# PREDICTORS FOR MORTALITY FROM ACUTE UNDIFFERENTIATED NEONATAL CALF DIARRHEA.

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# PREDICTORS FOR MORTALITY FROM ACUTE UNDIFFERENTIATED NEONTAL CALF DIARRHEA.

A PROJECT

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

Master of Veterinary Science

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Western College of Veterinary Medicine

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By

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DEPARTMENT OF VETERINARY INTERNAL MEDICINE

CERTIFICATION OF PROJECT WORK

We, the undersigned, certify that Samuel Kingori Muriuki

(full name)

candidate for the degree of Master of Veterinary Science

has presented his project with the following title Predictors for Mortality from Acute Undifferentiated Neonatal Calf Diarrhea

(as it appears on the title page of project)

that the project is acceptable in form and content, and that a satisfactory knowledge of the field covered by the project was demonstrated by the candidate through an oral examination. February 21, 1992

(date)

internal ~~examiners~~

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Dedicated to

My wife

Sarah Kingori

for enduring the loss of the company of her husband during the study period.

My daughter

Janet Kingori

for making everything worthwhile.

# PREDICTORS FOR MORTALITY FROM ACUTE UNDIFFERENTIATED NEONATAL CALF DIARRHEA

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ABSTRACT

A prospective study involving 77 neonatal calves was carried out to determine which factors in management, physical status and laboratory findings at time of presentation to the clinic might help to predict wether a calf shall die or survive . Calf history and physical examination where done using a standard protocol . At presentation blood samples were collected for blood gas analysis, hematology and biochemistry . Twenty four hours later after the calf had been rehydrated a blood sample was collected for serum protein electrophoresis . Calves that died were taken for necropsy and histopathology, bacteriology and virology performed on standard range of tissues . The calves that later died had significantly lower segmented neutrophils, serum total proteins, body temperature, and serum calcium level and higher serum phosphorus level . It was concluded that serum total protein and body temperature may help predict wether calves shall die or survive .

Introduction

Although knowledge of the epidemiological factors, pathogenesis and microbiological agents associated with neonatal calf diarrhea has increased, neonatal calf diarrhea remains a major cause of mortality in beef calves less than 30 days old on some farms (1,2). In a survey of beef herds in Alberta, Schumann et al (2) found that, although 79% of the 686 farms surveyed reported no deaths attributable to neonatal calf diarrhea, 4% of the farms had diarrhea-associated mortality rates greater than 4% to a maximum of 16.3%. In a more detailed examination of 27 farms with diarrhea-associated mortality rates greater than 2%, the mean morbidity and mortality of calves less than 30 days old were 34% (± 23%, SD) and 6.24% (± 3.05%, SD) respectively. Two earlier surveys in the same geographical area reported morbidity rates of 16.7% and 21.98% and mortality rates of 1.51% and 3.06% respectively in calves less than 30 days old (3,4). Surveys of calfhood mortality in dairy calves have been reported much more frequently and mortality rates in calves up to 90 days of age have varied from 3.5% to 27.2% (5-10).

Severe diarrhea causes marked metabolic changes, notably hyponatremia, hypochloremia, hyperkalemia, uremia, hyperlactatemia, acidemia and dehydration (11-17). Hypoglycemia has also been reported (18). Death in neonatal diarrhea is caused by a combination of the dehydration, acidosis and heart failure induced by the hyperkalemia and low concentrations of myocardial potassium (11-17). Calves that die from diarrhea have lower serum total protein and immunoglobulin concentrations than those which survive

(19-26); this is associated with poor transfer of maternal immunoglobulins from dam to offspring (27-31). In addition, epidemiological studies of neonatal calf diarrhea have shown that a high mortality is associated with certain management practices, prevailing climatic conditions and, to a lesser extent, breed (5-10, 32-34).

The mortality caused by neonatal calf diarrhea represents a significant financial loss to the livestock industry, especially to the cow-calf industry (1,35). Estimates of monetary losses rarely include the cost of medication and treatment of sick calves, some of which may not survive, and the inconvenience and increased man-hours required to treat sick calves (35). The present study was undertaken to determine which factors in herd management, physical status and laboratory data determined at the time of presentation for veterinary treatment might predict whether a calf with severe, undifferentiated diarrhea would survive or die.

## Materials and Methods

All calves 30 days old or less presented to the Western College of Veterinary Medicine Veterinary Teaching Hospital between January 1, 1991 and June 30, 1991 with clinical signs of diarrhea were included in the study. A standard history was taken for each calf, by interviewing the owner from a 23 question questionnaire, which covered most aspects of farm management, calf and dam history. Each calf was examined clinically according to a standard physical examination protocol. Depression was scored by the method used by Kasari and Naylor (36).

At the time of admission, blood for blood gas analysis was collected anaerobically from the jugular vein into heparinized plastic syringes; the analysis was performed immediately. Blood for hematology and serum biochemistry was also collected from the jugular vein into evacuated tubes containing potassium ethylediamine tetraacetate or no additives respectively (Terumo Medical Corporation, Elston, MD, USA). Twenty-four hours after admission another blood sample was collected from each calf for serum electrophoresis.

