Indian Journal of Science and Technology, Vol 9(25), DOI: 10.17485/ijst/2016/v9i25/97202, July 2016
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Effect of Heat Treatments for Hand in Raynaud`S Phenomenon

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Abstract

Background/Objectives:Heat treatment of physical agent modalities (hot pack, paraffin bath, infrared lamp) was widely used in the treatment of the Raynaud`s phenomenon. The aim of this study was to investigate effective heat treatment of physical agent modalities for hand hypothermia. Methods/Statistical Analysis: Forty-two subjects were classified into hypothermia group (21 adults) and control group (21 healthy adults). The heat treatment was applied on the subjects after exposing central part of their hands in a laboratory at 23 to 25 °C for 10 minutes before applying the heat treatment, and measured temperature of central part of their hands through Digital Infrared Thermal Imaging before and after treatment. The heat treatment included hot pack, paraffin bath, infrared lamp, and each heat treatment were applied for 20 minutes. Findings: Significant difference appeared in three factors of each group when skin temperature was compared before and after the heat treatment application. The hot pack and paraffin bath showed significant difference when temperature of the experiment group and control group were compared temperature difference before and after the application. When each factor was compared in the experiment group by temperature difference before and after the heat treatment application, between the hot pack and infrared lamp were showed significant difference. According to the result of this study, each heat treatment can be considered to have effect in increasing the skin temperature for both groups. The hot pack treatment applied to people with hypothermia is considered to show better effects when treating hypothermia. **Application/ Improvements:** heat treatment is considered to be an appropriate physical therapy for people with hypothermia.

Keywords: Digital Infrared Thermal Imaging, Hypothermia, Hot Pack, Infrared Lamp, Paraffin bath

1. Introduction

Raynaud`s phenomenon was decreased blood flow in response to cold or emotional stress in distal extremities[1]. According to some reports based on 7,000 of general population, the prevalence rate of paresthesia on hands and feet, especially cold sensitivity of hands and feet, reaches up to 12%. Female has higher prevalence rate about four to nine times compared to male. Especially, due to hormonal abnormality related to menopause, blood circulation problem and nerve paralysis are caused in peripheral body parts[2-4]. The cold sensitivity examining has lacking objectivity because it depends on subjective description of patients. Therefore, researches have been done for objectification and objectification of cold sensitivity diagnosis through infrared-ray scan on body temperature has been tried in various ways[5].

Digital infrared thermal imaging (D.I.T.I) is a method of examining changes in skin's thermal control function caused by exercise or disease, a new method of examining body's physiological changes[6]. It converts fine thermal changes around the affected body parts into the images on computer; therefore, the status can be objectified and observed. Before measurement of the D.I.T.I, dynamic equilibrium between exterior temperature and body temperature needs to be reached as the first requirement. In order to reach that, a subject should be totally undressed and to be exposed to the exterior temperature for the certain amount of time. Several cautions should be noted for this process. For example, temperature, atmosphere,

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humidity and heat sources in the examination room needs to be carefully monitored. Furthermore, for accurate body temperature examination, proper time for adapting into the temperature should be kept[7].

Heat therapy can be used for the purpose of pain decrease and short-term relaxation with other mediating therapies as supplement. Also, it removes metabolites creating pain with increased blood flow and temporarily increases the threshold of fibers delivering pain, which induces pain decrease. Heat therapy used for decreasing pain increases metabolic activities, satisfies increased oxygen demand, increases cellular metabolic activities to remove wastes, and causes expansion of blood stream[8]. The heat therapy was classified into superficial and deep heat treatments according to depth of thermal conduction. However, there has been no distinct therapy for hand hypothermia other than applying heat therapy onto the affected body parts[4].

Heat treatment of physical agent modalities (hot pack, paraffin bath, infrared lamp) was widely used in the treatment of the Raynaud`s phenomenon. Although, previous study reported the effects of each physical agent modality, there was insufficient to compare effects of physical agent modalities. The aim of this study was to investigate effective heat treatment of physical agent modalities for hand hypothermia.

2. Materials and Methods

2.1 Subjects

42 subjects were recruited and agreed to participate as the subject in this study. The subjects were classified into two groups using digital infrared thermal imaging (IRIS-XP®, Medicore, Seoul). The hand hypothermia group was included 21 subjects (age: 19.91.6, male: 8, female: 13). Temperature difference for hand hypothermia group between brachial center and palm of hand was -1.78~1.07℃ (Table 1). The difference for 21 control subjects (age: 19.30.9, male: 6, female: 15) was 0.94~0.67℃. The temperature of palm was measured before and after the heat treatment of physical agent modalities (Figure 1). The heat treatment include hot pack, paraffin bath, infrared lamp, and each heat treatment were applied for 20 minutes.

2.2 Procedure

After setting up the laboratory temperature in between 23°C to 25°C, measure the temperature of subjects' palm and apply hot pack, paraffin bath, and infrared lamp.

