Indian Journal of Animal Sciences **82** (4): 369–373, April 2012

Rumen impaction in buffaloes A haemato-biochemical study

S A HUSSAIN[1] and S K UPPAL[2]

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab 141004 India

Received: 24 May 2011; Accepted: 29 October 2011

ABSTRACT

The present study was conducted on 13 buffaloes diagnosed with rumen impaction out of 173 buffaloes suffering from gastrointestinal disorders. The haemato-biochemical parameters of these 13 buffaloes were studied, together with 10 healthy buffaloes as control. Haematological picture revealed reversal of neutrophil to lymphocyte ratio. Left shift or toxic changes in neutrophils were observed in less than 50% of cases. The diseased buffaloes had significantly higher bilirubin, aspartate aminotransferase, glucose, blood urea nitrogen, creatinine, lactate and fibrinogen levels and significantly lower calcium, potassium, chloride and fibrinogen ratio than the control values. The levels of alkaline phosphatase, gamma glutamyltrasferase, cholesterol, triglyceride, total protein, albumin, globulin, sodium, phosphorus and magnesium did not differ significantly from the respective control values.

Key words: Biochemistry, Buffalo, Haematology, Rumen impaction

Rumen impaction is mainly encountered during the months of feed scarcity when dry feeds like wheat straw and paddy straw form a substantial part of the ration of the animals (Prasad and Rekib 1979). It occurs due to feeding of poor quality hay, straw or roughages deficient in protein and readily digestible carbohydrate, overeating of young grasses, ingestion of mouldy or decomposed feed, polythene bags, ropes and other plastic materials, and exposure to hot and dry weather conditions (Llewellyn 1976, Joshi and Misra 1977, Nwity and Chaudhary 1995, Kohli *et al.* 1998, Radostits *et al.* 2010). The clinical signs include decreased rumen motility or rumen atony, abdominal distension, anorexia, constipated faeces, occasional diarrhoea, normal to increased temperature, increased pulse rate, hard consistency of rumen and solid mass on left side on per rectal examination (Prasad and Joshi 1975, Rao 1987, Nwity and Chaudhary 1995). Most of the previous studies on biochemical changes in rumen impaction have been carried out on few parameters. So the present study was undertaken to investigate several aspects of blood biochemical profile in buffaloes showing rumen impaction.

MATERIALS AND METHODS

Selection of animals: The present study was conducted on 13 buffaloes, out of 173 clinical cases of gastrointestinal disorders, presented at Large Animal Clinics of Veterinary Teaching Hospital, Department of Teaching Veterinary Clinical Complex, GADVASU, Ludhiana during the study period from May 2009 to April 2010. The diagnosis of rumen impaction was done on the basis of hard consistency of rumen on per rectal examination (Grymer and Ames 1981) or exploratory laparorumenotomy.

Signalment and anamnesis: Detailed signalment, viz. age, sex, duration of illness, pregnancy and lactation status was recorded in all the animals. A detailed history of feed intake, water intake, type of feed, rumination status, defecation, calving status, any complaint in last pregnancy, reduction in milk yield, type of tympany, fever, pain and any prior treatment given were noted in every case.

Physical examination: Each animal was thoroughly evaluated for its general condition and hydration status. The physical parameters (rectal temperature, heart rate, respiration rate, colour of mucous membrane, muzzle status, rumen consistency and rumen motility) were recorded at the time of presentation in resting animal. Quantity and consistency of faeces in rectum, faecal colour, rumen consistency, rumen size and fill were recorded on rectal examination.

Haematological parameters: Blood samples (2 ml) were collected aseptically from jugular vein in EDTA coated vials. Haemoglobin (Hb, g/dL), packed cell volume (PCV,%), total leukocyte count (TLC, per/µl) and differential leukocyte count (DLC,% and per/µl) were estimated by standard methods (Benjamin 1985). Further a thorough examination

Present address: [1]Senior Research Fellow (draashiqhussain @gmail.com), [2]Professor, Department of Teaching Veterinary Clinical complex (skuppal@gadvasu.in).

of stained blood smears was done to determine blood cell changes such as left shift and toxic changes in neutrophils, if any.

Blood biochemical analysis: Blood samples were collected in acid free vials without any anticoagulant, serum was separated and transferred to a dry clean vial for storage at –20°C till further evaluation. For glucose estimation blood samples were collected in vials containing sodium fluoride. A commercial system was used for estimation of total bilirubin, aspartate aminotrasferase (AST), alkaline phosphatase (ALKP), gamma glutamyltrasferase (GGT), glucose, lactate, total protein, albumin, blood urea nitrogen (BUN), creatinine, sodium, potassium, chloride, calcium, phosphorus and magnesium. Cholesterol and triglyceride were estimated by autoanlyser using diagnostic kits. Blood samples (2 ml) were collected in sodium citrate coated vials for fibrinogen estimation. Plasma was separated and fibrinogen was estimated by heat precipitation method using hand held refractometer (Feldman *et al.* 2000).