Blood gas analysis was determined on an automated blood gas analyzer (ABL 330 Acid-Base Laboratory, Radiometer, Copenhagen, Denmark). The complete blood count was determined on an electronic cell counter (Coulter Electronics, Model S-Plus IV, Coulter Electronics Inc., Hialeah, Florida) and the differential white cell count was determined by counting 100 white cells on a blood smear stained with Wright's stain. The total protein concentration of the plasma was determined by refractometry and the concentration of fibrinogen estimated following heat precipitation of the sample of plasma. Serum was harvested after the blood samples were incubated at 37°C for 30 minutes. Serum biochemistry was determined on an automatic analyzer by standard methods (DACOS, Coulter Electronics Inc., Hialeah, Florida). The gammaglobulin concentrations were calculated from the total serum concentration following electrophoresis of the serum samples on agarose gel (Titan Gel Serum Protein System, Helena Laboratories, Beaumont, Texas).

The calves were treated with oral (14 calves) or intravenous

fluids (63 calves) according to the individual needs of each calf (37). Antibiotics were given parenterally if deemed necessary. The progress of the calves which were discharged from the clinic was followed by telephoning the owner after seven days and again after 30 days. The status of the calf, alive or dead, was recorded.

The calves that died during the study were submitted for necropsy according to a standard protocol and histopathology, bacteriology, and virology performed on a standard range of tissues.

Statistical Analysis System (38) was used to verify the data, generate descriptive statistics, to assess the normality of the distribution of the continuous variables, to perform non-parametric one-way (Kruskal-Wallis test) on the continuous variables not normally distributed, and to perform Student's t test on continuous variables and chi-square on categorial variables. The Biomedical Data Program (39) was used to perform stepwise logistic regression analysis on variables that were significantly associated with mortality as determined by chi-square and Student's t test analysis. Initially, the p-value to enter and remove variables was 0.15. Only those variables that were significantly related to mortality ($p < 0.05$) were allowed to remain in the final model. A TI-59 (Texas Instruments, Texas) was used to do Student's t test analysis on the continuous variables between diarrheic calves and reference values (52).

Results

Seventy-seven calves were selected for the study. The majority of the calves were beef breeds, eg. Hereford, Limousin, Simmental and Charolais and crosses of those breeds, but five Holstein calves were also included. The mean age was 11 days with a range of one to 30 days. Seventy-five percent of the calves were 14 days old or less at the time of presentation and 95 percent were 21 days old or less. There were 32 (41.6%) females and 45 (58.4%) males.

The pre-admission history of the individual calves and the background history of the 50 herds that presented the 77 calves are presented in Tables 1 and 2. The number of calves presented per herd for treatment varied between one and eight; single individual calves came from 35 herds; ten herds presented two calves and only five herds presented three or more calves for treatment. The majority of calves had been treated before admission, either with oral antibiotics, parenteral antibiotics or oral electrolytes, but mostly with oral electrolyte therapy and either oral or parenteral antibiotics (Table 1). A small number of calves had not received colostrum at birth, and, interestingly, nearly a quarter of the calves had been supplemented with cows' colostrum. None of the calves had been given any of the commercially available colostrum supplements. Just over one third of the herds vaccinated the cows against the neonatal calf diarrhea agents (Table 2).

Most calves were severely depressed with many in lateral recumbency on presentation. Calves that died were significantly more depressed, hypothermic and had lower heart rates than calves

which survived (Table 3). There was no significant difference in the dehydation scores of the two groups. Eight calves, including three of the calves which subsequently died, had rectal temperatures of 35°C or less. Seven of the nine calves which died had rectal temperatures of less than 37.75°C; this was significantly more than 18 of 62 calves that survived ($p = 0.003$, Odds ratio 9.01).

Seven (9%) calves died in the clinic during treatment, six within approximately 24 hours of admission and one on the sixth day of treatment. Seventy (90.9%) of the calves were discharged alive from the clinic. Six of the discharged calves (8.6%) were lost to follow up at 30 days: one calf was sold; another, the farmer could not identify later; and the others were lost because of recording error. Two calves died within one week of discharge from the clinic. The remaining sixty-two calves were known to be still alive 30 days after discharge. The case fatality rate before day 30 in this study was 9/71 (12.7%). The mean duration of stay in the clinic for the calves that survived was 2.5 days with a range of zero to 13 days.

The major laboratory findings determined at the time of admission are presented in Table 4. These variables were compared with the published values for normal calves (Table 4). The diarrheic calves had significantly higher hematocrits, leucocyte and segmented neutrophil counts, phosphorus, magnesium, urea and glucose concentrations. They were significantly more acidotic with higher anion gaps than normal calves. Calves eight days or older

were more acidotic than younger calves ($p = 0.03$). The calves that died had significantly lower segmented neutrophils, plasma total proteins, body temperature, and serum calcium concentrations, but higher serum phosphorus concentrations than the calves which survived (Table 4). The mean potassium concentration for all diarrheic calves was not significantly different from the published value for normal calves, but the calves which survived had a mean value of $7.11 \pm 2.74$ mmol/L; the calves which died had a mean value of $6.23 \pm 1.53$ mmol/L. The distribution of the plasma total protein, on admission, the serum total protein and gammaglobulin concentrations determined on samples collected 24 hours after admission are presented in Figures 1 and 2.

