Efficacy of pulse dye laser therapy for the treatment of ulcerated haemangiomas: a review of 78 patients

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Summary

Background. Haemangiomas are common vascular lesions occurring in up to 10–12% of infants by 1 year of age. Typically, these lesions are treated expectantly unless complicated by haemorrhage, ulceration, infection, or compromise of adjacent vital structures. Ulceration is a particularly difficult problem because of associated pain, infection, haemorrhage, and subsequent scarring.

Materials and Methods. Seventy-eight children (54 girls, 24 boys) with ulcerated haemangiomas, from our vascular malformation clinic were enrolled in a prospective pulse dye laser treatment protocol from April of 1995 to November of 2001. The mean size of the ulcerated haemangiomas requiring treatment was 21 cm². Lesions were treated with minimal debridement and the Cynosure pulse dye laser with a mean energy of 6.6 J, and a mean number of 173 pulses per treatment. Lesions were treated in a sequential pattern at 3–4 week intervals until cutaneous healing or involution of the haemangioma occurred.

Results. Seventy-one of the 78 patients (91%) responded to laser therapy alone with a mean number of 2.0 treatments. Six patients with very large haemangiomas required oral steroids (2–3 mg/kg/day) in combination with the pulse dye laser. After failing to improve on steroid therapy, two patients required the addition of interferon to their treatment protocol. The mean follow up time is 15 months with no sign of recurrent ulceration or regrowth of the haemangiomas in our study population.

Summary. Pulse dye laser therapy is a reasonably effective means of resolving the untoward complication of ulceration of haemangiomas. We report the largest series to date of ulcerated haemangiomas treated with this modality.

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Background

Vascular lesions presenting at birth or in the first months of life can cause concern both for parents and the physicians treating these infants. In the past, confusion over the diagnosis and treatment has been problematic. Mulliken’s classification system based on the histological finding of...
endothelial cell proliferation has helped to distinguish haemangiomas from other vascular malformations. Haemangiomas are common vascular lesions occurring in 2% of term newborns and in up to 10–12% of all infants by 1 year of age. The incidence in premature newborns less than 1000 g is 23%. Haemangiomas are more common in girls than boys by a ratio of 3:1.

Haemangiomas usually can be diagnosed clinically by their behaviour. This lesion is characterised by presentation at birth or shortly thereafter, then undergoes a rapid proliferative phase over the next 6–12 months. The haemangioma then usually stabilises and slowly involutes over a period of 5–7 years. The majority of haemangiomas will resolve spontaneously with 50 and 70% gone by age 5 and age 7 years, respectively. Approximately 10–12% of haemangiomas will develop complications necessitating intervention prior to the involution stage. Complications requiring treatment include obstruction of a vital structure, haemorrhage, and ulceration with secondary infection or pain. Obstruction of a vital structure such as the visual axis can result in amblyopia or blindness. Bleeding may occur secondary to trauma or as a result of ulceration. Ulceration is thought to occur when the haemangioma outgrows its blood supply. Secondary problems from ulceration can be significant and include pain, infection, bleeding, and long-term scarring.

Treatment options for the complications of a haemangioma are multiple, and their indications depend on the complication itself. Proposed treatment options include compression, intralesional steroids, sclerotherapy, systemic steroids, interferon, radiation therapy, surgical excision, and laser therapy. Patients with obstruction of a vital structure must be treated aggressively; options include intralesional steroids, systemic steroids, and interferon. Steroids have been shown to inhibit angiogenesis in both animal and clinical models. Typically, patients are put on 2–3 mg/kg/day of oral prednisone as first line therapy. The majority of haemangiomas will either regress or stabilise while on steroid therapy, regardless of the route of administration. Failure to respond to oral steroids is a bad prognostic sign, necessitating the use of interferon therapy. Interferon acts as both an anti-proliferative and anti-angiogenic agent. Interferon alfa-2a is given as an injection of 3 million units per meter squared body surface area for several weeks until stabilisation or regression occurs. Both steroids and interferon have significant associated side effects ranging from infection and stunted growth to spastic diplegia.

