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Epidermal nevi treated by carbon dioxide laser vaporization: A series of 25 patients

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Abstract

Background: Epidermal nevi are benign proliferations of epidermis. Numerous treatment modalities have been tried, but no ideal treatment is yet available. Objective: To report our experience with CO 2 laser vaporization in the treatment of verrucous epidermal nevi, and to identify which factors could have influence in long-term results. Methods: A total of 25 patients were treated with the CO2 laser in the superpulsed mode, focalized at 2 W/cm 2. The patients were between 3 and 41 years old (mean: 17 years). A total of 44% of lesions were < 20 cm 2, 40% measured between 20 and 100 cm 2 and 16% were > 100 cm 2. The follow-up was 4–79 months (mean: 28 months). In 76% of patients, multiple treatment sessions were required. Results: Good results were achieved in 92% of patients with soft, flattened nevi and in only 33% patients with keratotic nevi. In addition, 87% of the latter had moderate results and 12.5% had poor results. Conclusion: We conclude that the CO2 laser in superpulsed mode is an effective and safe treatment for verrucous epidermal nevi and provides fewer recurrences than other laser therapies. We also believe that the most determining factor for the cosmetic result is thickness of the nevus.

Key words: Carbon dioxide laser, epidermal nevus

Introduction

Epidermal nevi are a spectrum of hamartomatous lesions that arise from the embryonic ectoderm, limited to proliferation of epidermis (1). There are three subtypes which are histologically identical and differ only in the degree of clinical involvement. The most common subtype is the verrucous epidermal nevus (VEN), which are solitary or multiple localized lesions. Systematized nevus is a more severe and widespread lesion, and it is called nevus unius lateris when it affects one-half of the body (histopathological examination reveals epidermolytic hyperkeratosis) and ichthyosis hystrix when it has a bilateral or generalized distribution and tends to form wavy, transverse, scaly and erythematous bands on the trunk (2).

VEN may be present at birth or may develop during early childhood (3,4). They are commonly yellowish-brown warty papules that coalesce to form papillomatous plaques with irregular margins, usually localized on the trunk or extremities following Blaschko’s lines (3,5). They are flat, velvety lesions in the newborn and become more raised, verrucous and hyperpigmented during adolescence (2). Histology shows sharply demarcated hyperkeratosis, papillomatosis, mild acanthosis and elongation of the rete ridges (1,3). Some cases show increased melanin pigmentation in the basal layer (3). Distinct histological subtypes of epidermal nevus associated with at least six distinct syndromes are reported, including Schimmelpenning syndrome, nevus comedonicus syndrome, pigmented hairy epidermal nevus syndrome, Proteus syndrome, CHILD syndrome (2,6) and phakomatosis pigmentokeratotica (7–9).

Epidermal nevi are usually asymptomatic, benign lesions but the cosmetic appearance leads patients to seek advice (10). No ideal treatment is yet available because superficial removal techniques such as topical treatments often result in recurrence, and more aggressive approaches tend to produce postoperative scarring (11).

In the last three decades, multiple modalities of laser treatment have been tried but there are no large series reported comparing results. Based on selective
photothermolysis, pigment-specific lasers can be used to achieve significant cosmetic improvement of dark epidermal nevi with a reduced risk of scarring, but good results were not achieved in non-pigmented or keratotic lesions (3). Non-pigment-selective modalities such as the CO₂ and erbium-YAG laser have been useful for the treatment of superficial epidermal pigmented lesions. Their wavelengths are absorbed by the intra- and extracellular water of the epidermis and dermis, which results in a non-specific destruction (12). There is a relatively narrow margin of safety when treating epidermal nevi: if the treatment is too superficial with only the epidermis removed, the nevus will recur; if it goes too deeply into the reticular dermis, hypertrophic scar can develop (13). Vaporization should extend only into papillary dermis. In addition, the expected outcome after healing is hypopigmentation (13). However, it is more precise and easier therapy than surgery, with less morbidity (14).

