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EPIDEMIOLOGICAL, HAEMATOBIOCHEMICAL AND THERAPEUTIC STUDIES IN BOVINE KETOSIS

Hassen A. H. Bennasir[1], Abdul Qayoom Mir[1]*, Hamidullah Malik[2], Faizullah Peer[2] and Qurrat-ul-Ain Maqbool[1]

[1]Faculty of Pharmacy, Omar-Al-Mukhtar University, Derna, Libya.
[2]Faculty of Veterinary Medicine, Alfateh University, Tripoli, Libya.

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***Corresponding Author**
Dr. Abdul Qayoom Mir
Faculty of Pharmacy, Omar-Al-Mukhtar University, Derna, Libya.

ABSTRACT

Epidemiological studies on bovine ketosis indicated a prevalence rate of highest in the age group of 8 to 9 years (47.36%) and in 3rd lactation (42.10%). Maximum number of clinical cases were recorded in 1 to 2 months post-partum (42.10%). Apart from eosinophilia (7.47±0.47%), no significant hematological changes were observed. Hypoglycemia (25.72±0.90mg/dl), hypocalcaemia (8.89±0.24mg/dl) and increase in blood urea nitrogen (27.56±1.00mg/dl) and free fatty acid levels (40.07±0.79mg/dl) were the major biochemical observations recorded in the present study. The body temperature in all the cases was within the normal range (100.8-101.2°F). Marginal elevation of respiration and pulse rates with reduced ruminal movements were also recorded. Sudden drop in milk yield, selective feeding, wasting, anorexia, acetone smell in breath/milk, depression, nervous symptoms, constipation, dry and scant faeces and disinclination to move and to eat were the symptoms recorded in 100, 78.94, 21.05, 47.36, 63.15, 31.57, 15.78, 36.84 and 5.26 per cent cases, respectively. Economic implications of the disease were worked out on the basis of drop in milk yield, duration of illness, cost of treatment and management. The drop in milk yield ranged from 30 to 80 per cent with a mean of 54.12±2.73. Oral glucose therapy was evaluated in the treatment of 19 cases of bovine ketosis. The treatment regimen gave a 100 per cent recovery rate as against parenteral glucose (100%) and corticosteroid (33.33%) therapy. The mean recovery time in the three therapeutic regimens- oral glucose, parenteral glucose and corticosteroid (triamcinolone acetonide) was 2.33±0.23, 2.75±0.36 and 5.66±0.61 days. The cost of treatment in oral glucose therapy worked out was lesser as compared to parenteral glucose therapy.

Bovine ketosis, a metabolic disorder, is caused by impaired carbohydrate and fat metabolism and excessive production of ketone bodies (Radostits *et al*., 2000). It is of substantial economic significance and both clinical and sub-clinical ketosis are associated with production losses (Littledike *et al.*, 1981; Deluyker, 1989). Prevalence of ketosis is known since 19th century and even today this disease is detected in the primitive as well as the organized dairies (Lean *et al*., 1991). Clinical ketosis typically occurs spontaneously in susceptible high yielding dairy cows between the 2nd and 7th week of lactation (Dohoo and Martin, 1984; Grohn *et al.*, 1986). Varying clinical symptoms have been reported by different workers from different parts of the world (Radostits *et al*., 2000). Some of the symptoms are consistently repeated in majority of the cases and could possibly be utilized for its diagnosis under different agro-climatic and manage mental conditions. Biochemically, the disease is characterized by hypoglycemia, ketonaemia, ketonuria and low levels of hepatic glycogen (Radostits *et al*., 2000). The bulk of the economic loss is due to the loss of production while the disease is present and failure to return to full production after recovery (Waage, 1989) and treatment and management cost. Diagnosis of the disease is based on the clinical symptoms and determination of glucose levels in blood and ketone bodies in urine and milk. Several treatments for clinical ketosis like parenteral glucose solution, glucose plus insulin, corticosteroids, oral administration of sodium propionate and nicotinic acid have been reported with varying degrees of success (Shpigel *et al*., 1996 and Radostits *et al*., 2000). In some reports, a high percentage of recovery in clinical cases of bovine and ovine ketosis following oral glucose therapy has been reported (Herrler, 1989; Scholz, 1990 and Malik, 1996). The present work was, therefore, undertaken with the objectives to study the prevalence, clinical symptomatology, haematobiochemical findings and to evaluate the efficacy of different therapeutic regimens in treatment of bovine ketosis under field conditions.

MATERIALS AND METHODS

Total 19 recently calved crossbred cows from 2 local villages, cows brought to Veterinary Clinics and local Cattle Farms, Derna city of Libya were used for the present study. Detailed history, clinical observations and symptoms were recorded in each case found positive with Roth era's test. Urine and milk samples were subjected to detection of ketone bodies. For haematobiochemical studies, 10 ml of blood was collected from clinical cases of ketosis from jugular vein using aseptic syringes and collected in sterile heparinised glass vials. The sampling was done before treatment and after every 24 hours post-treatment. Hemoglobin

(Hb), packed cell volume (PCV), total erythrocyte count (TEC), total leukocyte count (TLC) and differential leukocyte (DLC) were estimated employing standard techniques as described by Jain (1986). Blood glucose was estimated by O-toluidine method (Winckers and Jacobs, 1971), blood urea nitrogen (BUN) by diacetylmonoxime method and plasma calcium by Cresolphthalein complexone method using reagent kits and plasma free fatty acids by the method described by Lowry and Tinsley (1976).

