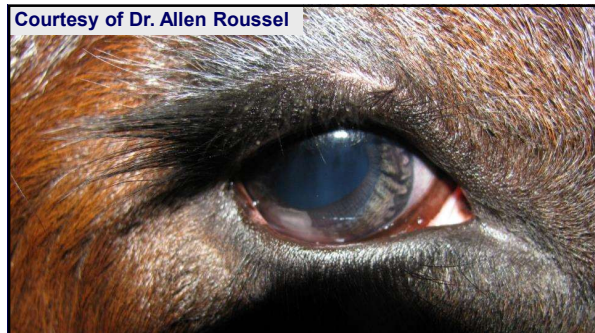
- Affected calves classically have some (rarely all) of the following signs:
 - Depression (head down, inactive)
 - Fever (Normal rectal temperature is 101-103.5 F (38.6-39.4 C), **DEPENDING** upon:
 - Environmental temperature/humidity
 - Hair color (black calves absorb sunlight and get warmer)
 - Calves laying down are often 0.5 to 1 degree higher
 - If in doubt, measure rectal temperature of an obviously healthy calf in same environment

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Septicemia

- Affected calves classically have some (rarely all) of the following signs:
 - Depression (head down, inactive)
 - Fever (must consider hair color, ambient temperature)
 - Poor nursing of mother
 - Hypopyon/Scleral injection

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Septicemia

- Affected calves classically have some (rarely all) of the following signs:
 - Depression (head down, inactive)
 - Fever (must consider hair color, ambient temperature)
 - Poor nursing of mother
 - Hypopyon/Scleral injection
 - Signs of CNS disease
 - Lameness/joint effusion (can have with or without septicemia)

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Septicemia

- Diagnosis
 - Presumptive diagnosis by history and physical examination
 - Definitive diagnosis requires blood culture (rarely practical for most farms unless very valuable calf)
 - Diagnosis of meningoenephalitis allows a strong probable diagnosis of septicemia

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Septicemia

- Treatment
 - Antibiotics
 - Ceftiofur (2.2 mg/kg IM or SQ, once daily)
 - In the US, to use it legally, you must administer it for at least 3 days and no more than 5 days
 - Florfenicol (20 mg/kg IM or SQ, on days 1 and 3)
 - Causes inflammation at site – may cause hyporexia
 - Can give higher dose 40 mg/kg once – more likely to cause hyporexia
 - Tulathromycin (2.5 mg/kg IM or SQ, every 3-5 days)
 - Sequesters in macrophages

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Septicemia

- Treatment
 - Antibiotics that are not allowed in food animals in the United States
 - Chloramphenicol
 - Fluoroquinolones
 - Glycopeptides (e.g., vancomycin)
 - Nitroimidazoles (e.g., metronidazole)
 - Nitrofurans
 - Antibiotics that have specific restrictions (be careful)
 - All cephalosporins except cephapirin and ceftiofur
 - Sulfa drugs

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Septicemia

- Treatment
 - Fluid therapy
 - Antibiotics cannot be absorbed from IM or SQ depots if the patient is severely dehydrated
 - Oral rehydration usually sufficient
 - IV fluids are needed for severely dehydrated (> 8%)
 - Anti-inflammatories
 - Flunixin meglumine (1.1-2.2 mg/kg IV daily for 3 days)
 - Has been given SQ without problem (not approved)

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Septicemia

- Treatment
 - Plasma transfusion (20 ml/kg IV)

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Meningoencephalitis

- Typically secondary to bacteremia
- Presumptive diagnosis is typically based upon physical examination

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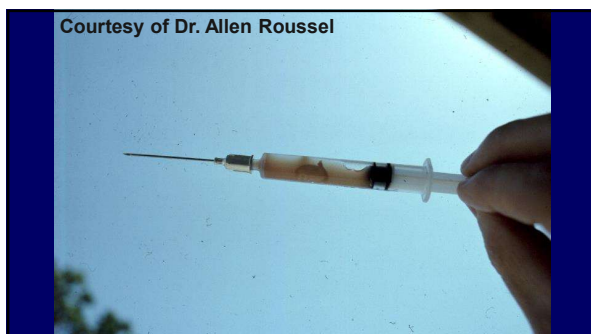


