Extreme Hyperphosphatemia and Hypocalcemic Coma Associated with Phosphate Enema

Heng Jung Hsu and Mai-Szu Wu

Abstract

Fleet enema (sodium phosphate, C.B. Fleet Co., Inc., Lynchburg, Virginia) is widely used for bowel preparation or constipation relief in the hospital and over the counter. The potential risks, including hyperphosphatemia and hypocalcemic coma should be kept in mind of primary care physician. The patients with older age, bowel obstruction, small intestinal disorders, poor gut motility, and renal disease are contraindicated or should be administered with caution. We present a patient with old age and chronic renal failure who developed severe hyperphosphatemia and hypocalcemic tetany with coma after sodium phosphate enema. We recommend the use of alternative enema preparations, such as simple tap water or saline solution enemas, which can prevent fatal complications in high risk patients.

Key words: hyperphosphatemia, hypocalcemia, sodium phosphate enema, renal failure

(Inter Med 47: 643-646, 2008)  
(DOI: 10.2169/internalmedicine.47.0704)

Introduction

Hyperphosphatemia is frequently associated with hypocalcemia, which may present with increased nerve and muscle excitability with Trousseau’s sign, Chvostek’s sign, prolonged QT interval, lethargy, confusion, and even coma. Furthermore, calciphylaxis and calcification of soft tissues, including blood vessels, cornea, skin, and kidney, may also develop in patients with hyperphosphatemia. Hyperphosphatemia is mainly caused by renal failure but also occurs in hypoparathyroidism, pseudohypoparathyroidism, rhabdomyolysis, tumour lysis syndrome, acidosis, and excess phosphate administration. Fleet enema (Fleet®, C.B. Fleet Co., Inc., Lynchburg, Virginia), a high sodium phosphate-based enema, is widely used for bowel preparation for flexible sigmoidoscopy and before large bowel surgical procedure. Besides, these enema preparations are frequently used for constipation. It is relative safe and effective for bowel cleaning except in patients with aging, renal dysfunction, bowel obstruction, small intestinal disorders, or poor gut motility. We present a patient with old age and chronic renal failure who develop severe hyperphosphatemia and hypocalcemic tetany with coma after sodium phosphate enema.

Case Report

An 81-year-old man patient was admitted to our ward due to abdominal fullness persisting for 3 days. He was just discharge from hospital for inguinal hernia with surgical repair one week ago. No stool passage was noted after discharge, and followed by abdominal fullness and nausea. He had Parkinsonism for 40 years, chronic kidney disease and hypertension for 6 years. He has been taking erythropoietin, calcium carbonate, and anti-parkinsonism agent since 5 years ago.

Abdominal X-ray revealed lots of stool and bowel gas in the colon. Bisacodyl and metoclopramide oral form was prescribed for him and followed by enema with one piece Fleet enema (sodium phosphate) for poor response. Each 118-ml enema contained 19 g of monobasic sodium phosphate and 7 g of dibasic sodium phosphate. Due to persistent little stool passage with abdominal fullness, digital examination was performed with finding of internal hemorrhoid. At that night, the patient passed a large volume of stool and his abdominal fullness subsided.

Diffuse muscle weakness, tetany and coma status were noted on the next day with low-grade fever (body tempera-
Table 1. Main Biochemical Data of the Patient with Chronic Kidney Disease and Hyperphosphatemia

<table>
<thead>
<tr>
<th>Parameter</th>
<th>value</th>
<th>Normal range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum urea</td>
<td>60 mg/dL</td>
<td>6-21 mg/dL</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>8.0 mg/dL</td>
<td>0.4-1.4 mg/dL</td>
</tr>
<tr>
<td>Creatinine clearance*</td>
<td>6.59 mL/min</td>
<td>80-120 mL/min</td>
</tr>
<tr>
<td>Serum sodium</td>
<td>149 meq/L</td>
<td>134-148 meq/L</td>
</tr>
<tr>
<td>Serum potassium</td>
<td>3.5 meq/L</td>
<td>3.0-4.8 meq/L</td>
</tr>
<tr>
<td>Serum calcium</td>
<td>5.2 mg/dL</td>
<td>7.9-9.9 mg/dL</td>
</tr>
<tr>
<td>Serum phosphate</td>
<td>19.5 mg/dL</td>
<td>2.4-4.7 mg/dL (adult)</td>
</tr>
<tr>
<td>Serum uric acid</td>
<td>3.1 mg/dL</td>
<td>&lt;8.0 mg/dL</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>4.1 g/dL</td>
<td>3.5-5.5 g/dL</td>
</tr>
<tr>
<td>i-PTH</td>
<td>268.4 pg/mL</td>
<td>7-53 pg/mL</td>
</tr>
</tbody>
</table>

*Creatinine clearance was estimated by Cockcroft Gault equation.

Figure 1. Calcium and phosphate levels during admission. At admission D4, enema with Fleet (sodium phosphate) was given for persistent constipation. Then severe hyperphosphatemia (P: 19.5 mg/dL) and hypocalcemia (Ca: 5.2 mg/dL) were noted with tetany and coma conscious level. After calcium gluconates and emergent haemodialysis at Day 5, Day 6, and Day 7, electrolyte disorder normalized and symptoms of hypocalcemic tetany and coma conscious subsided.

