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Intravenous fluid therapy for diarrheic calves

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Severely sick diarrheic calves are commonly treated with intravenous fluids (IV). Many practitioners are comfortable with their long-established treatment routines. However, a number of small advances in recent years have resulted in improvements in the way to handle these calves. In addition, modifications in the management of these cases have resulted from changes in the underlying assumptions about the presenting status of diarrheic calves. Using these new methods should make it possible to approach the 90% discharge rate reported in some studies of calves treated for diarrhea.

Initial evaluation

The initial triage of an individual diarrheic calf presented for treatment requires evaluation of a complex array of considerations, including:

- Is the calf severely bradycardic or arrhythmic? If so, proceed immediately to emergency therapy.
- How dehydrated is the calf?
- How acidotic is the calf?
- Is the calf hypothermic?
- Is the calf hypoglycemic?
- Is disease present in other organ systems?
- Is the calf bacteremic or septicemic?

Heart rate

If the calf is standing or sitting in sternal recumbency, it is unlikely to be in danger of imminent death. Some calves present in lateral recumbency and their mental status may be close to coma. For all calves in this category, the heart rate should be checked immediately on presentation. Most diarrheic calves have a heart rate ranging from 100 to 140 beats/minute. Calves with obvious arrhythmia or bradycardia (heart rate <100 beats/minute) should be immediately catheterized and started on IV fluid therapy (see below).

Dehydration

One reliable physical test for dehydration is the neck skin tent. Best results are obtained when the neck is held straight and the skin of the mid-neck is tented in the direction of the long axis of the neck to avoid the natural skin folds that run across the neck. Recently, Constable et al demonstrated that the eyelid skin tent, despite its widespread use in the past, is a less reliable measurement of dehydration than the neck skin tent.[1] Another reliable test is the degree of enophthalmia (sunken eyeballs). In a prospective study of calves with naturally occurring diarrhea, the point at which the globe of the eyeball just separated from the orbit was equivalent to 6% dehydration.[2] A guide to determining dehydration from physical signs is shown in Table 1; it may slightly overestimate the level of dehydration, but it is safer to give too much rather than too little fluid.

Acidosis

A wide variety of studies show that it is just as important to correct acidosis as dehydration in scouring calves. In practice, laboratory tests for acidemia are rarely available on an emergency basis. Fortunately, the degree of acidemia can be predicted from the calf's age and demeanour. In general, acidosis is most severe in calves > 8-days-old and in lateral recumbency (Figures 1 and 2). Dehydration has no correlation

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Table 1: Predicting dehydration from clinical signs

% dehydration	Enophthalmia	Neck skin tent, seconds	Mucous membranes
0	None	<1	Moist
1-5	None/slight	1-4	Moist
6-8	Slight separation of eyeball and globe	5-10	Tacky
9-10	Gap, <0.5 cm, between eyeball and orbit	11-15	
11-12	Gap, 0.5 to 1 cm, between eyeball and orbit	16-45	Dry

Table 2: Relationship between base excess values and blood pH obtained with a portable pH meter and an automated blood gas analyzer

Blood pH (Portable pH meter)	Blood pH (Blood gas analyzer)	Base excess (mmol/L)
6.8 - 6.94	6.78 - 6.87	-31.8 to -26.22
6.95 - 7.09	6.88 - 6.96	-25.82 to -20.27
7.1 - 7.24	6.97 - 7.06	-19.88 to -14.33
7.25 - 7.39	7.07 - 7.15	-13.93 to -8.39
7.4 - 7.54	7.16 - 7.25	-7.99 to -2.44
7.55 - 7.69	7.26 - 7.35	-2.05 to 3.5
7.7 - 7.85	7.36 - 7.45	3.89 to 9.83

with the overall level of acidemia, so giving a standard amount of fluid based on the level of dehydration is doomed to give suboptimal results.

