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Case Review: Therapeutic Approach to Post Parturient Hemoglobinuria in Cattle

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Abstract

Post parturient hemoglobinuria (PPH) is considered as metabolic disorder which primarily occurs due to deficiency of phosphorus nutrient inside the body of animal. This deficiency can have multiple causes such as poor dietry uptake, excessive discharge from milk (in case animal is lactating) and no replenishment from diet etc. The pathophysiology of PPH is closely associated with excessive haemolysis of erythrocyte due to increase fragility of erythrocytic wall that is in turn due to phosphorus deficiency. Here in this presented case, the lactating buffalo who parturiated 20 days ago, had complaint of haematuria, inappetence and reduction in milk production. Though the signs and other accessory symptoms were self-explanatory, the modalities like estimation of cbc and serum calcium and serum phosphorus were carried out to support tentative diagnosis and help arrive at conclusion w.r.t. diagnosis. Also keeping in mind other differentials, the blood smear examination was carried out, which yielded negative result (negative for any blood protozoa like babesia). The line of treatment included Buffered phosphorus and inosine injection, antioxidant injection, oral phosphorus powder, and supportively B-complex injection and intravenous fluid administration carried out. The medical management proved to be very efficient both in terms of improvement in blood parameters as well as colour of urine (which return to normal 5 days after treatment). Active, alert and appetite presenting animal thus recovered fully from metabolic disorder of PPH.

Keywords: Lecithin cholesterol acyltransferase (LCAT), PPH, Haematuria, Hypophosphatemia

Introduction

Postpartum hemoglobinuria (PPH) is a non-infectious condition that occurs occasionally and is mostly observed in bovines worldwide. High-yielding cows and buffaloes are most frequently affected by PPH in the early stages of pregnancy and lactation (Rahmati et al., 2021). PPH observed Due to phosphorus deficiency (Choudhary and Yadav, 2014) which is characterized in adult dairy cattle when it often experience intravascular hemolysis, hemoglobinemia, hemoglobinuria, and anemia, pph is more common during their third to sixth lactation (Gahlawat et al., 2007; Akhtar et al., 2007; Durrani et al., 2010). There is broad consensus that PPH is linked to hypophosphatemia in early stages of milk production in highly productive milking cows. If a Phosphorus shortage in the diet is severe enough or persists long enough, it can cause decreased milk production, develop pica, or corrupted appetite, and lower appetite and feed utilization efficiency (Underwood, 1981).

Case presentation:

A recently 5-year-old buffalo who recently undergone third parturition 20 days ago was presented with complaint of dark colour with foam and a generalized weakness since three days. The other clinical findings were constipation, decreased milk output and inappetance. The animal was kept indoor and supplemented mostly with the green fodders. Clinical examination revealed pale mucous membranes (Plate 1), dark urine (Plate 2), heart rate 98 beats per minute, respiratory difficulty and a normal rectal temperature (100°F). The animal was in a normal posture and gait, skin coat revealed moderate dehydration. Normal shape and size of pre-scapular lymph nodes, body coat bereft of ticks, mucous membrane was pale, Dry and firm feces voiding regularly. The illness was initially identified as postparturient-hemoglobinuria related to dietary phosphorus deficiency and hypophosphatemia according to clinical symptoms over which other diagnostic modalities were used.

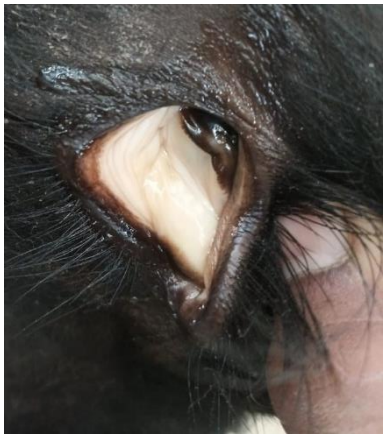


Plate 1- Pale mucous membrane before treatment

Plate 2- Dark coloured urine before treatment

Plate 3- Slight Pinkish mucous membrane post treatment

Plate 4- Normal Coloured urine post treatment

Diagnosis

For estimation, pretreatment samples such serum, whole blood, and urine were also gathered. Giemsa's stain was used to generate thin blood smears, which were then examined for blood parasites in the erythrocytes to distinguish hemoprotozoal illness. Hemoprotozoan parasites were not detected in the blood smear. Anemia (decreased Hb), hemoglobinuria, decreased packed cell volume (PCV), total leukocyte count (TLC), differential leukocyte count (DLC), and hemoglobinuria were all revealed by hematological data (Table 1). Table 2 shows that the buffaloes had a low level of serum inorganic phosphorus (2.1 mg/dl) according to the biochemical study.