Materials and methods

Out of 25 patients who had been treated with the carbon dioxide (CO₂) laser, 24 had VEN and one had systematized nevus (Table I). We excluded cases of inflammatory lineal verrucous epidermal nevus (ILVEN) and nevus unius lateris with epidermolytic hyperkeratosis. The patients were between 3 and 41 years old with a mean age of 17 years. Nine patients were male and 16 were female. A total of 11 (44%) lesions were small (<20 cm²), 10 (40%) measured between 20 and 100 cm² and four (16%) were extensive lesions (>100%). The most frequent location was on the trunk, followed by the neck, head and extremities. Only one lesion (4%) was widespread.

The skin was previously prepared with an antiseptic such as Betadine® or Clorhexidina⁸, and the treatment was performed under local anaesthesia (mepivacaine chlorhydrate).

The lesions were vaporized down to the superficial dermis with a CO₂ laser system (Frank Line SE-20–30W CO₂, Inter-medic (Barcelona, Spain)) in superpulsed mode, focalized at 2 W/cm². Only 58% of small lesions (<20 cm²) were vaporized in a single session. In most patients (76%), multiple treatment sessions were required to treat all the lesions. The mean number of sessions was four (range: 1–28). For lesions >20 cm², 64% needed between two and five sessions, and 24% more than six. On subsequent sessions, only the areas that were pigmented and still raised were treated further.

During the operative procedure, bleeding was controlled by intermittent application of saline-soaked gauze compresses. Postoperative instructions included application of an occlusive, non-adherent dressing (Tulgrasum®) and antibiotic ointment (mupirocin: Bactroban®) during the healing process.

Results

Clinical assessment of outcome was made by the physician who treated all the patients. He decided the parameters of treatment (mode, fluence of energy) and number of sessions according to the response. The following definitions were modified from Hohenleutner et al. (15) and used to evaluate the results:

- very good to good: complete or almost complete removal of lesions without or with very superficial, only slightly hypopigmented scar formation or minimum residual erythema
- moderate: hyper- or hypopigmented shallow atrophic or slightly hypertrophic scars, partial removal of the lesions and/or small recurrences
- poor: no remission or full recurrence of lesion and/ or hypertrophic or keloidal cosmetically unacceptable scarring.

One out of 25 patients had incomplete treatment, 64% showed good results, 32% moderate results and 4% poor results (Figure 7). Good results were achieved in 92% of patients with soft, flattened nevi and in only 33% of patients with keratotic nevi. In addition, 87% of the latter had moderate results and 12.5% had recurrences and hypertrophic scarring. There were five recurrences: 60% in patients with keratotic nevi. The mean follow-up was 2 years and 4 months (range: 4–79 months). In spite of the fact that most patients were children and multiple sessions were needed, the procedure was well tolerated. On the whole, they agreed with our clinical assessment and 92% of patients thought that good results were achieved.

Representative results are shown in Figures 1–6.

Discussion

Although epidermal nevi are benign epidermal hyperplasias, most of the attempted treatments have been not successful because of recurrences and anaesthetic scars.

The keratotic surface may be improved by topical treatments (14) – such as combined therapy with retinoic acid and 5-fluorouracil (16,17), chemical peels (3) and podophyllin (3,18) – but they always correlate with a great rate of relapses. Destructive therapies such as cryosurgery, electrocautery and dermabrasion are advocated but recurrences are commonly seen if the damage is superficial (14), and hypertrophic or hypopigmented scarring can occur if a significant proportion of the dermis is removed (11). Surgical excision always causes scar formation and is reserved for the smallest lesions (1–3,11,19). Systemic retinoids may be beneficial for the treatment of widespread systematized epidermal nevus
Table I. Summary of cases treated.

