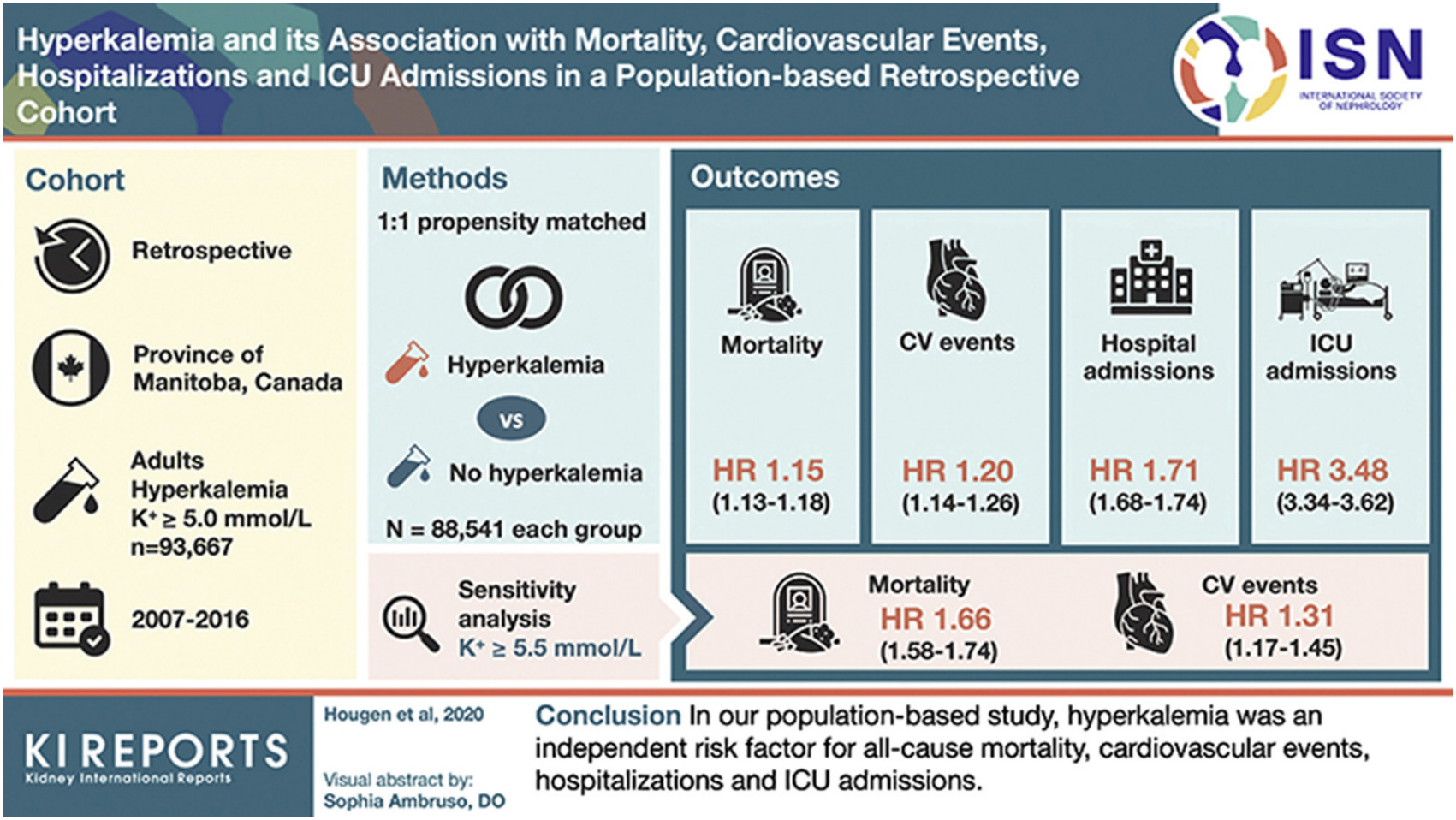
Hyperkalemia: Diagnosis and Treatment

Eric W. Robbins

Last updated: 11/01/2021

Table of Contents

Why Care



Source:[1]

[1] Ingrid Hougen et al. "Hyperkalemia and its Association With Mortality, Cardiovascular Events, Hospitalizations, and Intensive Care Unit Admissions in a Population-Based Retrospective Cohort". In: *Kidney International Reports* 6.5 (May 2021), pp. 1309–1316. ISSN: 24680249. DOI: 10.1016/j.ekir.2021.02.038. URL: https://linkinghub.elsevier.com/retrieve/pii/S2468024921001431.

