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ORIGINAL ARTICLE

Laser use for cutaneous vascular alterations of cosmetic interest

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ABSTRACT: In 1983, selective photothermolysis dramatically transformed vascular surgery, reducing the adverse effects and increasing its efficacy. As a result, laser surgery is now considered the gold standard treatment for many congenital and acquired skin vascular disorders.

In this paper, the authors analyze the main laser sources for vascular surgery, the general parameters regarding laser–tissue interactions that can influence the treatment (such as hemodynamic features, anatomical areas, vessel depth, and diameters), and other aspects important for a good laser practice. Afterward, the main indications for laser treatment in vascular cutaneous disorders are discussed, with particular reference to port-wine stain, hemangioma, facial telangiectasia, rosacea, spider angioma, venous lake, varicose leg veins, and leg telangiectasias.

KEYWORDS: hemangiomas, intense pulsed light, Nd:YAG laser, port-wine stains, pulsed dye laser, skin vascular lesions, telangiectasias

Introduction

Skin vascular lesions have been among the first applications of lasers in dermatology. Already in the 1960s, Dr L. Goldman, the pioneer of the dermatological laser surgery, tried to treat port-wine stains (PWSs) and skin vascular tumors with a ruby laser (1). It was only after 1983 that new laser devices, more suitable for vascular surgery, were developed according to the theory of selective photothermolysis by Anderson and Parrish (2). They hypothesized that some molecules (chromophores) present into the tissues can selectively absorb specific light wavelengths, converting the light energy to thermal energy after the absorption (FIG. 1). Therefore, a chromophore can be selectively damaged or destroyed by the absorption of an appropriate wavelength. A heated body cools delivering heat over the time by diffusion: the thermal relaxation time (TRT) is the time interval required for the target to deliver 50% of heat to surrounding tissues. To minimize the thermal damage to surrounding tissues and to avoid scarring, the laser pulse duration should be shorter or equal than the TRT of the target.

Thanks to this principal theory, laser surgery (and its related treatments by noncoherent light sources) is now considered the gold standard treatment for most of the vascular lesions.

- Chromophore: The main chromophore is represented by oxyhemoglobin. It has the main absorption peaks at 542 and 577 nm, and also a little peak at 1064 nm, whereas regarding

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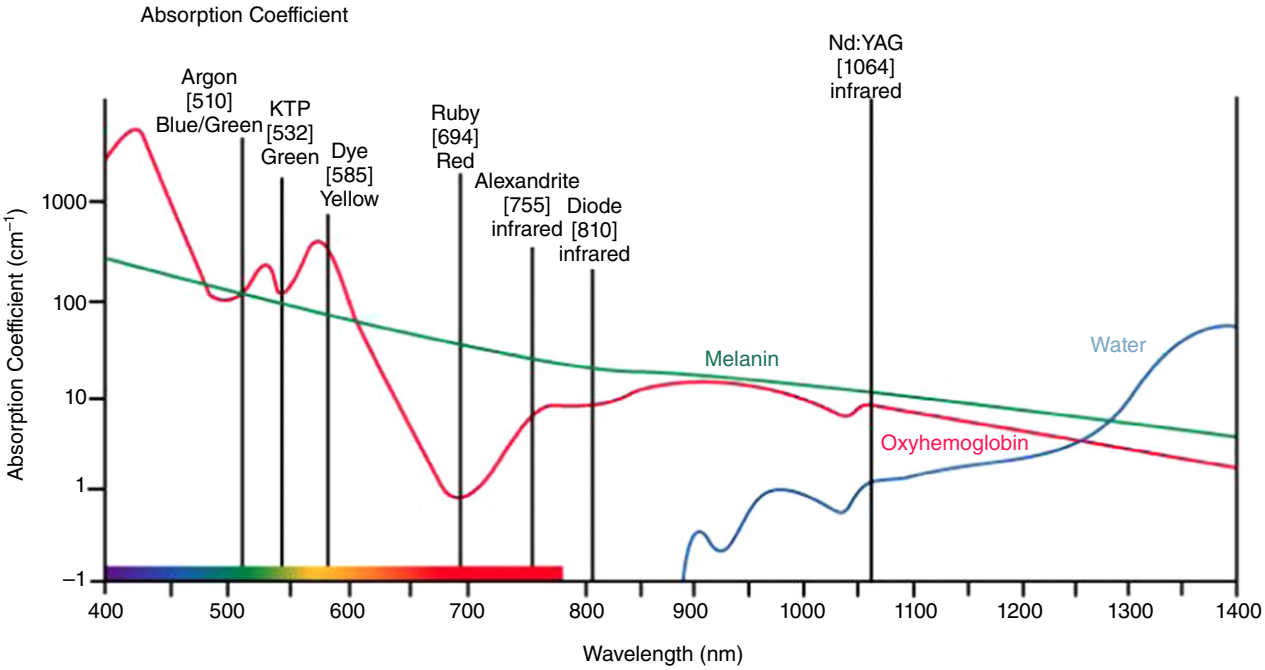

