A Short Presentation on Long QT Syndrome

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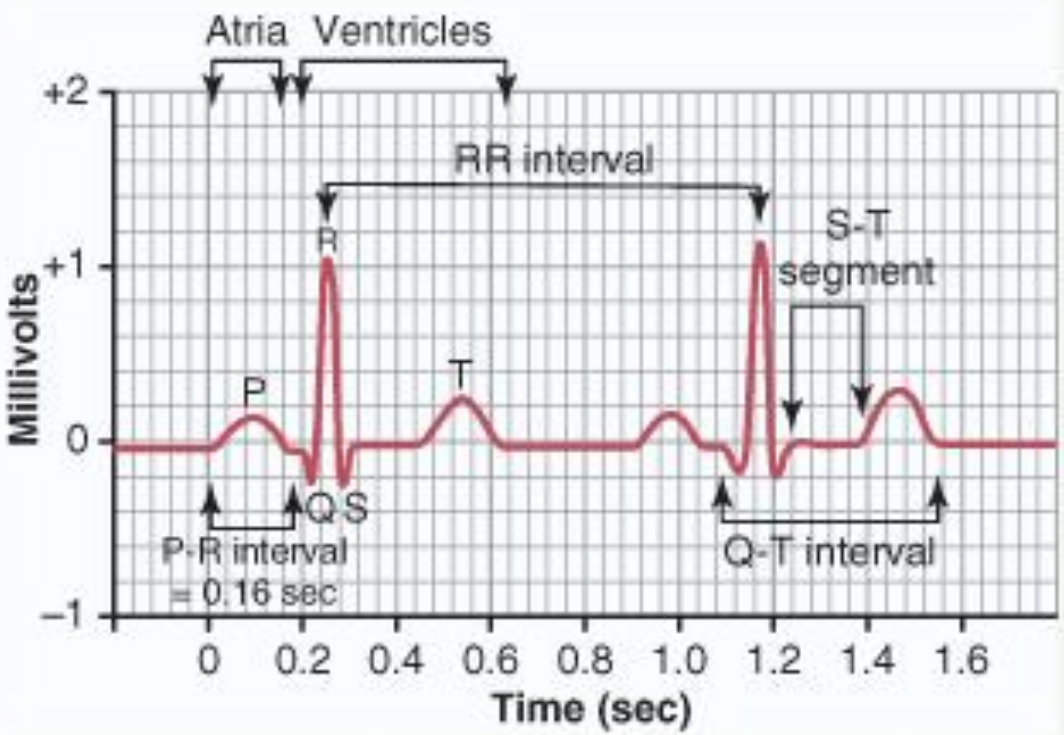
Normal QT Tracing& Physiology

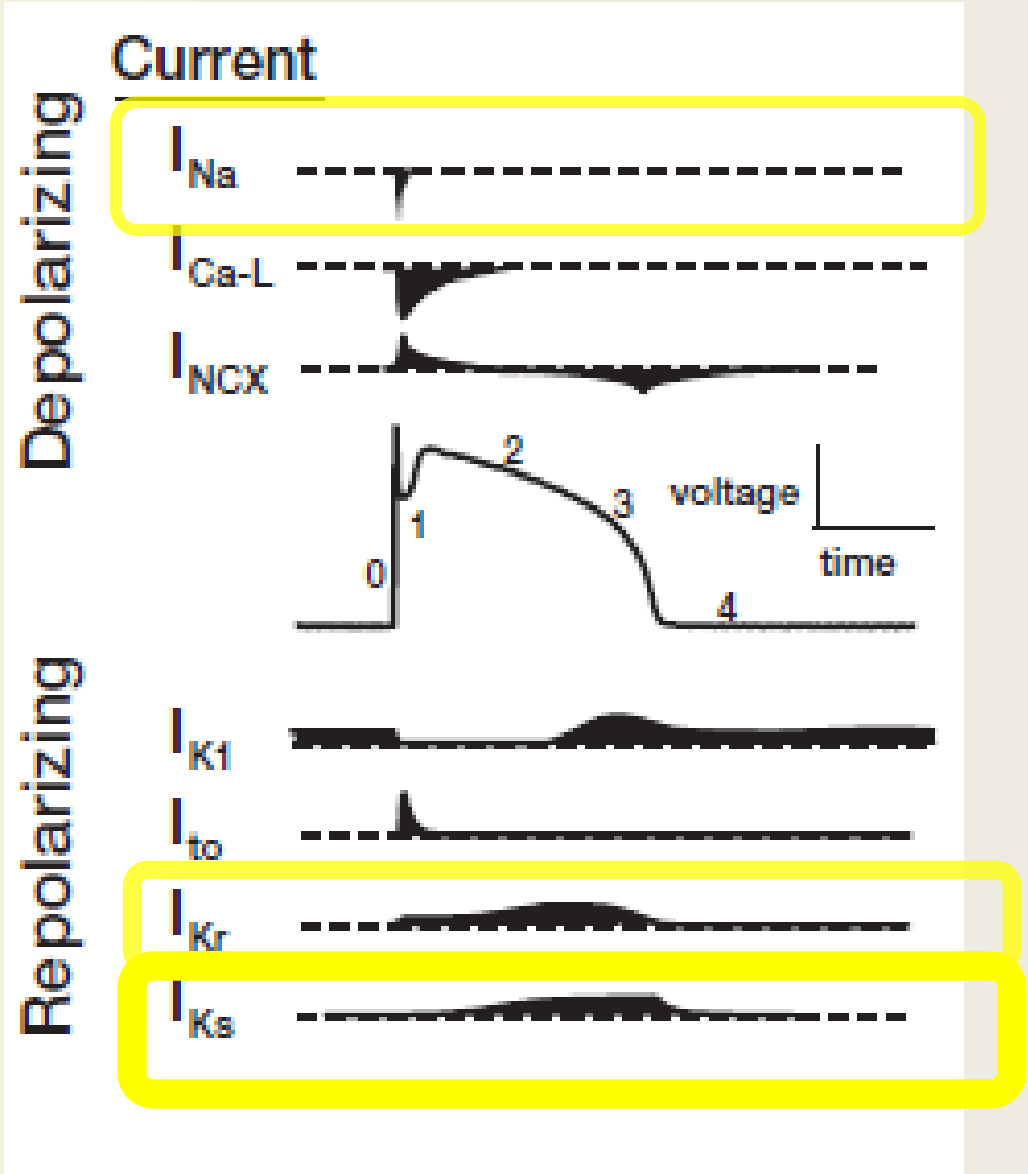
- Normal Time Range – Varies with Heart Rate
  - Should Be less than ½ R-R interval
  - Usually: 300ms ≤ QT ≤ 440ms
    - ~Seven to Eleven Little Boxes

