Case Report

Radiofrequency Catheter Ablation for Electrical Storm in a Patient with Dilated Cardiomyopathy

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We report a case of successful radiofrequency catheter ablation in a patient with dilated cardiomyopathy, who presented with multiple, haemodynamically poorly tolerated episodes of monomorphic ventricular tachycardia, resistant to antiarrhythmic drug treatment. The ablation procedure consisted of focal ablation of three mapped left ventricular sites, using pace and activation mapping. Additional linear ablation lesions were created across these sites. After the procedure, the patient remained free of tachycardia episodes and seven days post-ablation he underwent implantation of a cardioverter-defibrillator. During a twelve-month follow-up period, the patient has remained free of monomorphic ventricular tachycardia episodes. Radiofrequency catheter ablation is feasible in electrical storm, using conventional mapping techniques, even in haemodynamically unstable tachycardias.

Key words:
Catheter ablation, electrical storm, dilated cardiomyopathy.

Manuscript received:
May 3, 2005;
Accepted:
August 29, 2005.

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Electrical storm is an infrequent condition, characterised by recurrent or incessant ventricular tachycardia, and is associated with high mortality.[1] Antiarrhythmic drugs, temporary ventricular pacing and deep sedation have been used to treat this condition with moderate success.[1] Although radiofrequency catheter ablation in patients with electrical storm has been reported with satisfactory results,[2-5] many centres have only limited experience. Most of the reported information is related to patients with previous myocardial infarction and implanted defibrillator, presenting with multiple shocks due to episodes of haemodynamically stable ventricular tachycardia. We describe and discuss a case of successful radiofrequency catheter ablation in a patient with dilated cardiomyopathy, who presented with multiple episodes of haemodynamically poorly tolerated monomorphic ventricular tachycardia.

Case description

A 68-year-old man with dilated cardiomyopathy and severe global left ventricular dysfunction (ejection fraction of 20%) presented with sustained ventricular tachycardia associated with syncope. He was admitted to the coronary care unit, where he had recurrent episodes of ventricular tachycardia with two different morphologies, at rates of 210 and 200 beats per minute. The first tachycardia had a right bundle branch-left axis morphology and the second tachycardia had a right bundle branch-extreme right axis morphology (Figures 1 and 2). The electrical storm persisted, despite intubation and deep sedation, temporary pacing at various rates and several antiarrhythmic regimens, consisting of combinations of carvedilol, esmolol, amiodarone, lidocaine, mexiletine and procainamide. All episodes were poorly tolerated and required termination with external synchronised cardioversion. Three days after his admission, during which period over 20 direct-current shocks had been delivered to the patient, a radiofrequency catheter ablation procedure was decided upon.

The ablation procedure was performed with the use of three catheters: a quadripolar catheter across the tricuspid valve, a