Statistical analysis: The data were subjected to students *t*-test and means and standard errors were calculated for comparison between control and animals with rumen impaction. Significance was set at $P \leq 0.05$ and $P \leq 0.01$ levels.

RESULTS AND DISCUSSION

To the best of our knowledge, this is the first study to describe several biochemical changes of rumen impaction in buffaloes. The prevalence of rumen impaction was 7.51%, which may be actually higher than in general population of buffaloes, owing to inclusion of only those buffaloes which were confirmed to have gastrointestinal dysfunction. The historical findings and results of clinical examination are presented in Tables 1–3. Majority of animals were presented during green fodder scarcity period (May to July) and this corroborated with the findings of Prasad and Rekib (1979). It was also evident that majority of rumen impaction cases were associated with feeding of wheat straw which was in agreement with the findings of earlier workers (Toor and Saini 2008, Radostits *et al.* 2010). All the 13 buffaloes suffering from rumen impaction were 3–10 years old females and had been ill for 2–30 days (mean 7.00±2.11 days). Four animals were in mid pregnancy (3–6 months) and 1 animal was in advanced pregnancy (6–9 months). The animals were in first to sixth lactation except 1 heifer. On clinical examination, all animals were depressed and rumination was suspended in all cases. The pronounced clinical symptoms were anorexia, reduced water intake, congested mucous membranes, mild to moderate degree of dehydration, loss of defecation, absence of ruminal motility and hard rumen consistency on per rectal examination. These signs are similar to those reported by Prasad and Joshi (1975) and Nwity and Chaudhary (1995). None of the animals yielded peritoneal fluid. No abnormal sound was heard on auscultation of lungs and heart. Radiography of reticular area revealed no abnormality.

Table 1. Historical findings of 13 buffaloes with rumen impaction

Characteristic	Finding	Number of animals
Feeding pattern	Green fodder	1
	Green fodder and wheat straw	5
	Wheat straw	7
Feed intake	Reduced	1
	Absent	12
Water intake	Normal	1
	Reduced	12
History of abdominal pain	Present	1
	Absent	12
History of fever	Present	5
	Absent	8
History of tympany	Recurrent	1
	Absent	12
Defecation	Scanty	5
	Absent	8

Table 2. Clinical examination results of 13 buffaloes with rumen impaction

Characteristic	Finding	Number of animals
General condition	Moderately disturbed	5
	Severely disturbed	8
Visual examination	No abnormality	12
	Moderately distended on left side	1
Mucous membrane	Normal	2
	Congested	11
Dehydration	Mild	7
	Moderate	4
	Severe	2
Temperature	Normal (99-102^{0}F)	9
	Increased (>102^{0}F)	4
Heart rate/min	Normal (60-80)	8
	Low (<60)	3
	Slightly increased (81-90)	1
	Moderately increased (91-100)	1
Respiration rate/min	Normal (15-25)	6
	Slightly increased (>26-35)	7
Rumen motility	Reduced (<3/2minute)	1
	Absent	12
Rumen consistency	Hard	13

Haematology: The significant variations of haematological parameters from respective control values are presented in Table 4. Relative neutrophilia, absolute neutrophelia and leucopenia were recorded in 5, 3 and 1 cases, respectively, while in 4 cases no abnormality was observed

Table 3. Rectal exploration findings of 13 buffaloes with rumen impaction

Characteristic	Finding	Number of animals
Rumen size	Normal	6
	Moderate distension	5
	Severe distension	2
Rumen consistency	Hard	13
Intestines	Normal	11
	Mild distension	1
	Moderate distension	1
Rectal mucosa	Normal	10
	Sticky	2
	Bleeds easily	1
Hindered hand movements	No	10
	Yes	3
Faecal quantity in rectum	Reduced	1
	Scanty	6
	Negligible	2
	Absent	4
Faecal consistency	Normal	3
	Faeces Absent	4
	Pelleted	2
	Pasty	4

Table 4. Haematological parameters (mean ± SE) of apparently healthy buffaloes and those with rumen impaction

