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CASE REPORTS

Ineffective appropriate shocks in coronary artery spasm disease: when defibrillation is not enough

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1 CASE

A 50-year-old woman without relevant medical history or risk factors received a single-chamber Fortify Assura (St Jude Medical) implantable cardioverter defibrillator (ICD) after recovering from sudden cardiac death (SCD). No structural heart disease was documented and coronary angiogram performed showed normal coronary arteries. Submuscular left-sided ICD implantation with dual-coil electrode was performed without incidences, defibrillation test was not performed. ICD was programmed in VVI 40 bpm for bradycardia and two zones for tachycardia settings (170–200 bpm monitor and > 200 bpm with maximum energy shocks: 36J+40Jx5, RV to SVC&can, biphasic, tilt 65%/65%, 5.6 ms). The patient was discharged and some weeks later was readmitted after syncope. ICD was interrogated showing a ventricular fibrillation (VF) episode that is correctly detected and treated with appropriate ICD shocks. Stored intracardiac electrograms showed ineffective shocks at maximum energy (Fig. 1a). ICD parameters were in the normal limits. Defibrillation test was performed showing successful VF defibrillation at low energy shocks (Fig. 1b).

Telemetry ECG monitoring during admission showed a progressive ST elevation coincidental with chest discomfort and palpitations (Fig. 2) compatible with non-previously diagnosed coronary artery spasm (CAS). The episode was sustained developing polymorphic ventricular tachycardias and VF which were correctly detected by the ICD (Fig. 3). However, high-energy appropriate shocks applied were ineffective restoring sinus rhythm. In fact, sinus rhythm was restored spontaneously and ST segment normalized some minutes later. The patient started high doses of calcium channel blockers (diltiazem 120 mg/8 h) and remains without recurrences after over 3 years of follow-up.

CAS is a more common cause of SCD than previously expected in patients with absence of coronary artery disease [1]. Recurrent episodes and ventricular arrhythmias may be prevented if CAS can be effectively addressed with risk factor modification and ongoing treatment with nitrates and calcium channel blockers. Patients with life-threatening ventricular tachyarrhythmias secondary to CAS are at particularly high-risk for recurrence. In spite of medical intervention or if compliance is poor, 6% of patients suffered new events in the long-term. ICD implantation could be considered in secondary prevention [2]. Unfortunately, ICD therapies might not be efficient to prevent SCD in the setting of new prolonged ischemic episodes and during the subsequent reperfusion phase. The efficacy of ICD therapy may be hampered throughout refractory severe ischemia [3]. As shown in Fig. 1, successful low-energy shocks during defibrillation test at normal conditions does not imply the same efficacy during ischemic conditions. This fact highlights the importance of aggressive medical therapy directed against CAS in addition to ICD implantation in these patients. In our case, the patient was untreated because she received the ICD before being diagnosed of CAS. Further studies are needed to evaluate the role of ICD in CAS patients under optimal treatment.