Examination of categorical variables from the history and from the clinical data revealed few differences between calves that died and calves that survived except that calves at pasture were more likely to die than calves in corrals or barns ($p = 0.03$, Odds ratio 4.67). When the data were analyzed by logistic regression, low body temperature and low plasma total protein concentration were the only two variables that were found to be conditionally related to mortality (Table 5).

The results of the pathological examinations of the seven calves that died in the Veterinary Teaching Hospital are presented in Table 6. Enteric disease was diagnosed in four calves but it was the principal diagnosis in only three of the four calves. The only enteropathogen identified was coronavirus in two of the four calves. In addition to atrophy of the intestinal wall, one calf

(714) had a multifocal interstitial nephritis. This was the oldest calf admitted to the study and on hadmission had a serum phosphorus of 10.23 mmol/L, a serum urea of 29.6 mmol/L and a serum creatinine of 609 μmol/L. The youngest calf to die in the study had disseminated intravascular coagulopathy. No bacteria were isolated from tissues. Pasteurella multicocida was isolated from pulmonary lesions of an 11-day-old calf with bronchopneumonia and pleuritis; and P. haemolytica was isolated from a 28-day-old calf with pleuritis and peritonitis. The two calves which died after discharge from the Veterinary Teaching Hospital were not submitted for necropsy. One of these two calves, a Charolais bull calf, was admitted twice; first when it was four days old, then discharged after three days hospitalization, and again two days later, after relapsing, for a further ten days and discharged when it was 24 days old.

Discussion

The majority of calves in this study had been treated before being brought to the Veterinary Teaching Hospital, mostly with a combination of oral electrolytes and antibiotics. Our clients are encouraged to treat moderately dehydrated and depressed, diarrheic calves with commercially available oral electrolyte solutions containing an alkalinizing agent. As a result, most of the calves in this study had failed to respond to treatment by the owner. Many were severely depressed and unable to stand but are probably representative of diarrheic calves presented to many veterinary clinics.

The laboratory findings of calves admitted for treatment of neonatal diarrhea were comparable with previous studies (17,22), ie. they had increased haematocrits, hyperkalemia, uraemia and a metabolic acidosis. Hyponatremia and hypochloremia were not noted in this study. The total leucocyte and segmented neutrophil counts were also increased and this has been noted previously in diarrheic calves (22). Those calves which subsequently died had significantly lower body temperatures, heart rates, and plasma total protein and serum calcium concentrations, numbers of neutrophils and platelets and higher serum inorganic phosphorus concentrations than calves which were treated and survived. Conditionally, only low body temperature and low total plasma protein concentration were related by stepwise logistic regression as significant predictors of mortality.

The lower rectal temperatures, heart rates and rapid demise of the nine calves which died suggest that the calves were moribund on admission. A previous study (42) has shown that demeanour of diarrheic calves is highly correlated with hypothermia. Hypothermia induces acidosis, depressed cardiac function, hypovolemia, hypotension, altered blood clotting and altered sensorium ( ) and is likely to exacerbate the effects of the metabolic acidosis induced by the diarrhea. Hypothermia is frequently observed in neonatal lambs in which it is related to cold exposure or to hypoglycemia induced by starvation (43). Although the calves which died in the present study had lower blood glucose concentrations than the survivors, it was probably not

sufficiently low to have a role in the hypothermia. It has been suggested that the blood glucose concentration has to be less than 2 mmol/L to be significant at which point it is probably a terminal event (44). Three of eight of the calves that died did have blood glucose values of less than 2 mmol/L. The lower neutrophil and platelet counts in the calves which died may indicate shock and consumptive coagulopathy or may be related to the pathological lesions in other organ systems.

Most of the variation in total protein concentration is probably due to the difference in gammaglobulin concentration (24,45) because of the variable absorption of colostral immunoglobulins (27-31). It could also be the result of the increased catabolism of immunoglobulins and loss of protein into the intestinal tract in the diarrheic calves (46,47). Plasma total protein is a useful measure of immunoglobulin concentration (24) but it should be used with caution as individual variation in total protein concentration of precolostral serum or plasma occurs (44). The suggested lower limit for plasma total protein concentration is 60 g/L and for serum total protein 55 g/L (24). These values and those determined from other prospective surveys examining the relationship between immunoglobulin concentration and disease have repeatedly demonstrated that low concentrations of immunoglobulins are associated with increased levels of disease and mortality (19-22, 24-26). Furthermore, very low concentrations of passively acquired immunoglobulins were found at postmortem examination of calves that had died of infectious disease (23).

