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There was no difference in overall procedural time between MEM and PBP mapping (MD: -5.28 min; 95% CI: -38.71 to 49.27 min; I^2 = 88%; p = 0.81) (**Figure 1C**). There were insufficient data for pooled analyses of total or epicardial mapping times. Left ventricular endocardial mapping time was reduced using MEM by a mean of 11.63 min (95% CI: -22.89 to -0.36 min; I^2 = 60%; p = 0.04) (**Figure 1D**). There was no significant difference in total ablation times between MEM and PBP mapping (MD: 5.62 min, 95% CI: -13.10 to 1.86 min; I^2 = 0%; p = 0.14) (**Figure 1E**).

The trend toward reduced VT recurrence may be secondary to improved delineation of heterogeneity within scar with better treatment of arrhythmogenic substrate. Yamashita et al. (3) demonstrated that MEM enabled better identification of endocardial local abnormal ventricular activities (LAVAs) (96% vs. 80%; p = 0.002) and more complete LAVA elimination (68% vs. 51%; p = 0.05) (4). Similarly, in Maagh et al. (2), late potentials (LPs) and LAVAs were found significantly more often with MEM (LPs: 92.3% vs. 74.3%; p = 0.011; LAVAs: 76.9% vs. 40.5%; p < 0.005) (3). However, Acosta et al. (1) found no difference in LPs identified by either strategy.

Owing to a paucity of data comparing MEM versus PBP mapping, inclusion of observational studies with different population and procedural characteristics was a necessary limitation of this meta-analysis. In these studies, procedures done with MEM were temporally more recent than were those done with PBP mapping. For analysis of VT recurrence, data from one study had to be excluded because of substantial difference in follow up duration (320 days MEM, 788 days PBP mapping) (5). There are no available head-to-head studies using multielectrode catheters other than the PentaRay.

Despite the growing use of MEM, there is a paucity of clinical trials comparing these 2 strategies. Although there is no difference in acute procedural success, MEM associates with reduced mapping time (but not overall procedural time) and a trend toward reduced recurrence of VT. This may be secondary to improved characterization of VT substrate. Assuming a VT recurrence rate of 30% at 12 months, an RCT of 1,716 patients (858 in each arm) would be required for adequate power to determine if MEM causes a reduced recurrence of VT at 12 months. This would require a dedicated and coordinated multicenter effort, and until such a time, this study remains the best-quality evidence comparing these 2 strategies.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Clinical Electrophysiology* author instructions page.

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RESEARCH CORRESPONDENCE

Multilead QT Screening Is Necessary for QT Measurement

Implications for Management of Patients in the COVID-19 Era

During the current coronavirus disease-2019 (COVID-19) pandemic, there has been increased interest in using off-label medications for treatment of the novel severe acute respiratory syndrome-coronavirus-2, including drugs with

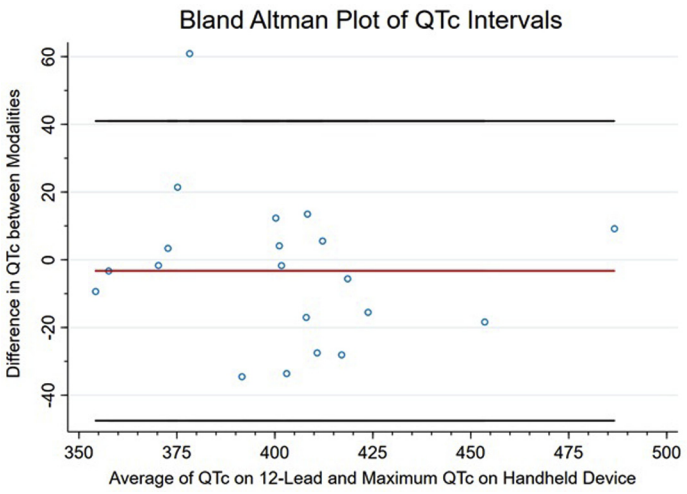
a propensity for QT interval prolongation, such as hydroxychloroquine and azithromycin (1). With the increasing availability of handheld electrocardiographic devices, these devices have been proposed as a means to evaluate and manage the QT interval in patients undergoing therapy (2,3).

This study received ethical approval from the University of British Columbia clinical research ethics board. We performed a prospective evaluation of the handheld electrocardiographic device and standard 12-lead electrocardiographic QT intervals in patients undergoing routine evaluation for inherited arrhythmia syndromes. Patients underwent a comprehensive evaluation, including 12-lead electrocardiography (ECG), exercise treadmill testing, cardiac imaging, and genetic testing when indicated. Following 12-lead ECG, eligible research participants recorded sequential single-lead electrocardiograms in the lead I, lead II, and precordial lead positions using a handheld electrocardiographic device (Kardia, AliveCor, Mountain View, California; leads III, aVR, aVL, and aVF were not recorded). The precordial lead electrocardiogram was recorded by placing the handheld device on the upper precordium (V_1 and V_2 positions) (4). Blinded QT interval measurements on the handheld device and 12-lead ECG used the maximum slope technique and were corrected using Bazett's formula. The longest QT interval measured across all leads on the 12-lead electrocardiogram was used. Corrected QT (QTc) intervals were compared using paired Students' *t*-tests and a Bland-Altman plot.

