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Electrocardiographic/QT interval monitoring with a portable device in hospitalized patients with COVID-19: a protocol proposal

Control electrocardiográfico del intervalo QT mediante dispositivo portátil en pacientes ingresados por COVID-19. Propuesta de protocolo

To the Editor,

The pandemic caused by severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) is posing a major challenge to the international scientific community and to health care worldwide. The lack of effective treatments has obligated the experimental or compassionate use of drug combinations, so that most protocols include combinations of protease inhibitors (lopinavir/ritonavir), antimalarials (chloroquine/hydroxychloroquine), and antibiotics and immunomodulators such as azithromycin,[1] among others. Many societies have already issued warnings about the use of these drugs and QT interval prolongation and the increased risk of sudden cardiac death from ventricular arrhythmias,[2] further aggravated by the use of antiemetics and antidiarrheals for the relief of gastrointestinal symptoms. While effective therapeutic tools against the virus remain unavailable, efforts should be made to optimize the prescription and safety of currently used drugs. Given that these patients are in respiratory isolation, it is difficult to perform serial electrocardiograms (ECGs). Thus, the Food and Drug Administration has included among its recommendations the use of remote connection devices such as the KardiaMobile 6L (AliveCor, United States). This device has previously been approved for the detection of atrial fibrillation and QT monitoring in this setting[3] and has already been mentioned in protocols such as that proposed by the Mayo Clinic.[4] Although other devices with similar benefits are currently available, such as EKGraph (Sonohealth, United States), WIWE (myWIWE Diagnostics, Hungary), and Wecardio (BORSAM Biomedical Instruments, China), our hospital has chosen the AliveCor device for its use in the electrocardiographic monitoring protocol. The large volume of patients and the lack of experience with the aforementioned drugs have led to the acquisition of this device for monitoring the corrected QT interval (QTc). This approach has advantages over conventional ECG: ease of use, affordability, small size, remote data transmission (which minimizes the risk of contaminating the receiving device), and simplicity of disinfection in 70° alcohol. This device can obtain brief ECG recordings (30 s), allowing many patients to be monitored in little time. A receiver (mobile phone or tablet) is needed that connects via bluetooth with a range of at least 10 linear meters. Although the device provides 6 leads for the frontal plane of the ECG, for simplicity we decided to use the 1-lead option. There is another version of the device that only provides 1-lead ECG, but it is not equipped with a bluetooth connection and so it would need to be close to the receiver. Before starting the protocol, and as an internal validation process, QTc was measured in lead V_5 on conventional 12-lead ECG and in the

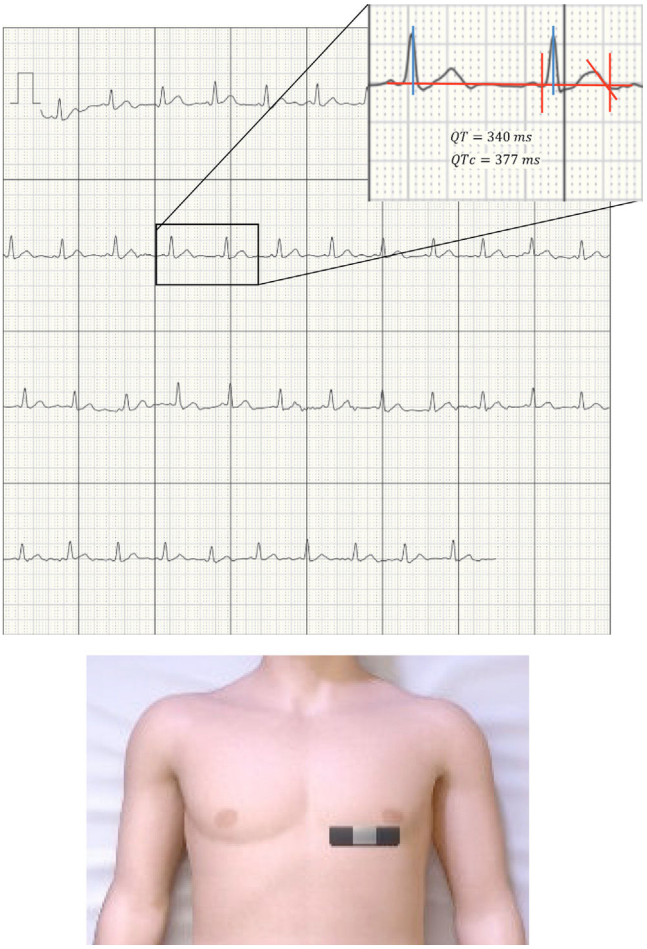

Figure 1. Recording obtained with the AliveCor Kardiamobile 6L device. Image used with the permission of AliveCor.