FIG. 1. Main skin chromophores absorption curve. (Courtesy of Palomar Medical, Inc., Boston, MA, USA)

melanin (that should be considered as the competitor chromophore), the longer the wavelength the less the absorption. Therefore, for darker phototypes longer wavelengths and longer pulse durations and intervals should be employed to avoid epidermal damage and posttreatment hyperpigmentation (3). However, other blood chromophores, such as deoxyhemoglobin, present in the leg veins, and metahemoglobin, produced during laser passes, should also be considered to efficiently treat vascular lesions. These chromophores absorb wavelengths also in the 800–1200 spectrum (4,5).

- Wavelengths: The longer the wavelength, the deeper the penetration into the dermis, thus lasers emitting longer wavelengths are more suitable for thicker and deeper lesions. However, the laser energy absorbed by oxyhemoglobin decreases, and higher fluencies are needed to compensate for the lower absorption.

Nevertheless, unlike other pathologies prone to laser surgery, other factors should also be considered to perform a proper laser treatment in vascular lesions:

1. Site of vessel and anatomical areas. Considering the depth of the lesions is mandatory during clinical evaluation: superficial lesions respond better to laser treatment with devices emitting shorter and more selective wavelengths, such as 532 and 595 nm, while deeper lesions should be treated by longer near-infrared lights. However, the vessels localized in the deep dermis and hypodermis poorly respond to trans-epidermal laser irradiation.Taking as example the leg veins, unlike the telangiectasias of the face, they have a muscular layer, thicker walls, and a very high hydrostatic pressure, thus requiring higher energies for an efficient thermocoagulation. Moreover, leg veins are bluer, deeper, and contain less oxyhemoglobin and more deoxyhemoglobin.
2. Chromophore versus targets. Unlike for tattoo and other pigmented lesions, where chromophore and target overlap, in vascular surgery the chromophore (oxyhemoglobin) differs from the target (the vessel wall). Therefore, the chromophore is used as a kind of optical firelighter, allowing the thermal energy produced within the red blood cells to diffuse through the blood and to damage the walls of the vessels, producing thrombosis. Accordingly, different laser pulse lengths must be considered taking into account the blood flow and the different diameters of the vessels: the larger vessels require longer pulse durations (6).
3. Blood flow. Our target in vascular lesions is a dynamic chromophore; as blood flows into the vessels, new, untargeted blood takes away the heat induced by light absorption, protecting the vessel by thermal induced damage. Large spot sizes are recommended to increase the heated volume of the blood.

Epidermal cooling

During laser coagulation of dermal vessels, the epidermis should be protected by overheating, in order to avoid damages to keratinocytes and melanocytes, or pigmentary and textural changes. Therefore, the use of a cooling system is mandatory to perform a safe laser vascular treatment. Different cooling devices can be employed (such as cryogen spray or cold sapphire contact handpiece). Moreover, skin surface can also be refrigerated by blowing precooled air on the epidermis. Attention must be kept when cooling device is set, because an important decrease of the skin temperature induces vasoconstriction, thus reducing the efficacy of laser treatment.

Main laser sources for vascular surgery

Flashlamp-pumped pulsed dye laser (PDL)

PDL has been the first laser based on the selective photothermolysis theory, which has been manufactured for vascular lesions, and until now is considered to be the laser of choice for safe treatments of many vascular lesions, such as PWSs, hemangioma, facial telangiectasia, and poikiloderma of Civatte. This laser emits a yellow light due to its lasing medium: the rhodamine 6G dye. Until few years ago, the PDL emitted a pulsed beam at 585 nm with a pulse duration of 450 μs, with limited results. Indeed, the short penetration of the laser light (no more than 0.2 mm below the dermo-epidermal junction) was insufficient to target many vascular lesions; moreover, its short pulse duration caused vessel disruption resulting in a cosmetically embarrassing, long lasting, post-treatment purpura. Now, PDLs have a longer wavelength (595), longer pulse durations (1.5–40 ms), and larger spot sizes to allow a deeper penetration and a more gentle vascular coagulation (7).

