Complete Loss of ICD Programmability After Magnetic Resonance Imaging

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FIEK, M., ET AL.: Complete Loss of ICD Programmability After Magnetic Resonance Imaging. *The purpose of this case report is to describe the effects of an MRI performed on a patient without realizing that an ICD has been previously implanted. After a few seconds of imaging the adversity was recognized and the examination was stopped immediately. The patient was not pacemaker dependent and had neither physical complaints nor electrocardiographic changes in the surface ECG. A consecutively performed ICD assessment showed a backup mode with standard parameters for pacing (VVI 50 beats/min) and arrhythmia detection and treatment. The device could not be programmed by the external programmer. With the exception of printing out the parameters, all software functions were no longer feasible. A device examination by the manufacturer after ICD replacement showed that a major portion of the device memory was corrupt. Even ICDs of a newer generation are susceptible to magnetic interference, with the danger of complete loss of programmability. (PACE 2004; 27:1002–1004)*

implantable cardioverter defibrillator, magnetic resonance imaging

Introduction

The presence of implantable devices like pacemakers (PM) and defibrillators (ICD) is usually a contraindication for magnetic resonance imaging (MRI). The electromagnetic interference may lead to dysfunction of ICDs such as inadequate therapy induction and thermal myocardial injury. Temporary or persistent changes of software programming and electromechanical components are also possible. New studies indicate however that MRI can be performed in patients with newer generation PMs under certain circumstances.[1] The effects on ICDs are still unknown and can only be estimated by theoretical models and considerations. This report describes a case where attempted MRI of the brain caused persistent loss of ICD programmability.

Case Report

A 49-year-old man showed an acute episode of ventricular fibrillation (VF) after an old anterior myocardial infarction. Being successfully resuscitated without hypoxic brain damage, a Ventak Mini III single chamber ICD (Model 1783, Guidant CPI Inc., St. Paul, MN, USA) was implanted using a submuscular pectoral position. As right ventricular lead, an Endotak model 0125 (CPI Guidant Inc.) with steroid eluting tip was used. Software programming included VF detection (heart rate >185 beats/min, duration 1 s) and treatment (DC shocks, 31 J) with backup VVI bradycardia pacing at a rate of 40 beats/min. Twelve months after implantation, an MRI of the brain was requested at a different hospital. Not knowing of the implanted defibrillator, an image sequence (0.5 Tesla) was started. After a few seconds of imaging its presence was recognized by MR image artefacts and the procedure was immediately stopped. No pain or inadequate therapies such as antitachycardia pacing or induction of shocks were observed by the patient. Syncope due to loss of bradycardia pacing could not occur as there was no PM dependency.

An ICD assessment was performed on the same day. After interrogation, a screenshot titled 'PG Fallback' appeared. The documented software parameters showed a complete change compared to the presetting (Fig. 1). VF detection was lowered to 165 beats/min, bradypacing now showed an intervention frequency of 50 beats/min with maximum output. All attempts of reprogramming failed, with the exception of printing a simplified parameter protocol, it was no longer possible to perform programming maneuvers. The patient was monitored in an intermediate care unit, the defibrillator was replaced the following day.

The explanted device was sent to the manufacturer for further examination. A lab analysis revealed a fault code in the memory which indicated the device had been reset. It could also be demonstrated that a major portion of the device memory was corrupt.

Discussion

At most institutions, implanted defibrillators are considered an absolute contraindication to MRI. A checklist paying attention to the presence of implanted devices, has to be completed by the radiographer when MRI is requested. It could not