When to Care

- EKG changes

[2] Zubaid Rafique et al. "Can physicians detect hyperkalemia based on the electrocardiogram?" In: *The American Journal of Emergency Medicine* 38.1 (Jan. 2020), pp. 105–108. ISSN: 07356757. DOI: 10.1016/j.ajem.2019.04.036. URL: https://linkinghub.elsevier.com/retrieve/pii/S0735675719302608.

[3] Keith D Wrenn, Corey M Slovis, and Bonnie S Slovis. "The ability of physicians to predict hyperkalemia from the ECG". In: *Annals of Emergency Medicine* 20.11 (Nov. 1991), pp. 1229–1232. ISSN: 01960644. DOI: 10.1016/S0196-0644(05)81476-3. URL: https://linkinghub.elsevier.com/retrieve/pii/S0196064405814763.

[4] Brian T. Montague, Jason R. Ouellette, and Gregory K. Buller. "Retrospective Review of the Frequency of ECG Changes in Hyperkalemia". In: *Clinical Journal of the American Society of Nephrology* 3.2 (Mar. 2008), pp. 324–330. ISSN: 1555-9041.

When to Care

- EKG changes
  - peaked T waves
  - PR depression
  - bradycardia (!)
  - sinusoidal pattern (!!)

[2] Zubaid Rafique et al. "Can physicians detect hyperkalemia based on the electrocardiogram?" In: *The American Journal of Emergency Medicine* 38.1 (Jan. 2020), pp. 105–108. ISSN: 07356757. DOI: 10.1016/j.ajem.2019.04.036. URL: https://linkinghub.elsevier.com/retrieve/pii/S0735675719302608.

[3] Keith D Wrenn, Corey M Slovis, and Bonnie S Slovis. "The ability of physicians to predict hyperkalemia from the ECG". In: *Annals of Emergency Medicine* 20.11 (Nov. 1991), pp. 1229–1232. ISSN: 01960644. DOI: 10.1016/S0196-0644(05)81476-3. URL: https://linkinghub.elsevier.com/retrieve/pii/S0196064405814763.

[4] Brian T. Montague, Jason R. Ouellette, and Gregory K. Buller. "Retrospective Review of the Frequency of ECG Changes in Hyperkalemia". In: *Clinical Journal of the American Society of Nephrology* 3.2 (Mar. 2008), pp. 324–330. ISSN: 1555-9041.

When to Care

- EKG changes
  - peaked T waves
  - PR depression
  - bradycardia (!)
  - sinusoidal pattern (!!)
- How Useful is the EKG?

[2] Zubaid Rafique et al. "Can physicians detect hyperkalemia based on the electrocardiogram?" In: *The American Journal of Emergency Medicine* 38.1 (Jan. 2020), pp. 105–108. ISSN: 07356757. DOI: 10.1016/j.ajem.2019.04.036. URL: https://linkinghub.elsevier.com/retrieve/pii/S0735675719302608.

[3] Keith D Wrenn, Corey M Slovis, and Bonnie S Slovis. "The ability of physicians to predict hyperkalemia from the ECG". In: *Annals of Emergency Medicine* 20.11 (Nov. 1991), pp. 1229–1232. ISSN: 01960644. DOI: 10.1016/S0196-0644(05)81476-3. URL: https://linkinghub.elsevier.com/retrieve/pii/S0196064405814763.

[4] Brian T. Montague, Jason R. Ouellette, and Gregory K. Buller. "Retrospective Review of the Frequency of ECG Changes in Hyperkalemia". In: *Clinical Journal of the American Society of Nephrology* 3.2 (Mar. 2008), pp. 324–330. ISSN: 1555-9041.

