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Original Article

Prognosis of patients with coronary vasospasm after successful resuscitation from ventricular fibrillation

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ABSTRACT

Ventricular fibrillation (VF) is an important cause of sudden cardiac death in patients with coronary vasospasm. Intensive medical treatment against coronary vasospasm is most important for prevention of VF recurrence, and the efficacy of implantable cardioverter-defibrillator (ICD) devices is controversial. We examined 19 consecutive patients with coronary spasm who had been successfully resuscitated from VF between 1993 and 2010, 13 of whom underwent ICD implantation. There were no apparent differences in the results of coronary angiography and acetylcholine provocation test or in medical therapy among them. Six patients underwent electrophysiological tests during the acetylcholine provocation test, and 3 of them showed ventricular arrhythmia. Three patients had recurrent VF under treatment with single calcium channel blocker (CCB), nitrates, and/or nicorandil. Two of them were without ICDs and were left in vegetative states, and the third was successfully resuscitated by an appropriate ICD discharge. The results of our study suggest that dual or multiple CCB treatment is preferable to prevent VF recurrence, and that combined treatment with ICD may be effective for some patients with coronary vasospasm who have been successfully resuscitated from VF. However, reasonable risk stratification for ICD implantation in these patients needs to be established in the future.

1. Introduction

The spread of basic life support (BLS), including use of automated external defibrillators in the general public, may increase the chance of survival from sudden cardiac death (SCD). Survivors usually have underlying cardiac diseases, such as coronary artery disease, cardiomyopathy, valvular heart disease, or myocardial channel disease. Ventricular fibrillation (VF) is one of the important causes of SCD [1,2] in patients with coronary vasospasm. The Guidelines for Risks and Prevention of Sudden Cardiac Death 2010 (Guideline 2010) [3] stated that fatal ventricular arrhythmias, including VF, in patients with variant angina should be prevented by intensive medical therapy against coronary vasospasm. However, there are some patients who are refractory to intensive medical therapy and are at high risk of recurrent VF [4].

At our institution, we treated patients with coronary vasospasm only by medical therapy until 2005, because we were not permitted to perform implantation of implantable cardioverter-defibrillators (ICD) until 2004, and we started ICD therapy in 2005. Between 2005 and 2010, 13 patients who survived VF and had positive acetylcholine (ACh) provocation test underwent ICD implantation in addition to medical therapy.

Although there have been reports that ICD is useful for patients with coronary vasospasm complicated by VF [5–8], implantation of ICD in these patients remains controversial and is regarded as Class 2b in the Guideline 2010. In this study we examined 19 patients with coronary vasospasm complicated with VF and considered the effective treatment and prevention of its recurrence.

2. Methods

2.1. Study population

One hundred eighty-six patients (132 male, 54 female) with aborted SCD were admitted to our hospital between November 1993 and February 2010. Twenty-eight of them were diagnosed with variant angina or coronary spastic angina (CSA), and the remaining 158 were diagnosed with other cardiac diseases. Of the 28 patients with CSA, 25 were successfully resuscitated and left the hospital without any severe sequelae. The causes of SCD were ventricular fibrillation in 19 patients, complete atrioventricular block in 1 patient, and unknown fatal arrhythmia in 5 patients

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who had presented in cardiopulmonary arrest on arrival. We studied the 19 patients with coronary vasospasm who were successfully resuscitated from VF. Clinical characteristics, results of coronary angiography (CAG), ACh provocation test, and electrophysiological study (EPS), and treatment and clinical course were compared among them.

2.2. Acetylcholine provocation test for coronary vasospasm

Seventeen patients underwent ACh provocation test. Following control CAG, ACh was injected into the coronary artery in incremental doses (50 and 100 μg for left coronary artery (LCA); 25 and 50 μg for right coronary artery (RCA)) under backup pacing. A positive response was defined as the development of ≥90% stenosis with or without chest pain and/or ST-segment change on electrocardiogram (ECG). If spasm of LCA occurred, isosorbide dinitrate (ISDN) was injected to LCA and ACh provocation test for RCA was not performed unless the physician decided to do so (Fig. 1).