Cifications with less long-term functional implications can be treated with locally directed therapy.

Ulceration, the most frequent complication of haemangiomas, occurs in 5–13% of cases. Ulceration is problematic because it can be painful, result in haemorrhage, and become infected. Topical antibiotics, compression, surgical excision, and laser therapy are all treatment modalities that have been described for this very frequent complication. In 1990, pulse dye laser therapy began to be used for the treatment of complicated haemangiomas. We report the largest prospective series to date of the long-term results of treatment of ulcerated haemangiomas in multiple anatomic sites using pulse dye therapy.

Materials and methods

All patients who presented to our institution with ulcerated haemangiomas from April 1995 to November 2001 were considered for enrolment in this prospective nonrandomised study. Consent was obtained from the parents of all patients treated in the study protocol. All study patients were evaluated and followed at the Vascular Malformation Clinic at Wake Forest University Medical Center. All study patients were treated in outpatient surgery under general anaesthesia with the Cynosure PhotoGenica V pulse dye laser. The laser wavelength used was 585 nm. The energy utilised ranged from 5 to 6.8 J with a rate of 1 Hz and a pulse width of 300–500 μs. The hand piece used was either 5 or (7 ± 0.5) mm. All patients were treated post-operatively with topical Silvadene, with the exception of the periocular region where bacitracin was used. The patients were then followed on a weekly basis. Repeat laser surgery was done every 3–4 weeks until complete epithelialisation of the ulcer was seen. Data was collected regarding lesion location, age at presentation, patient demographic information, laser treatment specifications, response to therapy, and need for additional or multi-modality therapy. Patients were followed on a regular basis after the completion of therapy to monitor for recurrent ulceration or other complications.

Results

Seventy-eight patients were enrolled in this study over a period of 78 months. The study patient population consisted of 54 girls and 24 boys with a
mean age of 5.5 months at the time of presentation. A total of 147 surgical procedures were performed involving 116 facial, 12 upper extremity, 13 lower extremity, eight trunk, four perineal, and three perianal ulcerated haemangiomas (Fig. 1). The mean size of the haemangioma undergoing treatment was 21 cm². Each patient underwent a mean of 2.0 laser treatments performed at 3–4 week intervals. The mean number of pulses for each treatment was 173, and the mean energy level was 6.6 J. The hand piece size utilised was either 5 or 7 mm.

The mean follow up time was 25 months; only two patients were lost to follow up. All but six of the 78 patients responded to laser therapy alone (Figs. 2 and 3). Six patients required multi-modality therapy because of progressive increase in size of the lesions. Following the institution of oral prednisone at 2–3 mg/kg/day for 6 weeks, four of these patients stabilised or showed involution (Figs. 4 and 5). Two patients did not respond to steroid therapy and required the addition of interferon therapy. These two patients did stabilise on interferon therapy (Fig. 6). None of the study patients required surgical excision to treat the complication of ulceration.

**Discussion**

The majority of haemangiomas never require any treatment. Simple observation and parental reassurance suffice. Complications of haemangiomas pose a difficult problem because there is no ideal treatment option and those that currently exist all have associated complications. In fact, some physicians argue against the use of any active therapeutic intervention for haemangiomas.

Laser therapy to treat vascular lesions was first proposed in the early 1990s. Laser is an acronym for 'light amplification by stimulated emission radiation'. The pulse dye laser uses the mechanism of selective photothermolysis. Specifically, it affects blood vessels by heat transfer. Nonspecific thermal injury of adjacent dermal tissue is minimised because the laser energy—through careful choice of wavelength, pulse duration, and dose—is selectively absorbed by oxyhaemoglobin, the target chromophore. As a result of this selective targeting, there is minimal heat radiation to the surrounding tissues.