The plasma total protein concentrations determined on admission are likely to have been higher than the prediarrheic values: Groudtides and Michell (17) noted that the serum total protein concentration increased by nearly 7.5 g/L in dying diarrheic calves compared to their prediarrheic values. Similarly, the decision to quantitate the gammaglobulin concentration on blood samples collected 24 hours after admission and following rehydration may have underestimated the prediarrheic value. It has previously been noted that the plasma total protein concentration decreased by a mean of 16.75 g/L after 24 hours of rehydration in a similar clinical population (48). Certainly there was a marked difference between the plasma total protein concentration on admission and the serum total protein concentration determined 24 hours after admission. Thirty calves had a plasma total protein concentration of less than 60 g/L on admission and 36 calves had a serum total protein concentration of less than 55 g/L. Unfortunately, most of the calves which died, did so before a blood sample could be taken for serum electrophoresis., but two of the three calves for which values were determined had gammaglobulin concentrations of less than 2.5 g/L. These values are considerably lower than the 4-5 g/L gammaglobulin deemed acceptable for calf survival (24,49).

The recovery rate with treatment in this study was considerably higher than previous studies (50,51). In one study, also from this clinic and involving 254 calves, the recovery rate, determined as calves alive at discharge, was 71.5% (51); the

comparable figure in the present study was 91%. This increase in the recovery rate reflects a better understanding of the pathophysiology of diarrhea. Four of the seven calves that were examined pathologically had lesions in organs other than the intestines. However, all seven calves were admitted with a history of diarrhea and at least on initial clinical examination, no clinical signs referable to other systems were found.

The youngest calf that died had disseminated intravascular coagulopathy. These lesions were suggestive of E. coli septicaemia; no organisms were isolated from the tissues and there was no history of treatment with antibiotics. This calf had a profuse, watery diarrhea on admission, but it developed convulsions several hours after admission and was suspected of having meningitis. The oldest calf in the study had an interstitial nephritis which was probably a sequel to a systemic coliform infection. As in the previous case no definitive bacteria were isolated but this calf had been treated with trimethoprim-sulfadoxine. The second oldest calf in the study died of an acute, severe, pleuritis and peritonitis from which P. haemolytica was isolated; it had been diarrheic for two days before admission. One 11-day-old diarrheic calf had a severe, necrotizing, fibrinous pneumonia from which P. multocida was isolated. In the three calves that died of enteric disease, only coronavirus was identified in two. No exhaustive effort was made to identify etiological agents in the majority of calves, but in those calves which were examined, coronavirus, rotavirus and Cryptosporidium

spp. were found most frequently.

In conclusion, this study has once again demonstrated the importance of the absorption of adequate colostral immunoglobulins by the newborn calf. It has also been demonstrated that diagnosing abnormalities in other organ systems in scouring calves is difficult, as was pointed out in a previous study (51), but identifying these abnormalities is vital to the eventual outcome of the calf. Furthermore, it should be stressed to owners that every effort should be made to maintain body temperatures by supplementary heat if necessary.

