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Short Communication

Evaluation of Local Chromotherapy on Carrageenaninduced Acute Inflammatory Pain in Rats

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Abstract

Introduction: Pain is an unpleasant sensory and emotional experience, which follows a harmful stimulus. In conventional medicine pain is treated with non-steroidal anti-inflammatory drugs, opioid analgesics and local anesthetics. Chromotherapy is a noninvasive complementary therapy, which uses the colors of the visible light region of the electromagnetic spectrum for the treatment of pathologies such as inflammations, dermatological changes and respiratory tract disorders. The mechanism of treatment would be based on the fact that the body is able to absorb electromagnetic waves at different wavelengths, which interact with cells and substances producing a beneficial effect for the patient. This would happen due to the fact that electrons leave from a lower energy level to a higher one, the moment light reaches the tissues, and thus begins a cascade of biochemical reactions that lead to the improvement of the pathogenic picture, which remains until the electron returns to its normal energy level. That would be the theory of direct effect. The indirect effect theory proposes that tissues would not absorb light, but would react to chemical stimuli produced by photons, so that they would stimulate the release of hormones and anti-inflammatory mediators through photoreceptors that would be present in cells, which convert the electromagnetic wave into an electrical stimulus, passing through the terminations and being distributed throughout the body. These photoreceptors would be present especially in the retina. OBJECTIVE: evaluation of the antinociceptive action of chromotherapy, specifically evaluate seven colors of the visible light region of the electromagnetic spectrum using a pain model in rats.

Methods: Wistar rats were used, divided into 8 groups, in which carrageenan was applied to the paw at a dose of 250 µg/animal to induce inflammatory pain. After 3 hours until the fourth hour, the rats were submitted to the nociceptive paw compression test every five minutes, and the pressure threshold for the occurrence of paw removal was measured in grams. Before starting the experiment, it was verified whether the effect of containment would influence the nociceptive response of the animal. All conditions of the chromotherapy experiment were reproduced, except for the fact that light was not applied.

Results: There is no statistically significant difference between the responses of the animal with and without the containment in the pressure stimuli applied. The experiments show that the acute application, for 20 minutes, of the colors blue, red, green, orange, yellow, violet and white did not alter carrageenan-induced hyperalgesia in rats, and no significant difference was indicated between the values of the nociceptive threshold of the exposed groups and their respective controls.

Conclusion: chromotherapy was not effective in the treatment of acute inflammatory pain, in the conditions described in this study.

Keywords: Chromotherapy; Antinociception; Inflammatory Pain

Introduction

The integrity of the body is guaranteed by the immune system and the body's ability to warn the brain of some kind of danger [1]. This ability is characterized by the sensation of pain, which is an unpleasant sensory and emotional experience, which follows a harmful stimulus. According to the International Society for the Study of Pain (IASP, 2008), "pain is a specific sensation and an emotional event, which is linked to the actual and potential tissue injury or is described in terms of such injury".

Pain can be classified as acute or chronic [2]. Acute pain is that from trauma or inflammation, well responsive to analgesics and stimulates tissue repair. It's considered a symptom. On the other hand, chronic pain is described as one that lasts for a long period of time, in general the authors consider above 1 month [3], and leads to discomfort such that it decreases the patient's quality of life. It's not responsive to painkillers. Unlike acute pain, chronic pain is a disease itself.

The social and economic impacts in Brazil and in the world caused by pain have received great attention in recent years. Statistics show that in children and adolescents low back pain, headache and abdominal pain reach about 20% of cases, while spinal pain, especially in older people, reaches 36% of cases of quality-of-life loss. Neuropathic pain has an index of approximately 9%, and the largest stop is caused by cancer. Musculoskeletal pain is responsible for almost 25% of cases and are the main causes of absence from work [3]. Almost all of these types of pain are not responsive to common analgesics and, when they are, these analgesics are accompanied by important adverse effects that limit the patient's quality of life, often leading to treatment abandonment and greater complaints and sometimes worsening of the condition.

Chromotherapy is a noninvasive alternative therapy, which uses the colors of the visible light region of the electromagnetic spectrum for the treatment of pathologies such as inflammations, dermatological changes and respiratory tract disorders [4]. The Egyptians, as well as other peoples, such as the Chinese and Indians, used this practice in ancient civilizations. For them, color therapy would cause beneficial changes in people's health and was widely used [4,5]. Today, it is associated with other therapies such as acupuncture, massage and aromatherapy.