- Bazzet's Formula

$$QTc = \frac{QT\ interval}{\sqrt{R\text{-}R\ interval}}$$

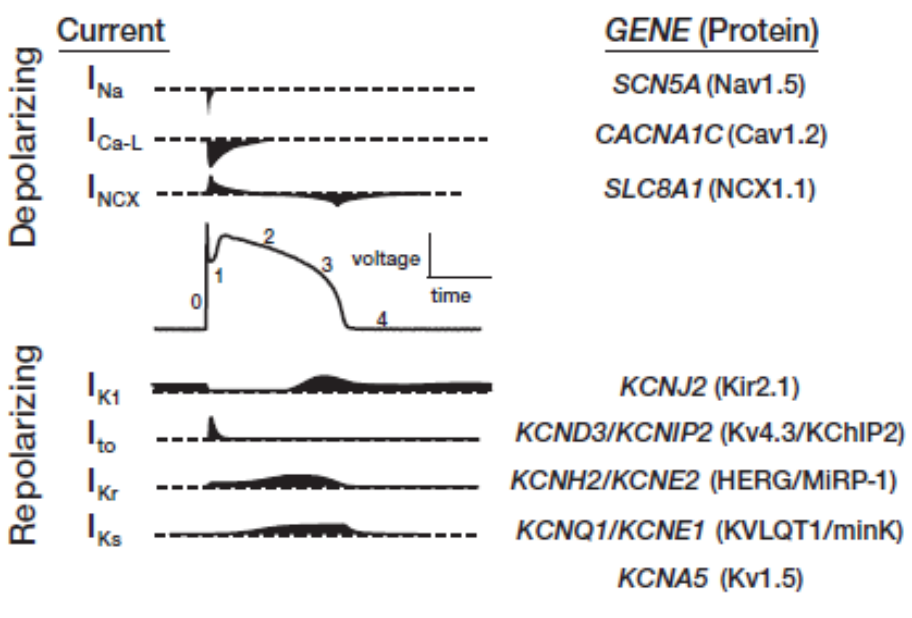


Channels Involved in Repolarization & LQTS



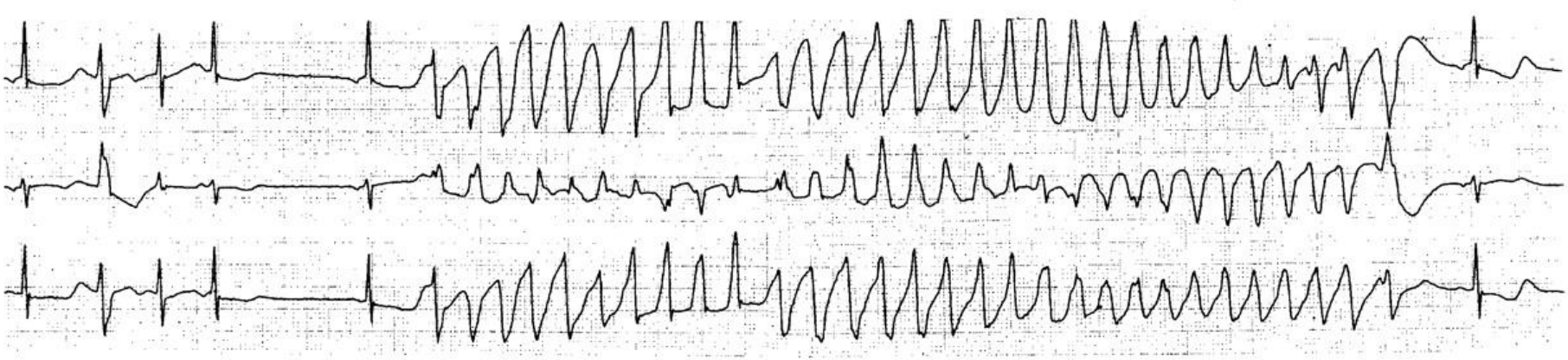
Ion Channels - Long QT Syndrome

- I_{Na} – Associated **[Brugada** and **LQT3]**
- $I_{Ca\text{-}L}$ – L-type Voltage Dependent Ca^{2+} Channel [**Brugada**, **Timothy Syndrome (LQT8),** and maybe **Bipolar Disorder**]
- I_{NCX} –
- I_{K1} – K inward rectifier – **Anderson-Tawil** Syndrome (**LQTS-7**)
- I_{to} – A-type Voltage Gated K^+ Channel (Transient Outward)
- I_{kr} – Rapid Delayed Rectifier
  - HERG = "**h**uman ***E**ther-à-go-go* **R**elated **G**ene"
- I_{Ks} – Slow Delayed Rectifying



Why is Long QT Syndrome Dangerous?

- Long Action Potentials lead to Ca Accumulation in cardiac myocytes
  - Early After-Depolarizations cause re-opening of Calcium Channels → Cells remain depolarized
  - Sudden Cardiac Death will result if Torsade de Pointes is not converted back to sinus rhythm



Congenital Acquired Long QT Syndrome

- **LQTS** – Incidence = 1 : 7,000-10,000
- **Romano-Ward** (LQT1)
  - Most Common LQTS
- **Brugada** Syndrome is a SHORT QT Syndrome
  - It is essentially the opposite of LQT3
- **Jervell and Lange-Nielson Syndrome**
  - Homozygous Recessive sub-type of LQTS1
  - Associated with Deafness
  - Affects 1.6-6 people per million

Sub-type	Frequency	Gene	Mutation Effect	ECG finding
