Knowledge Deficits Related to the QT Interval Could Affect Patient Safety

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Background: Recently, some QT-prolonging, noncardiac medications were withdrawn from the U.S. drug market because of continued inappropriate use by health care practitioners despite warnings and label changes from both the drug manufacturers and the U.S. Food and Drug Administration. This led us to assess the health care practitioners' knowledge of the QT interval and medications that may prolong it.

Methods: We surveyed health care practitioners, primarily specialists in cardiology, to identify knowledge deficits related to the QT interval.

Results: From a total of 334 survey respondents, 157 (47%) were physicians; 271 (81%) stated that cardiology was their area of specialization. Most of the respondents (86%) said that they would check an ECG before and after starting QT-prolonging medications, but less than half (42%) of all respondents and only 60% of physician respondents were able to accurately measure a sample QT interval on the survey. Less than two-thirds (63%) of respondents were able to accurately identify possible QT-prolonging medications, while only about half (51%) could accurately identify medication combinations that might prolong the QT interval.

Conclusions: We identified significant knowledge deficits regarding the QT interval and QT-prolonging medications. Additional research is needed to determine the extent to which these knowledge deficits may negatively affect patient safety. We must also develop effective strategies to eliminate these deficits.

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Many medications have been implicated in prolonging the QT interval and causing torsades de pointes. These medications include not only antiarrhythmic agents but also many other drugs that are used to treat non-cardiac diseases including some antimicrobials, antidepressants, and antipsychotic agents.[1–6] In the US, several medications have recently been withdrawn from the market because of their risk of causing torsades de pointes.[7] For terfenadine and cisapride, this risk was heightened by the continued co-prescription of medications known to inhibit the clearance of both drugs despite numerous warnings by the U.S. Food and Drug Administration and the drugs' manufacturers.[8,9]

Motivated by the controversies surrounding the true clinical significance of QT prolongation by nonantiarrhythmic agents and methods to measure and correct the QT interval, we developed a pilot study to assess health care practitioners' knowledge about the QT interval and medications that may cause QT prolongation.

METHODS

Two large national meetings were selected that would be attended by a large number of health care practitioners in cardiology. The first meeting was a satellite symposium on medical errors in the management of non-ST segment elevation myocardial infarction conducted at the 73rd American Heart Association Annual Scientific Session in New Orleans, in November 2000. Approximately 730

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people attended the session. The questionnaire was distributed to all meeting attendees at the beginning of the meeting. An announcement by the session moderator was made to remind attendees to complete the questionnaire; completed questionnaires were collected at the end of the session.

The second meeting was an investigators' meeting, conducted in February 2001 for a large multicenter cardiology trial. Approximately 550 people attended. The questionnaire was included in the meeting packet; attendees were asked to complete the questionnaire and turn it in with their other forms at the completion of the meeting.

The questionnaire was a two-sided form with three general information questions and seven questions on the QT interval. The general information questions requested the respondent's discipline, area of specialization, and practice setting. One of the seven questions on the QT interval asked the respondent to measure a QT interval from a sample ECG complex and record their answer in milliseconds. The remaining questions were multiple choice questions. The questions were designed to assess practitioners' knowledge of the following: (1) the meaning of a QT interval on the ECG, (2) potential causes of QT prolongation, (3) patient factors that increase the risk of torsades de pointes in a patient taking a QT-prolonging antiarrhythmic agent, (4) drugs and drug combinations that can cause QT prolongation, and (5) whether the respondent would routinely obtain an ECG to measure the QT interval in patients receiving a drug that might prolong the QT interval.

For the measurement of the QT interval, a recorded value was considered correct if between 400 and 440 ms (±20 ms of actual value). The ECG complex presented for measurement was very straightforward with no U waves and in sinus rhythm. The single complex was enlarged for viewing and gridlines were included. The start of the Q wave and end of the T wave were very clear and fell exactly on horizontal gridlines. The number and percentage of all respondents and physician respondents who answered the question correctly were calculated.