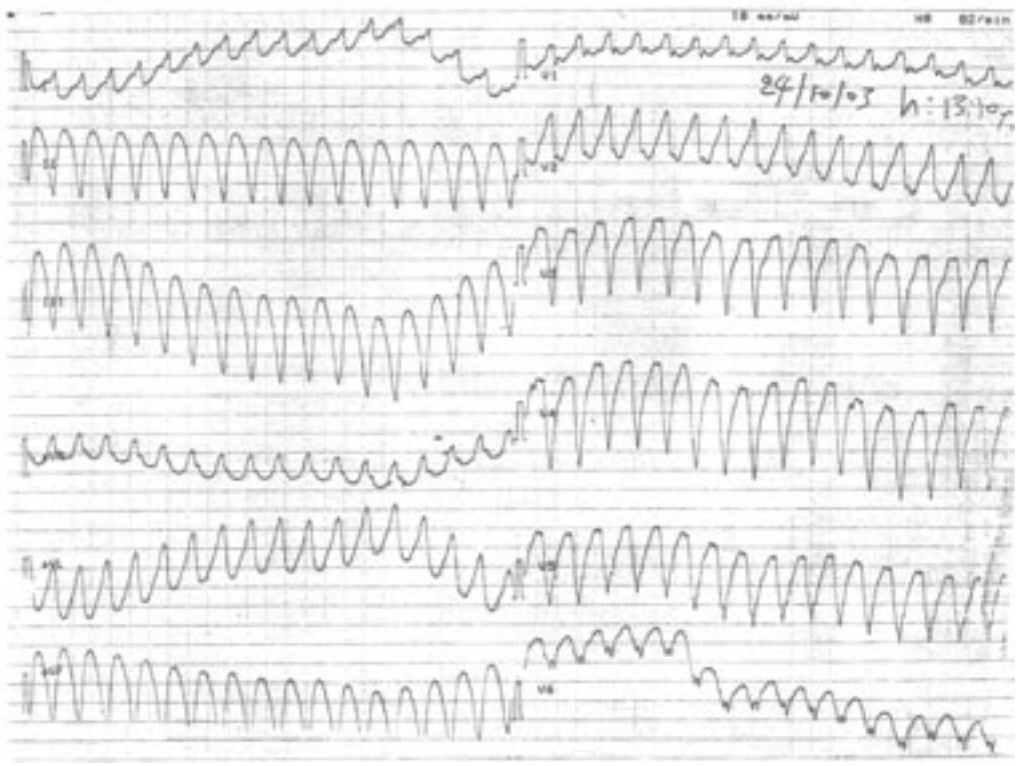

Figure 1. Ventricular tachycardia on admission.

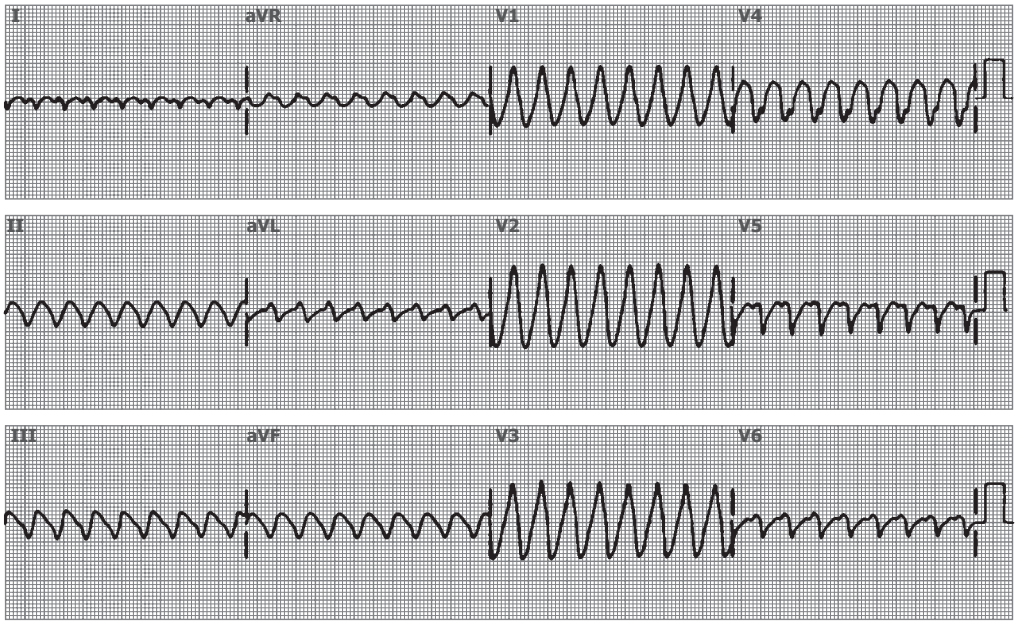

Figure 2. Ventricular tachycardia with a second morphology.

quadripolar catheter placed at the right ventricular apex and a third catheter used for mapping and ablation. Left ventricular mapping was performed retrogradely using a steerable catheter with a 4-mm electrode tip (Biosense Webster, Diamond Bar, CA, USA). After the catheter was positioned in the left ventricle, 5,000 IU of heparin were administered, with an additional 1,000 IU hourly. Bipolar electrograms were recorded on a multichannel system (BARD electrophysiology, Lowell, MA, USA) and filtered at 30-500 Hz.

Targets for ablation were determined based on pace mapping, using short bursts of unipolar pacing from the distal electrode of the mapping catheter, as previously described for haemodynamically unstable

