

A patient with severely reduced LV function and electrical storm saved by wearable cardioverter-defibrillator: a case report

Introduction

Implantable cardioverter-defibrillators (ICD) have proven to be effective in treatment of ventricular tachyarrhythmias, therefore they are used in patients being at risk for sudden cardiac death (SCD). Early ICD implantation in patients with newly diagnosed left ventricular function (LVEF) < 35% is not indicated within the first weeks after diagnosis [1] even though they are known to have a certain risk of life threatening arrhythmias like ventricular tachycardia (VT) or ventricular fibrillation (VF).

Besides LVEF, no method of risk stratification has been found to detect patients at high risk for SCD [1]. There is a novel method of risk stratification by Magnetic field imaging (MFI). MFI is a noninvasive method to register cardiac electromagnetic activity. Early reports have suggested a positive predictive value of electromagnetic QRS fragmentation index for the occurrence of ventricular arrhythmias [2]. The Apollo system of BMDsys is a newly developed appliance for MFI registration of high-sensitive electromagnetic activity of the heart, but the use for risk stratification is still unclear, especially in patients without coronary artery disease.

For patients with temporarily or unclear high risk of SCD, the wearable cardioverter-defibrillator (WCD) can be used to bridge the time until an ICD is indicated. The WCD is an external device capable of automatic VT/VF detection and defibrillation, which can deliver up to five shocks

in case of arrhythmia [3]. The WCD consists of a garment with installed electrocardiogram (ECG)-electrodes and shock-electrodes, an alarm and monitor system, and a take home interrogation base station connected to the hospital via computer or a modem system. The weight of the WCD is 1.5 kg and maximal energy output is 150 J (biphasic truncated exponential shock). In case of a life threatening arrhythmia, the dry electrodes will automatically deploy conductive gel prior to delivering a shock.

Case presentation

A 41-year-old male patient was brought to hospital for increasing dyspnea and repeated dizziness. The transthoracic echocardiogram revealed a severely reduced LVEF, that was not known before, furthermore a ventricular thrombus. A coronary angiogram was performed showing normal coronary status. Cardiac MRI investigation showed a dilated left ventricle with severely reduced LVEF without any sign of myocarditis, but histological investigation showed some signs of myocarditis. During monitoring, nonsustained VTs were found twice, and patient was symptomatic with dizziness.

The patient received medication for heart failure consisting of angiotensin receptor blocker, diuretics, aldosterone antagonist, digitalis, and betablockers. Furthermore, we decided to give a WCD to the patient for repeated symptomatic nonsustained VTs.

Three weeks later, the patient had syncope with deliverance of WCD shock. Interrogation of the stored ECG showed correct WCD shock for VT that degenerated to VF. The patient was brought to hospital, the WCD was changed, and during the next day in hospital course, two more shocks were delivered by the WCD, again both of them for VF (see **Fig. 1**).

For further risk stratification, we performed an MFI imaging one day after the last VF episode and found a normal intra QRS fragmentation index of 1.05 (normal range 0.8–1.2, see **Fig. 2**). The patient was set on amiodarone and a one-chamber ICD was implanted.

During follow-up of 1 year, no more VT or VF episodes were detected, but LVEF remained severely reduced.

Discussion

This case report describes a patient with newly diagnosed severely reduced LVEF, who had symptomatic episodes of nonsustained ventricular tachycardia. In our investigations, it remained unclear, whether the patient suffered from acute myocarditis or from a newly diagnosed nonischemic cardiomyopathy. Therefore, we decided not to implant an ICD: LVEF should recover, if the patient had an acute myocarditis, and in case of nonischemic cardiomyopathy, prophylactic ICD implantation is only indicated in patients being on optimized medical treatment for up to 9 months [4]. As the patient showed signs of arrhythmic instability with repeated non-