The pulse dye laser has some adverse effects, as reported by Levine in his review of 500 patients treated with pulse dye laser for port-wine stains, telangiectasias, and haemangiomas. The complications identified in their study included dermatitis (0.04%), atrophic scarring (< 0.1%), hyperpigmentation (1%), and hypopigmentation (2.6%). We did not observe any long-term complications in our study population.

Review of the literature demonstrates several case reports of the use of the laser to treat haemangiomas beginning in 1990. Achauer first reported successful use of the argon laser to treat ulcerated perineal and perianal haemangiomas in 10 infants. Subsequently, both Sherwood and

**Fig. 1** Graphic distribution of the location of the haemangiomas in the study population.
Morelli reported success with the pulse dye laser for the treatment of ulcerated haemangiomas in one and nine cases, respectively.\textsuperscript{24,32} The use of the pulse dye laser then broadened to include patients with noncomplicated haemangiomas. Scheepers, reporting the use of the pulse dye laser to treat 57 patients with strawberry haemangiomas, saw improvement in colour but not bulk.\textsuperscript{33} Barlow et al. reported seven cases of functional impairment secondary to a haemangioma that they successfully treated with the pulse dye laser. Four of these seven patients were being treated for ulceration.\textsuperscript{27} Lacour reported 13 cases of ulcerated haemangioma. Five were treated conservatively, and eight were treated with the pulse dye laser. His results demonstrated a good response to the laser, and he recommends laser for patients who fail conservative therapy.\textsuperscript{5} Genonemus used the laser

Fig. 2 (A) Ulcerated scalp haemangioma prior to laser therapy. (B) Healed scalp haemangioma after one treatment with the pulse dye laser.
Fig. 3 (A) Ulcerated lower extremity haemangioma prior to laser therapy. (B) Ulcerated lower extremity haemangioma completely epithelialised 3 weeks after one treatment with the pulse dye laser.
Fig. 4  (A) Obstructing facial haemangioma necessitating treatment with oral steroids at 2 mg/kg/day. (B) The same girl with ulceration prior to laser therapy. (C) Resolution of the ulceration demonstrated after two treatments with the pulse dye laser.
Fig. 5  (A) Three-month-old girl with a large ulcerated facial haemangioma. (B) The same girl after three treatments with the pulse dye laser and the use of systemic steroids.
Fig. 6  (A) A 3-month-old girl with airway haemangiomas necessitating a tracheostomy. (B) Progressive haemangioma growth was not successfully treated with steroids and required interferon therapy. The perioral ulcerations responded well to the pulse dye laser.
Fig. 7 (A) Scanning laser Doppler of the girl in Fig. 4(A)–(C) prior to pulse dye laser therapy. (B) Scanning laser Doppler image of the same lesion after pulse dye laser therapy.
to treat haemangiomas and recommended using the laser during the proliferative phase at 2-week intervals. Additionally, he recommended using the 7 mm over the 5 mm spot size for deeper penetration. Achauer reported in 1996 his findings of a significant advantage of laser therapy over more conservative management in terms of improvement in both volume and texture of the haemangioma. The largest reported series of the use of laser therapy to date is a retrospective 10 year study of 60 patients treated with a combination of therapies. In this study 22 patients were treated for ulceration; 11, or 50%, of these showed definite improvement with the laser. Pulse dye laser therapy is being used with reasonable success for increasing clinical indications, including haemangiomas and their complications.

Summary

Our series of 78 patients supports the use of pulse dye laser therapy for the complication of ulceration seen in the haemangioma patient. It is the largest reported series of patients with ulcerated haemangiomas followed in a prospective manner. We have not identified any significant long-term complications in our patient population. We have found the pulse dye laser to be effective for the alleviation of pain, decreasing infection, and decreasing bleeding by promoting the epithelialisation of the ulcer. Pulse dye laser treatment is a safe and effective means of resolving the untoward complication of ulceration in haemangiomas.

References

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