



Review Article

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## ADVANCED PERSPECTIVE ON HYPERPHOSPHATEMIA

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### ABSTRACT

Hyperphosphatemia, characterized by elevated serum phosphate levels, stands as a significant metabolic derangement with far-reaching clinical implications. The genesis of hyperphosphatemia is multifactorial, commonly stemming from renal dysfunction, excessive dietary phosphate intake, endocrine disorders, or medication usage. While often asymptomatic in its early stages, chronic hyperphosphatemia can instigate systemic complications, notably vascular calcification, cardiovascular events, and renal impairment, thereby underscoring its prognostic significance. Diagnosis of hyperphosphatemia necessitates meticulous evaluation, incorporating serum phosphate levels, renal function

assessments, and clinical history. Laboratory investigations, including serum phosphate assays and renal function tests, serve as cornerstone diagnostic tools, complemented by imaging studies to discern underlying pathology. Therapeutic strategies for hyperphosphatemia revolve around phosphate control and mitigating associated complications. Pharmacological interventions, such as phosphate binders and calcimimetics, aim to reduce phosphate absorption and enhance phosphate excretion, thereby restoring phosphate homeostasis. Additionally, dietary modifications, including phosphate-restricted diets and nutritional counselling, play a pivotal role in long-term management, empowering patients to adopt healthier dietary practices.

**Key Words:** Hyperphosphatemia, Hypocalcemia, Bone mineralisation.

## **INTRODUCTION**

### **PHOSPHATE**

1% of an individual's total body weight is composed of the mineral phosphorus. It is the body's second-most common mineral. (1)

Every cell in our body contains the mineral phosphorus. Phosphorus is mostly found in teeth and bones, and it can also be found in your genes. Phosphorus is necessary for your body to produce energy and to perform a number of critical chemical reactions. One element that is crucial to the body is phosphorus. Nearly majority of the phosphorus in the body is combined with oxygen to produce phosphate. One of the minerals in the body called an electrolyte, or minerals with an electric charge when dissolved in bodily fluids like blood, is phosphate; however, most phosphate in the body is uncharged. About 85% of the phosphate in the body

is found in bone. The remainder is mostly found inside cells, where it contributes to the synthesis of energy. (2)

Phosphate is responsible for several functions in the human body. Its role in different parts of the body are as follows:

- Bone mineralization: The mineralization of the bone matrix is caused by phosphate. Endochondral Ossification: The endochondral ossification of the bone is brought about by phosphate. It is essential for the mineralization of the enamel, dentin, cementum, and alveolar bone, which are the teeth's structural constituents.
- Cellular functions: Phosphate is a crucial part of the lipid bilayer that surrounds proteins, DNA, RNA, and cell membranes in cells. It is in charge of several enzymatic processes that occur inside the cells, such as ammoniogenesis and glycolysis. It responds to phosphates and kinases by attaching or detaching from various molecules, changing their behavior. Additionally, it performs oxidative phosphorylation, the process that changes adenosine diphosphate into adenosine triphosphate, the cell's energy currency.
- Phosphate has a role in the oxygen-carrying capacity of hemoglobin by regulating the synthesis of 2,3-bisphosphoglycerate. (3)
- Phosphorus works with the B vitamins. Moreover, it supports healthy renal function, heart rhythm, muscular contractions, and nerve transmission.
- Normal ranges for adults' serum or plasma phosphate concentrations are 2.5–4.5 mg/dL (0.81–1.45 mmol/L). Serum phosphate concentrations below the low end of

the normal range are referred to as hypophosphatemia, while those above the high end of the range are referred to as hyperphosphatemia. (2)

## **HYPERPHOSPHATEMIA**

An excess of phosphate (phosphorus) in the blood is known as hyperphosphatemia. Hyperphosphatemia can strike anyone. However, if you have renal failure or advanced chronic kidney disease, your risk of developing hyperphosphatemia is higher. Renal failure or chronic renal disease are more likely to occur in people who having diabetes, high blood pressure (hypertension), heart disease, family history of kidney disease, abnormal kidney structure, Black, Hispanic, Asian, Native American, First Nations or Alaska Native, or over 60 year of age group, who have a long history of taking pain relievers frequently, including over-the-counter (OTC) products such as nonsteroidal anti-inflammatory drugs (NSAIDs).