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Meningoencephalitis

- Definitive diagnosis requires CSF tap and microscopic examination of CSF fluid for bacteria and neutrophils
 - Finding that CSF fluid “clots” is strong presumptive evidence

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Meningoencephalitis

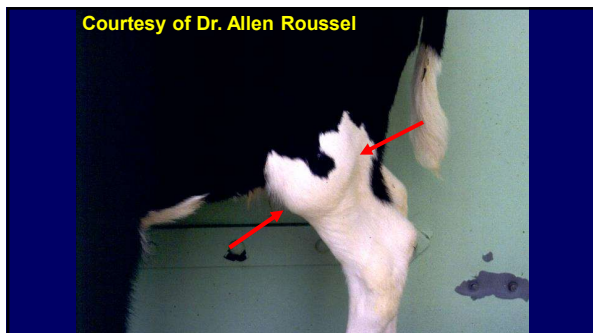
- Definitive diagnosis requires CSF tap and microscopic examination of CSF fluid for bacteria and neutrophils
 - Finding that CSF fluid “clots” is strong presumptive evidence
- Prognosis is extremely poor – patients seldom respond even to aggressive medical treatment with antibiotics and anti-inflammatory drugs

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Septic Arthritis

- May or may not be associated with septicemia
- Lameness in a calf < 1-2 weeks of age is almost always (not always, but almost always) a septic joint
- May or may not see obvious swelling at joint
- Look for evidence of infection elsewhere (e.g., navel)

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Septic Arthritis

- Careful physical examination
 - Limping
 - Swollen joint
 - Look for evidence of infection elsewhere (e.g., navel)
 - Palpate for crepitus to be sure the swelling is not due to a fracture instead of a septic joint

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Septic Arthritis

- Definitive diagnostic test is joint aspiration and examination of joint fluid
 - Best to examine under a microscope for bacteria and/or neutrophils
 - Infected joint fluid tends to have very low viscosity (Normal joint fluid is thick and viscus)

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Septic Arthritis

- Therapy
 - Antibiotics
 - Florfenicol
 - Tulathromycin
 - Anti-inflammatories
 - Flunixin meglumine (Ideally give IV immediately)
 - Meloxicam (1 mg/kg PO, 2 days later start 0.5 mg/kg PO q2d) (Ideally, give immediately after Flunixin)

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Septic Arthritis

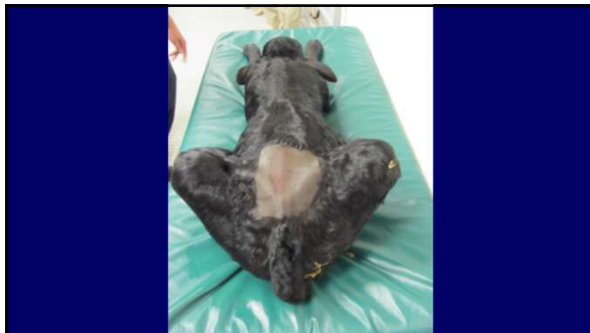
- For severe cases or valuable calves, you can surgically drain and flush joint (especially the stifle joint)
- The next 5 slides are courtesy of Dr. Allen Roussel

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Procedure For Spinal Anesthesia For Joint Lavage/Drainage

- Xylazine 0.1–0.20 mg/kg IV or IM. Start with a low dose – you can always give more later
- IV administration give quick results, but does not last as long as IM
- Do all of your clipping and first prep of the stifle under xylazine before you perform the epidural/spinal
- Lidocaine 3 ml/45 kg for spinal (double for epidural)
- Keep the head higher than spine
- “Most” of the time, the calf will respond when the dura is pierced (a good sign)

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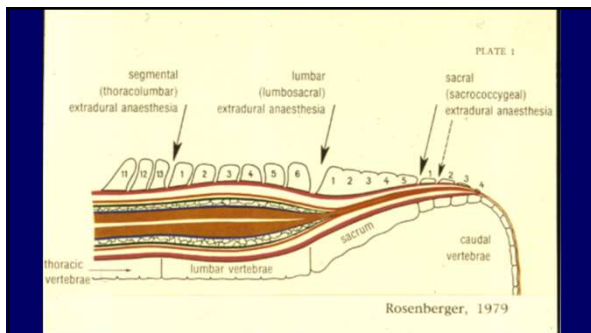


