

Water intoxication in cattle

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ABSTRACT

Water intoxication is a condition that is common in cattle, and has also been reported in other domestic animals and man. A comprehensive description of the condition is lacking. For a better understanding of the condition, this paper reviews work that has been reported previously by various authors.

Key words: adult cattle, calves, milk, salts, water intoxication.

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INTRODUCTION

Water intoxication is a condition that occurs when excessive quantities of water are ingested by very thirsty animals³. It commonly occurs in animals that have been subjected to severe exercise or high environmental temperatures¹⁶.

Water intoxication was first reported as a distinct syndrome in man²⁸. Subsequently, naturally occurring cases have been reported in man^{12,17,25}, sheep¹, pigs¹⁹, camels²⁷, calves^{2-7,10,11,13,16,18,24,26,29} and adult cattle⁸. Calves are the most commonly affected animals³.

ANIMALS AFFECTED

In cattle, the condition has been reported to occur in all ages, but it is more common among calves 2–10 months of age and is most frequent in calves 3–5 months of age^{2,7,8,29}. All breeds of cattle are affected. The condition has no sex predilection.

PREDISPOSING FACTORS

A number of factors predispose calves to water intoxication¹⁵. Young bucket-fed calves usually drink excessive quantities of water if it is offered to them in the manner in which they usually receive their milk. Under such circumstances, the limit of their consumption is apparently governed not by satiety, but by the physical limit of capacity of the gut. Another predisposing factor is the high ruminal capacity to hold ingested water as compared with total body size.

Chronic subclinical dehydration ac-

companied by increased environmental temperature, exercise or increased body water loss due to diarrhoea or fever also predisposes calves to water intoxication. Calves in an oliguric state or those that fail to rapidly develop diuresis after water overloading have a higher predisposition to water intoxication than normal calves.

More recent findings indicate that failure to provide calves with both water and salts²⁷ from as early as 2 weeks of age to weaning predisposes them to water intoxication^{20,22}. Under experimental conditions, calves raised solely on milk from 2 weeks of age to weaning developed the condition while those raised on milk, water and salts did not. The salts used in the experiment included many minerals. However, the authors did not determine the role that each mineral component of the salt played in prevention of water intoxication.

Age has also been reported to predispose animals to the condition¹⁴. Haemoglobinuria is found most frequently in calves 3–5 months of age.

In adult cattle, the most common predisposing factor is chronic subclinical dehydration due to prolonged failure of water supply, accompanied by increased environmental temperature. They develop chronic oliguria and fail to rapidly develop diuresis after water overloading⁸.

HISTORY

In Kenya, a similar case history is given by farmers in almost all cases reported

(Clinical Records, Large Animal Clinic, Clinical Studies Department, University of Nairobi). Animals are exposed to a water source where they drink *ad libitum* after a long period of restriction and they then start voiding 'bloody' urine. The farmer may report having raised calves on milk or milk substitutes alone, without access to additional water, followed by either unlimited water supply or an automatic water source^{7,8,29}. One or 2 calves are usually involved on small-holder farms, while several may be involved on large beef and dairy farms²⁹. In adult cattle, the commonly reported cases involve beef herds raised on rangelands that have had no water supply, followed by excess supply⁸.

CLINICAL SIGNS

In a group of calves, water intoxication may be manifested in all or only a few of the animals^{2,9,18,29}. Clinically, the condition is characterised by haemoglobinuria and nervous signs. The nervous signs include hyperaesthesia, muscular tremors, nystagmus and lethargy^{20,22}. Mild cases recover in 3–4 hours. In severely affected animals, lethargy may progress to depression and coma, and death occurs in 24–48 hours^{11,15,20,22}. In some cases haemoglobinuria is the only clinical sign observed^{22,29}; in others, the nervous signs predominate and haemoglobinuria is not detected^{7,9}. Additional signs include hypothermia, salivation, severe ruminal tympany, colic, diarrhoea, arrhythmia, oedema of the eyelids and erection of body hair^{7,11,15,20}.

In adult cattle, water intoxication is manifested clinically by haemoglobinuria. Other signs present in calves are rare. Unlike camels²⁷, bloody diarrhoea and abortion have not been recorded in cattle.

