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SEEING RED: PEARLS FOR VASCULAR LASER TREATMENT

Introduction

Dermatologists diagnose vascular lesions routinely in clinical practice. Many such lesions are benign neoplasms (e.g. cherry angiomas, venous lakes), while others occur in the setting of a dermatological condition (e.g. rosacea) that can be managed in part with an existing medical toolbox of treatment options. While some patients are reassured once a benign diagnosis has been established, some may seek elective treatment of these lesions. As dermatologists, we are in position to provide safe and effective elective treatment with various physical modalities. Vascular lasers are a group of devices that can target hemoglobin as a chromophore, providing treatment selectivity and the potential for scarless outcomes. This article aims to share practical pearls for the optimization of vascular laser treatments in clinical practice.

Is the condition responsive to vascular laser?

In general, telangiectasias, spider angiomas, cherry angiomas, and venous lakes are conditions that are very responsive to vascular laser surgery: 1-2 treatments will usually provide significant improvement. Background erythema[1], as in the setting of rosacea, may require a few additional treatments for a clinically satisfactory response.

Erythematous or red scars also require multiple treatments[2] (**Figure 1**), while periscar telangiectasias (common with flap reconstructions) will respond as stated above. A positive outcome may require more treatments for erythematous scars that are on the body (e.g. surgical scars) rather than on the face (e.g. acne scars), in part owing to more conservative treatment.

Capillary vascular malformations respond predictably to vascular lasers, however several treatments are required and clearance may be partial. Establishing the diagnosis prior to performing laser surgery is critical: some uncommon erythematous conditions, such as keratosis pilaris rubra faciei, may have a protracted response to vascular laser treatment. Some benign lesions are only partially vascular in structure and may be incompletely improved by vascular laser: for instance, the author prefers treating angiofibromas with an ablative laser. Confirming the diagnosis is the first step towards formulating a treatment plan which includes communicating reasonable expectations for patients with respect to lesion clearance. The absence of a confident diagnosis for a lesion could be considered a relative contraindication to treatment.

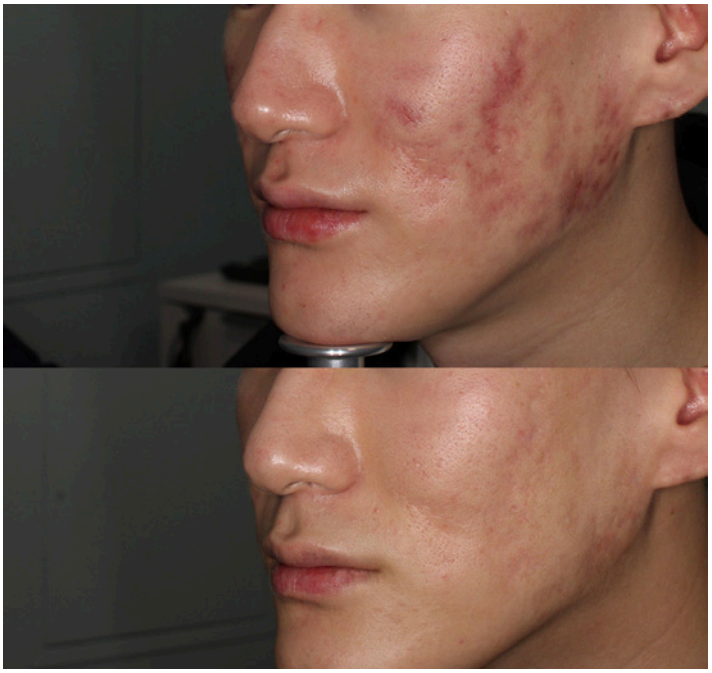

Figure 1. *Erythematous scars treated with three sessions of 532 nm KTP laser; image courtesy of Vincent Richer, MD*

