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Long-Term Outcome of Verapamil-Sensitive Sustained Left Ventricular Tachycardia in Patients Without Structural Heart Disease

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Objectives. **This study attempted to determine the long-term outcome of verapamil-sensitive sustained left ventricular tachycardia in patients without apparent structural heart disease.**

Background. **Several types of idiopathic ventricular tachycardia have been reported, and their clinical, electrophysiologic and electropharmacologic characteristics are different. It is possible that the prognosis of each type of ventricular tachycardia might also be different.**

Methods. **We studied mortality and morbidity in 37 consecutive patients (27 male, 10 female; mean [±SD] age 33 ± 14 years) with verapamil-sensitive sustained left ventricular tachycardia who had no apparent structural heart disease. Patients were followed up for 1 to 13 years (mean 5.8). Verapamil repeatedly terminated ventricular tachycardia in all patients. Ventricular tachycardia originated from the inferior and inferoseptal regions of the left ventricle in 33 patients and the superior and superioseptal regions in 4. Severity of ventricular tachycardia was classified according to the extent to which symptoms limited daily activities. Ventricular tachycardia was mild (minimal limitation) in 14 patients, moderate (some limitation) in 17 and severe (severe limitation) in 6.**

Results. **Fourteen patients with mild ventricular tachycardia were followed up without any drug therapy, and the ventricular tachycardia remained mild in all patients. Antiarrhythmic therapy was initiated empirically in the 23 patients with moderate and severe ventricular tachycardia (verapamil in 20, propranolol in 2, digoxin in 1). Moderate ventricular tachycardia became mild ventricular tachycardia after drug therapy in all patients, but the six patients with severe ventricular tachycardia showed no improvement. The six patients with severe ventricular tachycardia had nonpharmacologic therapy (cryosurgery in one, catheter ablation in four, antitachycardia pacing device in one). During the follow-up period, all patients remained alive except for one who died suddenly after implantation of an antitachycardia pacing device.**

Conclusions. **1) The long-term prognosis of verapamil-sensitive sustained left ventricular tachycardia in patients without apparent structural heart disease is good. 2) Verapamil is the drug of choice for alleviating symptoms, but nonpharmacologic therapy is necessary in some patients.**

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Idiopathic ventricular tachycardia is usually defined as ventricular tachycardia that occurs in patients without apparent heart disease or any identifiable predisposing cause of arrhythmia. The prognosis of patients who have ventricular tachycardia without apparent structural heart disease is believed to be good (1,2), but occasional sudden cardiac deaths have been described (1,3).

Several types of idiopathic ventricular tachycardia have been reported (4–9), and their clinical and electrophysiologic characteristics are quite different. Thus, it is possible that the prognosis might also vary according to the type of idiopathic ventricular tachycardia. During the past 15 years, we have identified a group of patients with idiopathic ventricular tachycardia originating from the left ventricle that is sensitive to verapamil (6), but the long-term prognosis of this particular group of patients has been unclear. Thus, the purpose of this study was to determine the long-term outcome of verapamil-sensitive sustained left ventricular tachycardia in patients without apparent structural heart disease.

Methods

Patients. The study included 37 patients (27 male, 10 female; mean age 33 years, range 12 to 68) seen at the National Cardiovascular Center between January 1979 and April 1992 who met the following inclusion criteria: 1) electrocardiographically documented recurrent sustained monomorphic ventricular tachycardia originating from the left ventricle; 2) no apparent structural heart disease; and 3) repeated termination of ventricular tachycardia by verapamil (Fig. 1).

Ventricular tachycardia was diagnosed using standard electrocardiographic (ECG) criteria and confirmed from His bundle electrograms. The origin of ventricular tachycardia was determined by identifying the earliest ventricular activation site during ventricular tachycardia or by pace mapping during sinus rhythm. The presence of sustained ventricular tachycar-

