Magnesium–Aluminum Hydroxide Suspension for the Treatment of Dermal Capsaicin Exposures

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Abstract

Objectives: To determine whether magnesium–aluminum-hydroxide–simethicone suspension (MgAl) is an effective treatment for dermal capsaicin exposures. **Methods:** The authors performed a double-blind, randomized, controlled, pilot study comparing the effect of MgAl with that of saline in the treatment of dermal capsaicin exposures. Ten volunteers were sprayed with a commercial defensive spray containing 10% capsaicin on the flexor surface of both forearms. A dressing embedded with MgAl (Maalox) suspension was randomly applied to one arm and a saline-embedded dressing was applied to the other arm. Pain was assessed on a 10-cm visual analog scale at 0, 10, 20, 30, 60, 90, and 120 minutes. **Results:** Mean pain scores were significantly lower in the MgAl group as compared with the saline (S) group at 10, 20, and 30 minutes. Differences in pain scores were not statistically significant at times 60, 90, and 120 minutes. **Conclusions:** During the initial 30 minutes of treatment, there was a statistically significant decrease in pain scores with MgAl as compared with saline treatments. Although the difference in means may have questionable clinical significance, MgAl is cheap and readily available, and has minimal side effects. Thus, MgAl may be an appropriate treatment for dermal capsaicin exposure.
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Many plants of the genus Capsicum produce capsaicin (trans-8-methyl-N-vannillyn-6-noneamide) and several closely related substances called capsanoids. Upon contact, these compounds can cause a burning sensation of the oral mucosa and the skin. This ability to cause local irritation has led to the development of commercial concentrated liquid solutions of capsaicin-containing products. These products are often marketed as self-defense agents and they have been included in many law enforcement arsenals. These products are considered to be able to subdue combative and violent humans and animals with less physical force than traditional methods. As the popularity of these agents grows, there are increasing reports of adverse events due to capsaicin-containing products, which have included corneal abrasions, respiratory failure, and possibly death.[1–3]

Recently, Herman and colleagues reported the successful use of magnesium–aluminum-hydroxide–simethicone suspension (MgAl; Maalox) in the treatment of seven patients with dermal capsaicin exposures.[1] The mechanism of action of MgAl in the treatment of capsaicin-induced symptoms is unclear. The release of substance P from the nerve cell is hypothesized to be mediated by cellular ion influx, since the release of substance P is inhibited by the removal of calcium ions from an experimental medium and stimulated by potassium ions. MgAl may exert its effect through an ion-mediated mechanism.[4–8] Presently, there are no reported controlled studies evaluating efficacy of MgAl as a treatment for capsaicin exposures. Our objective was to determine whether MgAl is an effective treatment for dermal capsaicin exposures.

METHODS

Study Design. We conducted a double-blind, randomized, controlled, prospective pilot study comparing MgAl with saline as treatments for capsaicin exposure. This study was approved by our institutional review board.

Study Protocol. Ten volunteers with healthy intact skin were sprayed with a commercially available "defensive" product containing 10% capsaicin (10% Pepper Guard, Mace Security Inc., Benington, VT) on the flexor surface of the right and left forearms simultaneously. An approximate 1-second burst was used on each forearm. A 10 cm × 10 cm cotton gauze embedded with room-temperature MgAl was applied to one arm and another gauze embedded with room-temperature saline was applied to the other arm. The treatment-embedded dressings were applied immediately after application of capsaicin. The subjects

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were not allowed to visualize the spraying of capsaicin or the dressing treatments. The subjects' arms were randomized to treatments.

Measures. Pain was assessed on a 10-cm visual analog scale (VAS) at 0, 10, 20, 30, 60, 90, and 120 minutes. Investigators administering the questionnaire were blinded to the treatment protocols.

Data Analysis. The subjects' VAS scores are reported as means with 95% confidence intervals (95% CIs) and compared by Student's t-test with a $p < 0.05$ considered statistically significant.

RESULTS

The means of the various times are shown in Table 1. Statistically significant differences in mean pain scores were noted at 10-, 20-, and 30-minute intervals. However, at no point was the difference of the means greater than 1.29 cm. Mean pain scores were consistently lower in the MgAl treatment arm, with the exception of the score 120 minutes. Peak mean pain scores occurred at 30 and 60 minutes in both arms.

