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QTc Prolongation is Associated with Hypokalemia and Hypocalcemia in Emergency Department Patients

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Division of Emergency Medicine
QTc Prolongation

- **Congenital**
  - Six types (LQT1-LQT6)
  - Mutations in genes encoding potassium and sodium transmembrane channel proteins

- **Acquired**
  - Hypokalemia, hypocalcemia, hypomagnesemia, HIV, myocardial ischemia, numerous medications and drugs (i.e. cocaine)
QTc Prolongation

- Increased risk of cardiac arrhythmias
  - Torsades de pointes
  - Ventricular fibrillation
  - Sudden cardiac death
Multiple case reports and small studies in select populations have shown a correlation between electrolyte abnormalities and prolonged QTc interval.

Recently Golsari et al evaluated 258 medicine admit patients and did not find any association between electrolyte abnormalities and QTc interval.
Methods

Retrospective chart review of all ED patients who received an ECG for any reason during the 5 month period of June 2009 – October 2009 at a large volume, tertiary care center.

**Inclusion Criteria:** Patients with a computer generated QTc ≥ 460 ms.

**Exclusion Criteria:** Bradycardia (HR < 60 bpm)
Tachycardia (HR > 100 bpm)
QRS > 120 ms
Non-sinus or paced rhythm
Patients who left without being seen or against medical advice

ED electronic medical records were reviewed for patient demographics, presenting symptoms, comorbidities, electrolyte concentrations, medication administration, and disposition.

Statistical Analysis - Data is expressed as proportion with 95% confidence intervals. Data was compared among groups using a Chi-squared test.
RESULTS

11,359 Patients

- 8957 pts (80%) Normal QTc
- 2402 pts (20%) QTc ≥ 460 ms

- 1318 pts (55%) Excluded
- 1084 pts (45%) Eligible

Excluded Patients
- QRS > 120 ms 559 pts
- Tachycardia 581 pts
- Bradycardia 151 pts
- Non-sinus rhythm 239 pts
- Paced rhythm 182 pts
- LWBS or AMA 27 pts

- 615 pts (57%) QTc 460-479 ms
- 274 pts (25%) QTc 480-499 ms
- 195 pts (18%) QTc 500+ ms

% of all pts
- 5.4%
- 2.4%
- 1.7%
Presenting Symptoms

- Chest Pain
- SOB
- Lightheaded/dizzy
- Syncope
- Ingestion
- Palpitations
- Fatigue/weakness
- Seizure

Proportion Present
Presenting Symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>460-479 ms</th>
<th>480-499 ms</th>
<th>500+ ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest Pain</td>
<td></td>
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<td></td>
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<tr>
<td>SOB</td>
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</tbody>
</table>

Proportion Present

- Chest Pain
- SOB
- Lightheaded/dizzy
- Syncope
- Ingestion
- Palpitations
- Fatigue/weakness
- Seizure
Past Medical History

Proportion Present

<table>
<thead>
<tr>
<th>Condition</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Htn</td>
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<tr>
<td>DM</td>
<td>0.3</td>
</tr>
<tr>
<td>CHF</td>
<td>0.2</td>
</tr>
<tr>
<td>CAD/MI</td>
<td>0.2</td>
</tr>
<tr>
<td>Pacemaker/AICD</td>
<td>0.1</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>0.1</td>
</tr>
<tr>
<td>Psych</td>
<td>0.2</td>
</tr>
<tr>
<td>Drug Abuse</td>
<td>0.1</td>
</tr>
<tr>
<td>HIV</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Past Medical History

Proportion Present

- Htn
- DM
- CHF
- CAD/MI
- Pacemaker/AICD
- Arrhythmia
- Psych
- Drug Abuse
- HIV

- 460-479 ms
- 480-499 ms
- 500+ ms
Electrolytes Obtained

- [K] obtained
- [Mg] obtained
- [Ca] obtained

Proportion Present

- 460-479 ms
- 480-499 ms
- 500+ ms
Electrolyte Abnormalities and association with QTc interval

* p<0.01
Electrolyte Repletion

- Potassium was repleted in $66 \pm 10\%$ of patients with hypokalemia.
- Calcium was repleted in $13 \pm 5\%$ of patients with hypocalcemia.
- Magnesium supplementation occurred in only $2 \pm 1\%$ of pts.
  
  Only $1 \pm 0.6\%$ of pts with QTc $> 500$ ms had magnesium supplementation.
CONCLUSIONS

- QTc prolongation is associated with hypokalemia and hypocalcemia in ED patients
- The decision to replete electrolytes in the ED does not appear to be related to QTc interval
- ED patients with prolonged QTc infrequently have Mg determined and rarely receive prophylactic treatment
- Further studies necessary to determine effect of electrolyte repletion and magnesium prophylaxis in prevention of cardiac dysrhythmias in ED patients
BIBLIOGRAPHY