A variety of laboratory tests are available to measure acidemia. Strip chemistry machines can measure serum bicarbonate; others, such as the Harleco and other total CO_2 machines, measure total carbon dioxide, which is basically serum bicarbonate. Low serum bicarbonate or total CO_2 values indicate metabolic acidosis. A direct reading pH meter gives a good correlation between blood pH and metabolic acidosis, but a conversion chart must be used as the numbers are not the same (Table 2). Practitioners may be able to cap a heparinized blood sample from which all air bubbles have been expelled and take it to the local laboratory in an ice-filled styrofoam cup for processing in a blood gas analyzer, within 4 hours of collection.

Recent advances in acidemia center on our understanding of the underlying processes responsible for this problem. Research conducted 10 to 20 years ago by our group at the WCVM failed to find convincing reasons why older calves were more prone to acidosis.[3] These studies focused on one contributing factor to acidemia – L-lactic acidosis – since, at that time, L-lactic acidosis and enteric loss of bicarbonate were thought to be the major causes of acidemia in calves. Recently, we discovered a new cause of acidemia in diarrheic calves: D-lactic acidosis. Depending on the study, this is as important, or even more so, than L-lactic acidosis.[4-8] The exact origins of D-lactic acidosis have not been determined. The obvious source is the gut since some varieties of bacteria, including lactobacilli, are efficient producers of this acid. D-lactic acidosis has been described in calves that are ruminal drinkers and it is a well-recognized result of grain overload in adult cattle. It has also been observed in human short-bowel syndrome. To date, our research indicates that in some diarrheic calves, D-lactic acid is produced in the rumen and in others, the intestines.

Hypothermia

Hypothermia is readily detected with a rectal thermometer; those with a digital reading are more capable of measuring the very low temperatures occasionally found in hypothermic calves. In calves, the normal rectal temperature is 38.5° to 39.5° C. Slight hypothermia is a rare occurrence in calves; most hypothermic calves have rectal temperatures below 37.5° C.

Glycemia

A number of simple hand-held glucometers are now available that facilitate routine blood glucose measurement at presentation. In general, diarrheic calves fall into 3 ranges:

- >2.5 mmol/L, adequate blood glucose
- 1 to 2.5 mmol/L, hypoglycemic
- < 1 mmol/L, severely hypoglycemic.

Intercurrent disease

A careful physical examination is required to detect intercurrent disease. Some enteric pathogens are also respiratory pathogens. Pneumonia, navel ill (omphalitis), and arthritis are common complications of neonatal enteritis.

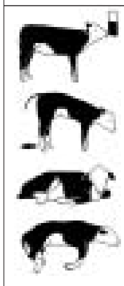
Bacteremia or sepsis

Veterinarians should distinguish between calves with a primary septicemia, those with a primary enteritis that is likely to be complicated by bacteremia, and those with enteritis that is unlikely to be complicated by bacteremia.

Calves with a primary, fulminant septicemia usually present in the first 3 to 4 days of life. They are weak or collapsed, and frequently have diarrhea, which may be the presenting complaint; however, it is rarely profuse. Careful physical examination often reveals evidence of meningitis (stiff neck, preference for lying with the neck stretched in the same position, blindness, depression), eye problems (hypopyon, constricted pupil in the absence of a corneal ulcer, sometimes with a swollen, ridged iris), or a septic joint (swollen on palpation, pain may be difficult to assess as the condition is often bilateral or the calf is unable to stand). Calves with fulminant septicemia carry a very poor prognosis and this should be discussed with the owners before committing to costly treatments that have a poor chance of success.

