Treatment of Nevus of Ota by the Q-switched Alexandrite Laser

TINA S. ALSTER, MD
CARMEN M. WILLIAMS, MD

BACKGROUND. The Q-switched alexandrite laser (755 nm, 100 nanoseconds) selectively targets and destroys cutaneous pigment such as that found in dermal pigmented lesions and tattoos. The nevus of Ota is a benign dermal melanocytic lesion, which, due to its large size and periorbital location, has been notoriously difficult to treat. Utilizing the principles of selective photothermolysis, the alexandrite laser could effect an excellent treatment for nevus of Ota.

OBJECTIVE. To report the effectiveness of the Q-switched alexandrite laser in treating nevus of Ota.

METHODS. Seven patients with nevus of Ota were treated with the Q-switched alexandrite laser (755 nm, 100 nanoseconds) with energy densities ranging from 4.75 to 7.0 J/cm² at 8–12-week intervals. Response to therapy was evaluated through independent observation and rating of sequential photographs by two blinded observers. Histologic examinations of lesional skin biopsies before and after completion of laser treatments were performed.

RESULTS. An average of two laser treatments were required to effect an average clinical improvement of 50%. Five patients showed 100% lesional clearance after an average of five treatments. No scarring, textual changes, or pigmentedary side effects were observed in treated skin. Histology of laser-irradiated lesions revealed elimination of upper dermal pigmentation without epidermal disruption, and rare melanophages and pigmented spindle cells in the deep reticular dermis. No lesional recurrences were observed up to 1 year following treatment.

CONCLUSION. The Q-switched alexandrite laser can effectively eliminate nevus of Ota without untoward side effects, such as scarring. Dermatol Surg 1995;21:592-596.

Nevus of Ota is a benign dermal melanocytic lesion that is usually unilateral and is distributed along the paths of the first and second branches of the trigeminal nerve. It most commonly affects Asians, with an incidence of 0.2–0.6% in the Japanese population. Many lesions are present at birth, but most appear by the second decade of life. Females are five times more likely to be affected. While most lesions are uncomplicated, malignant degeneration has been reported on rare occasions.

Many individuals affected with nevus of Ota seek treatment to eliminate their lesions because of the physical disfigurement and psychosocial trauma their marks impart. Several treatments have been advocated in the past, including surgical excision, dermabrasion, chemical peels, and cryosurgery, however, all have been associated with significant scarring and permanent pigmentedary alteration. In recent years, laser surgery treatment for these lesions has been advocated.

Certain lasers that can selectively target pigment-containing melanocytes have revolutionized the treatment of a variety of benign pigmented lesions. The process whereby light is preferentially absorbed in a target with heat production leading to the target's ultimate destruction is termed “selective photothermolysis,” a theoretical concept first introduced by Anderson and Parrish in the early 1980s. Various lasers have shown the capacity to selectively destroy cutaneous pigment, including the ruby, Nd:YAG, pulsed dye, alexandrite, copper vapor, and argon lasers. Dermal pigment is most effectively treated with lasers at longer wavelengths, such as the ruby, Nd:YAG, and alexandrite lasers, due to their capacity for deeper tissue penetration. In addition, since melanosomes have a short thermal relaxation time (50–100 nanoseconds), those lasers with very short pulsewidths are best suited to treat pigment-containing lesions. The Q-switched ruby laser at 694 nm and 28–40-nanosecond pulse duration has generally been accepted as the treatment of choice for nevus of Ota due to its high selectivity for dermal pigment; however, more recently, the Nd:YAG laser at 1064 nm has also been used to treat these lesions with similar results (Dr. Ken-ichiro Kasai, unpublished data, 1994). While the newest pigment-specific laser, the Q-switched alexandrite, has been shown to effectively remove dermal tattoos, no previous reports have demonstrated its effectiveness in treating nevus of Ota.
Table 1. Nevus of Ota: Patient Characteristics

<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Age (Years)</th>
<th>Race</th>
<th>Lesion Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>44</td>
<td>S. American</td>
<td>V₁/V₂</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>17</td>
<td>Asian</td>
<td>V₁/V₂</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>18</td>
<td>Asian</td>
<td>V₁/V₂</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>22</td>
<td>Black</td>
<td>V₁</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>19</td>
<td>Caucasian/Asian</td>
<td>V₁/V₂</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>30</td>
<td>Asian</td>
<td>V₁/V₂</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>22</td>
<td>Black</td>
<td>V₁</td>
</tr>
</tbody>
</table>

Materials and Methods

Seven patients (two males, five females, 17-44 years old) with nevus of Ota were treated with the Q-switched alexandrite laser with a 755-nm wavelength and 100-nanosecond pulse duration (Candela Laser Corporation, Wayland, MA) at 8-12-week intervals. No patients had received prior treatment to their lesions. All had unilateral involvement of the ophthalmic and/or maxillary branches of the trigeminal nerve (Table 1).

At each visit, the entire lesion was treated with adjacent, nonoverlapping, 3-mm laser pulses at energy densities ranging from 4.75 to 7.0 J/cm². Energy threshold fluences were determined by a characteristic tissue whitening immediately following laser irradiation. Energy densities were reduced if tissue splatter or bleeding was encountered. No general or intralosalional anesthesia was administered during the procedure; however, topical anesthesia with 30% lidocaine cream was applied upon patient request. Lead eyelids were inserted after instillation of tetracaine hydrochloride 0.5% eye drops as protection during eyelid treatment. No attempt was made to treat scleral pigmentation in those patients so affected. Tissue biopsies of lesions were obtained prior to and following laser treatment for histologic examination in two patients. Postoperatively, patients were instructed to cleanse the laser-treated areas with mild soap and water twice daily, followed by application of a topical antibiotic ointment and nonstick bandage. Patients were also advised to avoid exposing their healing lesions to ultraviolet light.