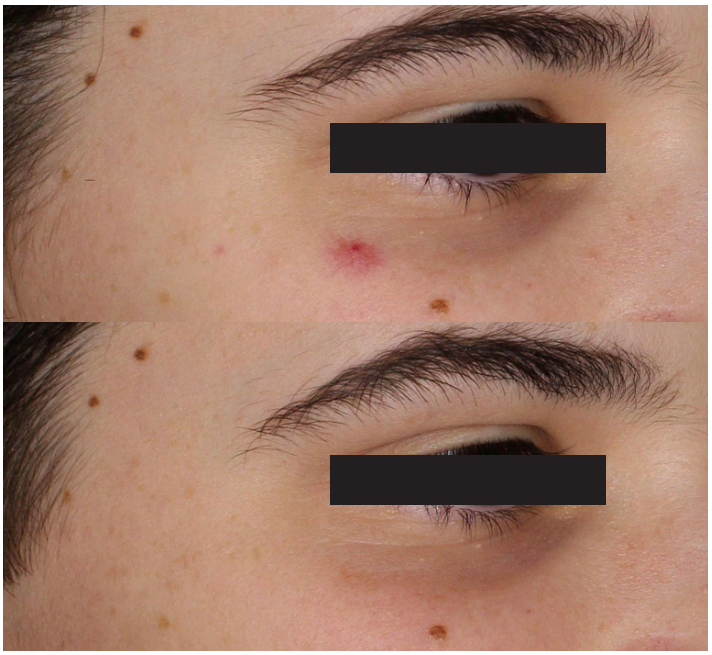

Figure 2. *Spider angioma treated with combination 532 nm KTP laser and 1064 nm Nd:YAG laser; image courtesy of Vincent Richer, MD*

Select an appropriate wavelength (or two!)

In keeping with the theory of selective photothermolysis[3], the laser wavelength chosen for treatment should have affinity for hemoglobin as a chromophore and should reach the desired depth of treatment to reach that chromophore. "Classic" vascular laser wavelengths include the 532 nm "KTP laser" (frequency-doubled Nd:YAG) and 585-595 nm pulsed dye laser (PDL). These wavelengths take advantage of one of the three peaks of absorption of hemoglobin (417 nm, 542 nm, 577 nm). Their depth of penetration is at the superficial dermis, with the PDL having slightly deeper penetration.

For the optimal treatment of some lesions, more deeply penetrating wavelengths may be required. Commercially available "KTP" and PDL lasers carry the Nd:YAG 1064 nm wavelength, which allows for energy delivery to deeper vascular lesions and takes advantage of the affinity of the 1064 nm wavelength for deoxyhemoglobin. For instance, a spider angioma usually has a deeper central vessel that can be sealed with a pulse of Nd:YAG laser while the remainder of the lesion can be treated with a more superficial wavelength (**Figure 2**). Another example is a capillary malformation with vascular blebs in which the macular component can be treated with "KTP" or PDL laser while the blebs are best addressed with deeper wavelengths. As a laser surgeon, one may consider using a long pulse alexandrite laser or a long pulse diode laser to treat deeper vascular lesions. Clinicians should avoid pulse-stacking (immediate delivery of a pulse following the initial pulse, often using the repetition rate feature of laser devices) and look out for the relevant biological endpoint when using more deeply penetrating wavelengths – overly enthusiastic treatment may result in crusting, ulceration and scarring.

Is the patient's background skin a good candidate for vascular laser?

In practice, there are very few contraindications to vascular laser surgery[4]. Treatment of pregnant/breastfeeding patients is generally avoided, as is initiating treatment with active infection/inflammation at the site of treatment. If patients have a significant tan on the skin on the day of the treatment or cannot properly avoid sun exposure after treatment, rescheduling the procedure is judicious. A history of keloid scarring is worth exploring, however in the author's practice this is not a contraindication to treatment but rather a guide for treatment modification. If there is a history of herpes simplex virus (HSV) infection and the perioral area is treated, antiviral prophylaxis may be considered. Though several guidelines recommend avoiding treatments in patients who are on photosensitizing medications, vascular lasers emit light within the visible and infrared spectrum: these are rarely responsible for drug sensitivity. It would be best to avoid vascular laser treatment in patients with skin diseases that are aggravated by visible light (eg. porphyria, chronic actinic dermatitis, solar urticaria). Isotretinoin treatment within the last 6 months was once thought to be a contraindication to vascular laser treatment, a dogma that has been refuted by the American Society for Dermatologic Surgery task force which identified little evidence to delay treatment[5]. Lastly, there is a concern that unstable vitiligo or psoriasis could Koebnerize within the area of local treatment.

