Fluid Therapy for the Bovine Patient

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The purpose of this presentation is to illustrate our use of fluid therapy on bovine patients. There will not be a detailed discussion on serum electrolyte and/or pH changes. I do not wish to ignore the importance of those changes, as they were reviewed very closely in establishing our protocol for fluid therapy. However, my goal today is to keep detailed physiological information to a minimum in order to stress the very basics of how to initiate intravenous fluid therapy. Although I recognize the importance of oral fluid therapy, this paper will not address it.

The biggest adjustment I made when beginning use of fluid therapy was dealing with the large volumes required by the bovine patient. Carrying such large volumes in the practice vehicle created problems.

A liter of Ringers contains the correct electrolytes, but will not go far in rehydrating a mature cow. Not only is it physically impossible to carry enough of these in a practice vehicle, but it would also be very expensive. Our small animal colleagues have a definite advantage in that a liter of Ringers can rehydrate a cat quite nicely and be economical at the same time.

Although there is variation in urine pH between all the domestic species, renal function is basically the same in the method of electrolyte excretion and/or absorption. As a result, the main difference in rehydration is that of volume. Although a liter would be more than adequate for a cat, we must think in much larger quantities when dealing with the mature bovine.

We do not necessarily have to talk in terms of rivers, but certainly we must deal with larger volumes than liters. In order to make it simpler for me and so that the dairyman has a better understanding of the quantities with which we are dealing, I prefer to speak in terms of gallons rather than liters.

To deal with larger volumes, we had to find a suitable container that was compact and reusable. After several attempts with gallons jugs, we decided upon a 5 gallon plastic water bag.[1] It is lightweight, easy to store, and may be used many times over.

To facilitate suspending the filled water bag upside down, a tent and awning company sewed together a canvas bag.[2] Grommets were placed in the top of the canvas bag for ropes or other means of suspension. The bottom of the canvas bag has a hole to accomodate the spigot of the water jug. The canvas bag is easy to keep clean and professional looking.

There are several ways to suspend the fluids after filling. On the farm, I generally use a beam hook and a light rope or baler twine; however, I have of necessity used everything from ladders to Bobcats. All that is really needed is something that will support 40 lbs., 4-6 feet from the ground.

In order to have the potential for large volumes of fluids in our vehicles, we make up concentrated solution. Two 500cc bottles of Ringer's concentrate will be diluted to 5 gallons. The dilution is done on the farm using tap water. This caused some concern in that the water was not sterile and that the hardness and water quality varied from farm to farm. These problems will be addressed later.

Below is the formula used in making the Ringer's Concentrate:

Ringer's Concentrate[3]

162.5	grams	NaCL	.... $.02
5.65	grams	K CL	.... $.08
6.25	grams	CaCl	.... $.04

These electrolytes will yield 5 gallons of Ringer's solution when diluted. To simplify things we use straight Ringer's as our stock solution. Later we will discuss how and when this stock solution should be changed. I would also like to point out that the cost of electrolytes at $.14 per 5 gallons makes large volume fluid therapy inexpensive. The only other cost is office labor used in dissolving, filtering, and sterilizing the electrolytes.

If mixing up the concentrate as a liquid is a problem, there is no reason why the electrolytes cannot be pre-weighed, carried in the dry form, and dissolved on the farm. I prefer the liquid concentrate because of convenience and unfiltered solutions will have impurities floating around. I do not feel they will hurt anything, but I feel better if I do not have to look at them.

Because we use tap water and non-sterile solutions, and because the water jug, when full, ranges between 4½-5 gallons, we were concerned about the effect inaccurate concentrations would have on the patient. Although we sterilize the concentrated solutions, the fluids delivered to the patient are non-sterile. To reduce the risk of septicemia, it is necessary to be as clean as possible and use the solutions immediately after mixing. The patients are also on antibiotics during and after administration. We reluctantly forfeited asepsis in order to keep administration of large volumes practical.