LQTS 1	30-35%	KVLQT1	$^{-}K^{+}$ Efflux	Broad, late-inset, T wave
LQTS 2	25-30%	HERG	$^{-}K^{+}$ Efflux	Widely-split, low-amplitude, T wave
LQTS 3	5-10%	SCN5A	Prolonged Na^{+} influx	Biphasic or peaked, late-onset, T wave
LQTS 4	1-2%	ANKB	Build-up of Na^{+} within cell and Ca^{2+} outside of cell	Variable Qt interval prolongation
LQTS 5	1%	Mink	$^{-}K^{+}$ Efflux	Not defined
LQTS 6	rare	MiRP1	$^{-}K^{+}$ Efflux	Not defined
LQTS 7	rare	KCNJ2	$^{-}K^{+}$ Efflux	Modest prolongation of Qt interval
LQTS 8	rare	CACNA1C	Prolonged Ca^{2+} influx	Exaggerated Qt interval prolongation
LQTS 9	rare	CAV3	Prolonged Na^{+} influx	Not defined
LQTS 10	Extremely rare, found in 1 family	SCN4 β	Prolonged Na^{+} influx	Not defined

Long QT Syndrome – The Bottom Line

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- Diagnosis
  - HX: Syncope
  - LQT on Routine ECG
  - Point System – Takes Many Variables into Account (eg. QTc, Notched T-Waves, Syncope, deafness, etc)
  - Genetic Testing
- Treatment
  - Lifestyle modification
    - Intense Exercise should be avoided & Swimming prohibbited with LQT1
    - Exercise is encouraged in LQT3
  - Beta Blockers
    - Especially helpful for LQT1 and LQT2
    - Sotalol, however, can Provoke LQTS!
    - Contraindiated for LQTS3 – Arrythmias occur during slower heart rates
  - ICD for people suffering from Syncope or Arrythmia
  - K+ supplements for LQTS2
  - Mexiletine for LQTS3
  - Early ICD Placement for people with LQTS2 or LQTS3

Thank You