In the author's practice this has yet to happen, however the possibility should be discussed with patients ahead of treatment.

Treat towards a known biological endpoint

There are many operator-dependent factors involved in treatment with a vascular laser. Treating to the appropriate biological endpoint can help maximize safety (minimize overtreatment) and efficacy (minimize undertreatment)[6].

Purpura is a well-established biological endpoint during vascular laser surgery. It is classically recommended in the treatment of port-wine stains or observed within a cherry angioma after laser exposure, for instance. In other scenarios, purpura is not necessary for clinical response and is undesirable to patients who want to avoid prolonged social "downtime". Non-purpuric biological endpoints include vessel clearance, temporary blanching, and venous constriction.

Vessel clearance is a relevant and satisfying biological endpoint (**Figure 3**) in the treatment of telangiectasias, as may be observed in erythematotelangiectatic rosacea or around scars from flap reconstruction.

Temporary blanching is often the desired biological endpoint in the treatment of background erythema or scars. Venous constriction can be observed when treating deeper venous lesions, such as a venous lake. This phenomenon may be associated with an audible "pop" and a slight shockwave felt via the handpiece.

Treating to an endpoint avoids "cookie-cutter" treatment. The author will commonly use conservative laser settings, deliver a few pulses to the treatment area, and observe the skin for a few seconds. In the absence of the desired response, fluence may be increased incrementally and an adjacent area tested. Pulse duration may also be adjusted to match the size of the target, with larger structures generally needing to be matched with a longer pulse duration.

Some biological endpoints herald the potential for complications[7]. Though purpura can be a desired biological endpoint, it may appear to be a complication to a patient who has not been warned of its possibility. Though there is no unanimous "purpuric threshold", it is observed more frequently with shorter pulse durations and higher fluences. Some authors have argued that stacking pulses of lower fluence may have the advantage of heating vessels to a critical temperature without creating purpura.[8] We would only advise this with vascular lasers of shorter penetrating wavelengths (532, 585-595 nm).

Observing persistent blanching or gunmetal gray discoloration should immediately prompt the laser surgeon to stop treatment, reassess settings, consider more conservative treatment or halt treatment altogether.

Deliver treatment with 10-15% overlap with 532 and 585-595 nm wavelengths

With vascular laser, patients can expect pain during laser exposure, heat/burning sensation, edema, and purpura if it is a desired endpoint. Treating to endpoint with the lowest effective fluence reduces the possibility of post-inflammatory pigment alteration, crusting, ulceration, or scarring. As mentioned previously, pulse stacking deeply penetrating wavelengths like the 1064 nm Nd:YAG can significantly increase the possibility of scarring. Minimizing side effects is also about the placement of laser pulses. Honeycombing/footprinting is a side effect that can be observed with vascular lasers when there are gaps between the laser pulses (**Figure 4**). This is most observed when the biological endpoint is temporary blanching, as when treating background erythema, which can make keeping track of the treated area more challenging. Overlapping pulses by 10-15% when treated with a "KTP" laser or PDL can minimize the risk of honeycombing. Thankfully, if it does occur, the solution is simply to provide additional vascular laser treatment.