To determine how much the concentrations varied, we ran sodium, potassium, chloride, and calcium levels on several

of the solutions prepared for administration. Ringer's solution was our goal and is listed first.

	meq/l Na+	meq/l K+	meq/l Cl−	meq/l Ca++	Total
Ringer's Sol.	147	4	156	5	312
F B	148	4	135	7	300
J G	132	4	198	8	342
L K	132	3	135	6	276
W B	165	3	142	6	316
T C	163	4	120	5	267

The only electrolyte that varied to any degree was calcium. This was due to the fact that calcium gluconate was added to many of the solutions for the cows that were weak and/or down. These solutions represent chlorinated city water as well as dairies with water softeners and those without.

The remaining portion of this paper will be a discussion on rules of thumb. Although what I have stated is true in most cases, it is not absolute. A good source of background material can be found in *Bovine Medicine and Surgery* by Amstutz or *Current Therapy for Food Animals* by Howard.

Because bovine patients require large volumes of fluids, we must be able to determine how much fluid the bovine requires. In other words, do we administer 5, 10, or 15 gallons of fluids? The degree of dehydration based on a physical examination and strictly on clinical judgement, determines the volume of fluid. Below are the parameters I use to determine the degree of dehydration:

Degree of Dehydration			
Parameter	**Minimum 4% B.W.**	**Moderate 4-6% B.W.**	**Severe 6-10% B.W.**
1. Skin	Pliable	Leathery	Very Unpliable
2. Eyes	Bright, Slightly Sunken	Dull, Obviously Sunken	Cornea Dry, Eye Deeply Sunken
3. Mouth	Moist & Warm	Sticky & Dry	Dry, Cold & Cyonatic
4. PCV	32-42	42-48	48-55

Taken from lecture notes by Dr. O. M. Radostits

In some patients that have come into the clinic, we will occasionally use the PCV; however, I rely most heavily on the eyes and skin.

Once the degree of dehydration has been determined, plug it into the following formula to determine the volume needed.

$$\frac{\text{Body weight} \times \%\ \text{dehydration}}{8\ \text{lbs./gal.}} = \text{Deficit in Gallons}$$

eg.

$$\frac{1400\ \text{lbs.} \times 4\%\ \text{dehydration}}{8\ \text{lbs./gal.}} = 6\ \text{gallon deficit}$$

As a general rule, we do not bother giving fluids intravenously unless a minimum of 5 gallons is needed.

We must also be concerned with what type of fluid to give. It is very important to determine if the cow is in an alkalotic or an acidotic state. As stated earlier, we use straight Ringer's and alter it as the metabolic state of the patient dictates. Acidosis and alkalosis are again determined solely through physical examination. The urine pH of cattle is unreliable to determine the state of alkalosis or acidosis and the lab tests commonly used to determine these states are not immediately available in our practice.

The following conditions will render the bovine patient alkalotic:

Alkalotic States

1. Abomasal disorders
2. Intestinal obstructions
3. Generalized G.I. stasis

All of the above inhibit or prevent the chloride ion from being reabsorbed in the small intestine after being excreted in the abomasum. This will cause a buildup of serum bicarbonate ion as well as a hyochloremia.

Therefore, to correct the alkalotic state, we need a solution rich in chloride ion. Ringer's Solution will correct the chloride deficit associated with alkalosis. This solution is used to replace the entire volume deficit in our alkalotic patients. Five to ten gallons is usually sufficient if the underlying causes can be corrected.

Following are the conditions that render the bovine patient acidotic:

Acidotic States

1. Toxic mastitis
2. Toxic metritis
3. Grain overload
4. Diarrhea
5. Pharyngitis

These conditions are basically anything other than a displaced abomasum, gastro-intestinal stasis, or intestinal obstruction. Again, physical examination is used to determine if any of these conditions are present.