Table 1: Hematological analysis

Parameter	Before treatment	After treatment	Reference values
Hemoglobin (gm%)	5.5	10.7	10-14
PCV (%)	17.5	31.7	30-40
TLC (10^3 /cumm)	6.8	7.2	6-12
TEC(10^6/cumm)	2.85	6.3	5.5-8.5
Neutrophils (%)	53	39	30-40
Lymphocytes (%)	38	64	50-65

Eosinophils (%)	02	02	1-2

Table 2: Biochemical analysis

Parameters	Before treatment	After treatment	Reference values
Calcium ((mg/dl)	7.94	10.7	9.7-12.4
Phosphorus (mg/dl)	2.1	5.3	5.6-6.5

Line of treatment and basis of treatment:

Inj. Novizac 50ml I.V on first day (25ml I.V for next 4 days) diluted in Inj NS.

According to the study, the primary biochemical abnormality in phosphorous deficiency is caused by reduced erythrocyte glucose uptake, which in turn results in low levels of cellular ATP, reduced glutathione, reduced nicotinamide adenine dinucleotide (NADH), and 2,3-Diphosphoglycerate (2,3-DPG).The in vivo effects of inosine (present as one of constituent of Novizac) pyruvate, and phosphate on the oxygen-hemoglobin affinity in rhesus monkeys are reported in Blood Journal, vol. 39, No. 4 (April), 1972. According to the tests, erythrocyte 2, 3-DPG levels can be raised by administering inosine, pyruvate, and phosphate.

The finding that replenishing inorganic phosphorous in vivo or in vitro results in the correction of all metabolic abnormalities and recovery further supports the function of phosphorous in this disease.

Inj Ascorbic acid @ 15-20mg/kg IV as antioxidant for 5 days.

According to Soren et al. (2014), a stronger response was observed when the aforementioned medication was combined with ascorbic acid, an antioxidant that helps to lower intravascular hemolysis and RBC oxidative stress.

Inj Iron dextrose 10 ml IM was given on alternate two days

The reticuloendothelial system's macrophages consume iron dextran through endocytosis. Ferrous iron (Fe[2+]) is released when the freshly formed endosome fuses with the acidic lysosome, causing the carbohydrate shell to split. Fe(2+) is released from its complex and then transported by the divalent metal transporter 1 (DMT1) over the endolysosomal membrane and into the cytoplasm. There, it can be stored as a Fe-ferritin complex or transported into the bloodstream by the transmembrane protein ferroportin. Fe(2+) enters the bloodstream and is instantly converted by ceruloplasmin to ferric iron (Fe[3+]). Transferrin then binds the iron and transports it to different parts of the body for use, such as the liver for storage or the bone marrow for hemoglobin synthesis.

Inj. B complex 15 ml IM

Inj. 20% Dextrose20 500 ml IV given as a supportive treatment for 5 days.

Both of these were administered as supportive therapy in this case.

To maintain the serum phosphorus levels, 100 grams of powdered sodium acid phosphate was given orally for next five days.

Post-treatment recovery:

