Copper Vapor Laser and Microsclerotherapy of Facial Telangiectases
A Patient Questionnaire
PAUL KENNETH THIBAULT, MBBS

BACKGROUND. Facial telangiectasia due to photodamage is a common disfiguring condition in modern society. Over the past 10 years yellow light laser photocoagulation has become the treatment of choice.

OBJECTIVE. To compare the effectiveness of copper vapor laser alone with combined microsclerotherapy and copper vapor laser in the treatment of facial telangiectases.

METHODS. Two hundred thirty-nine consecutive patients were asked to complete a questionnaire evaluating the two different treatments; 180 (75%) patients responded.

RESULTS. Both treatments were found to be effective but patients who received the combined treatment gave significantly higher ratings in effectiveness and overall satisfaction. There was also non-significant reduction in the incidence of adverse effects reported by patients treated by the combined method.


Telangiectases are ectatic dermal vessels visible to the human eye. They usually measure 0.1 to 1 mm in diameter and may originate from arterioles, capillaries, or venules. Clinically, telangiectases can be classified into four types: linear, arborizing, spider and punctiform. Punctiform telangiectases are frequently associated with collagen diseases and genetic syndromes such as hereditary hemorrhagic telangiectasia. Although punctiform telangiectases are relatively uncommon, the other three types are frequently encountered on the face.

The most common etiological factor in the occurrence of facial telangiectasia is chronic sun exposure. Invariably, the presence of facial telangiectasia will be associated with other manifestations of photodamage such as irregular pigmentation, dermal elastosis, epidermal atrophy, and actinic keratoses. In actinically damaged skin histologic changes can be found in dermal arterioles, capillaries, and venules, with the postcapillary venules showing the most obvious effects. Spider telangiectases arise from a central filling vessel of arteriolar origin while facial linear and arborizing telangiectases usually arise from the postcapillary venule. Frequently all three types will coexist in the same patient. Apart from actinic damage, other common etiological factors for facial telangiectases are genetic predisposition, rosacea, surgical trauma (eg, postrhinoplasty), topical or systemic steroid use, postmenopausal hormonal supplements, and radiation therapy.

The predominant presenting symptom of patients with facial telangiectasia is cosmetic disfigurement and therefore effective treatment should be relatively free of adverse sequelae. In recent years laser photocoagulation of facial telangiectases using yellow light wavelengths of 577 to 585 nm has become the treatment of choice, displacing earlier techniques using diathermy and argon laser. Adverse sequelae such as pain, hypo- and hyperpigmentation, hyper- and atrophic scarring which were frequently reported with diathermy and argon laser therapy theoretically should occur less frequently with laser therapy utilizing wavelengths of 577 to 585 nm. These wavelengths result in optimum absorption by hemoglobin when treating ectatic dermal blood vessels. Despite this there have been reports of the occurrence of these adverse sequelae following treatment of facial telangiectases using yellow light lasers.

Microinjection of sclerosant solutions to treat telangiectases was first described by Biegeleisen in 1934. While this method has become the treatment of choice for lower limb telangiectases, there has been only an occasional report of successful application of this technique to treat facial telangiectases. Goldman has hypothesized that there may be theoretical advantages in combining...
sclerotherapy with pulsed dye laser when treating leg telangiectases. Similarly, combined microsclerotherapy and laser photocoagulation offers both theoretical and practical advantages over either modality alone when treating facial telangiectases. When treating larger facial telangiectases, particularly on the nasolabial folds, laser treatment has often been ineffective or has caused atrophic scarring\textsuperscript{15,19,20} owing to the high powers required to photocoagulate these vessels. It is possible that more reliable results with a lower incidence of scarring may be achieved by obliterating or reducing the size of larger telangiectases using microsclerotherapy prior to laser photocoagulation.

The aim of this study was to evaluate the effectiveness of copper vapor laser photocoagulation with and without supplementary microsclerotherapy in the treatment of linear, arborizing, and spider telangiectases affecting the face. As the symptoms of these lesions are usually confined to the patient’s perception of disfigurement, the patient’s own assessment has become the accepted method of comparing the effectiveness of various treatment methods.\textsuperscript{9,21}

Materials and Methods

A questionnaire similar to that of Pickering et al\textsuperscript{18} was distributed to 239 consecutive patients treated for facial telangiectasia. The patients had all completed treatment at least 6 months prior to entering the study. There were 13 questions covering the following areas:

1. Pain experienced during treatment
2. Effectiveness of treatment
3. Adverse effects of treatment
4. Overall satisfaction with treatment

Most questions were constructed with a bipolar scale with patient responses being collated on Claris Filemaker II database (Claris Corporation, Santa Clara, CA) on an Apple MacIntosh 30SE computer (Apple Computer, Inc., Cupertino CA). For analysis, patients were categorized into four groups according to type of telangiectasia and treatment method:

1. Linear and/or arborizing telangiectasia treated with copper vapor laser alone.
2. Linear and/or arborizing telangiectasia treated with combined microsclerotherapy and copper vapor laser.
4. Spider telangiectasia treated with combined microsclerotherapy and copper vapor laser.