The mechanism of treatment would be based on the fact that the body is able to absorb electromagnetic waves at different wavelengths, which interact with cells and substances producing a beneficial effect for the patient. This would happen because electrons come out from a lower energy level to a higher one, the moment light reaches the tissues, and thus a cascade of biochemical reactions begins that lead to the improvement of the pathogenic picture, which remains until the electron returns to its normal energy level, called direct effect theory. It was also discussed the theory of indirect effect [6], in which tissues would not absorb light, but would react to chemical stimuli produced by photons. For example, they would stimulate the release of antiinflammatory hormones and mediators through photoreceptors that would be present in cells, which convert the electromagnetic wave into an electrical stimulus, passing through nerve endings and being distributed throughout the body. These photoreceptors would be present mainly in the retina.

Each wavelength must be individually focused, i.e., each color should be individually incided. This is due to the fact that the cell would not respond to multiple wavelength stimuli [7].

The objective of this work is to evaluate the antinociceptive effect of local chromotherapy on acute inflammatory pain induced by carrageenan in rats.

Materials and Methods

Animals

Male Wistar rats, average weight 160 ± 30 g, from the Bioterism Center of the Institute of Biological Sciences of the Federal University of Minas Gerais (CEBIOICB/UFMG) were used. For the experiment, the animals were kept, on the previous two days and on the day of the experiment, in plastic boxes with shaving bed, under controlled conditions of temperature (23 ± 2°C) and luminosity (light/dark cycle of 12 hours, with light starting at 07:00 h) for environmentalization. They had free access to feed and water. All experiments were carried out between 07:00 h and 17:00 h, in the light phase.

Drugs

To induce the inflammatory reaction, carrageenan lambda (Sigma, USA) was used in a suspension prepared in physiological saline (NaCl 0.9%). The suspension was prepared on the day of the experiment. The prepared suspension was administered subcutaneously on the plantar surface of the right hind paw of the rat (intraplantar route), in a volume of 100 µL/paw. The dose was 250 µg/animal, in order to cause maximum hyperalgesic effect in the 3rd hour from the application of the drug, at which time the nociceptive threshold was measured.

Chromotherapy

Containment

A containment model was used, consisting of a plastic cylinder with 4 holes in order to allow free access to the limbs, for exposure to the lights of the visible spectrum. This model was adapted involving the plastic cylinder with black leather, producing a blackout-like environment inside so that the animal would not receive light through the retina.

Chromatic stick

For the application of chromotherapy, a chromatic stick (Zots, Brazil) was used. This rod consists of a brass tube, in which there are two openings for placement of light filters; a quartz crystal at one end and at the other, the power button on/off, which also acts as a thread cap of the battery compartment, which feeds the light source, composed of 9 LED lamps. The crystal tip is natural hyaline quartz, only polished; this ensures that the crystal formation orientation is respected, causing the crystal to perfectly transmit light.

Application

For the application of chromotherapy, the animal was carefully maintained in the containment system for 20 minutes, during which time the colored light was directed to the inflamed site. This period was stipulated to cover a time of application similar to that recommended in several types of complementary therapies, such as acupuncture. The treatment was performed with application about 0.5 cm away from the paw. The red, orange, yellow, green, blue and violet lights were applied, in addition to the white light.

Description of the experiment

The experimental procedure was performed based on data from preliminary experiments described in the literature. 2:40 h after carrageenan application, the test animal was submitted to containment and chromotherapy was applied for 20 minutes, as described above. This time was stipulated so that the first measurement, both of the control group and of the test group, occurred in the 3rd hour after the application of the drug, at which time the maximum hyperalgesic effect induced by carrageenan is perceived in rats.

From the 3rd hour, the mechanical nociceptive threshold of paw reflex [8] was measured at intervals of 5 minutes until 3:20 h from the application of carrageenan. From this, these intervals were extended to 10 minutes until the 4th hour, moment that marks the end of the experimental procedure. In all time intervals, three measurements were performed, and an average was recorded.