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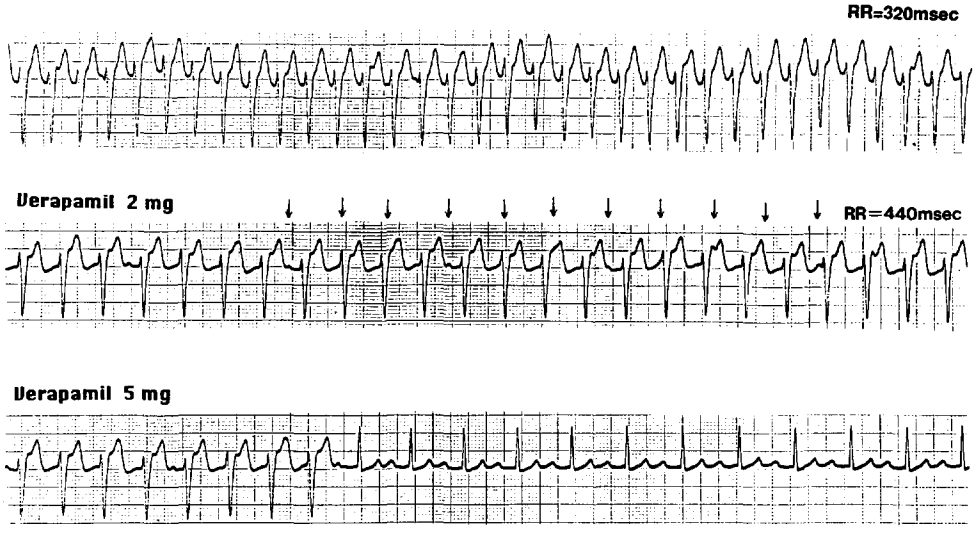

Figure 1. Electrocardiograms showing ventricular tachycardia. **Top,** Before administration of verapamil. **Middle,** After 2 mg of intravenous verapamil. Note that the ventricular tachycardia rate is slowed and that atrioventricular dissociation is now apparent (**arrows** indicate atrial activity). **Bottom,** After 5 mg of intravenous verapamil has terminated the ventricular tachycardia.

dia was confirmed by ECG monitoring, and spontaneous termination was not recognized in any of the patients.

The absence of organic heart disease was diagnosed on the basis of 1) normal findings on cardiac examination; 2) normal findings on the rest ECG and chest X-ray film; 3) lack of any significant ST depression or ST elevation during or after a submaximal treadmill exercise test; and 4) normal findings on the echocardiogram and radionuclide angiogram. The absence of organic heart disease was further confirmed by normal findings on coronary angiography, left ventriculography and right ventriculography in 17 patients.

Severity of ventricular tachycardia was classified according to the extent to which symptoms limited daily activities: mild (minimal limitation), moderate (some limitation) and severe (severe limitation).

Antiarrhythmic therapy was initiated empirically in patients with moderate or severe ventricular tachycardia. Patients were followed up for 1 to 13 years (mean 5.8) from hospital discharge to time of death or the last day of the study. The response of ventricular tachycardia to drug therapy was evaluated during the follow-up period, and the efficacy of nonpharmacologic intervention was also studied.

Statistics. The survival curve was obtained using the Kaplan-Meier method.

Results

Table 1 shows the clinical profile and follow-up data of all study patients. The age at onset of ventricular tachycardia was 10 to 19 years in 14 patients, 20 to 29 years in 11, 30 to 39 in 3, 40 to 49 years in 6, 50 to 59 years in 1 and >60 years in 2.

The QRS configuration during ventricular tachycardia was right bundle branch block with left-axis deviation in 33 patients (Fig. 2A), and their ventricular tachycardia originated from the inferior and inferoseptal regions of the left ventricle. The QRS configuration during ventricular tachycardia was right bundle branch block with right-axis deviation in the other four patients (Fig. 2B), and the origin of their ventricular tachycardia was the superior and superoseptal region of the left ventricle.

