Full-Face Laser Resurfacing Using a Supplemented Topical Anesthesia Protocol

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Background: Laser resurfacing has become a popular modality for the treatment of photodamaged skin, rhytids, and acne scarring. In many cases, this procedure is performed under general anesthesia or intravenous sedation in conjunction with nerve blocks and local infiltration.

Objective: To evaluate the safety and efficacy of facial carbon dioxide laser resurfacing using a supplemented topical anesthesia protocol.

Design: Nonrandomized case series of patients observed for 1 year.

Setting: Outpatient surgery center.

Patients: Two hundred consecutive patients undergoing treatment for facial rhytids or acne scarring.

Intervention: Full-face carbon dioxide laser resurfacing procedures were performed using a supplemented topical anesthesia protocol. Pretreatment medications included diazepam, oral analgesics, and intramuscular ketorolac tromethamine.

Main Outcome Measures: Tolerability of procedure, healing times, and adverse effects.

Results: Topical anesthesia provided effective and sufficient anesthesia in most cases. Only 10 of 200 patients required additional anesthesia (regional nerve blocks and/or local infiltration). Substantial improvement of rhytids, photodamage, and acne scarring was observed. Posttreatment hypopigmentation was seen in 1 patient. Scarring was not observed.

Conclusion: A supplemented topical anesthesia protocol for full-face laser resurfacing is a safe and effective alternative to traditional anesthesia strategies.

Arch Dermatol. 2003;139:1279-1283

Carbon dioxide laser resurfacing of the face is an effective and well-established treatment of rhytids, photodamaged skin, and acne scarring. Because this procedure involves removal of the entire epidermis and upper portions of the dermis, carbon dioxide laser resurfacing requires adequate anesthesia to maximize tolerability. Traditionally, general anesthesia or regional nerve blocks (with or without intravenous sedation and regional infiltration) have been used. Regional anesthesia of the face has also been used for laser resurfacing. While effective and efficient, regional nerve blocks require multiple needle injections causing many patients unwanted discomfort and anxiety. Furthermore, regional nerve blocks often leave “skip areas” that are deficient in analgesia. Some researchers have advocated the use of tumescent anesthesia as an adjuvant to nerve blocks. While effective, tumescent anesthesia often requires multiple needlesticks and may increase the cumulative dose of lidocaine. While this infiltration of dilute lidocaine is unlikely to cause toxic effects, postoperative edema is markedly increased.

With the emergence of laser procedures, a corresponding need for topical anesthesia has arisen. The most common of the various preparations, EMLA (a proprietary acronym for eutectic mixture of local anesthetics; AstraZeneca Pharmaceuticals LP, Wilmington, Del), has been used successfully for a variety of procedures, including venipuncture, treatment of molluscum contagiosum, shave biopsies, excisional biopsies, split-thickness skin grafts, and debridement of venous leg ulcers. Laser treatments for vascular lesions have also been performed using topical anesthesia. Previously, there have been a number of studies using erbium:YAG laser resurfacing with topical anesthesia alone. The results, however, have been mixed, with 1 study showing that most patients required additional anesthetic infiltration. While erbium:YAG resurfacing is
After informed consents were obtained, 200 consecutive full-face carbon dioxide laser-resurfacing procedures were performed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 performed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 forformed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 forformed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 forformed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 forformed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 forformed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 forformed using topical anesthesia. 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METHODS

After informed consents were obtained, 200 consecutive full-face carbon dioxide laser-resurfacing procedures were performed using topical anesthesia. The demographics of the patient population were as follows: 193 women, 7 men; 181 managed using this protocol. Finally, our results demonstrate an excellent safety profile, with very low rates of hypopigmentation and scarring.

Supplemented Topical Anesthesia Protocol

1. After washing face and placing hot compresses for 10 minutes, patient applies 30 g of EMLA cream to face under occlusion.
2. Ninety minutes later, patient is given 1-2 tablets of 5-mg hydrocortisone/500-mg acetaminophen po, 5-10 mg of diazepam po, and/or 30-60 mg of ketorolac IM. An additional 30 g of EMLA cream is applied under occlusion. Anatomic areas are covered with individual pieces of plastic wrap. Special care is taken to avoid any skip areas.
3. Forty-five to 60 minutes later, laser resurfacing is performed. Plastic wrap from 1 area is removed, and the EMLA cream is wiped dry with gauze immediately prior to treatment. When possible, repeat passes are performed on same area before moving to the next quadrant.

Abbreviations: EMLA, eutectic mixture of local anesthetics; IM, intramuscularly; po, by mouth.

more superficial, carbon dioxide resurfacing produces deeper thermal injury, presenting a greater challenge for adequate pain control.

We report here the use of EMLA in a supplemented topical anesthesia protocol specific for full-face carbon dioxide laser resurfacing. With a treatment group of 200 patients, we demonstrate that this method of anesthesia is safe and tolerable. Substantial improvement of rhytids, photodamage, and acne scarring was achieved using this protocol. Finally, our results demonstrate an excellent safety profile, with very low rates of hypopigmentation and scarring.

RESULTS

ANESTHESIA

Under our supplemented topical anesthesia protocol, 95% of patients (190/200) did not require additional pain control. Patients were continuously monitored for pain. When pain or discomfort occurred during the procedure, patients were immediately offered additional anesthesia. Whenever possible, a low threshold to add adjuvant anesthesia was maintained. Only 5% of patients (10/200) required nerve blocks (infraorbital, mandibular, and/or supratrochlear). Only 1 patient required localized infiltration of 1% lidocaine. While the vast majority of patients noted minimal discomfort during the first pass, additional passes were associated with somewhat more discomfort, especially in perioral areas.

