

Influence of cryotherapy application time on skin sensitivity*

Influência do tempo de aplicação da crioterapia na sensibilidade cutânea

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ABSTRACT

BACKGROUND AND OBJECTIVES: Cryotherapy is a treatment modality with several therapeutic effects, of low cost and easy to apply and access. This study aimed to observing whether there are changes in sensitivity according to cryotherapy application time, in addition to skin sensitivity behavior after treatment.

METHODS: Participated in the study 21 individuals (14 females and 7 males, mean age 23.8±4 years) who were randomly distributed in three groups with 7 individuals each. Groups received cryotherapy application for 10, 20 or 30 minutes and were called groups C10, C20 and C30, respectively. All participants were previously submitted to skin sensitivity evaluation by Semmes-Weinstein monofilament and were evaluated immediately after cryotherapy application, 5, 10 and 15 minutes after application. Data were analyzed with Friedman's test complemented by multiple comparisons post-test (Dunn's post hoc).

RESULTS: All individuals had hypoesthesia in the evaluation immediately after cryotherapy application. There has been significant difference in sensitivity recovery of group C20 as compared to C10 and C30 10 minutes after the intervention (p=0.0498). For groups C10 and C30, sensitivity has returned 15 minutes after the end of application.

CONCLUSION: There has been lack of tactile sensitivity five minutes after the end of application, regardless of intervention time. Normal sensitivity recovery was observed after 10 minutes when cold was applied for 20 minutes, and after 15 minutes when cold was applied for 10 or 30 minutes.

Keywords: Cryotherapy, Hypoesthesia, Pain, Tactile perception.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A crioterapia é uma modalidade de tratamento com inúmeros efeitos terapêuticos, de baixo custo, de fácil aplicação e acesso. Os objetivos deste estudo foram verificar se existe alteração na sensibilidade de acordo com o tempo de aplicação da crioterapia além do comportamento da sensibilidade cutânea pós-aplicação.

MÉTODOS: Vinte e um sujeitos (14 mulheres e 7 homens, idade média 23,8±4 anos) foram divididos aleatoriamente em 3 grupos, com 7 sujeitos cada, tendo recebido aplicação da crioterapia por 10, 20 ou 30 minutos, denominados respectivamente grupos C10, C20 e C30. Todos foram previamente submetidos à avaliação da sensibilidade cutânea com monofilamento de Semmes-Weinstein, e avaliados imediatamente ao término da aplicação da crioterapia, 5, 10 e 15 minutos após a aplicação. Para análise dos dados foi utilizado o teste de Friedman complementado pelo pós-teste de comparação múltipla (post hoc de Dunn).

RESULTADOS: Na avaliação imediatamente após a aplicação da crioterapia todos os sujeitos apresentaram hipoestesia. Observou-se diferença significativa no retorno da sensibilidade do grupo C20 em relação aos demais, após 10 minutos da intervenção (p=0,0498). Para os grupos C10 e C30, o retorno da sensibilidade ocorreu após 15 minutos do término da aplicação.

CONCLUSÃO: Cinco minutos depois do término da aplicação da crioterapia observou-se ausência de sensibilidade tátil, independentemente do tempo de intervenção. O retorno da sensibilidade normal foi observado depois de 10 minutos quando se aplicou o frio por 20 minutos, e depois de 15 minutos quando aplicado por 10 ou 30 minutos.

Descritores: Crioterapia, Dor, Hipoestesia, Percepção do tato.

INTRODUCTION

Investigating methods for pain relief is critical for the advance of science. Within this context, cryotherapy has been used for several years to treat musculoskeletal injuries for being a low cost, easy to apply and to be accessed therapeutic modality. This technique aims at relieving pain and decreasing edema and sequelae related to the injury process, decreasing the area of secondary injury¹⁻³.

Cold as therapy induces important neuromuscular changes, because cooling increases tissue rigidity, thus decreasing tis-

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sue viscoelasticity⁴, in addition to the well-known benefits for recovery and treatment of neuromusculoskeletal system injuries⁵. There is also decrease in nervous impulse transmission velocity which gradually decreases as temperature decreases, until the moment when conduction is totally blocked³. There is increase in sensory nerve action potential duration by the increase of absolute and relative refractory periods.

