Drug Guideline  Potassium Dihydrogen Phosphate

Summary:
This guideline outlines the use of phosphate in intensive care. Phosphate is a major intracellular anion. Total body phosphate in normal adult is about 700g. Approximately 85% is found in bone, the remaining 15% is in extracellular fluid and soft tissues. It is important for many cellular actions and also acts as a buffer. Normal serum phosphate level is 0.8 – 1.5 mmol/L.5,6

Approved by:  ICU Medical Director
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Replaces Existing Drug Guideline:  Phosphate
Previous Review Dates:  2005

1. Introduction:

Patient safety

The Aims / Expected Outcome of this drug guideline:

Phosphate will be administered safely and appropriately without any adverse side effects

Related Standards or Legislation

- NSQHS Standard 1 Governance
- NSQHS Standard 4 - Medication Safety

Related Policies

- LH_PD2013_C03.01 Drug Administration
- LH_PD2010_C03.00 Drug Prescribing
- LH_PD2008_C03.12 Administration of IV Medication

2. Policy Statement

- All care provided within Liverpool Hospital will be in accordance with infection control, manual handling and minimization and management of aggression guidelines.
- Medications are to be prescribed and signed by a medical officer/authorized nurse practitioner (NP) unless required during an emergency.
• All drugs administered during an emergency (under the direction of a medical officer/authorised nurse practitioner) are to be documented during the event, then prescribed and signed following the event.
• Medications are to be given at the time prescribed (as close to the time as is possible when multiple drugs require ‘same time’ administration and, when the nurse is caring for more than one patient, recognition is given to a possible short delay to administration – antibiotics and other lifesaving drugs are to be prioritised) and are to be signed by the administering nurse.
• Parenteral medication prescriptions and the drug are to be checked with a second registered or endorsed enrolled nurse prior to administration. The “rights of drug administration” must be followed: right: patient, drug, dose, route, administration, time, reason for the drug, documentation, education and evaluation/outcome.
• Adverse drug reactions are to be documented and reported to a medical officer.
• Medication errors are to be reported using the hospital electronic reporting system: IIMS.
• Guidelines are for adult patients unless otherwise stated.

3. Guideline

Actions 1,7
• Phosphate acts as a buffer for the maintenance of plasma and urinary pH.
• It is involved in energy storage and transfer, utilisation of Vit B complex, buffering of body fluids and in renal excretion of hydrogen ions.
• It is important in bone structure in the form of calcium phosphate.
• Phosphate is primarily excreted in the urine. Over 90% of plasma phosphate is filtered in the kidneys, with the majority being reabsorbed in the proximal tubule.
• Parathyroid hormone decreases the tubular reabsorption of phosphate, thereby increasing urinary excretion.
• Phosphate levels are inversely related to serum calcium levels and to the renal metabolism of vitamin D.
• A decrease in serum calcium levels will increase serum phosphate levels.

Indications 1,9
• Treatment of hypophosphataemia (serum level <0.8mmol/L).
  The symptoms of hypophosphataemia include:
  * Muscle weakness, paraesthesia, convulsions, cardiomyopathy, respiratory failure and haematological abnormalities.
• Treatment of hypophosphataemia where oral therapy is not possible (the cause of hypophosphataemia should be identified and treated).
  In hospitalized patients hypophosphataemia may occur as a result of refeeding syndrome, chronic alcohol use, antacid therapy, respiratory alkalosis, correction of chronic respiratory acidosis and DKA.9

Contraindications 1,3
• Severe renal impairment.
• Hyperphosphataemia.
• Hypocalcaemia, due to the close relationship between hypocalcaemia and hyperphosphataemia.
• Hyperkalaemia, due to the potassium component found in both forms of phosphate replacement.
• Addison’s disease and Urolithiasis, increase risk of hyperkalaemia in these patients.
Precautions

- Phosphate should be administered with caution in conditions where high phosphate levels may be encountered, such as hypoparathyroidism, chronic renal disease and rhabdomyolysis.
- Use with caution in conditions where low calcium levels may be encountered, such as hypoparathyroidism, osteomalacia, chronic renal disease, acute pancreatitis, rhabdomyolysis and rickets.
- It must be administered with caution in conditions with high potassium levels (e.g. acute dehydration, pancreatitis, rhabdomyolysis, severe renal insufficiency and extensive tissue damage in the case of severe burns).

