Cutaneous CO\textsubscript{2} Laser Resurfacing Infection Rate With and Without Prophylactic Antibiotics

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BACKGROUND. Cutaneous laser resurfacing is a well-accepted modality, with excellent clinical outcomes and low morbidity rates, for the treatment of a variety of epidermal and dermal lesions. The use of antibiotic prophylaxis continues to be an area of controversy, with laser practitioners divided in their approach.

OBJECTIVE. To identify the rate of postoperative bacterial infection following full-face carbon dioxide (CO\textsubscript{2}) laser resurfacing with and without antibiotic prophylaxis.

METHODS. A retrospective chart review of 133 consecutive patients following full-face CO\textsubscript{2} laser resurfacing was performed. The rate, severity, duration, and subsequent treatment of bacterial infections observed in four treatment categories were recorded: (1) no antibiotic prophylaxis; (2) intraoperative single-dose intravenous cephalixin (1 g); (3) postoperative oral azithromycin (1.5 g over 5 days); (4) intraoperative IV cephalixin (1 g) and postoperative oral azithromycin (1.5 g).

RESULTS. A significantly higher rate of infection occurred in patients receiving combination intraoperative and/or postoperative antibiotic prophylaxis. The most frequently cultured organisms included Enterobacter and Pseudomonas species.

CONCLUSION. The rate of postoperative bacterial infections after full-face CO\textsubscript{2} laser resurfacing in this retrospective study was not significantly reduced with the use of prophylactic antibiotics.

CUTANEOUS LASER resurfacing is currently a well-accepted treatment for rhytides, acne scars, and other skin imperfections. Although excellent postoperative clinical outcomes are common, various side effects and complications including, but not limited to, cutaneous bacterial infections have occurred. Because laser skin resurfacing produces integumental injury, proper wound healing remains essential to obtain optimal results.

The development of wound infection in dermatologic surgery is influenced by a number of factors, including wound location, concomitant skin infection, intraoperative aseptic technique, and the patient's overall nutritional and immunologic status. Infection after cutaneous laser resurfacing has been associated with prolonged postoperative erythema and a higher risk of scarring. Infected wounds do not heal properly due to the innate limitations of tissue repair. The degree to which the administration of antibiotic prophylaxis mitigates the development of wound infection remains inconclusive and controversial. At the center of the controversy is the absence of a definitive study demonstrating its efficacy.

Antibiotic prophylaxis in surgery refers to the administration of antimicrobial agents to surgical patients who do not have an established infection, with the ultimate goal being a reduction in postoperative wound infection or other infectious sequelae. The choice of antibiotic depends on its activity against likely endogenous flora, its inherent toxicity, and its cost. The incidence of infection in clean surgery (surgery with no major contamination of the operative site) is less than 2%. Despite such a low rate of infection, the overwhelming opinion expressed in the medical literature (which parallels discussions in the lay press) is that the medical community continues to overadminister antibiotics. While it remains difficult to establish general management policies when analyzing retrospective studies (as opposed to controlled prospective studies), retrospective reports are often the only ones available on which to base patient management decisions. Accepted indications for administering prophylactic antibiotics include "clean-contaminated" procedures, but new indications that take into consideration wound contamination, together with the anesthetic risk and the relative duration of the operation, are being determined. The purpose of this study was to help elucidate the role of antibiotic prophylaxis in extensive (full-face) cutaneous laser resurfacing procedures.

Materials and Methods

All records of patients undergoing full-face carbon dioxide (CO\textsubscript{2}) laser resurfacing for the treatment of facial rhytides, atrophic scars, and photoaged skin from January 1, 1995 to June 30, 1998 were reviewed for postoperative bacterial infections. A retrospective analysis of 133 consecutive full-face
Table 1. Proportion of Patients with Postoperative Bacterial Infections

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of infections</th>
<th>p value (versus control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Category</td>
<td>14 (0%)</td>
<td>N/A</td>
</tr>
<tr>
<td>IV Only Total Category</td>
<td>7 (14.3%)</td>
<td>0.3333</td>
</tr>
<tr>
<td>Oral Only Category</td>
<td>20 (0%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Oral + IV Category</td>
<td>92 (20.7%)</td>
<td>0.0689</td>
</tr>
<tr>
<td>Total</td>
<td>133 (20%)</td>
<td>0.0404</td>
</tr>
</tbody>
</table>

CO₂ laser resurfacing patients (14 men, 119 women, average age 41 years) was performed by a single investigator (SW). An infection was defined as the presence of a positive bacterial culture with clinical signs and symptoms of infection.

All CO₂ laser procedures were performed using identical laser parameters and techniques. No particular preoperative skin preparation was prescribed prior to laser irradiation; however, 20% of the patients were using a topical glycolic or retinoic acid maintenance regimen on a daily basis. No patients had a prior history of immunologic disease or problems with wound healing. Immediately prior to the laser resurfacing procedure, the entire face was cleansed with a nonalcoholic facial cleanser and thoroughly rinsed with water. Betadine was used to prepare the skin using standard techniques. Intraoperatively, partially desiccated tissue was manually removed after each laser pass using sterile saline-soaked gauze. An “open” postoperative wound care regimen involving round-the-clock application of ice water compresses and Catrix-10 or Aquaphor ointments in order to maintain a moist wound environment was used by each patient. Residual serous exudate and crusting was removed with gentle in-office steaming and dilute hydrogen peroxide and acetic acid compresses on a daily basis, beginning on the third or fourth postoperative day.