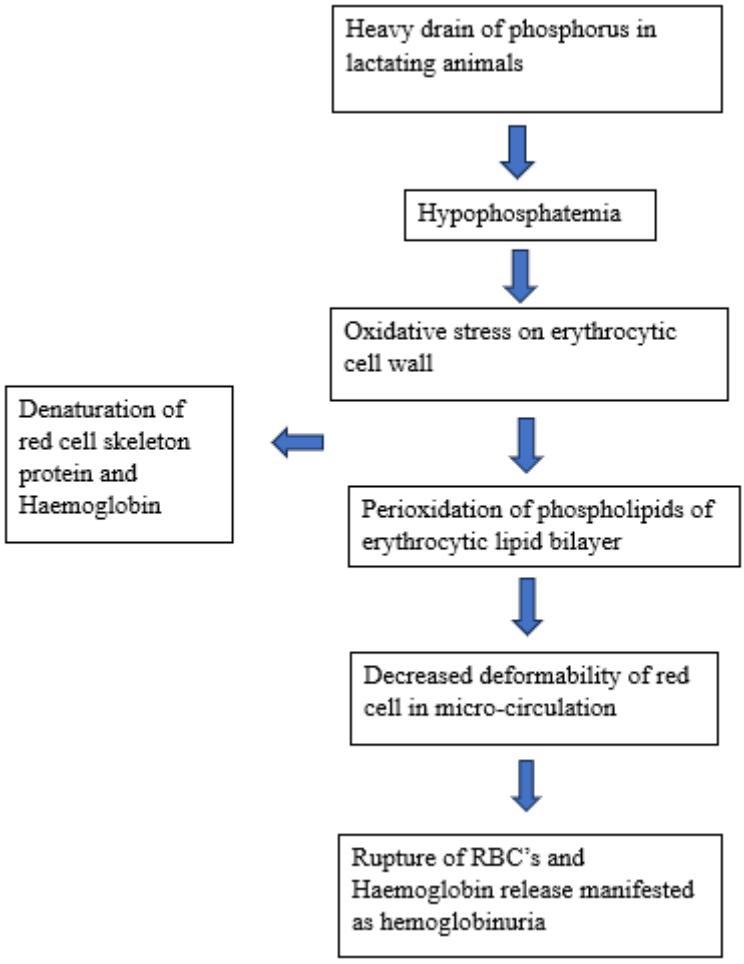
As shown in above blood investigation the overall increase in haemoglobin, PCV, TEC as well as serum calcium and phosphorus concertation was, evidence about the appropriateness of diagnosis and administered treatment (Table 1 and Table 2). The urine colour was also return to normal within 4 days of treatment. What was pale conjunctiva before initiation of treatment turned around normal colour. Appetite enhancement, active and alert animal with gradual increase in milk production were signs of improvement. (Plate 3 and Plate 4).

Discussion

Reductions in blood serum phosphorus levels disrupt the phospholipid layers of red blood cells, leading to hemoglobinuria, reduced milk supply, anorexia, and, in cases where treatment is not received, animal mortality become inevitable. Drought circumstances and phosphorus-deficient soils are assumed to be related factors, and the illness frequently affects specific farms (Stocdale et al., 2005).

Lecithin cholesterol acyltransferase (LCAT) activity may be used as a diagnostic indicator of PPH (Ghanem and El-Deeb, 2010). The diagnosis is made on the basis of the history of exclusive feeding of dry roughage to advanced pregnant or recently calved high yielding animals and characteristic clinical signs–coffee-colored urine, pale mucous membrane, straining during defecation with normal body temperature (Bhikane and Syed, 2014).

Flow chart of Recent parturition and post-parturient haemoglobinuria Mechanism:



While the exact cause and pathophysiology of PPH remain unknown, it is generally accepted that phosphorus insufficiency is the cause of this issue, which could explain why the incidence of PPH may be rising in high-yielding dairy animals at the start of lactation (Resum et al., 2017) (Grunberg et sl., 2015). Oxidative stress, a significant component of aerobic metabolism, has now been connected to hypophosphatemia in the periparturient period of dairy cows. It's described as an imbalance between peroxidants and antioxidants that favors the former. This element has been well investigated in connection with numerous postpartum illnesses. Although the precise relationship between hypophosphatemia and

oxidative stress is still unclear, it is believed (Mata and Bhardwaj, 1985) that hypophosphatemia causes low ATP production, which weakens the body's antioxidant system, which is made up of biological antioxidants like ascorbic acid (Vitamin C), alpha tocopherol (Vitamin E), and ceruloplasmin, among other enzymes.

Acute hemoglobinuria may result from Phosphorus deficiency's documented ability to lower the adenosine triphosphate level of red blood cells, which might alter the cell's structure and function and increase fragility and hemolysis. A decrease in normal deformability, an increase in fragility and hemolysis, which leads to hemoglobinuria, and changed structure and function of red blood cells are all caused by subnormal ATP concentrations. (Wang et al., 1985).

According to the study, the primary biochemical abnormality in phosphorous deficiency is caused by reduced erythrocyte glucose uptake, which in turn results in low levels of cellular ATP, reduced glutathione, reduced nicotinamide adenine dinucleotide (NADH), and 2,3-Diphosphoglycerate (2,3-DPG). Heinz bodies are precipitated and aggregated by reduced erythrocyte ATP and oxidative stress. Hemoglobin is the component of hemoglobin.

According to Bhikane and Syed (2014), the diagnosis is based on the patient's history of exclusively feeding dry roughage to high-yielding pregnant or recently calved animals, as well as the patient's distinctive clinical signs, such as coffee-colored urine, pale mucous membranes, and straining during defecation with ambient body temperature. According to Ghanem and El-Deeb (2010), lecithin cholesterol acyltransferase (LCAT) activity may be utilized as a PPH diagnostic indication. Lecithin cholesterol acyltransferase (LCAT) is a serum enzyme that catalyses esterification of free cholesterol to produce cholesteryl ester (CE).

