

ECG restitution of the beat-to-beat QT-TQ intervals in humans

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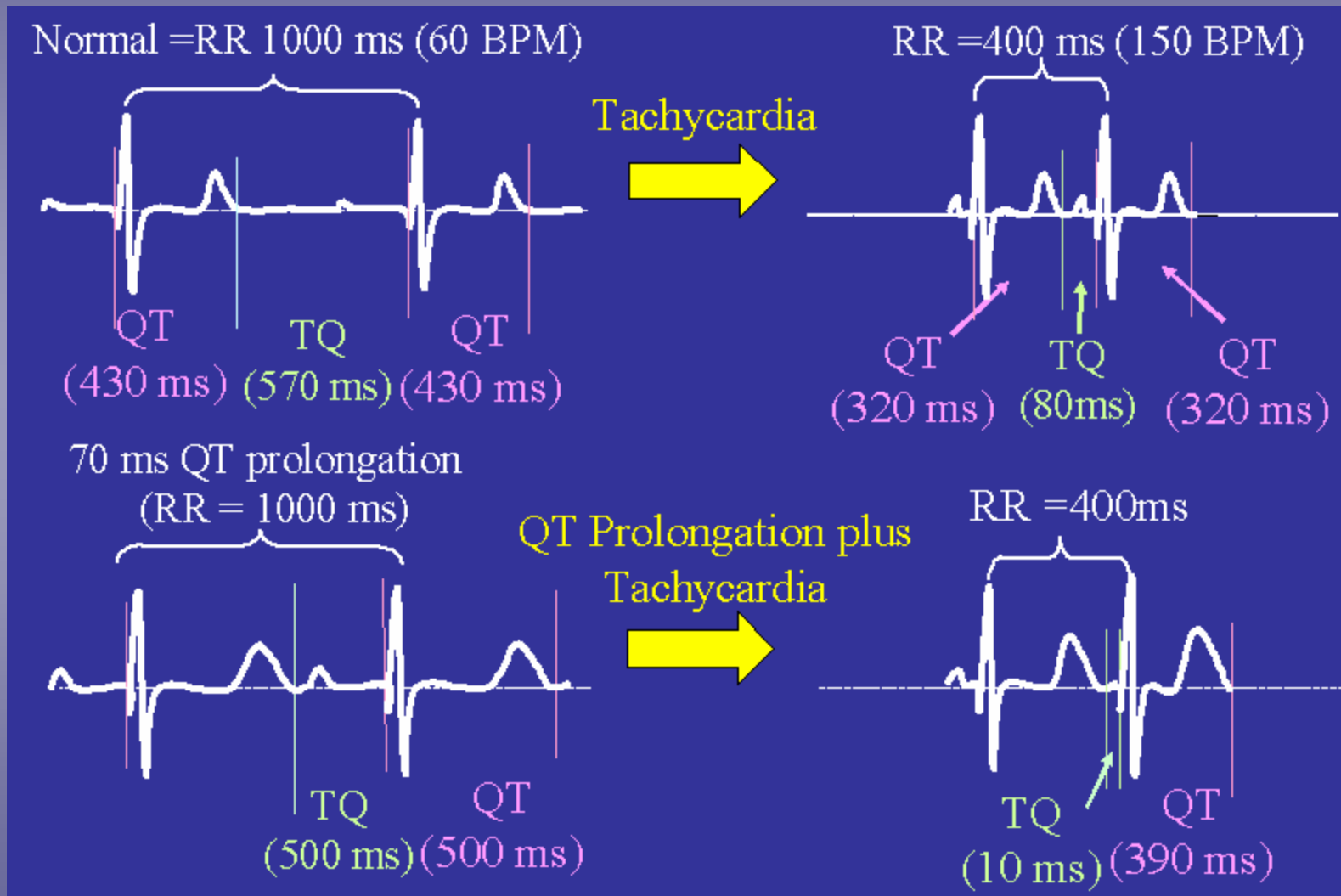
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ECG Restitution

- Ability of the heart to recover from one beat to the next.
- Examines the relationship between action potential duration (QT interval) and diastolic interval (TQ interval) through the ECG.
- Replaces the traditional invasive electrophysiology procedure
- As QT/TQ ratio increases between beats this may be associated with increase arrhythmia vulnerability due to re-entry