Consider treating epidermal pigmented lesions with a vascular laser

Although many laser devices exist to target pigment, laser surgeons benefit from maximizing the number of clinical applications available for each of their devices. Sometimes a Q-switched or picosecond laser is not available, or a patient being treated for a vascular lesion may also derive value from treating an epidermal pigmented lesion during the same visit. Targeting epidermal pigment with classic "vascular lasers" is best done with a small spot size to treat pigment focally, shorter pulse durations to match the thermal relaxation time of pigmented structures, and with reduced cooling to encourage some epidermal damage. The targeting of epidermal pigment must be done conservatively to avoid targeting endogenous pigment and resultant post-inflammatory pigment alteration. In particular, the author's treatment of choice for small seborrheic keratoses/dermatosis papulosa nigra is the long pulse "KTP laser"[9] (**Figure 5**). The desired biological endpoint in this case is slight scaling/graying of the

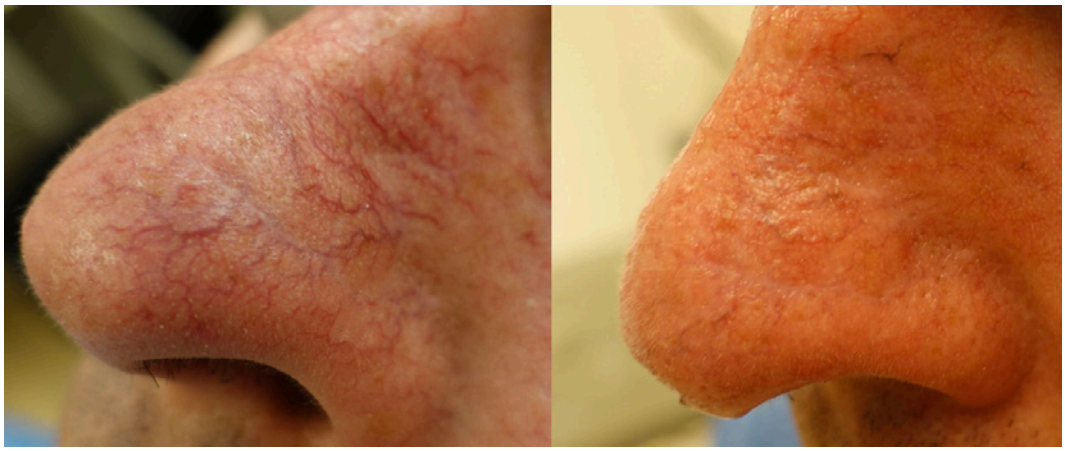

Figure 3. *Biological endpoint of vessel clearance when treating telangiectasias of the nose; image courtesy of Vincent Richer, MD*

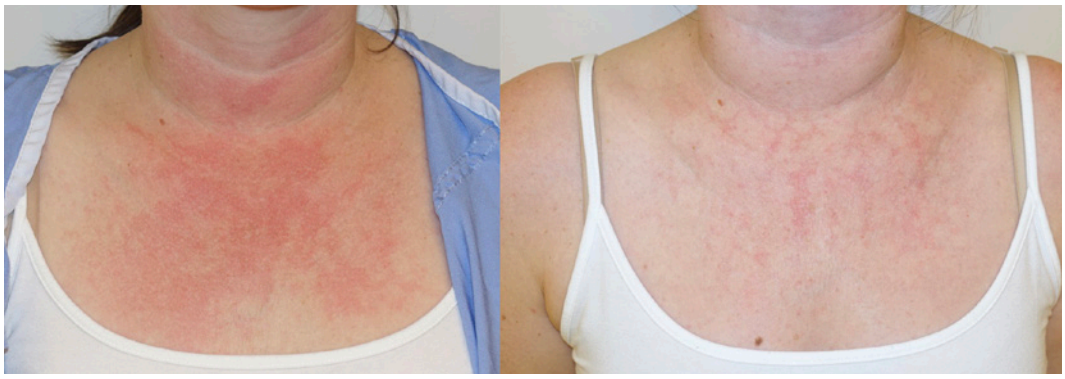

Figure 4. *Footprinting/honeycombing observed due to incomplete overlap during the delivery of vascular laser treatment; courtesy of Vincent Richer, MD*