Twenty-two research participants performed the handheld electrocardiographic recordings. Patients had histories of unexplained cardiac arrest (n = 2), syncope (n = 3), or palpitations (n = 2) and were asymptomatic probands (n = 3) or first-degree family members (n = 12). The median age was 38 years (interquartile range [IQR]: 26 to 52 years), and 32% were women. One-half of patients (n = 11) were deemed unaffected or normal after comprehensive evaluation. One participant was excluded because of an unmeasurable QT interval using the handheld device because of flattened T waves (in all recorded leads), and 1 participant was excluded because of ventricular bigeminy throughout all handheld electrocardiographic recordings.

The median QRS duration was 92 ms (IQR: 89 ms to 103 ms), and the median QTc interval measured by 12-lead ECG was 400 ms (IQR: 385 ms to 414 ms). The median QTc interval measured using the handheld device in lead I was 360 ms (IQR: 344 ms to 376 ms), in lead II was 366 ms (IQR: 354 ms to 386 ms), and in a precordial lead was 354 ms (IQR: 340 ms to 392 ms). There was no difference in the maximal QTc interval measured by 12-lead ECG compared with the maximal QTc interval measured across all positions using the handheld device (401 ms vs. 404 ms; p = 0.259) (**Figure 1**). The QTc interval measured by 12-lead ECG was significantly longer than the lead I QTc interval on the handheld device (+23 ms; 95% confidence interval: 13 ms to 34 ms; p < 0.001) and the precordial lead QTc interval on the handheld device (+11 ms; 95% confidence interval: 1 to 20 ms; p = 0.018). The QTc interval measured by 12-lead ECG was not significantly different from the lead II QTc interval on the handheld device (+5 ms; 95% CI: −10 to 20 ms; p = 0.244). The longest QTc interval measured by 12-lead ECG was frequently in the precordial leads.

FIGURE 1 **Bland-Altman Plot Comparing QTc Intervals Measured Using 12-Lead ECG and Maximum QTc Measured on Handheld Device, Across Various Positions**



ECG = electrocardiography; QTc = corrected QTc.

We demonstrate that QTc intervals can be measured reproducibly using a single-lead handheld device in a cohort of patients undergoing evaluation for inherited arrhythmia syndromes, but this requires capture of multiple vectors with the handheld device and not a single-lead electrocardiographic capture alone. The QTc interval measured by 12-lead ECG was no different than the maximal QTc interval measured using the handheld device across multiple positions but was consistently longer than the QTc interval measured in any single lead position alone.

Studies have shown that administration of QT interval-prolonging drugs is associated with an almost 3-fold increased risk for sudden arrhythmic

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death (5). Prior to initiation of QT interval-prolonging medications, a baseline 12-lead electrocardiogram should be obtained, in addition to exercise treadmill testing when congenital long-QT syndrome is suspected (6). Although a larger systematic evaluation is required to determine how much single-lead ECG will underestimate the QTc interval, our pilot data in ambulatory patients suggested that the QTc interval measured by 12-lead ECG was numerically longer than any single position alone (lead I, lead II, precordial) and significantly longer in 2 of 3 positions. Although the lead II QTc interval on the handheld device was not significantly shorter, systematic measurement of QTc intervals in a single position may lead to underreporting of the QTc interval, particularly in patients with abnormal QT configurations.

It is appealing to use the handheld electrocardiographic device as a QT screening tool in patients with COVID-19. In the context of off-label medications that prolong the QT interval, handheld devices should be used in multiple lead positions to determine baseline QTc intervals. The practical application of these results is to perform 12-lead ECG, multilead handheld ECG, or single-lead handheld ECG in at least 3 lead positions. This may be challenging for patients but is clearly necessary on the basis of the presented data. The maximum QTc interval can be used as a baseline and for surveillance when patients with COVID-19 receive QT interval-prolonging medical therapies. Measuring the change (delta) in QTc interval with therapy will augment risk stratification but also should not be performed alone, as both the absolute and delta QTc intervals are required to establish baseline risk and proarrhythmia. These are important considerations both in hospitalized patients who had serial electrocardiographic studies pose exposure hazard to patients and providers and in ambulatory patients undergoing medical therapy at home.

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TO THE EDITOR

Intracardiac Versus Transesophageal Echocardiography

If You Don't Compare Them You Don't Have the Answer

We have read with interest the paper by Friedman et al. in a previous issue of this journal entitled "Predictors of Cardiac Perforation With Catheter Ablation of Atrial Fibrillation" (1). The authors analyzed predictors of cardiac perforation in a nationwide registry of 102,398 patients undergoing atrial fibrillation (AF) ablation. The strongest predictor of cardiac perforation was the nonuse of intracardiac echocardiography (ICE). In this registry, ICE was used in 73% of patients and absence of ICE use was associated with a significantly higher rate of cardiac perforation (odds ratio: 4.85; 95% confidence interval: 4.11 to 5.71; $p < 0.0001$). In view of these results, the authors state that intraprocedural ICE use should be considered as a recommendation in the next iteration of the AF ablation guidelines. However,