Out of these anorectic/partially anorectic dairy cows screened for urine and milk ketone bodies and blood biochemistry, 19 animals of 4-11 yr of age, 1-6th lactation and 0.5-6 months' post-partum were found positive for primary ketosis. These animals were randomly divided into three groups of 7, 6 and 6 animals each and treated by three different therapeutic regimens. The ketotic cows of Gr I were drenched 500 g of glucose solution immediately following premedication with 30 g of sodium bicarbonate solution orally. The animals of Gr II received two pints (1080 ml) of 25 percent glucose solution iv. The ketotic cows of Gr III were treated with corticosteroid (triamcinolone acetonide) @ 0.5 mg/kg b wt im. The treatments were repeated on 2-3 occasions depending upon the clinical response and recovery of the animals. The therapeutic approach was evaluated on the basis of recovery percentage, time required for complete recovery, frequency of relapses, repeat therapy, blood biochemistry and cost of treatment. The data were analyzed by Student's paired't'- test and Chi-square test (Snedecor and Cochran, 1976).

RESULTS AND DISCUSSION

In the present study, out of these anorectic/partially anorectic dairy cows screened for urine and milk ketone bodies and haematobiochemistry, 19 were found positive for primary (clinical) ketosis thereby. Our observations are in agreement with Dohoo *et al.*, (1983) and Bendixen *et al.*, (1987) who reported 4.4 and 4.41 percent of prevalence of clinical ketosis in Canadian Holstein-Friesian and Swedish Red cattle, respectively. Age-wise prevalence of clinical ketosis recorded in the present study was highest in the cows of 8-9 yr (47.36%) followed by 10-11 (31.57%), 6-7 (16.78%) and 4-5 (5.26%) yrs of age. Bhuin *et al.*, (1993) reported highest incidence of clinical ketosis in cow's ≥ 8 yrs of age. Increased incidence at higher age may be due to the decreased metabolic efficiency and decreased feed conversion efficiency of the animals. Lactation-wise prevalence was highest in 3rd lactation (42.10) followed by 4th (31.57%), 5th (10.52%) and 1st, 2nd and 6th (5.26% each) lactation in the study. A prevalence of 3, 7, 20, 22 and 13 percent in bovine ketosis at 1st, 2nd, 3rd, 4th and 5th or later

calving, respectively has been recorded (Kauppinen,1983). Animals usually in peak stage of lactation are highly susceptible to ketosis (Bergman, 1971), when nutrient demands of the mammary gland are an obvious challenge to the supporting metabolic activities of the body (Kronfeld, 1980). Clinical ketosis occurring in late pregnancy (Radostits *et al*., 2000) but mostly during 1st 10 days to 8 weeks after parturition has been observed. However, in the present study, maximum number of cases were recorded in 1 to 2 months (42.10%) followed by 0 to 1 (25.31%), 2 to 3 (15.78%), 3 to 4 (10.52%) and 5 to 6 (5.26%) months post-partum.

The body temperature in all the cases was within the normal range (100.8- 101.2^{0}F). Marginal elevation of respiration and pulse rates with reduced ruminal movements were also recorded. Urine and milk were clear and showed strong color (per magnate) reaction to Rothera's test. Similar observations have been made by Baird (1982) and Radostits *et al*. (2000) in ketotic cows. Initially there was sudden drop in milk yield followed by partial anorexia and selective feeding. Sudden drop in milk yield, selective feeding, wasting, anorexia, acetone smell in breath/milk, depression, nervous symptoms, constipation, dry and scanty feces and disinclination to move and to eat were the symptoms recorded in 100, 78.94, 73.68, 21.05, 47.36, 63.15, 31.57, 15.78, 36.84 and 5.26 per cent cases, respectively. Refusal of concentrates in 47.81 and 16.60 percent clinical cases of ketosis have been reported by Venkateshwarula *et al*. (1994) and Rao and Balakishan (1998), respectively. The Hb, PCV and TEC values showed non-significant changes during pre-treatment and post-treatment periods. However, there was a significant ($P<0.05$) increase in total leukocyte count of pre treatment ketosis which is in agreement with the observations of Chugh *et al*. (1992). The leucocytosis could be due to stress and adrenal hyperactivity (Radostits *et al*. 2000). The differential leukocyte count showed non-significant changes in neutrophil, lymphocyte, basophil and monocyte counts during pre-treatment and post-treatment periods. However, there was a moderate but statistically significant ($P<0.05$) increase in eosinophil count during ketosis before the treatment. In the present study, the objective of studying hematology was to ensure that clinical cases recorded were those of primary ketosis only and to rule out other chronic conditions and associated diseases.