Fourteen patients were classified as having mild, 17 had moderate and the remaining 6 had severe ventricular tachycardia. The 14 patients with mild ventricular tachycardia were followed up without any drug therapy. In all 14 patients, ventricular tachycardia remained mild, or symptomatic ventricular tachycardia ceased during the follow-up period. Antiarrhythmic therapy was initiated empirically in the patients with moderate and severe ventricular tachycardia. Verapamil (160 to 320 mg/day) was given to 20 patients either alone or in combination with other drugs (procainamide [1.5 to 2.0 g/day] in 3, propranolol [40 to 120 mg/day] in 2 and digoxin [0.25 mg/day] in 1). Propranolol (40 to 120 mg/day) administration alone was initiated in two patients and digoxin alone in one. In both patients taking digoxin, the effectiveness of this drug was confirmed by an electrical stimulation test that showed that ventricular tachycardia became noninducible during digoxin therapy. Of the 23 patients in whom antiarrhythmic drugs were initiated, 6 became free of symptomatic ventricular tachycardia, and ventricular tachycardia became mild in another 11. However, all six patients with severe ventricular tachycardia continued to have ventricular tachycardia episodes that severely limited their daily activities despite various drug regimens.

Accordingly, patients with severe ventricular tachycardia had nonpharmacologic therapy. Cryoablation was performed in one patient (Patient 31) and catheter ablation in four patients (Patients 22, 25, 32 and 36); an antitachycardia device was implanted in one patient (Patient 8). Three patients with catheter ablation (Patients 25, 32 and 36) and one with cryoablation (Patient 31) became free of symptomatic ventricular tachycardia after these procedures. One patient with catheter ablation (Patient 22) had recurrent ventricular tachycardia that was controlled by verapamil therapy. The patient with the implanted antitachycardia device died suddenly at home on the day of discharge from hospital. Actuarial survival

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Table 1. Clinical Characteristics and Follow-Up Data for 37 Study Patients

Pt No./ Gender	Age (yr)	Age at Onset of VT (yr)	QRS Axis During VT	Symptoms Before Therapy	Pharmacologic Therapy	Symptoms After Therapy	Other Therapy	Follow-Up Duration (yr)	Outcome
1/M	30	17	L	Moderate	Ver	Mild	—	5.0	Alive
2/F	38	11	L	Moderate	Prop	Mild	—	13.3	Alive
3/M	45	41	L	Moderate	Ver	Mild	—	11.0	Alive
4/M	41	29	L	Moderate	Ver	Mild	—	10.8	Alive
5/M	22	13	L	Moderate	Ver	Mild	—	10.5	Alive
6/F	25	23	L	Mild	None	Mild	—	10.3	Alive
7/F	23	11	L	Mild	None	Mild	—	9.5	Alive
8/M	12	12	L	Severe	Ver, PA	Severe	Antitachy	3.7	Dead
9/M	41	41	L	Mild	None	Mild	—	9.8	Alive
10/F	36	36	L	Moderate	Ver, PA	0	—	8.6	Alive
11/M	25	12	L	Moderate	Ver	0	—	7.3	Alive
12/F	31	27	L	Moderate	Ver	Mild	—	8.3	Alive
13/F	12	14	L	Moderate	Ver	Mild	—	7.2	Alive
14/M	30	28	L	Moderate	Ver	Mild	—	5.8	Alive
15/F	19	13	L	Mild	None	Mild	—	6.8	Alive
16/M	63	48	L	Mild	None	0	—	6.8	Alive
17/M	22	16	L	Moderate	Dig	0	—	5.4	Alive
18/F	68	65	L	Moderate	Ver	0	—	5.4	Alive
19/M	40	40	L	Mild	None	0	—	5.8	Alive
20/M	33	30	L	Mild	None	0	—	5.4	Alive
21/M	29	29	L	Mild	None	0	—	8.3	Alive
22/M	19	19	L	Severe	Ver	Severe	CA	4.0	Alive
23/M	37	29	L	Mild	None	0	—	3.4	Alive
24/M	31	15	L	Moderate	Ver	Mild	—	3.1	Alive
25/F	20	16	L	Severe	Ver	Severe	CA	2.3	Alive
26/M	42	42	L	Mild	None	Mild	—	3.0	Alive
27/M	29	25	L	Mild	None	Mild	—	2.7	Alive
28/M	64	63	L	Moderate	Ver, PA	0	—	2.2	Alive
29/M	16	16	L	Moderate	Ver	Mild	—	1.7	Alive
30/M	53	45	L	Mild	None	Mild	—	1.8	Alive
31/M	49	39	L	Severe	Ver, Prop	Severe	Operation	10.0	Alive
32/M	26	23	L	Severe	Ver	Severe	CA	1.5	Alive
33/M	28	26	L	Mild	None	0	—	1.1	Alive
34/M	21	20	R	Mild	None	0	—	8.3	Alive
35/M	51	51	L	Moderate	Ver, Dig	0	—	0.5	Alive
36/M	18	16	L	Severe	Ver, Prop	Severe	CA	4.9	Alive
37/F	30	26	R	Moderate	Prop	Mild	—	0.7	Alive

