Electrodiagnostic study of Sympathetic Skin Response on Normal Korean Subjects

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요 약

Sympathetic skin response (SSR) is defined as a minute change of skin potential after electrical stimulation. This test measures the change in voltage that originates from the surface of the skin and is attributed to sudomotor activity. The aim of this study was to define the criteria for validation of the responses. 40 normal subjects (20-73 years of age) with non-sympathetic dysfunction were tested and SSR was generated form all subjects. SSR latency was 1331.22±177.51ms in the right palm, 1331.74±156.42ms in the left palm, 1851.79±220.99ms in the right sole, and 1874.10±215.01ms in the left sole. And SSR amplitude was 595.83±221.16μV in the right palm, 605.33±226.45μV in the left palm, 291.76±133.36μV in the right sole, and 288.77±129.70μV in the left sole. SSR latency and amplitude had no significantly difference between the right and the left side. SSR latency was consistently shorter ($p<0.001$) and SSR amplitude higher ($p<0.001$) in feet than in hands. SSR waveforms were P-type (32 subjects, 75%) and N-type (8 subjects, 25%), respectively. The SSR latency and amplitude in palms/soles were closely correlated with age ($p<0.05$) and height ($p<0.05$). The SSR test is one of methods assessing impairment of sympathetic fibers in peripheral neuropathy as well as a disorder of sympathetic system in other diseases and so our results from normal healthy subjects can be used as clinical criteria for SSR test.

1. Introduction

Sympathetic skin response (SSR) is defined as a minute change of skin potential after electrical stimulation by a electromyography. and can be measured the change in voltage originated from the surface of the skin [1].

SSR can be generated from skin potential changes by various internal and external alerting stimuli like as an algesia, a cough, a deep breathing, and an emotional change etc. [2]. SSR using surface electrodes is very simple and a useful electrophysiological test [3, 4]. So far, we have been used the criteria of overseas [5] because there was no SSR diagnostic criteria for normal korean.

So in order to offer a useful SSR diagnostic criteria for korean, we have studied on specific characters of SSR latency and amplitude from normal korean adults.

2. Materials and Methods

We have selected 40 healthy volunteers (male 20, female 20) who were working at a general hospital in Gyeonggi province and had no a sympathetic dysfunction and symptom, a sensory disorder, and a muscular strength weakening in neurological tests from April to October in 2008 years. The average age and height of subjects

were 44.1±15.6 age (20-73 years of age) and 165±7.8 cm, respectively. To estimate whether the symptom of the autonomic nervous system is existence or not, we performed a neurological test and then excluded the subjects who had the symptom of the autonomic nervous system in a medical examination from this study.

EMG was recorded with two channels. SSR waveforms were recorded after electrical stimuli were given to the right median nerve and to the right posterior tibial nerve, respectively.

SSR onset latency (ms) was calculated from the time between the muscle activity and the first deflection (usually negative) appeared by electrical stimulation, and SSR amplitude (uV) was estimated by potential differences between the base line and the peak of the first deflection. SSR test was carried out in the upper limbs at first and next, the lower limbs.

SSR was recorded by the electromyograph (EMG system D182), 6200A Sierra (Cadwell Inc. USA) and measuring values were fixed up as Table 1. Data from our study were analyzed by SPSS 10.0 program.

[Table 1] Set up of the equipment for SSR test

Setting Items	Stimulating conditions
Stimulating intensity	30 mA
Stimulating duration	0.1ms
Frequency filter	0.1-1000Hz
Amplification sensitivity	5000μV/division
Sweep speed	750ms/division
Recording electrodes	disposable surface electrode

3. Results

SSR was obtained in 40 normal healthy korean (Table 2). In these results, there were no differences in the SSR latency and amplitude between right and left limbs, but the SSR latency and amplitude were significantly more shorter ($P<0.001$) and higher ($P<0.001$) in the palm than in the plantar, respectively.

The positive (P) type waveform of SSR was appeared in 32 cases (75%) and negative (N) type in 8 cases (25%).

In the correlation coefficient between age and the SSR amplitude and latency in both limbs, the SSR latency with increasing age was prolonged and have a statistical correlation at both soles in lower limbs, and SSR amplitude with increasing age was declined and have a statistical correlation (Table 3). And also the SSR latency with increasing height was prolonged and have a statistical correlation at both soles in lower limbs, and SSR amplitude with increasing height was increased and have a statistical correlation at both soles in lower limbs (Table 4).

[Table 2] SSR Latency and amplitude

	Latency (ms)	Amplitude (μV)
Rt. palm	1331.22±177.51	595.83±221.16
Lt. palm	1331.74±156.42	605.33±226.45
Rt. sole	1851.79±220.99	291.76±133.36
Lt. sole	1874.10±215.01	288.77±129.70

Values are mean±SD

[Table 3] Pearson correlation coefficient between age and the SSR latency and amplitude

	Latency	Amplitude
Rt.. palm	0.146	-0.448**
Lt.. palm	0.300	-0.368*
Rt. plantar	0.417**	-0.564**
Lt. plantar	0.404**	-0.532**

Values are correlation coefficient

[Table 4] Pearson correlation coefficient between height and SSR latency and amplitude

	Latency	Amplitude
Rt. palm	0.150	0.176
Lt. palm	0.022	0.209
Rt. plantar	0.451**	0.448**
Lt. plantar	0.402**	0.416**

The same as above.

4. Discussion

SSR can be evoked by potential difference between two skin surfaces after the automatic nerve system makes a sweat gland be activated

by various stimuli. [6]. Many researchers have been used only SSR amplitude as a significant mark but not SSR latency in spite of the habituation of SSR amplitude [3]. But SSR amplitude was affected by various factors, SSR latency was not affected by the tense and stimulus types, and SSR latency values were affected by the efferent nerve were changed consistently according to recording positions [7, 8].

In our study, the SSR latency and amplitude had no significantly difference between right and left sides. SSR latency was consistently shorter ($p<0.001$) and SSR amplitude higher ($p<0.001$) in foot than in hand. These our results were agreed with the report that the SSR latency and amplitude at limbs had no difference between right and sides [8]. And with increasing age, the SSR latency and amplitude at both soles were prolonged and declined, respectively, and had a statistical correlation. These our results were very similar with the reports that SSR amplitude with increasing age was decreased [9] and SSR latency with advancing age was prolonged [10]. So we thought that the prolonged latency and the declined amplitude with increasing age were due to the degenerative changes of the peripheral and the central nervous systems caused by aging. And also with increasing height, the SSR latency and amplitude at both soles were prolonged and increased, respectively and had a statistical correlation. These our results were very similar with the reports that SSR latency with increasing height was prolonged in a correlation between height and SSR [7].

On the other hand, SSR according to a polarity was classified two types, positive (P) and negative (N) type. In our study, positive (P) type from 40 normal healthy subjects was 32 (75%) more than negative(N) type 8 (25%). these our results correspond with the reports that P-type (84%) was more than N-type (26%) in 32 normal subjects [11].

Shahini et al [3] suggested that SSR could be used as a useful mark to make an diagnosis of diseases injuring an unmyelinated axon. In patients with a stroke, SSR latency was prolonged [12] and in patients with multiple sclerosis, the abnormal diagnostic rate (94.2%) was higher in the SSR test than in other evoked potential tests [7].

Therefore, we expect that our results on the characteristics of the SSR amplitude and latency in normal healthy korean can be used widely as a clinical criteria for SSR test.

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