POTASSIUM CONTROVERSIES

#KDIGO

#KDIGOpotassium
KDIGO Controversies Conference on Potassium Management

Co-Chairs: Catherine Clase and Roberto Pecoits-Filho
DISCLOSURES

• Speaker: Catherine Clase has received honoraria for consultation or advisory board membership, or research funding from the Ontario Ministry of Health, Pfizer, Leo Pharma, Astellas, Janssen, Amgen, Boehringer-Ingelheim and Baxter

• KDIGO potassium controversies conference sponsored at arm’s length by Fresenius Medical Care, AstraZeneca, Vifor Fresenius Medical Care, Relypsa, and Bayer

• Off-label use
• Binders for some indications
• All management of acute hyperkalemia
Outline

• Out-patient management of chronic hyperkalemia
• In-patient and ER management of hyperkalemia
• Novel diagnostic approach to hypokalemia
Chronic Hyperkalemia
Out-patient management of chronic hyperkalemia

Gasparini Nephrol Dial Transplant 2018
Kovesdy Eur Heart J 2018
Risk factors for hyperkalemia

- Low GFR
- High UACR
- Male sex
- White
- Diabetes
- Baseline potassium

- Potassium-sparing diuretics
- Renin-angiotensin-aldosterone system blockers
- Potassium supplements
- Calcineurin inhibitors (cyclosporine, tacrolimus)
- Salt substitutes
CONSEQUENCES

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 Gasparini Nephrol Dial Transplant 2018
Management options

• Dietary change (but potential for harm)
• Permissive approach (unstudied)
• **Review medications predisposing to hyperkalemia**
• **Use potassium-wasting diuretic**
• Laxatives
• Correction of coincident acidosis
• More frequent dialysis
• Lower potassium bath
• SPS (small RCT, large-scale observational evidence on safety)
• Newer binders – patiromer, zirconium cyclosilicate (larger RCTs, no large-scale experience)
Acute Hyperkalemia
Prognostic significance of hyperkalemia in hospitalized patients

Retrospective analysis of the US VA national cohort

(2,103,422 records/245,808 veterans with at least 1 hospitalization and at least 1 inpatient or outpatient serum K record during fiscal year 2005)

**odds ratio of death within 1 day of an hyperkalemic event**

<table>
<thead>
<tr>
<th>Potassium level, mEq/L</th>
<th>INPATIENT</th>
<th>OUTPATIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No CKD</td>
<td>CKD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5.5</td>
<td>1206165</td>
<td>830998</td>
</tr>
<tr>
<td>≥5.5 and &lt;6.0</td>
<td>24190</td>
<td>20717</td>
</tr>
<tr>
<td>≥6.0</td>
<td>10747</td>
<td>10905</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OR (95% CI)</th>
<th>Number of records</th>
<th>Number of death events</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>(reference)</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1.12 (1.05, 1.19)</td>
<td>444029</td>
<td>256 (1.8%)</td>
<td>8.02</td>
</tr>
</tbody>
</table>

Q3 At what level of high potassium, measured as an outpatient, do you direct patients to the ER?
## Acute hyperkalemia - ECG

<table>
<thead>
<tr>
<th>Serum potassium</th>
<th>Expected ECG abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5–6.5 mmol/L</td>
<td>Tall, ‘peaked’ T-waves with narrow base, best seen in precordial leads</td>
</tr>
</tbody>
</table>
| 6.5–8.0 mmol/L  | Peaked T-waves  
Prolonged PR interval  
Decrease amplitude of P-waves  
Widening of QRS complex |
| > 8.0 mmol/L    | Absence of P-wave  
Intraventricular blocks, fascicular blocks, bundle branch blocks, QRS axis shift  
Progressive widening of QRS resulting in bizarre morphology  
‘Sine wave’ patterns (sinoventricular rhythm), VF, asystole |
Acute hyperkalemia – frequency of ECG changes
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Serum potassium: Expected ECG abnormality

- 6.5-6.9 mmol/L: T waves with normal base, broadening in proximal leads
- 6.5-7.0 mmol/L: Prolonged QT interval, decreased amplitude of QRS complex
- ≥7.0 mmol/L: Abnormality of T waves, fasciculation, bundle branch blocks, ventricular tachycardia, cardiac arrest

High risk for hyperkalemia:
- Point of care K^+ > 6.0 mmol/L
- Lab report K^+ > 6.0 mmol/L

- Kyphosis
- IV inulin and glucose and/or esterification
  - Consider i.v. furosemide (without volume overload)
  - Consider i.v. furosemide unless anuric ESKD or severe volume depletion
  - Consider K^+ binders

- AKI or CKD

- Repeat K^+ > 6.0 mmol/L
  - Yes: Corridor dialysis
  - No: Exit

Airway
- Breathing
- Circulation

Assess and manage underlying cause

Volume
- CVP
- Acidosis
- Monitor glucose

- Yes: Coreflow
- No: Exit

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AKI or CKD

No

Repeat K⁺ > 6.0 mmol/L

No
Exit

Yes
Consider dialysis†
Acute hyperkalemia

- iv 3 g calcium gluconate (1 amp = 10 ml of 10% solution, 3* 93 mg elemental calcium, 3*2.3 mmol) **May need to give repeatedly**, or
- iv 1 g calcium chloride (1 amp = 10 ml of 10% solution, 273 mg elemental calcium, 6.8 mmol) **May need to give repeatedly**
- iv regular insulin 5 units plus 25 g glucose (50 ml of 50%)
- albuterol (salbutamol) 10 mg nebulised (MDI = 100-200 mcg)
- iv bicarbonate (1 amp = 50 ml of 8.4% solution, Na = 50 mmol Na, HCO₃ = 50 mmol) over 15 mins
- monitor for **hypoglycemia**
- SPS 15 – 60 g po/pr. Don’t give with sorbitol
- Newer binders – zirconium cyclosilicate (not patiromir)

Elliot. CMAJ 2010
Kessler J Hosp Med 2011
Approach to Hypokalaemia
History and physical

GI losses? Diuretics?*
Other medications? (e.g., cisplatin, amphotericin, licorice)
Acute intracellular shift? (e.g., insulin, catecholamine excess, HPP)

Yes

Stop

No

Hypertension

Yes

Check plasma aldosterone:renin**

Mineralocorticoid excess?

Surreptitious vomiting/laxative/diuretic use?

Tubulopathy? (e.g., Gitelman, Bartter, RTA)

Severe hypomagnesemia?

No

Check urine Na⁺, Cl⁻, K⁺, Cr***
Diagnosis of hypokalemia

• May still consider aldosterone excess in some patients on diuretics
• Plasma renin-aldosterone ratio, after correcting serum potassium levels, off mineral-receptor antagonists, but other medications, may be continued; interpretation dependent upon local lab methods and reporting
• **Typical presentations:**
  • Tubulopathy: urine K/Cr > 2.5 (transtubular potassium gradient not thought valid)
  • Vomiting: low urine Cl
  • Laxative: high urine Cl
  • Diuretic: similar to tubulopathy unless remote use
  • Tubulopathy may be confirmed by genetic testing
• Hypomagnesemia – GI losses, nephrotoxins, PPI, thiazides (not with K sparing; not loop)

Kieboom. Pharmacoepidemiol Drug Saf. 2018
Cheungpasitporn. Ren Fail. 2015
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