Significant interactions

- Concurrent use with ACE inhibitors may result in hyperkalaemia especially with renal impairment.
- When administered with calcium containing medication, there may be increased risk of calcium deposits in soft tissues.
- Concurrent administration with digitalis glycosides, potassium sparing diuretics and NSAIDs may result in hyperkalaemia.
  - When phosphate is administered to patients already stabilised on salicylates, an increase in serum concentration of salicylates (since salicylate excretion is decreased in acidified urine) may result in toxic salicylate concentrations.

Incompatibilities

- Phosphate is incompatible with calcium or magnesium containing solutions (formation of crystals will occur when in contact with phosphate).
- Aciclovir, amiodarone, ciprofloxacin, dobutamine, pantoprazole, rocuronium solutions containing other cations such as iron and aluminium may also precipitate.

Adverse effects

- Hyperkalaemia leading to confusion, tiredness or weakness, irregular or slow heart rate, numbness or tingling around lips, hands or feet, unexplained anxiety, weakness or heaviness of legs.
- Hypernatraemia leading to confusion, tiredness or weakness,
- Hyperphosphataemia, hypocalcaemia or hypomagnesaemia leading to convulsions, muscle cramps, numbness, tingling, pain or weakness in hands or feet, shortness of breath or troubled breathing, tremor.

Presentation

- Potassium dihydrogen phosphate (KH$_2$PO$_4$) 1.36 g in 10mL ampoule
- The pH of the solution is 4.5 and each mL contains 1 mmol potassium (10mmol/10mL), 1 mmol phosphate (10mmol/10mL) and 2 mmol hydrogen (20mmol/10mL).

Administrations Guidelines

Refer to the potassium protocol as welll. Potassium Dihydrogen Phosphate must be diluted before use. The drug can be given in 0.9% sodium chloride or 5% glucose solution. It should be administered by slow infusion to avoid phosphate intoxication.

N.B: If serum potassium levels ≥ 5.0mmol or renal failure is present, to prevent excess potassium loading if patient requires phosphate replacement use sodium phosphate dibasic dodecahydrate, as the potassium content is only 2.6 mmol/20mL ampoule.
**For intravenous administration only via:**

**Intravenous Catheter (IVC)**
If administered peripherally the drug must be diluted in a minimum volume of 1,000mL and a maximum concentration of 4 x 10ml ampoules of potassium dihydrogen phosphate (which contains 40mmol of potassium) per 1000mL.

**Central Venous Catheter (CVC)**
When administered via central line, dilute the desired dose with sterile 0.9% sodium chloride or 5% glucose to a total volume of 50mL and administer via syringe driver.

**Phosphate Infusion Regimen:**
- Mild Hypophosphataemia (PO4 > 0.5 - 0.7 mmol/L) - administer 15mmol Potassium dihydrogen phosphate ($\text{KH}_2\text{PO}_4$), at an infusion rate of 10mmol/hr.
- Moderate Hypophosphataemia (PO4 >0.35 - 0.5 mmol/L) - administer 20mmol Potassium dihydrogen phosphate ($\text{KH}_2\text{PO}_4$), at an infusion rate of 10mmol/hr.
- Severe Hypophosphataemia (PO4 < 0.35 mmol/L) - administer 25mmol Potassium dihydrogen phosphate ($\text{KH}_2\text{PO}_4$), maximum infusion rate 15mmol/hr.

Recheck serum sodium, phosphate, potassium, corrected calcium, magnesium, urea and creatinine at six (6) hours post infusion or as per medical request.

**Clinical Considerations**
- Conversion to oral phosphate therapy should occur as soon as possible.
- Monitor ECG, renal function, and electrolytes.
- If the dose is given too rapidly or the patient has renal impairment, hyperkalaemia can result, and it can develop rapidly and asymptptomatically.
- Central access must be utilised for concentrated solutions of phosphate.
- Avoid extravasation as phlebitis, pain and tissue necrosis may occur due to acidity of the solution.
- The symptoms of hyperphosphataemia include:
  - Muscle weakness, paraesthesia, convulsions, cardiomyopathy, respiratory failure and haematological abnormalities.
  - In turn will lead to hypocalcaemia and to ectopic calcification, which may be severe.

**Treatment of hyperphosphataemia**
- Immediate cessation of phosphate therapy.
- Correction of serum electrolyte concentration, especially calcium. First-line therapy is a calcium-based phosphate binder e.g. calcium carbonate per specialist supervision.
- General supportive treatment.

**4. Performance Measures**

All incidents are documented using the hospital electronic reporting system: IIMS and managed appropriately by the NUM and staff as directed.

**5. References / Links**


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