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Case Report

Complete Atrioventricular Block Smartwatch Enhanced Diagnosis in Lyme's Carditis: A Case Report and an M-Health Utilization

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Abstract

A 35-y old healthy sportsman complained paroxysmal dyspnea and migrating erythema some weeks after jogging in the woods. Non-invasive diagnostic tools excluded pathologic findings. A personal smartwatch was lent by his cardiologist, on-demand Remote ECG monitoring was started, and paroxysmal complete AV block was diagnosed. In Emergency Department AV block was confirmed. Empiric intravenous prednisolone 25 mg every 8 hours was administered in the suspicion of a hypersensitive milieu. AV block completely recovered in a few hours. Laboratory tests showed elevated C-reactive protein and neutrophilic leukocytosis. Serological screening highlighted anti-Borrelia burgdorferi antibodies, suggesting a Lyme's carditis related AV block. Oral Doxycycline led to complete clinical and laboratory parameters normalization in one week. 1 year loop recorder monitoring showed no further AV block relapse with nocturnal sinus bradycardia only. To the best of our knowledge, this is the first report describing Smartwatch-enhanced complete AV block diagnosis; we noticed as well a sudden resolution of Lyme's carditis related av block parallelly to empiric Steroid therapy.

Keywords: Smartwatch ECG; mHealth; Remote monitoring; Complete AV block; Lyme's Carditis; Other diagnostic techniques; Telemetry

Introduction

ECG Prolonged Telemonitoring via multiparametric sensors has been recognized as an excellent tool for arrhythmias diagnosis, complete AV block included, mostly when Loop recorder implantation is not warranted by guidelines [1-4]. Unfortunately, to date, despite definitive Telemedicine Systems start up by the Health Systems, remote telemonitoring device assignment and reimbursement may still represent an organizational/insurance challenge both in US and in Europe, in the context of the Next Generation EU Plan and insurance plans, and mostly depend on chronic pathologies as stated by recent national legislation [5-7]. Parallelly, Smartphones and smartwatches have been recognized as excellent tools in arrhythmia diagnosis even with fleeting or null symptoms [8], although complete AV block recognizability has raised concern at today. Lyme's Disease (LD) is a tick-borne Borreliosis, caused by Borrelia Burgdoferi, typical of temperate climate woodlands. LD is a multisystemic disease characterized by migrating erythema 7-15 days after infection.

LD may lead to cardiac involvement, Lyme's Carditis (LC), in up to 10% of cases, with high degree AV block in up to 80-90% of LC patients. Antibiotic therapy (AT) is the cornerstone in LC management [9]. AV conduction usually recovers in 10 days after AT. Temporary pacing may be necessary in case of severe bradycardia, with eventual definitive pacemaker implantation whether atrioventricular conduction does not recover after AT.

Case Presentation

A 35-y old Italian Caucasian sportsman, living in the Tuscany Region, consulted a Cardiologist complaining recent paroxysmal self-resolving dyspnea at rest, with no other associated symptom. Standard noninvasive diagnostic workflow including chest Roentgram, Pulmonary function tests, Transthoracic Echocardiogram, Ambulatory and Stress ECG was followed first, and pathological findings were excluded (data not shown). In the uncertainty context of available and reimbursable resources (see discussion for details), the Apple Watch ECG app (Apple inc. Cupertino, US), was hypothesized as a possible on-demand telemonitoring capability; factory smartwatch features allow the remote visualization and storage of the acquired ECG on the paired device. Both Apple Watch and smartphone (iPhone 13, Apple inc. Cupertino, US) belonged to the Cardiologist, who lent the smartwatch to the patient. Informed consent and privacy statement were achieved, and an on-demand, remote ECG monitoring was started, being the patient encouraged to record and submit a smartwatch ECG to the cardiologists' smartphone in case of any abnormal symptom. Paroxysmal dyspnea relapsed three days after remote monitoring start, and the Apple Watch ECG highlighted complete AV block with narrow QRS escape rhythm (Figure 1, Apple Inc.). The patient was contacted and invited to access the Emergency Room (ER), where AV-block was confirmed. In this setting the patient reported recent torso erythema as well, interpreted -in conjunction with dyspnea- as a hypersensitive milieu sign, leading to early empirical bidaily intravenous 25 mg prednisolone administration. Elevated C-reactive protein (0.54 mg/dl) and neutrophilic leukocytosis (16.590/mm3; 11.910 /mm3) were detected. The patient was admitted to Cardiac Intensive Care Unit, where AV-block and dyspnea resolved in 24 hours with no further relapse. Deeper anamnestic investigation highlighted recent frequent jogs in the woods. Subsequent serodiagnosis showed anti-Borrelia Burgdorferi antibodies (IgM >6.0 UA/ml, IgG 206.9 UA/ml), confirming LC related AV-block. Oral Doxycycline 100 mg twice daily was started, with laboratory parameters normalization in one week. A Reveal LINQ (Medtronic Inc, Minneapolis, Minnesota) was implanted at discharge. One-year remote monitoring excluded AV block relapse

Figure 1: Complete AV block diagnostic Smartwatch ECG.

Discussion

Smartwatch heart rhythm monitoring is achieving increasing evidence and clearance in AF monitoring [10-12]. Actual best practice in Smartwatch ECG rhythm monitoring indicates necessary medical surveillance, with some concerns about automatic non-AF rhythm recognition, like heart block [13-14]. Smartphone reliability has been reported in terms of AF and other arrhythmias diagnosis in comparison with 12 lead ECG in normal individuals, athletes and cardiology patients [14]. Recent evidence confirmed smartwatch ECG as a reliable tool in other arrhythmias recognition, eventually confirmed by definitive ECG diagnosis [13-16]; ends positions alternative to wrist-opposite arm finger -i.e., chest or ankles juxtaposition, with derived precordial or peripheral leads- may increase diagnostic sensitivity and specificity, especially in rhythms other than AF [17,18]. In these series however, complete AV block diagnosis was not reported; conversely, our report indicates an accurate diagnosing capability in this context. In this specific case, smartwatch ECG monitoring supply resulted particularly beneficial because of apparent healthy status of the patient: remote ECG monitoring was not conceivable nor considered reimbursable in a Telemedicine/Telemonitoring regional program, if operating [5-7]; no clear indication to Loop Recorder implantation had been formulated neither. This alternative approach might allow speculation on further noninvasive rhythm diagnostic tool spread in the population, especially in such cases of indication and process controversy. An additional aspect we notice is a dramatically shorter LC related AV block resolution in comparison to usual natural history of the disease, in temporal coincidence with empirical steroidal therapy. Antinflammatory therapy is optional asides antibiotic therapy in post-LD therapy, mostly for persistent arthritis and uveitis, and steroidal therapy remains controversial [19-21]. We finally wonder if fast AV-block recovery is a matter of mere coincidence or raises the question of a deterministic relation with steroid administration, with eventual room for further investigation.

Conclusions

This first report highlights Smartwatch ECG as a useful and accurate tool for complete AV-block diagnosis in a Telemedicine fashion, especially in cases of controversial remote monitoring/ Telemedicine assignment. A very short inpatient duration was noted in coincidence with Steroids administration in acute LC related complete AV-block. Further investigation might be warranted.

Conflict of interest: Dr Turreni has received fees as a proctor in AF Cryoablation procedures for the Medtronic dealer "Smart Medical Technology SRL". This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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