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# FIG. 1: TOTAL PROTEINS CONCENTRATION IN 56 CALVES WITH DIARRHEA

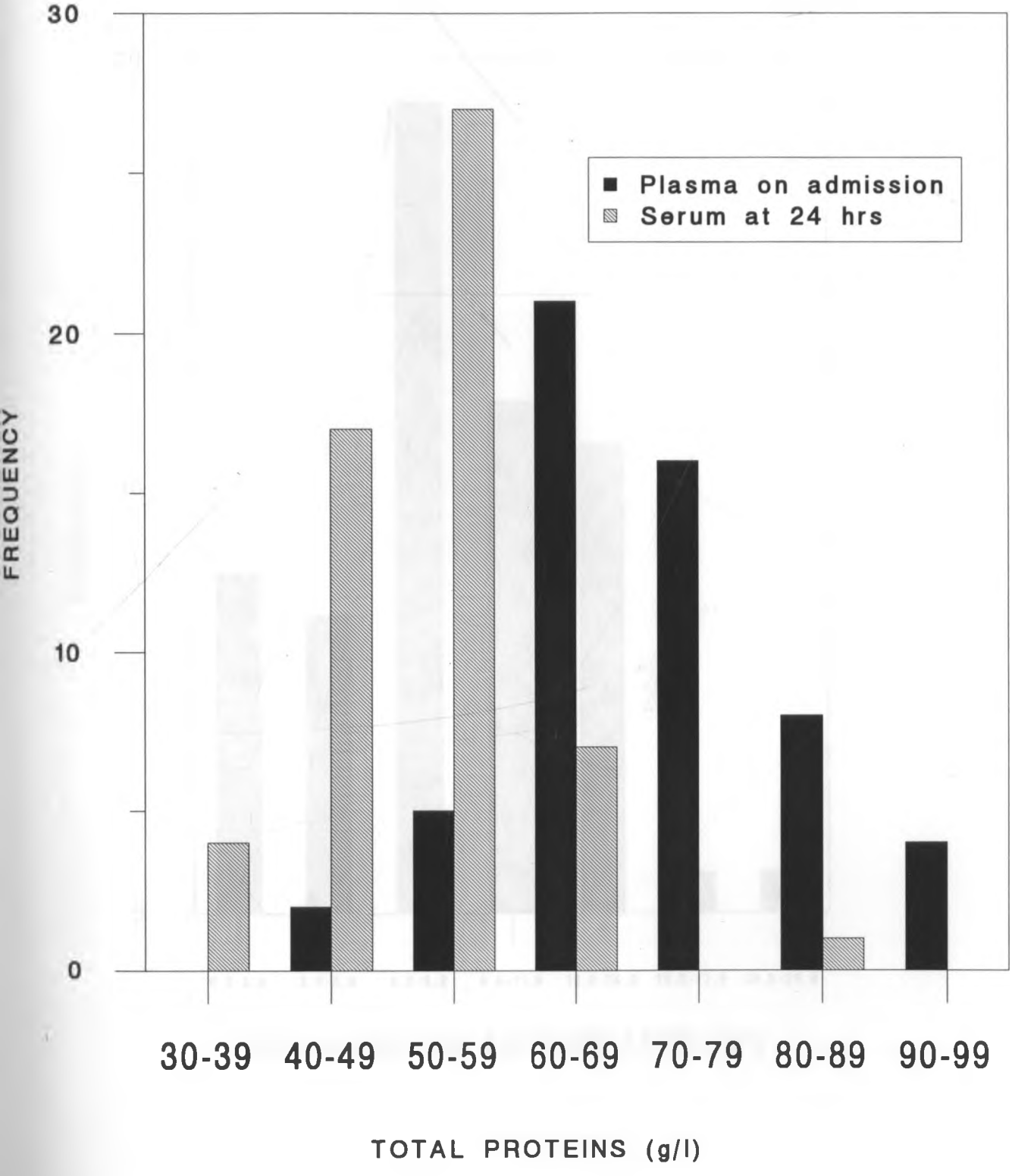

FIG. 2: GAMMAGLOBULINS CONCENTRATION IN 59 DIARRHEIC CALVES

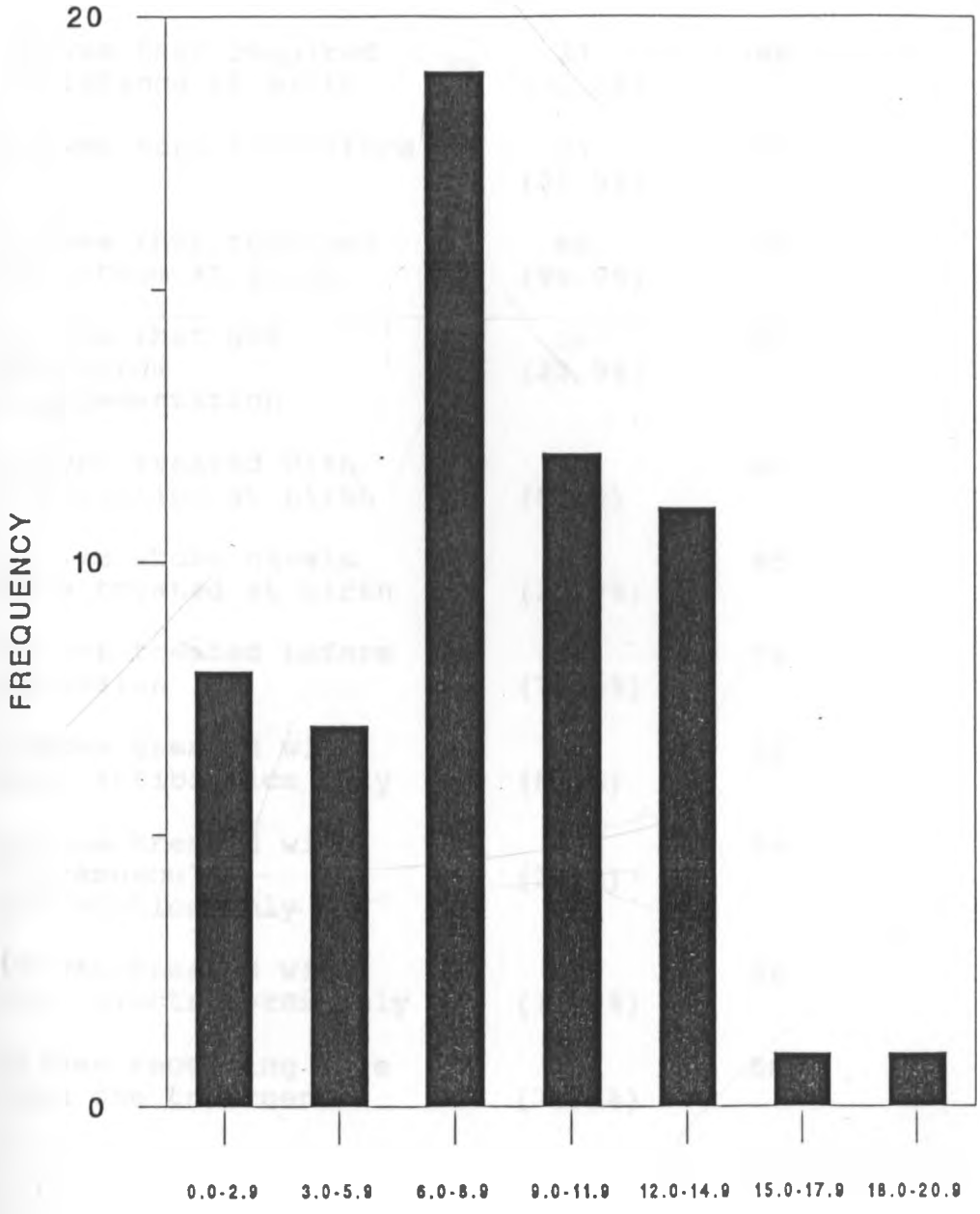

TABLE 1

PRE-ADMISSION HISTORY OF INDIVIDUAL CALVES
PRESENTED FOR TREATMENT OF NEONATAL CALF DIARRHEA

| | NUMBER | N | MISSING DATA |
|---|---|---|---|
| Calves that required assistance at birth | 23 (33.3%) | 69 | 8 |
| Calves born to heifers | 21 (30.9%) | 68 | 9 |
| Calves that received colostrum at birth | 60 (90.9%) | 66 | 11 |
| Calves that got colostrum supplementation | 16 (23.9%) | 67 | 8 |
| Calves treated with antibiotics at birth | 6 (8.7%) | 69 | 8 |
| Calves whose navels were treated at birth | 18 (27.7%) | 65 | 12 |
| Calves treated before admission | 58 (76.3%) | 76 | 1 |
| Calves treated with oral antibiotics only | 5 (8.6%) | 58 | |
| Calves treated with intramuscular antibiotics only | 2 (3.4%) | 58 | |
| Calves treated with oral electrolytes only | 8 (13.7%) | 58 | |
