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Original Article

The Role of Sympathetic Skin Response in Assessing Autonomic Function in Normal Adults

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ABSTRACT

Background: Sympathetic Skin Response (SSR) is a simple, non-invasive and reproducible test to assess the impairment of the sympathetic fibers of the peripheral nerves. It measures the change in electrical skin potential to a variety of stimuli. The objective of this study was to assess SSR in a sample of normal healthy adults. **Method:** 25 normal healthy adults who volunteered to participate were assessed for SSR in their foot and hand. SSR was assessed using Neurowerk EMG/NCV equipment capable of assessing SSR. Electrical current was used on the median nerve at the wrist to elicit SSR. **Results:** SSR was elicited in all 25 participants. The mean SSR latency and SSR Amplitude for the hand were 1.2 (+/- 0.42) secs and 2503 (+/- 1424) micro Volt respectively. The mean SSR Latency and SSR Amplitude for the foot were 1.8 (+/- 0.44) secs and 1749 (+/- 1252) micro Volts respectively. It was observed that there was no significant difference in the SSR values when compared between male and female participants, so gender had no effect on SSR values. There was no association of SSR values with the BMI of the participants. Characteristics of the SSR curves were discussed. **Conclusion:** Mean values of SSR latency measured at hand and foot are 1.2 (+/- 0.42) secs and 1.8 (+/- 0.44) secs respectively. Mean values of SSR amplitude measured at hand and foot are 2503 (+/- 1424) micro Volts and 1749 (+/- 1252) micro Volts respectively. Gender had no effect on SSR values in this study.

Keywords: Sympathetic Skin Response, Autonomic Function, Healthy Adults, Electrical Current

Introduction

The autonomic nervous system (ANS) is a very complex group of nerves (nerve structures) with specific effects on each organ and system. Therefore, the assessment of the ANS is a very difficult task. Sympathetic Skin Response (SSR) is a test that assesses the impairment of the sympathetic fibers of the peripheral nerves. The SSR test is a simple, noninvasive, and reproducible technique for assessing this impairment. SSR is a measure of the change in electrical skin potential in response to a variety of stimuli. SSR was first introduced by Sahani, et al. (1) in 1984 and later explored by Knezeric and Bajada (2)(2). SSR is a polysynaptic reflex with distinct afferents, a common efferent pathway through the spinal cord, pre- and postganglionic sympathetic fibers, and sweat glands as effectors (3). In this study, we attempted to assess SSR in a group of normal healthy subjects at a tertiary care referral center. The primary aim of this study was to evaluate SSR and describe its properties in the sample of normal healthy adults.

Methodology

After receiving Institutional Ethics Committee approval, 25 healthy subjects who volunteered for this study were enrolled. Normal healthy adults between the ages of 16 and 60 years of both sexes were considered as study participants. However, participants with a history of surgery, who were pregnant, had a diagnosis of neuromusculoskeletal and cardiorespiratory disease, and were receiving medication for injury or disease were excluded from this study.

NEUROWERK EMG/NCV devices manufactured by SIGMA Medizin-Technik GmbH, Germany (Fig. 1) were used to assess SSR in this study. SSR was assessed with participants lying supine on a couch in a room maintained at a temperature of 25°C. SSR was assessed by placing disposable surface EMG electrodes on the palm and dorsum of the hand, and the sole and dorsum of the foot. Recordings were obtained with a filter setting comprising a bandpass of 0.5-1000 hertz, a sensitivity of 0.2-0.5 millivolts per division, and a sweep speed of 1 second per division. The stimulus was a short electrical pulse (0.2-millis duration and 15-milliampere intensity) delivered to the median nerve at the right wrist every 60 seconds or longer to avoid habituation. The skin temperature at the test site was 32°C or higher. The test was considered abnormal if no response was detected after at least 10 stimulations. The hand and foot recordings were made sequentially with an interval of 10 minutes between recordings. A well-defined response was selected from 5 consecutive responses and the peak-to-peak amplitude was measured. Abnormal SSR was considered when there was no response or the amplitude was less than 2 SD of the normal mean of Kim, et al. (4).