QT prolongation during tachycardia dramatically impairs restitution (increase QT/TQ ratio >1)



Methods in normals and TdP

Normals subjects (from two studies)

- Baseline values and autonomic challenges
 - standing, burst exercise, isoproterenol and phenylephrine
- Baseline and oral sotalol challenge
 - 160 (n= 38) or 320 (n=19) mg

TdP Case Study

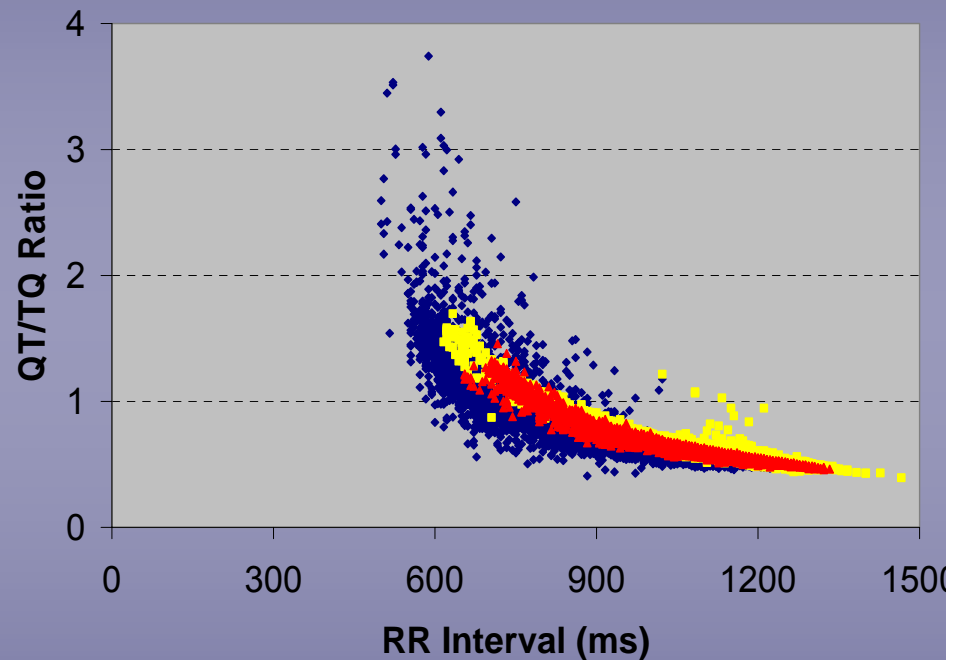
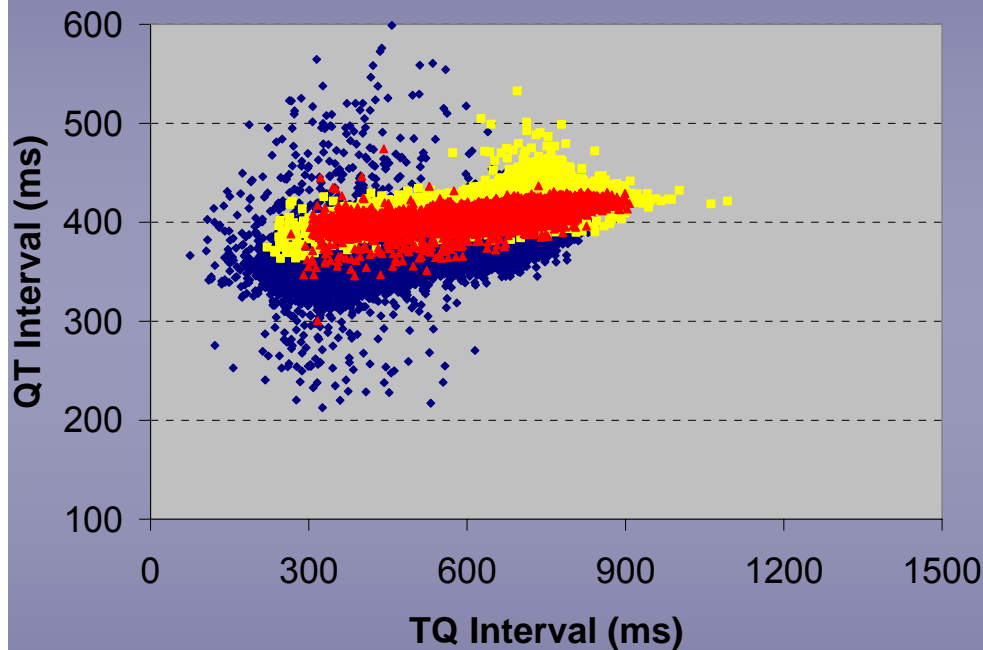
- 66 yo female CAD: Holter after sotalol (2 mg/kg, iv) prior to TdP