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Procedure For Spinal Anesthesia For Joint Lavage/Drainage

When the calf is positioned, take your finger and walk down the dorsal processes until you are slightly behind the tuber coxae. Your finger should slide off of the last of process into a depression. That's the lumbosacral space. Insert a needle in the middle of that space perpendicular to the skin or with a 10° angle point cranially. I think you can get by with a 1.5 inch needle. That always works on calves of 100 pounds or less. If there's a longer one available, I would have it available in case. Use a 20 gauge or 18 gauge. Depending on the level of sedation, you probably won't have to block the skin and SQ tissue.

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Septic Arthritis

- Drain and flush joint
 - Open joint laterally by placing a needle into the joint and following the needle with a scapel blade
 - First remove any fibrin clots with hemostats
 - Next, open the other side of the joint and insert an IV tube attached to a large bag of fluids
 - Finally, bandage the joing and allow to granulate in

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Respiratory Infections

- May or may not be associated with septicemia
- Careful physical examination
 - Tachypnea/Open mouth breathing
 - Fever

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Respiratory Infections

- May or may not be associated with septicemia
- Careful physical examination
 - Tachypnea/Open mouth breathing
 - Fever
 - Thoracic auscultation may reveal inspiratory crackles or much **louder** than normal sounds, like tracheal sounds, in cranial ventral lungs due to consolidation

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Respiratory Infections

- Therapy
 - Be sure the patient is hydrated – give oral rehydration fluids if necessary
 - Antibiotics
 - Ceftiofur
 - Florfenicol
 - Tulathromycin
 - Anti-inflammatories
 - Flunixin meglumine

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Fluid Therapy

- The most important supportive therapy for calves that are ill from almost any cause
- Need good peripheral perfusion to absorb drugs given IM or SQ or orally and deliver them to site of disease
- Need good circulation to prevent tissue hypoxia with subsequent organ failure, and to maintain renal function and acid-base balance

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Fluid Therapy

- Need to assess (guess) the degree of dehydration in order to know whether to give oral rehydration fluids or intravenous fluids
- Should give **intravenous (IV)** fluids if **> 8% dehydrated**
- Recommend **oral** rehydration fluids if **< 8% dehydrated**
 - Oral rehydration is the most common technique
 - Give with esophageal feeding tube

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Estimate Dehydration

% dehydration	0	2%	4%	6%	8%	10%	12%	14%
eyeball recession (mm)	0	1	2	3	4	6	7	8
skin tenting durations (sec)	2	3	4	5	6	7	8	9

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Estimate Dehydration

- Urine concentration helps estimate degree of dehydration (urine color is NOT as reliable)
 - > 800 mOsm/kg suggests dehydration
 - > 1.035 suggests dehydration
 - Use a refractometer, do not use a dipstick to estimate urine concentration
 - **Most useful for monitoring progress while giving fluids**

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Estimate Dehydration

- Severe dehydration causes decreased peripheral perfusion and subsequent lower temperature of body extremities
 - If the difference between the rectal temperature and the temperature of the hind fetlocks is $> 7\text{ C}$ (13 F), then cardiac output is decreased about 65% – calf is in severe shock

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Fluid Therapy

- Often difficult to accurately determine % dehydration
- Best approach is to “guess and reassess”
- It is usually better to err on the side of giving **a little bit** too much fluid as opposed to giving too little fluid
- If in doubt, it is usually better to give fluids and later find that they were not needed, rather than to wait and find out that the calf really needed them several hours ago

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Oral Rehydration Fluid Therapy

- Oral rehydration fluids fall into **two main categories**
 - Give **non-alkalinizing** fluids to rehydrate non-acidotic calves (simple dehydration due to lack of intake, especially if have high ambient temperature)
 - Give **alkalinizing** fluids to calves with diarrhea of any cause (almost all are acidotic and hyponatremic)

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Oral Rehydration Fluid Therapy