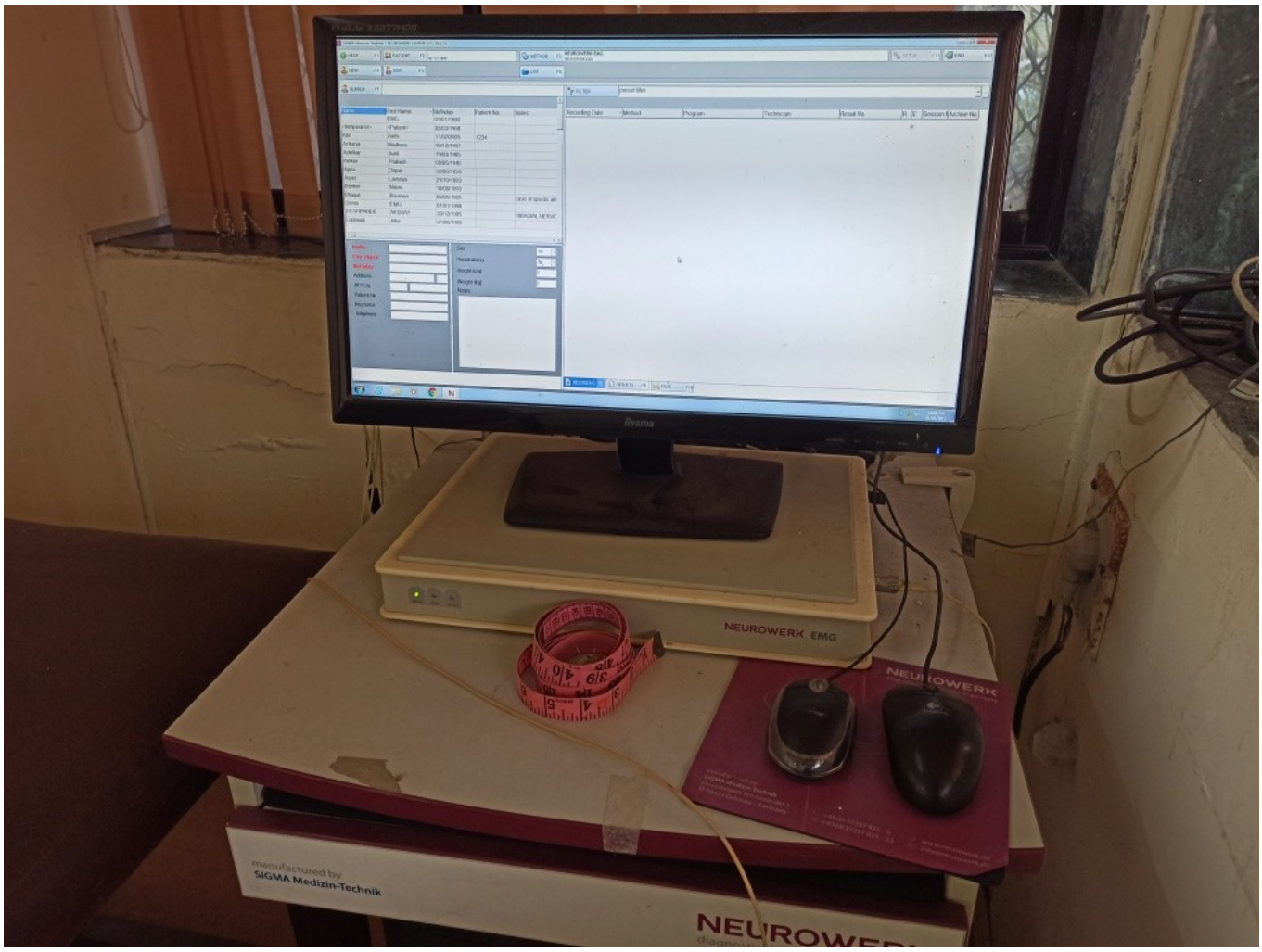

Figure 1. *Instrumentation of the EMG/NCV Equipment used to assess SSR*

25 normal healthy adults who volunteered to participate in this study and met the inclusion and exclusion criteria were considered for this study. All participants were assessed for Sympathetic Skin Response (SSR) using Neurowerk EMG/NCV devices capable of recording SSR. The method used to study SSR was based on standard guidelines based on the method of Shahani, et al. (1) Silver surface electrodes were used actively in palm and sole, reference in dorsum of hand and foot. The response was processed using Neurowerk EMG/NCV devices capable of generating SSR sets with a time base of 500-1000 millis/div, a sensitivity of 500 microV/div and a filter band range of 0.1-2 record Hz. SSR was recorded first in hand and then in the foot with a 10-minute interval between the 2 tests. SSR latency in seconds and SSR amplitude in microvolts (Fig. 2).