DISCUSSION

When applied to the skin, capsaicin produces both afferent and efferent responses via capsaicin-sensitive sensory nerve fibers. Upon contact with the nerve terminal, capsaicin opens a cell membrane channel, which is permeable to both monovalent and divalent cations. This causes the generation of a sensory nerve impulse (pain) and the local release of neuromediators, especially substance P and calcitonin gene-related peptide (CGRP). These neuromediators can induce a neurogenic inflammatory state consisting of hyperemia, vasodilatation, plasma extravasation, and leukocyte adhesion to the vascular endothelium.[1,4–8]

Although the dermal effects of exposure to capsaicin have been well documented, there does not appear to be a treatment for this condition that is both effective and has a rapid onset. The most common remedies recommended for the relief of dermal symptoms have been cool tap water or vegetable oil massaged over exposed dermal areas. Neither of these treatments provides immediate, lasting relief, and few studies have compared the effectivenesses of these modalities.[1] One controlled study found cold water provided more rapid relief than vegetable oil, but the relief was not as long-lasting as in the vegetable oil group.[6]

TABLE 1. Mean Visual Analog Pain Scores (95% CI)

Minutes	MgAl* Treatment	Saline Treatment	p-value
0	0.89 (−0.19, 1.97)	1.33 (−0.34, 3.05)	0.22
10	1.60 (0.28, 2.92)	2.30 (0.68, 3.92)	0.02
20	2.40 (1.13, 3.67)	3.30 (1.87, 4.73)	0.01
30	3.30 (2.03, 4.57)	4.40 (2.85, 5.95)	0.01
60	3.20 (2.75, 3.65)	4.20 (2.99, 5.41)	0.70
90	3.17 (2.41, 3.93)	3.33 (2.61, 4.05)	0.70
120	1.89 (1.22, 2.50)	1.89 (1.33, 2.45)	1.00

*MgAl = magnesium–aluminum-hydroxide–simethicone suspension (Maalox).

In our study, MgAl appeared to be more effective than saline in reducing VAS scores of pain. Mean VAS scores of the MgAl treatment arm were consistently lower than the saline arm at all time measurements except at the 120-minute mark. There was a statistically significant reduction with MgAl as compared with saline treatments at times 10, 20, and 30 minutes. However, the mean of these points was less than 1.29 cm, which may have questionable clinical significance.

Prior studies assessing VAS scores have reported that a 1.3-cm difference in VAS scores is the minimum change in acute pain that is clinically significant. The clinical response of this score equated to a ''little more/less pain.'' In these studies assessing pain measurements, the authors concentrated on a measurement of a single painful stimulus over time.[9,10] In our study, we were comparing two treatments and measuring two sets of VAS scores simultaneously. Thus, the 1.3-cm cutoff for clinical significance may not apply in this setting.

All subjects were able to tolerate the capsaicin and the treatments, and no subjects dropped out. Since this treatment is cheap, has minimal side effects, and is readily available in hospital and out-of-hospital settings, MgAl may be an appropriate treatment for dermal capsaicin exposure.

LIMITATIONS

This was a pilot study using a small sample size, and this presents a significant limitation to routinely apply our conclusions. We did not compare MgAl with a true placebo. The use of saline may be similar to immersion in cold water, an established treatment; we did not meticulously control for the temperature of the treatments. We also did not meticulously control for amounts of capsaicin, saline, and MgAl delivered.

We designed this study to administer the two treatments at the same time. The pain caused on one of the patient's arms may have distracted the subject and altered the VAS score for his or her other arm. Future studies may use a crossover design or larger numbers of participants being tested with one treatment at a time.

Finally, we chose to study dermal exposures because there have been reported cases to support MgAl efficacy. Future studies should explore the use of MgAl in corneal exposures and the much more frequent, but often voluntary, oral mucosal exposures.

CONCLUSIONS

In our randomized, controlled, pilot study comparing MgAl and saline as treatments for dermal capsaicin exposure, we found a statistically significant pain relief with MgAl as compared with saline treatments at 10, 20, and 30 minutes. MgAl may be an appropriate treatment for dermal capsaicin exposure.

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Erratum

An error occurred in the spelling of an author's name in a reference citation in an article in the April 2003 issue of *Academic Emergency Medicine* (McClure KB, DeIorio NM, Gunnels MD, Ochsner MJ, Biros MH, Schmidt TH. Attitudes of emergency department patients and visitors regarding emergency exception from informed consent in resuscitation research, community consultation, and public notification. Acad Emerg Med. 2003; 10:352–9). In the text of the article, page 358, left column, second full paragraph, and in the reference list on page 359, reference number 13, first listed author, the correct spelling of the author's name is ''Baren'' (not Barren).