Pearson’s $\chi^2$ statistic was used to test for association between the treatment groups and the outcome variable, as well as treatment type (copper vapor laser alone or combined) and whether linear or spider separately. $P$ values are presented in the tables, with $P \leq 0.05$ being taken as statistically significant.

The treatment method chosen for each patient was not randomized but resulted from the development of the combined technique in July 1990 that was thereafter applied to all patients presenting with spider telangiectases and those patients with linear/arborizing telangiectases whose vessels were technically possible to inject. The number of patients responding to the questionnaire in each group is shown in Table 1. The response rate compared favorably with Pickering’s study in which 59% of patients with facial telangiectases and 66% of spider nevi patients returned completed questionnaires.

The copper vapor laser used in this study was a Vis-Erase 3w (Visiray Pty Limited, Hornsby, N.S.W., Australia). This freestanding mobile unit uses a vaporized metallic copper discharge tube to produce yellow light at 578 nm. Laser light is delivered to the patient via a fiber optic delivery system made up of a 5 m length of 200-µm fiber cable terminated with a lightweight optical delivery handpiece that is fitted with a lens holder. The laser beam could be focused to either a spot size of 150-µm diameter or 400-µm diameter by a simple interchange of lenses. The operator used 8X magnifying loupes (Zeiss, Germany) with a specific eye protection filter for the wavelength of 578 nm. The patients’ eyes were protected at all times with occlusive shields.

When treating linear and arborizing telangiectases, the operator traced individual vessels precisely from distal (thinnest) to proximal (thickest) utilizing the 150-µm spot size. This ensured that the minimum power necessary to photocoagulate the vessel was used. The end point was complete disappearance or blanching of the vessel. Powers ranging between 300 and 500 mW were used. When treating spider telangiectases with the copper vapor laser alone, a similar method was used with the operator tracing the peripheral “arms” first using the 150-µm spot then changing to the 400-µm spot to vaporize the central vessel. The end point of this latter procedure was a visible and audible “popping” of the central feeding arteriole which usually required powers in the range of 600 to 700 mW impinging on the vessel for less than one second.

Microsclerotherapy of facial telangiectases requires a modified technique compared with that used in treating lower limb telangiectases. Sodium tetradecyl sulphate (STD, STD Pharmaceuticals, Hereford, England) was used because of its highly specific sclerosant action, intrinsic vasospastic activity, and safety when injected (inadvertently) extravascularly in concentrations of less than 0.3%.\textsuperscript{16,22-24} Sodium tetradecyl sulphate has been...
found to be a very potent sclerosant with clinical and histologic efficacy at concentrations as low as 0.1\% \textsuperscript{23,25} in this study concentrations ranging from 0.05\% to 0.15\% were used, depending on vessel diameter and clinical assessment of possible patient sensitivity to the solution. In general, females required lower concentrations (often 0.05\%) compared with males (usually 0.1\%). Concentrations of sodium tetradecyl sulfate of 0.05 to 0.15\% were obtained by diluting sodium tetradecyl sulfate 3\% in normal saline. A 2 mL plastic syringe (Becton Dickinson, Singapore) attached to a 30-gauge needle (Becton Dickinson, Singapore) bent to an angle of 30 to 50° to reduce the risk of vessel transection was used. Vessel cannulation was aided by the operator using optical magnification by 3.5 X panoramic prismatic loupes (Keeler Instruments, Inc., Broomall PA).

Due to absence of hydrostatic back pressure, facial telangiectases have high flow rates manifested by their red color. Goldman\textsuperscript{1} has stated that facial telangiectases are less reliably responsive to microsclerotherapy with sodium tetradecyl sulfate compared with lower limb telangiectases because the high flow rates do not allow adequate time for the sclerosant to react with endothelium, being inactivated by serum factors and/or diluted to a "safe" concentration by the rapid flow. To overcome this technical problem a slow injection technique was used allowing prolonged contact of a dilute solution with the endothelium. The end-point of an injection was determined by visual evidence of vasospasm or increased pressure required to depress the syringe plunger. With this technique duration of injection was typically 15 to 30 seconds. Following withdrawal of the needle, digital pressure was re-applied to the puncture site until hemostasis was achieved. A successful injection would be indicated by cessation of flow in the vessel with complete vasoconstriction within several minutes of injection. If this occurred the solution concentration was reduced for subsequent injections.