| Calves receiving more than one treatment | 43 (74.1%) | 58 | |

TABLE 2

HERD HISTORY OF CALVES PRESENTED FOR TREATMENT OF NEONATAL CALF DIARRHEA

| | NUMBER | MEAN | SD | RANGE | N | MISSING DATA |
|---|---|---|---|---|---|---|
| Cows per herd | 46 | 67 | 49 | 7-200 | 46 | 4 |
| Heifers per herd | 40 | 24 | 5 | 0-150 | 40 | 10 |
| Calves born per herd before first calf scoured | 47 | 32 | 29 | 1-155 | 47 | 3 |
| Calves with diarrhea per herd at time of presentation of calf | 46 | 5 | 8 | 0-42 | 46 | 4 |
| Herds experiencing mortality from calf diarrhea | 34 | | | | 50 | 0 |
| Dead calves per herd at time of presentation of calf | 49 | <1 | 1 | 0-7 | 49 | 1 |
| Herds that isolated diarrheic calves | 27 | | | | 48 | 2 |
| Herds that vaccinated against calf diarrhea | 17 | | | | 45 | 5 |

TABLE 3

CLINICAL FINDING

| | Calves - Survived | Calves- Died |
|---|---|---|
| Depression score maximum = 9 | 3.9 | 6.8* |
| Dehydration score maximum = 7 | 2.2 | 2.7 |
| Heart rate (Beats/min) | 127 | 97* |
| Respiratory rate (Breaths/min) | 42 | 39 |
| Rectal Temperature (°C) | 38.2 | 36.3* |