Photographs were obtained from the patients prior to each laser treatment employing identical lighting, camera settings, photographer, and film processing techniques. Individual responses to treatment were made independently by two adult observers who were unaware of the patients’ treatment status. Simultaneous projection of pre- and posttreatment photographs allowed for clinical grading along a generally acceptable scale, where the degree of lightening was measured in 10% increments from 0 to 100%. A 100% clinical rating represented complete lesional clearance with laser-irradiated lesional skin virtually indistinguishable from untreated normal skin.

Results

Fifty percent lesional lightening was observed in all patients following two laser treatments (Figure 1). An average of five treatments at a mean fluence of 60 J/cm² was necessary to achieve clearing in the five patients demonstrating total lesional eradication (Figure 2). Individual responses to treatment are further outlined in Table 2. No hypopigmentation, textural changes, or scarring was observed in any of the laser-treated sites.

Histologic examination of lesional specimens revealed absence of nevus cells in the papillary and mid-dermis following laser irradiation. There was no disruption of the epidermis, and fibrotic changes were not observed. Rare pigmented spindle cells and dermal melanophages were scattered in the deep reticular dermis (Figure 3).

Discussion

This study demonstrates the effective use of the Q-switched alexandrite laser in the treatment of nevus of Ota. The basis for the success of this laser as well as with other Q-switched laser systems, such as the ruby and Nd:YAG, lies in the fact that their red and near-
infrared wavelengths can preferentially destroy pigment-laden melanosomes through thermomechanical damage. The lack of injury to non-pigment-containing cells is enhanced by appropriately brief pulse durations that correspond to the thermal relaxation time of the targeted melanosome, thereby eliminating heat conduction to normal surrounding tissue structures, such as collagen.

Table 2: Nests of Ota: Response to Alexandrite Laser (755-nm) Treatment

<table>
<thead>
<tr>
<th>Patient</th>
<th>Energy (J/cm²)</th>
<th>No. of Treatments</th>
<th>Lesional Clearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.75-6.75 (6.0)</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>4.75-7.0 (6.25)</td>
<td>6</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>4.75-6.5 (6.0)</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>4</td>
<td>5.5-6.5 (6.0)</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>5</td>
<td>6.0-7.0 (6.75)</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>6</td>
<td>4.75-5.25 (5.0)</td>
<td>2</td>
<td>50%</td>
</tr>
<tr>
<td>7</td>
<td>6.0-6.5 (6.25)</td>
<td>4</td>
<td>100%</td>
</tr>
</tbody>
</table>

While the Q-switched alexandrite laser yielded clinical results similar to those reported with the ruby and Nd:YAG lasers, there were some distinct advantages associated with its use that merit comment. First, there were no long-term pigmenary changes, such as that reported following ruby laser treatment. The slightly longer wavelength of the alexandrite laser allows for less epidermal melanin absorption, deeper tissue penetration, and thus, fewer pigment irregularities. Second, the alexandrite laser produced no tissue splatter, which is particularly common with Nd:YAG laser use, due to the significantly higher energy densities required to effect the desired degree of lesional lightening by this laser. The energies used in this study afforded excellent clinical responses without the risks inherent with tissue debris exposure. Last, the 1-Hz repetition rate and the larger 3-mm spot size of the alexandrite laser allowed for rapid treatment sessions with minimal discomfort (especially in comparison with the Nd:YAG laser), thereby reducing the need...
for anesthesia commonly used with other Q-switched lasers.

The preponderance of dermal melanin in lesions of nevus of Ota provided a perfect target for the Q-switched alexandrite laser. The specificity of the alexandrite laser for dermal pigment was evident clinically and histologically. The lack of pigment in the papillary dermis without disruption of the overlying epidermis or fibrosis of the surrounding collagen substantiated what was seen clinically as complete lesional eradication without scarring or textural change.

The finding of persistent deep dermal pigmentation in lesions of nevus of Ota that had clinically cleared has also been reported following ruby laser treatment. Whether the residual reticular pigment will lead to lesional recurrence is unknown, however, it should be noted that 6-month follow-up examinations of all cleared patients and an additional 12-month follow-up in two others did not reveal any evidence of repigmentation.

Of final note is the interesting observation of a racial division in lesional location. The two patients of African-American descent demonstrated involvement only of the maxillary division of the trigeminal nerve (without the ophthalmic involvement seen in the five Asian patients). The significance of this observation is unclear, especially in light of the small sample size, but may indicate a genetic predisposition to certain types (or locations) of nevi.

In conclusion, the Q-switched alexandrite laser successfully cleared lesions of nevus of Ota with an average of five laser treatments. The absence of adverse sequelae, such as scarring or hypopigmentation, make this laser an attractive treatment alternative. Individuals who are afflicted with these psychologically devastating lesions can now be safely and effectively treated and should, therefore, be offered the Q-switched alexandrite laser as a viable treatment option. Further studies are needed to determine how effective the Q-switched alexandrite laser will be in treating other dermal melanocytic processes.

References
21. Garden JM, Poik LL, Tan CT. The treatment of port-wine stains by the pulsed dye laser: analysis of pulse duration and long-term