When to Care

- EKG changes
  - peaked T waves
  - PR depression
  - bradycardia (!)
  - sinusoidal pattern (!!)
- How Useful is the EKG?
  - study of ESRD pts getting emergent HD (n = 317)[2]
  - SEN 0.19, SPEC 0.97, PPV 0.92, NPV 0.46
  - Other studies were worse[3]

[2] Zubaid Rafique et al. "Can physicians detect hyperkalemia based on the electrocardiogram?" In: *The American Journal of Emergency Medicine* 38.1 (Jan. 2020), pp. 105–108. ISSN: 07356757. DOI: 10.1016/j.ajem.2019.04.036. URL: https://linkinghub.elsevier.com/retrieve/pii/S0735675719302608.

[3] Keith D Wrenn, Corey M Slovis, and Bonnie S Slovis. "The ability of physicians to predict hyperkalemia from the ECG". In: *Annals of Emergency Medicine* 20.11 (Nov. 1991), pp. 1229–1232. ISSN: 01960644. DOI: 10.1016/S0196-0644(05)81476-3. URL: https://linkinghub.elsevier.com/retrieve/pii/S0196064405814763.

[4] Brian T. Montague, Jason R. Ouellette, and Gregory K. Buller. "Retrospective Review of the Frequency of ECG Changes in Hyperkalemia". In: *Clinical Journal of the American Society of Nephrology* 3.2 (Mar. 2008), pp. 324–330. ISSN: 1555-9041.

When to Care

- EKG changes
  - peaked T waves
  - PR depression
  - bradycardia (!)
  - sinusoidal pattern (!!)
- How Useful is the EKG?
  - study of ESRD pts getting emergent HD (n = 317)[2]
  - SEN 0.19, SPEC 0.97, PPV 0.92, NPV 0.46
  - Other studies were worse[3]
- What about Cardiologists?[4]

[2] Zubaid Rafique et al. "Can physicians detect hyperkalemia based on the electrocardiogram?" In: *The American Journal of Emergency Medicine* 38.1 (Jan. 2020), pp. 105–108. ISSN: 07356757. DOI: 10.1016/j.ajem.2019.04.036. URL: https://linkinghub.elsevier.com/retrieve/pii/S0735675719302608.

[3] Keith D Wrenn, Corey M Slovis, and Bonnie S Slovis. "The ability of physicians to predict hyperkalemia from the ECG". In: *Annals of Emergency Medicine* 20.11 (Nov. 1991), pp. 1229–1232. ISSN: 01960644. DOI: 10.1016/S0196-0644(05)81476-3. URL: https://linkinghub.elsevier.com/retrieve/pii/S0196064405814763.

[4] Brian T. Montague, Jason R. Ouellette, and Gregory K. Buller. "Retrospective Review of the Frequency of ECG Changes in Hyperkalemia". In: *Clinical Journal of the American Society of Nephrology* 3.2 (Mar. 2008), pp. 324–330. ISSN: 1555-9041.

When to Care

- EKG changes
  - peaked T waves
  - PR depression
  - bradycardia (!)
  - sinusoidal pattern (!!)
- How Useful is the EKG?
  - study of ESRD pts getting emergent HD (n = 317)[2]
  - SEN 0.19, SPEC 0.97, PPV 0.92, NPV 0.46
  - Other studies were worse[3]
- What about Cardiologists?[4]
  - n = 90 of K $\geq$6.0
  - n = 24 had "T wave changes" (21 were non-specific)
  - n = 3 had "Peaked T waves" (3.33%)

[2] Zubaid Rafique et al. "Can physicians detect hyperkalemia based on the electrocardiogram?" In: *The American Journal of Emergency Medicine* 38.1 (Jan. 2020), pp. 105–108. ISSN: 07356757. DOI: 10.1016/j.ajem.2019.04.036. URL: https://linkinghub.elsevier.com/retrieve/pii/S0735675719302608.

[3] Keith D Wrenn, Corey M Slovis, and Bonnie S Slovis. "The ability of physicians to predict hyperkalemia from the ECG". In: *Annals of Emergency Medicine* 20.11 (Nov. 1991), pp. 1229–1232. ISSN: 01960644. DOI: 10.1016/S0196-0644(05)81476-3. URL: https://linkinghub.elsevier.com/retrieve/pii/S0196064405814763.