Measurement	Control (n=10)	Rumen impaction (n=13)
Haemoglobin (g/dL)	11.05±0.47	11.90±0.58
PCV (%)	34.43±1.43	37.53±1.70
Total leucocyte count (/µL)	9121.00±658.32	7684.62±824.88
Neutrophils		
(%)	36.60±1.52	54.08±4.84**
(/µL)	3347.60±273.95	4124.50±541.31
Lymphocytes		
(%)	61.50±1.38	43.92±4.72**
(/µL)	5607.78±426.40	3421.38±563.53**
Monocytes		
(%)	1.00±0.45	1.08±0.49
(/µL)	77.40±32.92	69.08±30.95
Esinophils		
(%)	0.90±0.31	0.92±0.59
(/µL)	88.22±30.87	69.65±46.44
Neutrophil/lymphocyte ratio	0.60±0.04	1.65±0.36*

*Difference significant at $P \leq 0.05$;**difference significant at $P \leq 0.01$.

on haematological examination. The toxic changes in neutrophils were mild in 3 cases and severe in 1 case. Left shift was mild to moderate in 4 cases and marked in 1 case. In present study Hb and PCV were within normal limits. However, there are different views regarding Hb and PCV in rumen impaction. Hb has been reported to be normal (Nagarajan and Rajmani 1973), increased (Dakshinkar *et al.* 2002) or decreased (Nwity and Chaudhry 1995) while PCV may be increased (Nagarajan and Rajmani 1973, Rao 1987 and Dakshinkar *et al.* 2002) or decreased (Nwity and Chaudhry 1995). Neutrophilia might have resulted from chronic irritation of the forestomach wall by impacted feed materials, leaving the wall exposed to secondary infection, which resulted in inflammation (Hailat *et al*. 1996). Decreased lymphocytes could be due to release of corticosteroid as a result of stress (Feldman *et al.* 2000).

Biochemical analysis: The significant differences of various biochemical parameters from control values are presented in Table 5. The increased bilirubin level in present study may be attributed to absorption of toxic substances from rumen (Pienkowski 1969). Impaired uptake and excretion of bilirubin due to deranged liver function, as evident by increased liver enzymes, may have resulted in increased serum bilirubin concentration. The increased bilirubin may also be due to constipation and starvation (Kaneko *et al.* 2008). The possible cause of higher AST could be necrosis of liver due to toxaemia from the damaged rumen mucosa (Garry 2002). In rumen impaction the putrefied ingesta liberates toxic amines like histamine in rumen which after absorption into circulation increases BUN concentration (Dain *et al.* 1995). The increased BUN level could also be

Table 5. Biochemical parameters (mean ± SE) of apparently healthy buffaloes and those with rumen impaction

Measurement	Control (n=10)	Rumen impaction (n=13)
Total bilirubin (mg/dL)	0.09±0.01	2.02±0.44**
AST (U/L)	123.30±8.59	374.08±44.55**
ALKP (U/L)	105.90±13.37	121.69±34.99
GGT (U/L)	41.30±3.08	59.77±16.74
Glucose (mg/dL)	61.30±2.66	97.00±16.27**
Cholesterol(mg/dL)	61.30±6.65	63.59±7.81
Triglyceride (mg/dL)	41.80±1.82	31.33±5.21
Lactate (mmol/L)	0.81±0.07	7.40±1.63**
Total protein (g/dL)	7.36±0.12	6.91±0.32
Albumin (g/dL)	3.34±0.05	3.08±0.14
Globulin (g/dL)	4.02±0.08	3.82±0.33
Fibrinogen (g/dL)	0.32±0.05	0.75±0.15*
Fibrinogen ratio	26.11±3.24	14.54±3.34*
BUN (mg/dL)	20.30±1.21	41.08±5.19**
Creatinine(mg/dL)	1.58±0.11	2.90±0.54*
Sodium (mmol/L)	140.90±2.00	128.85±2.37
Potassium (mmol/L)	4.33±0.14	3.45±0.35*
Chloride (mmol/L)	102.50±1.71	80.38±2.72**
Calcium (mmol/L)	9.34±0.31	7.98±0.29**
Phosphorus (mmol/L)	5.70±0.18	5.18±0.54
Magnesium (mmol/L)	2.60±0.23	3.37±0.43

*Difference significant at $P \leq 0.05$; **difference significant at $P \leq 0.01$.

attributed to decrease in renal blood flow as a part of compensatory mechanism to maintain circulation in hypovolemia associated with dehydration (Kaneko *et al.* 2008) and same phenomenon may be held responsible for increased creatinine concentration. Moreover, during ruminal disorders there is failure of urea cycling process and urea is not utilized by rumen microbes (Singh *et al.* 2001).