Four different antibiotic prophylaxis categories were identified: (1) no antibiotic prophylaxis; (2) intraoperative single-dose intravenous cephalexin (1 g); (3) postoperative oral azithromycin (1.5 g over 5 days); (4) intraoperative IV cephalexin (1 g) and postoperative oral azithromycin (1.5 g over 5 days). All patients also received antiherpetic prophylaxis with either acyclovir 400 mg by mouth three times a day or valacyclovir 250–500 mg twice a day. The rate of bacterial infection was determined for each category (Table 1). Initiation dates and duration of infection with subsequent treatment regimens were recorded and analyzed (Table 2).

**Results**

Over the 3-year period, 133 full-face CO₂ laser resurfacing procedures were performed. Category 1 (no
prophylaxis) included a total of 14 patients in whom no infections occurred (0%). Seven patients were treated with intraoperative cephalexin (category 2), one of whom developed apparent toxic shock syndrome on the sixth postoperative day without evidence of cutaneous infection. No other cutaneous infections were noted in this group. Twenty patients were treated with oral postoperative azithromycin (category 3) without infection (0%). Ninety-two patients received intraoperative cephalexin and postoperative azithromycin (category 4), with 19 patients (21%) developing a bacterial infection. Infections were observed 4–12 days postoperatively (mean 6 days). The most commonly cultured pathogens were Enterobacter \( (n = 8) \), Pseudomonas aeruginosa \( (n = 7) \), and Staphylococcus aureus \( (n = 5) \). Two individuals in category 4 also had mucocutaneous herpes simplex reactivation and another category 4 patient had concomitant cutaneous candidiasis in the laser-irradiated skin. Infection with multiple bacterial pathogens were seen in four patients—a combination of gram-negative and gram-positive organisms being most common. Two patients were infected with two different gram-negative organisms. A significantly higher rate of infection (24%) occurred in patients receiving combination intraoperative and postoperative antibiotic prophylaxis compared to that seen in the non-antibiotic-treated group. Two-sided statistical analysis of data revealed that the infection rates differed between antibiotic-treated patients and control untreated patients \( (p < .06) \).

**Discussion**

A major area of concern for dermatologic surgeons is determining the circumstances under which antibiotics should be prescribed in order to prevent or reduce the incidence of postoperative wound infection. Antimicrobial prophylaxis in any surgery is deemed necessary in situations where there is a high risk for postoperative infection and/or if the anticipated postoperative infection is potentially severe. Clean wounds created in uncontaminated sterile skin generally exhibit infection rates lower than 5%, whereas “clean-contaminated” wounds, which occur in contaminated areas (eg, perineum, oral mucosa) or as a result of minor breaks in septic technique, are associated with infection rates of 10%. On the basis of standard criteria, the wound after laser resurfacing should be considered “clean uncontaminated.” It is not until a wound is “contaminated” that unacceptably high (20–30%) rates of infection are seen. Previous studies have shown that surgical procedures such as laser vaporization on noninfected skin have a very low rate (0.5–4.5%) of postoperative infection. Srirachya-Anunt et al, first reported postlaser infection rates as high as 4.3%, presumably due to the use of a “closed” postoperative dressing technique. Despite the use of prophylactic ciprofloxacin, these same investigators showed in a later retrospective study an infection rate of 8.2%. Other investigators demonstrated postoperative bacterial infection rates ranging from 0% to 1%, using predominantly an “open” wound care regimen. Only one prospective study assessing postoperative infection rates with laser resurfacing has been reported in which the authors support the use of prophylactic narrow-spectrum antibiotics. However, the number of extensive (full-face) laser procedures analyzed in this latter study were few and information regarding predisposing risk factors for infection were not disclosed.

In our study the rate of postoperative infection was not significantly reduced with the use of prophylactic oral and/or intravenous antibiotics in the peri- or postoperative period. Additional chi-squared analysis comparing the antibiotic-treated and untreated groups with respect to possible risk factors for infection, including patient age and presence of comorbidity (eg, diabetes, corticosteroid use), failed to demonstrate differences that could account for the variable infection rates seen. All groups were also found to be comparable with respect to the use of topical ointments and oral antiviral treatments.

Known adverse effects of antibiotic prophylaxis include drug-associated toxicities, suprainfection, gastrointestinal upset, and allergic reactions. The development of antimicrobial resistance to prescribed antibiotics is another realistic concern, as cutaneous CO\(_2\) laser resurfacing produces a wound bed similar to that of a partial-thickness burn, with creation of sparsely vascular residual tissue which may limit the ingress of host defense factors and systemically administered antibiotics.