Analysis of Results

Considering hyperalgesia as the decrease of the nociceptive threshold, the results were presented as the difference (Δ) between the basal nociceptive threshold and the nociceptive threshold in the intervals described between the third and fourth hours after the injection of carrageenan, from the arithmetic mean of three measurements in each time interval, and applied statistical treatments for the determination of standard errors of the means (E.P.M.). These data were then Analyzed by the Variance Analysis test (ANOVA) followed by the Bonferroni test for multiple analyses. $P<0.05$ values were considered statistically significant. The number of animals per experiment had a total of 8, being 4 test animals and 4 control animals.

Results

Effect of containment

Before the experiment with the lights, a test was carried out to evaluate whether the containment has an influence on the nociceptive threshold of the animal. All conditions of the chromotherapy experiment were reproduced, except for the fact that light was not applied. From the results, it was noticed that there is no statistically significant difference between the nociceptive threshold of the animal with and without the containment (Figure 1A). Thus, for the control group, the animals without containment were used and the animals of the test group remained in the equipment for the application of the treatment, aiming at the practicality of the method.

Chromotherapy treatment

The experiments showed that the acute application of blue (Figure 1B), red (Figure 1C), green (Figure 1D), orange (Figure 1E), yellow (Figure 1F), violet (Figure 1G) and white (Figure H) for 20 minutes, did not alter carrageenan-induced hyperalgesia (250 μg/animal) in rats, and no significant difference was indicated between the Δ values of the nociceptive threshold of the light exposed groups and their respective controls.

Discussion and Conclusion

The dose of carrageenan used (250 μg/animal) was chosen since according literature [9], this dose is sufficient to cause adequate hyperalgesia in male Wistar rats used in present study.

In a study with chromotherapy in foot reflexology zones for treatment of chronic sinusitis [10], patients were instructed to look at an indigo color role and mentalize the color. Then they should close their eyes and relax while certain areas of the feet were pressed. The authors realized that this procedure was able to reduce secretion and nose congestion, headaches and heavy headache, common symptoms of sinusitis.

Chromotherapy was also used for wound treatment [5,11]. The authors performed chromotherapeutic treatment of an ulcerative wound in an 81-year-old woman, refractory to conventional treatments. The researchers noticed the positive evolution of the lesion, so that on the 48th day the ulcer was practically healed.

Studies on the evaluation of chromotherapy in pain were also conducted [4], using colored lights in the treatment of pathologies that cause pain (burn, ulcerative thrombophlebitis, leg ulcers, rheumatoid arthritis). The time used was a maximum of 10 minutes, 2 times a day, and was successful in pain control. In

another study [7], it was obtained good results in controlling pain caused by ulcerative injury in a case of cutaneous leishmaniasis, using colored lights for 30 minutes daily. Those two studies suggest that the time of exposure to colored lights used in our experiment was not determinant to analgesia did not occur, since in the first study the time was shorter than that used in our study, while in the second the time was longer.

Lines of research believe that Chromotherapy would act, therefore, on a preventive basis, rather than curative, since the waves emitted by the light source in association with the colored filters would be able to reverse the alteration caused in the electromagnetic field before the manifestation of the disease, but would not be able to reverse it after the onset of physical disease [12]. This theory could explain the results obtained in the present study, since acute pain was induced, with the peak of hyperalgesia being in the third hour after carrageenan application and at the end of six hours there is no more hyperalgesia [8], characterizing the physical disease itself. However, it is in contradiction with the results obtained in the studies of [7] and achieved analgesia in physically ill patients.

Another theory suggests that, in fact, it is necessary to participate in retinal sensitization in order to have an analgesic effect of chromotherapy, in agreement with the theory of indirect effect [6]. This can also be suggested by a study [10], in which it was necessary to use vision for the effect of chromotherapy. In our experiments, the animals had their eyes covered so that one could evaluate only the direct effect of light on the tissue. In the present study, the absence of reduction of hyperalgesia may be correlated with the blackout containment device. The experiment conducted by Ibrahim and his collaborators [13] suggested the importance of the participation of visual stimulus for chromotherapy antinociception to occur, since the animals that used opaque contact lenses did not have analgesia, while the animals that used green, transparent lenses or did not use lenses had significant analgesia.