- Oral rehydration fluids fall into two main categories
 - Alkalinizing fluids are similar to non-alkalinizing fluids except:
 - In the US, most alkalinizing fluids contain acetate
 - Some alkalinizing fluids have bicarbonate, citrate, propionate or formate instead of acetate

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Oral Fluid Therapy – Diarrhea

- Oral rehydration fluids for calves with diarrhea (almost all are hyponatremic) are **very different** than oral rehydration fluids for **human babies** with diarrhea (almost all are hypernatremic)
- In diarrheic calves, do **not** use fluids $< 300\text{ mOsm/kg}$: give fluids with $300\text{-}700\text{ mOsm/kg}$ (so there will be enough sodium)

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Oral Fluid Therapy – Diarrhea

- Best to **NOT** mix initial oral rehydration powder with milk replacer
 - Giving oral rehydration powder mixed with water allows better fluid resuscitation of patient
- Make sure that plenty of fresh water to drink is always available

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Oral Fluid Therapy – Diarrhea

- Start giving milk (or replacer) within 24 hours – fresh milk is better because it has trophic factors that help heal the gut
- If withholding milk for first 24 hours (??), use oral fluids with 600 mOsm/kg because they have more energy
- If giving calf milk (not fluids) initially, then use oral fluids with 300 mOsm/kg – mix the oral fluid **powder** with milk (do not mix milk and reconstituted oral rehydration **fluid**)

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Oral Fluid Therapy – Diarrhea

- An emergency recipe for calves with diarrhea (not as good as commercial products, but much better than nothing)
 - 1 package of fruit pectin
 - 1 teaspoon of Lite Salt (commercial product of NaCl + KCl)
 - 2 teaspoons of baking soda
 - 1 can of chicken stock (do not use beef stock or consommé)
 - Enough warm water to make 2 quarts

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IV Fluid Therapy

- When calf is $\geq 8\%$ dehydrated
 - Best to replace deficit (% dehydration) with IV fluids in first 4-6 hours
 - This is usually 3-5 liters in a 50 kg calf
 - Warm the fluids (cold fluids decrease body temp)
 - Once calf is rehydrated, then can often switch to oral rehydration fluids for next 1-2 days

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IV Fluid Therapy – Diarrhea

- For calves with diarrhea (almost all are acidotic and hyponatremic)
 - Need to give plenty of sodium – avoid solutions with < 140 mEq Na/L
 - Best to add glucose (10 g/L) to first day fluids because hypoglycemia is common

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IV Fluid Therapy – Diarrhea

“Perfect World”

- If **severely acidotic** (i.e., $\text{pH} < 7.2$) and weak (stands weakly or not at all), give hypertonic sodium bicarbonate solution (500-750 mmol NaHCO_3) over 8-10 minutes, followed by maintenance 0.9% NaCl solution
- If **severely acidotic but able to stand up strongly**, give 250 mmol NaHCO_3 over 8-10 minutes, followed by 0.9% NaCl solution
- If calf is strong and **still drinking**, just give oral rehydration fluids

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IV Fluid Therapy – Diarrhea

Real World

- The problem is that essentially all farms (and almost all veterinary practices) cannot measure blood gas; hence, you can only guess at the pH and the serum bicarbonate concentration
- Diarrheic calves > 1 week old tend to be more acidotic (mean base deficit 15-20 mEq) than calves < 1 week old (mean base deficit is 10-15 mEq/L)
- **15 mEq/L is a reasonable guess at base deficit in both cases**

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IV Fluid Therapy – Diarrhea

Real World

- Assume the calf has a 15 mEq/L base deficit:
- For a 40 kg calf, this is a total base deficit of 360 mEq

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IV Fluid Therapy – Diarrhea

Real World

- Assume the calf has a 15 mEq/L base deficit:
- For a 40 kg calf, this is a total base deficit of 360 mEq
- If you give this 40 kg calf 8.4% NaHCO₃ IV at 10 ml/kg (400 ml) over 8 minutes, that will be 400 mmol of HCO₃

