Aborted sudden cardiac death in a 52-year-old man without structural heart disease

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Sudden cardiac death in the absence of apparent structural heart disease is an uncommon phenomenon. The majority of these patients do not have 'normal' hearts and specific diagnostic tools are required to identify structural or functional abnormalities. We describe the history of a 50-year-old man who survived ventricular fibrillation. Clinical investigation, including a coronary angiography and electrophysiological study, appeared to be normal. An implantable cardioverter defibrillator was inserted. Follow-up Holter monitoring was performed after a recurrent episode of ventricular tachycardia. It demonstrated transient ST-segment elevation. An acetylcholine provocation test was subsequently carried out. Reversible coronary spasm of the left descending coronary artery was found, during which a diagonal branch was occluded. It may be concluded that coronary spasm provocation is of value in the routine diagnostic work-up of patients surviving sudden cardiac death without apparent heart disease. (*Neth Heart J* 2008;16:239-41.)

Keywords: coronary spasm, ventricular fibrillation

A 50-year-old man who had previously been in good general health was admitted to our department after an out-of-hospital cardiac arrest, with documented

ventricular fibrillation. Normal sinus rhythm was restored by defibrillation and our patient experienced an uneventful neurological recovery. The baseline ECG was normal (figure 1). Apparent underlying heart disease, including myocardial ischaemia, was excluded by echocardiography, bicycle ergometry, coronary angiography and Holter monitoring. Flecainide drug challenge did not demonstrate Brugada ECG patterns. Electrophysiological study did not reveal any inducible ventricular arrhythmia. An implantable cardioverter defibrillator was inserted, which delivered therapy on two separate occasions during follow-up due to ventricular tachycardia. These events occurred two years after the index episode, six-months apart and on both occasions not related to exercise or other specific activity. Outpatient follow-up Holter monitoring demonstrated transient ST-segment elevation in the infero-lateral ECG leads, during which the patient suffered from atypical chest discomfort in the early morning hours, not related to physical exertion (figure 2). Subsequently repeated coronary angiography, including fractional flow velocity reserve measurements, was normal. However, an extended and diffuse coronary spasm of the left descending coronary artery, occluding the first diagonal branch, was found following intra-coronary administration of acetylcholine (figure 3). The spasm resolved and the flow was restored after administration of nitroglycerin. A calcium channel blocker, angiotensin-converting enzyme inhibitor, aspirin and statin therapy were started before discharge. Neither symptoms nor ICD therapy recurred during the following 18 months of follow-up.

Discussion

Our patient survived sudden cardiac death due to ventricular fibrillation. Structural heart disease was not found in the initial clinical work-up. The principles of diagnosis and management for patients surviving sudden cardiac death can be adapted from the European Society of Cardiology's guideline on sudden cardiac death.¹ Besides history (including family history) and physical examination, at least the following investigations should be performed in the event of symptomatic arrhythmia and/or sudden cardiac death:

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Figure 1. Baseline 12-lead electrocardiogram.

laboratory testing (e.g. electrolytes), ECG, echocardiography, ischaemia detection and coronary angiography. In patients in whom no ischaemia or structural heart disease can be detected, and additional diagnostics have offered no likely explanation, non-invasive ECG monitoring and programmed electrical stimulation (PES) may be of use. Nevertheless, the diagnostic yield of this strategy is limited. Among the 86 patients without evidence of structural heart disease enrolled in a European registry, UCARE, only 50%

were inducible by PES. Polymorphic sustained ventricular tachycardia or fibrillation were the most frequently observed rhythms but both positive and negative predictive values were low.^{2,3} Data are limited with regard to the appropriate additional investigations for patients when the evaluation outlined above is unrevealing. Body surface mapping and evaluation of sympathetic innervation may enhance the identification of patients at higher risk.⁴ Although recommended, the performance of a coronary spasm provocation test has not been included in the guidelines mentioned above as a routine investigation for patients surviving sudden cardiac death.¹ Therefore, we speculate that coronary spasm could be underdiagnosed in the patient group with 'idiopathic ventricular fibrillation', especially in patients in whom variant angina pectoris is not evident at first presentation, as was the case in our patient.

Pathophysiology

Although spasm is associated with (noncritical) coronary lesions, this phenomenon is also known to be found in patients with normal angiograms.⁵ Coronary vasospasm was proposed to cause variant angina by 'temporary increased tonus' in a high-grade obstruction of a major coronary artery as early as in 1959.⁶ The key finding in the diagnosis of variant angina is temporary ST-segment elevation, as was detected in our patient. Intracoronary acetylcholine provocation has been reported to be a safe and useful test to support the diagnosis.⁷ Fractional flow reserve measurements were performed in our patient before and after acetylcholine administration. Although the presence of a coronary guidewire may potentially induce coronary spasm, the risk is reported to be very low.⁸ Furthermore, the use of a Doppler coronary guidewire in spasm provocation has been advocated as a diagnostic tool, to selectively measure ergonovine-induced flow alteration in variant

Figure 2. Holter recording during transient anginal chest pain in the morning hours, not related to physical exertion. ST-segment elevation is recorded.

Figure 3. Selective contrast injection into the left coronary artery before the administration of acetylcholine (right panel). A fractional flow reserve (FFR) wire was introduced into the left anterior descending artery before acetylcholine provocation and not manipulated following FFR measurement, which appeared to be normal. Vessel diameter is reduced significantly due to coronary spasm after coronary administration of acetylcholine (left panel).

angina, not inducing spasm itself in patients or healthy volunteers.⁹ Because a normal coronary angiogram does not fully exclude the presence of atherosclerosis, intravascular ultrasound (IVUS) may be helpful as well.

Treatment

Both medication and ICD implantation have been investigated as treatment options in survivors of sudden cardiac death without apparent heart disease. According to UCARE investigators, prevention of recurrence with antiarrhythmic agents and β -blockers failed in the UCARE registry, in which 9% of the patients were treated with sodium channel blockers.² This group had a 30% recurrence rate with two SCDs. Long-term follow-up of all six patients with idiopathic ventricular fibrillation in whom PES had shown suppression of inducibility with sodium channel blockers suffered a recurrence of 100%.² Survivors of idiopathic ventricular fibrillation should be regarded as candidates for an ICD, since this is the safest and most effective secondary prevention therapy.^{1,3} A positive coronary spasm provocation has important therapeutic implications, since calcium channel blocker therapy may provide protection against sudden cardiac death following this finding.^{5,10} Drug therapy may thus be effective in addition to ICD implantation and prevent ICD activation. As was mentioned before, other agents are beneficial in restoring endothelial function and thus preventing coronary spasm: among them ACE inhibitors, angiotensin receptor blockers, nitrates and statins have been advocated in this respect.¹¹ Coronary stenting has been proposed as a therapeutic strategy in patients with spasm refractory to conventional therapy.¹² This would probably not have been effective in our case, however, since the spasm involved an extended segment of the coronary artery.

Conclusion

The routine work-up outlined above did not identify the cause of the recurrent ventricular tachycardia in our patient. This was only established following routine Holter investigation which revealed possible myo-

cardial ischaemia at rest, and subsequent coronary angiography and spasm provocation testing. We emphasise the importance of this test in the management of patients surviving sudden cardiac death without apparent heart disease and propose that it may be adopted in the next guideline addressing this patient category. ■

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