When injecting spider telangiectases the concentration of sodium tetradecyl sulfate was 0.1\% in all cases. The bevel of the 30-gauge needle was inserted precisely into the central vessel and very slow injection produced peripheral blanching less than 1 cm in diameter. It was necessary to maintain (but not increase) this blanching by gentle plunger pressure for approximately 30 seconds. Following needle withdrawal digital pressure was required for up to 2 minutes to achieve hemostasis.

Microsclerotherapy was always used as the initial modality in patients treated with combined microsclerotherapy and copper vapor laser. In patients with spider telangiectases, copper vapor laser was used immediately after microsclerotherapy to the central feeding arteriole. The laser technique differed from the copper vapor laser-alone group in that only the central vessel was treated. Copper vapor laser treatment to the telangiectatic "arms" was not required in this group. In contrast, copper vapor laser was used at least 4 weeks following microsclerotherapy in patients with linear and arborizing telangiectases to allow full resolution of the sclerosing process. The laser method was identical to that used in the copper vapor laser-alone group (Group 1).

Postoperatively, patients with linear and arborizing telangiectases treated with copper vapor laser applied silver sulphadiazine cream (Silvazine, Smith and Nephew, Clayton, Victoria, Australia) to the treated areas every 2 hours during waking hours until complete healing occurred. Spider telangiectases did not require post-operative dressings, neither did patients with linear and arborizing telangiectases following microsclerotherapy. Patients receiving copper vapor laser were not allowed to apply make-up to the treated areas until all crusting had cleared. To minimize the incidence of post-sclerotherapy hyperpigmentation all patients were required to avoid sun exposure for at least 2 months.

Patients with linear and arborizing telangiectases treated with CVL usually developed epidermal blistering on day 2 with the resultant crusts resolving between day 7 and 14. Edema in the treated area and adjacent areas such as the periorbital region frequently occurred in the first 3 days following copper vapor laser when extensive areas were treated. Following microsclerotherapy of linear and arborizing telangiectases, minor swelling and purpura was apparent in the treated area for 3 to 5 days. In all cases macroscopic resolution of the sclerosing process occurred by day 7. Spider nevi lesions treated with copper vapor laser alone and combined copper vapor laser and microsclerotherapy usually healed by day 7.
COPPER VAPOR LASER FOR TELANGIECTASES

### Results

#### Treatment

For all groups combined, 28% of patients reported mild pain, 51% moderate pain and 18% complained of severe pain; 23% of patients required local anaesthetic. As expected from the localized nature of spider telangiectases, groups 3 and 4 had less moderate and more mild pain than groups 1 and 2, although all groups had similar amounts of severe pain. There was no statistically significant difference in pain experienced between the two treatments.

#### Effectiveness

Eighty-six percent of all patients had a moderate to total reduction in area of their telangiectatic lesions; 5% had mild reduction while 9% had no reduction. The reduction in area varied between the four treatment groups. Spider telangiectasia and combined treatment had statistically greater reduction in area affected. This resulted in Group 4 (copper vapor laser sclerotherapy for spider telangiectasia) having the highest percentage, 86% with large/to- tal reduction, and Group 1 (linear/arborizing telangiectasia treated with copper vapor laser alone) having the lowest percentage, 47% with large/total reduction.

Ninety-two percent of all patients said their appearance was improved. Only two patients were moderately worse and five felt they were somewhat worse. Again there were differences between the treatment groups which were however, only just statistically significant ($P = .03$). The major difference was in group 1 (linear/arborizing telangiectasia treated with copper vapor laser alone) which had 50% of patients report much better, while the other groups had 68% or more report much better (Table 3).

#### Adverse Effects

Fifty-two percent of patients reported skin texture to be the same, while 38% reported smoother texture. Only two patients reported a much rougher texture. Fifty-nine percent of patients reported the color of the treated area to be normal, with 33% reporting a paler color. Group 1 (linear/arborizing telangiectasia treated with copper vapor laser alone) had 47% of patients reporting a paler color compared with the other three groups, which had less than 30% however, these differences were not statistically significant.

Twenty percent of all patients reported some atrophic scarring, although many commented that this was temporary or minor in degree. Seven percent reported raised scarring. Only three cases of atrophic scarring were observed by the physician with one of these resulting from a microinjection of sodium tetradecyl sulfate 0.1% on the nasal alar fold. There were no cases of hypertrophic scarring observed by the physician. Two patients who the physician had documented as having an excellent result with no adverse effects reported atrophic scarring in their questionnaire.

