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Clinical Review

THE SAFETY OF TOPICAL ANESTHETICS IN THE TREATMENT OF CORNEAL ABRASIONS: A REVIEW

Anand Swaminathan, MD, MPH,* Karalynn Otterness, MD,* Ken Milne, MD,† and Salim Rezaie, MD‡

*Department of Emergency Medicine, New York University School of Medicine/Bellevue Hospital, New York, New York, †Schulich School of Medicine and Dentistry, Western University, London, Ontario, Canada, and ‡University of Texas Health Science Center, San Antonio, Texas
Reprint Address: Anand Swaminathan, MD, MPH, Department of Emergency Medicine, New York University School of Medicine/Bellevue Hospital, 462 1st Ave, OBV-A341, New York, NY 10016

☐ **Abstract—Background: Despite the fact that topical anesthetics provide superb analgesia to the painful eye, they are not prescribed routinely to patients when they are discharged from the emergency department because of concerns for delayed healing and corneal erosion. Objective: To summarize the evidence for the safety of topical proparacaine and tetracaine for pain relief in patients with corneal abrasions. Methods: This is a systematic review looking at the use of topical anesthetic agents in the treatment of corneal abrasions in the emergency department. Results: Our literature search produced two emergency department–based, randomized, double blind, placebo-controlled studies on human patients with corneal abrasions. Additionally, we found four studies that investigated the application of topical anesthetics in patients who underwent photorefractive keratectomy. All six studies demonstrated that a short course of dilute topical anesthetic provided efficacious analgesia without adverse effects or delayed epithelial healing. Conclusion: Limited available data suggests that the use of dilute topical ophthalmologic proparacaine or tetracaine for a short duration of time is effective, though their safety for outpatient use is inconclusive.** © 2015 Elsevier Inc.

☐ **Keywords—corneal abrasions; topical anesthetic; tetracaine; proparacaine**

INTRODUCTION

Corneal abrasions account for approximately 10% of eye-related visits to the emergency department (ED), making them one of the most common eye-related presentations (1) The cornea is highly innervated, and even small abrasions can cause substantial pain. Pain control is one of the fundamental goals of emergency medical care. The first documented use of topical ophthalmologic anesthetics was in 1818. A cocaine derivative (erythroxylum coca) was used to effectively block nerve conduction in the superficial cornea and conjunctiva (2).

A number of proposed dangers, however, limit the use of topical anesthetic agents for the treatment of corneal abrasion associated pain. These dangers include delayed healing secondary to mitosis inhibition and decreased corneal sensation. The latter issue is of concern because of the potential for the abrasion to progress to an ulcer without the patient noticing. In addition, these agents may have direct toxicity to corneal epithelium with prolonged use, leading to increased corneal thickness, opacification, stromal infiltration, and epithelial defects. The fear of these complications has led to the pervasive teaching that topical anesthetics should never be used for the outpatient management of corneal abrasions and is reflected in the condemnation of their use in major emergency medicine (EM) textbooks, including *Rosen's Emergency Medicine* and *Tintinalli's Emergency Medicine*.

Scant literature defends the theoretical harms of topical anesthetic agents. In addition, recent evidence demonstrates safety of this pain control modality. This article reviews the historical basis for the recommendation against

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the use of topical anesthetics as well as the increasing amount of literature demonstrating its safety.

MATERIALS AND METHODS

We performed a systematic search using PubMed and EMBASE. Our search included the terms proparacaine, tetracaine, and corneal abrasion. Our search resulted in 38 citations. Three investigators evaluated trial eligibility. We included all prospective, human trials that were randomized, double-masked, or observational and that used the topical anesthetics tetracaine or proparacaine. All studies in animals, articles not written in English, case reports, and case series were excluded and not evaluated in this publication. Case reports and series are near the bottom of the evidence-based medicine hierarchy, just above expert opinion. These types of reports and series are at high risk of various forms of bias. Conflicting opinions exists whether to include this form of evidence in systematic review. Our opinion is the bias of case reports and series justify their exclusion.