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age on diagnosis</th>
<th>Sex</th>
<th>Location</th>
<th>Size (cm²)</th>
<th>Epidermal hyperplasia</th>
<th>No. of sessions</th>
<th>Results</th>
<th>Follow-up</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>M</td>
<td>Face (right side of forehead)</td>
<td>63</td>
<td>Medium</td>
<td>4</td>
<td>Good</td>
<td>1 year and 8 months</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>F</td>
<td>Systematized epidermal nevus</td>
<td>Diffuse</td>
<td>High</td>
<td>4</td>
<td>Moderate</td>
<td>4 months</td>
<td>Incomplete treatment</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>F</td>
<td>Right side of trunk</td>
<td>64</td>
<td>Medium</td>
<td>2</td>
<td>Very good</td>
<td>5 years and 7 months</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>F</td>
<td>Trunk</td>
<td>12</td>
<td>Medium</td>
<td>1</td>
<td>Good</td>
<td>6 months</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>M</td>
<td>Upper lip</td>
<td>0.64</td>
<td>Medium</td>
<td>1</td>
<td>Very good</td>
<td>4 years and 9 months</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>13</td>
<td>M</td>
<td>Right side of neck</td>
<td>6</td>
<td>High</td>
<td>5</td>
<td>Moderate</td>
<td>4 years and 3 months</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>M</td>
<td>Left axilla and left side of trunk</td>
<td>450</td>
<td>Medium</td>
<td>28</td>
<td>Good</td>
<td>6 years and 7 months</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>41</td>
<td>F</td>
<td>Left upper chest</td>
<td>10</td>
<td>Medium</td>
<td>2</td>
<td>Good</td>
<td>10 months</td>
<td>No</td>
</tr>
<tr>
<td>9</td>
<td>18</td>
<td>F</td>
<td>Abdomen</td>
<td>55</td>
<td>High</td>
<td>1</td>
<td>Good</td>
<td>2 years and 6 months</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>28</td>
<td>F</td>
<td>Left side of trunk and abdomen</td>
<td>72</td>
<td>High</td>
<td>2</td>
<td>Moderate</td>
<td>1 year and 11 months</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>37</td>
<td>F</td>
<td>Back side of right shoulder</td>
<td>8</td>
<td>Medium</td>
<td>1</td>
<td>Very good</td>
<td>1 year and 1 month</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>35</td>
<td>F</td>
<td>Front side of left thigh</td>
<td>32.5</td>
<td>High</td>
<td>2</td>
<td>Good</td>
<td>1 year and 2 months</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>19</td>
<td>M</td>
<td>Left palm</td>
<td>30</td>
<td>High</td>
<td>6</td>
<td>Good</td>
<td>1 year and 2 months</td>
<td>No</td>
</tr>
<tr>
<td>14</td>
<td>7</td>
<td>F</td>
<td>Right side of neck</td>
<td>15</td>
<td>Medium</td>
<td>1</td>
<td>Very good</td>
<td>1 year and 4 months</td>
<td>No</td>
</tr>
<tr>
<td>15</td>
<td>26</td>
<td>F</td>
<td>Left ear</td>
<td>1.2</td>
<td>High</td>
<td>1</td>
<td>Good</td>
<td>1 year</td>
<td>No</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>F</td>
<td>Right upper chest</td>
<td>36</td>
<td>Medium</td>
<td>4</td>
<td>Medium</td>
<td>2 years and 2 months</td>
<td>No</td>
</tr>
<tr>
<td>17</td>
<td>14</td>
<td>M</td>
<td>Right side of neck</td>
<td>28</td>
<td>Medium</td>
<td>2</td>
<td>Very good</td>
<td>5 months</td>
<td>No</td>
</tr>
<tr>
<td>18</td>
<td>13</td>
<td>M</td>
<td>Abdomen</td>
<td>40</td>
<td>High</td>
<td>2</td>
<td>Poor</td>
<td>4 years and 7 months</td>
<td>Yes</td>
</tr>
<tr>
<td>19</td>
<td>11</td>
<td>M</td>
<td>Front side of neck</td>
<td>4</td>
<td>High</td>
<td>5</td>
<td>Moderate</td>
<td>1 year and 7 months</td>
<td>No</td>
</tr>
<tr>
<td>20</td>
<td>7</td>
<td>F</td>
<td>Left side of neck</td>
<td>12</td>
<td>Medium</td>
<td>2</td>
<td>Very good</td>
<td>10 years</td>
<td>Yes</td>
</tr>
<tr>
<td>21</td>
<td>12</td>
<td>M</td>
<td>Left side of neck, left axilla and left side of trunk</td>
<td>168</td>
<td>High</td>
<td>6</td>
<td>Moderate</td>
<td>4 years</td>
<td>No</td>
</tr>
<tr>
<td>22</td>
<td>18</td>
<td>F</td>
<td>Inner right thigh</td>
<td>48</td>
<td>Medium</td>
<td>6</td>
<td>Very good</td>
<td>3 years</td>
<td>No</td>
</tr>
<tr>
<td>23</td>
<td>9</td>
<td>F</td>
<td>Retro auricular and left side of neck</td>
<td>16</td>
<td>High</td>
<td>6</td>
<td>Moderate</td>
<td>3 years and 9 months</td>
<td>No</td>
</tr>
<tr>
<td>24</td>
<td>11</td>
<td>F</td>
<td>Left side of neck</td>
<td>5</td>
<td>High</td>
<td>1</td>
<td>Good</td>
<td>1 year</td>
<td>No</td>
</tr>
<tr>
<td>25</td>
<td>3</td>
<td>F</td>
<td>Right buttock and back side of right thigh</td>
<td>168</td>
<td>High</td>
<td>2</td>
<td>Moderate</td>
<td>1 year and 1 month</td>
<td>No</td>
</tr>
</tbody>
</table>
but the requirement of life-long therapy is inappropriate for smaller lesions (15,11).