As result of the association of decreased impulse transmission velocity and increased threshold necessary for nervous stimulation, there might be skin sensitivity loss^{2,6}. So, when this therapy is associated with any other needing preserved sensitivity, one may trigger skin injury or even inefficacy of the combined therapy by simple conflict of pathways⁷.

A way to analyze these changes in skin sensitivity is by means of the esthesiometer, which consists in nylon monofilaments with different thicknesses. Diameter and deformation coefficient are predefined and when adequately applied, represent the pressure supply received by the skin (and may vary from 0.05g to 300g), thus reflecting different levels of sensitivity².

Since cryotherapy offers the already mentioned numerous benefits, there is the need to quantify sensitization change response after application of this technique, because health professionals use some resources which require decreased sensitivity; however, in some situations, decreased sensitivity exposes patients to risks. So, this study aimed at checking whether there is sensitivity change related to cryotherapy application time, in addition to checking whether time to return to normal sensitivity is related to cryotherapy application time.

METHODS

This is an experimental research, without control group, carried out in the Clinic-School of Physiotherapy, Anglo-Americano University, Foz do Iguaçu, PR. To recruit volunteers, investigators have invited all students of the Physiotherapy course of the institution, informing all research procedures.

Thirty students came for the baseline evaluation. All were again informed about research objectives and procedures and have signed the Free and Informed Consent Term according to Resolution 196/96. This evaluation has investigated whether subjects had some exclusion factors: hypersensitivity to cold, Raynaud syndrome, central or peripheral neurological disorder, diabetes *mellitus*, hanseniasis, presence of scar or history of forearm fractures, current pharmacological treatment with analgesics and/or current physiotherapeutic treatment for upper limbs and/or cervical spine disorders.

Then, sensitivity was evaluated with the subject in the supine position and forearm in the supine position, following recommended guidelines⁸. Brachial biceps muscle tendon was marked with a dermatographic pencil as reference at the joint line of elbow and long palmar muscle tendon at wrist joint line.

A measuring tape was used to measure the distance between both points, dividing it in three parts. So, forearm was divided in three equal parts: proximal, medial and distal. A central point was marked on each of these parts. These three points were considered for sensitivity evaluation performed with Semmes-Weinstein 0.05 grams monofilament, previous gauged in a precision scale. This monofilament was selected because its weight indicates normal sensitivity².

With the subject blindfolded, the monofilament was perpendicularly and randomly applied twice to each point. After each application, volunteers had five seconds to verbally indicate where they felt the pressure.

Subjects with normal sensitivity were submitted to sensitivity to cold test to evaluate the presence of hypersensitivity. An ice cube was applied to the anterior region of forearm for 30 seconds. After ice removal, subjects were observed for five minutes looking for signs of hives which, if present, were considered research exclusion factors. In this case, volunteers would remain in observation until the disappearance of signs and were excluded from the study.

Six subjects were excluded for presenting reaction to the sensitivity test and three did not show up in the intervention day. So, sample was made up of 21 subjects who were randomly distributed in 3 groups of 7 subjects: group C10 received cryotherapy for 10 minutes; group C20 for 20 minutes; and group C30 for 30 minutes.

The day after evaluation forearm was once more marked according to already described standards. Soon after marking, cryotherapy was applied using a gel bag, brand Chattanooga, measuring 34.3x36.5 cm, at -5° C, which was applied to the forearm anterior region, according to specific times for each group. Immediately after the end of cryotherapy application, 5, 10 and 15 minutes after application, sensitivity was again evaluated following the same procedure of the baseline evaluation.

For data analysis, Friedman test was used for non parametric variance analysis, complemented by multiple comparisons post-test (Dunn post hoc). Significance level was 5% for all tests. The program GraphPad InStat 3.0 was used.

This study was approved by the Ethics and Research Committee, Assis Gurgacz University (CEP/FAG), opinion 350/2008.

RESULTS

Table 1 shows sample characteristics stratified by group. There were no differences among groups.

Table 1. Sample characteristics

	Group C10	Group C20	Group C30	p value
Age (years)	25.7±4.3	22.7±4.2	23.1±3.5	0.2034
Gender				
Female	5	4	5	0.3679
Male	2	3	2	

In the evaluation immediately after cryotherapy application, all subjects had hypoesthesia. All group C20 subjects showed sensitivity recovery 10 minutes after intervention. In groups C10 and C30 normal sensitivity for all subjects was only observed 15 minutes after application. Statistical analysis has shown significant difference ($p=0.0498$) in intergroup comparison 10 minutes after intervention (Table 2).