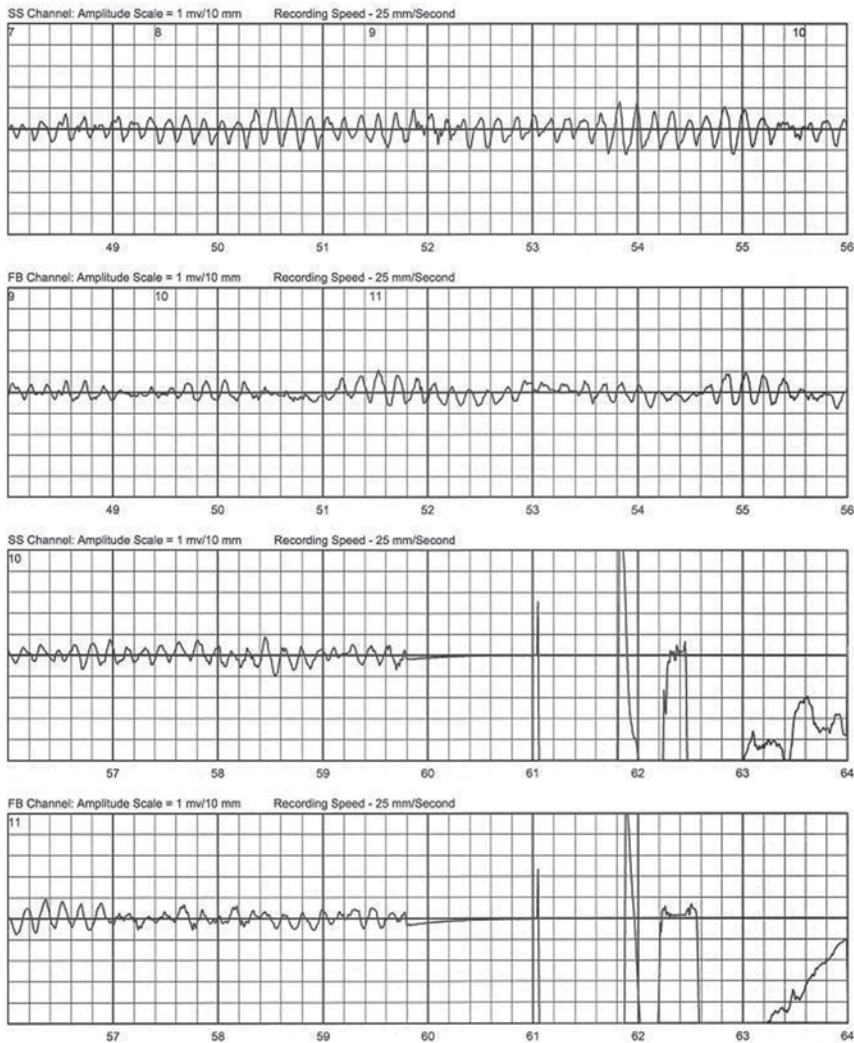


Fig. 1 ▲ ECG of ventricular fibrillation stored by the WCD

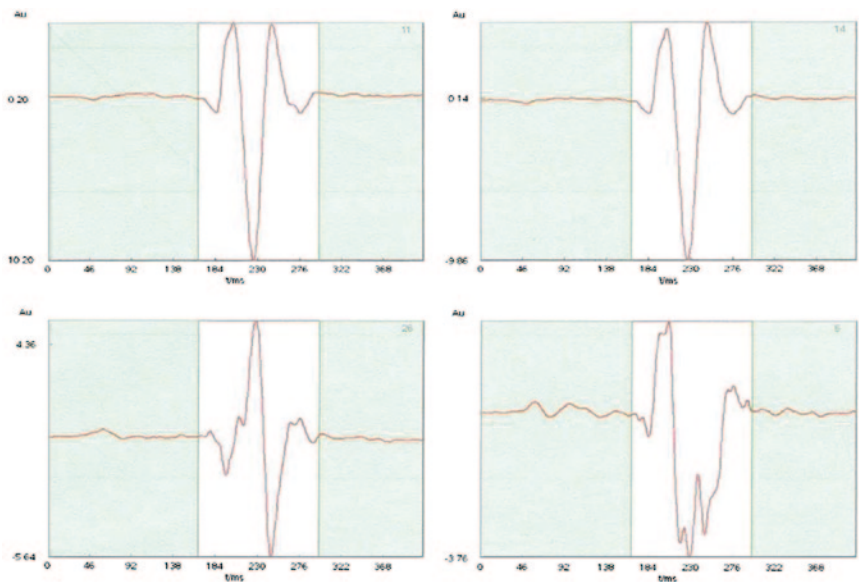


Fig. 2 ▲ Normal intra QRS fragmentation of the patient

sustained VTs and dizziness, we decided to give a WCD to the patient in order to avoid SCD during the acute phase of illness. Three weeks later, the patient presented with adequate shock for ventricular fibrillation, so the novel therapy with the WCD saved his life.

Risk stratification is difficult in patients with nonischemic cardiomyopathy: predictors of total mortality also predict the risk of SCD and generally reflect the severity of the disease, but do not specifically predict arrhythmic death [5]. Premature ventricular complexes, nonsustained VT, and induction of VT in electrophysiology (EP) testing failed to identify patients at high risk of SCD [6]. In patients with ischemic cardiomyopathy, an increased intra-QRS fragmentation in magnetocardiography has shown to predict increased risk of arrhythmic events [2], therefore we considered, whether this method could also be used to identify patients at risk for SCD with dilated cardiomyopathy. Our patient, however, showed a normal fragmentation index of 1.05 (normal range 0.8–1.2). Further studies will show, whether this new method can be used for risk stratification in nonischemic cardiomyopathy.

The wearable defibrillator is a good tool for patients being at temporarily high risk for SCD. It can deliver up to 5 shocks with an energy of 150 J by a biphasic shock waveform. First success rate of the WCD shock is described as 98%. As the shock can only be successfully delivered with the conductive gel on the body surface, an electrical storm with several episodes of ventricular tachyarrhythmia could possibly not be treated successfully, when the patient stays at home after the first shock. Our patient called the emergency ambulance after his first WCD shock and was brought to hospital, where the life vest was changed with new electrodes. During hospital stay, two more serial shocks were successfully delivered. The patient survived electrical storm, because he arrived at hospital before the next series of ventricular tachyarrhythmia occurred.