EFFICACY

Patients with rhytids, photodamage, and acne scarring were treated in this study. All treated patients had substantial improvement of their conditions. For patients with photodamage and rhytids, representative treatment results are seen in Figure 1.

POSTOPERATIVE COURSE

Complete reepithelialization occurred at the following rates: 21% (41) by day 6, 89% (178) by day 7, 96% (191) by day 8, and 100% (200) by day 9. In 7 patients, postoperative infections occurred (6 bacterial and 1 herpes simplex virus), all of which resolved with modifications of antimicrobial treatment. Contact dermatitis was seen in 2 patients.

IMMEDIATE ADVERSE EFFECTS

Immediate adverse effects from using EMLA were not seen. Symptoms and signs of lidocaine toxic effects such as vertigo, metallic taste, tachypnea, tachycardia, and central nervous system depression were not observed. Symptoms and signs of methemoglobinemia, a known complication of EMLA application in children, were not observed. As indicated in the following tabulation, corneal damage from contact with topical anesthesia was not seen:

<table>
<thead>
<tr>
<th>Adverse Effect of EMLA Treatment</th>
<th>No. (%) of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs of lidocaine toxic effects</td>
<td>0</td>
</tr>
<tr>
<td>Corneal damage</td>
<td>0</td>
</tr>
<tr>
<td>Infection</td>
<td>7 (4)</td>
</tr>
<tr>
<td>Contact dermatitis</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Hyperpigmentation</td>
<td>28 (14)</td>
</tr>
<tr>
<td>Hypopigmentation</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Scarring</td>
<td>0</td>
</tr>
</tbody>
</table>
DELAYED ADVERSE EFFECTS

Transient hyperpigmentation was seen in 18% of patients (31 mild, 4 moderate), resolving in 8 to 10 weeks. Hypopigmentation was seen in 1 patient at 12 months. The hypopigmentation involved an area smaller than 8 cm² along the mandibular line. Scarring was not observed.

HISTOLOGIC STUDIES

Biopsy specimens were taken from EMLA-treated skin and skin to which EMLA had not been applied in 3 patients. In all 3 patients, the results were similar. The maximum depths of thermal damage were similar where EMLA was applied and where it was not (Figure 2). While skin without EMLA displayed confluent superficial thermal

Figure 1. A and C, Photographs representing the skin of 2 of our patients before full-face laser resurfacing using our supplemented topical anesthesia protocol. B and D, Same patients after treatment. Note the improvement of rhytids, photodamage, and dyspigmentation.
necrosis, EMLA-treated skin displayed patchy thermal necrosis superficially (Figure 2). Both EMLA-treated skin and skin to which EMLA was not applied demonstrated deeper thermal damage with islands of sparing (Figure 2).

**COMMENT**

In this report, we demonstrate the safety and efficacy of topical anesthesia for full-face carbon dioxide resurfacing. This large group of patients tolerated the procedure with minimal pain, and only 5% of patients required adjuvant anesthesia in the form of nerve blocks or local infiltration. While additional patient comfort was achieved by administering the described preprocedure cocktail, neither intravenous sedation nor intravenous analgesics were necessary.

Carbon dioxide laser resurfacing ablates tissue in a controlled and predictable fashion. Studies have shown that the UltraPulse 5000 laser used at 450 mJ and 5 W ablates 20 to 30 µm of tissue after a single pass, with an additional 20 to 70 µm of thermal coagulation necrosis after 1 to 3 passes. While sufficient anesthesia likely requires anesthetic depths deeper than the sum of ablated and thermally necrotic tissue (approximately 100 µm), this summative depth is the absolute minimum. This minimum depth is far exceeded by the capable depth of anesthesia produced by EMLA. One study showed that anesthesia depths of up to 5 mm could be achieved 2.5 hours after application. Hence, the development of optimized protocols can drastically affect the depth of EMLA efficacy and ultimately its potential utility as a solo agent.

In the present study, there were no adverse effects seen with topical EMLA. Previous studies have shown that a 3-hour, 60-g EMLA application (2.5 hours, 60 g used in the present protocol) produced peak blood levels of lidocaine and prilocaine that are 1% and 0.6% of systemic toxic levels, respectively. The most important adverse effect of EMLA is methemoglobinemia, which has mostly been seen in infants. None of our patients exhibited any symptoms or signs of cyanosis. Other unusual adverse effects, including contact dermatitis and eye injury, were not observed.

The vast majority of patients were fully reepithelialized by day 7. Reduction of rhytids, photodamage, and acne scarring was evident and substantial. At this time, it is not known whether the application of EMLA affects the efficacy of carbon dioxide laser resurfacing. Ongoing studies comparing the posttreatment results of hydrated and nonhydrated skin should resolve this issue.

Post–carbon dioxide resurfacing adverse effects were unusually low with topical anesthesia. Only 1 patient (1%) was found to have hypopigmentation at 1 year. Scarring was not observed. One explanation for the excellent safety profile is the hydrating effect of topical EMLA application. Because the target for the carbon dioxide laser is water, this hydration may be protective. Histologic studies were performed to explore this issue. While EMLA-treated skin and skin without EMLA revealed similar depths of thermal damage, EMLA-treated skin displayed nonconfluent superficial thermal damage. This uneven thermal damage with islands of normal tissue may explain the low rate of scarring and hypopigmentation.

In summary, carbon dioxide laser resurfacing can be performed comfortably, effectively, and safely using the supplemented topical anesthesia protocol described here. Preliminary data suggest that the hydrating effects of topical anesthesia may contribute to the low rate or absence of hypopigmentation and scarring.

Accepted for publication April 30, 2003.
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**REFERENCES**


35. van den Hove J, Decroix J, Tennstedt D, Lachapelle JM. Allergic contact dermatitis from prilocaine, one of the local anaesthetics in EMLA cream. Contact Dermatitis. 1994;30:239.