Neodymium:yttrium-aluminum-garnet (Nd:YAG) laser

This solid state laser has the primary wavelength of 1064 nm. This wavelength allows a deeper penetration, being able to create coagulation effects at a depth of 5–6 mm (8). In spite of an absolute lower absorption of this wavelength by hemoglobin, the ratio of melanin to blood absorption is similar at 585 and 1064 nm; however, the lack of hemoglobin selectivity has to be compensated by an increase in fluence. The 1064-nm absorption coefficient of the blood is higher than that of the surrounding dermis, leading to a selective and relatively safe treatment of deeper blue and larger vessels (9–11). However, an efficient cooling system is mandatory to avoid potential thermal damages (such as blistering, crusting, pigmentary, and textural abnormalities and scarring).

Doubled 532-nm Nd:YAG laser

A second 532-nm wavelength can be obtained by Nd:YAG laser doubling the primary 1064 wavelength by a crystal of potassium tytanil phosphate (KTP). The oxyhemoglobin preferentially absorbs the 532-nm light, but this wavelength is too short to penetrate into the dermis and efficiently coagulate medium deep vessels, therefore its action is limited to smaller and more superficial vessels. Caution should be taken when pigmented skins are treated, because its interaction with epidermal melanin can cause dyschromia and textural changes due to thermal damage of the epidermis.

Intense pulsed light (IPL) devices

The IPL is not a laser, but only a noncoherent light beam with a wide spectrum of wavelengths, ranging from 500 to 1200 nm. The function of IPL is, in an approximate way, inspired by the selective photothermolysis theory. In order to achieve selectivity, appropriate cutoff filters for vascular lesions are used. Compared with lasers, these devices generate energy in single or multiple pulse modes with adjustable pulse duration and pulse delay. This allows a regulation of treatment parameters according to the wide variety of vascular lesions, but on the contrary of lasers, IPL emits several not selective wavelengths in the same beam. Moreover, to avoid the negative effects of the significant divergence of its beam, the handpiece must be in contact with the skin surface, often resulting in ineffective treatment because of vessel compression (12). Treatment efficacy varies between the different IPL systems, and not all of them are equally effective. Finally, ideal parameters for reproducible results have not been established.

Patients' selection and main contraindications to vascular laser surgery

Before vascular surgery, all patients should be screened for conditions contraindicating laser treatment such as keloids, unstable vitiligo, lichen ruber planus, psoriasis, and a history of photoin-

duced dermatoses. Moreover, subjects treated with immunosuppressive drugs, taking oral isotretinoin or other oral retinoids, patients with unrealistic expectations, or not cooperative patients should also be excluded.

Main vascular disorders responsive to vascular surgery

Vascular malformations: PWSs

PWSs are congenital low flow vascular skin malformations occurring in 0.3% of the population (13). At birth, these lesions are superficial, appearing as light pink flat patches. However, they do not show any spontaneous resolution with age, tending on the contrary to become dark purple in color due to progressive vessel ectasia. In almost two-thirds of middle-aged patients, nodules and plaques can develop due to deeper hypertrophy (14,15). Because of its vascular selectivity, 585-nm PDL treatments have been considered the gold standard in therapy for the vascular birthmarks (16,17). However, sometimes the results are unpredictable, as several factors may influence the response to PDL treatment. In fact, the following aspects should be considered before performing therapy:

- Videodermoscopy pattern. It has been well illustrated that videodermoscopy of PWSs shows two different patterns of vascular alterations. Type 1 is characterized by blobs of tortuous, superficial, enlarged capillary loops (FIG. 2), whereas type 2 consists of typical rings and arched lines due to ectatic vessels in the superficial horizontal vascular plexus (FIG. 3). Obviously, patients with the more superficial type 1 pattern respond better to flashlamp-pumped pulsed dye laser treatment (18).
- Anatomical localization: PWSs arising on the extremities have a poor response, probably because of blood deoxygenation and gravitational effects (19). Some other anatomical variations may influence the response to treatment: the centrofacial areas and the skin region corresponding to the dermatome V2 respond less than the other facial sites, probably due to more deeply located vessels (20,21).
- Size of malformation: The extent of the PWS may seriously affect the results. Indeed, it has been shown that PWSs larger than 60 cm^2 have worse clearing rates compared with smaller lesions (22).
- PWS evolution: Moreover, the typical evolution of the PWS toward hypertrophy and thickness makes the conventional 585 dye laser treatment more difficult in the adults, with variable degrees of clearing, even after several dye laser sessions (23).