Discussion

Phosphorus is the sixth most abundant element in the human body. It is critical for bone mineralization, cellular structure, genetic coding, and energy metabolism. Phosphate homeostasis is regulated by both intracellular movement of phosphorus as well as excretion of the substance by the kidneys. Renal excretion is so efficient in normal subjects that balance can be maintained with only a minimal rise in serum phosphate concentration even if phosphate intake is increased to as much as 4,000 mg/day (130 mmol/day). The response of increase phosphate intake is in part mediated by a direct effect of minimal hyperphosphatemia to diminish proximal tubular phosphate reabsorption, via inhibition of sodium-phosphate co-transporters in the luminal membrane.
that allow reabsorption of filtered phosphate. An increased secretion of parathyroid hormone (PTH) also may contribute to the reduction in phosphate reabsorption, because some of the excess phosphate may complex with calcium in the serum. The following fall in serum ionized calcium concentration provides the signal for increased PTH release.

Most of the clinical effects of hyperphosphatemia are related to secondary changes of calcium metabolism, including conscious lethargy and coma. Hyperphosphatemia induces hypocalcemia by several mechanisms, including decreased production of 1,25-dehydroxycholecalciferol (1), precipitation of calcium (2), and decreased absorption of calcium from the gastrointestinal tract, presumably due to a direct effect of phosphorus on calcium absorption. As calcium is necessary for normal physiological function, hypocalcemia may affect multiple organs, especially the neuromuscular system. Neuromuscular and neurological manifestations include muscle spasms, carp pedal spasm, facial grimacing, laryngeal spasm and convulsion. Severe hypocalcemia may even cause lethargy or confusion, seizure and coma.

Conscious change may result from diffuse or multifocal dysfunction of both cerebral hemispheres or of the reticular activating system in the brain stem. Unilateral cerebral lesions, such as stroke or tumor, rarely impair consciousness unless they produce sufficient mass effect to compress the opposite hemisphere or the brain stem. Metabolic disorders impair consciousness by diffuse effects on both cerebral hemisphere, such as drugs and toxins, sepsis, hypoglycemia, hyponatremia, hypernatremia, hypoxemia or hypercapnia, hypercalcaemia, hyperparathyroidism, liver failure, renal failure, or thiamine deficiency. Besides, hypertensive encephalopathy, global cerebral ischemia, CNS infection, sepsis, and seizure can also cause conscious drowsy and even coma.

Sodium phosphate-based enemas are widely used for bowel preparation for flexible sigmoidoscopy and before bowel preparation for flexible sigmoidoscopy and before large bowel surgical procedure. Also these enema preparations are frequently used for constipation. Although generally safe and well tolerated in adults, serious metabolic complications and fatalities have been described as rare consequences of sodium phosphate enema administration in infants and small children (3). Further, acute phosphate nephropathy has also been found after oral sodium phosphate bowel purgative in adults (4, 5). Typical finding of diffuse tubular injury with abundant tubular calcium phosphate deposits was noted on renal biopsy.

Fleet phospho-soda contains a mixture of sodium biphosphosphate and sodium phosphate. In normal adults, approximately 60-65% of dietary phosphate is absorbed. However, if gut peristalsis is impaired, intestinal absorption of phosphate may be enhanced.

The magnitude of serum hypocalcemia is proportional to the degree by which the solubility product of calcium phosphate is exceeded. Each enema contains approximately 19 g of sodium biphosphate, 7 g of sodium phosphate, and 4.4 total grams of sodium per delivered dose. An experimental study in the swine model showed that the retained Fleet enema solutions at a dose of 20-30 ml/kg was uniformly fatal in pigs which caused severe hyperphosphatemia, hypocalcemia, hyponatremia, and metabolic acidemia (6). The study suggested that the rectum was a possible portal for phosphate reabsorption in animals.

Hyperphosphatemia after giving phosphor-soda rectally has previously been described in about 10 adults. Fatal hypocalcemic, hyperphosphatemic, metabolic acidosis following sequential sodium phosphate-based enema administration has also been described in adults with phosphate enema overdose with elevated serum phosphate level up to 3.36 mmol/L and decreased serum calcium level down to 1.1 mmol/L (7). Hyperphosphatemic hypocalcemic coma caused by Fleet enema has also been described with an underlying disease of megacolon (8).

We present an elderly patient with chronic renal failure and constipation who developed severe hyperphosphatemia and hypocalcemic coma after sodium phosphate enema. Neither sodium phosphate overdose nor gastrointestinal disorder was noted in our case. But severe hyperphosphatemia (6.3 mmol/L) and hypocalcemia (1.3 mmol/L) with tetany and coma occurred. It seems to us that there are three factors that contributed to the severe toxicity in our patient. First, he had colonic retention for many hours without defeation and subsequently increased absorption of these elements in an atomic bowel. Secondly, he was up to 80 in age. Finally, he had a chronic renal failure, which was associated with decreased P excretion in kidney. Therefore, after Fleet enema, subsequently continuous absorption of phosphate from the bowel may increase the serum phosphate level. But this patient with old age and poor renal function could not excrete phosphate promptly and then severe hyperphosphatemia and hypocalcemia occurred.

In summary, sodium phosphate enema should be used cautiously in patients with impaired renal function, older age (10, 11), younger age (12), impaired bowel motility (13), bowel obstruction (14, 15) or small intestinal disorders (16). Alternative enema preparations, such as simple tap water or saline solution enemas, can be used.

This case illustrates clearly the need for physicians to be fully cognizant of all medications being prescribed and administered. In particular, all health care personnel using sodium phosphate-based enema preparations should recognize the potential of severe symptomatic hyperphosphatemia and hypocalcemia.

References


Inter Med 47: 643-646, 2008 DOI: 10.2169/internalmedicine.47.0704

645


© 2008 The Japanese Society of Internal Medicine
http://www.naika.or.jp/imindex.html