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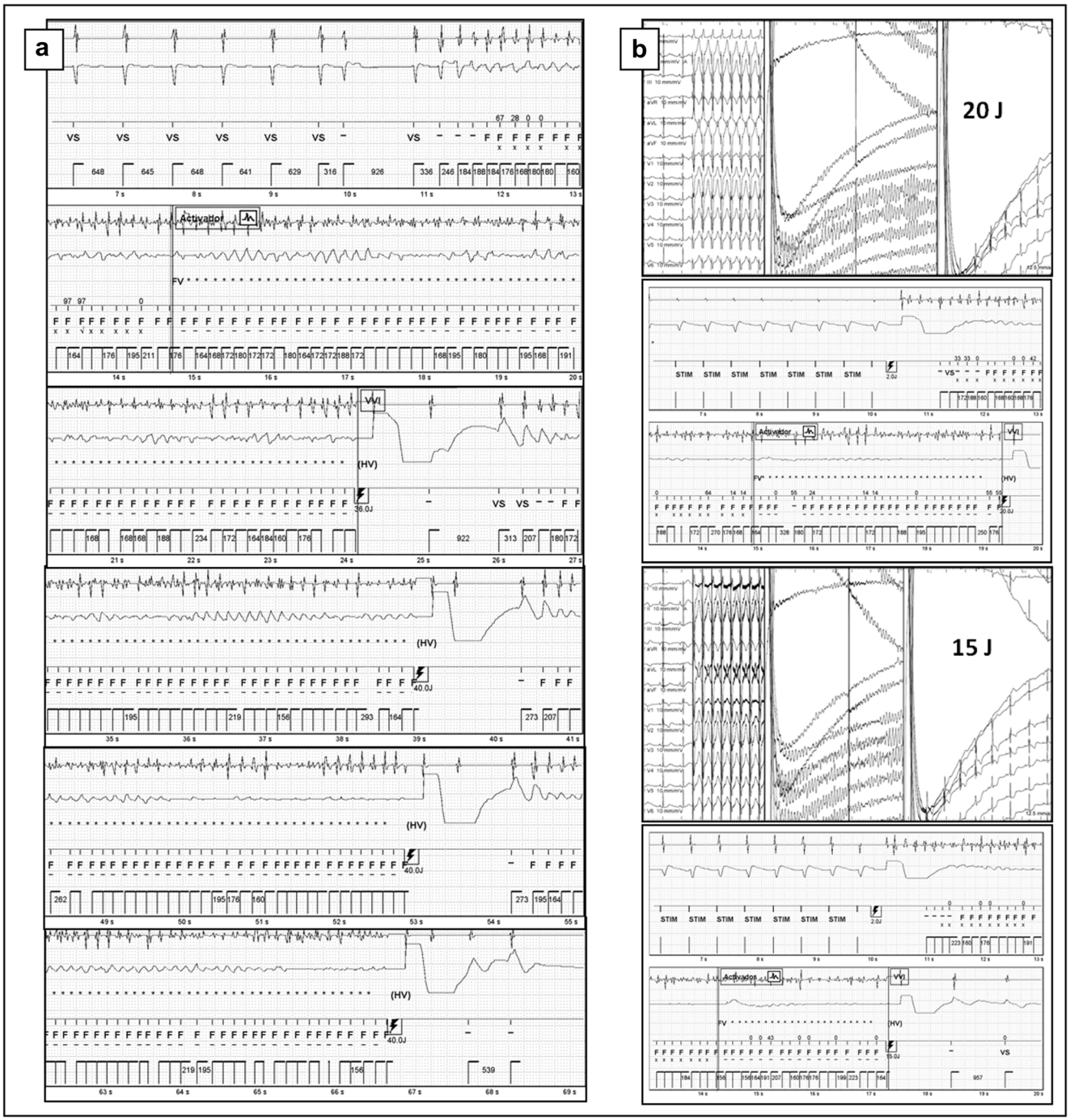

Fig. 1 **a** Stored intracardiac electrograms (EGMs) showing the ICD interrogation after admission. The EGMs show a ventricular fibrillation (VF) episode that is correctly sensed and classified by the device. At 24th second a first 36 J-energy shock is delivered but VF resumes soon after. Some seconds later, two 40-J energy shocks are delivered but again fail in reversing the VF. Finally a 40-J shock successfully restores sinus rhythm (SR). Note that 4 ICD shocks, three of them applied at maximum energy, were necessary to restore SR. **b** ECG and EGMS during defibrillation test using shock on T wave method to induce VF. Two VF inductions were performed; VF was correctly sensed and classified by the ICD. Applied ICD shocks at decrementing levels of energy (20 J and 15 J) successfully restored SR. Note that in this occasion, low energy shocks were enough to successfully treat the VF

