Guideline for medical interventions
Veterinary Medicine
Large Ruminant Medicine

Metabolic hypophosphatemia (postparturient hemoglobinuria PPH)

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Executive Chief of the Egyptian Health Council: Prof. Mohamed Mustafa Lotief.

Head of the Committee: Prof. Ahmed M Byomi

The rapporteur of the Committee: Prof. Mohamed Mohamedy Ghanem.

Scientific Group Members: Prof. Nabil Yassien, Prof. Ashraf Aldesoky Shamaa, Prof. Amany Abbas, Prof. Dalia Mansour, Dr Essam Sobhy Dr Mohamed Elsharkawy, Prof. Dr Gamal A. Sosa., Dr Naglaa Radwan, Dr Hend El Sheikh

Editor/Author: Prof. Mohamed Ghanem

Definition

Periparturient hemoglobinuria (PPH), also called *post-parturient hemoglobinuria*, is a metabolic and hematologic disorder primarily affecting high-producing dairy cows during late pregnancy or early lactation. It is characterized by intravascular hemolysis, hemoglobinuria, anemia, and, in severe cases, death. The disease is closely associated with severe hypophosphatemia, oxidative stress, and increased metabolic demands during lactation.

PPH is reported globally but is most common in high-yielding dairy breeds such as Holstein-Friesians. Cows between **4–8 years** and those in the **first 4–6 weeks of lactation** are most frequently affected. Incidence increases in areas with dietary phosphorus deficiency or in herds fed high-oxalate roughages.

Etiology

1-Hypophosphatemia: The central etiological factor. Low phosphorus leads to:

- reduced ATP synthesis
- fragile erythrocyte membranes
- decreased 2,3-DPG levels
- impaired glycolysis: This instability increases susceptibility to oxidative hemolysis.

2-Oxidative Stress: High milk production increases oxidative load. Reduced glutathione levels weaken erythrocytes, leading to hemolysis.

3-Dietary Risk Factors

- Diets deficient in phosphorus (like Barseem rich in Ca deficiency in P)
- High-oxalate feeds (beet tops)
- Imbalanced Ca:P ratio (2:1).
- The disease mostly occurs in spring season in egypt due to feeding mainly on Barseem

4-Increased Metabolic Demand

During early lactation, phosphorus is heavily diverted toward milk production, exacerbating pre-existing dietary deficiency.

Pathogenesis

PPH develops through a sequence of metabolic events:

1. **Negative phosphorus balance** occurs due to increased lactational demand.
2. **Serum inorganic phosphorus falls below 1.0 mmol/L**, impairing erythrocyte energy metabolism.
3. ATP depletion leads to **membrane fragility**.
4. Oxidative stress causes **massive intravascular hemolysis**.
5. Free hemoglobin saturates plasma-binding proteins and spills into urine → **hemoglobinuria**.

6. Resulting **anemia**, hypoxia, and renal hemoglobin damage contribute to morbidity.

Clinical Signs

1-Early Signs

- Sudden drop in milk yield
- Anorexia, depression
- Pale or icteric mucous membranes

2- Hemoglobinuria

- Passage of **dark red to coffee-colored urine**
- Normal consistency (distinguishes from myoglobinuria)

3- Systemic Manifestations

- Tachycardia, dyspnea due to anemia
- Weakness, reluctance to move
- Constipation or reduced rumen motility

4- Severe Cases

- Recumbency
- Hypothermia
- Death within 2–3 days if untreated

Figure (2): A buffalo with hemoglobinuria due to hypophosphatemia

Diagnosis

Laboratory Findings

- **Decreased serum P level**
- Hemolytic anemia
- Hemoglobinemia
- Elevated bilirubin
- Normal muscle enzymes (to rule out myopathy)
- Normal or slightly elevated calcium

Differential Diagnoses of diseases causing red urine in cattle

- Bacillary hemoglobinuria
- Leptospirosis
- Babesiosis
- Copper toxicity

- Water intoxication

Disease	Cause	Fever	Type of red urine	Key clinical signs	Laboratory findings	Distinguishing features
Metabolic hypophosphatemia (Post-parturient hemoglobinuria)	Phosphorus deficiency causing RBC fragility	Usually absent or mild	Hemoglobinuria	Early lactation, weakness, anemia, reduced milk	Low phosphorus, anemia	Fresh cow with low phosphorus and no infectious signs
Babesiosis	*Babesia* spp. infection	High fever	Hemoglobinuria	Tick exposure, anemia, jaundice	Parasites in RBCs	Blood smear positive
Leptospirosis	*Leptospira* infection	Fever common	Hemoglobinuria	Abortion, mastitis, jaundice	Serology positive	Reproductive problems present
Bacillary hemoglobinuria	*Clostridium haemolyticum*	High fever	Hemoglobinuria	Sudden onset, depression	Elevated liver enzymes	Severe toxemia and liver infarcts
Copper poisoning	Chronic copper accumulation	Variable	Hemoglobinuria	Jaundice, weakness	High liver copper	Hemolytic crisis after stress
Chronic bracken fern poisoning	Bone marrow suppression	Usually absent	Hematuria	Weight loss, tumors, chronic bleeding	Pancytopenia	Chronic course with bladder tumors

Enzootic hematuria	Bracken fern toxicity	No	Hematuria	Chronic blood loss	RBCs in urine sediment	True hematuria not hemoglobinuria
Urinary tract infection	Bacterial infection	Sometimes	Hematuria	Dysuria, frequent urination	RBCs and WBCs in urine	Pain during urination
Urolithiasis	Urinary calculi	Usually absent	Hematuria	Straining, colic signs	Crystals in urine	Obstruction signs
Trauma to urinary tract	Injury	No	Hematuria	Injury history	RBCs in urine	Trauma evidence

Confirmatory diagnosis

A combination of hypophosphatemia + hemoglobinuria + recent calving is usually diagnostic.

Treatment

1-Phosphorus Supplementation (Essential)

- **IV sodium acid phosphate:** Provides rapid correction
- **Oral phosphorus salts** (dicalcium phosphate, monosodium phosphate)
- Maintain serum levels after IV therapy

2-Antioxidants

- Vitamin C
- Vitamin E and selenium

3-Supportive Care

- Blood transfusion in severe anemia (after cross-matching blood testing)
- High-quality diet with adequate phosphorus
- Fluid therapy for dehydration or renal compromise

Prevention and Herd Management

Nutritional Management

- Ensure 0.35–0.45% phosphorus in lactation diets
- Maintain **Ca:P ratio at 2:1**
- Avoid prolonged feeding of phosphorus-deficient crop residues like barseem

Supplementation Strategies

- Free-choice mineral licks
- Concentrates fortified with P
- Pasture fertilization in deficient areas

Prognosis

- **Good** if treated early
- **Poor to guarded** if severe hemolysis and renal damage occur
- Chronic phosphorus deficiency in the herd may lead to recurrent cases

References

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