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Images in Cardiology

Transient Acquired QT Interval Prolongation After Administration of Intravenous Ondansetron

Ruochen Mao, MD,[a] Evan J. Wiens, MD, MSc, FRCPC,[a,b] and Basem Elbarouni, MD, FRCPC[a,b]

[a] *Department of Internal Medicine, University of Manitoba, Winnipeg, Manitoba, Canada*

[b] *Section of Cardiology, Department of Internal Medicine, University of Manitoba, Winnipeg, Manitoba, Canada*

A 62-year-old man with a history of stable ischemic heart disease presented to the emergency room with nausea, vomiting, and chest pain at rest. The chest pain was atypical in nature; it did not respond to nitroglycerin and did not worsen with exertion. He took only aspirin, metoprolol, and ramipril at home. The patient was normotensive and normoxemic. Serial high-sensitivity troponin test results were normal, and other bloodwork (including calcium and magnesium levels) was unremarkable, with the exception of a serum potassium level of 2.4 mmol/L.

His presenting electrocardiogram (ECG; Fig. 1A) showed sinus rhythm with a right bundle branch block and a mildly prolonged QTc interval (450 msec using Bazett's formula[1]). However, conduction delays prolong the QRS interval, which affects the length of the QT interval without significant impact on the repolarization duration. Bogossian's formula can correct the QTc interval in the presence of bundle branch blocks, and this yielded a normal QTc interval of 302 msec.[2]

During his time in the emergency room, he experienced nausea and was given 4 mg of ondansetron intravenously. He was also given 40 mmol of KCl orally for his hypokalemia. Fifteen minutes later, the patient had a mild recurrence of atypical chest discomfort at rest, and another ECG Fig. 1B) was performed. This showed nonspecific ST changes with profound QTc interval prolongation, using both Bogossian's formula (562 msec) and Bazett's formula (628 msec). In addition to QTc interval prolongation, there was a dramatic difference in T wave morphology, including prolongation of the T_{peak}–T_{end} interval. Ten minutes later, an ECG (Fig. 1C) and blood work were repeated, which showed a serum potassium level of 3 mmol/L, and partial resolution of the ST changes. The patient was not given any further QT-prolonging medication, and he was subsequently diagnosed with noncardiac chest pain after undergoing normal stress myocardial perfusion imaging.

Novel Teaching Points

- Proper assessment of the QT interval is important in the setting of a bundle branch block, as widening of the QRS will cause subsequent QT interval prolongation without significant impact on the duration of repolarization.
- Bogossian's formula is an alternative method for calculating the QT interval in the setting of a bundle branch block. However, no single formula is perfect for QTc interval calculation in every situation.
- Caution is needed when prescribing medications that prolong the QT interval, especially for patients with an underlying predilection for QT interval prolongation.

Severe hypokalemia is a known cause of QT interval prolongation.[3] However, this patient's initial ECG demonstrates a normal (by Bogossian's formula) or only modestly prolonged (by Bazett's formula) QTc interval. Subsequent administration of IV ondansetron resulted in profound transient QTc interval prolongation relative to this patient's baseline, and marked changes in T wave morphology. It has been previously described that intravenous ondansetron administration can lead to QT interval prolongation and T wave changes. Our patient had a history of ischemic heart disease; the presence of structural heart disease increases the risk for acquired QT interval prolongation. Such prolongations of the QTc and T_{peak}–T_{end} intervals are associated with increased risk of Torsades de Pointes and sudden cardiac death, with the risk increasing proportionally to QTc interval duration.[4-6]

These images demonstrate the importance of cautious administration of QT interval–prolonging medications, particularly in the presence of other risk factors for QT interval prolongation such as hypokalemia and underlying

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Corresponding author: Dr Ruochen Mao, Department of Internal Medicine, University of Manitoba, GF328, 820 Sherbrook Street, Winnipeg, Manitoba, Canada R3A 1R9. Tel.: +1-204-770-2220.