Bacteremia is a frequent complication of severe enteritis in diarrheic calves. Many enteric pathogens damage intestinal epithelial cells and the mucosal barrier to the entry of organisms. Bacteremia is well-documented in a proportion of naturally-occurring diarrheic calves.[9,10] Some calves experimentally infected with enteric pathogens die with septic problems in their joints or lungs.[11] Not all diarrheic calves are bacteremic. In one study, recumbency, absence of suck reflex, age <1 week, and the presence of a focus of infection were important risk factors.[10] *Escherichia coli* and *Campylobacter fetus* are common bacteremic organisms.[10]

Figure 1: Prediction of base deficit and total sodium bicarbonate requirements from demeanour in calves presented for diarrhea and < 8-days-old.



Clinical Assessment: visual	Clinical Assessment: descriptive	Base Deficit (mmol/L)	Therapy: 30 kg	35 kg	40 kg	45 kg	50 kg	55 kg	60 kg
	standing, strong suck reflex	0	oral*						
	standing, weak suck reflex	5							
	sternal recumbancy	10	intravenous** 150	175	200	225	250	275	300
	lateral recumbancy	10	150	175	200	225	250	275	300

* Should contain at least 60 mmol/L of acetate or bicarbonate
** Total bicarbonate requirement for intravenous fluid therapy, mmol

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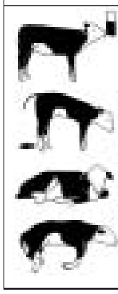
Figure 2: Prediction of base deficit and total sodium bicarbonate requirements from demeanour in calves presented for diarrhea and ≥ 8-days-old.



Clinical Assessment: visual	Clinical Assessment: descriptive	Base Deficit (mmol/L)	Therapy: 30 kg	35 kg	40 kg	45 kg	50 kg	55 kg	60 kg
	standing, strong suck reflex	5	oral*						
	standing, weak suck reflex	10							
	sternal recumbancy	15	intravenous** 225	262.5	300	337.5	375	412.5	450
	lateral recumbancy	20	300	350	400	450	500	550	600

* Should contain at least 60 mmol/L of acetate or bicarbonate
** Total bicarbonate requirement for intravenous fluid therapy, mmol

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Treatment

At its simplest level, treatment is aimed at correcting the previously diagnosed problems. Fluid therapy is often reduced to empirical formulae, but it may be helpful to review the principles.

Emergency therapy

Bradycardic calves may be hypothermic, severly hypoglycemic or hyperkalemic; arrhythmia makes hyperkalemia more likely. Arrhythmic calves should be immediately catheterized and started on a solution of isotonic saline mixed with isotonic sodium bicarbonate ($NaHCO_3$) in a 1:1 ratio. It is common to administer one 50 mL vial containing 50 mmol of $NaHCO_3$ intravenously through a needle prior to catheterization to help stabilize the heart. Once the catheter is placed and fluid therapy has started, the calf can be more carefully evaluated and fluid therapy adjusted.

Placing an IV catheter

Diarrheic calves often have poor circulation and are difficult to catheterize. A 14-gauge, 3.5 inch over-the-needle catheter is appropriate. Long, through-the-needle catheters may reach the right atrium and produce arrhythmia. There are a number of ways to facilitate the process. The skin should be shaved and disinfected prior to attempting catheterization. It is usually advisable to perform a cut down, either by tenting the skin over the jugular vein or by pulling it to the side before making a 1 cm deep incision ideally using a #15 surgical blade. Resting the calf's head at a slightly lower level than the body may help the jugular vein fill with blood. The catheter is inserted until the tip is thought to be in the vein, which is usually a question of feel. At this point, blood may reflux through the catheter, if not, gently aspirate. Once the tip of the catheter is in the vein, it should be seated by changing the angle of attack to a shallower angle and advancing it up to 1 cm further. At this point, the outer catheter can be advanced into the vein. In difficult cases, it is helpful to have an assistant gently infuse saline down the needle at the same time. This dilates the vein and makes passage of the catheter easier. Once seated, the catheter can be taped, sewn, or stapled in place. Never rely on a single point of attachment and always tape the fluid line to the calf (the ear is often convenient), to reduce the chance of the catheter being pulled.