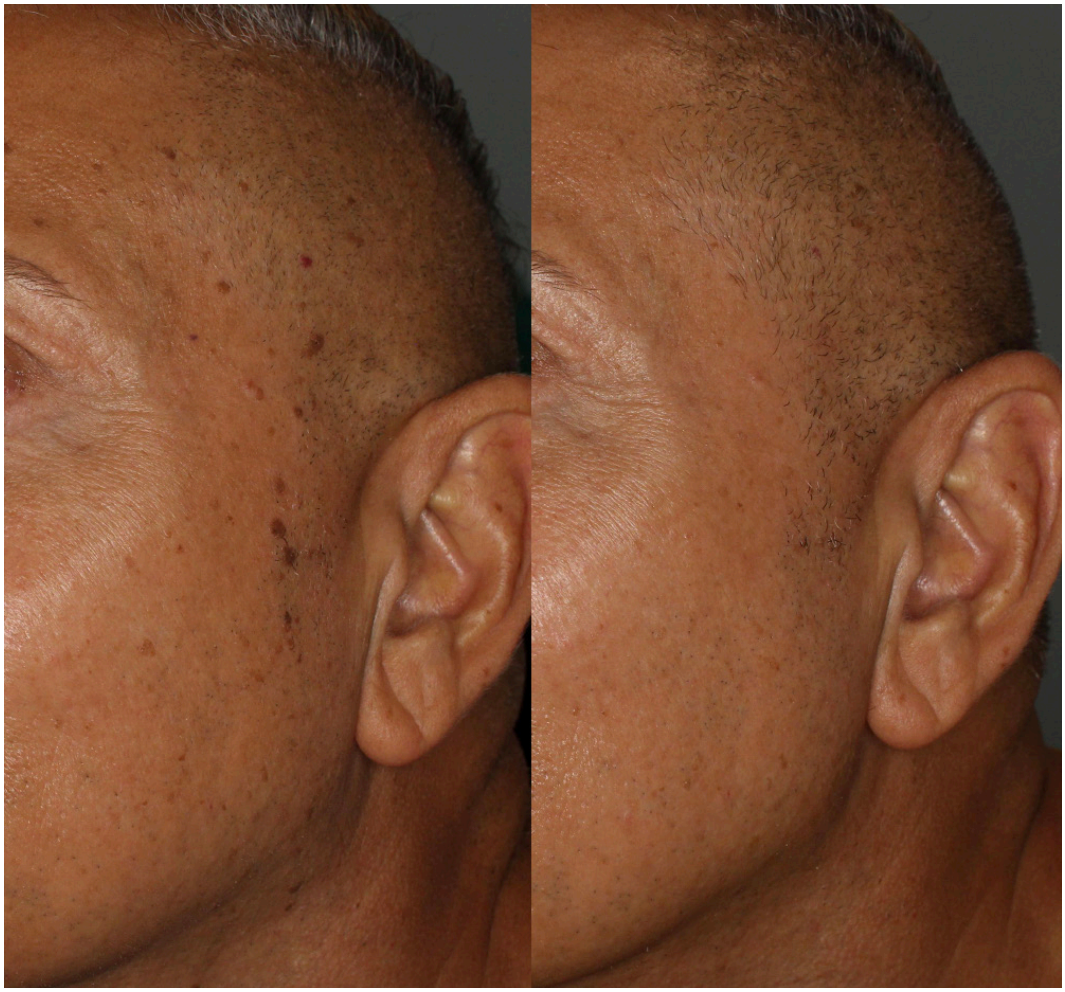

Figure 5. *Small seborrheic keratoses / dermatosis papulosa nigra treated with one session of 532 nm KTP laser; image courtesy of Vincent Richer, MD*