TABLE 4

Hematology, Blood Gas and Serum Chemistry Values for the Diarrheic Calves

| | All Diarrheic Calves | | | Calves that Died (N = 8) | | | Reference Values | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | N | Mean | SD | P[b] | Mean | SD | N | P[a] |
| **Hematology** | | | | | | | | | | |
| Erythyrocytes x $10^{12}$/L | 10.22 | 2.21 | 68 | 10.85 | 3.78 | NS | 7.38[c] | 1.14 | 64 | <0.001 |
| Hemoglobin g/L | 125.1 | 31.32 | 68 | 137.8 | 43.37 | NS | 105[c] | 19 | 64 | <0.001 |
| Hematocrit L/L | 0.39 | 0.1 | 68 | 0.43 | 0.14 | NS | 0.33[c] | 0.06 | 17 | 0.02 |
| Leucocytes x $10^9$/L | 14.98 | 7.31 | 68 | 10.5 | 5.48 | NS | 8.5[c] | 2 | 17 | <0.001 |
| Segmented Neutrophils x $10^9$/L | 8.56 | 6.03 | 64 | 3.52 | 3.55* | 0.018 | 2.7[c] | 1.6 | 17 | <0.001 |
| Lymphocytes x $10^9$/L | 4.75 | 1.89 | 64 | 4.36 | 2.99* | NS | 5.1[c] | 1.5 | 17 | NS |
| Monocytes x $10^9$/L | 0.59 | 0.43 | 63 | 0.3 | 0.18* | NS | 0.6[c] | 0.3 | 17 | NS |
| Platelets x $10^9$/L | 829.4 | 364.1 | 56 | 578.4 | 248.76 | 0.015 | | | | |
| Total Protein g/L | 68.7 | 12.12 | 68 | 57.6 | 9.6 | 0.009 | 64.5[e] | 13.4 | 9 | NS |
| **Blood Gas (Venous)** | | | | | | | | | | |
| pH | 7.10 | 0.17 | 69 | 7.07 | 0.13 | NS | 7.34[d] | 0.04 | 12 | <0.001 |
| $pCO_2$ TORR | 48.79 | 13.9 | 69 | 56.51 | 15.03 | NS | 57.2[d] | 4.38 | 12 | 0.04 |
| $HCO_3$ mmol/L | 15.62 | 8.18 | 69 | 16.44 | 7.35 | NS | 30.3[d] | 3.8 | 12 | <0.001 |
| Base Deficit mmol/L | 13.3 | 10.38 | 69 | 15.16 | 8.54 | NS | 4.9[d] | 4 | 12 | 0.007 |
| **Serum Biochemistry** | | | | | | | | | | |
| Sodium mmol/L | 141.2 | 9.78 | 66 | 143.1 | 7.14 | NS | 141.4[d] | 2.6 | 12 | NS |
| Potassium mmol/L | 6.9 | 2.58 | 66 | 6.24 | 1.53 | NS | 5.3[d] | 0.4 | 12 | NS |
| Chloride mmol/L | 104.7 | 9.28 | 66 | 105.5 | 8.35 | NS | 103.5[d] | 3.2 | 12 | NS |
| Calcium mmol/L | 2.8 | 0.46 | 66 | 2.47 | 0.55 | 0.003 | 2.6[d] | 0.19 | 12 | NS |
| Phosphorus | 3.9 | 1.6 | 66 | 5.33 | 2.49 | 0.002 | 2.9[d] | 0.15 | 12 | 0.03 |
| Magnesium mmol/L | 1.4 | 0.41 | 66 | 1.51 | 0.49 | NS | 0.88[d] | 0.14 | 12 | <0.001 |
| Anion Gap mmol/L | 28.86 | 6.93 | 66 | 30.0 | 4.38 | NS | 12.8[d] | 2.4 | 12 | <0.001 |
| Urea mmol/L | 19.08 | 12.53 | 66 | 22.72 | 16.14 | NS | 4.27[d] | 1.6 | 12 | <0.001 |
| Creatinine umol/L | 286.9 | 215.8 | 66 | 317.0 | 204.28 | NS | 70.0[f] | 2.3 | 19 | <0.001 |
| Glucose mmol/L | 5.46 | 3.53 | 66 | 4.26 | 3.98 | NS | 4.39[f] | 0.16 | 90 | 0.005 |
| Osmolality mmol/Kg | 310.8 | 24.44 | 66 | 314.0 | 25.81 | NS | 290.2[g] | 11.49 | 24 | NS |

* N = 6 WBCs too disintegrated to differentiate in two calves.

[a] Probablity that means for all diarrheic calves are different from reference normal values using a two-tailed Students t test.

[b] Probablity that means for calves that died are different from calves that survived.

[c] Reference 40 [d] Reference 36 [e] Reference 41 [f] Reference 17 [g] Reference 15

NS = Not Significant

TABLE 5

Factors associated with mortality from calf diarrhea in the final logistic regression model

| Variable | B[a] | OR[b] | 95% CL[c] | P[d] |
|---|---|---|---|---|
| Temperature | -0.17 | 0.85 | 0.73, 0.99 | 0.006 |
| Protein | -0.75 | 0.47 | 0.23, 0.95 | 0.002 |

[a] estimated regression coefficient

[b] adjusted odds ration (OR=exp B)

[c] 95% CI= exp B$\pm$ 1.96* SE B)

[d] p - value

Student: _____

CALF ID _____

## HISTORY SHEET

1. What breed is the calf? _____

2. How old is the calf? _____

3. How long has the calf had diarrhea _____ days

4. Have you treated the calf for diarrhea? Y/N

5. How did you treat it? (x)

   a) Oral antibiotics ( )

   b) Injectable antibiotics ( )

   c) Oral electrolytes: ? Product (x): ( )

   Lifeguard ( ), Revibe ( ), Hydra ( ), Other ( )

6. When did you start treating it? (x)

   a) With the first signs of scouring ( )

   b) When it looked depressed ( )

   c) When the calf became recumbent ( )

7. Has the calf suffered from any other disease?

   a) Pneumonia Y/N

   b) Navel Ill Y/N

   c) Joint Ill Y/N

   d) Other - Describe _____ Y/N

   _____

8. Did the calf require assistance at birth?

   a) No assistance 1

   b) Easy Pull 2

   c) Hard Pull 3

   d) Caesarian section 4

9. Is the mother (dam) a heifer (first calving) Y/N

10. Did the calf suckle colostrum? Y/N

11. How did you determine the calf had sucked colostrum? (x)

a) Saw it nursing ( )

b) Checked the fullness of its stomach ( )

c) Checked slackness of cow's udder ( )

d) Assisted it to suckle ( )