Restitution Parameters

- **Lower TQ 5th quantile:** boundary of lower 5% of beats
- **% Beats with $QT/TQ > 1$:** Reflects relative time spent in on steep portion of restitution relationship
- **Upper 98% quantile of QT/TQ ratio:** reflects degree and magnitude of steepness in restitution relationship for beats that may pose the greatest risk

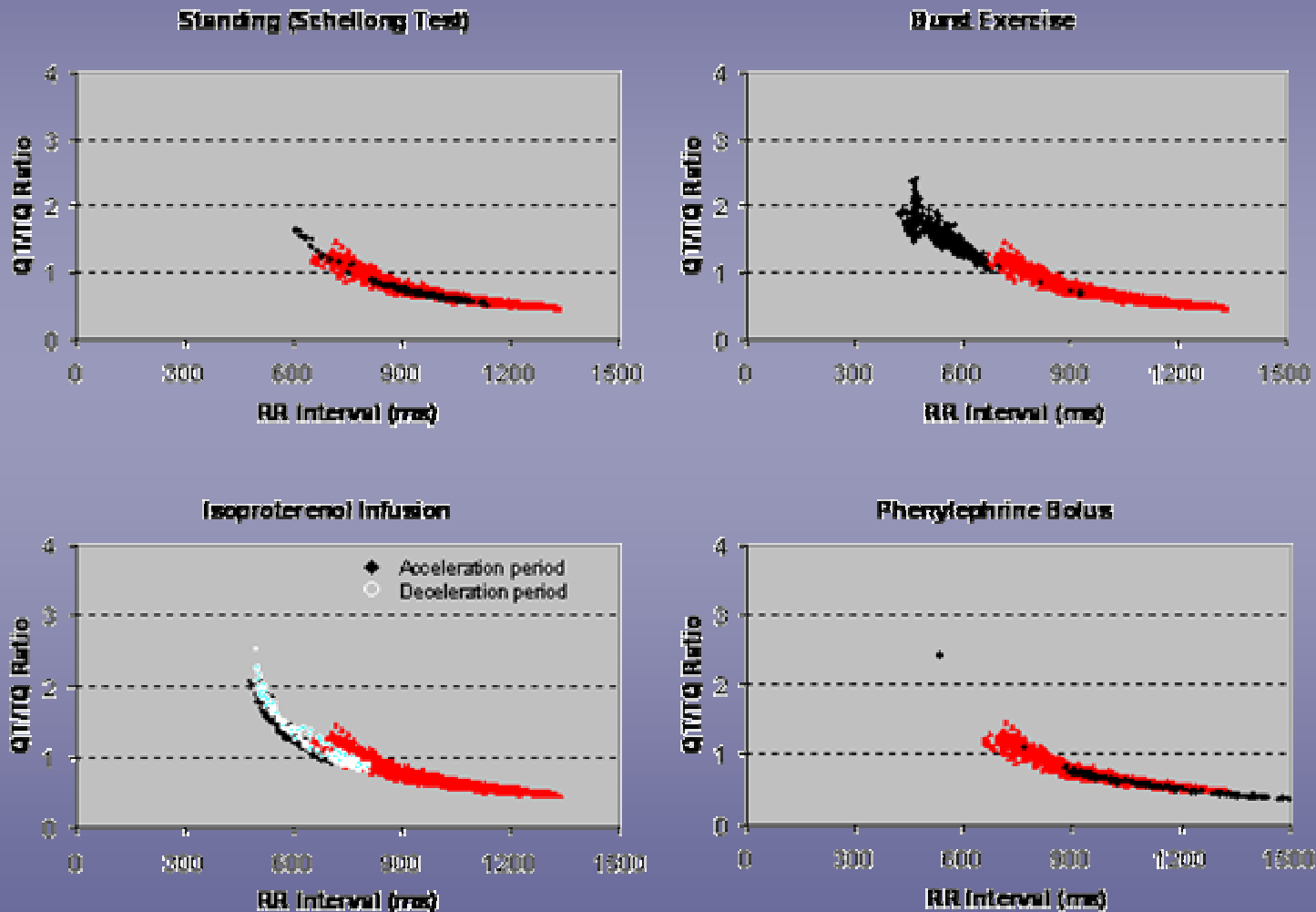
ECG restitution at ambulatory and resting baselines in normal subjects (n = 6)