The intense public and medicolegal pressure to use prophylactic antibiotics creates an ideal environment for the development of bacterial resistance. Because antibiotic prophylaxis does not intuitively appear to be necessary to compensate for infection rates of less than 5%, emphasis should be placed on strict adherence to aseptic surgical technique rather than on antibiotic prophylaxis. Prophylactic antibiotics will not surpass the importance of surgical skill, and if the bacterial challenge is sufficiently high, or if the patient’s resistance is sufficiently low, prophylactic antibiotics will not prevent the development of an infection.

In fact, published studies on antibiotic prophylaxis have demonstrated that a single preoperative dose of an appropriate antimicrobial agent provides optimal prophylaxis and postoperative doses yield no further benefit. The Medical Letter on Drugs and Therapeutics states that “a single dose of a parenteral antimicrobial given within 30 minutes of an operation usually provides adequate tissue concentrations throughout the
procedure; postoperative administration of prophylactic drugs is usually unnecessary and may be harmful."17

Most investigators involved in surgical antibiotic research are in general agreement that postoperative antibiotic use beyond 24 hours increases the risk of bacterial resistance and increases the potential for drug toxicity.9

Along the same line, the general consensus among burn specialists is that systemic antibiotic prophylaxis is unwarranted in the management of burn wounds. The fact that bacteria traditionally isolated from burn wounds is virtually identical to those species isolated from the patients in our study confirms categorization of the laser-induced wound as a "burn" wound and gives further strength to the argument against prophylactic antibiotic use. Several comparative studies have been performed on the treatment of extensive burns with and without antibiotics, all of which show no objective evidence that antibiotics reduce the incidence of infections, complications, or the mortality rate.18-21 Improved survival rates of burn victims has been shown to be most dependent on good wound care rather than on prophylactic antibiotic use.22 In fact, only a small percentage (2-5%) develop infections even when no systemic prophylaxis is used.23,24

In summary, the results of this retrospective study demonstrated that the rate of postoperative infections following full-face CO2 laser resurfacing is not significantly reduced with prophylactic antibiotic use. While the number of patients evaluated in each group were not equal (thereby making the result difficult to interpret), the study raises the concern that pre- and/or post-operative antibiotic use may increase the incidence of antibiotic resistance and predispose the patient to infections with organisms of increased pathogenicity. For routine dermatologic laser surgery without complicating host or environmental factors (class 1: clean, uncontaminated wounds), prophylactic antibiotics appear to be unnecessary, particularly if appropriate postoperative wound care is being followed.

While this retrospective study is not intended to establish general management policies, its results are consistent with a trend that mitigates against the use of prophylactic antibiotics in class 1 clean uncontaminated wounds. In order to reach a definitive conclusion on this issue, however, a well-controlled prospective study is necessary.

References
13. Sriprachya-Anunt S, Fitzpatrick RE, Goldman MP, Smith SR. In-
Antibiotic prophylaxis is generally considered for two indications. One is to prevent sub-acute bacterial endocarditis and infection of various prostheses and transplants. The second indication is to prevent wound infection. Despite the availability of antibiotics for more than fifty years, the efficacy of antibacterial prophylaxis has been controversial for both of these indications. This is especially true in dermatologic surgery. In the area of prevention of wound infection by antibacterial use can decrease the rate of wound infection. Accepted use of antibiotic therapy in this setting is to give one preoperative dose of the antibacterial agent. None of these studies specifically addressed cutaneous surgery. Surgery involving only the skin and superficial subcutaneous tissue in non-contaminated areas is associated with a very low rate of infection. In this author’s practice it is possible that the antibiotic prophylaxis may in fact promote infection by altering the normal skin flora and allowing for a super infection with typically non-responsive organisms. As the authors state and this author agrees strongly, the most important aspect of prevention of postoperative wound infection in CO₂ laser resurfacing (and in any surgical procedure) is meticulous and expert surgical technique followed by appropriate postoperative care and close follow-up. This author does not and has never used prophylactic antibiotics in resurfacing procedures. Unquestionably an occasional infection occurs. Because we follow our patients closely these are picked up, cultured, and appropriately treated. With early diagnosis and treatment these infections do not result in increased long-term complication and only a minimal delay in the overall recovery process. Dr. Walia and Dr. Alster use an open dressing technique postoperatively. This author uses a closed technique. It was reported by Goldman et al. that the use of occlusive dressings increases the rate of infection postoperatively in resurfacing procedures. In their study the dressing was applied and left in place intact for one week. This resulted in approximately a doubling of the postoperative infection rate. In our practice we change the occlusive dressing at day one and three and discontinue its use at day five. Meticulous cleansing occurs at each dressing change. Employing this technique we have not exhibited an increase rate of infection postoperatively in our resurfacing patients. Drs. Walia and Alster support a long held belief by this author that prophylactic antibiotics are neither necessary nor indicated in laser resurfacing patients and may in fact promote infection along with the other problems associated with widespread antibiotic use. While this is not a popular finding I applaud their forthright reporting of their experience and hope that the readers will respond appropriately. The most effective preventive activities we can take against wound infection is precise surgical technique and close postoperative follow-up and antibiotics are certainly no substitute for either of these actions.

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