### Table 2. Reduction in Area by Treatment Group

<table>
<thead>
<tr>
<th>Group 1 (N = 58)</th>
<th>Group 2 (N = 52)</th>
<th>Group 3 (N = 28)</th>
<th>Group 4 (N = 42)</th>
<th>Total (N = 180)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None-mild</td>
<td>13.8</td>
<td>19.2</td>
<td>17.9</td>
<td>4.8</td>
</tr>
<tr>
<td>Moderate</td>
<td>39.7</td>
<td>13.5</td>
<td>17.9</td>
<td>9.5</td>
</tr>
<tr>
<td>Large</td>
<td>20.7</td>
<td>40.4</td>
<td>25.0</td>
<td>21.4</td>
</tr>
<tr>
<td>Total removal</td>
<td>25.9</td>
<td>26.9</td>
<td>39.3</td>
<td>64.3</td>
</tr>
</tbody>
</table>

Test for association between treatment group and reduction in area ($P = .0001$); separately for treatment type ($P = .005$) and clinical classification ($P = .002$).

### Table 3. Change in Appearance by Treatment Group

<table>
<thead>
<tr>
<th>Group 1 (N = 58)</th>
<th>Group 2 (N = 52)</th>
<th>Group 3 (N = 28)</th>
<th>Group 4 (N = 42)</th>
<th>Total (N = 180)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worse or no change</td>
<td>6.9</td>
<td>11.5</td>
<td>7.2</td>
<td>7.1</td>
</tr>
<tr>
<td>Somewhat better</td>
<td>19.0</td>
<td>5.8</td>
<td>17.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Moderately better</td>
<td>24.1</td>
<td>11.5</td>
<td>7.1</td>
<td>16.7</td>
</tr>
<tr>
<td>Much better</td>
<td>50.0</td>
<td>71.2</td>
<td>67.9</td>
<td>73.8</td>
</tr>
</tbody>
</table>

Test for association between treatment group and change in appearance ($P = .05$); separately for treatment type ($P = .01$) and clinical classification ($P = .3$).
Table 4. Satisfaction with Treatment by Treatment Group

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (N = 58) %</th>
<th>Group 2 (N = 52) %</th>
<th>Group 3 (N = 28) %</th>
<th>Group 4 (N = 42) %</th>
<th>Total (N = 180) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissatisfied or indifferent</td>
<td>12.1</td>
<td>13.5</td>
<td>10.7</td>
<td>9.5</td>
<td>11.7</td>
</tr>
<tr>
<td>Slightly satisfied</td>
<td>15.5</td>
<td>1.9</td>
<td>14.3</td>
<td>2.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Rather satisfied</td>
<td>34.5</td>
<td>23.1</td>
<td>17.9</td>
<td>26.2</td>
<td>26.7</td>
</tr>
<tr>
<td>Very satisfied</td>
<td>37.9</td>
<td>61.5</td>
<td>57.1</td>
<td>61.9</td>
<td>53.3</td>
</tr>
</tbody>
</table>

Test for association between treatment group and satisfaction with treatment (P = .007); separately for treatment type (P = .002) and clinical classification (P = .004).

Overall Satisfaction

Eighty-eight percent of all patients were satisfied with the treatment. When comparing the different treatments, Groups 2 and 4 (combined treatment) showed greater satisfaction than Groups 1 and 3 (copper vapor laser alone) (62% and 44% being totally satisfied, respectively, P = .007) (Table 4).

Eighty-three percent of all patients indicated they would recommend the treatment to others who had similar conditions. However there were significant differences between treatment groups. Groups 2 and 4 (combined treatment) recommended treatment more than Groups 1 and 3 (copper vapor laser alone), and patients with spider nevi recommended treatment more than those with linear/arborizing telangiectasia. Both factors were statistically significant (Table 5).

Overall, 82% of all patients rated the treatment good to very good. Only 4% of patients rated the treatment badly. Again, combined copper vapor laser and microsclerotherapy rated higher (P = .03) than copper vapor laser alone in both types of telangiectasia (Table 6).