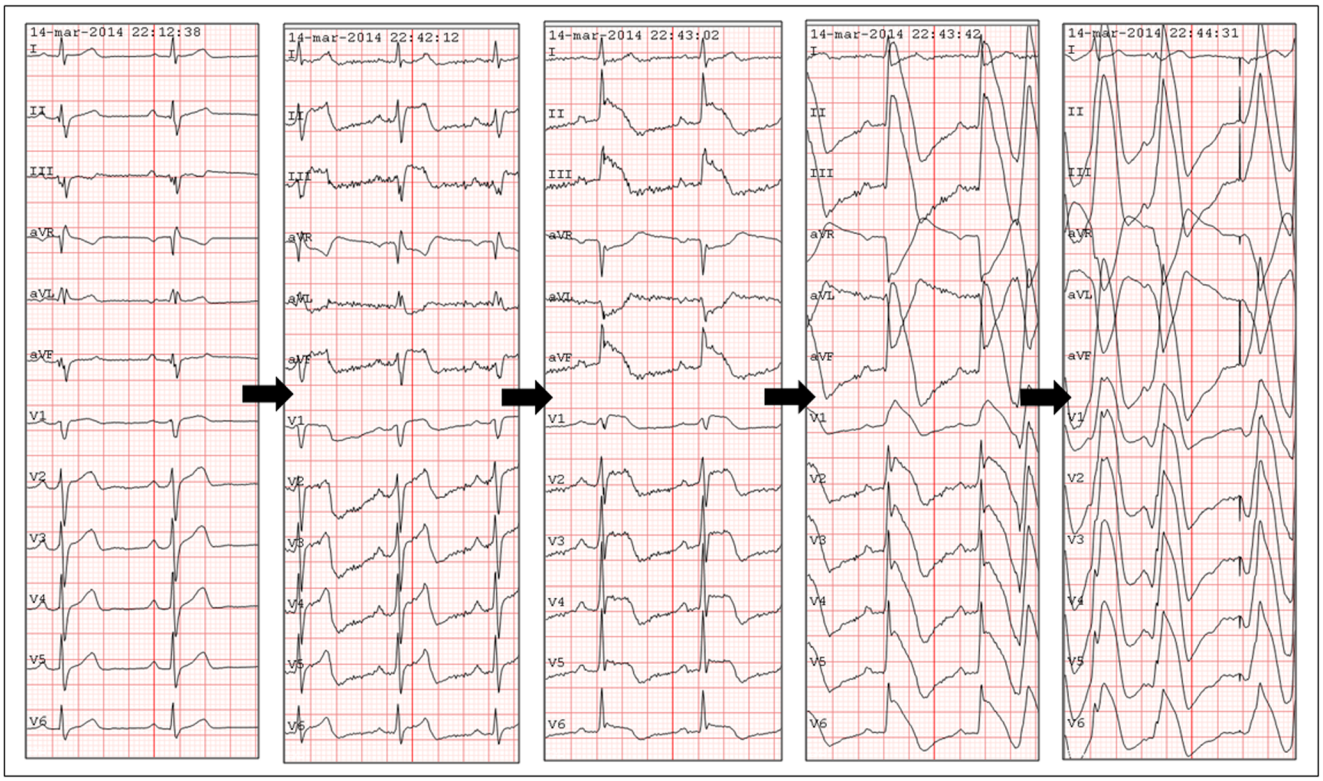

Fig. 2 ECG telemetry recordings during admission showing rapidly progressive ST elevation in inferior and precordial leads during a chest pain episode compatible with coronary artery spasm

