Hypokalemia and Hypomagnesemia in Peritoneal Dialysis Patients

Elaine Cheng, B.Sc.(Pharm.), ACPR, PharmD
Clinical Pharmacy Specialist – Nephrology
Vancouver General Hospital

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Outline

• **Background**
  – Potassium and magnesium
  – British Columbia Renal drug funding

• **Hypokalemia and Hypomagnesemia Study in British Columbia Peritoneal Dialysis Patients**
  – Objectives, design and methods, results, discussion, limitations, conclusion
Potassium and Magnesium

- Potassium and magnesium essential for normal cellular function and processes

- Potassium – 2\(^{nd}\) most abundant cation in body and major intracellular cation
  - Normal serum level 3.5-5 mmol/L

- Magnesium – 4\(^{th}\) most abundant cation and 2\(^{nd}\) most common intracellular cation
  - Normal serum level 0.7-1.1 mmol/L

Can J Anaesth 1993; 40:227-46
Br J Anaesth 1999;83:302-20
Potassium and Magnesium in CKD

Pre- or Hemodialysis

- Hyperkalemia
- Hypermagnesemia

Peritoneal Dialysis

- Hypokalemia
- Hypomagnesemia

Hypokalemia Complications

- **Neuromuscular:** weakness, tetany, cramps, paralysis (flaccid), ileus, constipation, urinary retention

- **Cardiovascular:** abnormal ECG and arrhythmias, abnormal contractility, potentiation of digitalis toxicity

- **Metabolic:** decreased insulin release, abnormal tolerance to glucose causing diabetes, impaired hepatic glycogen and protein synthesis, decreased aldosterone and growth hormone secretion, growth retardation, maintenance of metabolic alkalosis

- **Renal:** decreased renal blood flow and GFR, impaired urine concentration, increased renal ammonia genesis, precipitating encephalopathy, increased renal HCO$_3$ reabsorption, chronic tubulointerstitial disease, cyst formation, proximal tubular vacuolization, rhabdomyolysis

Fluid electrolyte and acid-base disorders: Clinical evaluation and management. 2$^{nd}$ ed.
Hypomagnesemia Complications

<table>
<thead>
<tr>
<th>Signs</th>
<th>Symptoms</th>
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<tbody>
<tr>
<td>Chvostek’s sign</td>
<td>Nausea</td>
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<tr>
<td>Trousseau’s sign</td>
<td>Vomiting</td>
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<tr>
<td>Tremors</td>
<td>Apathy</td>
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<tr>
<td>Muscle fasciculations</td>
<td>Weakness</td>
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<tr>
<td>Hyperreflexia</td>
<td>Anorexia</td>
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<tr>
<td>Seizures</td>
<td>Mental retardation</td>
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<td>Depression</td>
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<tr>
<td>Psychosis</td>
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<tr>
<td>Prolonged QT interval</td>
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<td>Cardiac arrhythmias</td>
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<tr>
<td>Decreased myocardial</td>
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<tr>
<td>contractility</td>
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<tr>
<td>Hypertension</td>
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<td>Sudden death</td>
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Fluid electrolyte and acid-base disorders: Clinical evaluation and management. 2nd ed.
Hypokalemia and Hypomagnesemia Associated Mortality in PD Patients

• **Lee S et al 2017 (Potassium):**
  – Prospective, observational cohort study of 3230 patients undergoing HD (64.3%) or PD (35.7%)
  – Lower serum potassium levels (< 4.5 mmol/L) occurred more commonly in PD than in HD patients
  – Hypokalemia was independent predictor of mortality

• **Cai K et al 2016 (Magnesium):**
  – Single-center retrospective study of 253 incident PD patients
  – Low serum magnesium levels common among PD patients
  – Hypomagnesemia was independent predictor of all-cause and cardiovascular mortality

BC Renal Drug Funding

BC Renal funds a number of medications essential in the care and treatment of kidney disease patients. Potassium and magnesium supplements are not funded!

<table>
<thead>
<tr>
<th>ACIDOSIS</th>
<th>Calcium channel blockers</th>
<th>INFECTIONS</th>
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<tbody>
<tr>
<td>Sodium bicarbonate</td>
<td>Calcium</td>
<td>Topical Antimicrobials</td>
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<tr>
<td></td>
<td>Channel blockers</td>
<td>topical antibiotics</td>
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<td></td>
<td></td>
<td>Clotrimazone</td>
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<td></td>
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<td>Gentamicin cream &amp; ointment</td>
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<td></td>
<td></td>
<td>Mupirocin cream &amp; ointment</td>
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<tr>
<td>ANEMIA</td>
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<td><strong>Antifungal</strong></td>
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<tr>
<td>Erythropoiesis-stimulating agents</td>
<td></td>
<td><strong>Antifungal</strong></td>
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<tr>
<td>Darbepoetin alfa (Aranesp®) [restricted] Δ</td>
<td></td>
<td><strong>Antifungal</strong></td>
</tr>
<tr>
<td>Epoetin alfa (Procrit®) [restricted]</td>
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<td><strong>Antifungal</strong></td>
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**Potassium and magnesium supplements not funded!**
Hypokalemia and Hypomagnesemia Study in British Columbia Peritoneal Dialysis Patients