PATHOGENESIS

After drinking too much water, animals develop a state of positive water balance. The excess water circulating in the body leads to haemodilution. In cases of water intoxication in both calves and adult cattle under experimental conditions, a sharp drop in plasma Na⁺ concentration due to haemodilution has been reported^{21,22}. This leads to increased absorption of water

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*The salt (Maclik Super[®], Unga Feeds, Kenya) used had the following constituents: NaCl 27%; Ca 18.51%; P 11.00%; Mg 3.00%; Fe 0.50%; Cu 0.16%; Mn 0.40%; Zn 0.50%; S 0.40%; Co 0.02%; I 0.02%; Se 0.0015%; Mo 0.0002%.

down a concentration gradient into the cells. Cellular hydration occurs and in organised tissues, the cells increase in turgidity; this is evident in the brain, where oedema occurs, causing nervous signs^{3,22,23}. In unorganised tissues, particularly the erythrocytes, hypotonicity of the blood leads to lysis of the cells and the resulting haemolysis may cause severe anaemia and haemoglobinuria^{3,22-24}. In calves, haemoglobinuria has also been attributed to fragility of erythrocytes. The osmotic fragility of erythrocytes has been found to be higher in calves suffering from water intoxication than those that do not suffer from the condition²². In adult cattle, fragility of erythrocytes has not been reported to play a role in the pathogenesis of water intoxication.

POST MORTEM LESIONS

In both calves and adult cattle, the carcass is usually in poor condition and shows severe ruminal tympany^{8,22,23}. Grossly, there may be fluid in both the abdominal and thoracic cavities. The fat in the coronary grooves of the heart may be gelatinous. The urinary bladder usually contains red urine. The kidneys appear dark. In calves, the sulci on the surface of the brain are flattened, indicating a degree of oedema. This has not been reported in adult cattle. Unlike in the camel, rupture of the abomasum has not been observed in either calves or adult cattle. Ruptured abomasum has been reported to be the only significant *post mortem* finding in camels²⁷.

Microscopic changes have been reported only in calves. Histological examination reveals oedema and haemorrhage of the brain parenchyma²³. Cerebral veins and venules are congested and fill the Virchow-Robin spaces. The kidney may show marked lymphocytic infiltration of the cortex and fibrosis around the capillaries. The renal medulla may have areas of haemorrhage and congested capillaries. The epithelial cells of the kidney tubules contain fine, red granules. The urinary bladder may have areas of oedema, both beneath the stratified mucosa and in the muscular layer²³.

DIAGNOSIS

Diagnosis of water intoxication is based on age incidence, history of free access to water after a period of restriction, rapid onset of nervous signs and mortality, haemoglobinuria and the finding of pulmonary oedema at necropsy^{7,22}. Confirmatory diagnosis is achieved by elimination of other diseases that cause nervous signs and haemoglobinuria in cattle and, retrospectively, by response to treatment.

DIFFERENTIAL DIAGNOSES

Water intoxication needs to be distinguished from other diseases that cause nervous signs and haemoglobinuria. Numerous diseases and intoxications can cause nervous signs in cattle of various ages. Babesiosis is the most usual cause of haemoglobinuria in adult cattle, and may sometimes be observed in calves.

TREATMENT

Hypertonic saline (5 %) given intravenously has been recommended for treatment of water intoxication⁹. However, this is effective only in mild to moderate cases. In severe cases, use of both 5 % dextrose-saline solution intravenously and a tranquilliser such as acetylpromazine has been found to achieve a better response in calves^{11,22}.

PREVENTION

Prevention of water intoxication can be achieved by provision of salts and water *ad libitum* to calves from as early as 2 weeks of age. The salts may be provided as blocks or powder licks for the calves to lick *ad libitum*²².

WATER INTOXICATION AND SALT POISONING

Whereas water intoxication results from a state of positive water balance within the body, salt poisoning occurs when excessive amounts of salt are ingested or animals have been drinking saline water without access to fresh water. The salt ingested causes irritation of the gastrointestinal tract. This is manifested as diarrhoea with mucous in the faeces, depression of body temperature, abdominal pain and anorexia. Some salt is absorbed and may cause involvement of central nervous system. The signs in this case are similar to those of water intoxication in calves. However, a nervous syndrome due to salt poisoning is present in both calves and adult cattle, while that due to water intoxication is common only in calves. Haemoglobinuria is the most common clinical sign in cases of water intoxication but has not been reported in salt poisoning. In salt poisoning, the plasma Na⁺ is elevated while in water intoxication it is lower than in healthy animals.

Cattle that die of salt poisoning show marked congestion of the mucosae of the omasum and abomasum. Fluid faeces that are dark in colour may be present.