E-mail: maor@myumanitoba.ca

See page 111 for disclosure information.

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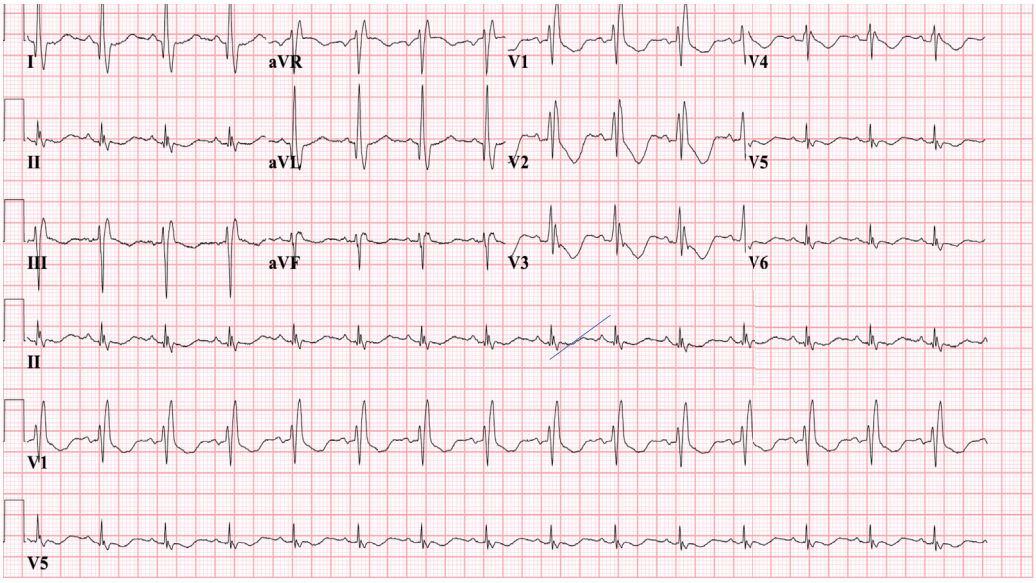
A