References:

1. Akhtar, M.Z., Khan, A., Zaman, T. and Ahmed, N. 2006. Some clinico-Epidemiological and biochemical observation of parturient hemoglobinuria in nili ravi buffaloes (Bubalus bubalis). Pak. Vet. J. 24(4): 151-156
2. **Bhikane, A.U and Syed, A.M. (2014). Recent Trends in management of Metabolic disorders of transition cows and buffaloes. *Intas Polivet*. 15(2): 485-496.**
3. Durrani, A.Z., Kamal, N., Shakoori, A.R. and Younus, R.M. 2010. Prevalence of post parturient hemoglobinuria in buffalo and therapeutic trials with toldimfos sodium and tea leaves in Pakistan. Turk J Vet Anim Sci., 34: 45-51.
4. Failla S, Parmar M. Iron Dextran. [Updated 2023 May 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan.
5. Gahlawat, I., Singh, K. and Kumar, R. 2007. Investigations on oxidative stress in postparturient hemoglobinuria in buffaloes receiving sodium acid phosphate therapy. Italian J. Anim. Sci. 6(2): 974-977.
6. Grunberg, W., Mol, J.A. and Teske, E. (2015) Red Blood Cell Phosphate Concentration and Osmotic Resistance during Dietary Phosphate Depletion in Dairy Cows. Journal of Veterinary Internal Medicine, 29, 395-399. https://doi.org/10.1111/jvim.12497
7. Mata, M.M. and Bhardwaj, R.M. 1985. Possible alterations in erythrocyte metabolism and integrity in post-parturient hemoglobinuria. Indian J. Vet. Med. 5(2): 67-72.
8. Mohamed M. Ghanem, Wael M. El-Deeb, Lecithin cholesterol acyltransferase (LCAT) activity as a predictor for ketosis and parturient haemoglobinuria in Egyptian water buffaloes, Research in Veterin-

ary Science, Volume 88, Issue 1, 2010, Pages 20-25.

9. Rahmati, S., Aziz, A., Tawfeeq, M.M., Zabuli, J. and Nazhat, S.A. (2021) Clinical Features of Post-Parturient Hemoglobinuriain Dairy Cattle and Buffaloes: A Review. Open Journal of Veterinary Medicine, 11, 143-155.
10. Resum, N.S., Kour, P., Singh, H. and Sharma, N. (2017) Post-Partum Hemoglobinuria (PPH) in Bovine. Theriogenology Insight—An International Journal of Reproduction in All Animals, 7, 51. https://doi.org/10.5958/2277-3371.2017.00016.X.
11. Soren, S., Srivastava, M., Kachhawa, J.P. and Soren, P. 2014. Clinical study on postpartum hemoglobinuria in buffaloes. Intas Polivet. 15(2): 518-522.
12. Stockdale CR, Moyes TE, Dyson R. Acute post-parturient haemoglobinuria in dairy cows and phosphorus status. Aust Vet J. 2005 Jun;83(6):362-6. doi: 10.1111/j.1751-0813.2005.tb15635.x.
13. Underwood EJ. 'The Mineral Nutrition of Livestock'. 2nd edn. Commonwealth Agricultural Bureaux, Farnham Royal, 1981.
14. Wang XL, Gallagher CH, McClure TJ, Reeve VE, Canfield PJ. Bovine postparturient haemoglobinuria: effect of inorganic phosphate on red cell metabolism. Res Vet Sci 1985;39:333-339.
15. Yadav, S., Jain, V.K., Kumar, R. and Sridhar, 2014. Assessment of Therapeutic Effect of Buffered Phosphorus in Post Parturient Hemoglobinuria (PPH) in Buffaloes. Intas Polivet. 15(2): 515-517.
16. Bhikane, A.U. and Syed, A.M. 2014. Recent Trends in Management of Metabolic Disorders of ransition Cows and Buffaloes. Intas Polivet. 15(2): 485-4 Ghanem, M.M. and El-Deeb, W.M. 2010. Lecithin cholesterol acyltransferase (LCAT) activity as a predictor for ketosis and parturient hemoglobinuria in Egyptian water buffaloes. Res.
17. Vet. Sci. 88: 20–Assessment of Therapeutic Effect of Buffered Phosphorus in Post Parturient Hemoglobinuria (PPH) in Buffaloes. Intas Polivet. 15(2): 515-517 Assessment of Therapeutic Effect of Buffered Phosphorus in Post Parturient Hemoglobinuria (PPH) in Buffaloes. Intas Pol