12. Did you supplement the calf with colostrum from a cow? Y/N

13. Did you feed the calf with a colostrum substitute? Y/N

If yes, what product did you use _____

14. a) Did you vaccinate the dam against calf diarrhea? Y/N

b) If yes, when? Month _____ Year _____

c) If yes, what product did you use? _____

15. Did you vaccinate the calf against calf diarrhea? Y/N

If yes, what product did you use? _____

16. Did you give any antibiotics to the calf at birth? Y/N

If yes, what product did you use? _____

17. Did you treat the navel at birth? Y/N

18. Are your cows/calves in

a) Barn ( )

b) Corrals ( )

c) Pasture ( )

19. a. How many cows and heifers have you to calve this year? _____

b. How many heifers do you have to calve this year? _____

20. How many calves have you now? _____

21. How many calves have scoured so far this year? _____

22. Have any calves died from scours? Y/N

If yes, how many? _____

23. Do you isolate your scouring calves? Y/N

Clinician: _____

Student: _____

CALF ID _____

## PHYSICAL EXAMINATION

1. TEMPERATURE _____ PULSE _____ RESPIRATORY RATE _____

   BODY CONDITION (x): Good ( ) Moderate ( ) Thin ( )

   WEIGHT (kg) _____

2. DEPRESSION - Circle Appropriate Value (CAV)

| | Method of Assessment | Interpretation | Score |
|---|---|---|---|
| Suck reflex | Index finger over tongue | Strong and coordinated. | 0 |
| | | Weak but coordinated. | 1 |
| | | Chewing. | 2 |
| | | Absent. | 3 |
| Menace reflex | Rapid hand movement toward eye | Instantaneous. | 0 |
| | | Slow. | 1 |
| | | Absent. | 2 |
| Tactile response | Skin pinched over lumbar area | Skin and head move. | 0 |
| | | Skin only twitches. | 1 |
| | | No response. | 2 |
| Ability to stand | Prod thorax with pen | Stands voluntarily. | 0 |
| | | Stands with assistance. | 1 |
| | | Refuses/unable to stand. | 2 |
| | | TOTAL: | ___ |

3. HYDRATION STATUS (Circle appropriate value)

| | Method of assessment | Interpretation | Score |
|---|---|---|---|
| Eyeball | Visual | No sinking of eyeball in orbit | 0 |
| | | Slightly sunken eye but no separation of globe from orbit | 1 |
| | | Sunken eye with separation of globe from orbit | 2 |
| | | Severely sunken eye : 0.5-1 cm gap between globe and orbit | 3 |
| Skin tenting | Pinch skin over eyelid | Skin tent rapidly returns. | 0 |
| | | Skin remains tented for 1 to 3 seconds | 1 |
| | | Skin remains tented for 4 or more seconds | 2 |
| | | Total: | ____ |

4. FECAL CONSISTENCY (CAV)

| | | |
|---|---|---|
| Firm | | 0 |
| Pasty | | 1 |
| Loose | | 2 |
| Watery | | 3 |
| | | ____ |
| COLOUR: _____ | BLOOD | Y/N |

5. JOINTS

1) Normal Y/N
2) Swollen, hot or painful Y/N
3) Number affected ____
4) Which? _____

6. NAVEL

1) Normal Y/N
2) Wet Y/N
3) Purulent Discharge Y/N
4) Swollen Y/N
5) Pain Y/N

7. PNEUMONIA:

Signs associated:

| | | |
|---|---|---|
| 1. | Spontaneous cough or cough after holding breath for 30 seconds. | Y/N |
| 2. | Abnormal lung sounds at rest or abnormal lung sounds after holding breath for 30 seconds. | Y/N |
| 3. | Increased respiratory rate (> 40). | Y/N |
| 4. | Nasal discharge (x): mucoid ( ), purulent ( ) | Y/N |

8. EYES:

| | | |
|---|---|---|
| 1. | Normal | Y/N |
| 2. | Cloudy Anterior Chamber | Y/N |
| 3. | Pus in anterior chamber | Y/N |
| 4. | Constricted pupils < 2 mm | Y/N |

9. NERVOUS SYSTEM (MENINGITIS):

| | | |
|---|---|---|
| 1. | Fever | Y/N |
| 2. | Depression | Y/N |
| 3. | Convulsions | Y/N |
| 4. | Stiff Neck | Y/N |
| 5. | Opisthotonus | Y/N |
| 6. | Nystagmus | Y/N |
| 7. | Strabismus | Y/N |

COMMENTS



| SAMPLES TO BE TAKEN | | | Check |
|---|---|---|---|
| A. | Blood Gas | | 0 |
| B. | CBC | | 0 |
| C. | Renal Panel | | 0 |
| D. | 24 hours | Serum/ A/G electrophoresis | 0 |