Laser therapy offers a potential method of ablating epidermal nevi whilst producing minimal scarring.

Figure 1. Patient 5: upper lip with small, flat, verrucous epidermal nevus before treatment.

Figure 2. Patient 5: very good result. Complete removal without scarring after one CO₂ laser treatment session.

Figure 3. Patient 1: widespread soft verrucous nevus on the left side of the forehead before treatment.

Figure 4. Patient 1: good result after four CO₂ laser treatment sessions.

Figure 5. Patient 10: widespread, hard verrucous epidermal nevus with a high level of epidermal hyperplasia on the left side of the trunk and abdomen before treatment.

Figure 6. Patient 10: moderate result with hypopigmented and slightly hypertrophic scar formation after two CO₂ laser treatment sessions.

(20,21), but the requirement of life-long therapy is inappropriate for smaller lesions (15,11).

Laser therapy offers a potential method of ablating epidermal nevi whilst producing minimal scarring.
In patients with systematized nevus, laser ablation offers a valuable therapeutic tool and relief that would otherwise be unavailable (15,14). Success with this therapy is related to the type of lesion and its clinical characteristics (2). Different types of laser have been reported to be effective.

The argon laser is a continuous wave laser with a wavelength (488 nm and 514 nm) absorbed by melanin (22). However, the thermal relaxation time of the melanosome is exceeded and thermal energy dissipates to surrounding tissue causing an increased risk of hypertrophic scarring and pigmentary changes (3,10,22). This treatment was found to achieve complete or almost complete lesion removal with only slight scarring in all patients with ‘soft’, flat, velvety, verrucous nevi (3,15,10). Patients with ‘hard’, keratotic verrucous nevi showed incomplete response or recurrence after treatment (15,10).