If we had treated the patient according to the actual guidelines, he would have probably died, so the physician should consider the treatment of each patient carefully and individually.

Conclusion

The wearable ICD is a good tool to treat life-threatening arrhythmias in patients being at temporarily high risk for SCD. It remains still unclear whether QRS fragmentation as measured by the Apollo System has any use for risk stratification in patients with nonischemic cardiomyopathy.

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Consent. Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Authors' contributions. M. Strauss has written the manuscript. K. Kouraki, A. Skarlos and R. Zahn have been involved in drafting the manuscript and revising it critically. T. Kleemann performed the MFI measurement and was a main contributor in revising the manuscript.

Conflict of interest. The authors declare that there is no actual or potential conflict of interest in relation to this article.

References

- Zipes DP, Camm AJ, Borggrefe M, Buxton AE, Chaitman B, Fromer M, Gregoratos G, Klein G, Moss AJ, Myerburg RJ, Priori SG, Quinones MA, Roden DM, Silka MJ, Tracy C (2006) ACC/AHA/ESC 2006 guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death. *Europace* 8:746–837
- Korhonen P, Husa T, Tierala I, Väänänen H, Mäki-järvi M, Katila T, Toivonen L (2006) Increased intra-QRS fragmentation in magnetocardiography as a predictor of arrhythmic events and mortality in patients with cardiac dysfunction after myocardial infarction. *J Cardiovasc Electrophysiol* 17(4):396–401
- Klein HU, Meltendorf U, Reek S, Smid J, Kuss S, Cygankiewicz I, Jons C, Szymkiewicz S, Buhtz F, Wollbrueck A, Zareba W, Moss AJ (2010) Bridging a temporary high risk of sudden arrhythmic death. Experience with the wearable cardioverter defibrillator (WCD). *PACE* 33:353–367
- Jung W, Andresen D, Block M, Böcker D, Hohnloser SH, Kuck HK, Sperzel J (2006) Leitlinien zur Implantation von Defibrillatoren. *Clin Res Cardiol* 95:696–708
- Gradman A, Deedwania P, Cody R, Massie B, Packer M, Pitt B, Goldstein S (1989) Predictors of total mortality and sudden death in mild to moderate heart failure. *J Am Coll Cardiol* 14:564–570

