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ORIGINAL ARTICLE

Hypoalgesic effect of Bernard's diadynamic currents on healthy individuals*

Efeito hipoalgésico das correntes diadinâmicas de Bernard em indivíduos saudáveis

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SUMMARY

BACKGROUND AND OBJECTIVES: Diadynamic currents are alternate currents rectified in complete waves or half waves and were developed by Pierre Bernard. These currents are used in the clinical practice for analgesia and soft tissue healing; however, without scientific evidences. This study aimed at investigating the hypoalgesic effect of Bernard's diadynamic currents in healthy individuals and the sensory discomfort of each current.
METHOD: Participated in this study 75 healthy volunteers, being 35 males and 40 females aged from 18 to 60 years. Volunteers were randomly distributed in five study groups (15 participants per group), as follows: fixed diphase (DF), fixed monophase (MF), short periods (CP), long periods (LP) and control group (CG). Diadynamic currents were applied for 15 minutes to the non-dominant forearm and pressure pain thresholds were measured on hand and forearm before, during and 15 minutes after currents application.
RESULTS: There has been no statistically significant difference among groups on hand pressure pain threshold in the 5th minute (p = 0.490), 10th minute (p = 0.590), 15th minute (p = 0.996) and 30th minute (p = 0.489). There has also been no significant differences among groups on forearm in the 5th minute (p = 0.767), 10th minute (p = 0.439), 15th minute (p = 0.395) and 30th minute (p = 0.915). There has been no statistically significant difference in discomfort evaluated in the 5th minute (p = 0.087) and 10th minute (p = 0.055). However, in the 15th minute, CP current has shown a lower discomfort index as compared to MF (p = 0.021).
CONCLUSION: There has been no difference in pressure pain threshold among studied groups.
Keywords: Electrical stimulation therapy, Pain, Pain threshold.

RESUMO

JUSTIFICATIVA E OBJETIVOS: As correntes diadinâmicas são correntes alternadas retificadas em ondas completas ou semiondas e foram desenvolvidas por Pierre Bernard. Essas correntes são utilizadas na prática clínica para analgesia e reparação de lesões de tecidos moles; entretanto, sem evidências científicas. O objetivo deste estudo foi investigar o efeito hipoalgésico das correntes diadinâmicas de Bernard em indivíduos saudáveis e o desconforto sensorial de cada corrente.
MÉTODO: Foram recrutados 75 voluntários saudáveis, sendo 35 homens e 40 mulheres na faixa etária de 18 a 60 anos. Os voluntários foram distribuídos aleatoriamente em cinco grupos de estudo (15 participantes por grupo), a saber: difásica fixa (DF), monofásica fixa (MF), curtos períodos (CP), longos períodos (LP) e grupo controle (CG). As correntes diadinâmicas foram aplicadas durante 15 minutos no antebraço não dominante e medidas de limiar de dor por pressão foram realizadas na mão e no antebraço antes, durante e 15 minutos após a aplicação das correntes.
RESULTADOS: Não houve diferença estatisticamente significante entre os grupos no limiar de dor por pressão na mão no 5° minuto (p = 0,490), 10° minuto (p = 0,590), 15° minuto (p = 0,996) e 30° minuto (p = 0,489). No antebraço também não foram encontradas diferenças significantes entre os grupos no 5° minuto (p = 0,767), 10° minuto (p = 0,439), 15° minuto (p = 0,395) e no 30° minuto (p = 0,915). Não houve diferen-

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ça estatisticamente significante no desconforto avaliado no 5° minuto (p = 0,087) e 10° minuto (p = 0,055). No entanto, no 15° minuto a corrente CP apresentou menor índice de desconforto quando comparado à corrente MF (p = 0,021).
CONCLUSÃO: Não houve diferença no limiar de dor por pressão entre os grupos de estudo.
Descritores: Dor, Limiar da dor, Terapia por estimulação elétrica.