The long-pulsed ruby laser is a pigmented-specific laser with a selective thermolytic effect, and has been used for the treatment of superficial pigmented disorders (23,24). There are a small series of epidermal nevi reported with successful effects in 50–80% of the cases, especially in lesions with darker pigmentation, less thickness and a more flattened surface (12,25,26). After one to four sessions, Baba et al. (12) obtained good cosmetic results without recurrences during 2 or 3 years of follow-up. Hypopigmentation (transient or permanent) in patients with darker skin and a decrease in hair growth were noted in some cases. However, its efficacy has not been shown in non-pigmented epidermal nevi.

The continuous wave CO2 laser has been shown to be more effective for removing keratotic verrucous epidermal nevi than the argon laser in a study of 43 patients with verrucous epidermal nevi (15). Hohenleutner et al. (27) achieved complete removal without scarring or recurrence of a widespread epidermal nevus treated with CO2 laser. Ratz et al. (28) reported that this treatment was successful in 15 patients with epidermal nevus.

The best results were observed when a relative low output power of 5 W was used (28), whereas power higher than 10 W led to unacceptable hypertrophic scarring in two of three patients (15).

Ultrapulsed, superpulsed lasers and scanners have allowed for more controlled tissue ablation with greater control of the depth of thermal damage and less risk of scarring (3,29). Boyce and Alster (29) treated three extensive epidermal nevi with the pulsed CO2 laser in one or two sessions, without scarring or recurrences over 10–12 months of follow-up. Michel et al. (19) treated five linear epidermal nevi with a superpulsed laser, and they had successful results with one to four sessions. Satisfactory cosmetic results were obtained with only slight hyperpigmentation, and there was no recurrence in 2 years of follow-up.

The pulsed erbium:YAG laser operates at 2940 nm, and this wavelength light is strongly absorbed by tissue water. The penetration of the laser beam is limited and the pulse energy is concentrated into the ablative process with minimal adjacent thermal diffusion. For this reason, tissue damage is minimized, decreasing postoperative morbidity and allowing shorter postoperative recovery (5). Literature relating to the erbium:YAG laser is mainly concentrated on resurfacing techniques. There are three series (1,5,30) with excellent cosmetic results without apparent scarring in patients with epidermal nevi located in problematic sites, such as the neck and upper chest. These could be due to biases in the selection of cases with superficial or small lesions. The pulsed erbium:YAG laser is therefore an effective treatment for epidermal nevi, which can present a problem for adequate cosmetic treatment. Also, wound healing was complete in 10 days, which is faster than the continuous-wave (14–28 days) and ultrapulsed CO2 laser (10–14 days) (5). However, thick, verrucous lesions may not respond or produce hypertrophic scars, owing to the unpredictable penetration of the laser beam through the warty tissue. Also, 25% of patients can show a relapse within 1 year after the treatment (5).

In our patients, the hyperkeratotic level of the epidermis is the most important variable regarding the results. However, age of the patient at the time of treatment and location of lesions are not related to the final cosmetic outcome. When we considered separately the results in the head and neck, extremities and trunk, we found that 75% of patients had good or very good results regardless of the location of the epidermal nevus. We use low-energy fluences to minimize the risk of scarring or other secondary effects of laser vaporization, even if the rate of recurrences is higher. The treatment of epidermal nevi is usually a cosmetic problem and the final outcome with good aesthetic results is very important, so we think it could be better to perform more sessions to obtain these results.
We conclude that the CO₂ laser is an effective and safe treatment of verrucous epidermal nevi. In comparison with other laser therapies, it provides more favourable results with fewer recurrences, but more scarring risk. Although we usually need a greater number of sessions to remove the nevus, it could be worth using the superpulsed mode and low levels of energy at first in cosmetic areas such as the face because, in our experience, it provides better aesthetic results with a lower risk of scarring without having a much higher rate of recurrence.

We also believe that the most determining factor for the cosmetic result is thickness and time of evolution of the nevus. Therefore, recent and flattened lesions could be effectively removed with this technique.

References