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IV Fluid Therapy – Diarrhea

Real World

- Assume the calf has a 15 mEq/L base deficit:
- For a 40 kg calf, this is a total base deficit of 360 mEq
- If you give this 40 kg calf 8.4% NaHCO₃ IV at 10 ml/kg (400 ml) over 8 minutes, that will be 400 mmol of HCO₃
- It is **EXTREMELY IMPORTANT** that you give 2 Liters of oral rehydration fluids **IMMEDIATELY** after the IV administration of hypertonic bicarbonate

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IV Fluid Therapy – Diarrhea

- Bicarbonate solutions degrade if kept in plastic containers – you have two options:
 - Buy expensive commercial preparations in glass bottles
 - Formulate bicarbonate solutions at farm
 - Weight out different amounts of baking soda into syringe cases – mark the level so you can always measure it out in the field

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IV Fluid Therapy – Diarrhea

- 1 tsp of Baking soda (4.2 grams) = 50 mmol
- 3 tsp of Baking soda (13 grams) = 150 mmol
 - 3 tsp of Baking soda in 1 Liter of water is 1.3% and is isotonic
- 5 tsp of Baking soda (21 grams) = 250 mmol of HCO₃
- 10 tsp of Baking soda (42 grams) = 500 mmol of HCO₃
- **20 tsp of Baking soda (84 grams) = 1000 mmol of HCO₃**
 - **20 tsp of Baking soda (84 grams) in 1 Liter of water is 8.4% and is hypertonic**

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IV Fluid Therapy – Diarrhea

- If you have to make your own parenteral solution on the farm:
 - **Drinking water** can have endotoxins or pyrogens in it, which can cause problems even if you sterilize it
 - **Distilled water** is safer to use
 - If given IV, then a few bacteria in the blood will usually not cause a problem in most cattle
 - If given SQ, even a few bacteria may cause an abscess
 - If give SQ, need to be very careful with sterile technique

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IV Fluid Therapy – Septicemia

- For calves with septicemia
 - Have increased vascular permeability; therefore, do not fluid overload with aggressive rates (if give isotonic, replacement fluids, administer < 20 ml/kg/hr)
 - May give 7.2% hypertonic saline at 4-5 ml/kg over 5 minutes initially, and then start isotonic fluids
 - If give hypertonic IV fluid resuscitation, **NEED TO GIVE** oral rehydration fluids immediately afterwards

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IV Fluid Therapy – Septicemia

- For calves with septicemia
 - Always include **glucose** in IV fluids after initial resuscitation
 - Need to monitor blood glucose concentration

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IV Fluid Therapy – Septicemia

- For calves with septicemia
 - Always include glucose in IV fluids after initial resuscitation
 - Need to monitor blood glucose concentration
 - Need to monitor for overhydration: **moist cough** and/or **tachypnea** suggest fluid overload causing pulmonary edema

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IV Fluid Therapy – Septicemia

- For calves with septicemia
 - Always include glucose in IV fluids after initial resuscitation
 - Need to monitor blood glucose concentration
 - Need to monitor for overhydration: moist cough and/or tachypnea suggest fluid overload causing pulmonary edema
 - Need to monitor urine production: failure to produce urine suggests oliguric renal failure

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Fluid Therapy – IV and Oral

- Initially measuring PCV and Plasma Total solids will **NOT** tell you how dehydrated the calf is
- Initially measuring and then sequentially measuring PCV and Plasma Total solids will tell you if you are gaining ground or losing ground as you administer fluids

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Diarrhea

- Major causes (there are many other possibilities):
 - Rotavirus, Coronavirus
 - Cryptosporidia
 - *E. coli*, *Salmonella*
- Diarrhea is the major cause of mortality in calves
- Diarrhea increases morbidity and mortality in calves < 1 month old

