Use of a Novel Pulse Dye Laser for Rapid Single-Pass Purpura-Free Treatment of Telangiectases

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BACKGROUND Purpura-free elimination of telangiectases with a single pass of a pulsed dye laser with a large spot has proved difficult.

OBJECTIVE The purpose of this report was to define parameters that achieve single-pass purpura-free telangiectasia reduction.

MATERIALS Thirty patients between the ages of 23 and 78 years were treated with a pulsed dye laser with a 10-mm spot and fluences ranging from 9 to 10 J/cm^2. The macropulse width was 20 ms. Each macropulse was composed of eight pulselets. Treatments were carried out over facial areas with discrete telangiectases.

RESULTS Smaller telangiectases ($<$600 μm) showed transient bluing followed by stenosis. Larger vessels (600–10,000 μm) showed bluing but inconsistent closure. A second pass typically resulted in closure.

CONCLUSION A modified pulsed dye laser was capable of single-pass purpura-free reduction with a 10-mm spot size.

The laser used in this study was provided by the Candela Corporation. Yacov Domankevitz, Ph D, is a full-time employee of Candela.

The 595-nm pulsed dye laser (PDL) enjoys a superb reputation in the treatment of vascular lesions. When purpura is induced as a part of treatment, PDL achieves predictable single-pass reduction of telangiectases.[1] The cosmetic liability of purpura [and the introduction of purpura-free alternatives, i.e., potassium-titanyl-phosphate (KTP) laser and intense pulsed light (IPL)], however, has encouraged physicians to adopt creative approaches to telangiectasia treatment with PDL.[2,3]

Extended-pulse PDLs (0.45- to 40-ms range) have become popular; however, when using a 10-mm spot size, power limitations and pulse characteristics have compromised purpura-free telangiectasia reduction. Accordingly, avoiding purpura has required multiple passes or pulse stacking.[4] These approaches are time-consuming when treating large areas. Much of the failure of extended-pulse PDLs to achieve single pass purpura-free vessel clearance has been attributed to pulse structure. Pulses from extended-pulse PDLs are comprised of very short pulselets. Because the duty cycle (the percentage of time the laser is actually "firing" during the macropulse) is characteristically small, vessels encounter "high"-energy subpulses likely to cause purpura. Tanghetti and coworkers,[1] for example, could not achieve single-pass clearance with a three-pulselet format, even with pulses as long as 40 ms.

Purpura-free vessel reduction has been obtained with smaller (5 or 7 mm) spots using long-pulse PDLs (6- to 40-ms range),[5] and most modern PDLs provide sufficient power (with these smaller spots) to allow for pulse width–fluence combinations that achieve single-pass treatment of discrete facial telangiectasia. The slow coverage rate, however, prohibits rapid (less than 15 minutes' total treatment time) full-face or neck treatments in patients with confluent telangiectases or diffuse erythema.

We report consistent single-pass purpura-free reduction of facial telangiectases with a 10-mm spot

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• Published by Blackwell Publishing •ISSN: 1076-0512 • Dermatol Surg 2007;33:1–4 • DOI: 10.1111/j.1524-4725.2007.33317.x

size using a new class of PDL system. With this system, safe, effective, consistent, and rapid vessel reduction was achieved.

Methods

Thirty patients between the ages of 23 and 78 years were treated. Informed consent was signed by each patient. The study protocol conformed to the guidelines of the 1975 Declaration of Helsinki and was approved by our institutional review board. All patients were Fitzpatrick skin types I to III, and all had telangiectases on their nose, neck, chest, or cheeks. All patients underwent a single treatment session using a newly introduced 595-nm PDL system (Vbeam Perfecta, Candela Corp., Wayland, MA). The laser is capable of delivering radiant exposures up to 10 J/cm^2 via a 10-mm spot, at a repetition rate up to 1.5 Hz. The laser delivers a series of eight micropulses that comprise a longer macropulse. The older version (original Vbeam) used four micropulses per macropulse. The energy in each of the eight subpulses is approximately one-eighth of the total energy. In the old Vbeam the energy per each subpulse is one-fourth of the total energy. Assuming that the pulse duration is equal, the peak power of a subpulse from the new eight subpulses laser is one-half of the older Vbeam. The purpose of increasing the number of pulses was to reduce peak power and consequently purpura. The eight subpulses are equally spaced throughout the overall pulse duration. Therefore, for the 20-ms total pulse duration the time between each subpulse is 2.857 ms. In the old Vbeam there is 6.66 ms between each subpulse.

Treatments in this report were carried out at 9 or 10 J/cm^2 with a 10-mm spot size. For any patient, the smaller of the two fluences that caused immediate stenosis of smaller vessels was applied throughout the treatment session. Cryogen spray cooling (DCD) was set at a 40-ms spray and 20-ms delay. The macropulse duration was 20 ms.

