Sequential Application of Long Pulsed dye/Nd-YAG Lasers is a Superior Method for Management of Infantile Hemangiomas

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Abstract

Objective: To evaluate the efficacy of sequential application of long Pulsed dye/Nd-YAG lasers in the management of skin and mucous membrane infantile hemangiomas.

Background Data: Management of infantile hemangiomas may be a challenge. Different laser systems have been reported to be of great help for such cases with variable results.

Patients and Methods: In this study we present a unique sequential laser system which deliver pulsed dye laser PDL 595nm followed by Nd-YAG 1064nm to be superior than other reported techniques. Twenty five cases of infantile hemangiomas in the head and neck region were selected to be enrolled in this study. Assessment for progress was achieved clinically.

Results: We achieved excellent results in eighteen patients (72%) out of the treated 25 patients, with no recurrence after 6 months follow-up. Laser application from skin and mucous membrane sides (sandwich technique) decreased number of sessions.

Conclusion: The sequential PDL followed by Nd-YAG laser can be considered as one of the superior methods for management of infantile hemangiomas specially in the head and neck region, due to its excellent cosmetic results with fewer number of treatment sessions.

Key Words: Hemangioma – Pulsed dye laser – Nd-YAG laser.

Introduction

INFANTILE hemangiomas are benign vascular neoplasms that have a characteristic clinical course marked by early proliferation and followed by spontaneous involution. During the proliferative phase in the neonatal period or early infancy, a rapidly dividing endothelial cell proliferation is responsible for the enlargement of these lesions [1].

Occasionally, hemangiomas may impinge on vital structures, ulcerate, bleed, or cause high-output cardiac failure or significant structural abnormalities. Rarely, a cutaneous hemangioma is associated with one or more underlying congenital anomalies [2].

The incidence of hemangiomas is approximately 22-30% of preterm infants with birthweight less than 1kg; for preterm infants with birthweight greater than 1.5kg, the incidence is the same as for term infants. Thirty percent of hemangiomas are present at birth and 70% of them initially appear in the first several weeks of life. They are more frequent in females 3-5 times than males [3].

Fifty percent of infantile hemangiomas show complete involution by age 5 years and 70% by age 7 years; the remainder may take an additional 3-5 years to complete the process. Of lesions that have involuted by age 6 years, 38% will have residual evidence with scar formation, telangiectasia redundant or anetodermic skin. Hemangiomas that take longer to involute have a higher incidence of permanent cutaneous residual. Eighty percent of lesions that show complete involution after age 6 years may exhibit cutaneous residual [4].

Different modalities have been employed in the treatment of hemangiomas, including systemic therapy - antiangiogenic drugs, i.e. systemic corticosteroids and alpha-interferon - and local therapy - surgical procedures, arterial embolization and cryotherapy [5].

For superficial hemangiomas, the flashlamp pumped pulsed dye laser in particular has proven
itself in numerous studies. In the treatment of hemangiomas with subcutaneous components, the Nd:YAG laser is the treatment of choice [6].

Laser photocoagulation, particularly with the neodymium-yttrium aluminum garnet (Nd-YAG) laser, has been successful in the majority of patients, with minimal morbidity and good results. There was excellent regression with minimal damage to the surrounding tissue [7]. As Nd-YAG laser is a deep photocoagulating laser which target tissue protein epidermal changes and sometimes scarring may result after treatment; thus to minimize this cryogen cooling of the skin is better applied to protect the epidermis and papillary dermis, while achieving deep tissue photocoagulation during Nd:YAG laser irradiation [8].

Patients and Methods

Our study was conducted on 25 cases (19 female and 6 male) complaining of infantile hemangioma in the head and neck region. Age of the patients ranged from 3 months to 5 years.

Sites of the lesions within the head and neck region were in the upper-lip, cheeks, forehead, lower-lip and chin.

All patients were subjected to standard fixed examinations which include, case history, MRI imaging, complete blood count (CBC), bleeding profile (thrombin and prothrombin time), before and after photographs.

Six patients gave history of previous attempts of treatment with very minimal or no improvement; 4 cases gave history of intralesional corticosteroid injection with minimal or no improvement (so they refused to continue treatment) and 2 cases were resistant to pulsed dye laser after 5 treatment sessions with hardly minimal improvement.

The procedure was explained to the patient as well as the post treatment expectations. All parents signed treatment consent.

