DOI: 10.1111/jce.14726

EDITORIAL-INVITED

WILEY

Mobile cardiac monitoring during the COVID-19 pandemic: Necessity is the mother of invention

Krishna Kancharla MD | **N. A. Mark Estes MD**

Department of Medicine, Heart and Vascular Institute, University of Pittsburgh Medical Center and School of Medicine, Pittsburgh, Pennsylvania

Correspondence
N. A. Mark Estes, MD, UPMC Heart and Vascular Institute, University of Pittsburgh School of Medicine, South Tower, 3rd Floor, E352.2, 200 Lothrop St, Pittsburgh, PA 15213.
Email: estesna@upmc.edu

Disclosures: None.

Since the development, commercialization, and initial clinical use of electrocardiographic monitoring in the early 1950s, the technology has evolved currently allowing real-time telemetry-based monitoring of multiple physiologic parameters via wireless connectivity on inpatients.[1] Ambulatory electrocardiographic monitoring has been limited by memory, the necessity of hardwiring leads to skin electrodes, and other technologic restraints.[2] Historically only short term (24–48 h) continuous monitoring (Holter) or longer-term intermittent (triggered) monitoring with event or loop recorders have been possible on outpatients.[2] Over the last decade novel leadless monitoring devices allowing extended ambulatory monitoring have been developed.[3] They have emerged as an important diagnostic tool for the detection of occult atrial fibrillation, risk stratification, or evaluation of arrhythmias symptoms including palpitations and syncope.[3] With the demands for cardiac monitoring exceeding the capacity of many hospital telemetry units, innovative approaches were essential to continuously assess the rhythm and electrocardiographic intervals during the coronavirus disease-2019 (COVID-19) pandemic.[4,5] Despite the absence of actionable evidence related to safety and efficacy, both hydroxychloroquine and azithromycin were used for COVID-19-positive patients. Because both drugs can prolong the QT interval inpatient monitoring has been recommended.[6,7] Novel approaches using mobile cardiac monitoring, previously used exclusively for ambulatory monitoring, have emerged as a clinical tool for inpatients based on this need for greater inpatient monitoring capacity during the COVID-19 pandemic.[4,5]

In this issue of the Journal of Cardiovascular Electrophysiology (JCE), Braunstein et al.[8] report the results of an observational study using a patch-based mobile cardiac telemetry system previously reserved for the outpatient setting. This approach was used to assess rhythm and QT intervals for COVID-19-positive hospitalized patients in a unit not used previously for telemetry while receiving one or more medications with potential for QT prolongation. The patch-based cardiac monitoring technology (Zio Patch AT (iRhythm Technologies Inc., San Francisco, CA, USA) had been approved by the US Food and Drug Administration (FDA) for arrhythmia monitoring in the outpatient setting.[8] This system received emergency FDA approval for inpatient monitoring during COVID 19 pandemic.[8]

The study reports 82 patients in whom this mobile patch-based technology was used on an inpatient basis for monitoring of arrhythmias and QT intervals.[8] Thirty-eight percent of patients met the primary outcome, a composite of detection of new arrhythmias, and changes in clinical management. New arrhythmias were detected in 29% of patients. QT-interval measurements were feasible in 93% of patients. Among patients who had mobile telemetry strip and 12-lead electrocardiograms (EKGs) on the same day, there was no significant difference between the mobile telemetry strip measurements and the investigator-measured QT-intervals on the 12-lead ECG.[8] The study identified age and heart failure were associated with the primary outcome. Interestingly the study did not find an association of arrhythmia to the mortality in this disease condition, but this could be different based on the indication of monitoring.[8]

There are previous reports of the feasibility of using a different cardiac monitoring technology during the COVID-19 pandemic.[4,5] The report in this issue of JCE confirms these and extends arrhythmia and QT monitoring with different patch-based technology.[8] As an observational study, there are inherent limitations, including the absence of a control group using conventional monitoring.[8] Other limitations include a relatively small number of patients in a single healthcare system and lack of enrollment of consecutive patients.[8] Despite these limitations, the observations that this approach performed well for the detection of arrhythmias, monitoring the QT interval, and inform patient management are valid. In this respect, the report advances the emerging role of a monitoring technology previously reserved for the outpatient setting in the management of hospitalized patients.[4,5,8]

It is evident also that patch-based wireless technology also represents an approach to reduce infection risk to healthcare providers and patients by limiting direct patient contact while preserving personal protective equipment. Mobile cardiac monitoring could potentially be extended to patients needing cardiac monitoring in the setting of other acute illnesses thereby limiting the risk of staff exposure and the spread of infections to immunocompromised patients. The study estimates 595 min of reduced staff viral exposure time during 75 patient care days, by replacing EKGs related to QT monitoring.[8] Patch-based mobile telemetry eliminates the need for a dedicated telemetry unit and staff thereby increasing the availability of patient care locations.[8] This approach might be extended to lower-risk patients hospitalized with cardiac conditions such as those in chest pain centers, syncope units, and patients needing antiarrhythmic drug initiations. As noted by the authors, outpatient transition of monitoring is feasible at the time of hospital discharge.[8] Patch-based monitoring might be initiated even before the patient's arrival to the hospital by first responders without the common loss of important data in the transitions of care. Whether this approach can be extended to other clinical settings and improve patient outcomes at a lower cost is one of many questions best answered based on evidence obtained from appropriately designed prospective multicenter trials. These would include randomization in multicenter trials to novel versus conventional monitoring with appropriate clinical outcomes with cost–benefit analyses.