Discussion

When treating dermal blood vessels, laser selectivity is dependent on the wavelength, pulse duration and focusing of the laser light as well as the thermal relaxation time of the illuminated blood vessels.26 The thermal relaxation time for blood vessels of diameters from 10 to 150 μm ranges from 0.1 to 10 milliseconds, respectively.14 The copper vapor laser emits pulsed light at a wavelength of 578 nm, which is within the optimum range when using hemoglobin as the target chromophore. The pulse duration of the copper vapor laser is extremely short at 20 nanoseconds, with a repetition frequency of 15,000 kHz. The high repetition rate means that many pulses are absorbed by each vessel during the thermal relaxation time, and, therefore, the copper vapor laser should be considered to be operating in continuous mode with a stepwise increase in intravascular temperature causing thermal necrosis. Following copper vapor laser, initial epidermal damage consisting of superficial blistering occurs but histologic studies at 3 months have shown that this damage is not permanent.27 The initial observed response of the skin to the copper vapor laser is blanching caused by heat conduction from hemoglobin resulting in thermal necrosis of endothelial cells and transmitted thermal damage to perivascular connective tissue. It is likely that damaged endothelial cells swell resulting in total occlusion of the lumen.28 By using magnified vision and a small spot size of 150 μm diameter, damage to the skin surrounding ectatic vessels is minimized. This technique has been previously described using the argon-pumped tuneable dye laser,29 and, when treating facial telangiectases, has theoretical advantages over the pulsed dye laser which, due to its unfocussed method7 unavoidably illuminates uninvolved skin surrounding the telangiectasia.

Although copper vapor laser utilizes the hemoglobin specific wavelength of 578 nm, epidermal melanin absorption still occurs.30 The major adverse effect reported in this study was hypopigmentation. Frequently this is
the result of contrasting between laser treated telangiectatic skin and untreated actinically hyperpigmented skin. Patients with extensive photodamage may therefore develop unwanted demarcation lines. The hyperpigmentation caused by photodamage has been shown to be responsive to topical tretinoin therapy.17-20 Therefore patients with evidence of coexisting actinically induced hyperpigmentation should have pretreatment with topical tretinoin for at least 2 months prior to copper vapor laser. This is likely to reduce significantly the incidence of post-copper vapor laser hypopigmentation, in addition to providing beneficial treatment to the associated actinically induced dermal elastosis, epidermal atrophy, and actinic keratoses, and may improve post-laser healing.

The incidence of scarring reported by patients in this study was higher than expected and in most cases was of a temporary nature. In several instances, these reports conflicted with the physician’s assessment. The incidence of scarring reported by the patients is related to the continuous mode of operation of the copper vapor laser, which results in thermal damage to the epidermis and perivascular connective tissue. However, subsequent re-epithelialization from the hair follicles and sebaceous glands results in resurfacing of the photodamaged area, which in a significant proportion of patients leads to improvement of skin texture. Atrophic scarring reported by patients did not appear to be a significant factor in causing dissatisfaction because most of the patients who reported atrophic scarring were none-the-less satisfied with the treatment and recommended treatment to others.

Many dermatologic surgeons are fearful of performing sclerotherapy on the face because of the potential for complications arising from deep anastomoses with central cerebral vessels. The mechanism of action of sodium tetradecyl sulphate is by specific endosclerosis through damage to endothelium and not through thrombosis.25,35 Intracranial thrombophlebitis is invariably due to secondary infection from middle ear and mastoid cells, from infected paranasal sinuses, or skin infections around the upper lip and nose.36 Aseptic thrombosis of intracranial vessels is rare and requires predisposing factors such as postpartum and postoperative states, characterized by thrombocytosis and hyperfibrinogenemia; congenital heart disease and marasmus in infants; sickle cell disease; and primary and secondary polycythemia.36 In the absence of these predisposing factors, microsclerotherapy of facial telangiectases using the technique and sclerosant strength described above is a safe procedure that will produce rewarding results.

The results of this study confirm that the copper vapor laser is an effective surgical tool in the treatment of facial telangiectases. However pretreatment of larger telangiectatic vessels by microsclerotherapy using sodium tetradecyl sulfate gives significantly improved patient acceptance. The benefits may arise for two reasons. First, laser light with a wavelength of 578 nm has little effect on vessels lying deeper than 0.5 mm below the epidermis.28 These vessels, which may be either venules associated with arborizing telangiectases or arterioles associated with spider nevi, are likely causes of recurrence following laser photoagulation. Second, pretreatment with microsclerotherapy results in reduction of the flow rate and diameter of superficial dermal telangiectases, enabling the use of lower laser powers with resultant reduction in adverse effects such as hypopigmentation. It is essential however that low concentrations of sodium tetradecyl sulfate and slow injection technique as described above are utilized to avoid possible adverse effects of microsclerotherapy, in particular cutaneous necrosis and subsequent atrophic scarring.

Acknowledgments I wish to thank Dr. R. Gibberd from the Department of Statistics at the University of Newcastle for his assistance in the statistical analysis.

References

54 THIBAULT
FEATURES • PHLEBOLOGY

J Dermatol Surg Oncol
1994;20:48 – 54