Our study is in line with literature data [13], showing that the lighting of the experimental room (white light) did not alter the nociceptive threshold. However, the green and blue lights, applied chronically, were able to induce analgesia in the animals in a thermal stimulus model. Even antinociception reached a plateau on the second day and remained for four days.

Conclusion

The present study demonstrates that chromotherapy was not effective in acute pain control, in the experimental conditions described in this study. However, there are data in the literature that state that this treatment can be effective in controlling chronic pain, and therefore an experimental study is necessary to prove this efficacy.

Chromotherapy is still a branch of integrative medicine that has been little studied, but it is widely used. Due to the few references and published works, the efficacy and mechanisms of color treatment constitute a knowledge gap that is worth filled.

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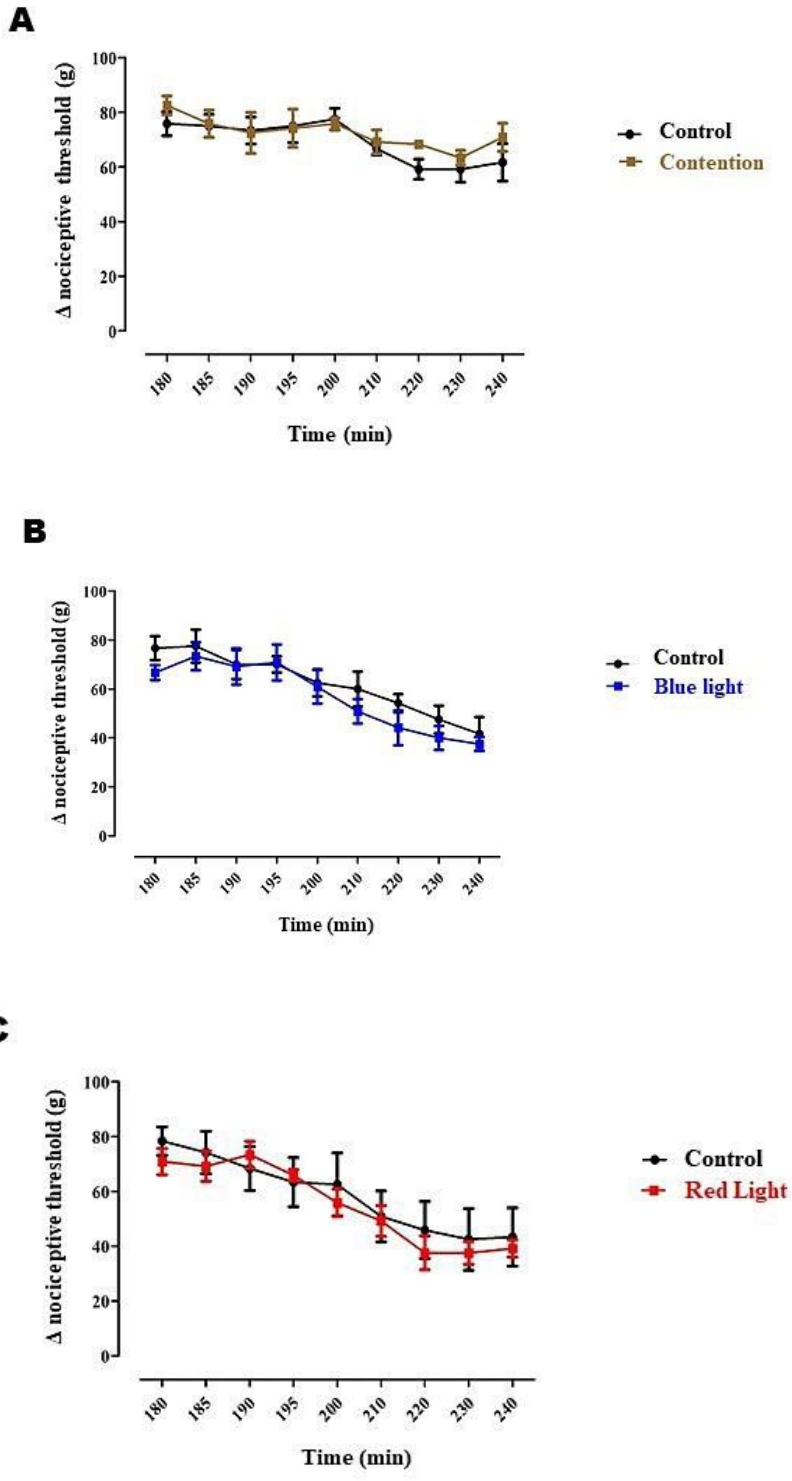
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Contention
B
Δ nociceptive threshold (g)
Time (min)
Control
Blue light
C
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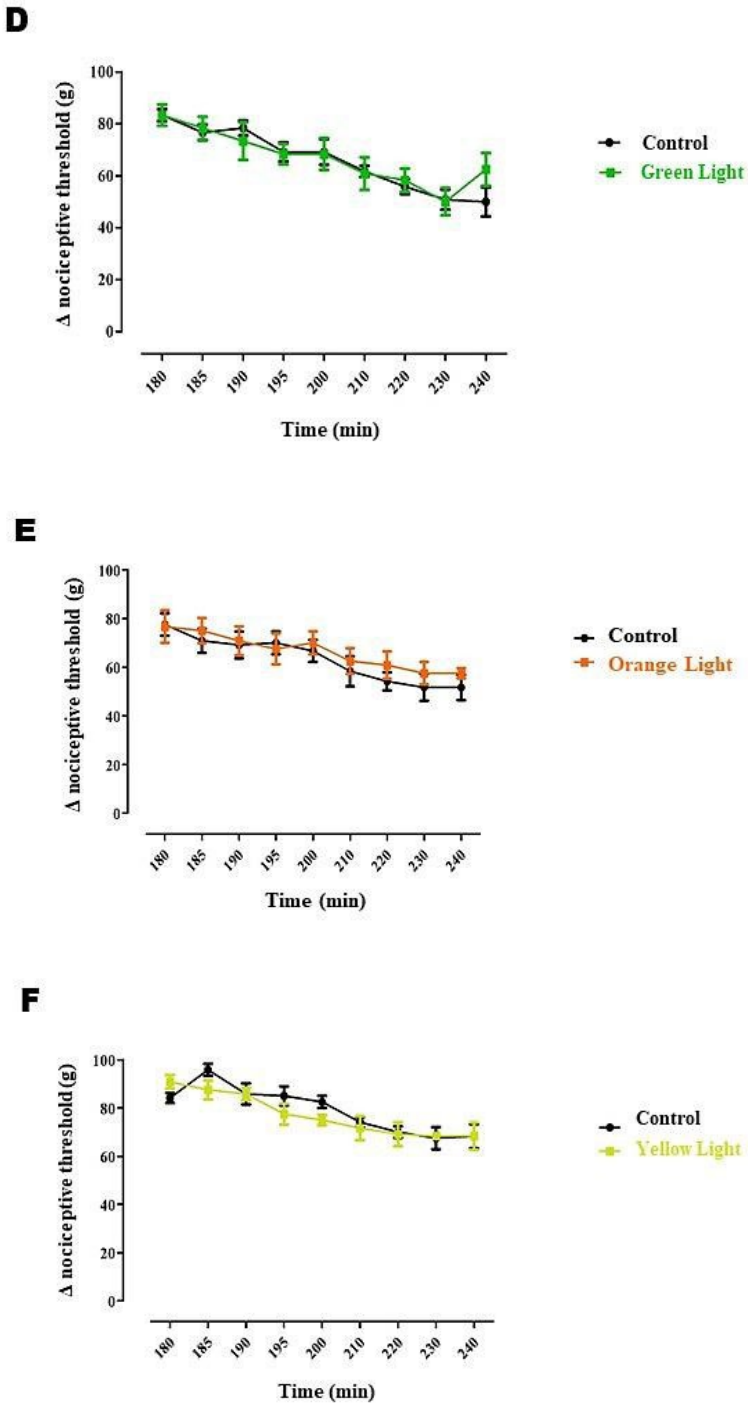
Time (min)
