LETTERS TO THE EDITOR

Relation Between QT and RR Intervals

Karjalainen et al. (1) showed that a single linear equation is inadequate to represent the QT-RR relation over a wide range of RR intervals in healthy young men. They developed a nomogram for measured QT intervals to obtain a heart rate-adjusted QT value, using three linear regression equations for three ranges of RR intervals (<600, 600 to 1,000, and >1,000 ms). They compared their analysis with three other formulas but not with the exponential formula, which should have been considered, because their linear equations had decreasing slopes with increasing RR values. In Figure 1 (shown here), we reproduced the three regression lines as given in their Figure 3 and superimposed a single exponential curve derived to closely approximate all three lines.

There are theoretic limitations common to all population-derived multiparameter formulas when they are applied to a real QT interval from an individual patient. The best fitting formula can reliably estimate how much the measured QT interval deviates from the normal population value at the prevailing heart rate of the patient. However, there is no existing method to estimate the patient’s QT interval at a different heart rate (e.g., 60 beats/min) without making the arbitrary assumption that the intrinsic QT-RR relation for that patient is exactly parallel to the population curve. Such an assumption, for example, ignores the possibility of reverse use dependency of class III antiarrhythmic drug action (3). Otherwise, the problem is the mathematical equivalent of one equation and multiple unknowns. The nomogram presented by Karjalainen et al. (1) is subject to this insurmountable limitation.

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References

Correcting the QT Interval: Is It Relevant?

I read with interest the novel approach by Karjalainen et al. (1) to correct the QT interval on the basis of the prevailing heart rate. From the results of their study it could be seen that the mean-squared residual values for the nomogram correction had increased in the middle-aged subjects compared with those in the younger, healthy male group (on the basis of whom the nomogram was derived). This in itself implies the relative inadequacy of the nomogram for the middle-aged subjects. A nomogram would be acceptable to predict a change in a dependent variable that has a direct and fixed relation with only one other independent variable. However, the QT interval is a dynamic interval that is affected by multiple factors, such as exercise, catecholamine levels, diurnal variations, electrolyte levels and autonomic tone, in addition to heart rate (2). It thus appears rational to infer that the QT interval would respond differently in different hemodynamic settings, making a nomogram inappropriate for correcting the QT interval in different disease states.

The authors also fail to mention the clinical state of the subjects when the QT interval was recorded at high heart rates. An important physiologic response to take into consideration is the QT hysteresis effect (3) that results from the exercise-recovery cycles accompanying daily routine activities and which itself could interfere with correction of the QT interval. It is important that the correction formula be limited to the steady state because there is a risk of overcorrection or undercorrection during any physiologic or pharmacologic maneuvers.

In view of these multiple influences on the QT interval, it appears unlikely that any linear correction formula or nomogram could appropriately correct the QT interval. Moreover, even 24-h ambulatory QT monitoring, the QT correction formula derived by linear regression

Figure 1. The lines connecting the square symbols represent the three regression lines proposed by Karjalainen et al. (1). The solid smooth curve represents a single exponential equation derived to closely approximate all three lines.