■ 20 hr Ambulatory ■ 2 hr Nocturnal ■ 2 hr Awake supine



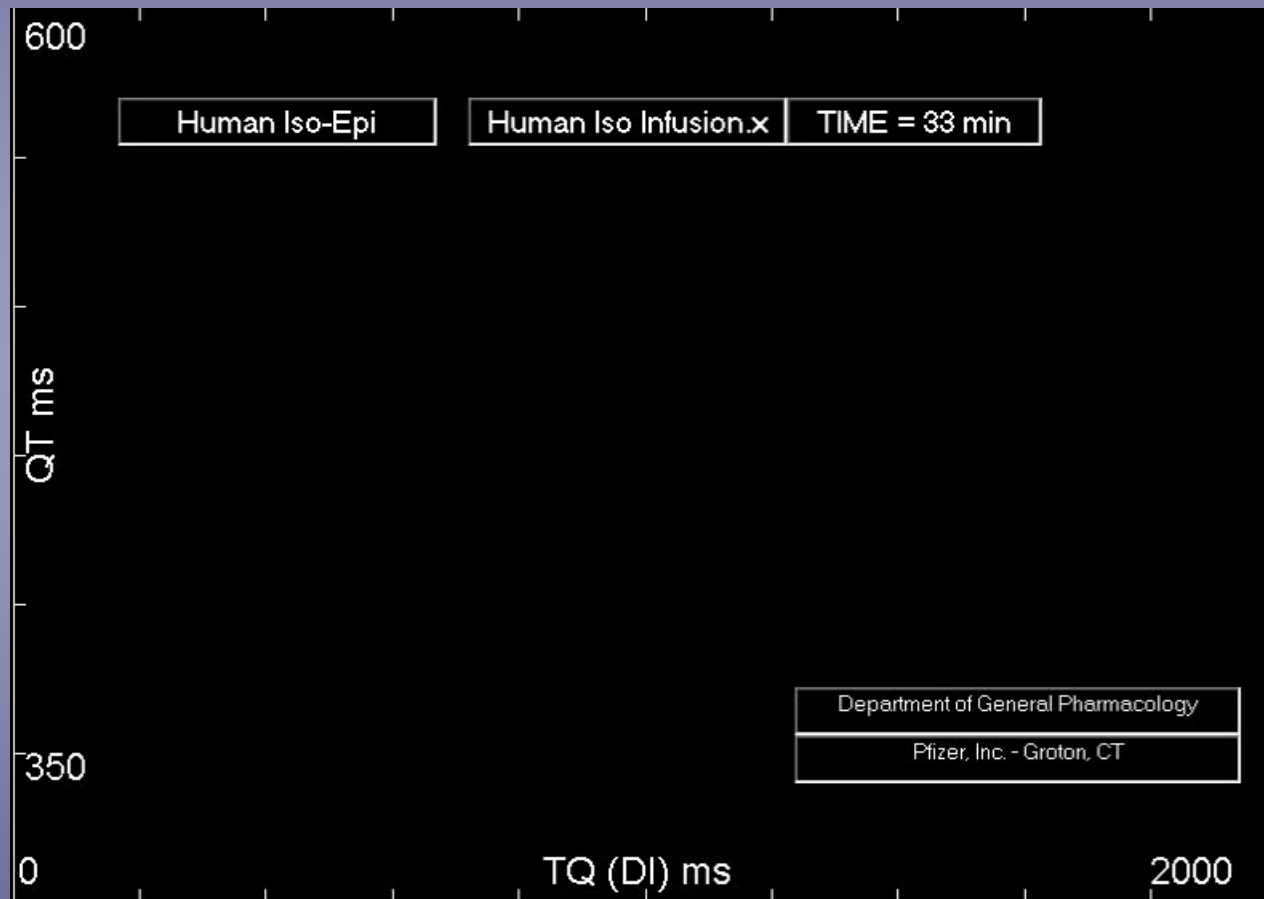
	Ambulatory	Nocturnal	Awake
Median TQ	531	660	685
Lower 5% TQ Quantile	327	420	440
% QT/TQ Ratio > 1	11.9	4.5	4.3
Upper 98% QT/TQ ratio	1.3	1.2	1.1