Antitachy = antitachycardia pacing device; CA = catheter ablation; Dig = digoxin; F = female; L = left-axis deviation; M = male; PA = procainamide; Prop = propranolol; Pt = patient; R = right-axis deviation; Ver = verapamil; VT = ventricular tachycardia; 0 = free of symptomatic ventricular tachycardia; — = nil.

is shown in Figure 3. All patients remained alive, except for the one with the antitachycardia device.

Discussion

Effect of oral verapamil. Oral verapamil alone or in combination with other drugs was effective in alleviating the symptoms of most of our patients with moderate ventricular tachycardia. However, the patients with severe ventricular tachycardia were not helped by verapamil administration, and all eventually required nonpharmacologic treatment. The discrepancy between the effectiveness of intravenous and oral verapamil in the patients with severe ventricular tachycardia was probably related to differences in the drug concentration achieved through each route. The two patients who responded to digoxin were worthy of note. They were initially misdiagnosed as having supraventricular tachycardia and were thus given digoxin, but this drug was actually able to prevent the initiation of ventricular tachycardia by ventricular stimulation in both patients.

Nonpharmacologic treatment. There has been increasing interest in the nonpharmacologic treatment of tachyarrhythmias, including antitachycardia pacing, implantable automatic cardioverter-defibrillators and ablative techniques, such as catheter ablation or map-guided cryosurgery. In patients with recurrent sustained ventricular tachycardia who do not respond to antiarrhythmic therapy, surgical intervention also offers a reasonable alternative because the introduction of intraoperative mapping to localize the site of origin of ventricular tachycardia has improved the results. In our series, one

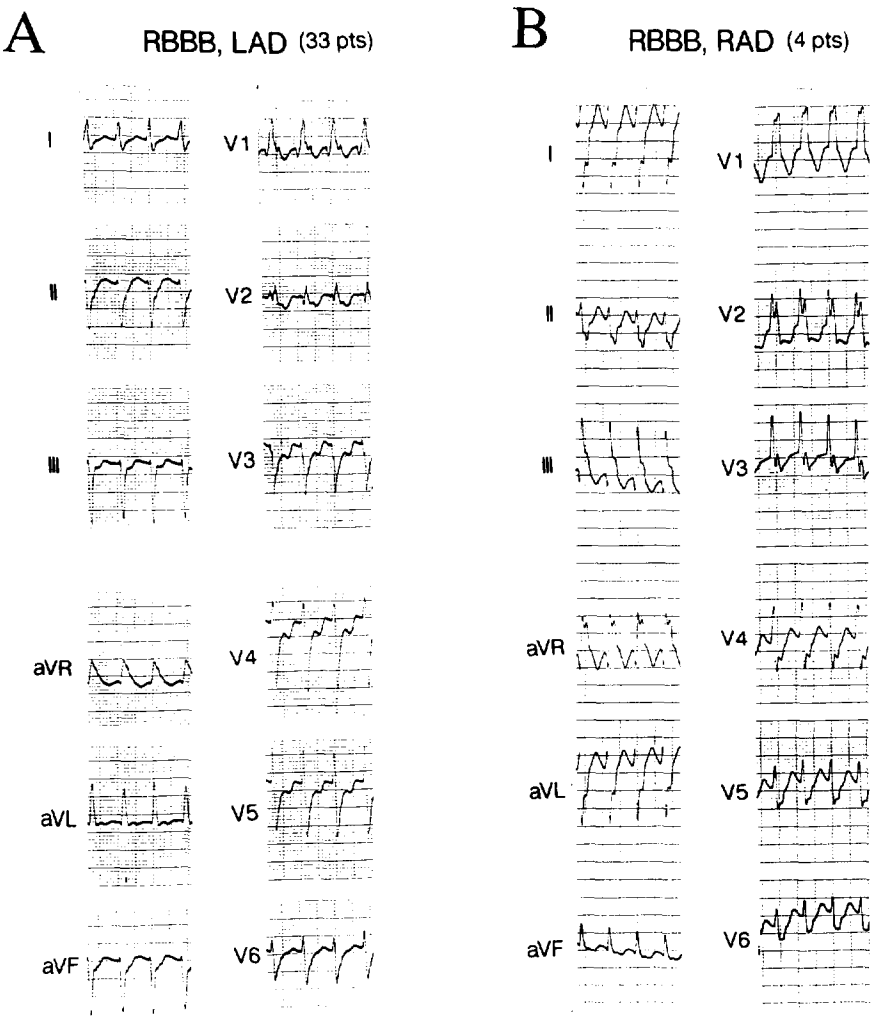
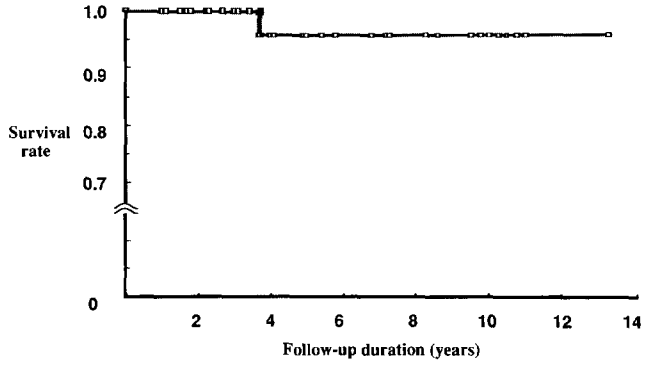