If the calf cannot be catheterized by these means, prepare the other jugular vein. Make sure everything is ready and then have an assistant hold the calf by the hind legs over a gate or bar. The calf's residual blood will distend the jugular vein facilitating catheterization. Place the calf on its side as soon as the catheter is seated, carefully holding the catheter in place, to minimize the length of time in the inverted position.

Correcting dehydration

Total fluid requirements are usually calculated using the formula in Table 3.

Correcting acidemia

In severely acidotic calves, $NaHCO_3$ is the only agent that reliably corrects acidosis.[12] Bicarbonate requirements are calculated most accurately from body weight and base deficit:

$NaHCO_3$ required, mmol = body weight (Kg) x base deficit (mmol/L) x 0.5

The 0.5 factor is the volume of distribution of bicarbonate in the calf. It is an experimentally derived number and varies from calf to calf. Values as high as 0.7 have been reported.[3,12]

If total CO_2 or serum bicarbonate is measured, a slightly different equation should be used:

$NaHCO_3$ required, mmol = body weight (Kg) x (30 – bicarbonate mmol/L) x 0.6

The value 30 is the normal venous plasma bicarbonate for calves (which is higher than that in adults). A volume of distribution of 0.6 reflects the contribution of non-bicarbonate buffering systems.

In practice, these calculations are usually made by reading the appropriate values from conversion wheels or charts (Figures 1 and 2). Depending on the calf's weight and the severity of acidosis, 150 to 600 mmol of bicarbonate, or 1 to 4 L of isotonic $NaHCO_3$ solution, are typically required to correct acidemia. One to two liters of bicarbonate, depending on the calf's size, are generally sufficient for diarrheic calves that are <8-days-old and for depressed, but standing older calves. Fifty-five kg calves, >8-days-old that present in sternal recum-

Table 3: Formula for calculating the total volume of fluid required for the first 24 hours:

Replacement:	Body weight, kg X % dehydration	= __ L
Ongoing losses:	Experimentally varies from 1 to 4 L depending on severity of diarrhea	= __ L
Maintenance:	Estimated at 50 mL or 0.05 L / kg body weight	= __ L
Total		= __ L

This formula typically yields a total fluid requirement of 5 to 12 L depending on the calf's weight and severity of the diarrhea.

bency require 2.7 L, and those in lateral recumbency require 3.5 L of isotonic $NaHCO_3$. Although the standard prediction charts do not show this possibility, some diarrheic calves present with venous blood pH <7.0 and a base deficit as great as 30 mmol/L. These calves may require 5 L of isotonic $NaHCO_3$ to correct their acidosis.

Hypothermia

The rapid infusion of fluids at room temperature can further depress core temperature by 1° or 2° C. If hypothermia exists, warming the IV fluid is an important step for recovery. One efficient means of doing so is to add a second coil to the IV fluid line and place this in a bucket of very hot water. A heat lamp and old enema or calf feeding bags filled with hot water and placed between the legs near the major vessels will further assist warming.

Hypoglycemia

Dextrose 50%, can be either piggybacked onto the IV line or added to the fluid mix. Dextrose should always be given as a constant infusion; recommendations based on foals are for a rate of 4 to 8 mg (0.008 to 0.016 mL of 50% dextrose)/ kg body weight per minute. Ideally, this should be given by piggybacking a second line. Alternatively, adding dextrose to the electrolyte solutions for a final concentration of 2.5% (50 mL of 50% dextrose/L) and infusing 4 L of the mixture in the first 4 hours of therapy will deliver approximately 8 mg/kg per minute to a 50 kg calf. Adding dextrose to a final concentration of 5% can be used if hypoglycemia persists into the phase of slow fluid administration.