Our treatment was done on basis of out patient clinic using only topical anesthesia cream EMLA cream for at least one hour under occlusion before treatment. (For intra-oral portion of the lesion topical anesthesia were applied (Xylocaine® spray adrenaline 2% Astra®) before field block local anesthesia injection (3ml of Mepecaine®L, each 1ml contains mepivacaine HCI 20.0mg and Levonordefin HCI 0.06mg), in a circular manner surrounding the lesion.

Cases were managed using Cynergy Multiplex laser system emitting both Pulsed dye 595nm and Nd-YAG 1064nm wavelength sequentially (Cynergy Multiplex, Cynosure, USA). Our laser parameters were: Pulse duration; for Pulsed dye 2msec and for Nd-YAG 15msec, energy for Pulsed dye ranged from 5.5 to 6.5 J and for Nd-YAG from 25-35 J, 50msec delay time between pulses. The spot size was 10mm. The laser spot was adjusted to include 1-2mm of the normal skin or mucous membrane beside the edge of the lesion within the active beam field to be sure that the outer edge of the lesion was radiated. The laser was coupled to chilled air cooling apparatus (Smartcool, Cynosure, USA) during radiation of skin lesions, but for oral portion of the lesion we did not use air cooling because, the forced cold air flow makes difficulty in respiration for most of our patients. We tried to compress lesions if possible to enhance laser penetration. Compression was done from inside the oral cavity to the outside during irradiation of the outer cutaneous side and from the outside to inside during irradiation mucous membrane portion of the lesion. Lesions in the middle of the face (cheek, upper lip and lower lip) were irradiated from skin and mucous membrane sides, sandwich technique).

Session were performed 4-6 weeks apart with total number of sessions ranging from 4-12 treatment sessions for skin lesions according to the size and thickness of the lesion. Mucous membrane lesions usually needed less number of sessions up to 4 sessions. Immediately after the session patients applied cold ice packs, they were given topical antibiotic and steroid cream (Fucicort cream LEO pharma) for five days and instructed to avoid sun exposure and apply sun-screen cream SPF not less than 50. For oral lesions the patients were instructed to eat soft and cold food during the first three post-operative days. Oracure gel (Alex Pharma. Comp.) (each 100g contains: Lidocaine HCl 2.0g. & Cetylpyridinium Chloride 0.1g.) was prescribed during the first week as pain control. Bleeding was encountered with one case only during the laser session as it was a large lesion with tense skin, energy was lowered to the minimum of our range for both lasers and ice packs were applied for few minutes till bleeding stopped as the bleeding profile of the patient was normal. Another patient who picked the fine crust that sometimes occurred
specially after the first session also reported slight bleeding at home which was controlled by compression alone.

Results

Results were given excellent when there was complete resolution without any skin changes (no color or textural changes) and no recurrence of the lesion after follow-up period of minimum 6 months. Good was given to the case when there was complete resolution but with mild skin changes (slight hyper/hypopigmentation or textural changes) and no recurrence after 6 months follow-up period. Fair was assigned for incomplete resolution (thick lesional skin after treatment) with slight enlargement of the skin or scar formation.

Excellent results were found in 18 (72%) of our cases. Good results were found in 4 (16%) cases and fair results were reported in 3 (12%) cases. Fair results occurred in thick large or extensive lesions. The residual skin felt slightly firm which may be due to post-treatment fibrosis. Excellent results were found to be in small lesions specially in the cheeks, upper lip and forehead lesions. Good results were accomplished with slight textural changes or color changes which didn’t change up to 6 months follow-up. Mucous membrane component of the lesions required less number of sessions to achieve complete resolution than cutaneous portion. Thin crust over skin lesions was sometimes reported by patients which was left to peel-off alone and this usually didn’t take more than a couple of weeks.
Discussion

Hemangiomas can present a difficult management. Much controversy exists over whether it is better to watch and wait for natural involution or to be more aggressive and attempt to prevent some of the potential negative sequels [6].

Approximately 50-60% of all hemangiomas resolve incompletely, leaving permanent changes in the skin. These changes include telangiectases, superficial dilated veins, stippled scarring, anetoderma or epidermal atrophy (particularly with superficial lesions), hypopigmentation and/or redundant skin with fibro-fatty residual (especially with subcutaneous lesions) which is in most of cases cosmetically unacceptable [9]. Occasionally they may impinge on vital structures and interfere with breathing, vision, eating, or hearing and also bleeding and ulceration of certain areas (e.g., diaper area, neck, mucosal surfaces) is not uncommon [4]; thus medical interference is the best approach in these cases. Oral mucous membrane hemangioma should be treated as early as possible because the eruption of deciduous teeth in the area related to the lesion will lead to continuous trauma, bleeding and infection. Therefore early interference may give better cosmetic and functional results [10] to avoid skin redundancy and mucous membrane continuous bleeding, infection and trauma. Thermal penetration of the Nd-YAG laser which was aided in large lesions by compression to attack the base of the lesions this enabled us to achieve complete resolutions and skin tightness.