Control
Red Light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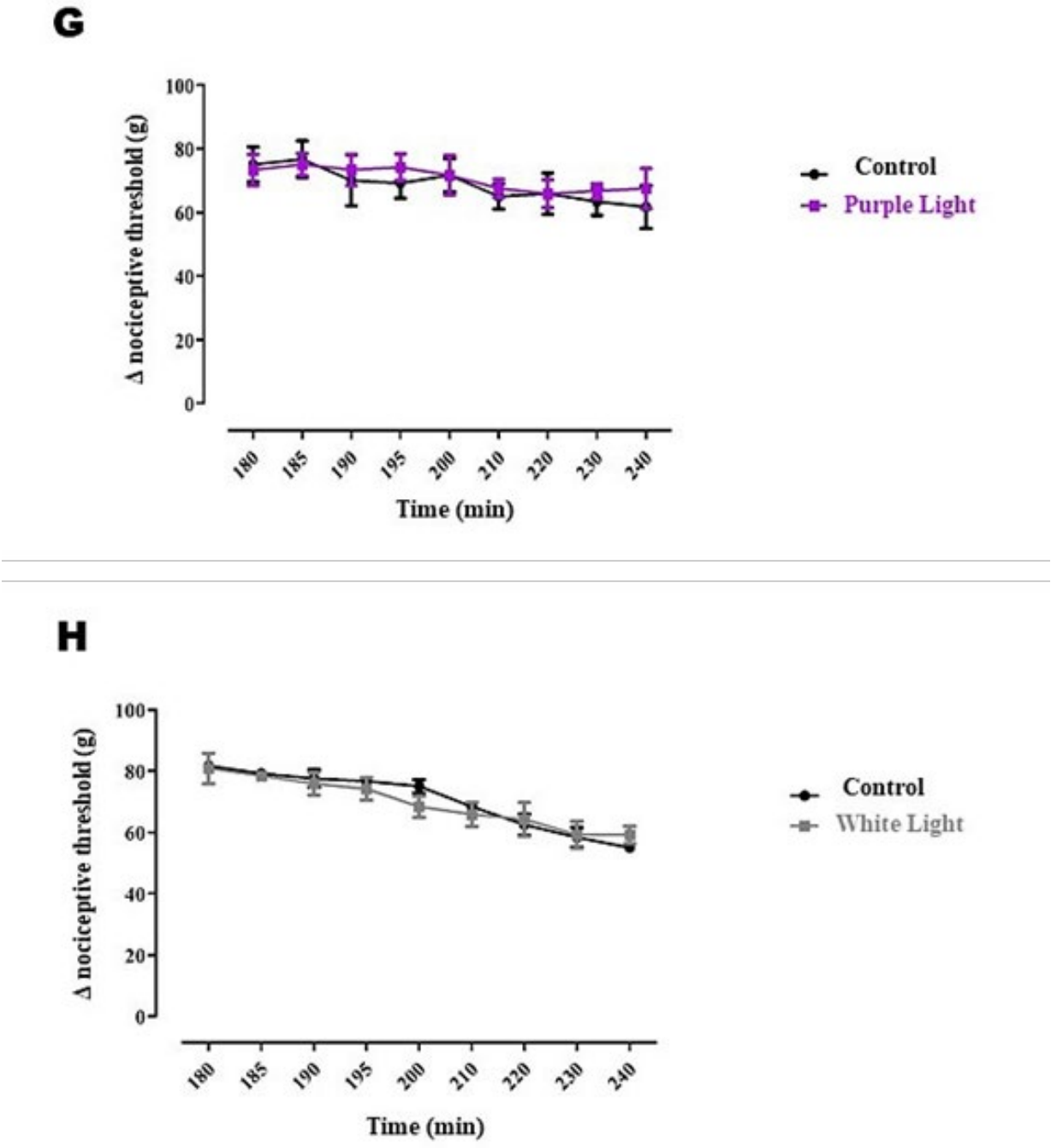

Figure 1: Effect of containment (A), blue (B), red (C), green (D), orange (E), yellow (F), violet (G) and white (H) light on carrageenan-induced hyperalgesia (CG; 250 μg/paw) in rats. CG was administered 2 hours and 40 minutes before the start of exposure, or not to light, which lasted 20 minutes. The hyperalgesia measurement was evaluated using a mechanical pressure method, initiated at the 3rd hour. Each point represents the standard error of the mean (n = 4). $p<0.05$, ANOVA + Bonferroni post-test for multiple comparisons.