Restitution steepness increases with sympathetic-mediated tachycardia

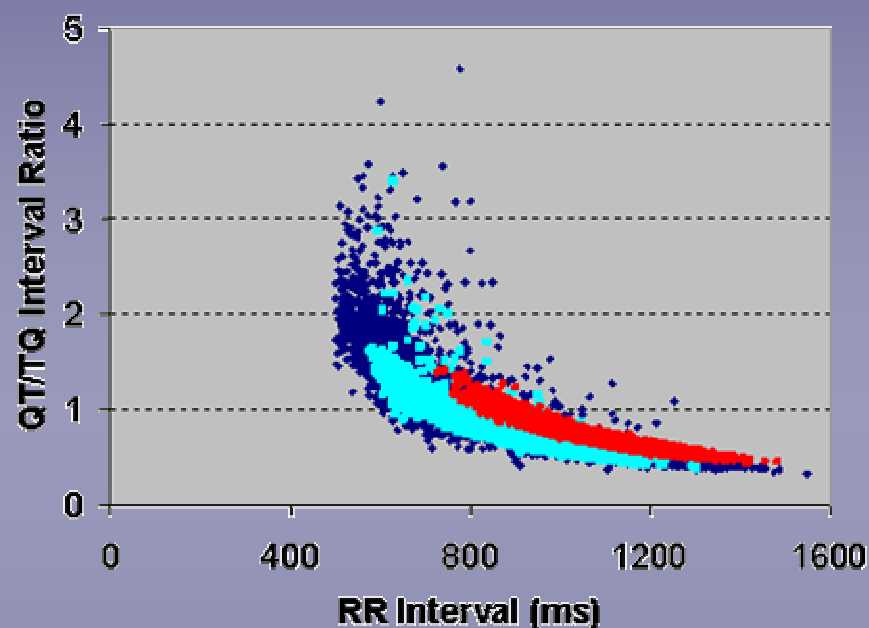
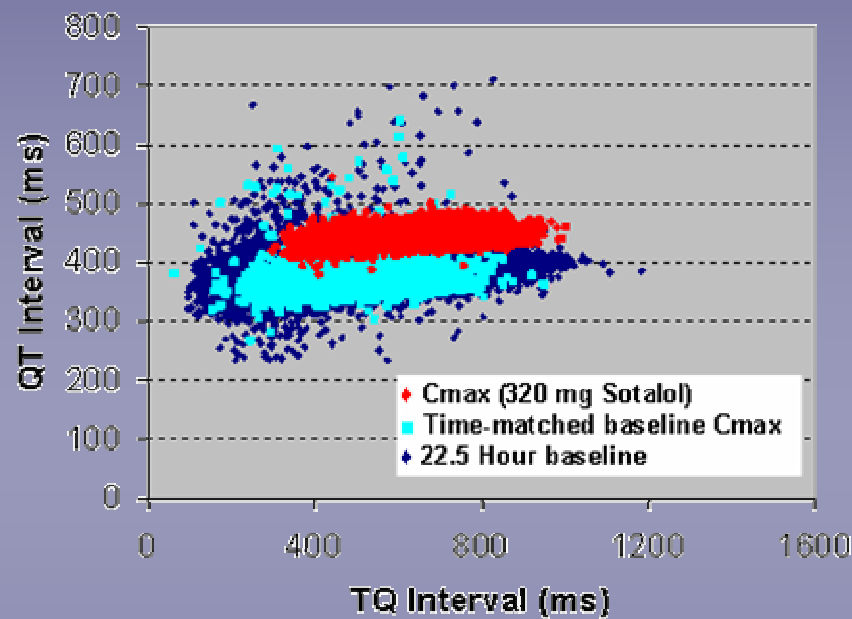