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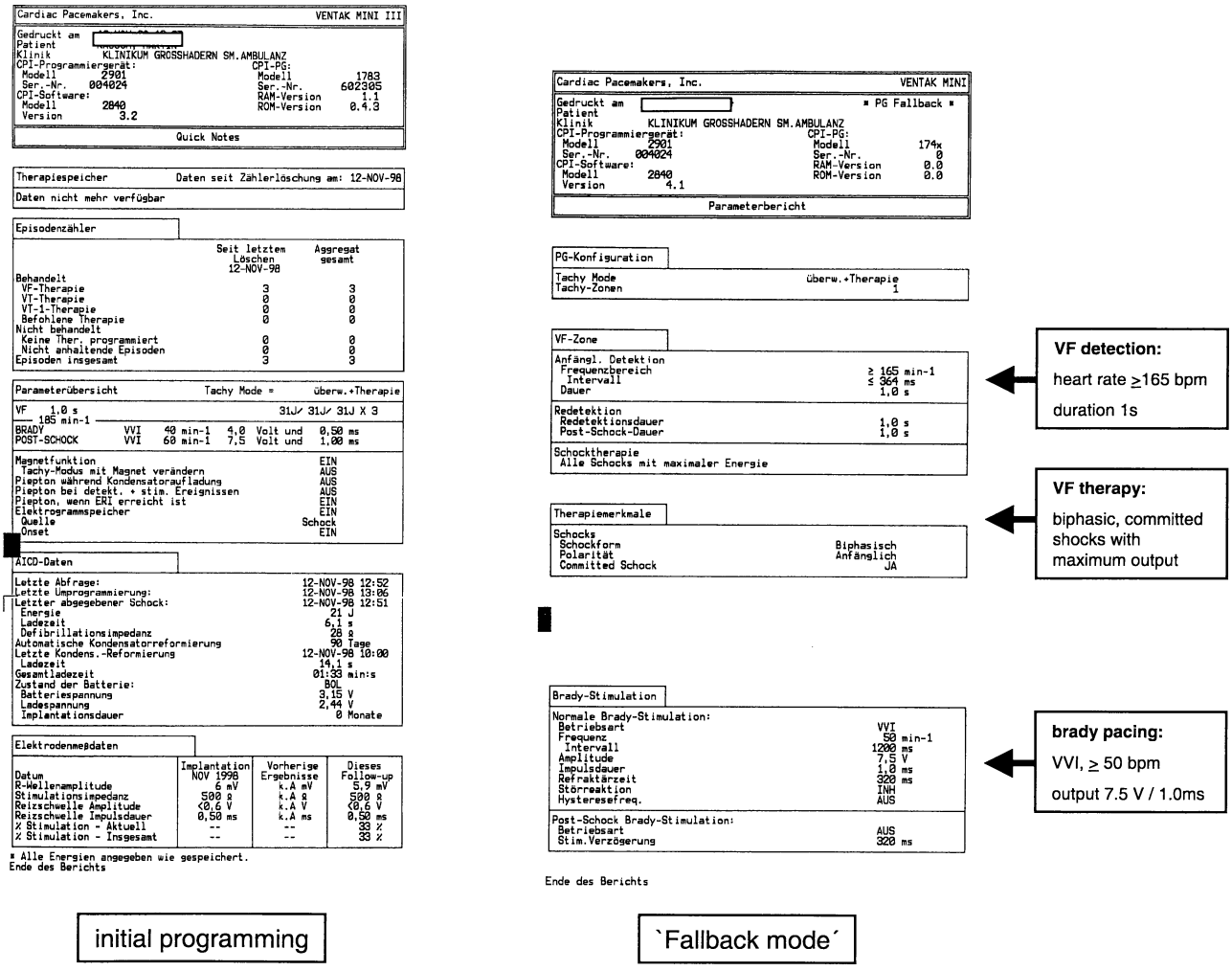

Figure 1. *Printout of the ICD software parameters pre- and post-MRI. On the right side the simplified parameter protocol after the interference.*

be clarified why in this case the measure failed. The management of patients with implanted metal devices and MRI is controversially discussed. The results of several experimental and human studies with PMs are available. Inhibition, asynchronous pacing, high rate pacing and myocardial necrosis as well as proper PM function have been described after MRI.[2–8] In PM patients, the change of the pacing mode to asynchronous modes may avoid the most frequent problems during imaging.[9] The situation seems to be more complex when regarding implantable defibrillators. In general, ICDs show a much higher sensitivity, the larger batteries and volume may cause high magnetic forces resulting in strong torque.[10] Due to their capacities, a variety of malfunctions beside pacing anomalies are possible such as misdetection of artefacts with consecutive therapy delivery, induction of ventricular arrhythmias through inadequate therapies, prevention of detection of adequate life-threatening arrhythmias, charge time prolongation, and complete loss of programmability as described in this case. Only limited experience with ICDs and MRI exists. One case report by Anfinsen et al.[11] describes both temporary and permanent effects. During imaging, electromagnetic interference was detected as VF and nearly caused inadequate DC shocks. Furthermore, the charge time was prolonged and the battery indicator switched to 'end of life', both could be restored by the next ICD assessment. In addition to these temporary disturbances, a significant increase of the pacing threshold was recognized 3 months later, it is however, not proven that it was MRI related. In this patient, proper ICD function was restored by ICD assessment, and was demonstrated

afterwards through testing with induced VF. In our case, no procedure was successful in evaluating and restoring device function. ICD change was therefore imperative. Despite the device showing standard detection and therapy parameters in the 'PG Fallback' mode, it remains unclear whether the device would have really functioned properly in the case of a ventricular arrhythmia.

Conclusion

Although present data indicates the practicability of performing MRIs on PM patients, this example demonstrates that the presence of an ICD is still an absolute contraindication. Compared to PMs, defibrillators show, due to their capacities, a wider spectrum of malfunctions including the complete loss of programmability.

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