Figure 2. *Assessment of SSR*

Statistical analysis

Data were tested for normality using the Shapiro-Wilk test. All data passed the normality test. Mean and standard deviations were used for descriptive statistics. The t-test was used to test the significance between male and female participants' SSR scores. Pearson's correlation coefficient was used to correlate the SSR values with the BMI of the sample.

Results

The average age of the participants was 30±6.58 years. The included sample consists of 13 male and 12 female participants. SSR was triggered in all 25 participants. From Table 1, it can be seen that the mean SSR latency and SSR amplitude for the hand were 1.2±0.42 seconds and 2503±1424 microvolts, respectively. The mean SSR latency and SSR amplitude for the foot were 1.8±0.44 seconds and 1749 microvolts, respectively. The shape of the SSR curve obtained was triphasic in hand and biphasic in the foot (Fig. 3). When comparing the SSR scores between male and female participants, it was found that there was no statistical significance (Table 2). In addition, SSR scores were also not associated with BMI (Table 3).

Table 1. *Latency and Amplitude of SSR assessed in Hand and Foot (mean±SD).*

Parameter	N=25
SSRH latency (sec)	1.2±0.42
SSRH amplitude(microvolts)	2503±1424
SSRF latency (sec)	1.8±0.44
SSRF amplitude(microvolts)	1749±1252

