Electrolytes and the Heart

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The normal state of cardiac cell membrane polarization is dependent on the maintenance of a normal ionic balance:

- Potassium
- Magnesium
- Calcium

Remember:
- 12 lead ECG changes will occur in all leads
- Do not wait for the ECG, send a laboratory test

Hypokalemia: ventricular irritability
- Flat T with prominent U wave
- T-wave + U-wave same amplitude
- ST seg flattening
- Prolongation of QT interval (K⁺ < 2.0)
- ST segment depression
Case Study January 13

64 y/o female comes to ED for syncopal episode at home while working with a physical therapist.

She began feeling strange, light, and almost passed out

BP 100/50 lying and 60/30 standing

Has had several episodes of feeling dizzy and light-headed.

In ED, had another syncopal episode when she got up to go to the bathroom.

Family states she had not been eating or drinking well.

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**Home meds**

**PRESCRIPTION:**

1. Albuterol 2 puff every 4 hours as needed.
2. Almotript 2 pills ME every 4 hours as needed.
3. Rabeprazole 20 mg b.i.d.
4. Citalopram 40 mg daily.
5. Captopril 5 mg daily.
6. Cefpodoxime 50 mg p.o.
7. Dexameth 0.6 mg daily.
8. loratadine 10 mg 1/2 every 6 hours.
9. Fosamax 70 mg weekly.
10. Imipramine 10 mg nightly.
11. lansoprazole 20 mg b.i.d.
12. Levitironid 60 mg daily.
13. metoprolol 50 mg daily.
14. Nitroglycerin 0.6 mg every 5 hours as needed.
15. Moxifloxacin 10 mg nightly.
16. Niasin 100 mg b.i.d.
17. Omeprazole 20 mg b.i.d.
18. Propranolol 40 mg every 4 hours.
19. Pravastatin 40 mg weekly.
20. Sertraline 150 mg at bedtime.
21. Tamsulosin 0.4 mg b.i.d.
22. Topiramate 10 mg b.i.d.

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**EKG 1 year earlier**

October 18, 2003
EKG: 6 weeks prior to ED visit December 4, 2009

EKG in ED: January 13, 2010 @ 1541

Home meds

- Albuterol 2 puff(s) MDI every 30 minutes as needed.
- Benadryl 15 mg q.i.d.
- Cetirizine 40 mg daily.
- Colchicine 30 mg daily.
- Dolobid 25 mg q.d.
- Esterine 125 mg q.i.d.
- Fexofenadine 120 mg q.d.
- Ibuprofen 600 mg p.o.
- Ketotifen 0.02% drops b.i.d.
- Lamotrigine 100 mg q.d.
- Triamterene 25 mg q.d.
- Trimethoprim 5 mg q.d.
- Venlafaxine 150 mg p.o.
- Zyrtec 10 mg q.d.

January 13, 2010 @ 2100

January 15, 2010 0530
Electrolytes and the Heart
- Hyperkalemia; asystole, depression
  - $>5.5$ tall, narrow, peaked T waves
  - QRS widens
  - P-wave widens
  - $>6.5$ QRS widens
  - $>8.0$ wide QRS
  - P-wave barely visible
Hyperkalemia
Treatment:
- Remove Potassium: Lasix, Kayexalate or dialysis
- Shift Potassium: insulin and dextrose, NaHCO
- Calcium: to protect the heart

Hypocalcemia: Torsades de Pointes
- Prolonged QT
- Prolonged ST seg

Hypercalcemia: agonal or asystole
- Bradycardia and heart block
- Shortened QT
- Shortened ST seg

Calcium
- Positive inotropic effect
- Contractility
- Cellular response to contraction

Magnesium
- Required to support the heart muscle contraction-relaxation actions
- Anti-Inflammatory Action
- Cardiac and Pulmonary
**Electrolytes and the Heart**

- Hypomagnesemia: Torsades de Pointes
- Prolonged QT
- Broad, flattened T-wave
- Depressed ST segments
- Dysrhythmias
- Hypermagnesemia: agonal to asystole
- PR, QT prolonged—wide QRS
- Prolonged QRS

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**Common Causes of QT Prolongation**

- **Drugs** — Type IA (quinidine, procainamide, disopyramide) and Type III (sotalol, dofetilide, amiodarone) antiarrhythmic agents; — Tricyclic antidepressants/phenothiazines
- **"Lytess"** — Hyperkalemia (or hypomagnesemia), — Hypocalcemia
- **CNS** — CNS catastrophes (e.g., stroke, seizure, coma, intracerebral or brainstem bleeding)

**NOTE** - Several other conditions (e.g., bundle branch block, infarction, and ischemia) may also cause QT prolongation. However, the presence of these other conditions will usually be obvious from inspection of the ECG.

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**Electrolytes and the Heart**

- Just a note on: Torsades de Pointes
- Prolonged QT interval
- Pause then VT
- Polymorphic VT
- Normal QT interval
- Premature beat
- VT