Figure 2. Electrocardiograms of ventricular tachycardia originating from the midapical inferior (**A**) and superior (**B**) left ventricle. **A,** Right bundle branch block (RBBB) and left-axis deviation (LAD). **B,** Right bundle branch block and right-axis deviation (RAD). pts = patients.

patient underwent cryosurgery, and the site for ablation was determined by activation mapping during ventricular tachycardia. The patient has subsequently remained free of symptomatic ventricular tachycardia without antiarrhythmic drugs for 10 years.

Electrical catheter ablation is a relatively new method for the treatment of ventricular tachycardia. Unfortunately, the success rate of catheter ablation is not high in patients with ventricular tachycardia (10). However, promising results have been achieved when catheter ablation is used to treat idiopathic right (11) or idiopathic left (12) ventricular tachycardia. The optimal site for ablation was determined by pace mapping or by Purkinje potential recording during ventricular tachycardia in patients with idiopathic left ventricular tachycardia. In the present series, direct current catheter ablation was performed at the site determined by pace mapping during sinus rhythm. Three of the patients remained free of ventricular tachycardia, and one developed recurrence of the arrhythmia, which was controlled by verapamil.

Figure 3. Actual survival rate for all 37 patients (Kaplan-Meier method). One patient died during follow-up.



Most ventricular tachycardia can be terminated by pacing. However, antitachycardia pacing in ventricular tachycardia incurs the risk of inducing ventricular fibrillation (13). In this regard, the patient (Patient 8) unfortunately had an antitachycardia device implanted without a backup defibrillator while he was away from Osaka.

Long-term prognosis. The present study confirmed previous findings (1,2) that idiopathic ventricular tachycardia has an excellent prognosis, suggesting that patients with verapamil-sensitive sustained left ventricular tachycardia probably should

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be treated on a symptomatic basis. The patients with mild ventricular tachycardia remained mildly symptomatic without any therapy during follow-up. In contrast, the patients with severe ventricular tachycardia remained severely symptomatic despite verapamil therapy and required nonpharmacologic intervention. The patients with moderate ventricular tachycardia were likely to respond to verapamil, and such patients should be considered for oral verapamil therapy. However, radiofrequency ablation might become an alternative therapy for patients with moderate ventricular tachycardia because many patients prefer definite cure of their arrhythmia rather than long-term antiarrhythmic therapy.

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