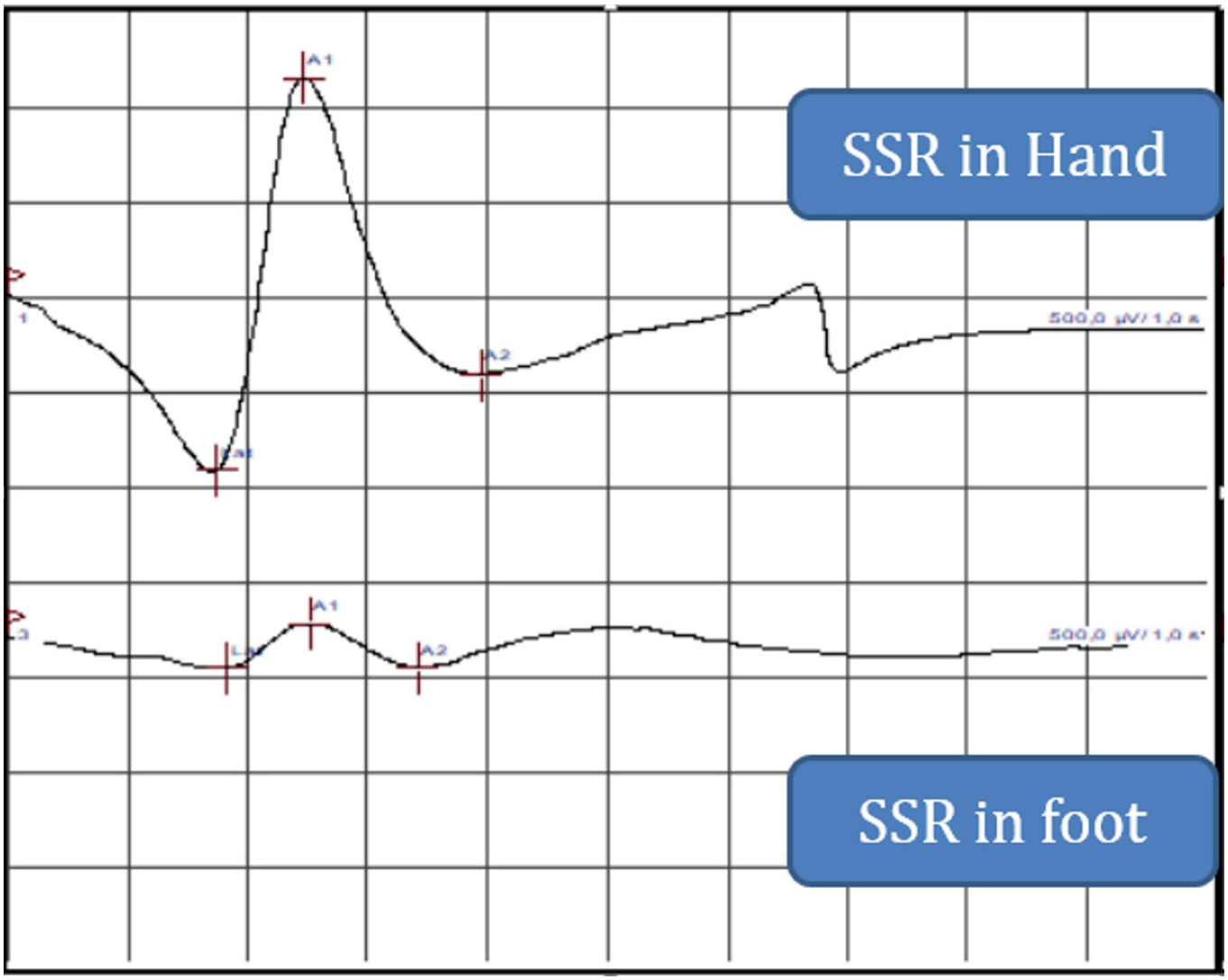

Figure 3. *Sympathetic skin response from hand and foot*

Table 2. *Comparison of Latency and Amplitude of SSR assessed in Hand and Foot between Male and Female subjects. (Mean±SD).*

Particulars	Male	Female	P Value	Significance
SSRH latency (Secs)	1.208±0.4092	1.13±0.447	0.6352	NS
SSRH amp (microvolts)	2219±1110	2810±1698	0.32	NS
SSRF latency (Secs)	1.854±0.2817	1.73±0.568	0.5165	NS
SSRF amp (microvolts)	1404±1153	2123±1295	0.158	NS

Table 3. *Correlation between Mean and SD of Latency and Amplitude of SSR assessed in Hand and Foot with BMI of the participants.*

Particulars	Mean (SD)	BMI Mean (SD)	r Value	Significance
SSRH Latency (in Secs)	1.2±0.42	25±3.2	0.2592	NS
SSRH Amp (in microvolts)	2503±1424		0.0323	NS
SSRF Latency (in Secs)	1.8±0.44		0.0038	NS
SSRF Amp (in microvolts)	1749±1252		0.0353	NS

Discussion

The primary aim of this study was to assess the SSR in a sample of normal healthy adults and to describe the obtained properties of the SSR. From the results of this study, it can be seen that the SSR assessment method was successful in all 25 participants to elicit the SSR. Electrical stimulation also seems to be a simple and good method to trigger SSR. Similar methods have been used by different authors to induce SSR (8). The shape of the SSR curve obtained was biphasic in the foot and triphasic in hand, which is supported by various studies from the literature (9-11). From the results of this study, it can be observed that the mean SSR values obtained from hand and foot were similar to those found in the literature. (12, 13) The latency obtained from hand was shorter that obtained from foot. The amplitude obtained from the hand was significantly higher than that from the foot. The electrical stimulation-elicited response (SSR) had to travel a longer distance to reach the pick-up electrode in the foot than in the hand. This explains the difference in the amplitude of the SSR. Similar observations were found by Aramaki, et al. (13) and Drory, et al.(14). In addition, the analysis revealed that SSR latency and amplitude were not associated with subjects' BMI. This result was supported by Dag, et al (15). The SSR values also behaved similarly in male and female participants in this study.

Conclusion

From the results of the study, it can be concluded that the method used in this study is successful in eliciting SSR. The mean SSR latency of hand and foot were 1.2 (+/− 0.42) secs and 1.8 (+/− 0.44) secs, respectively and the mean SSR amplitude of hand and foot were 2503 (+/− 1424) micro volts and 1749 (+/− 1252) micro volts, respectively. Gender had no effect on SSR values assessed in this sample. Also, SSR is not associated with BMI of the participants.

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Conflict of interest

The authors claim no conflict of interest

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