To correct the acidosis, we use sodium bicarbonate to neutralize the excess acid. Arm & Hammer baking soda is all that is needed and is readily available in grocery stores. This in turn is packaged in 50 or 60 gram whirl packets. When using sodium bicarbonate as a neutralizing agent, it should be remembered that heating bicarbonate will render it inactive.

It takes 120-125 grams of $NaHCO_3$ to correct the acidosis of a 1000 pound cow. The $NaHCO_3$ is added to the first 5

gallons of Ringer's solution that is given. Once the acidosis is corrected, straight Ringer's is used if additional fluids are needed. It usually takes approximately one hour to administer 5 gallons. If administration approaches 2-3 hours there is a chance the $NaHCO_3$ will form a calcium carbonate precipitate.

An alternative solution that will not precipitate can be made by adding 50 grams $NaHCO_3$ per gallon of water. This gives an isotonic solution and would be used to correct the initial acidosis, followed again by Ringer's if more fluids are needed. Three to four gallons of isotonic $NaHCO_3$ solution will correct the acidosis in most cows.

The majority of calves requiring fluid therapy are suffering from diarrhea and as a result are acidotic. It takes 26 grams or 2 tablespoons of $NaHCO_3$ to correct the acidosis in a calf. This is usually given as an isotonic bicarbonate solution by mixing it with 2 quarts of water.

During acidosis excess hydrogen ion will force potassium out of the cell. Returning potassium to the cell is an active transport mechanism, therefore it is useful to add enough dextrose to the electrolyte solution to yield a 1-1½% dextrose solution. 500cc of 50% dextrose per 5 gallons will make the energy available but will not exceed the renal threshold and cause diuresis.

Administration of the fluids is achieved by suturing a 12 gauge 4 inch needle in the jugular vein and attaching a simplex. The solution is allowed to flow freely through the 12 gauge needle. For long term administration (greater than 6 hours), the patient's jugular vein is catheterized and a coiled air hose transports the solution from the bag to the cow. The coiled air hose will allow the cow freedom to move about and be comfortable. It is quite easy to administer fluids for 3-6 days.

Administration of fluids as described above will usually cause a cow to urinate after 2-3 gallons. Even severely dehydrated cows will usually urinate after 5-8 gallons if they have renal function. If a cow has not urinated by the time 5-10 gallons have been administered, there is a very poor prognosis even if dehydration is corrected and the patient appears better. Although my experience is somewhat limited, I have yet to see a patient live when there is no evidence of renal function after administration of 10 gallons. Histologically, the kidneys from these cows have undergone acute tubular necrosis of the proximal tubules. This is most likely caused by toxins and/or anoxia. Diuretics and other attempts at medical management of these cows have been unsuccessful in my experience. Even though these types of patients can be very frustrating, the majority of the patients respond favorably when volume deficits are replaced and electrolyte imbalances and metabolic states are corrected. Intense fluid therapy is both practical and economical, and when combined with a positive patient response, it is both acceptable and appreciated by the dairyman.

[1]#510 Handl-Pak #53M/M C Cap C/W Gasket ($1.85 ea.) #HD Assy. C/W Gasket ($.45 ea.)	— Reliance Products, Ltd. 1830 Dublin Ave. Winnipeg, Canada R3H DH3 Tel: (204) 633-4403
[2]Canvas Holder	— Baraboo Tent & Awning — 123 2nd St. Baraboo, WI 53913 Tel: (608) 356-8303
Tubing & Connectors (5 in 1)	— American Scientific Products 1210 Waukegan Rd. McGaw Park, ILL 60085 Tel: (800) 323-4515

[3] Product Availability

Potassium Chloride ($5.87/lb.)	— Wedor Chemical Co. 1108 Columbia Ave. So. Milwaukee, WI 53712 Tel: (414) 762-0440
Calcium Chloride ($2.79/lb.)	
Sodium Chloride	— Feed Mill