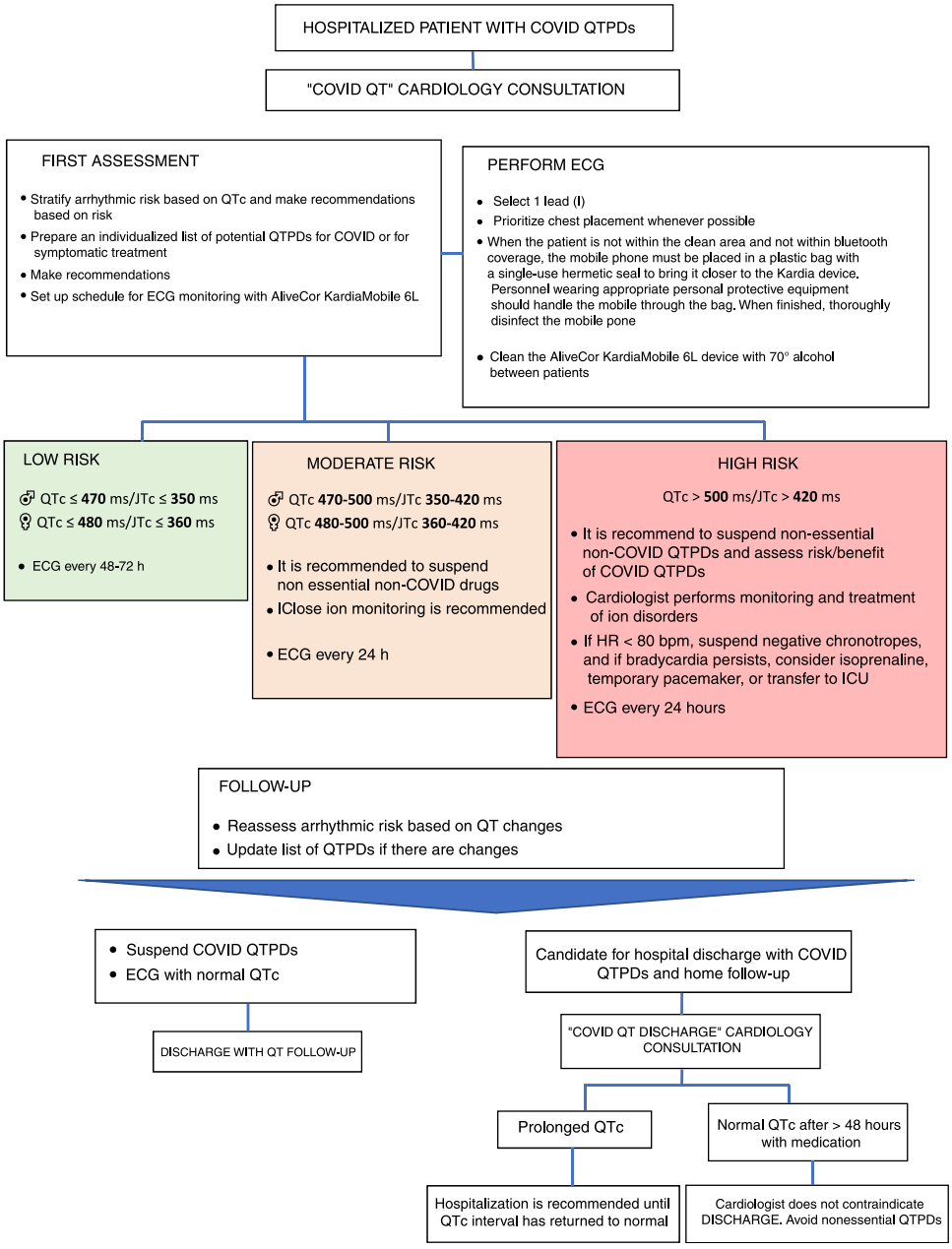

Figure 2. Proposed protocol for monitoring patients with the Kardiamobile device. COVID-19, coronavirus disease 2019; ICU, intensive care unit; QTc, corrected QT interval; QTPD, QT-interval prolonging drugs.

single lead of the Kardia device placed under the left breast or over the fingertips (figure 1). A series of 50 patients (33 patients with COVID-19 and 17 admitted to cardiology for other causes) underwent the protocol. An intraclass correlation coefficient of 0.902 was obtained (95% confidence interval, 0.811-0.950). No differences in QT measurement were observed between the fingertips and the thorax. Its placement on the chest was easier for nurses and the ECG recording in this area was subjectively better (higher voltage, allowing better differentiation of the T wave). Moreover, chest placement does not require the collaboration of the patient (figure 1).

All patients with suspected or confirmed SARS-CoV-2 infection who needed hospitalization underwent baseline 12-lead ECG. The QT-interval monitoring protocol (figure 2) starts when the service managing the patient initiates treatments that carry a risk of QT prolongation. This service requests a cardiology consultation, immediately followed by assessment of the QTc interval (JTc in the case of wide QRS) using the AliveCor KardiaMobile 6L device for monitoring. Follow-up notes are entered in the patient's electronic health record, which includes arrhythmic risk stratification (see figure 2). Special attention is paid to concomitant drugs and ionic imbalances that may prolong the QT interval. Based on these findings, recommendations are made in conjunction with the treating physician and ECG monitoring with KardiaMobile is scheduled. To streamline the protocol during the current overload situation, we stratified arrhythmic risk using only the duration of the QT interval and chose a single-lead recording of 30 s, prioritizing placement in the chest whenever possible.