In order to achieve a major efficacy in these difficult-to-treat PWSs, the PDL has evolved, passing from the old 585-nm short-pulsed instrument to a new device delivering a 595-nm wavelength in a longer pulse duration with cryogen gas sprouting. These features have increased the tissue penetration maintaining an adequate vascular specificity (24,25); moreover, the cryogen cooling protects the epidermis from overheating, allowing the safe use of higher fluencies, which accelerate the clearance of the PWSs (26–29) (FIG. 4a,b). For these reasons, PDL still represents the gold standard treatment for the majority of PWSs (30), even

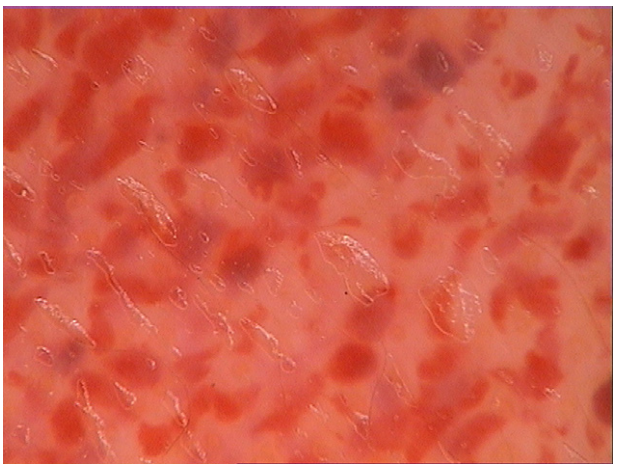

FIG. 2. Videodermoscopy showing type 1 vascular pattern: blobs of enlarged capillary loops.

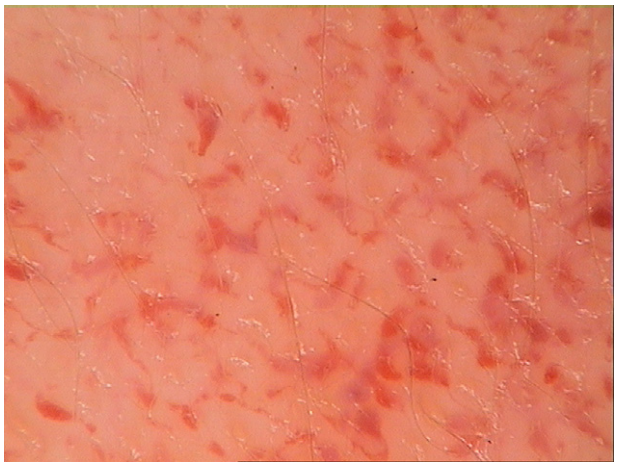

FIG. 3. Videodermoscopy showing type 2 vascular pattern: typical rings and arched lines due to ectasias of superficial horizontal vascular plexus.

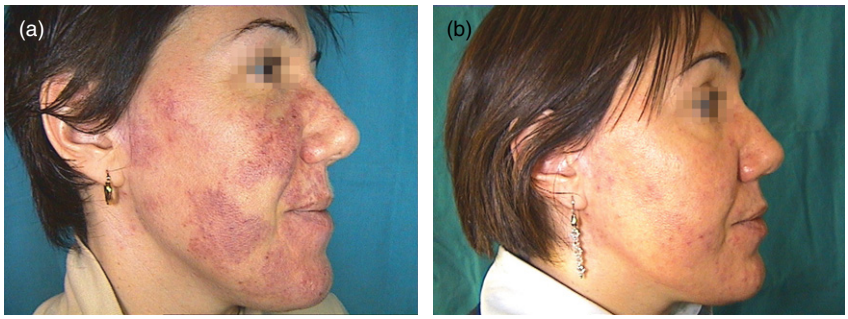

FIG. 4. (a) Port-wine stain before treatment. (b) Port-wine stain after treatment with pulsed dye laser.

if the results on nodular PWSs still remain unpredictable (31) and many of these lesions fail to fully respond.

Multiple passes or pulse-stacking techniques have been used to improve the extent and rate of fading (32–34). According to Rajaratnam (34), all these techniques may be useful but deserve further scrutiny with randomized prospective studies and histological analysis to confirm the increased depth of vascular injury.

Light sources other than PDL have been experimented in the recent past to accelerate resolution of difficult PWSs. More specifically, intense broad-spectrum pulsed light (IPL) (35,36), Alexandrite 755-nm laser, and 1064-nm Nd : YAG long-pulsed laser (18,37) have been previously evaluated. In particular, 1064-nm Nd:YAG long-pulsed laser has been recently used on PWSs because of its ability to penetrate deeper (38). Unfortunately, the high energies required for this laser treatment can cause scarring due to epidermal overheating and burning (38,39).

