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A Study of Sympathetic Skin Response in Burns with Different Mechanisms

Setareh Satari[1], Sharareh Roshanzamir[2*]

[1] Shiraz University of Medical Sciences, International branch, Shiraz, Iran

[2] Department of Physical Medicine and Rehabilitation, International Branch, Shiraz University of Medical Sciences, Shiraz, Iran

*Correspondence should be addressed to Sharareh Roshanzamir, Department of Physical Medicine and Rehabilitation, International Branch, Shiraz University of Medical Sciences, Shiraz, Iran; Tel: +989131288837; Fax: +987132319040; Email: sharareh.roshanzamir@gmail.com.

ABSTRACT

Sensory, motor, and autonomic neuropathies have been reported after electrical injuries. In addition subclinical involvement of the sympathetic nervous system during post injury and late clinical manifestations of this involvement have been pointed out in some studies. The present study was done to explore how the clinical and electro-diagnostic manifestations of sympathetic involvement would change over time in burn victims. About 164 patients with electrical, chemical and thermal burn injuries were explored for sympathetic skin response (SSR) and monitoring of automatic system derangement symptoms. The wave amplitude of the sympathetic response of the patients with chemical electrical and thermal burn is reduced, compared with the control group and it is not significant (P>0.05). The latency value of the SSR wave of the patients with the three types of burn injuries indicates that the SSR wave height is reduced and the reduction has been significant compared with the control group (P<0.05). And there was a significant different between the group with chemical burn injuries and the groups with thermal and electrical burn injuries in terms of latency value. There was no significant relationship between SSR latency and overall body surface burn. There was no significant relationship between SSR amplitude and the total overall body surface burn (P>0.05). SSR intensity can be used as a predictive test for the automatic system derangement symptoms that occur after burn injury.

Key words: Electrical Burn Injury, Thermal Burn Injury, Sympathetic Skin Response (SSR)

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1. INTRODUCTION

In the burn center of Shiraz city in the southern Iran, burn injuries are the cause of 4.8 of the visits (1-6). The neurological and psychological symptoms are suggested to be the most common consequences of burns. In a study it was found that neurological symptoms appear after burns (7-10). Compressed peripheral neuropathy is one of the systemic effects of burn injuries. Electrophysiological studies have found peripheral neuropathy after burns. Some believe that this is due to the change in the burn type (11). Recording sympathetic skin response (SSR) is a simple and useful way for exploring a part of peripheral nervous system (small fibers without myelin) that cannot be evaluated using common electro diagnostic techniques. SSR is defined as momentary changes in the electrical skin potential that is created due to internal or external stimulations such as deep inhalation, painful stimulations and electrical stimulations of the peripheral nerves (12). In addition to sensory and motor nervous system, some studies points out the symptoms of the autonomic system involved in electrical burns. Previous studies showed the production of the involved sensory and motor neurons as the burn systemic reaction (3, 13-15). The aim of this study is exploring the sympathetic skin response in burns with different mechanism. However, the involvement of motor nervous system has been shown in another study (16). The study indicated the involvement of the sympathetic nervous system in different burns to be different (17). The questions that were raised are, how the electro, chemical and thermal diagnostic features of autonomic derangement would change with time and how it might be related to clinical manifestations of this derangement. The present study was designed in response to such concerns.

2. MATERIALS AND METHODS

2.1. The patients in the study

This study was done in a cross-sectional way on 59 patients with electrical burn injuries, 72 individuals with thermal burn injuries and 33 individuals with chemical

burn injuries visiting (Ghotb Edin) Burn Center of Shiraz. The samples were selected from those visiting Gotb Edin Burn Center of Shiraz in 2011. The sampling method was objective-based convenience sampling. The patients were receiving, Pregabalin and Nortriptyline for pain relief. The participation diagram for the patients in this study is presented in Figure 1. As shown in Figure 1, out of 240 individuals that entered the study, 39 individuals were excluded from the study, 21 individuals did not have the necessary criteria, 8 individuals did not agree to participate and 172 individuals remained. Out of the 172 remaining individuals, 5 individuals canceled their participation and 3 individuals were excluded from the study due to consumption of drugs that affect the nervous system and finally, 164 individuals remained in the study .inclusion criteria consisted of burns as result of each of these three mechanisms namely electrical, chemical or thermal and time passed after burns between two to twelve months. Exclusion criteria were positive history of central or peripheral neuropathy, diabetes mellitus or drugs affecting autonomic nervous system, also presence of any dressing, wound or scar that caused mechanical problem assessing SSR and patients with electro-diagnostic peripheral neuropathy.