Treatment of salt poisoning involves removal of the toxic feed or water and provision of fresh water in small quantities. In cases of nervous involvement, treatment is similar to that for water intoxication in calves with nervous signs.

REFERENCES

1. Abdelrahim A I, Hagir B S, Talgeldin M M and Shommein A M 1985 Acute water intoxication in sheep in Sudan. *Revue d'Élevage et de Médecine Vétérinaire des Pays Tropicaux* 38: 180-184
2. Ascoli E W 1936 Water intoxication in calves. *Veterinary Record* 48:1082
3. Blood D C, Radostits O M 1989 *Veterinary medicine, a textbook of the diseases of cattle, sheep, pigs, goats, and horses* (7th edn). Baillière Tindall, London
4. Dolci G 1957 Lemoglobinuria parossistica da sovraccarico idrioc del vitello. *Goat vet, Milano* 4: 18-20
5. Fernegel E 1936 Paroxysmal haemoglobinuria in young calves. Inaugural dissertation, Hanover: 53, abstracted in *Veterinary Bulletin* 11: 113
6. Gibbons W J 1965 Water intoxication. *Modern Veterinary Practice* 40: 84
7. Gibson E A, Counter D E, Barnes E G 1976 An incident of water intoxication in calves. *Veterinary Record* 98: 486-487
8. Gray T C 1970 Dehydration and water intoxication of range cattle. *Journal of the American Veterinary Medical Association* 157: 1549-1556
9. Hannan J 1965 Water intoxication in calves. *Irish Veterinary Journal* 19: 211-214
10. Harvey F T 1936 Water poisoning in calves. *Veterinary Record* 48: 641
11. Harwood D G 1976 Water intoxication in calves. *Veterinary Record* 99: 76
12. Helwig F C, Schulz C B, Kuhn H P 1938 Water intoxication. *Journal of the American Medical Association* 110: 644-645
13. Hornbogen F 1938 Blood picture in experimentally produced haemoglobinuria in calves. *Inaugural dissertation*, Berlin
14. Jain N C 1986 *Schalm's veterinary hematology* (4th edn). Lea and Febiger, Philadelphia
15. Kirkbride C A, Frey R A 1967 Experimental water intoxication in calves. *Journal of the American Veterinary Medical Association* 151: 742-746
16. Lawrence J A 1965 Water intoxication in calves. *Journal of the South African Veterinary Association* 36: 377-378
17. LeQuesne L P 1954 Post operative water retention. *Lancet* 266: 172
18. Llewellyn-Jones H 1936 Excess of water as a cause of haemoglobinuria. *Veterinary Record* 48: 1056
19. Lu W H, Xie Q R, Zhao T L, Yang R Y, Dong F L, Fen S W, Lu H Z, Zhou Q 1984 Water intoxication in pigs. *Journal of Veterinary Science*, Technical No. 4: 15-19
20. Maribei J M, Njoroge E M, Mbugua P N 1998 Clinical manifestation of experimental water intoxication in calves. *Indian Journal of Animal Science* 68: 531-532
21. Mielke H 1979 Elicitation of increased diuresis, and of water intoxication induced by diuresis inhibition, by oxytocin and vasopressin in lactating cows. *Archiv für Experimentelle Veterinärmedizin* 33: 569-593
22. Njoroge E M 1993 Studies on experimental water intoxication in calves. MSc thesis, University of Nairobi
23. Njoroge E M, Maribei J M, Mbugua P N 1997 Pathological changes of calves suffering from experimental water intoxication. *Onderstepoort Journal of Veterinary Research* 64: 110-114
24. Papadaniel S 1955 Paralytic haemoglobinuria and pulmonary oedema in calves following ingestion of large quantities of water. *Delter Hellen Kten Hetair* 2: 619-623,

- abstracted in *Veterinary Bulletin* 2: 76
25. Scott J C, Welch J S, Berman I B 1965 Water intoxication and sodium depletion in surgical patients. *Obstetrics and Gynaecology* 26: 168–175
26. Verhoeff J 1980 Water intoxication in calves. *Tijdschrift voor Diergeneeskunde* 105: 727–728
27. Waitumbi J N, Conor R J 1987 Beware of watered camels. *Veterinary Record* 121: 407
28. Wier J E, Larson E E, Rowntree L G 1922 Studies in diabetes insipidus, water balance and water intoxication. *American Medical Association Archives. Internal Medicine* 29: 306–330
29. Wright M A 1961 Hemoglobinuria from excess water drinking. *Veterinary Record* 73: 129–130