[4] Brian T. Montague, Jason R. Ouellette, and Gregory K. Buller. "Retrospective Review of the Frequency of ECG Changes in Hyperkalemia". In: *Clinical Journal of the American Society of Nephrology* 3.2 (Mar. 2008), pp. 324–330. ISSN: 1555-9041.

Formal Definition

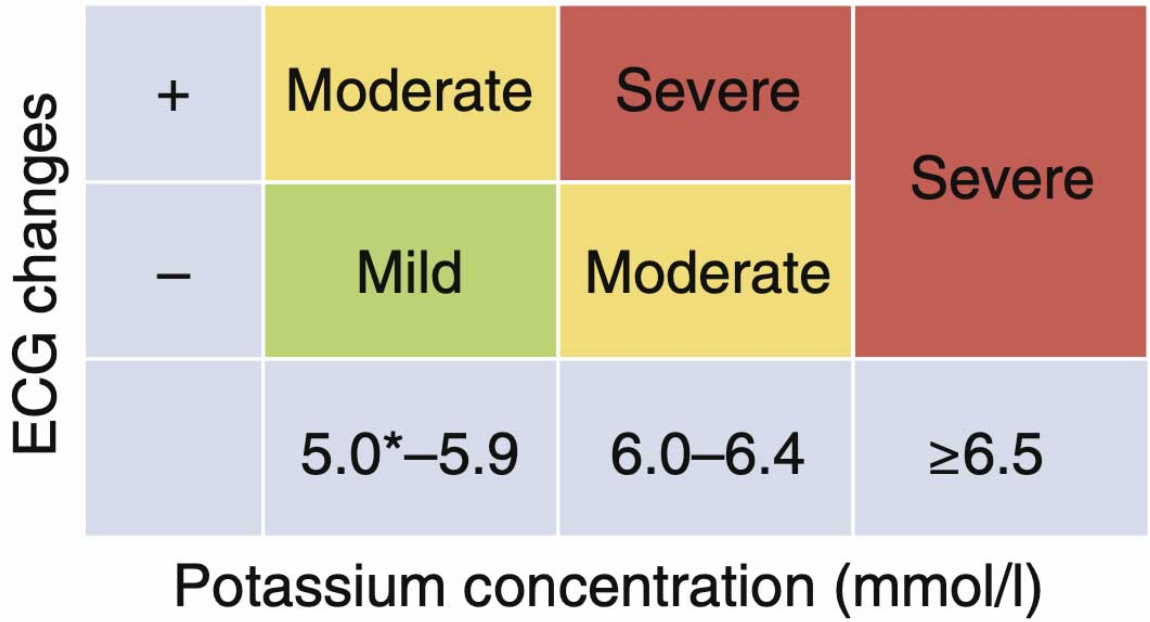


Figure 4| Severity of acute hyperkalemia: expert opinion-based risk classification. *5.0 or upper limit of normal range. ECG, electrocardiogram.

Clase CM et al. PMID 31706619

Source:[5]

[5] Catherine M. Clase et al. "Potassium homeostasis and management of dyskalemia in kidney diseases: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference". In: *Kidney International* 97.1 (Jan. 2020), pp. 42–61. ISSN: 00852538. DOI: 10.1016/j.kint.2019.09.018. URL: https://linkinghub.elsevier.com/retrieve/pii/S0085253819310129.

What Works

- Myocardial Stabilization
- Push K Back In
- Get Rid of K
- Prevent Recurrence

Myocardial Stabilization

Clinical Pearls

- Saves lives!
- Gluconate vs Chloride
  - 1–3 g CaGluc or 1 g CaCl[6]
- Redosing?
  - Optimal regimen unknown[7]
  - Calcium only lasts for 30–60 min
  - Redose if unstable arrhythmia (brady, wide QRS)

---

[6] Catherine M. Clase et al. "Potassium homeostasis and management of dyskalemia in kidney diseases: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference". In: *Kidney International* 97.1 (Jan. 2020), pp. 42–61. ISSN: 00852538. DOI: 10.1016/j.kint.2019.09.018. URL: https://linkinghub.elsevier.com/retrieve/pii/S0085253819310129.