However, recent studies indicate that in difficult-to-treat PWSs we can obtain a wide vascular damage, with a lower incidence of complications, by stimulating methemoglobin formation; this can be achieved through photoinduced oxidation by using a combination system of a 595-nm laser and a 1064 Nd-YAG wavelength (40,41) or a dual-wavelength approach with 585-nm PDL laser and 800-nm diode laser (42).

Photodynamic therapy is a relatively new approach in the treatment of PWS. In this therapy, an exogenous chromophore-like porphyrin derivative is administered into the blood circulation, and concentrates in the ectatic capillaries. Subsequent irradiation by either coherent or noncoherent light of appropriate wavelength generates oxygen-derived free radicals in the presence of the porphyrin derivative and oxygen, selectively damaging the capillary wall (43). However, further clinical trials and other investigations are mandatory to confirm these preliminary results.

Infantile hemangiomas

Infantile hemangiomas are now considered benign involuting vascular tumors well separated from PWSs by clinical and laboratory features (39) (Table 1). The main clinical hallmark of hemangiomas is their typical evolution, characterized by a proliferative early phase lasting several months, gradually continuing into an involutive phase. However, the spontaneous involution may be incomplete, so that 15–20% of the lesion may not disappear (44). Moreover, residual evidence with scar formation, fibrofatty masses, atrophic wrinkling, yellowish discoloration, and telangiectasias is usually seen after complete involution.

Two main distinct subgroups can be commonly observed at the onset:

1. Hemangiomas announced by precursor lesions: these lesions can mimic a PWS and may consist of superficial telangiectasias with surrounding pallor, pink patches, or blue bruise like macules.
2. Typical fully formed hemangiomas.

Moreover, they can be superficial (involving only the upper part of the dermis; they have a bright red and finely lobulated surface), deep (involving the deep dermis and the subcutis and appearing as a warm, bluish mass with normal overlying skin), or mixed.

Treatment. The majority of hemangiomas are small and require only little intervention. However, in 10–15% of cases (e.g., segmental and multifocal infantile hemangiomas, or occurring in the periocular, airway, or perineal area, when complications such as ulceration are present), treatment is mandatory.

Unfortunately, the confusing nomenclature and the wide spectrum of clinical manifestations

Table 1. Main differences between infantile hemangiomas and vascular malformations

	Infantile hemangioma	Malformations
Epidemiology	• Female/male ratio: 5 : 1 • More frequent in premature newborns or in children of mothers having post-chorionic villus sampling	• No gender prevalence • No particular gestational features
Clinical	• Rarely present at bith • Rapid growth • Natural trend to involution overtime	• Present at birth • Slow and progressive growth overlife • Trend to hypertrophy and nodularity in adulthood
Histopathology	Proliferative phase • Endothelial cell hyperplasia • Lobule formation • Several mast cells Involutive phase: • Decreased number of mast cells • Fibrofatty tissue replacement	The main histological features are: • telangiectasia of normal capillaries • sometimes congenital abnormal increase of the number of cutaneous vessels
Immunohistochemistry	GLUT1-, Lewis y antigen-, Merosin-, FcγRII-positive	GLUT1-, Lewis y antigen-, Merosin-, FcγRII-negative

Modified by Garzon MC. Infantile hemangiomas. In Bolognia JL, Rizzo JL, Rapini RR, eds. Dermatology second edition, vol. 103. Mosby Elsevier 2008: 1565–1580.

make the management of hemangiomas controversial (45). The "non-intervention strategy" awaiting a spontaneous regression, which was generally adopted in the past, must be now critically reviewed, in consideration of the risk of permanent scarring associated with the spontaneous involution of many hemangiomas. A complete analysis and discussion of the several therapeutic options lies outside of this paper. To summarize, early surgery, extensive cryosurgery, and radiotherapy should be avoided because of poor outcomes and significant side effects (45). According to the American Academy of Dermatology (46), the treatment should:

1. Prevent or reverse life-threatening complications.
2. Prevent disfigurement left by residual skin changes.
3. Minimize psychological stress.
4. Avoid scarring procedures.
5. Prevent or treat ulcerative lesions to minimize infection, pain, or scarring.

Systemic corticosteroid therapy has been, until now, the first-line treatment for severe infantile capillary hemangiomas (47), but it is possible that the guidelines are about to change to include new promising treatments such as propranolol, a non-selective beta blocker (48). Other anti-angiogenic molecules such as interferon and vincristine have also been used, but toxicities and several worrisome side effects limit their routine use (47).