The increase in glucose level may be due to stress of impaction leading to adrenocorticosteroid release, which has glycogenolytic effect, causing hyperglycemia. The secretion of insulin in ruminants is induced by butyrate and propionate (Mann and Boda 1966) which in turn may lead to suppression of gluconeogenesis and increases in lipogenesis. After rumen impaction volatile fatty acids are not synthesized in sufficient quantity to meet the energy demand, so the animal has to depend on oxidation of glucose rather than volatile fatty acid metabolism (Kaneko *et al.* 2008).

The lactate level was higher than reference (0.6–2.2 mmol/l, Radostits *et al.* 2010) and control value. The lactate level of blood is elevated when the rate of lactate production exceeds its use. An increase in blood lactate implies increased anaerobic metabolic activity, plus or minus a decrease in hepatic utilization and, to a lesser extent, renal excretion. Hughes (1999) has suggested that the degree of hyperlactatemia is directly associated with the severity of hypoperfusion. In present study, dehydration could be the causes for hypoperfusion and increased lactate level. According to Allen and Holm (2008) tissue hypoxia, responsible for increased lactate levels, may have several causes such as hypoperfusion (decreased cardiac output or hypovolemia), anaemia (decreased arterial blood oxygen content) or oedema (decreased tissue ability to mobilise oxygen). Furthermore, Vary *et al.* (1988) reported that not only hypovolemia or oxygen debt but also metabolic conditions such as hepatic malfunction with decreased lactate uptake or diabetic ketoacidosis may induce hyperlactatemia.

Fibrinogen is said to be sensitive indicator of inflammation in bovines (Prathaban and Gnanaprakashan 1990). The increased fibrinogen in present study may be due to tissue inflammation which was apparent on haematological examination. The normal fibrinogen ratio in bovines is >15 (Feldman *et al.* 2000) and this ratio gives more realistic picture of increased fibrinogen in inflammatory conditions and rules out any alterations due to dehydration. So the lower fibrinogen ratio (14.54±3.34) in present study indicated marked increase in fibrinogen.

Hypokalemia could be attributed to anorexia and urinary loss of potassium (Ward *et al.* 1993). Hypokalemia could also be due to fasting and adaptive response to continued hypoadrenocortical activity due to chronic stress (Kaneko *et al.* 2008). According to Sielman *et al.* (1997) inappetance to anorexia for a number of days would cause a fall in plasma potassium concentration below normal because ruminant diet is rich in potassium. Same may be the reason for lower potassium in majority of animals in present study. Hypocalcaemia and hypochloremia may be due to less assimilation of feed materials as a result of long standing anorexia (Sethuraman and Rathore 1979, Radostits *et al.* 2010). Daniel (1983) reported that both rumen and abomasal motilities were similarly reduced in hypocalcemia due to general effect of depression of levels of ionised calcium on smooth muscle contractibility. Similarly, reduced calcium level in present study may have contributed to decreased ruminal motility.

The study revealed 7.51% prevalence of rumen impaction in buffaloes. Most of the cases were associated with feeding of wheat straw and mainly occurred in summer. The haematological changes were–increase in number of neutrophils and corresponding decrease in lymphocytes. None of the animals showed neutrophilic leukocytosis. Left shift or toxic changes in neutrophils was not a consistent finding. The biochemical alterations were deranged liver and kidney function tests increased fibrinogen and lactate decreased fibrinogen ratio, calcium, potassium and chloride levels. So these biochemical changes should be taken into consideration while treating rumen impaction in buffaloes.

ACKNOWLEDGEMENTS

The authors would like to thank Dr Sushil Prabhakar, Professor cum Head, Department of Teaching Veterinary Clinical Complex, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India, for providing the research facilities.

REFERENCES

Allen S E and Holm J E. 2008. Lactate: physiology and clinical utility. *Journal of Veterinary Emergency and Critical Care* **18**: 123–32.

Benjamin M M. 1985. *Outline of Veterinary Clinical Pathology*. Pp. 60–63, 71–75. Kalyani Publisher, New Delhi, India.

Dain T A, Neal A L and Dougherty R W. 1995. The occurrence of histamine and tyramine in ruminal ingesta of experimentally urea fed sheep. *Journal of Animal Science* **14**: 930–55.

Dakshinkar N P, Bhonje G R and Suklikar S B. 2002. Ruminal acidosis in cattle. *Indian Veterinary Journal* **72**: 1132–33.

Daniel R C W. 1983. Motility of rumen and abomasum during hypocalcemia. *Canadian Journal of Comparative Medicine* **47**: 276–80.

Feldman B F, Zinkl J G and Jain N C. 2000. *Schalm's Veterinary Haematology*. 5th edn. Lee and Febiger, Philadelphia.