INTRODUCTION

Diadynamic currents were developed in France by dentist Pierre Bernard in the early 1950s. These are alternate currents rectified in complete or half waves, with frequency of 50 and 100 Hz[1]. According to Pierre Bernard, these currents have a broad analgesic effect on soft tissue injuries and systemic disorders.
Diadynamic currents are classified in five types and each one has different physiological and therapeutic effects. So, the choice of the current to be used depends on the proposed therapeutic objective[2,3].
Fixed double-phase current induces fast and temporary analgesia by masking central nervous system, in addition to having spasmolytic effect. Fixed monophase current is indicated for muscle electrical stimulation and improvement of local circulation. Shorts periods current has more intense circulatory effects.
Long period's current is characterized by persistent analgesic effect. Its syncopated rhythm aims at muscle contractions. However, the effects of each current seem to be based on practical experience of professionals using diadynamic currents rather than on results of controlled experimental studies. In addition, there are no scientific evidences confirming that such currents have analgesic effects.
So, our study aimed at evaluating the effect of diadynamic currents on pressure pain threshold and sensory discomfort of healthy individuals.

METHOD

Participated in this study 75 healthy volunteers, being 35 males and 40 females, aged from 18 to 60 years, who were interviewed by investigator 1 to check the presence of contraindications to procedures, including upper limbs nervous injury, pain, pregnancy, chronic diseases, pacemaker, epilepsy, allergy to electrodes, pain killers, skin injuries or lack of sensitivity where electrodes were to be positioned.
After signing the free and informed consent term, participants were randomly allocated to one of the five study groups, with 15 participants per group: fixed diphase (DF), fixed monophase (MF), long periods (LP), short periods (CP) and control group (CG). Patients were randomized by means of the sequentially numbered opaque and sealed envelopes method. Volunteers were divided by gender to assure the same number of males and females in each group.
This study was approved by the Ethics Committee, City of São Paulo University, under protocol 13526064/2010.

Volunteers' preparation

Upper limb was cleaned with soap and water before marking electrode sites and pressure algometry area. These areas were marked with adequate pen, with volunteers sitting in front of a table and the forearm in the supine position.
Two pressure pain threshold measurement areas were marked on the non-dominant arm: 1. 3.5 cm distally from the anatomic snuffbox toward the midline of the dorsal interosseous muscle; 2. On anterior forearm, 8.5 cm proximally to the fist distal fold[4-6].
Aluminum electrodes used had the standard size of 4.3 cm x 11.3 cm, covered by a wet sponge and positioned as follows: a) on distal fist fold; b) on lateral forearm, 10 cm proximally to the distal fist fold. These electrodes stimulated the superficial radial nerve and the median nerve.
A demo of the treatment was made on the dominant forearm before PPT reading. Participants of groups DF, MF, CP and LP were not informed to which group they belonged; they were only informed that would feel a sensation of paresthesia.
All groups were submitted to the same procedures, since electrodes placement until current application, however in the control group individuals were informed that they would receive no current during the 15 minutes.
Current amplitude adjustment was standardized for groups DF, MF, CP and LP, increasing 1 mA of current every second until participants would report strong, however comfortable paresthesia. As from this moment, application time started to be measured. Participants of all groups were asked every 5 minutes whether they were comfortable, and have filled an evaluation form during this period regarding their discomfort with the treatment, except CG.

Pressure pain threshold measures

Pressure pain threshold was measured by investigator 2 who was blind to the distribution of the groups, with a

Wagner FDX pressure algometer gauged according to manufacturer's instructions. Electrodes were placed on the forearm of all participants and the electrical stimulation panel was covered during PPT measurement so that the investigator would not know which type of current was being applied.

During PPT measurement, algometer's circular probe with area of 1 cm^2 was placed perpendicular to the skin and pressed at a constant speed of approximately 5 Newtons per second (N/s)[4]. Participants were asked to close their eyes and to say "stop" when pressure or discomfort became pain sensation. Three Newton measures were collected from each area every time and mean was used for data analysis. Pressure in kPa (kilo Pascal) was calculated by the following formula P [Pa} = F [N]/A [m^2], where P is pressure, F is applied force and A is the algometer tip area[4]. Treatment (BDC) was not interrupted for PPT measurement.