Intralesional corticosteroid injections are an alternative to systemic steroid for limited hemangioma. Adverse effects include subcutaneous fat atrophy, epidermal necrosis, and temporary dyspigmentation of the treated area. This treatment modality should be limited to nonperiocular areas, because it carries the risk of embolization, retinal artery occlusion, and subsequent blindness (49).

Laser treatment. PDL treatment is effective for the precursor lesions and for small superficial hemangiomas; according to Dr Goldman, this laser should be used at the earliest sign of hemangioma and as soon as possible in the proliferative phase (50).

Early treatment with the 595-nm PDL can also safely and effectively diminish proliferative growth of superficial infantile hemangiomas of difficult skin areas such as the eyelid (51). Moreover, involuting superficial lesions respond quickly to treatment with a faster resolution than that observed during the spontaneous course of the disease, without scarring, atrophy, or hypopigmentation (52). PDLs are also used to treat ulcerations and residual skin defects (53); however, mixed or deep hemangiomas hardly respond to this treatment alone, showing only lightening of the most superficial area. Thus, PDL should be used in combination with intralesional steroid to treat the deepest proliferation (50). Alternatively, longer wavelengths, such as Nd:YAG laser, have to be tried to increase the depth of light irradiation (54). Recently, excellent results in 18 out of 25 cases of infantile hemangiomas, with no recurrence after a 6-month follow-up, have been reported by application of dual long-pulsed 595 dye/Nd:YAG lasers (55).

When used with adequate wavelengths, fluences, and pulse durations, also the IPL source can be useful to treat infantile hemangioma (56). Finally, ablative and nonablative fractional lasers have been recently proposed as interesting options for the treatment of atrophic and scarring residual hemangiomas (57,58).

Telangiectasias

Several lasers and light sources have been used to treat the facial telangiectasia (KTP, PDL, Nd:YAG, and IPL) with its own advantages and limitations. However, classic PDL seems to have a superior clearance rate compared with other sources, but disfiguring bruising represents an important side effect in short-pulse PDL. Indeed, a longer pulse (10 ms) and multiple passes are recommended to have an effective purpura free treatment (59).

IPL is an effective alternative to the lasers in the treatment of facial telangiectasias (60). However, long-pulse PDL treatments seem to be superior in vessel clearance than IPL treatments and it has been reported that the majority of patients preferred the long PDL treatments because of superior efficacy and less treatment-related pain (61,62).

Finally, the Nd : YAG laser is indicated for treatment of deeper, bluish veins and of a broad range of vessel diameters in pigmented skin types. To avoid overheating of the epidermis and textural changes, an efficient cooling system is required (63).

Rosacea-associated telangiectasia

Rosacea is a chronic dermatosis of the face and is characterized by flushing, nontransient erythema telangiectasia, papules, pustules, and inflammatory nodules. Long-pulsed duration, 595-nm PDL is proven to be effective for treating both erythema and telangiectasia (FIGS. 5a,b, 6a,b) with minimal side effects and no long-term complications (7,64–66). However, diffuse erythrosis is difficult to treat, requiring a high number of sessions.

Also, IPL seems to be safe and effective; Schroeter (67) demonstrated that IPL can be successfully used for a long-term clearance of telangiectasia

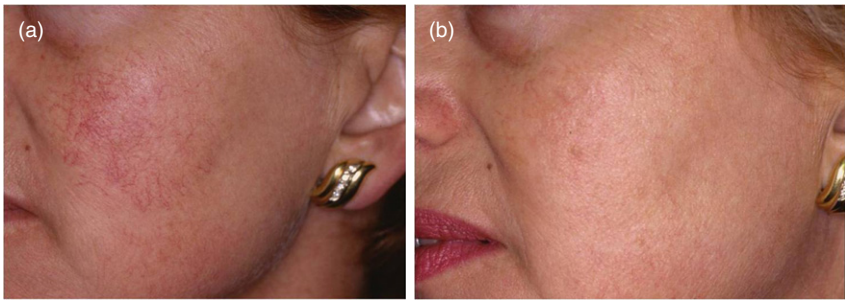

FIG. 5. **(a) Facial telangiectasias before treatment. (b) Facial telangiectasias after three treatments with long-pulse pulsed dye laser.**