Table 1. Subject characteristics (n = 42)

Group	Hypothermia Group	Control Group
Age	19.9±1.6	19.3±0.9
Height	165.4±9.1	168.4±7.8
Weight	59.3±6.1	66.1±13.2
Temperature difference between brachial center and palm of hand	1.78±1.07	0.94±0.67
Sex	M : 8 F :13	M : 6 F : 15

Data are presented as mean ± SD

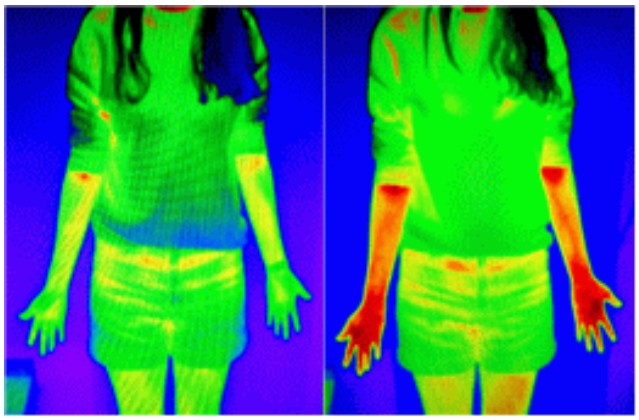

Figure 1. Thermographic images of palmar aspect of hand before and after the heat treatment.

After applying hot pack, paraffin bath, and infrared lamp, measure the temperature of the center their palm. All the subjects were applied to only one factor out of three on each day, or took 4-hour interval when applied to two. Also, all the subjects did not play sports nor consume foods 30 minutes before the experiment.

2.3 Application of Hot Pack

The hot pack was set at 80°C. The hot pack was applied for 20 minutes after subjects supinated their palm and covered it with three towels. More towels were added when subjects complained of pain.

2.4 Application of Paraffin Bath

The paraffin bath was set at 55°C. Subjects have put their hands in and out 6 times repeatedly with 10-second interval on each. Then without washing off the paraffin, they put disposable synthetic resins gloves on, wrapping up with two layers of towels, for another 20 minutes.

2.5 Application of Infrared Lamp

The infrared lamp, an electric power of 250W and diameter of 50mm, is available for height and angle adjustment. All subjects supinated their palm during the experiment. The lamp was consistently 50 centimeters away from their palm and the distance was measured by the tapeline. They were tested for 20 minutes with the maximum power of the infrared lamp.

2.6 Statistical Analysis

All the measured values were statistically processed using SPSS 18.0 for Windows. The temperature was used to perform an independent t-test to determine the variances between the control and hypothermia groups. Temperature of the post-intervention was used one-way ANOVA to analysis difference among the physical agent modalities. The significance level for all the statistical analyses was set at $p<0.05$.

3. Results

The comparison of the temperature of palm is shown in Table 2. As a result, significant differences were shown between before and after intervention for all physical agent modalities ($p<0.05$). The temperature of palm for control group was increased hot-pack; 34.80, paraffin bath; 34.95, and infrared lamp; 34.19 degree. The hypothermia group was increased hot-pack; 34.44, paraffin bath; 34.07, and infrared lamp; 33.15 degree (Table 2). The comparison of physical agent modalities was significant difference between hot pack and paraffin bath for the hand hypothermia group ($p<0.05$). However, there was no significant difference among heat treatment of physical agent modalities for control group (Table 3) ($p>0.05$).

Table 2. Temperature differences of palm for heat treatment of physical agent modalities

Group	Physical Agent	Pre-Intervention	Post-Intervention
Control	Hot Pack	33.03±0.88	34.80±0.38*
	Paraffin Bath	32.45±0.97	34.95±0.44
	Infrared Lamp	32.24±0.80	34.19±0.69*
Hypothermia	Hot Pack	31.30±1.37	34.44±0.78*
	Paraffin Bath	31.06±1.07	34.07±0.74
	Infrared Lamp	30.79±1.56	33.15±1.14*

Values indicate mean ± standard deviation and * indicate $p<0.05$ between control and hypothermia group each modality.

Table 3. temperature variation for modalities

Modalities	Group	Temperature Variation
Hot Pack*	Control	1.77±0.87
	Hypothermia	3.14±1.36
Paraffin Bath*	Control	2.50±0.94
	Hypothermia	3.04±0.64
Infrared Lamp	Control	1.95±0.97
	Hypothermia	2.36±0.84

Values indicate mean ± standard deviation and * indicate $p<0.05$.

4. Conclusions

This study investigated the effects of the heat treatment of physical agent modalities for the hand hypothermia. The temperature of palm was increased by all physical agent modalities. There were no temperature differences among the physical agent modalities in the control group. However, the hot pack increased the temperature to compare with infrared lamp in the hypothermia group. Previous study reported that heat treatment of physical agent modalities increased skin temperature in company with skin microcirculation (blood flow and vasomotion)[2]. The mechanism of Raynaud`s phenomenon was hyperactive vasomotor and local hyper-sensitivity of the digital arteries[1].

Therefore, the heat treatment of physical agent modalities influenced excessive activity of vasomotor and arteries. In conclusion, the hot pack to apply to people with hypothermia is considered to show better effects. In addition, to intervention by considering needs of the subjects and convenience of heat treatment is considered to be an appropriate physical therapy for people with hypothermia.

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