Ventricular Late Potentials in Patients with Systemic Sclerosis without Overt Cardiac Disease

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The myocardial fibrosis which is present in patients with systemic sclerosis (SSc) is associated with perturbations of cardiac rhythm and conduction system or ischemic alterations. Ventricular late potentials (VLP) are low-amplitude high-frequency signals occurring in the terminal part of the ORS complex, corresponding to a delayed and fragmented ventricular activation. They are concealed in the conventional surface electrocardiography because of the low amplitude of the signal and overlay of noise, but they can be visualized on the surface by means of high-resolution and signal-averaged electrocardiography (SAECG). The study was designed to estimate the occurrence of VLP in SSc patients without overt cardiac disease as compared to healthy controls. Eighteen SSc patients and 16 healthy individuals were examined. The time domain of high-resolution signal-averaged electrocardiography was recorded. Quantitative analysis of the filtered ORS complex included: the total filtered ORS duration (U-ORS), the root-mean square voltage of the terminal 40 ms of the filtered ORS complec (RMS40), the duration of low voltage oscillation remaining below 40 uV of the ORS complex (LAS40). The obtained results are as follows: U-ORS: 108.389 and 105.625 ms; RMS40: 61.929 and 72.793 uV; LAS40: 26.889 and 25.063 ms in SSc patients and controls, respectively. The VLP were found in 1/16 healthy subjects and in 2/18 SSc patients. Thus, the incidence of VLP in SSc patients was only slightly higher than in the controls.

Key words: systemic sclerosis, ventricular late potentials, high-resolution signal-averaged ECG

INTRODUCTION

Systemic sclerosis (SSc) is a chronic progressive disease of the connective tissue associated with vascular changes and widespread fibrosis of the skin and internal organs (1, 2). Pathological changes of the heart muscle, including myocardial fibrosis, have been shown in 50–80% of SSc patients. Myocardial fibrosis is widespread throughout the both ventricles and is found in the entire thickness of the myocardium (3). Fibrotic changes impair stimuli transmission within the heart muscle. The fibrotic plaques can be responsible for generation of abnormal stimuli of high frequency (usually higher than 25 Hz) and low amplitude order of a few uV – the so-called ventricular late potentials (VLP). They occur at the end of ventricular depolarization and may overlap to the beginning of the ST segment. VLP are recorded from the body surface by high-resolution signal-averaged electrocardiography. The aim of the present study was to determine whether VLP occur in the group of SSc patients without overt cardiac disease and if the duration of SSc influences the frequency of VLP presence.

MATERIALS AND METHODS

Eighteen patients (2 men, 16 women) with definitive SSc, aged 42–72 years (mean, 54.0 ± 9.5 years) were investigated. The symptoms of the disease lasted from 1 to 20 years prior to the study. Patients with a significant heart failure (determined by M-mode, two-dimensional and doppler ultrasonography, and clinical examination), as well as with respiratory and/or renal insufficiency were excluded. Only patients with the sinus rhythm without ventricular conduction disturbances were included in the study. The control group consisted of 16 healthy individuals age- and sex-matched to the SSc patients. They had no signs or symptoms of heart disease; their electrocardiographic recording, ultrasonocardiographic finding and exercise test were normal. None of

the study patients had signs or symptoms of cardiac disease and hadn't undergone any cardiac treatment. High-resolution signal-averaged ECG (SAECG) was registered using a standard computer system. The recorded signals were presented in orthogonal leads which were amplified, averaged and combined into a vector magnitude – filtered ORS complex. Filter frequencies of 40 to 250 Hz were used (4–6). Analysis of the filtred ORS complex included: total filtered ORS duration (U-ORS), the root-mean square voltage of the terminal 40 ms of the filtered ORS (RMS40), and the duration of the low voltage oscillation remaining below 40 uV of the ORS complex (LAS40) (17). The onset and offset of ORS complex were determined by computer algorithm as the midpoint of a 5 ms segment, in which the average signal exceeded the noise level mean plus 3 standard deviations and could be verified visually (8–9).

Adequate criteria determining the existence of late potentials, using 40 Hz high-pass bidirectional filtering are: 1) the filtered ORS complex is greater than 114 ms, 2) there is less than 20 uV of the signal in the last 40 ms of the vector magnitude complex, and 3) the terminal vector magnitude complex remains below 40 uV for more than 38 ms. The existence of a least two of the above-mentioned criteria indicates the presence of VLP (10). Minimum 401 of the ORS complex were recorded. The time of registration was from 5 to 9 min, depending on the heart rate of the people undergoing this examination.

Statistical significance of the differences was determined with the Student's t test.

RESULTS AND DISCUSSION

The mean value of ejection fraction (EF) of the SSc patients was 50.2 SD ± 3.06, SEM 0.818 (minimum 44% and maximum 54%).

VLP were found in one patient of control group (1/16, *i.e.* 6.25%) and in two SSc patients (2/18, *i.e.* 11.11%). In two other patients an abnormal time of the averaged ORS complex, lasting more than 114 ms, was shown. The results are summarized in Table.

Table. **Comparison of quantitative SAECG parameters in SSc patients and healthy controls (mean ± SEM)**

	SSc patients (n = 18)	Healthy group (n = 16)	
U-ORS (ms)	108.389 ± 3.158	105.625 ± 1.897	NS
RMS40 (uV)	61.929 ± 7.540	72.793 ± 7.917	NS
LAS40 (ms)	26.889 ± 2.006	25.063 ± 2.015	NS

NS – not statistically significant.

VLP were present in patients with EF 51% and 52%.

In previous papers, it has been shown that SSc patients without overt cardiac manifestation are characterized by a high incidence of silent angina detectable by 24-hour electrocardiographic recording (11). The suggestion of concealed ventricular damage resulting in occurrence of VLP was not confirmed in the present study. The incidence of VLP was also lower than that reported by Paradiso et al. (12). They found VLP in about one-third of the SSc patients. These patients were in an advanced state of the disease and they had cardiac symptoms. Similar results were shown by Moser et al. (13). In the study of Pignone et al. (14) the incidence of VLP was 30.8% and 23.1% in relation to the filtration applied, *i.e.* 25 and 40 Hz, respectively. The incidence of VLP in healthy individuals was 7.7% irrespective of the filtration. In general, VLP are seldom reported in healthy subjects, and it is difficult to estimate their prognostic value (15–16).

The present study indicated that VLP were only slightly more common in SSc group than in the controls, and VLP may be considered as a sign of heart muscle damage in patients with SSc without overt cardiac disease, although VLP determination is not recommended as a routine procedure in SSc patients.

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S a n t r a u k a

Tirti 18 ligonių, sergančių sistemine skleroze, ir 16 sveikų asmenų, registruojant laiko domeną aukštos skiriamosios gebos vidutinio signalo elektrokardiografijos būdu. Gauti rezultatai parodė, kad ŠSVP sisteminės sklerozės ligoniams aptinkamas tik nežymiai dažniau, negu sveikiems asmenims.