In the two areas, hand and forearm (Figure 1), PPT was measured before starting current application (0 min), at 5 min, 10 min and 15 min of application, and 15 min after current application. During the study, PPT readings of both areas were randomly taken. PPT measuring order randomization was also made by opaque and sealed envelopes. All participants had two demos of PPT collection on their dominant arm to assure that they understood the PPT measure concept before starting the study.

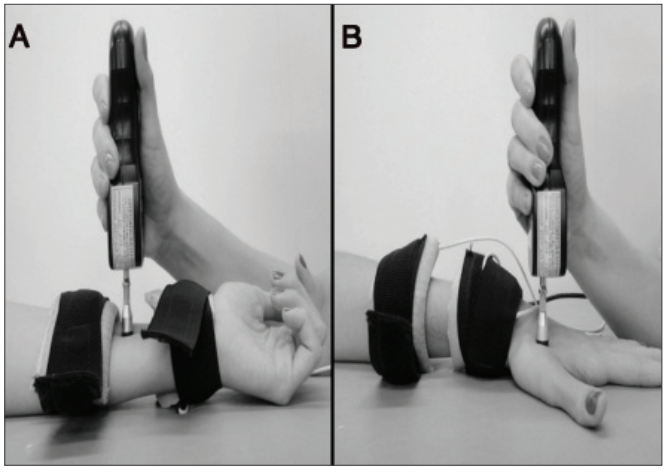


Figure 1 – Position of electrodes on forearm and PPT measuring areas on forearm (A) and hand (B).

Sensory discomfort analysis

To evaluate the level of discomfort during electrical stimulation, the 10-cm visual analog scale (VAS) was used where the left edge means "very comfortable" and the right edge means "very uncomfortable"[7]. VAS was used to quantify current discomfort detected by the participant during 5, 10 and 15 minutes of application, except for the control group who did not receive electrical current.

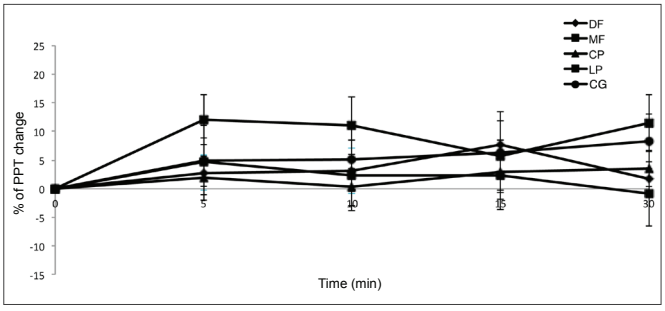
Data analysis

A mean of three PPT measures was used for analysis. Variation of baseline values (pretreatment) was evaluated by the Analysis of Variance (ANOVA) of one intergroup pathway. When ANOVA detected statistically significant difference Tukey's *post hoc* was used. Significance level was established as $p < 0.05$.

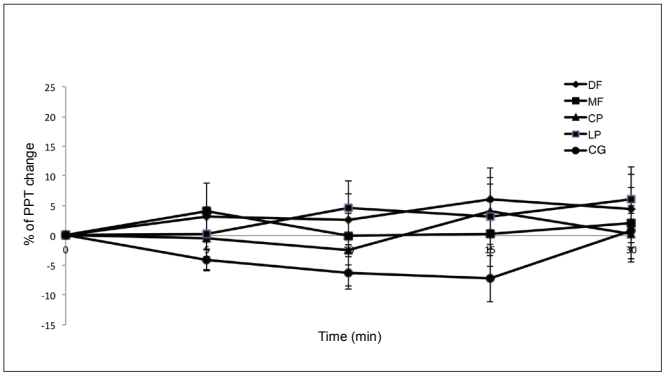
RESULTS

Participated in this study 75 individuals with mean age of 28.16 ± 10.2 years (SD=10.2) body mass index (BMI) of 24.07 ± 4.0 kg/m². One MF group volunteer was excluded because at 5 minutes of current application he presented severe urticarial reaction on forearm.

Percentages of changes in pressure pain threshold on hand and forearm are shown in graphs 1 and 2, respectively.