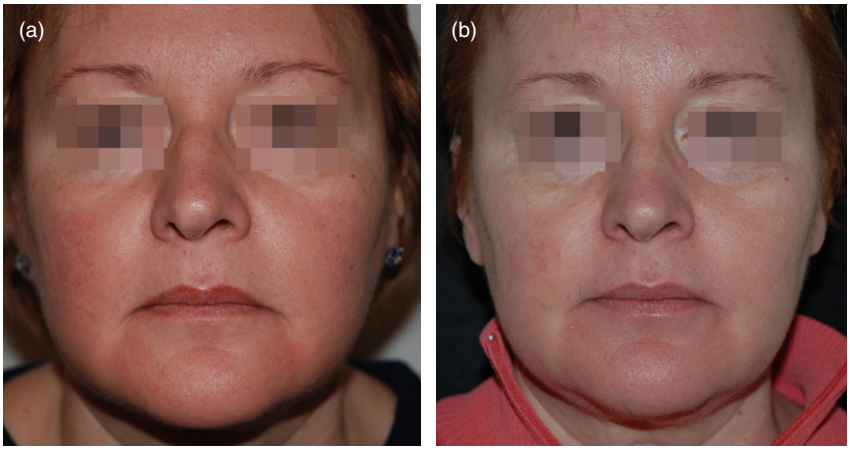

FIG. 6. **(a) Rosacea before treatment. (b) Rosacea after three treatments with long-pulse pulsed dye laser.**

associated with rosacea. However, no significant difference was noted between PDL and IPL treatments (68).

Finally, we suggest the following practical key points for a correct laser treatment:

1. A preliminary consultation is required in order to discuss the patient's expectations. In case of rosacea, clarify whether the patient's priority is the treatment of telangiectatic vessels, of erythema, or both. Make clear that flushing does not respond to laser treatment.
2. Inform patients that they might be required several laser sessions.
3. Avoid topical anesthesia because of its vasoconstrictor action.
4. Laser parameters should be varied depending on the size of the vessels to treat.
5. Hold the handpiece perpendicular to the skin surface.
6. Use PDL or IPS for the treatment of both erythema and telangiectasia associated with rosacea. Regarding PDL treatment, preferably use larger spots (7–10 mm in diameter), uniformly distributed on the skin surface
7. Laser treatment should be used with caution on the ala nasi and alar creases because of the risk of atrophic scars. The lowest fluence suggested should be used, and only in case of persistence of the vessel, fluence may be increased.
8. For large and blue telangiectasias, as well as for dark-skinned patients, Nd : YAG laser should be preferred.
9. Subsequent treatments should be scheduled at 4–6 week intervals.

Poikiloderma of Civatte

Poikiloderma of Civatte is a common benign condition involving mainly the sun-exposed areas of the neck, and is characterized by atrophy, hyper- and hypopigmentation, and telangiectasias. It is a difficult condition to treat, and special care must be taken in case of laser treatment of the neck, for a higher risk of textural changes and scarring due to a paucity of pilosebaceous glands. Unfortunately, guidelines for the treatment of poikiloderma of Civatte do not exist. Although several devices (argon lasers, KTP lasers, PDLs, and IPLs) have been used to treat this condition, a complete clearing is difficult to achieve and several side effects such as scarring with irregular hypopigmentation, post-inflammatory hyperpigmentation, posttreatment purpura, mottled appearance, crusting, and erythema have been reported (54). These side effects seem to be less common with the newer generation 595-nm PDLs using low fluencies, longer pulses, and dynamic cooling sprouting. Thus, an optimal clearing of poikiloderma-associated telangiectasias and pigmentation with minimal reticulation and purpura has been reported; however, multiple sessions are necessary to obtain optimal clearing. It is recommended to use the lowest possible fluences, and not to exceed an upper limit of 5 J/cm^2, with a 10-mm spot size, but more researches are required to define an optimal pulse duration. Generally, adverse effects are avoided by the use of lower fluences, nonoverlapping pulses, and repetitive gentle treatments (69). Finally, ablative and nonablative fractional photothermolysis has been reported (70,71) to be effective in removing the telangiectatic component and also in the lightening of dyspigmentation. Because the IPL emits a broad band of wavelengths, it is possible to treat simultaneously both vascular and pigment abnormalities. Moreover, the near-infrared component of IPL appears to improve skin atrophy associated with this condition, making this device one of the best instruments for poikiloderma of Civatte (54).

Spider nevus

It is characterized by a central feed arteriolar vessel with radiant fine red telangiectasia. Spider nevus is successfully treated with PDL, but several treatment sessions are needed because of its high flow.

Venous lake

PDL, IPL, and Nd:YAG laser have been all reported as very effective to treat this dilated "lake-like" venule. Among them, in our experience, the long-pulsed Nd:YAG laser is superior to achieve fast and safe results.

Leg veins and telangiectasias

The venous system of the legs is composed of a series of valved vessels in order to overcome the effects of gravity. Thus, also with the help of surrounding muscles, blood is pumped out of the legs and returns to the heart. During development, this vascular system undergoes differentiation through multiple stages. After the regression of the left side structures, the right side vessels develop with differences among individuals (72).