Table 2. Number of subjects stratified by group according to time to sensitivity recovery. Intergroup and intragroup analysis after cryotherapy application

Sensory recovery	Group C10	Group C20	Group C30	p-value ²
Immediate	0	0	0	-
5 minutes	1	1	0	0.3679
10 minutes	5	7	3	0.0498*
15 minutes	7	7	7	-
p-value ¹	0.0013*	0.0003*	0.0009*	

¹p-value for intragroup analysis; ²p-value for intergroup analysis; *significant.

According to evaluations, intragroup comparisons were performed in the post-test. There has been significant difference in all groups when evaluation 15 minutes after cryotherapy was compared to evaluation immediately after application. Group C20 has also shown difference in the comparison between evaluation 10 minutes after cryotherapy and evaluation immediately after, and group C30 between evaluation 15 minutes after cryotherapy and evaluation 5 minutes after cryotherapy (Table 3).

Table 3. Intragroup comparison according to evaluation moment after cryotherapy

	Group C10	Group C20	Group C30
5 minutes vs. immediate	$p>0.05$	$p>0.05$	$p>0.05$
10 minutes vs. immediate	$p>0.05$	$p<0.05$ *	$p>0.05$
15 minutes vs. immediate	$p<0.05$ *	$p<0.05$ *	$p<0.05$ *
10 minutes vs. 5 minutes	$p>0.05$	$p>0.05$	$p>0.05$
15 minutes vs. 5 minutes	$p>0.05$	$p>0.05$	$p<0.05$ *
15 minutes vs. 10 minutes	$p>0.05$	$p>0.05$	$p>0.05$

*significant.

DISCUSSION

All subjects had decreased sensitivity after gel bag application, thus allowing sensitivity recovery evaluation. It is suggested that changes in sensitivity found in this study are consequence of neurological changes triggered by cryotherapy, because its use may lead to increased pain tolerance threshold at application site and also distally to application site⁹. After cold application, action potential is maintained with increased refractory period, decreasing conduction velocity. So, sensory perception is transmitted in reduced form, being associated to sensitivity changes³, that is, such changes modify pathways which capture, transform and

conduct nervous impulses, thus changing perception of the stimulation applied².

It was expected that the group receiving cryotherapy for 10 minutes would recover sensitivity earlier as compared to remaining groups, as well as it was expected that the group receiving intervention for 30 minutes would take longer to recover. However, differently from such assumptions, the group receiving cryotherapy for 20 minutes had the earliest sensitivity recovery, 10 minutes after cryotherapy.

Differently from these results, Carvalho & Chieritch² state that five minutes after gel bag application one may apply a different technique requiring patients' preserved sensitivity. Moreover, skin temperature decrease after cryotherapy lasts for at least 10 minutes and, 30 minutes after removal, temperature returns to normal levels¹⁰.

A factor which may influence sensitivity recovery is gender, because after cooling processes with ice packs, higher skin temperature was observed among males, fact which suggests the participation of sexual hormones in peripheral thermoregulation control and adjustment processes¹¹. Our study has not performed analysis by gender, however all groups were made up of males and females and have not shown differences among them ($p=0.3679$).

It is also known that walking after cryotherapy application accelerates sensory and motor nervous conduction recovery process¹²; however, in our study subjects have remained at rest after cryotherapy. In addition, cryotherapy improves the level of patients' satisfaction as compared to other analgesic modalities¹³.

Our study decided for the gel bag due to practicality and availability in the service. However, according to Enwemeka et al.¹⁴, the gel bag after being placed on the skin starts to lose its tissue cooling power because there is no melting point to be overcome before heating.

As limitations to this study one may mention lack of gel bag temperature monitoring during application. In addition, there are few studies regarding tactile sensitivity evaluation after cryotherapy, which makes difficult the comparison of our research results.

CONCLUSION

Considering the experimental conditions described, there is lack of tactile sensitivity up to five minutes after the end of cryotherapy, regardless of intervention time. Normal sensitivity recovery can be observed 10 minutes after the end when cold is applied for 20 minutes and 15 minutes after the end of cryotherapy application for 10 or 30 minutes.

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