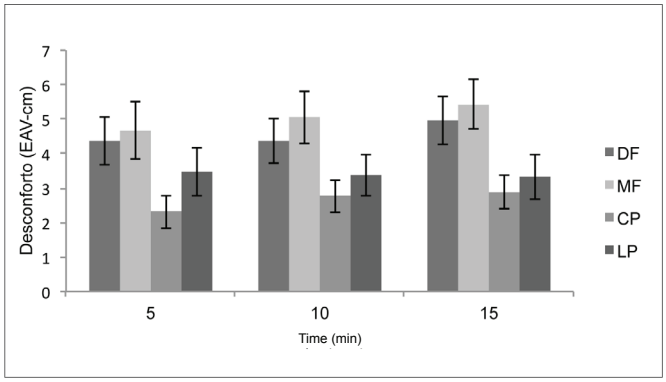


Graph 1 – Percentages of changes in pressure pain threshold on hand of experimental groups.
DF = fixed diphase; MF = fixed monophase; CP = short periods; CP = long periods; CG = control group.



Graph 2 – Percentage of changes in forearm pressure pain threshold in experimental groups.
DF = fixed diphase; MF = fixed monophase; CP = short periods; CP = long periods; CG = control group.

Hand pressure pain threshold statistical analysis has not shown significant differences among groups at 5 minutes (p = 0.490), 10 minutes (p = 0.590), 15 minutes (p = 0.966) and 30 minutes (p = 0.489).
Forearm pressure pain threshold statistical analysis has also not shown significant differences among groups at 5 minutes (p = 0.767), 10 minutes (p = 0.489), 15 minutes (p = 0.395) and 30 minutes (p = 0.915).
With regard to sensory discomfort, there has been no statistically significant difference at 5 minutes (p = 0.087) and 10 minutes (p = 0.055). However, there has been less discomfort in CP group at 15 minutes, as compared to the MF group (p = 0.021) (Graph 3).



Graph 3 – Sensory discomfort during diadynamic currents application.
*CP current group had less discomfort as compared to MF group at 15 minutes of application (p = 0.021)
DF = fixed diphase; MF = fixed monophase; CP = short periods; LP = long periods.

DISCUSSION

Electrotherapeutic resources to control pain in different painful syndromes is becoming more popular in the clinical practice and provides improved functionality and quality of life of individuals[11,12]. Diadynamic currents are often used in the clinical practice to control pain and heal biological tissues, in spite of the few studies available in databases such as LILACS, Scielo and Medline, to show the efficacy of such currents, in addition to their characteristics[12,13]. Pressure algometer has been used as measurement tool, which is currently an effective tool to identify pain threshold[4-6,8-10].
A study has used diadynamic currents (DF and LP) with and without 1% hydrocortisone iontophoresis to treat chronic low back pain. Each current was applied for 5 minutes and both groups had statistically significant pain improvement after seven consecutive sessions[13]. Similar results were observed by a recent study where there has been low back pain relief in disc disease patients with the use of diadynamic currents[1].
In our study, LP group current had a trend to hand hypoalgesia, since pain threshold has increased in the beginning of the application, however there has been no statistically significant difference among groups. MF group had a trend to hyperalgesia because pain threshold has decreased along time, however also without statistically significant difference.
Our results have shown that DF current does not induce fast analgesia as advocated by Pierre Bernard. On forearm, all currents had hypoalgesic trend as compared to the control group, however also without statistically significant differences. Our results confirm the findings of other authors who have also not found significant differences with the use of DF current in an experimental ischemic pain model in healthy subjects[2]. It is possible that patients with pathophysiological tissue changes and pain will respond more favorably to diadynamic currents than healthy individuals submitted to induced pain[1,13].
According to sensory discomfort scale results, CP current induced the least discomfort among currents, being more comfortable as compared to MF. So, our data suggest that MF current should not be used for analgesia because in addition to being more uncomfortable for people, it does not induce further hypoalgesia as compared to other currents.
New studies are needed, with a higher number of participants, as well as with patients with pain and/or pathophysiological tissue changes to confirm or not our results.

CONCLUSION

There has been no pressure pain threshold difference among groups, that is, no significant hypoalgesic effect was obtained among applied currents and there have been no significant differences among groups receiving currents and the CG. CP current has induced less sensory discomfort in the 15th minute of stimulations as compared to the MF current.

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