◆ 2Hr Awake Resting Baseline ◆ Autonomic Challenge Response

Isoproterenol Challenge



Sotalol improves restitution despite QT prolongation

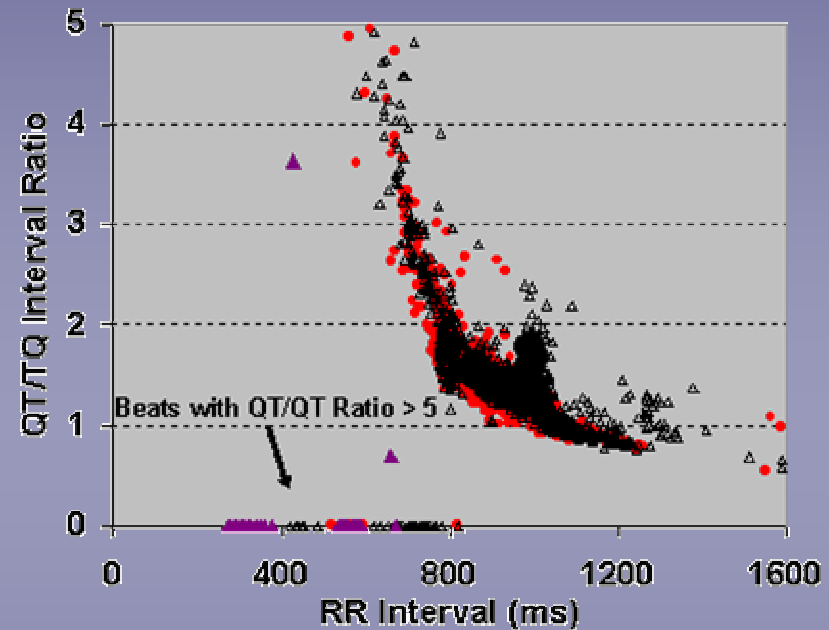
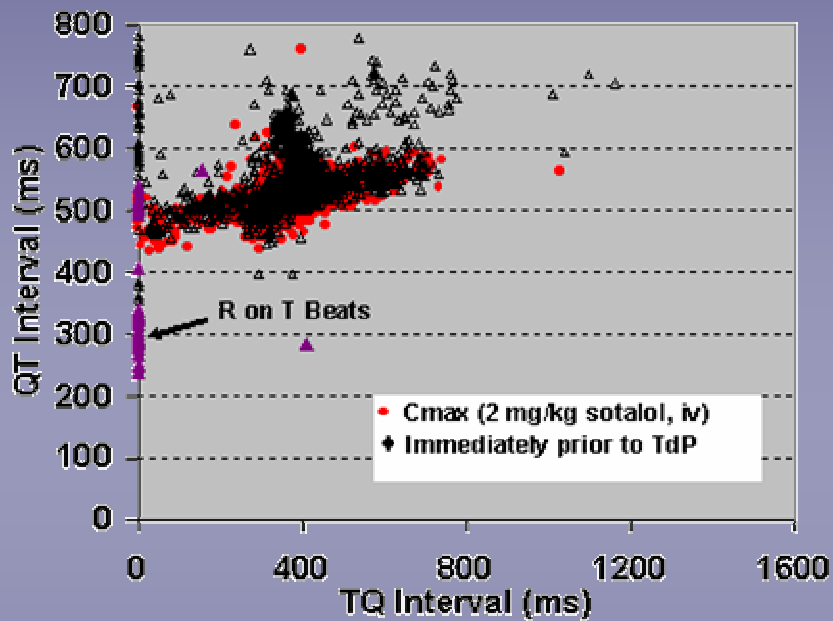


Comparison of Cmax period to time-matched baseline

RR: ↑ 235 ms
QT: ↑ 101 ms
TQ: ↑ 134 ms
QTc: ↑ 52 ms

TQ 5th Quantile: ↑ 115 ms
QT/TQ 98th Quant: ↓ 15%
%QT/TQ beats >1: ↓ 30%

Restitution is impaired prior to TdP



Comparison to Cmax period from normals

RR: ↓ 172 ms

QT: ↑ 53 ms

TQ: ↓ 225 ms

QTc: ↑ 95 ms

TQ 5th Quantile:

↓ 126 ms

QT/TQ 98th Quant:

↑ 58%

%QT/TQ beats >1:

↑ 722%

ECG Restitution Summary

- Can be obtained through digitized Holter recordings
- May be used to assess changes in autonomic state in conjunction with QT prolongation
- If boundaries can be defined, could delineate normal from abnormal repolarization status.

Other Contributors

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