[7] Heather A. LaRue, Gary Daniel Peksa, and Shital C. Shah. "A Comparison of Insulin Doses for the Treatment of Hyperkalemia in Patients with Renal Insufficiency". In: *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy* 37.12 (Dec. 2017), pp. 1516–1522. ISSN: 02770008. DOI: 10.1002/phar.2038. URL: https://onlinelibrary.wiley.com/doi/10.1002/phar.2038.

Pushing K Back In

- Options

[8] M Allon, R Dunlay, and C Copkney. "Nebulized albuterol for acute hyperkalemia in patients on hemodialysis.". In: *Annals of internal medicine* 110.6 (Mar. 1989), pp. 426–9. ISSN: 0003-4819. DOI: 10.7326/0003-4819-110-6-426. URL: http://www.ncbi.nlm.nih.gov/pubmed/2919849, M Allon and C Copkney. "Albuterol and insulin for treatment of hyperkalemia in hemodialysis patients.". In: *Kidney international* 38.5 (Nov. 1990), pp. 869–72. ISSN: 0085-2538. DOI: 10.1038/ki.1990.284. URL: http://www.ncbi.nlm.nih.gov/pubmed/2266671.

[9] H H Liou et al. "Hypokalemic effects of intravenous infusion or nebulization of salbutamol in patients with chronic renal failure: comparative study.". In: *American journal of kidney diseases : the official journal of the National Kidney Foundation* 23.2 (Feb. 1994), pp. 266–71. ISSN: 0272-6386. DOI: 10.1016/s0272-6386(12)80983-8. URL: http://www.ncbi.nlm.nih.gov/pubmed/8311086, A Mandelberg et al. "Salbutamol metered-dose inhaler with spacer for hyperkalemia: how fast? How safe?" In: *Chest* 115.3 (Mar. 1999), pp. 617–22. ISSN: 0012-3692. DOI: 10.1378/chest.115.3.617. URL: http://www.ncbi.nlm.nih.gov/pubmed/10084465.

Pushing K Back In

- Options
  - *IV* insulin ± dextrose
  - $\beta 2$ agonists
    - albuterol data is old (1980s–early 1990s)[8]
    - or is on IV salbutamol[9]
    - for unstable bradycardia ± shock, use epinephrine drip
  - if no hypervolemia, isotonic bicarb (D5W with 150 mEq/L NaHCO3)
    - per old RCTs, bicarb *ampules* don't work

[8] M Allon, R Dunlay, and C Copkney. "Nebulized albuterol for acute hyperkalemia in patients on hemodialysis.". In: *Annals of internal medicine* 110.6 (Mar. 1989), pp. 426–9. ISSN: 0003-4819. DOI: 10.7326/0003-4819-110-6-426. URL: http://www.ncbi.nlm.nih.gov/pubmed/2919849, M Allon and C Copkney. "Albuterol and insulin for treatment of hyperkalemia in hemodialysis patients.". In: *Kidney international* 38.5 (Nov. 1990), pp. 869–72. ISSN: 0085-2538. DOI: 10.1038/ki.1990.284. URL: http://www.ncbi.nlm.nih.gov/pubmed/2266671.