**However, excessively high phosphate levels might cause your bones to lose calcium, which can leave them fragile. Additionally, it may result in calcium deposits in your heart, blood vessels, lungs, and eyes, which over time may raise your risk of heart attack, stroke, and even death.**

For the majority of people worldwide, hyperphosphatemia on its own is uncommon. It is prevalent, though, if you have advanced chronic renal disease. (4)

## **ETIOLOGY**

Though less common, hyperphosphatemia can also arise from:

- advanced chronic kidney disease,

- hypoparathyroidism,
- lower-than-normal blood pH (increased acids in the blood) due to your lung's inability to expel all of the carbon dioxide from your body (respiratory acidosis),
- lower-than-normal blood pH for other reasons (metabolic acidosis).
- Diabetes-related ketoacidosis.
- Damage to your muscles (rhabdomyolysis).
- Severe infection (sepsis).
- Physical trauma from something heavy falling on you or pressing on you for a long time (crush injury).
- Consuming too much phosphate in your diet or receiving too much phosphate in an enema.

### **SIGN & SYMPTOMS:**

By themselves, hyperphosphatemia typically shows no symptoms right away. On the other hand, hypocalcemia may result from hyperphosphatemia's removal of calcium from your blood and bones. Symptoms of hypocalcemia include brittle nails and cramping in the muscles, with dryness of the skin and hair that is coarser than usual for you. Memory issues, sensitivity, tingling in your feet, fingers, tongue, or lips, convulsions, heart rhythm abnormalities, called arrhythmias. (5,6)

### **DIAGNOSIS AND TESTS**

Phosphate level greater than 4.5 milligrams per deciliter (mg/dL) indicates hyperphosphatemia. Medical history, physical examination and symptoms, diet and

medications currently taking should be asked for. Also, tests should be done to check kidney disease. Common blood tests may include:

- Urine protein test.
- Ultrasound.
- MRI.
- CT scan.
- Kidney biopsy.

## **MANAGEMENT AND TREATMENT**

In case your excessive phosphate levels are due to kidney failure, dialysis can be prescribed by your physician. Your kidneys do the work that dialysis does. It draws out waste materials and extra fluid from your blood, including phosphate.

Foods and drinks that have high levels of phosphorus are dairy, including milk, processed cheeses and yogurt, Soda pop, processed meats, fast food, nuts, whole grains, including wheat, oats and rice, beans, lentils. Renal diet is needed for its management. <sup>(7,8)</sup> Thus, stop the usage of those food products which are high in phosphates. Along with proper medication Treatment for hyperphosphatemia is based on the underlying cause of the blood phosphate accumulation. Phosphate levels can rise in response to specific foods, beverages, and drugs. It can be necessary to reduce or completely cut out certain foods and beverages from your diet, or it might be necessary to switch to medication that has a reduced phosphate

content.

Additionally, your doctor can recommend drugs that increase the difficulty of phosphate absorption by the body, causing more phosphate to be excreted in urine. Among these medications are

- Calcium acetate,
- Lanthanum
- Sevelamer.
- Sodium/hydrogen exchanger 3 (NHE3) inhibitors (tenapanor),
- Diuretics like Furosemide (Lasix) lower phosphate serum levels by enhancing renal excretion. (9)
- Phosphate Binders: Phosphate binders are the recommended treatment for individuals whose phosphate levels are consistently or gradually increasing even when they are following a diet low in phosphate. These are also used in conjunction with food restriction in cases where the patient's phosphate levels are extremely high (more than 6 mg/dl).
- Magnesium carbonate effectively reduces serum phosphate levels and shows good gastrointestinal tolerance. It also reduces vascular calcification.
- Others include: Sevelamer, Ferric Citrate, Nicotinic Acid and Nicotinamide, Tenapanor, etc.
- Hemodialysis in serious conditions, if needed.(10)

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