Since the start of the protocol, the QTc of 39 patients has been assessed (79.5% male; mean age, 62.4 ± 14.2 years). During follow-up, all patients received lopinavir/ritonavir, hydroxychloroquine, or azithromycin, in addition to medication for symptomatic relief.

Prolonged QTc appeared in 6 patients (5 with QTc > 500 ms and 1 with JTc > 420 ms due to complete right bundle branch block), which was corrected when part of the medication was suspended as recommended by the cardiologist. Since the implementation of the monitoring protocol, no patient has died due to suspected ventricular arrhythmia associated with prolonged QT interval. Acceptance by the nursing staff has been very satisfactory, because it represents a simple alternative to the complexity of performing 12-lead ECG in these patients.

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The presence of heart disease worsens prognosis in patients with COVID-19

La presencia de cardiopatía agrava el pronóstico de los pacientes con COVID-19

To the Editor,

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) gives rise to coronavirus disease 2019 (COVID-19) leading to acute respiratory distress. In Spain, the disease has changed the way hospitals function because they have been overwhelmed by the huge number of admissions and cases of respiratory failure. This situation has required the commitment of all hospital staff, and many cardiologists have been directly involved in the care of these patients. During this task, we have become aware of the clinical impact of cardiovascular risk factors and the prevalence of previous heart disease. We launched a registry to investigate the relevance of these aspects in patients with COVID-19.

Between March 15 and April 11, 2020, we included 522 consecutive patients admitted with a diagnosis of COVID-19, which was confirmed by real-time polymerase chain reaction (rt-PCR) using nasopharyngeal samples. Respiratory failure was defined as a pO_2 of less than 60 mmHg on arterial-blood gas test or O_2 saturation less than 90% without supplemental oxygen. All patients underwent chest X-ray, which was performed by an expert radiologist. Statistical analyses were conducted using parameters at admission.

Categorical variables are expressed as absolute frequency and percentage. Continuous variables are expressed as mean ± standard deviation under the assumption of normal distribution. Groups were compared using the Student *t* test for continuous variables between groups and the chi-square test or Fisher exact test for categorical variables. A logistic regression model was fitted to identify factors associated with hospital mortality. A *P* value of less than .05 was used as a cutoff for statistical significance.

A total of 68 patients (13%) were included in the heart disease group: 42 had ischemic heart disease (30 had a history of myocardial infarction, 32 had undergone percutaneous revascularization, 3 had undergone surgical revascularization, and 4 had compatible symptoms and a positive induced ischemia test), 24 had heart valve disease (all of which were moderate or severe), and 11 had cardiomyopathy (6 dilated, 2 hypertrophic, and 3 tachycardiomyopathy). Some patients had more than 1 heart disease.

Table 1 shows the comorbidities, clinical characteristics, analytical and radiological parameters, heart rhythm on admission, and clinical evolution of patients with and without heart disease. The patients had a mean age of 68 ± 15 years and 228 (44%) were women. Total mortality was 25% and that of patients with heart disease was 43% (29 patients; $P < .001$): 43% had ischemic heart disease, 37% had heart valve disease, and 64% had cardiomyopathy.

In total, 376 patients underwent an electrocardiogram (ECG), of whom 15 (4%) had a prolonged corrected QT interval, defined as more than 440 milliseconds in men and more than 460 milliseconds in women. Of the 146 without an ECG, 129 (88%) were taking at least 1 drug (lopinavir, ritonavir, hydroxychloroquine, azithromycin) that prolongs the QT interval.

A multivariate analysis was conducted to determine the variables associated with hospital mortality and the combined event of respiratory failure in the course of the disease and mortality). The following variables were included at admission: age, hypertension (HT), diabetes, chronic kidney disease, heart disease, O_2 saturation less than 90%, lymphocytes less than 1000/μL, D-dimer more than 500 μg/L, creatinine more than 1.5 mg/dL, and C-reactive protein more than 10 mg/L. The results are shown in table 2.

This study identified several relevant aspects related to COVID-19 and heart disease: *a)* cardiovascular risk factors (HT, diabetes mellitus, dyslipidemia, smoking) are very common in patients with COVID-19 and, logically, more common in those with heart disease; *b)* patients with heart disease with COVID-19 have a more indolent clinical course, because they very often have respiratory failure and higher mortality; *c)* heart disease is an independent predictor of the combined event of respiratory failure and death; and *d)* an ECG was only performed in 72% of patients despite the use of arrhythmogenic drugs that can prolong the QT interval.

Among the cardiovascular risk factors in our patients, we highlight that the prevalence of hypertension was higher in our series than in other series. An association has previously been found between hypertension and higher mortality in this disease.[1]