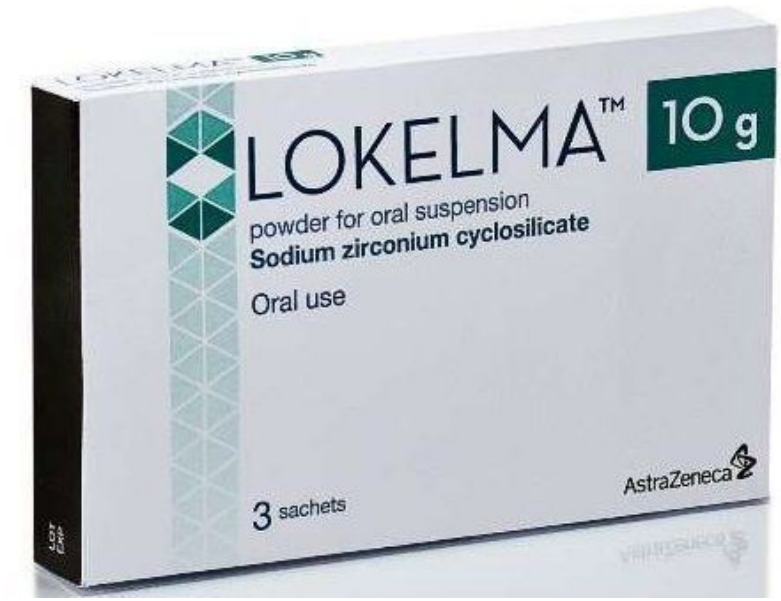
[9] H H Liou et al. "Hypokalemic effects of intravenous infusion or nebulization of salbutamol in patients with chronic renal failure: comparative study.". In: *American journal of kidney diseases : the official journal of the National Kidney Foundation* 23.2 (Feb. 1994), pp. 266–71. ISSN: 0272-6386. DOI: 10.1016/s0272-6386(12)80983-8. URL: http://www.ncbi.nlm.nih.gov/pubmed/8311086, A Mandelberg et al. "Salbutamol metered-dose inhaler with spacer for hyperkalemia: how fast? How safe?" In: *Chest* 115.3 (Mar. 1999), pp. 617–22. ISSN: 0012-3692. DOI: 10.1378/chest.115.3.617. URL: http://www.ncbi.nlm.nih.gov/pubmed/10084465.