Herzschr Elektrophys 2013 · 24:136–138 DOI 10.1007/s00399-013-0264-8
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A patient with severely reduced LV function and electrical storm saved by wearable cardioverter-defibrillator: a case report

Abstract

The wearable cardioverter-defibrillator (WCD) is indicated in patients who are considered to be at temporarily high risk for sudden cardiac death (SCD), when an implantable defibrillator is not yet clearly indicated.

We report the case of a 41-year-old patient with a newly diagnosed severely reduced left ventricular (LV) function for suspected myocarditis and repeated nonsustained ventricular tachycardia (VT). This patient was supplied with a WCD who came back to the hospital 4 weeks after discharge with an electrical storm and adequate discharge of the WCD. After application of amiodarone, no further arrhythmias were detected during intrahospital course.

For further risk stratification, we performed a magnetic field imaging (MFI), that

was reported to be useful in risk assessment of SCD in patients with ischemic cardiomyopathy. This measurement showed a normal result, but we decided to give an implantable cardioverter-defibrillator (ICD) to the patient. During a follow-up of 1 year, no further arrhythmias occurred.

With this case, we report the efficacy of a WCD, which is a novel tool in patients at temporarily high risk of SCD and we report a novel method of risk stratification in patients with a high risk of SCD.

Keywords

Wearable cardioverter-defibrillator · Sudden cardiac death · Magnetic field imaging

Hochgradig reduzierte linksventrikuläre Funktion und elektrischer Sturm bei einem Patienten mit tragbarer Defibrillator-Weste

Zusammenfassung

Die tragbare Defibrillator-Weste kann bei Patienten mit temporär hohem Risiko für einen plötzlichen Herztod (PHT) indiziert sein, wenn kein implantierbarer Defibrillator (ICD) indiziert ist.

Wir berichten über einen 41-jährigen Patienten mit neu diagnostizierter schwer reduzierter linksventrikulärer (LV-) Funktion bei V. a. Myokarditis und wiederholten nicht-anhaltenden ventrikulären Tachykardien (VT). Dieser Patient erhielt eine Defibrillator-Weste und stellte sich 4 Wochen nach Entlassung erneut in unserer Notaufnahme vor wegen eines electrical storm und adäquater Schockabgabe der Defibrillator-Weste. Nach Gabe von Amiodaron traten während des stationären Aufenthaltes keine weiteren Arrhythmien auf.

Zur weiteren Risikostratifizierung führten wir ein Magnetokardiogramm durch, das in

der Risikostratifizierung des PHT bei Patienten mit ischämischer Kardiomyopathie hilfreich sein kann. Die Messungen zeigten ein unauffälliges Ergebnis, dennoch entschieden wir uns dazu, dem Patienten einen ICD zu implantieren. Während einer einjährigen Nachbeobachtung, traten keine weiteren Arrhythmien auf.

Dieser Fall illustriert die Effektivität der Defibrillator-Weste als neue Therapie bei Patienten mit temporär erhöhtem Risiko für einen PHT sowie eine neue Methode zur Risikostratifizierung von Patienten mit einem besonderen Risiko für einen PHT.

Schlüsselwörter

Tragbare Defibrillator-Weste · Plötzlicher Herztod · Magnetokardiographie

- Kron J, Hart M, Schual-Berke S, Niles NR, Hosenpud JD, McAnulty JH (1988) Idiopathic dilated cardiomyopathy. Role of programmed electrical stimulation and Holter monitoring in predicting those at risk of sudden death. *Chest* 93:85–90