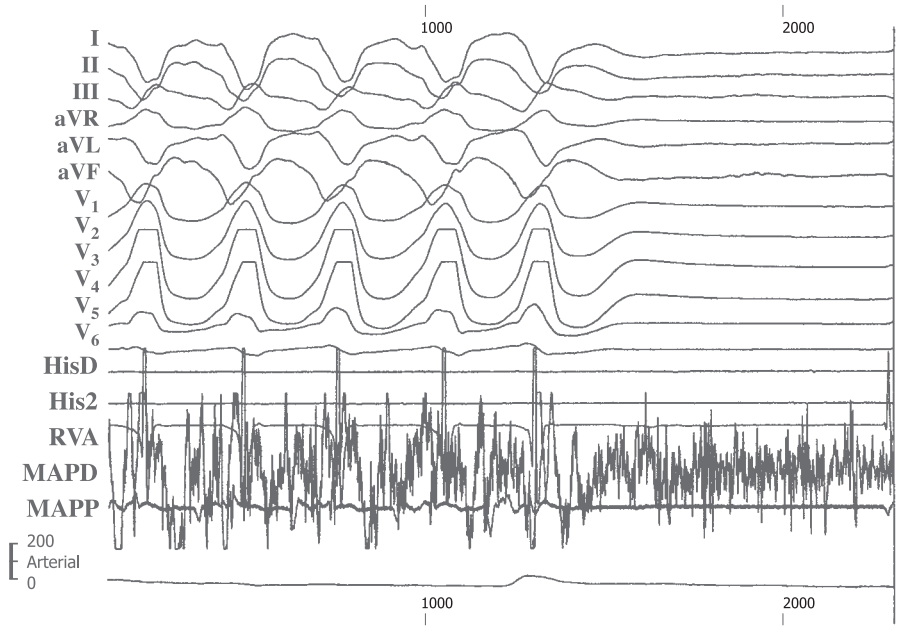

Figure 3. Termination of a ventricular tachycardia episode during radiofrequency energy application. Note the low blood pressure during ventricular tachycardia.

ventricular tachycardias.[6-8] Activation mapping during ventricular tachycardia was also performed, albeit to a limited extent given the haemodynamic instability. Sites displaying a bipolar ventricular electrogram preceding the onset of surface QRS deflection of over 30 ms were considered as potential ablation targets.

Based on these criteria, two left ventricular sites were defined as the sites of origin of the two clinical ventricular tachycardia morphologies and radiofrequency energy was delivered from the distal electrode of the mapping catheter with a pre-selected temperature of 65˚C at 50 W. The first focus was located at the inferoapical left ventricular septum (Josephson site 2)[9] and the second at the inferolateral left ventricular wall (Josephson site 7).[9] Energy application resulted in termination of the arrhythmia. A third, non-clinical ventricular tachycardia with a right bundle branch-extreme right axis configuration was mapped at the mid-basal inferior left ventricular wall (Josephson site 5)[9] and was successfully ablated. These three foci were thought to be entirely different circuits and not different exits of the same circuit. A total of 28 ablation lesions were delivered.

Figure 3 shows prompt termination of a sustained ventricular tachycardia episode after radiofrequency energy application. After successful ablation, additional linear lesions were created across the three ventricular foci, as previously described.[7,8] Programmed electrical stimulation with three extrastimuli at a basic pacing cycle length of 400 ms induced a fourth, rapid, non-clinical tachycardia, which could not be ablated. The total procedure duration was 4.5 hours, with 41 minutes of radiation time.

After the procedure, the patient remained free of tachycardia episodes and seven days post-ablation he underwent implantation of a cardioverter-defibrillator. Twenty-four hours after the procedure creatine kinase-MB levels were within normal limits, but cardiac troponin I levels were elevated at 1.0 ng/ml. During a twelve-month follow-up period, the patient has remained free of monomorphic ventricular tachycardia episodes. However, three months after implantation he experienced a defibrillator shock due to ventricular fibrillation. This classification was based on endocardial electrogram rate and morphology.

Discussion

Treatment of electrical storm is difficult and often ineffective. In accordance with previous studies,[2-6] our report emphasises the usefulness of radiofrequency catheter ablation in such cases. Furthermore, three points are worth noting.

First, catheter ablation for sustained ventricular tachycardia due to myocardial re-entry in patients with non-ischaemic dilated cardiomyopathy is feasible, albeit more difficult than in patients with previous myocardial infarction.[8,10] Our report confirms the value of such treatment even in the presence of multiple tachycardia morphologies.

Second, our patient underwent successful ablation of haemodynamically poorly tolerated ventricular tachycardia. Such tachycardias have been regarded as "unmappable" until recently. However, our experience, and that of others,[2-5] indicates that satisfactory results may be achieved even with suboptimal mapping criteria. Foci arising from the subendocardial Purkinje arborisation may be responsible for cases of electrical storm in patients with myocardial infarction.[11] Focal ablation is effective in these patients, even in cases presenting with polymorphic ventricular tachycardia.[11] Whether these findings apply in patients with non-ischaemic dilated cardiomyopathy remains to be seen. The use of additional linear ablation lesions within and around the tachycardia site of origin, resembling surgical endocardial resection, may be particularly useful in this regard.[6,7] In our patient, as well as in previous reports,[2-7] the favourable results were sustained during a medium-term follow-up.

Third, our patient underwent successful catheter ablation with the use of conventional mapping techniques, i.e. without the use of electroanatomical mapping or non-contact mapping systems. These systems have significantly improved the success rates of ventricular tachycardia ablation, especially in haemodynamically unstable arrhythmias.[7] Nonetheless, in agreement with previous reports,[12] our case shows that successful catheter ablation may be feasible without the use of newer mapping systems, even in complex cases. Despite the unquestionable value of these systems, such a policy obviates the need for emergency medical transfer in some cases.

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