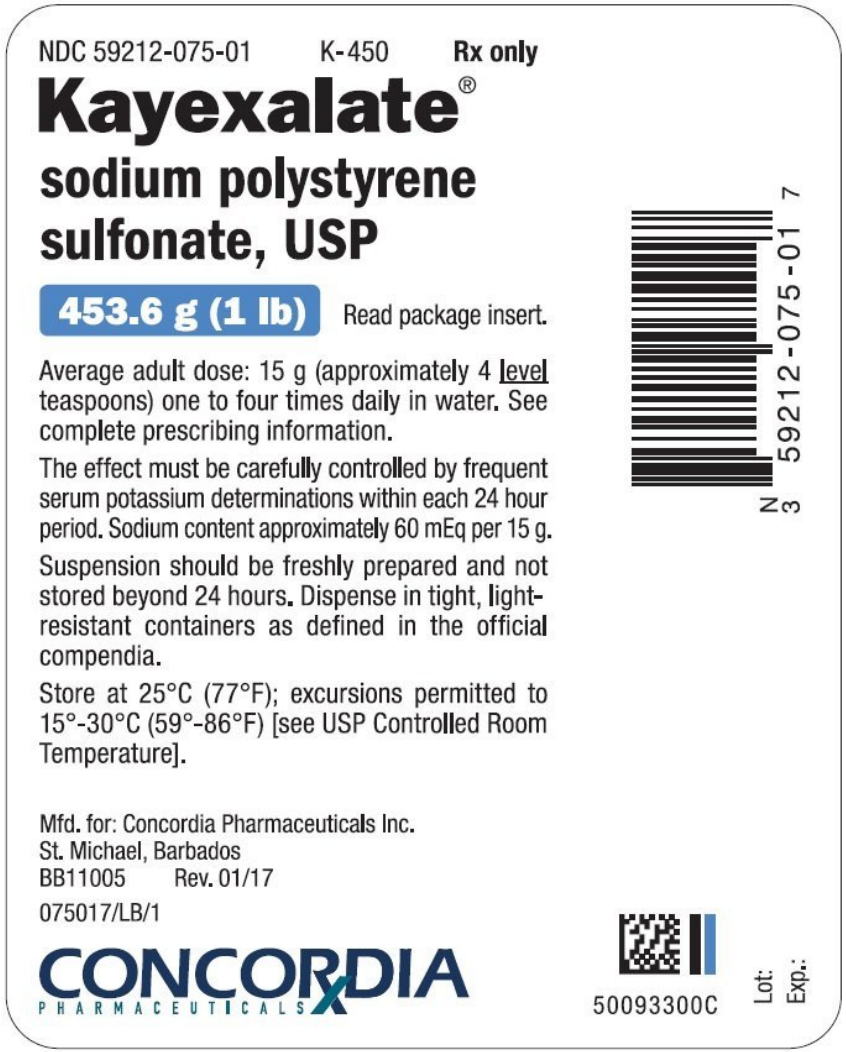
Getting Rid of K

Getting Rid of K

Preventing Recurrence

Preventing Recurrence





Conclusions

- Diagnose
  - Don't use EKG to decrease your concern
- Myocardium
  - CaGluc or CaCl saves lives
- Temporize
  - IV insulin
  - IV diuretics
  - IV bicarb or LR
- Reduce recurrence
  - sodium zirconium cyclosilicate (Lokelma)

References

[1] Ingrid Hougen et al. "Hyperkalemia and its Association With Mortality, Cardiovascular Events, Hospitalizations, and Intensive Care Unit Admissions in a Population-Based Retrospective Cohort". In: *Kidney International Reports* 6.5 (May 2021), pp. 1309–1316. ISSN: 24680249. DOI: 10.1016/j.ekir.2021.02.038. URL: https://linkinghub.elsevier.com/retrieve/pii/S2468024921001431.

[2] Zubaid Rafique et al. "Can physicians detect hyperkalemia based on the electrocardiogram?" In: *The American Journal of Emergency Medicine* 38.1 (Jan. 2020), pp. 105–108. ISSN: 07356757. DOI: 10.1016/j.ajem.2019.04.036. URL: https://linkinghub.elsevier.com/retrieve/pii/S0735675719302608.

[3] Keith D Wrenn, Corey M Slovis, and Bonnie S Slovis. "The ability of physicians to predict hyperkalemia from the ECG". In: *Annals of Emergency Medicine* 20.11 (Nov. 1991), pp. 1229–1232. ISSN: 01960644. DOI: 10.1016/S0196-0644(05)81476-3. URL: https://linkinghub.elsevier.com/retrieve/pii/S0196064405814763.

[4] Brian T. Montague, Jason R. Ouellette, and Gregory K. Buller. "Retrospective Review of the Frequency of ECG Changes in Hyperkalemia". In: *Clinical Journal of the American Society of Nephrology* 3.2 (Mar. 2008), pp. 324–330. ISSN: 1555-9041. DOI: 10.2215/CJN.04611007. URL: https://cjasn.asnjournals.org/lookup/doi/10.2215/CJN.04611007.

[5] Catherine M. Clase et al. "Potassium homeostasis and management of dyskalemia in kidney diseases: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference". In: *Kidney International* 97.1 (Jan. 2020), pp. 42–61. ISSN: 00852538. DOI: 10.1016/j.kint.2019.09.018. URL: https://linkinghub.elsevier.com/retrieve/pii/S0085253819310129.

[6] Heather A. LaRue, Gary Daniel Peksa, and Shital C. Shah. "A Comparison of Insulin Doses for the Treatment of Hyperkalemia in Patients with Renal Insufficiency". In: *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy* 37.12 (Dec. 2017), pp. 1516–1522. ISSN: 02770008. DOI: 10.1002/phar.2038. URL: https://onlinelibrary.wiley.com/doi/10.1002/phar.2038.

[7] M Allon, R Dunlay, and C Copkney. "Nebulized albuterol for acute hyperkalemia in patients on hemodialysis.". In: *Annals of internal medicine* 110.6 (Mar. 1989), pp. 426–9. ISSN: 0003-4819. DOI: 10.7326/0003-4819-110-6-426. URL: http://www.ncbi.nlm.nih.gov/pubmed/2919849.

[8] M Allon and C Copkney. "Albuterol and insulin for treatment of hyperkalemia in hemodialysis patients.". In: *Kidney international* 38.5 (Nov. 1990), pp. 869–72. ISSN: 0085-2538. DOI: 10.1038/ki.1990.284. URL: http://www.ncbi.nlm.nih.gov/pubmed/2266671.