Calves with blood glucose concentrations <1 mmol/L are often cachectic. If this is the case, very large amounts of glucose, eg, 1 to 2 L of 50% dextrose per day and careful monitoring may be required to maintain blood glucose concentrations. In this circumstance, it is best to piggyback 50% dextrose onto the fluid line and monitor blood glucose concentrations hourly until the calf can be fed or a steady, normal, blood glucose is achieved.

Antibiotics

If pneumonia or navel ill are detected, antibiotics should be administered. Depending on severity, a 5- to 10-day course is usually required. Calves with a high risk of bacteremia, but no overt signs of infection outside the gut, should be placed on a 3-day course of systemic antibiotics. Calves with a single septic joint can have the joint treated by needle lavage, but it is difficult to reliably find all the septic joints in a calf. Antibiotics may also be indicated to control enteric pathogens – notably bacterial agents. The severity of *E coli* diarrhea can be reduced by administering the appropriate antibiotic, and septicemia in calves with salmonellosis can also be treated with antibiotics.

Care following resuscitation

Typically, by the time IV fluids have been administered for 12 to 24 hours, the calf is standing and has a suck reflex. At this time, the calf can either be continued on IV fluids or switched to oral electrolyte solutions and a first start can be made on milk feeding. One approach is to feed whole cow's milk in small volumes aiming for an intake of 2.5 L of milk the first day, split between 3 to 4 feedings. The next day, total intake can be increased to 3.5 L, and to 4 L the following day. It is hoped that the calf will be home by this stage, so it may be necessary to instruct the farmer about restricting the amount of milk offered or suggest milking out the cow prior to nursing to prevent overengorgement.

Controversies in fluid therapy

Use of hypertonic saline solutions

Some practitioners add $NaHCO_3$ powder or concentrated $NaHCO_3$ solutions to saline to make a solution that is administered intravenously to the calf. There are 2 justifications for this:

- diarrheic calves are traditionally hyponatremic
- hypertonic saline solutions are beneficial in various types of shock.

However, recent studies at the WCVM reveal that many diarrheic calves presenting to the clinic are no longer hyponatremic. This change is likely related to the use of oral electrolyte solutions prior to presentation and the higher sodium content in newer formulations. On average, the sodium concentration in calves presenting to the clinic is normal, with hyponatremia and hypernatremia being equally common. In some cases, hypernatremia is so severe that it is likely to cause salt poisoning. Using IV solutions that have elevated sodium concentrations is likely to aggravate this problem. Since most practitioners cannot determine the plasma sodium concentration in diarrheic calves, it is safer to only use isotonic solutions of sodium chloride and $NaHCO_3$ in calves. It is easy to make an isotonic $NaHCO_3$ solution by simply adding 13 g of $NaHCO_3$ to 1 liter of sterile water. This solution contains 155 mmol of $NaHCO_3$. An isotonic saline solution can be made by adding 9 g of salt (NaCl) to 1 L of water.

Another possibility is to use hypertonic saline solutions to resuscitate diarrheic calves, followed by oral electrolyte therapy. This may work in calves experimentally administered a combination of 3 diuretics and sucrose to make them sick. However, it has limited application in naturally-infected diarrheic calves. At some point, sodium-free water needs to be administered to dilute the sodium since a 7.5% salt solution is nearly 9 times more concentrated than plasma sodium. Modern oral electrolyte solutions often contain no excess water. In addition, correcting acidosis is just as important as correcting dehydration and oral fluids are not very effective in calves with moderate to severe acidosis.

Should sterile solutions be used?

Almost all IV fluid preparations used in the treatment of diarrheic calves are "off label." However, the risk of harmful residues is believed to be negligible, as long as the IV fluids contain only water and electrolytes (sodium, potassium, calcium, magnesium, chloride or bicarbonate) and the reagents used are at least food grade. Baking soda (not baking powder) is an example of a food grade source of $NaHCO_3$. Unfortunately, it is difficult to obtain large volume sterile solutions of $NaHCO_3$ inexpensively; many practitioners simply add $NaHCO_3$ powder to water at the point of use. If the solution is well shaken, the $NaHCO_3$ powder will dissolve quickly. The $NaHCO_3$ should be added in a location where the air is as clean as possible since contamination of fluids when the bottle is open is common. The fluid should not sit before use. If sterile water is not available, substitute distilled or de-ionized water.