Evaluation

During treatment, a polarizing magnifying loupe (Model V300, Syris Scientific, Gray, ME) was used to assess real-time vessel responses. Photographs were taken at initial presentation and at the 30-day follow-up visit using a digital SLR camera (Nikon D70, Nikon, Tokyo, Japan) with an AF Micro Nikkor 60-mm lens. A polarizing filter attached to the flash unit (Canfield Scientific, Fairfield, NJ) highlighted individual blood vessels.

Figure 1. (A) Small telangiectases before treatment on cheek. (B) Just after treatment with Vbeam Perfecta pulsed dye laser at 9 J/cm^2, 20 ms, 10-mm spot.

Results

Using the polarizing loupes, we observed the following: For vessels <600 μm in diameter, we noted transient bluing followed by nearly immediate stenosis of the vessel (Figure 1). With larger vessels (600–1,000 μm), particularly in the nasal area, a single pulse typically resulted in bluing for 0.5–1 seconds, followed by (1) vessel disappearance, (2) macroscopic reperfusion (return to red color but sometimes with a decrease in diameter than pre-pulse), or (3) persistent bluing. Upon reperfusion, a second pass (interval no shorter than 10 seconds) sometimes resulted in closure but more commonly only caused a decrease in vessel diameter without complete closure. We did not attempt to stack pulses (that is, rapid application of passes at $\sim$1.5 Hz.). The most resistant vessels were larger telangiectases in the perinasal area.

We found the aforementioned parameter sets (9–10 J/cm^2, 10-mm spot size, 20-ms pulse duration) to be effective for single-pass reduction of telangiectases, so long as the telangiectasia diameters did not exceed 600 μm. Overall, we achieved approximately 70% reduction of smaller telangiectases with one session using these parameters. Pain was minimal to moderate and was greatest in the midface and nasal area. For larger-diameter lesions, either we were required to increase the fluence with the 7-mm spot with the same longer-pulse duration (typical fluence of 12 J/cm^2 and 20 ms) or, alternatively, we applied multiple passes (minimum of 10-second interval between passes) with the 10-mm spot with the 9 or 10 J/cm^2 fluence. No matter what sized vessel was treated and regardless of the treatment approach, purpura was not observed just after treatment nor was delayed purpura (even mild) reported by any patient.

We observed modest pigment reduction. Only the very darkest lentigos lightened, presumably because of the efficient cooling achieved with the dynamic cooling device.[6]

Discussion

This report demonstrates that it is possible to achieve single-pass purpura-free reduction of facial telangiectases with a large spot. Using a new class of PDL with parameter settings of 9 to 10 J/cm^2 with a 20-ms pulse duration and 10-mm spot size, vessel closure dynamics were slightly different than for IPL or KTP laser. For example, for intermediate-sized vessels (600–1,000 μm), the PDL was likely to cause transient bluing followed by vessel closure within 3 seconds of the pulse. In contrast, the KTP laser and IPL are more likely to close the vessel immediately. Most likely pulse structure, dynamic changes in blood optical properties, and variable heat-induced real-time microvascular reactions are responsible for the range of real-time observations during and after pulsed irradiation of vessels.[7–10]

With the older four-micropulse VBeam laser, we have achieved single-pass closure with minimal purpura (but not truly purpura-free) with the 7-mm spot size over a range of parameters (10–12 J/cm^2, 10- to 20-ms pulse duration). We were interested in using the 10-mm spot size, however, because its area doubles that of the 7-mm spot size. The new PDL can therefore treat areas much faster than some older version PDLs and even faster than some IPLs. For example, with a 10-mm spot size at 1.5 Hz, the laser covers 1.2 cm^2/second. This rate is significantly faster than the old versions with the 7-mm spot where one can cover only 0.6 cm^2/second. The coverage rate with the 10-mm spot also compares favorably with modern IPLs; although many IPLs have large footprints, the slower typical repetition rate limits the coverage speed. For example, an IPL with spot size of 12 × 12 mm operating at 0.5 Hz covers only 0.72 cm^2/second.

In the older version of the Vbeam PDL, the maximum fluence with the 10-mm spot was 7.5 J/cm^2. Using these settings with a 10- or 20-ms pulse duration, reports of purpura were rare with this four-pulselet system. Vessel closure required pulse stacking, however.[4] With the newer eight-pulselet system (VBeam Perfecta), one can achieve fluences as high as 10 J/cm^2 with the 10-mm spot size and achieve single-pass vessel clearance.

Our observations suggest that purpura threshold exceeds 10 J/cm^2 for a 20-ms pulse duration with this new eight-subpulse laser system. A previous study of a three-pulselet system found a mean purpura threshold on the buttock of 9 J/cm^2 for a 20-ms pulse duration and 10-mm spot size. More recently, Tanghetti and coworkers[1] found up to a 25% increase in purpura threshold using a six-pulselet versus three-pulselet format.[1] These findings and theoretical models suggest that increasing the number of subpulses within the macropulse increases the purpura threshold.

In conclusion, a new powerful eight-pulselet PDL allows for rapid purpura-free treatment of telangiectases. Studies are underway to compare efficacy and speed with competing non-PDL technologies.

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