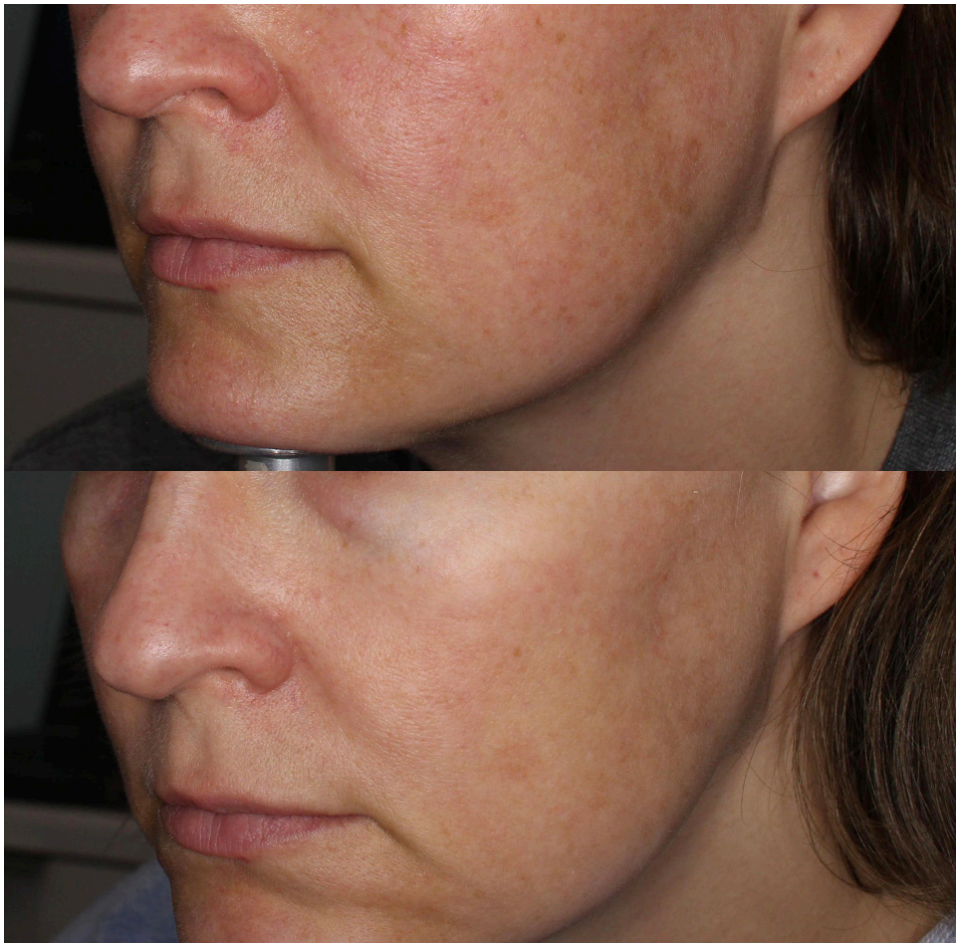

Figure 6. *Treatment of solar lentigines and telangiectasias with one session IPL delivered to reach relevant biological endpoints; image courtesy of Vincent Richer, MD*

lesion, which may be accompanied by a gentle "pop" or "click". Pulse stacking is often required to reach the desired endpoint in this clinical scenario.

Identify patients best suited for Intense Pulsed Light over vascular laser

Intense Pulsed Light (IPL) is a widely available technology that emits noncoherent broadband light between ~500-1200 nm. Its large crystal handpiece makes it convenient to use for the treatment of large surface areas, making full face or décolleté treatments more practical. Filters can be placed to select wavelengths that would be best suited to the treatment of vascular structures or pigment. Because of its wide array of target chromophores within the skin, the therapeutic window for IPL can be narrow. Endogenous melanin may be accidentally targeted during the treatment, making this modality best suited for fair skinned patients with solar lentigines and telangiectasias (**Figure 6**). Like a vascular laser, IPL can also be used to treat to a biological endpoint to reach optimal outcomes.

Conclusion

Treating patients with a vascular laser is a natural extension of the work of a dermatologist. With the right diagnosis, an understanding of laser-skin interactions and careful observation of the skin for relevant biological endpoints during treatment, dermatologists can provide safe and effective treatment of vascular lesions with lasers.

Patient data and photos used with permission; courtesy of Vincent Richer, MD

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