Hyperkalemia and cardiac arrhythmia

Hyperkalemia is thought to be a common predisposing factor to bradycardia in diarrheic calves. However, it is far from the only cause; severe hypothermia or severe hypoglycemia can produce bradycardia.

Hyperkalemia is more likely the cause if the rhythm is irregular. The common dogma is that hyperkalemia is chiefly the result of acidemia. Our research reveals that this is an oversimplification. Hyperkalemia in diarrheic calves is correlated not only with acidosis, but also with hypoglycemia, low plasma chloride, and markers of poor tissue perfusion.

From a therapeutic point of view, this means that a bottle of $NaHCO_3$ may not be the best solution for all arrhythmic calves. Correcting hypoglycemia and improving tissue perfusion are also important.

Why does fluid therapy fail?

There are a number of reasons for failure despite following the protocol outlined above. Two common reasons are failure to detect intercurrent infection and failure to correct acidosis. It is well recognized that it is difficult to detect every case of pneumonia or arthritis at presentation. Repeat physical examinations may help. A hemogram can be performed, but severe inflammation may simply reflect enteritis and does not necessarily imply infection in other areas.

In most practice situations, acidosis can only be estimated and since not every diarrheic calf is a textbook example, a few will be overestimated and others will be underestimated. Accurate guidelines for detecting these cases are lacking, but severe acidosis is most likely in older calves that present in coma. Measurement of blood pH or serum bicarbonate would be particularly helpful in calves that fail to respond.

Less common causes of treatment failure include a number of specific diseases:

White muscle disease: This may be the problem in calves that fail to stand, have respiratory signs, or are stiff following treatment. A serum creatine kinase (CK) estimation is usually $>5{,}000$ IU/L in nutritional muscular dystrophy. Values in the 100s may simply reflect recumbency. Either vitamin E or selenium defınciency may be the cause. An oral capsule of 400 mg (IU) of vitamin E may be given with injectable selenium to treat calves with white muscle disease.[13]

Fungal rumenitis: Affected calves are usually toxemic and experiencing pain (bruxism, pain on palpation). There is no effective treatment.

Intussusception: With diarrhea, intussusception occasionally develops in response to changes in motility. Signs may include an absence of feces, progressive abdominal distension, and abdominal pain. Since ileus and pain sometimes accompany enteritis, it can be difficult to differentiate between these possibilities at presentation although it may become clearer following IV fluid therapy.

Abomasal ulcers: A few calves with diarrhea may have or develop abomasal ulcers. Signs include bruxism and possibly, melena, although there are other causes of these problems. Cimetidine and ranitidine are effective orally in increasing abomasal pH.[14,15] A clinical response to IV cimetidine QID at human dosage levels has been observed. This treatment is off-label.

Chronic diarrhea: One of the more frustrating outcomes is to successfully resuscitate a calf with fluids, but be left with a chronically scouring calf that dehydrates when it is removed from IV fluids. A common cause of this problem is severe, persistent, intestinal damage. This can be the result of multiple or persistent infection, particularly with agents like *Cryptosporidium* that can auto-infect the calf. In addition, dehydration and acidemia inevitably lead to poor tissue perfusion. The counter-current blood supply to intestinal villi makes them particularly susceptible to anoxia during low flow states. As a result, severe damage can develop, which is difficult to heal. Part of the solution to the problem of chronic diarrhea is treating the calves early before secondary damage aggravates the situation. Another cause of chronic diarrhea is osmotic due to failure to adjust the nutrient load to the calf's reduced digestive capacity. Although some calves look really alert following initial therapy, if they drink a large volume of milk, more diarrhea and depression can follow. These calves will respond to restriction in oral intake. IV fluids alone can be used to supply water and electrolytes; oral intake can be restricted to whole milk in small amounts, 250 to 500 mL. Initially, feeds can be at intervals of at least 4 hours. The volume per feed can be slowly increased in increments of 100 to 250 mL per day and the number of feeds decreased.