The investigation of this novel approach in this extremely sick patient population during a pandemic is particularly laudable. Notably, the primary driving force for this innovative approach, an unmet clinical imperative, reminds us that commonly in clinical medicine necessity is the mother of invention.[9] While raising the possibility multiple other applications, clinicians should remain mindful of many current limitations of this technology and systems of implementation. With a single lead, only EKG monitoring limits the assessment of QT intervals in patients with low-T wave amplitudes, poor baselines, or rapid arrhythmias such as atrial fibrillation. Further validation of QT interval measurements with patch-based monitoring are essential. Current technology is limited by the absence of real-time access to patient's rhythm by onsite care team providing direct care. Systems of remote monitoring inherently have the potential for delays in communication to the onsite caregivers of critical information. Future advances of the technology need to be accompanied by refinements of systems of implementation. The enhanced storage capacity of patch-based remote monitoring presents research as well as clinical advantages. These include the use of artificial intelligence to predict and prevent emerging adverse arrhythmic events.[10,11] The clinical and economic impact of patch-based monitoring merit additional research with a comparison of outcomes and cost to conventional monitoring. While this report and other observational studies represent important initial steps, only robust prospective trials can ultimately provide the highest level of evidence for future patient selection, indications, and standards for clinical use of this novel approach to monitoring hospitalized patients.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

ORCID

N. A. Mark Estes https://orcid.org/0000-0002-5461-7247

REFERENCES

1. Sandau k, Funk M, Auerbach A, et al. Update to practice standards for electrocardiographic monitoring in hospital settings: a scientific statement From the American Heart Association. *Circulation*. 2017; 136(19):e273-e344.
2. Steinberg JS, Varma N, Cygankiewicz I, et al. 2017 ISHNE-HRS expert consensus statement on ambulatory ECG and external cardiac monitoring/telemetry. *Heart Rhythm*. 2017;(14):e55.
3. Turakhia MP, Hoang DD, Zimetbaum P, et al. Diagnostic utility of a novel leadless arrhythmia monitoring device. *Am J Cardiol*. 2013; 112(4):520-524.
4. Gabriels J, Saleh M, Chang D, Epstein LM. Inpatient use of mobile continuous telemetry for COVID-19 patients treated with hydroxychloroquine and azithromycin. *Heart Rhythm Case Rep*. 2020;6(5): 241-243.
5. Chang D, Saleh M, Gabriels J, et al. Inpatient use of ambulatory telemetry monitors for COVID-19 patients treated with hydroxychloroquine and/or azithromycin. *J Am Coll Cardiol*. 2020;75(23): 2992-2993.
6. Roden DM, Harrington RA, Poppas A, Russo AM. Considerations for drug interactions on QTc in exploratory COVID-19 (coronavirus disease 2019) treatment. *Circulation*. 2020;141(24):e906-e907.
7. Giudicessi JR, Noseworthy PA, Friedman PA, Ackerman MJ. Urgent guidance for navigating and circumventing the QTc-prolonging and torsadogenic potential of possible pharmacotherapies for coronavirus disease 19 (COVID-19). *Mayo Clin Proc*. 2020;95(6):1213-1221.
8. Braunstein E, Reynbakh O, Krumerman A, Di Biase L, Ferrick K. Inpatient cardiac monitoring using a patch-based mobile cardiac telemetry system during the COVID-19 pandemic [published online ahead of print August 27, 2020]. *J Cardiovasc Electrophysiol*. 2020; 31:2803-2811.
9. Benjamin J. *Plato's Republic: The Greek Text*. Vol 3. London, UK: Oxford University Press; 1894:82.
10. Attia ZI, DeSimone CV, Dillon JJ, et al. Novel bloodless potassium determination using a signal-processed single-lead ECG. *J Am Heart Assoc*. 2016;5(1):e002746.
11. Zhu H, Cheng C, Yin HY, et al. Automatic multilabel electrocardiogram diagnosis of heart rhythm or conduction abnormalities with deep learning: a cohort study. *Lancet*. 2020;2:e348-e357.

How to cite this article: Kancharla K, Estes NAM. Mobile cardiac monitoring during the COVID-19 pandemic: Necessity is the mother of invention. *J Cardiovasc Electrophysiol*. 2020;31: 2812-2813. https://doi.org/10.1111/jce.14726