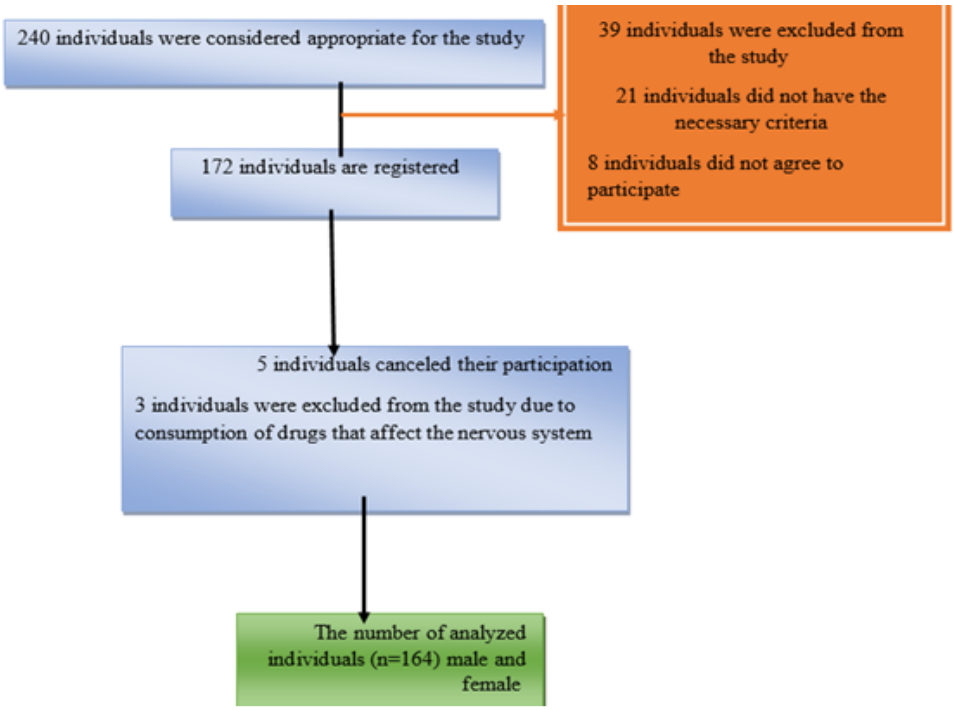

Figure 1. The flow chart of the number of patients in the study

2.2. SSR testing method

In order to do SSR test on patients, the patients were made to lie down on back on a bed in a room with a temperature between 24 to 32◦C and they were allowed to rest for at least 10 minutes. SSR test was done in a low light and quiet place. Explanations were given to the patients about the process before the test. Then, the active electrode was placed in the palm between the second and the third fingers, the reference electrode was placed on the hand's finger and the ground electrode was placed on the wrist. Stimulation was done in 3 cm from wrists distal line between the tendons of palmaris longus muscle and flexor carpi radialis muscle. 10 stimulations with at least 30-second intervals were applied and the time delay mean and the magnitude of rum placed of these values were recorded. Then, the recorded values, the delay time and the wave amplitude were considered for investigation. Electromyograph was used for recording SSR wave. Circular surface electrodes and gel were used.

2.3. Data analysis method

The collected data were analyzed using the software SPSS version 19. Student's t-test and ANOVA was employed for comparison of the data mean. The data were expressed in the form of mean ± standard deviation. A p-value of < 0.05 was regarded to be statistically significant.

3. RESULTS AND DISCUSSION

The conditions of 5 patients could not be followed and three patients were excluded from the study due to consumption of drugs that impacted the automatic nervous system during the study. One of the patients received Pregabalin and Nortriptyline for relief of the intense pain on the right hand (which was the site of the burn by the electricity). Two sympathetic responses that were obtained from this patient indicated very low recorded pain response intensity from hands and feet.

Table 1 shows that the patients' SSR wave amplitude value in patients with chemical, electrical and thermal burn injuries is reduced compared with the control group and the reduction was not statistically significant (P=0.741).

Table 1. Comparison of SSR wave amplitude in patients with electrical, chemical and thermal burn injuries with the normal value

Define	Normal	Electrical	Thermal	Chemical
Mean	518.5	334.5763	336.5278	336.0606
Standard deviation	88	14.77673	14.83807	13.67923
Minimum	229.75	310	310	320
Maximum	763.75	370	370	370

The long latency of SSR indicates the significance difference based on the burn type in a way that this length is higher in the chemical burn group than the electrical burn group and higher in the electrical burn group than the thermal burn group and has been increased then the normal group (P=0.000) (Table 2, Figure 2).