This search strategy identified two trials that were relevant to our question (Figure 1). We also reviewed the references in both of these trials, looking for studies that were otherwise missed, but none were found. We did find four studies in which authors discussed the use of topical anesthetic agents in patients who underwent photorefractive keratectomy (PRK). In PRK, a laser is used to ablate a portion of the corneal stroma, which creates a defect in the epithelium that is functionally similar to a corneal abrasion. Although the lesion created by this procedure is not identical to that reported in spontaneous corneal abrasions, we reviewed and analyzed these articles as well because of the dearth of literature on our core question.

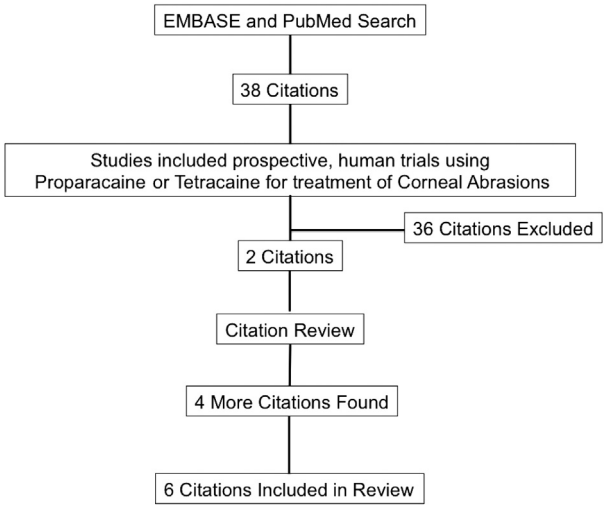

Figure 1. Search strategy.

RESULTS

Our search of the literature produced two studies in humans (149 patients) in which investigators evaluated the effectiveness and safety of topical anesthetics in patients presenting to the ED with corneal abrasions (Table 1). We also identified four studies from the ophthalmology literature evaluating the usefulness of topical anesthetics after PRK (Table 2).

Verma et al. published two studies in which they evaluated all patients receiving topical anesthetics after PRK for epithelial closure and pain control. In the 1995 study by Verma et al., pain was much better controlled in the topical tetracaine group vs. placebo (3). Both groups of patients had 10 of 10 pain after surgery on the Visual Analog Pain Chart. Instillation of tetracaine reduced the pain from 10 to 2.5, whereas the placebo group's pain only reduced from 10 to 6.5. There was no difference in rate of epithelial closure, with both groups having complete closure at 72 h. At 1-week follow-up, patients were asked whether their postoperative period was "painful" or "not painful." Although 85% of patients who received placebo stated that the postoperative period was "painful," only 39% who received tetracaine stated their postoperative period was "painful."

In a follow-up study by Verma et al. in 1997, a comparison of 0.75% bupivacaine vs. 1% tetracaine was performed (4). Again, full epithelial closure was noted in both groups at 72 h, whereas pain control for both groups was similar. Pain was rated on a 1–10 scale, with the tetracaine group having a maximum pain score of 3.5 compared with 5.5 in the bupivacaine group.

Another 1997 ophthalmology study by Shahinian et al. aimed to determine whether there is a nonanesthetic and nontoxic concentration of topical proparacaine to reduce pain after PRK (5). Patients who had PRK were asked about pain control 1 week after the procedure with 0.05% proparacaine or placebo; 92% of patients in the proparacaine group found the drops to be helpful in pain control, whereas only 30% of patients experienced pain control in the placebo group. There was no difference between the two groups in the number of days needed to reach complete epithelial healing.

The final ophthalmology study was by Brilakis and Deutsch in 2000, in which they evaluated the efficacy and safety of 0.5% tetracaine for pain control and epithelial healing (6). Again, none of the patients had epithelial defects when evaluated 3 days postoperatively after use of tetracaine. Two limitations of this study are the lack of a placebo group and the fact that the number of tetracaine drops used was minimal.

There have been two ED-based studies that evaluated the safety of topical anesthetics for corneal abrasions. In