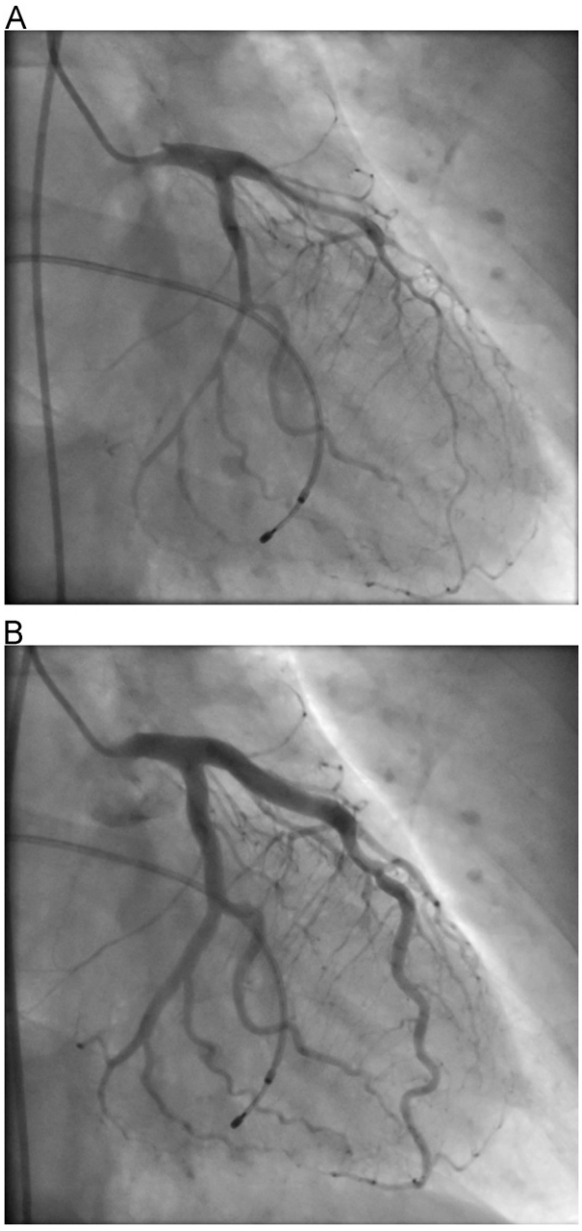

Fig. 1. Acetylcholine provocation test (Pt 15). (A) Spasm of LAD. Diffuse coronary spasm occurred in the middle and distal segments of LAD, with mild spasm in the distal segments of LCX. LAD: left anterior descending artery, LCX: left circumflex artery. (B) Relief of spasm with ISDN. Significant organic stenosis was not detected. ISDN: isosorbide dinitrate.

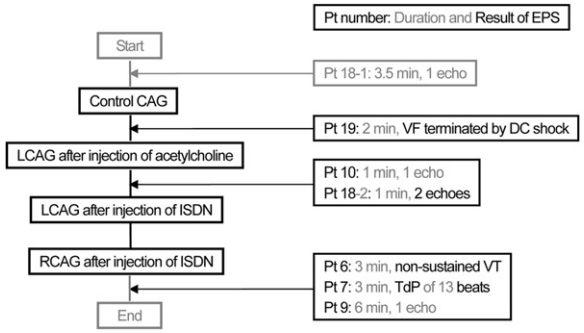

Fig. 2. Timing, duration, and results of EPS. EPS: electrophysiological study, CAG: coronary angiography, LCAG: left coronary angiography, ISDN: isosorbide dinitrate, RCAG: right coronary angiography, Pt: patient, VF: ventricular fibrillation, DC: direct current, VT: ventricular tachycardia, TdP: Torsades des Pointes.

2.3. Electrophysiological study for ventricular arrhythmia

Six patients underwent EPS during the ACh provocation test. We used a programmed stimulation protocol including basic pacing cycle length with single, double, and triple extra-stimuli at the right ventricular apex. The timing of programmed stimulation was before CAG in 1 patient who also underwent the test after injection of acetylcholine, before injection of ACh in 1 patient, between injection of ACh and left CAG with ISDN in 2 patients, and after right CAG with ISDN in 3 patients (Fig. 2). Basic cycle length, minimum coupling interval, and duration of EPS are shown in Table 4.

3. Results

3.1. Clinical characteristics

Clinical characteristics of all of the patients are listed in Table 1. Patients (Pts) from 1 to 5 were admitted before we began to perform ICD implantations. There was no past history of syncope, and no or unknown (Pt 5) family histories of SCD. Ten patients (53%) were smokers at onset, but all of them gave up smoking after the event. There were more patients with hypertension than with dyslipidemia (DL) or diabetes mellitus (DM). The dominant baseline ECG rhythm was sinus rhythm in 18 patients, and no one exhibited Brugada-type ECG changes. Pt 6 had dilated phase hypertrophic cardiomyopathy (HCM) with severely reduced left ventricular (LV) function. The other patients demonstrated normal or mildly reduced LV function. Two patients had histories of arrhythmia, but both of them had sinus rhythm on admission.

3.2. Organic coronary stenoses

All of the patients underwent CAG with ISDN either emergently or on the same day as ACh provocation test (Tables 2 and 3). Twelve patients had normal coronary arteries, 6 had mild stenoses, and 1 had 75% stenosis of the left anterior descending artery (LAD), which we did not regard as the cause of VF.

3.3. Diagnosis of coronary vasospasm

Chest pain and ST-segment elevation on ECG before VF detection were documented in 67% (12/18) and 38% (5/13) of the