Elaine Cheng, B.Sc.(Pharm.), ACPR, PharmD
Jinglin Tang, PharmD, ACPR
Dr. Suneet Singh, MD, FRCPC
Objectives

• To determine one-year prevalence of hypokalemia and hypomagnesemia in BC PD patients

• To assess one-year frequency and cost of prescription of potassium and magnesium supplements in BC PD patients
Design and Methods

• **Design:** multicenter, retrospective review utilizing PROMIS (Patient Records and Outcome Management Information System) database

• **Study Period:** May 1, 2017 to April 30, 2018

• **Inclusion Criteria:**
  – All BC patients on PD within study period
  – Serum potassium or magnesium level checked at least every 3 months
Design and Methods

• **Outcomes:**
  – Prevalence of hypokalemia: any serum potassium level < 3.5 mmol/L during study period
  – Prevalence of hypomagnesemia: any serum magnesium level < 0.7 mmol/L during study period
  – Prescription frequency of potassium and magnesium supplements
  – Yearly cost estimates of potassium and magnesium supplements based on unit costs and dispensing fees provided by BC Renal contracted community pharmacies (Macdonald’s and Laurel Pharmacies)
Results
Prevalence of Hypokalemia and Potassium Supplementation

*Note: Only 1187 PD patients (97.5%) had serum potassium level*
Breakdown of Potassium Levels

Percentage of all BC PD Patients with Serum Potassium Level (n=1187)

- 3 to < 3.5 mmol/L: 75.4%
- 2.5 to < 3 mmol/L: 21.8%
- 2 to < 2.5 mmol/L: 2.6%
- < 2 mmol/L: 0.2%
Prevalence of Hypomagnesemia and Magnesium Supplementation

*Note: Only 709 (58.3%) PD patients had serum magnesium level*
Breakdown of Magnesium Levels

Percentage of all BC PD Patients with Serum Magnesium Level (n=709)

- 0.6 to < 0.7 mmol/L: 69
- 0.5 to < 0.6 mmol/L: 25.3
- 0.4 to < 0.5 mmol/L: 5.2
- < 0.4 mmol/L: 0.5
Potassium and Magnesium Supplement Costs

- **Potassium supplements:** $15, 110/year for all BC PD patients
  - **Unit Pricing:**
    - Potassium chloride 8 mEq $0.0432/tab (generic)
    - Potassium chloride 8 mEq $0.1079/tab (Micro K)
    - Potassium chloride 20 mEq $0.21/tab (generic)
    - Potassium chloride liquid 20 mEq/15 mL $0.01512/mL
    - K-Lyte 25 mEq $0.645/tab (brand)

- **Magnesium supplements:** $2209/year for all BC PD patients
  - **Unit Pricing:**
    - Magnesium complex 100 mg $0.1099/tab
    - Magnesium glucoheptonate liquid $0.0215/mL
    - Magnesium sulfate 5 g $7.68/vial

- **Dispensing Fees:** $11 for Macdonald’s and $10.80 for Laurel
Potassium and Magnesium Supplements Prescribed at VGH

- KCl 8 mEq: 79%
- KCl 20 mEq: 14%
- KCl Liquid: 14%
- K-Lyte: 3%

- Mg Complex: 67%
- Mg Sulfate IP: 33%
Limitations

• Prevalence of hypokalemia and hypomagnesemia may be underreported as some sites did not monitor serum potassium and/or magnesium levels at all
  – Serum potassium level available for 97.5% of patients
  – Serum magnesium level available for 58.3% of patients

• Inaccuracy in supplement cost estimates due to:
  – Exclusion of patients from supplement cost analysis if exact dose could not be determined (n=25) or if as needed dosing regimen prescribed (n=20)
  – Use of algorithm to estimate pharmacy dispensing fee

• Individual patient charts not accessed to verify PROMIS data
Discussion

• Prevalence of hypokalemia and hypomagnesemia higher than actual prescription of potassium and magnesium supplements

• Cost may present as barrier even to patients with extended health benefits

• Potassium and magnesium supplements cost comparable to other similar medications listed on BC Renal dialysis formulary
Conclusion

• Nov/18: Study findings submitted to BC Renal to have potassium and magnesium supplements added to dialysis formulary for PD patients

• June/19: Potassium and magnesium supplements added to dialysis formulary

• Current: Guidance documents on management of hypokalemia and hypomagnesemia in PD patients and prescription of potassium and magnesium supplements being drafted
Questions?

I sent Sylvia a text asking her if she'd like to go to lunch.

I got a text back from her. All it said was "K."

What is that supposed to mean?

Maybe she wants to go somewhere that serves potassium.