Case 1

An 18-day-old calf is presented with diarrhea and sudden recumbency; it had been treated with an oral electrolyte solution and systemic antibiotics. Initial triage revealed an irregular heart rate (76 beats/min), a rapid respiratory rate (44 beats/min), and a low normal rectal temperature of 38.4° C.

The calf should be started on therapy immediately since, with bradycardia and arrhythmia, it could die at any time. Severe hypothermia is not the cause of the bradycardia and the irregular heart rate makes hyperkalemia a likely cause. A vial of 50-mmol of $NaHCO_3$ could be given IV in an attempt to transiently stabilize the heart during catheterization. The calf is catheterized and started on a mixture of IV saline (75 mmol/L) and $NaHCO_3$ (75 mmol/L). A more thorough evaluation is then performed. Dehydration is estimated at 6% to 8% after appraisal of the sunken eyeball and a neck skin tent of 7 sec. The calf is >8-days-old, depressed, and in sternal recumbency. The base deficit is estimated at 15 mmol/L (Figure 2). No evidence of other disease is found. Blood glucose should also be measured. Venous blood gas analysis confirmed severe metabolic acidosis and hyperkalemia (pH=7.098, pCO_2=47.6 mm Hg, bicarbonate=15.4 mmol/L, base deficit=14 mmol/L, serum sodium=124 mmol/L, potassium=11.25 mmol/L, and chloride=91 mmol/L).

The total fluid required for the first 24 hours for this calf (weight=45 kg), based on the formula in Table 3 would be: replacement (3.6 L)+ongoing losses (3.6 L)+maintenance (2.5 L)=a total of 9.7 L. Ongoing losses are estimated as equal to the replacement requirement, since the calf had apparently lost all fluid in 24 hours. At the same rate of loss, the next 24 hours would be similar. The total $NaHCO_3$ required would be: BW, Kg x base deficit, mmol/L x 0.5= 45 x 14 x 0.5=315 mmol. With rounding, 2 liters of isotonic, 13 g/L $NaHCO_3$ (155 mmol/L of $NaHCO_3$) would be adequate for this calf. Although the calf is not severely hypothermic, a heat lamp would be beneficial and, as it is arrhythmic, the initial fluid can be warmed to prevent cooling-induced bradycardia. After running the initial 2 L of fluid, continue with a further 8 L (7 L of saline and 1 L isotonic $NaHCO_3$).

Outcome: The calf was standing 6 hours after therapy; the following morning, it sucked oral electrolytes and began a mixture of milk (0.5 to 0.75 L feeds), oral electrolytes in 1 L volumes, and IV electrolytes. Two days later, the calf was very active with thick diarrhea and was discharged.

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Upcoming Meetings

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Editor's Note: Dr. Charles Rhodes has been appointed the new Dean of the Western College of Veterinary Medicine. Dr. Rhodes received his D.V.M. from the University of Minnesota and a M.Sc. in Animal Production from Iowa State University. Dean Rhodes first came to the WCVM in 1971 and was Head of the Dept. of Herd Medicine and Theriogenology from 1982-1990, Associate Dean Research from 1993-2002, and Acting Dean for 6 months. In his address to the College, Dean Rhodes emphasized the needs of food animal veterinarians, the challenges in finding matching funds for the recent $22.24 million grant from the Federal Government, and plans for an expanded and renovated Veterinary Teaching Hospital.

Do you have a review article suitable for large animal practitioners? Please contact the editor by E-mail, Jon.Naylor@usask.ca for publication and remuneration details.

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