Table 2. The comparison of SSR latency in patients with electrical, chemical and thermal burn injuries and the normal value

Define	Normal	Electrical	Thermal	Chemical
Mean	1.5	2.0644	2.0361	2.3333
Standard deviation	0.2	0.37681	0.18100	0.35765
Minimum	0.95	1.40	1.50	1.70
Maximum	2.05	2.90	2.50	2.90

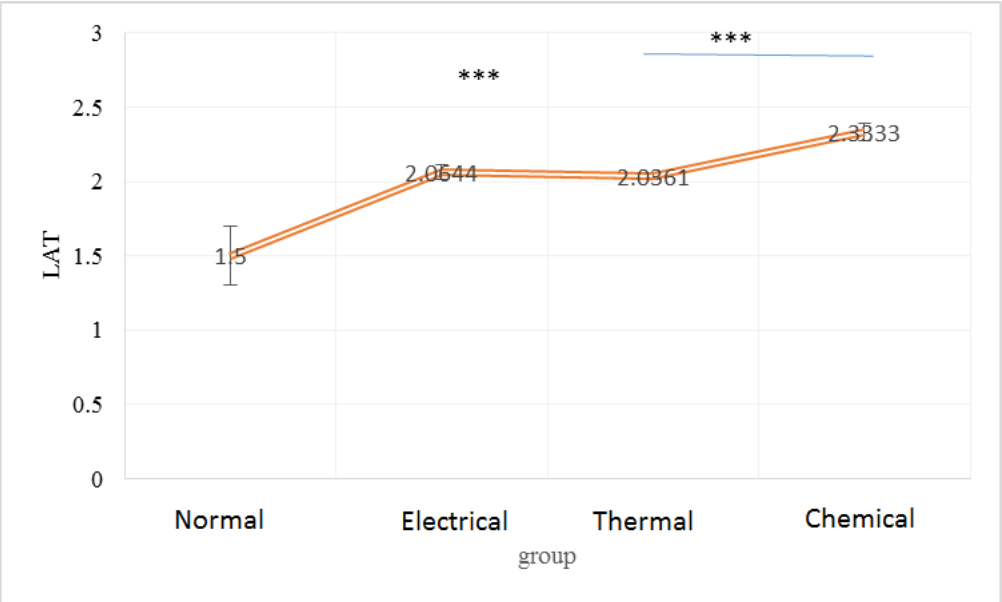

Figure 2. Comparison of SSR latency in patients with burn injuries
*****: P<0.0001**

There is no correlation between SSR latency and the surface involved in the burn in all the patients with burn injuries (P=0.16). There is no correlation between SSR amplitude and the surface involved in the burn in all the patients with burn injuries (P=0.752). Several studies have been conducted on the consequences of different types of burns (18). Based on the results 59.6 percent, the patients with burn injuries had sympathetic system derangement symptoms which were different in different types of burns (7). Though most of these patients mentioned that their symptoms are mild to medium and none of them sought medical help for the management of the symptoms. The symptoms may negatively impact the life quality and mental health of the patients. One of the shortcomings of this study is that these two important aspects were not considered in this study. As most burn patients are in their highly active years of life, timely diagnosis and control of sympathetic disorder can prevent many psychological,

social and financial problems. Many tests have been used for diagnosis of deformities and prediction of the consequences of different types of burns. X-ray, CT scan, MRI and bone scan all have not been able to be correlated with the symptoms of burns with different mechanisms (19). Nuclear medicine imaging of the brain has been mentioned as a tool for predicting the neurological consequences of electrical burns (20). However, this test is costly and is not cost-effective economically. As SSR intensity is significantly lower than that of patients without symptom, even in the latent period, it can be a good candidate for predicting visible disorders that allows us to be prepared before the emergence of symptoms and it is one of the best ways for identifying the symptoms. One of the patients in this study could not remain in the study till the end due to having exclusion criteria (consuming drugs that affect the automatic nervous system). It is unknown whether sympathetic derangement has a role in pain attacks and this needs more study. The long latency of SSR indicates the significance difference based on the burn type in a way that this length is higher in the chemical burn group than the electrical burn group and higher in the electrical burn group than the thermal burn group and has been increased then the normal group (P=0.000) (Table 2). The reduction of SSR intensity in patients with different types of symptoms may be due to the axonal damage in sympathetic nervous system during the burning. However, the SSR is also dependent from the functioning of sudoriparous glands, the reduction of intensity may be due to the reduction of the function or dysfunction of sudoriparous glands and not axonal damage. Therefore, more studies, both functional and histological, are needed to determine the reason for this reduction (21).

4. CONCLUSION

Sympathetic skin response may be a good option as an accessible, convenient and simple test for predicting sympathetic consequences of burns. SSR intensity can be used as a predictive test for the automatic system derangement symptoms that occur after burn injury.

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AUTHORS CONTRIBUTION

Sharareh roshanzamir cooperated substantially in designing of the study, image acquisitions and analyses of images & data, proposed the interpretation of data and the manuscript draft. Setareh satari participated substantially in study design and drafting of the manuscript and revising it critically.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interests with respect to the authorship and/or publication of this paper.

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