Optimal Location of the QT Interval Evaluation in Patients with Drug-induced QT Prolongation and Torsades de Pointes: Limb leads, Chest leads or Both?

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Long QT syndrome (LQTS) is characterized by prolongation of the QT interval on the electrocardiogram (ECG). Clinically, LQTS is associated with the development of Torsades de Pointes (TdP), a well-defined polymorphic ventricular tachycardia and the development of sudden cardiac death (1). The most common type is the acquired form caused mainly by drugs, it is also known as the drug induced LQTS (diLQTS) (2-5). The diLQTS is caused by certain families of drugs which can markedly prolong the QT interval on the ECG most notably antiarrhythmic drugs (class IA, class III), anti-histamines, antipsychotics, antidepressants, antibiotics, antimalarial, and antifungals (2-5). Some of these agents including the antimalarial drug hydroxycholoquine and the antibiotic azithromycin which are being used in some countries as therapies for the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)(6,7). However, these drugs have been implicated in causing prolongation of the QT interval on the ECG (2-5).There is a solution for monitoring this large number of patients which consists of using mobile ECG devices instead of using the standard 12-lead ECG owing to the difficulty of using the 12-lead ECG due to its medical cost and increased risk of transmitting infection. These mobile ECG devices have been shown to be effective in interpreting the QT interval in patients who are using QT interval prolonging drugs (8, 9). However, the ECG mobile devices have been associated with decreased accuracy to interpret the QT interval at high heart rates (9). On the other hand, some of them have been linked with no accuracy to interpret the QT interval (10). This can put some patients at risk of TdP and sudden cardiac death.

In this current issue of the Journal of Cardiovascular electrophysiology, Krisai P et al. reported that the limb leads underestimated the occurrence of diLQTS and subsequent TdP compared to the chest leads in the ECG device, this occurred in particular with the usage of mobile standard ECG devices which use limb leads only. To illuminate these findings, the authors have studied the ECGs of 84 patients who have met the requirements for this study, which are diLQTS and subsequent TdP. Furthermore, the patients in this study were also taking a QT interval prolonging drug. Krisai P et al. additionally reported the morphology of the T-wave in every ECG and classified them into flat, broad, notched, late peaked, biphasic and inverted. The authors showed that in 11.9% of these patients the ECG was non reliable in diagnosing diLQTS and subsequent Tdp using only limb leads due to T-wave flattening in these leads, in contrast to chest leads where the non- interpretability of the QT interval was never attributable to the T-wave morphology but to other causes. The authors further examined the QT interval duration in limb leads and chest leads and found that the QT interval in limb leads was shorter compared to that of the chest leads, but reported a high variability in these differences. Therefore, it should be taken into account when screening patients with diLQTS using only mobile ECG devices and these patients should be screened using both limb leads and chest leads. Moreover, the authors have highlighted the limitations of using ECG mobile devices as limb leads to interpret the QT interval especially in high heart rates (when Bazett's equation overcorrects the

QTc and overestimates the prevalence of the QT interval) and have advocated the usage of ECG mobile devices as chest leads instead of limb leads due to their superior ability to interpret the QT interval.

The authors should be praised for their efforts in illustrating the difference in the QT interval interpretability between the chest leads and the limb leads in patients with diLQTS. The authors also pointed out the limitation of using mobile ECG devices as limb leads for the diagnosis of diLQTS and recommended their usage as chest leads by applying their leads onto the chest due to their better diagnostic accuracy for detecting the diLQTS. The study results are very relevant, it further expanded the contemporary knowledge about the limitation of the QT interval interpretability using ECG mobile device only (11). Future investigation is needed to elucidate the difference in chest and limb leads interpretability of the QT interval and to assess the ability of the mobile ECG devices to interpret the QT interval.

References

1. Refaat MM, Hotait M, Tseng ZH: Utility of the Exercise Electrocardiogram Testing in Sudden Cardiac Death Risk Stratification. Ann Noninvasive Electrocardiol 2014; 19(4): 311-318.
2. Kannankeril P, Roden D, Darbar D. Drug-Induced Long QT Syndrome. Pharmacological Reviews. 2010;62(4):760-781.
3. Nachimuthu S, Assar M, Schussler J. Drug-induced QT interval prolongation: mechanisms and clinical management. Therapeutic Advances in Drug Safety. 2012;3(5):241-253.
4. Jankelson L, Karam G, Becker M, Chinitz L, Tsai M. QT prolongation, torsades de pointes, and sudden death with short courses of chloroquine or hydroxychloroquine as used in COVID-19: A systematic review. Heart Rhythm. 2020 ; S1547-5271(20)30431-8.
5. Li M, Ramos LG. Drug-Induced QT Prolongation And Torsades de Pointes. *P T* . 2017;42(7):473-477.
6. Singh A, Singh A, Shaikh A, Singh R, Misra A. Chloroquine and hydroxychloroquine in the treatment of COVID-19 with or without diabetes: A systematic search and a narrative review with a special reference to India and other developing countries. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2020;14(3):241-246.
7. Hashem A, Alghamdi B, Algaissi A, Alshehri F, Bukhari A, Alfaleh M et al. Therapeutic use of chloroquine and hydroxychloroquine in COVID-19 and other viral infections: A narrative review. Travel Medicine and Infectious Disease. 2020; 35:101735.
8. Chung E, Guise K. QTC intervals can be assessed with the AliveCor heart monitor in patients on dofetilide for atrial fibrillation. J Electrocardiol. 2015;48(1):8-9.
9. Garabelli P, Stavrakis S, Albert M et al. Comparison of QT Interval Readings in Normal Sinus Rhythm Between a Smartphone Heart Monitor and a 12-Lead ECG for Healthy Volunteers and Inpatients Receiving Sotalol or Dofetilide. Journal Cardiovasc Electrophysiol. 2016;27(7):827-832.
10. Bekker C, Noordergraaf F, Teerenstra S, Pop G, Bemt B. Diagnostic accuracy of a single-lead portable ECG device for measuring QTc prolongation. Annals Noninvasive Electrocardiol. 2019;25(1): e12683.
11. Malone D, Gallo T, Beck J, Clark D. Feasibility of measuring QT intervals with a portable device. American Journal of Health-System Pharmacy. 2017;74(22):1850-1851.