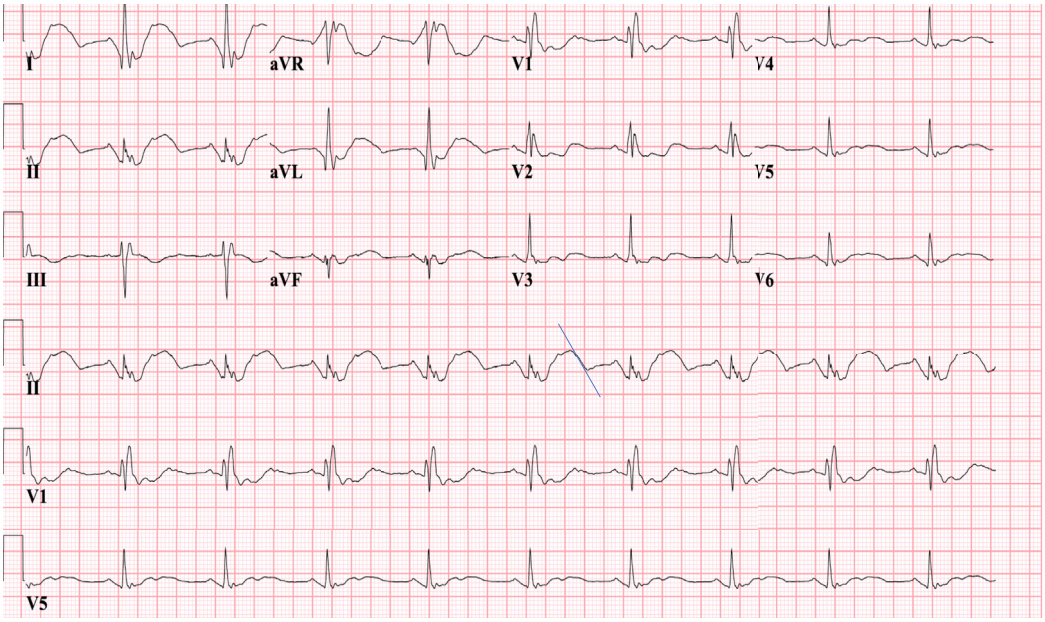
Bogossian's Formula

$QTc = QT_{bbb} - 48.5\% \, QRS_{bbb}$
= 360msec – 58msec
= 302msec

Bazett's formula

$$QTc = \frac{\text{QT interval}}{\sqrt{(\text{RR interval})}}$$
$= 360/\sqrt{(0.64)}$
=450msec

B



Bogossian's Formula

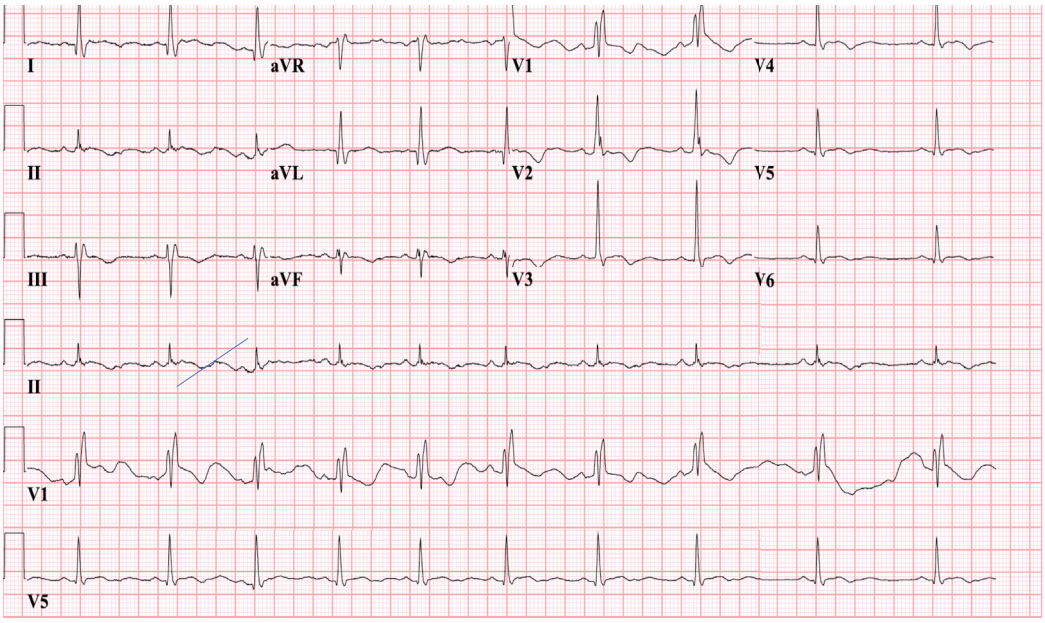
$QTc = QT_{bbb} - 48.5\% \, QRS_{bbb}$
= 640msec – 58msec
= 582msec

Bazett's Formula

$$QTc = \frac{\text{QT interval}}{\sqrt{(\text{RR interval})}}$$
$= 640/\sqrt{(1.04)}$
=628msec

Figure 1. Electrocardiogram showing (**A**) sinus rhythm with a right bundle branch block (bbb) and mildly prolonged QTc interval; (**B**) ST changes with profound QTc interval prolongation; and (**C**) partial resolution of the ST changes.

C



Bogossian's Formula

$QTc = QT_{bbb} - 48.5\% \, QRS_{bbb}$
= 440msec – 58msec
= 382msec

Bazett's Formula

$$QTc = \frac{QT\ interval}{\sqrt{(RR\ interval)}}$$
$= 440/\sqrt{(0.96)}$
=449sec

Figure 1. Continued

structural heart disease, even if the baseline QTc interval is not markedly prolonged.

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Disclosures

The authors have no conflicts of interest to disclose.

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