Persistence of embryonic veins after birth is associated with venous malformation of legs such as the Klippel–Trenaunay syndrome or chronic

Table 2. Clinical classification of venous disease: the CEAP classification

C0	No visible or palpable sign of venous disease
C1	Reticular veins or teleangiectasias
C2	Varicose veins
C3	Edema
C4a	Pigmentation or eczema
C4b	Lipodermatosclerosis or atrophic blanc
C5	Healed venous ulcer
C6	Active venous ulcer
S	Symptomatic
A	Asymptomatic

venous insufficiency. Other disorders include congenital venous aneurysm, valvular agenesis, and primary valvular insufficiency (73). Regardless of etiology, venous hypertension is the final result leading to the manifestation of varicose veins and telangiectasias.

In the upright position, the physiological effect of gravity and hydrostatic pressure hinder venous return. The relation between these forces and blood volume is essential to understand normal and abnormal functions of venous system (74). Normally, the venous valves and the calf muscle pump limit the accumulation of blood in the lower extremity veins and the increase in hydrostatic pressure.

Chronic venous insufficiency is a failure to reduce venous pressure during exercise, thus resulting in hypertension of ambulatory pressure.

High pressure in superficial veins (great saphenous vein: GSV; small saphenous vein: SSV; tributaries branch up to reticular veins) is directly transmitted in dermal capillary bed, leading to the formation of telangiectasias and extravasation of intravascular contents into interstitial space.

The management of patients with venous disease is based on the correct classification of the disorder. The diagnostic evaluation is organized into three levels of examinations, in accordance with the severity of the disease (Table 2).

Level 1: the office visit with history and clinical examination (including a handheld Doppler scanner or transillumination)

Level 2: noninvasive vascular laboratory testing: duplex color scanning with some plethysmography method added for C0-C4

Level 3: invasive investigation or more complex imagining studies (venography, venous pressure measurement, computed tomography, magnetic resonance imaging) for C4-C6 (75)

After diagnostic evaluation, reduction of venous hypertension by surgical or laser ablation of the incompetent superficial venous system (GSV, SSV, branch tributaries, and perforators) is a fundamental approach to the treatment of telangiectasias (76–78).

The endovenous laser treatment of the saphenous vein gives satisfactory esthetic and functional results with a low rate of complications (79), but this type of management goes beyond the aim of this paper.

Leg telangiectasias are difficult to treat with lasers because, in addition to the increased hydrostatic pressure and associated venous disorders, blood vessels are deeper than the facial vessels and they have thick adventitial tissue and increase basal lamina. For this reason to thermocoagulate the vessel of legs, lasers delivering very high energy pulses through large spots are needed.

Sclerotherapy is still the gold standard treatment for leg telangiectasias. On the other hand, laser treatment should be considered in patients with needle phobia or who had developed adverse effects from sclerotherapy (5). Laser sources are able to treat spider veins (0.2–2 mm red or blue), reticular veins (up to 5 mm), and telangiectasias (0.2–1 mm red or blue).

The laser of choice for leg vein treatment is Nd:YAG laser (wavelength of 1064 nm) (54). This wavelength has a deep penetration (5–6 mm) and is able to coagulate moderately deep vessels such as those of the legs. To perform a laser treatment on leg veins, the following practical key points are useful:

- Hydrostatic pressure and associated venous disorders must be treated before.
- The 3- or 6-mm spot sizes are suitable for superficial lesions (telangiectasias, spider veins), whereas the 6- or 8-mm spot sizes are used for reticular veins.
- The pulse duration required for these lesions is 20–50 ms (rarely longer).
- The fluences are variable in relation to spot size and pulse duration.
- Pre- and post-cooling are absolutely necessary because of the very high fluences needed (80).
- Overlapping of the treated area is not necessary when a large spot size is used, whereas a mild overlapping or a stacking double shot is required with a 3-mm spot size.
- When large reticular veins are to be treated, it is useful to apply a mild pressure on the handpiece to minimize the vein diameter in order to favor penetration and to decrease the fluency.
- The clinical end points are the darkening of vessel for blue veins and the disappearance for red vessels.

The treatment with long-pulsed Nd:YAG is painful, therefore cooling and sometimes topical anesthesia is required. A common side effect, even in lighter phototypes, is the hyperpigmentation that normally resolves with time, whereas hypopigmentation and scars are uncommon.

Contraindications for laser treatment are active local infections, unstable vitiligo, psoriasis, history of keloids, and patients with unrealistic expectations.

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