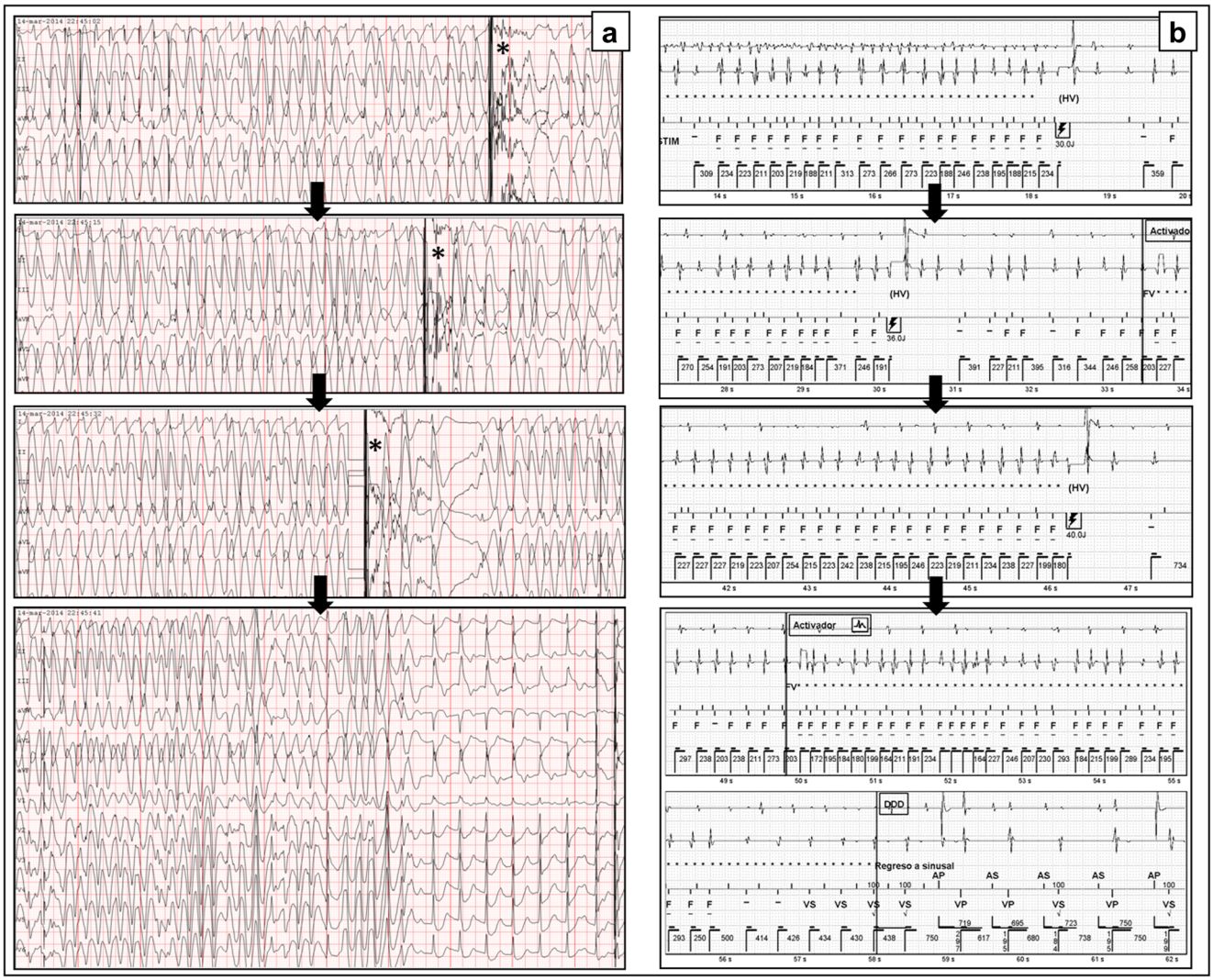

Fig. 3 **a** ECG telemetry recordings some minutes after the beginning of the episode showing polymorphic ventricular tachycardia / VF. Note in the ECG the presence of ineffective ICD shocks (*) in the three first strips and how finally SR is restored spontaneously in the fourth strip. **b** Stored intracardiac EGMs during the episodes. In the three first strips, VF is correctly sensed and classified leading to increasing energy ICD shocks (30 J, 36 J, and 40 J) that fail to restore SR. Finally, in the fourth strip, VF is detected and the ICD stars charging for a new shock that is aborted because SR is recovered spontaneously and detected by the device in the confirmation period before shock delivery

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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