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Colibacillosis

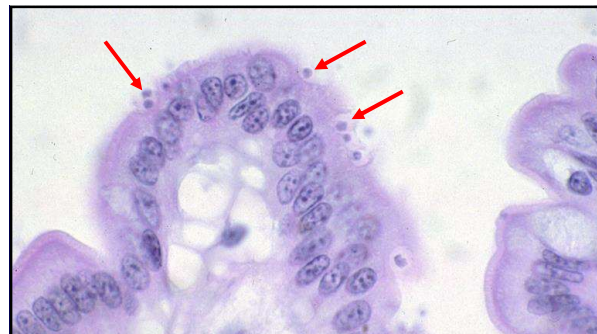
- *E. coli* (colibacillosis) primarily occurs in first week of life, with most cases in the first 2-5 days – it is rarely a cause of diarrhea in calves > 2 weeks old
- In the US, *E. coli* is usually resistant to most sulfa drugs, neomycin, ampicillin, penicillin-streptomycin and tetracycline
- In the US, *E. coli* is usually susceptible to sulfachloropyridazine and ceftiofur

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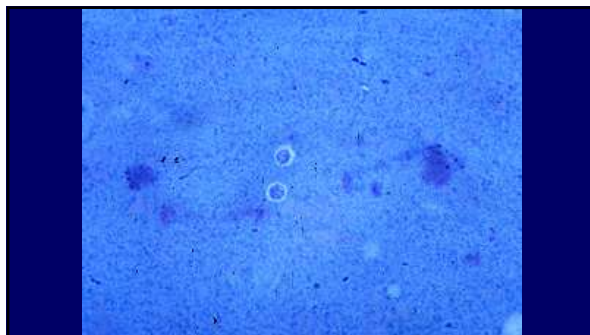
Cryptosporidiosis

- Cryptosporidiosis (especially common in dairy herds) is primarily seen in calves 10 days to 3 weeks old
 - Most are asymptomatic and not dehydrated
 - Co-infection with virus makes it worse
 - May present as “flat calf” (recumbent, comatose) due to hypoglycemia
 - No specific treatment and no use in giving antibiotics

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Cryptosporidiosis

- Cryptosporidiosis is a zoonosis – easily infects people

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Salmonellosis

- *Salmonella* is most often seen in calves > 2 weeks old
 - Often associated with blood and mucus in feces
 - Often associated with fever and depression
 - Worth doing culture and sensitivity if salmonellosis is suspected

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Diarrhea In General

- If calf is bright and alert, it almost never needs antibiotics (and maybe not even fluids)
- Fluid therapy (replacing water and electrolytes) is the most important therapy in clinically ill patients
- An NSAID (e.g., flunixin meglumine) might be anti-secretory and can be tried in early cases of colibacillosis in young calves

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Diarrhea

- If calf remains depressed after rehydration, then major rule outs are **acidosis** (most common) and **hypoglycemia**
- If do not have access to laboratory, then do therapeutic trials to determine which is the cause
 - First give 100 mEq NaHCO₃ IV and observe
 - If that fails, give 20 ml of 50% dextrose IV and observe
 - These treatments will quickly help if that is the problem, but will not hurt if that is not the problem

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Diarrhea

- Ideally should give milk to diarrheic calves
 - Feeding makes diarrhea worse but calf gets better faster (just be sure it does not become dehydrated)
 - Fasting increases weight loss and decreases ability of intestines to absorb nutrients
- Best to **NOT** mix milk and reconstituted oral electrolyte solutions

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Diarrhea

- Ideally alternate administration of small amounts of oral rehydration fluids with administration of whole milk

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Milk Replacements

- Fresh whole milk is best
- If buying a milk replacer, **FIRST look at ingredients**
 - First three ingredients should be milk derived products (such as whey or dried skim milk)
 - Products with fat or soy in first three ingredients are not as good
 - Want 18-22% protein + 10-22% fat (less in hot weather)

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Milk Replacements

- Can use esophageal tube for first couple of days
- After that calf needs to suckle or drink so that the esophageal groove closes and diverts milk to abomasum
 - If you administer milk via esophageal tube to a calf older than 3 days, it goes into the rumen where it ferments and can cause diarrhea and rumenal acidosis

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Milk Replacements

- Feed approximately 10-12% of body weight to larger calves and 12-14% of body weight to smaller calves
- For example:
 - A 90 lb (41 kg) calf should receive 9 lbs (4 kg) of milk per day
 - A quart weighs 2 lbs (1 kg)
 - This calf needs 4.5 quarts/day (give 2.25 quarts bid)

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Milk Replacements

- Start feeding a "calf starter" at 4 days of age to promote development of the rumen

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