Rapid Determination of Acid-Base Status in Diarrheic and Healthy Calves with the Cardy Twin Waterproof pH Meter

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A major problem with diarrheic calves is metabolic acidosis which can be difficult to accurately assess from physical findings. In our clinic, diarrheic calves that are mildly dehydrated can have mild to severe acidosis. The severity of acidosis in calves is influenced not only by the severity of dehydration, but also by the calf's age, and the amount and type of fluid therapy given. There is considerable variation in the amount of alkalizing agent (e.g. bicarbonate) present in oral electrolyte preparations. Calves treated by farmers with preparations containing little bicarbonate can be presented to veterinarians with mild dehydration but severe metabolic acidosis. Practitioners would be better able to treat diarrheic calves if there was a means of rapidly measuring the acid-base status of calves in the field. Conventional blood gas analyzers are expensive and are rarely purchased for practice laboratory. Samples cannot be sent to central laboratories for analysis because the results are usually required immediately. Furthermore, blood pH, bicarbonate and carbon dioxide content values change with time even if held at 4 °C. Because of these problems, we decided to evaluate the accuracy of the Cardy Twin Waterproof pH meter in measuring blood pH.

Venous blood samples were collected prior to treatment from 35 calves presented to the Western College of Veterinary Medicine (WCVM) for treatment of acute undifferentiated diarrhea. The calves were 11.5± 8.4 (mean ± SD) days old with a range from 2 days to four weeks old where beef breeds predominated. Normal blood gas values for healthy calves were obtained from 15 healthy Holstein male calves less than four weeks of age. The blood (2.5 mL) was collected aseptically from the jugular vein in a pre-heparinized plastic syringe (Smooth•E™, Radiometer America Inc., Westlake, OH). This blood was analyzed immediately in an automated blood gas analyzer (Ciba•Corning 288 blood gas system, Ciba•Corning Canada Inc., Markham, Ontario). The blood pH measurements were adjusted to the rectal body temperature of the calves. A pH meter (Cardy Twin pH meter, Spectrum Technologies Inc., Plainfield, Illinois) was used to measure blood pH. The pH meter was calibrated once a day against pH 7.00 and 4.00 solutions. Heparinized blood was placed on the sensor guard and the pH was obtained when the stabilization indicator appeared in the figure displayed. When the measurement was obtained, the sensor was rinsed with distilled water. All the measurements were performed at room temperature (23 °C). Linear regression analysis was used to investigate the correlation between the blood pH from both techniques or between blood pH measured with the pH meter and blood gas analyzer base excess. Statistical studies were analyzed with Systat (version 6.1, SPSS inc., Chicago, IL).

For 15 healthy and 35 diarrheic calves, there was a significant correlation (r^2= 0.931, $p < 0.005$) between blood pH obtained from the pH meter and the blood gas analyzer. A significant relationship (r^2= 0.911, $p < 0.005$) was also found between blood pH obtained from the pH meter and the base excess from the blood gas analyzer. The intra-assay precision was evaluated by repeated tests (n=10) of five samples at room temperature. The calculated coefficient of variation was less than 1%. The relationship between blood pH measured with the pH meter (pH_m) and the blood gas analyzer (pH_b) was: $pH_b = 2.159 + (0.676 \times pH_m)$. The relationship between blood gas analyser base excess (BE, mmol/L) and blood pH measured with the pH Meter (pH_m) was: $BE = -301.158 + (39.617 \times pH_m)$.

The rectal body temperature of the diarrheic calves were 37.3 ± 2.4 (mean ± SD) °C with a range from 30.0 to 40.2 °C. All the measurements obtained from the pH

meter were based upon room temperature (23.5 ± 0.5 °C). Although the pH meter cannot correct the blood pH with the actual patient temperature, our study shows good accuracy in estimating blood pH at room temperature. Further studies will be needed to determine the diagnostic value of the technique in a colder environment. In summary, the method is simple and portable for field use and samples can be processed in 5 minutes. The cost of the initial apparatus is around $226.00 U.S. The apparatus would also be useful for making measurements on horses and small animal patients. However, no study is available on these species so far.

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CVM UPDATE

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"Helping man and animals by ensuring the availability of safe and effective animal health products."
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HUMAN DRUG PRODUCT NOT EQUIVALENT TO VETERINARY CEFTIOFUR

FDA continues to receive reports that human labeled cefazolin products are being promoted as generic equivalents to the animal drug product Naxcel® (ceftiofur sodium). In 1996, letters were sent to all known manufacturers and distributors of human cefazolin advising them that this type of promotion was illegal.

Cefazolin and ceftiofur are not generic equivalents. Promoting human cefazolin products for animal uses causes the products to be adulterated or misbranded, and could subject the products and/or the distributors to regulatory action. The promotion of human labeled products for use in animals as equivalent to an approved animal drug is a violation of the Federal Food, Drug, and Cosmetic Act [Section 502 (f)(1)] since the human product does not have adequate directions for animal use. If the promotional material is also found to constitute labeling, the products would be considered unapproved new animal drugs in violation of Section 501 (a)(5) of the Federal Food, Drug, and Cosmetic Act.

Claims that cefazolin and ceftiofur are equivalent not only misbrand the human product, but are not true statements. Cefazolin and ceftiofur are different generations of cephalosporins that have different pharmacokinetics and effectiveness against different organisms. If a milk or tissue residue occurs as a result of this misrepresentation, the responsible party could be held accountable for the residue as well as for the misbranding violation. There is no approval for any cefazolin product in animals.

Questions about this subject may be directed to CVM's division of Compliance at 7500 Standish Place, HFV-232, Rockville, MD 20855, or by telephone on 301-594-1785.

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