The changes in biochemical values are presented in Table 1. Hypoglycemia in ketotic cows was found to be a consistent and significant biochemical finding and blood glucose levels were significantly lower before the treatment which returned to normal after the treatment at clinical recovery. This is in agreement with the observations of Radostits *et al*. (2000).

Hypoglycemia in ketosis is presumably due to large amount of glucose being removed by the mammary glands to make lactose coupled with insufficient food intake to replenish the glucose supply (Grohn *et al*. 1983). The increase in BUN levels during ketosis is because of altered metabolism wherein proteins and amino acids are mobilized from increased gluconeogenesis. T he significant fall in calcium levels could probably be due to increased loss of base in urine to compensate for acidosis which is generally associated with bovine ketosis (Radostits *et al*. 2000) or it may be secondary due to reduced feed intake (Cote *et al*. 1969). There was a significant increase in plasma free fatty acid levels in clinical ketotic cows before the treatment when compared with the values at clinical recovery after the treatment. Lipolysis in adipose tissue of ketotic cows results in elevation of free fatty acids in plasma (Brockman, 1979).

Table 1: Effect of treatments on biochemical values in clinical ketosis (n=19).

Parameter	Pre-treatment	Post-treatment
Blood glucose (mg/dl)	25.72 ± 0.90	56.35 ± 0.55*
Blood urea nitrogen (mg/dl)	27.56 ± 1.00	22.92 ± 0.64*
Blood calcium (mg/dl)	8.89 ± 0.24	10.96 ± 0.19*
Free fatty acids (mg/dl)	40.07 ± 0.79	33.13 ± 0.61*

*Significant at 5 per cent level ($p<0.05$)

The most significant economic loss observed in the present study was on account of decreased milk production due to bovine ketosis. The drop in milk yield ranged from 30 to 80 per cent with a mean of 54.12 ± 2.73 per cent. The fall in milk yield to the extent of 15 to 60 per cent has been reported in clinical ketotic cows (Miettene, 1994). Therefore, on the basis of drop in milk yield, duration of illness, cost of medication and the cost of management, the mean economical implications of bovine ketosis per animal was estimated to be Libyan dinars 20.13 ± 1.25 (1 USD= LYD 1.30) in the present study. Waage (1989) reported the annual economic loss caused by ketosis in dairy cows to the extent of 27 million Kroner (1USD= 7Nkr) plus an uncertain amount due to the reduced milk yield caused by clinical ketosis.

The comparative efficacy of different treatment regimens in bovine ketosis is given in Table 2. Animals of Gr I given oral glucose therapy gave a 100 per cent recovery. The recovery was associated with the disappearance of clinical symptoms and return of all biochemical parameters to normal levels (Table 1). The mean cost of treatment in oral glucose therapy was also much less than the parenteral glucose therapy. Our findings agree with Scholz

(1990), who successfully treated 23 cases of bovine ketosis with oral glucose therapy following premedication with vasopressin. Herrler (1989) reported a high recovery rate following treatment with oral glucose therapy after elicitation of reticular groove contraction and Malik (1996) observed 80 percent recovery rate with oral glucose therapy following premedication with vasopressin in ketotic ewes. The glucose reaches directly into the abomasum due to closure of reticular groove with sodium bicarbonate thereby avoiding the bacterial degradation in the rumen. The efficiency of oral glucose therapy seems to be related with slow and consistent absorption of glucose from abomasum and thus, maintaining the blood glucose levels over prolonged periods of time. Moreover, gut hormones released in response to oral glucose administration also play a role in maintaining glucostasis (Murray *et al*. 1993). Animals of Gr II receiving parenteral glucose also recorded 100 per cent recovery rate. However, only two animals recovered after 1st dose, whereas, one animal required 2nd dose and three required 3rd dose for complete recovery as also reported by other workers (Chug *et al*.1992; Radostits *et al*. 2000). Poor response of parenteral glucose therapy might probably be due to its inability to maintain blood glucose levels for sufficient time to allow the metabolic disturbances to stabilize. The animals of Gr III given corticosteroid (triamcinolone acetonide), showed only 33.33 per cent recovery rate. Prieto Montana *et al*. (1993) also reported similar findings. Four cases not responding to corticosteroid therapy were subjected to oral or parenteral glucose therapy following which an uneventful recovery was observed. Glucocorticoids increase blood glucose level by gluconeogenesis (Odedra *et al*. 1980).

Therefore, this study leads to the conclusion that oral glucose therapy following reticular groove closure effectively treats bovine ketosis, is more convenient and practically feasible under field conditions.

Table 2: Comparative efficacy of different treatment regimens in bovine ketosis.

Observations	Group I (Oral glucose)	Group II (Parenteral glucose)	Group III (Triamcinolone acetonide)
Percent recovery (%)	100	100	33.33
Mean recovery time (days)	2.33 ± 0.23	2.75 ± 0.36	5.66 ± 0.61
Frequency of relapses (%)	0.00	37.63	0.00
Recovery by single therapy (%)	88.88	25.00	0.00
Cost of treatment (LYD)	4.8 ± 0 .56	10.06 ± 1.30	7.60 ± 1.10

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