General Metabolic Disorders

Chairman: Dr. Francis Fox, Cornell University

Clinical Pathology of Metabolic Disorders

Acidosis in Ruminants

Enterotoxemia in Cattle

Rumenitis, Laminitis and Hepatitis in Feedlot Cattle

Aflatoxicosis

Toxic Pastures, Weeds and Chemicals

Nitrate and Urea Problems

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Today we are seeing more and more cattlemen and dairymen doing their own treatment and doing quite well. They can treat but they cannot diagnose. Yes, they can, but they need your help! I have been around a little, and I have visited many veterinarians and spent a day to a week with them, and I admire very much a practitioner who takes plenty of time on a diagnosis, looks the animal over, gets the history, the symptoms, and resorts to autopsies. Then with this magnificent computer, the brain, he comes up with a diagnosis! As you know, our brain is like a computer. They tell me our brain is equivalent to 48 acres of computers, and we only use about five acres of them at the very most. Even so, we have a built-in intuition and experience to diagnose, and we can certainly be a lot more helpful and more positive of our diagnosis by supporting this with a few laboratory tests. I am going to give you an example today where we can do a little barnyard clinical pathology to help with the situation at hand. We also need to be a little more sophisticated and send a blood sample to the laboratory so that when we come back and see the case again in a few days, we will have some information to either support or confirm our diagnosis. I am also going to tell you a little bit about the analysis of hair in your everyday practice. In order to be useful, these tests have to be fairly cheap, and they have to give us considerable information. As we learn to use them, we will soon get to the place where we feel almost helpless without some type of laboratory test.

Field Test for Renal Pathology (Table 1)

I like this example because here are two cows with the same symptoms—each of them milking about two months. They had a poor appetite, and they were standing alone, away from the herd, and they caused the owner some concern. After a physical examination of the respiratory and reproductive tract and digestive and mammary system very little was revealed. By taking urine samples, we see examples of two different situations, two different diagnoses, and two ways for treating. In Cow "C" the specific gravity of the urine was 1.015. She

Table 1

Field Tests for Renal Pathology

Cow C		Cow D
1.015	Urine Specific Gravity	1.030
50 mg.	Urine Protein	500 mg.
Neg.	Urine Cells or Bacteria	Pos.

had 50 milligrams of protein in the urine. The test for that is three drops of urine and about half a dropper full of 3% sulphuric acid. I find if I can read a newspaper through it, just make out the letters, it's approximately 50 milligrams of protein, which would be about one plus. For urine cells and bacteria, a quick test in the field is to dip a little blotter in an antibiotic disk in the urine, drop in the bottom of a dry tube, and add about three ccs of hydrogen peroxide. In less than a minute, if there are any cells and bacteria of significance, oxygen will appear on this little blotter, and the blotter will come to the top. This is a fairly good field test to confirm whether you have a pathologically significant amount of cells and bacteria in the urine. The calcium was negative.

Whenever I see acid urine in a cow I can be sure that she has a kidney problem. On most of the cows that have acid urine, the pathologist sends back a report of cloudy swelling in the kidney. My diagnosis of Cow "C" is a toxic nephritis, and this was rather interesting because I had a record of the herd. The month before she was treated for acute streptococcal mastitis when she was actutely ill. Now she is showing symptoms of not being up to par again, and I tied this in with mastitis a month before. Steroids were administered for four days in a row and she showed improvement.

I would like to have you contrast this to the other cow with the same line of symptoms, in which she had a urine specific gravity of 1.030, 500 milligrams of protein, positive for urine cells and bacteria, pH 10; diagnosis of pyelonephritis. She was treated with streptomycin for two weeks.

You see here, how a little urinalysis on the spot, in the field, gave us a diagnosis, and in my own mind, it would be impossible for me to differentiate these cases without some tests.

Blood Chemistry

The important thing is that you can perform 26 tests for $6.00. I think this is most unusual, but in order to use these laboratory tests, you have to be able to interpret them. I can send a sample in on Monday at 5:00 p.m. and get a report back on Thursday morning.

Look at the list of different laboratory tests (Table 2). The most informative is the one regarding calcium. In milk fever and ketosis it will be low; it will be high with excessive therapy and dehydration. In testing for blood glucose, we find quite often that in milk fever glucose will be elevated. The urea nitrogen is interesting because whenever I

find one at 70 or 80, I am sure that the cow is really in trouble. In order to evaluate albumin and globulin in the A/G ratio, you have to run a special test on the cow. You cannot use the Haba dye. You have to use a Brom-Cresol Green test. You have to be careful when using a human laboratory. All these tests cannot be run with the same technique. The Bilirubin might be more informative in a cow than even in a horse. Alkaline phosphatase does not mean as much to me as in a horse, and there you have to interpret with your tongue in your cheek also! LDH will be high in a malignant neoplasm or damage to the muscles. SGPT is probably more informative, and that is a good test on a downer cow. The CO_2 content can be low in the case of metabolic acidosis, and on the other hand, the respiratory alcolosis.