For the question on the timing of an ECG in a patient starting a potential QT-prolonging medication, the number and percentage of total respondents and physician respondents who selected each response was obtained. For the remaining questions, a mean accuracy score was calculated since there were multiple correct answers to each question. The number of correct, incorrect, and total choices for each question is shown in Table 1. Each question included a "don't know" response. An automatic score of 0% was given if this choice was selected, even if other choices were also selected. The remaining choices for a given question were assigned identical weights. The actual weight for each choice varied between questions because the number of possible choices for each question varied. The accuracy score for each respondent for each question was calculated by adding the weighted value for each correct selection and subtracting the weighted value for each incorrect selection. Then the mean of the accuracy scores for each question was obtained for all respondents and for the physician respondents. The number of respondents who received an accuracy score of 100% for each question was also calculated.

RESULTS

A total of 334 health care practitioners completed the survey. The overall response rate was less than 20%. Of the respondents, 127 (38%) were physicians, 30 (9%) were physicians in training, 149 (45%) were nurses, and 28 (8%) were from other health-related occupations. Cardiology was cited as the area of specialization for 271 (81%) of the respondents. Eighty-six percent of all respondents and 86% of the physician respondents stated that

Table 1. Number of Correct and Incorrect Choices for Each Multiple Choice Question

Question	Number of Correct Choices	Number of Incorrect Choices	Number of Possible Choices
Factors that may cause QT prolongation	4	3	7
Patient factors that may increase risk of TDP	2	3	5
Medications that may prolong QT interval	9	5	14
Medication combinations that may prolong QT interval	3	5	8

TDP = torsades de pointes.

Table 2. Survey Results

Subject of Question	Mean Accuracy Score, All Respondents (%)	Mean Accuracy Score, Physician Respondents (%)	Number (%) with an Accuracy Score of 100%
Factors that may prolong QT interval	74	83	66 (20)
Patient factors that may increase risk of TDP	55	66	22 (7)
Medications that may prolong QT interval	63	74	5 (1)
Medication combinations that may prolong QT interval	51	60	1 (<1)

TDP = torsades de pointes.

they would check a patient's ECG both before and after starting a medication that they thought could prolong the QT interval. Despite this, only 120 of the 287 respondents (42%) who answered this question were able to correctly measure the QT interval on the survey questionnaire within ±20 ms. The physician respondents fared better with 86 of the 144 (60%) respondents correctly measuring the sample QT interval.

Mean accuracy scores for the remaining survey questions are presented in Table 2. The number and percentage of respondents who received a score of 100% for each question are also presented in Table 2. The identification of drug–drug interactions that could precipitate QT interval prolongation was the most difficult question with only one (<1%) respondent achieving a mean accuracy score of 100%.

DISCUSSION

This study suggests a knowledge deficit among health care practitioners regarding the measurement of the QT interval, factors that may cause QT prolongation, and especially the drugs and drug combinations that may prolong the QT interval. These results come at a time when controversy exists regarding the standard method for measuring the QT interval on a 12-lead ECG, the best method for correcting the QT interval for heart rate, and the actual relationship between the degree of QT prolongation and the risk of torsades de pointes.[10,11] Whereas resolving the numerous controversies is essential to fully understand the scope of risk associated with changes in the QT interval, improving health care practitioners' knowledge of the less controversial and better understood areas is imperative for improving patient safety in the meantime. There are some basic concepts about the QT interval that may aid health care practitioners in safely assessing and using medications that have been shown to prolong the QT interval. Additionally, basic information on predisposing factors and which drugs have been shown to prolong the QT interval may provide practitioners with tools to better assess the potential risks to individual patients.

Limitations

It must be noted that this was a pilot study conducted in a population that may not be truly representative of health care practitioners in cardiology. In addition, the results may not be generalizable due to the low response rate. If practitioners who felt more confident in their answers were more likely to respond (a reasonable assumption), our results would actually underestimate the knowledge deficit. We are currently completing a larger and more rigorous evaluation using a similar survey tool to assess knowledge of the QT interval in health care practitioners.

Another limitation of the study is that the questionnaire relies on the practitioner's memory of very specific details. This may not accurately reflect the means by which practitioners would obtain this information in the practice environment. In actual practice, health care practitioners may rely on a variety of resources and references. After identifying a patient with possible QT prolongation, or when evaluating possible risks for individual patients, practitioners may also consult with colleagues.

Summary

Although most cardiology practitioners in this survey stated that they would measure the QT interval when starting a drug they thought could prolong the QT interval, we identified deficiencies in their ability to correctly measure the QT interval and to accurately identify medications or medication combinations that could prolong the QT

interval. These results suggest the need to improve practitioners' knowledge of some of the fundamental issues related to the QT interval in order to improve patient safety.

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