Garry F B. 2002. Indigestion in ruminants. *Large Animal Internal Medicine*. 3rd edn, Pp 748. (Ed.) Smith B P. Mosby Inc, Philadelphia, USA.

Grymer J and Ames N K. 1981. Bovine abdominal pings. Clinical examination and differential diagnosis. *Compendium on Continuing Education of Practicing Veterinarians* **3**: 311–18.

Hailat N, Nouth S, Al-Darraji A, Lafi S, Al-Ani F and Al-Manjali A. 1996. Prevalence and pathology of foreign bodies (plastic) in Awassi sheep in Jordan. *Small Ruminant Research* **24**: 43–48.

Hughes D. 1999. Lactate measurement: Diagnostic, therapeutic and prognostic implications. *Kirk's Current Veterinary Therapy Small Animal Practice*. XIII. Pp. 112–16.(Ed) Bonagura J. Philadelphia, WB Saunders,

Joshi B P and Mishra S S. 1977. Clinico-pathological basis of classification of spontaneous rumen dysfunction in zebu and buffaloes. *Indian Veterinary Journal* **54**: 105–09.

Kaneko J J, Harvey J W and Bruss M L. 2008. *Clinical Biochemistry of Domestic Animals*. 6th edn. Academic Press, London.

Kohli R N, Nadaf H and Ghardradan. 1998. Bovine indigestion due to chronic ruminal engorgement associated with ingestion of plastic materials: A retrospective study of 54 cases. *Indian Journal of Veterinary Surgery* **19**: 105–06.

Llewellyn C A. 1976. Acute impaction of the rumen in a heard of Friesian cows. *Veterinary Research* **99**: 456–57.

Mann J G and Boda J M. 1966. The influence of age of lambs on the ketogenicity and butyrate and tolerance to exogenous in vivo. *Journal of Agricultural Science* **6**7: 377–80.

Nagarajan V and Rajamani S. 1973. Alkaline indigestion and rumen putrefaction in cow. *Indian Veterinary Journal* **50**: 1147–51.

Nwity T N E and Chaudhary S V R. 1995. Ruminal impaction due to indigestible materials in the arid zone of Borno state of Nigeria. *Pakistan Veterinary Journal* **15**: 29–33.

Pienkowski M. 1969. Estimation of the functional state of liver in cows with acid indigestion. *Annals universitatis, Marial Curie-Skalodowska, Lublin Pulonia, Section* Vol XXIV **18**: 209–22.

Prasad and Rekib A. 1979. Studies on dietetic abnormalities in ruminants 1- Seasonal dynamics and etio-diagnosis of primary anorexia. *Indian Medicine Journal* **3**: 171–75.

Prasad T and Joshi B P. 1975. Biochemical exploration of primary rumen impactions in zebu and buffaloes. *Indian Veterinary Journal* **52**: 266–69.

Prathaban S and Gnanaprakashan V. 1990. Studies on plasma fibrinogen level of Indian crossbred cow in health and disease. *Indian Veterinary Journal* **67**: 453–56.

Radostits O M, Gay C C, Hinchcliff K and Constable P D. 2010. *Veterinary Medicine. A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats* 10th edn. Saunders Elsevier, Philadelphia.

Rao D S T. 1987. Importance of impaction of rumen in bovines. *Livestock Advisor* **12**: 25–26.

Sethuraman V and Rathor S S. 1979. Clinical, haematological and biochemical studies in secondary indigestion in bovines due to traumatic reticulitis and diaphragmatic hernia. *Indian Journal of Animal Sciences* **49** (6): 703–06.

Sielman E S, Sweeney R W, Whitlock R H and Reams R Y. 1997. Hypokalemia syndrome in dairy cows. *Journal of American Veterinary Medical Association* **210**: 240–43.

Singh N, Kumari R and Akbar M A. 2001. Ruminal pH as a regulator of blood metabolites in lactating Murrah buffaloes. *Indian Veterinary Medicine Journal* **25**: 253–56.

Toor A S and Saini N S. 2008. Diagnostic and prognostic indicator of omasal impaction in buffaloes (*Bubalus bubalis*). *Veterinary Record* **162**: 275–78.

Vary T C, Siegel J H, and Rivkind A. 1988. Clinical and therapeutic significance of metabolic patterns of lactic acidosis. *Perspectives Critical Care* **1**: 85–132.

Ward J L, Smith D F, Fubini S C and Grohn Y T. 1993. Comparison of 0.9, 3.6 and 7.2% sodium chloride for correction of experimentally induced hypochloremic, hyperkalemic metabolic alkalosis in sheep. *American Journal of Veterinary Research* **54**: 1160–69.