I often wonder when I see some of these sick cows whether I am dealing with hypocalcemia or whether I have another condition involved. After doing quite a large number of blood chemistries I am satisfied that we are justified in giving these cows calcium even with the different symptoms that they show. A downer cow with mastitis and muscle damage, if given too much calcium, may die. I have seen cows down every day for four and five days in a row, and each day they respond to calcium. Let's look at the Total Bilirubin in Table 2.

Table 2

Blood Chemistry

		Normal Bovine	I Downer, Mastitis Muscle Damage	II Downer, 4 days post-partum	III Anorexia Dysgalactia Diarrhea 2 Months postpartum
Calcium	mgm/100 ml.	9-12	15+	4.6	7.4
Inorg Phosphorous	mgm/100 ml.	5-7	3.3	2.0	7.0
Glucose	mgm/100 ml.	40-60	30	50	75
Urea Nitrogen	mgm/100 ml.	6-27	80	18	2
Uric Acid	mgm/100 ml.		1.0	1.4	2.3
Cholesterol	mgm/100 ml.	110.	445.	130.	120.
Total Protein	g/100 ml.	7.6	6.1	7.8	7.6
Albumin	g/100 ml.	3.6	.7	1.4	3.7
Globulin	g/100 ml.	3.9	5.4	6.4	3.9
A/G Ratio - must use Brom Cresol Green instead of Haba dye.					
Total Bilirubin		0-1.4	1.5	1.0	0.4
Alk. Phosphatase		(45)	350+	100	60
Lactic Dehydrogenase			1600+	600+	750
*SGOT Transaminase		50	250+	150	120
Sodium		142	123		144
Potassium		4.8	5.5		4.0
Carbon Dioxide Content		25.	30		26
Chloride		104	83.		99

*SGPT elevated from Tansy Ragwort; white muscle; selenium def.

I think the most informative tests in the bovine, especially in a downer cow, are LDH, the lactic dehydrogenase and the SGOT. You

will see that the downer cow, identified as number one, had 1600 plus in lactic hydrogenase, also 250 plus in SGOT, and whenever I see either SGOT or PT over 1500, I don't expect that cow ever to get up. That is why it is good to take your blood sample on the initial call if you have any suspicion of this. Then you have this information to go on as to whether it can really pay you to make return calls or not. Also, SGPT is elevated when the cow is poisoned, sometimes in the white muscle, selenium deficiencies. There are a number of veterinarians on the West Coast that have confirmed or used this for the diagnosis for these diseases.

Hair Analysis

The RCMP, the Royal Canadian Mounted Police, has recently had a case which started me thinking of the possibility of applying it to our area. A woman died and the pathologist gave a diagnosis of a toxic condition, but was non-specific. He could not decide what the toxic agent was. Sometime after the funeral and burial, the criminal pathologist was reviewing the case and by court order had the body exhumed. She had long hair and it was cut up in one-half inch sections and analyzed. Hair grows about one-half inch a month and three or six months ago there were large amounts of arsenic present. This compared exactly with the symptoms. She had been in the hospital, and as a result of the analysis of the hair, a man was accused of murdering his wife. It was more or less suspicious for he married a wealthy woman two days after his wife's funeral! He is now in jail—thanks to the analysis of his wife's long, beautiful hair. When we are interested in a nutritional deficiency in a herd, actually running a blood analysis is not nearly as informative as running hair analysis, because, the same as in a tree, if there is an excessive amount of minerals in the water, these minerals will be deposited in the leaves, and there they can be analyzed, the same as hair. Hair analysis gives an expression of mineral status during the months which the growth took place and is not subject to the rapid variations we see in the clinical picture in the cow that may be sick from metabolic disease. Analysis of hair is particularly significant when we are thinking of arsenic, calcium, phorphorus, or zinc, and the best place to obtain hair for analysis on a cow is between the horns. The veterinarians in England, who have done a large amount of analysis of the hair, have reported what they found in hair on their cows, so some of you who are going to send a sample in and have it tested by atomic absorption, if you are looking for an

Table 3

Normal Values from Cattle in England

Ca	1.78 = 0.42 parts per thousand
P	0.22 = 0.03 parts per thousand
Na	0.25 = 0.09 parts per thousand
K	0.35 = 0.16 parts per thousand

excessive amount of some of these chemical substances, refer to this work (Table 3). I have suggested also where you can send a sample, where you can do 26 tests for $6.00, and which will be as meaningful to you as you can interpret. Also, we have talked about analysis of hair. I hope that this has made some contribution to you as practitioners and as clinical pathologists.