QTc Prolongation

Thresholds, Culprit Drugs, and When to Act

The QTc interval reflects ventricular repolarization. Prolongation creates a vulnerable window for early afterdepolarizations, which can degenerate into torsades de pointes (TdP) — a potentially fatal polymorphic ventricular tachycardia.

Part 1 — Measuring QTc

The QT interval varies with heart rate. Correct it before interpreting it.

Formula	Use
Bazett $QTc = QT / \sqrt{RR}$	Standard formula. Most EHR systems use Bazett. Overcorrects (overestimates QTc) at fast rates (>100 bpm) and undercorrects at slow rates (<60 bpm).
Fridericia $QTc = QT / RR^{1/3}$	Preferred at heart rate extremes. More accurate when HR <60 or >100 bpm.

Normal thresholds and action points:

Finding	Threshold	Interpretation
Normal (men)	<450 ms	No prolongation
Normal (women)	<460 ms	No prolongation
Borderline	450–500 ms	Monitor; reassess with each new drug or electrolyte change
High Risk	>500 ms	Significant TdP risk — act now
High Risk	Increase >60 ms from baseline	Significant TdP risk regardless of absolute value — act now

> **Why women?** Women have longer baseline QTc than men due to hormonal effects on cardiac ion channels. They are 2–3× more likely to develop TdP from the same drug at the same dose.

Part 2 — Risk Factors for TdP

Drug-induced QTc prolongation becomes dangerous when additional risk factors are present. The more factors stacked, the higher the risk.

Category	Risk Factor
Patient factors	Female sex • Baseline prolonged QTc • Structural heart disease (LVH, cardiomyopathy, HF) • Age >65
Electrolyte	Hypokalemia (K^+ <3.5 mEq/L) • Hypomagnesemia (Mg^{2+} <1.8 mg/dL) • Hypocalcemia
Heart rate	Bradycardia (<60 bpm) — slower rates lengthen QT
Medications	Polypharmacy with QT-prolonging drugs • High-dose or IV administration of culprit drugs

The two most correctable risks are electrolytes. Before starting any QT-prolonging drug, check K^+ and Mg^{2+} and replete if low.

Part 3 — Culprit Drug Classes

Class	Examples	Clinical Note
Antiarrhythmics	Sotalol, quinidine, amiodarone, dofetilide	Highest risk class. Sotalol and quinidine are the most dangerous. Amiodarone prolongs QT but rarely causes TdP.
Antipsychotics	Haloperidol, ziprasidone, quetiapine	Risk increases with IV haloperidol. Telemetry monitoring recommended for IV use in ICU.
Antibiotics	Azithromycin, fluoroquinolones (ciprofloxacin, levofloxacin)	Azithromycin increases cardiovascular death in high-risk patients. Consider amoxicillin or doxycycline for CAP when feasible.
Antiemetics	Ondansetron, droperidol	IV ondansetron >32 mg in a single dose is contraindicated. Droperidol requires QTc check and telemetry.
Antifungals	Fluconazole	Dose-dependent QT prolongation. Risk increases with concurrent QT-prolonging drugs.

Check crediblemeds.org for the most current drug risk classification (Known Risk / Conditional Risk / Possible Risk). This database is updated continuously and is the clinical standard.

Management

Situation	Action
QTc >500 ms or increase >60 ms from baseline	Stop the offending drug. Correct K^+ and Mg^{2+}. Telemetry monitoring. Cardiology consultation.
Active TdP	IV magnesium sulfate 2 g over 15 min. Unsynchronized cardioversion if hemodynamically unstable. Overdrive pacing for recurrent TdP.
Pre-prescribing a high-risk drug	Obtain baseline QTc, K^+, Mg^{2+}. Correct electrolytes before starting. Never combine two high-risk drugs without cardiology input.
Monitoring on high-risk drug	Repeat QTc 2–4 hours after first dose (or after dose escalation). Document baseline and post-dose values.

CLINICAL RULE

QTc >500 ms or increase >60 ms from baseline → stop the offending drug and correct electrolytes. Before prescribing high-risk QT-prolonging drugs, check baseline QTc, K^+, and Mg^{2+}. Never combine two high-risk drugs without cardiology input.