Surgical excision of proliferating hemangiomas is quite hazardous because of the risk of hemorrhage and damage to vital structures associated with them (i.e., head and neck) [11]. Also the risk of bleeding or the need to hospitalization was avoided in our procedure.

Corticosteroid therapy should be administered during the proliferative phase because they have a negligible effect on involving otherwise stable lesions. The oral route generally is preferred over intrallesional therapy; however, the location, size, patient age and physician experience factor into the decision-making process [12]. Intrallesional corticosteroids injection also carry the risk of bleeding and resistance to treatment which was given as history in 4 of our patients.

Other therapies include Interferon alfa-2a. Mechanism of antitumor activity is not clearly understood; however, direct anti-proliferative effects against malignant cells and modulation of host immune response may play important roles. May be given topically, systemically and intralesionally. Different reports suggested its use with variables results and risks [13] thus laser treatment in comparison appear to be safer, easier and more economic.

Only a few case reports on biologic immune response modifiers and one small open-label uncontrolled trial suggest efficacy for its treatment of infantile hemangiomas. This treatment should be considered experimental until placebo-controlled trials are performed and determined safe for infants. Imiquimod cream is the only medication in this new class. It purportedly works by stimulation of toll-like receptor (TLR) 7 and increases local interferon alpha and gamma, through which it may exert its antiangiogenic effect. It is not FDA approved for children [14].

Lang 2001 said that lasers have added greatly to our armamentarium for managing vascular lesions but the ideal laser, however, has not yet been built that can effectively treat vessels of all sizes and depths. As knowledge of vascular lesions grow and laser technology advances, it may be possible to create such a laser. He suggested that until then, it will be necessary to use a combination of lasers and to combine lasers with other modalities to effectively manage the broad spectrum of vascular lesions [15].

Pulsed dye laser (PDL) is effective for treating thin superficial hemangiomas. Other lasers that appear to be effective in treating hemangiomas include the pulsed Nd:YAG and KTP, Copper vapor lasers. Each of these lasers has specific benefits and limitations regarding depth of penetration, absorption of skin chromophores and caliber of the vessel treated [16]. Tanghetti et al. [17], Dierickx et al. [18] and Mordon et al. [19] all demonstrated that pulse stacking or multi-passing in the micro-second realm increase penetration of vascular injury, allowing treatment of deeper vascular lesions. Black et al., have also suggested that multiple wavelengths used together should result in enhanced efficacy in the treatment of vascular lesions [20].

Complications also vary depending on the laser, settings and site treated. Targeting deep dermal lesions like infantile hemangiomas we need a deeper laser system than pulsed dye which is already absorbed the blood protein. Nd-YAG 1064nm when applied in free pulsed mode externally on the skin led to epidermal scarring it required cooling to decrease these cutaneous changes and also needed large number of treatment sessions according
to the size and site of the lesion. Reactional bleeding was also not uncommon [21].

Several studies demonstrated that pulsed dye laser in sub-therapeutic doses can alter the absorption characteristics of blood making it a better target for Nd-YAG 1064nm. PDL conversion of blood to a combination of methemoglobin (Met-Hb) and microthrombus temporary increase absorbance at 1064nm by approximately 3-5 folds that of normal blood [22]. This increased absorption allows for significantly reduced Nd-YAG laser fluences used about 2-3 times less then that applied using long pulsed Nd-YAG laser for vascular occlusion [23]. Thus decreasing side effects, increasing the efficacy of both PDL and Nd-YAG as well as decreasing the number of treatment sessions needed which is one of the main concerns of the patient. Tanghetti and Sherr used PDL 7-8 J, 10ms followed by Nd-YAG laser 40-50 J with pulse duration 10-40ms and delay time 50ms to treat facial telangiectasia, telangiectatic leg veins and bleb Port wine stain [24]. We considered these parameters high to use for our skin types in order to get acceptable cosmetic results and avoid skin complications. Also using Nd-YAG laser with reduced fluence provided deep penetration without dermal tissue scarring; the air cooling coupled with the procedure saved the epidermis as well thus decreased significantly the incidence of scarring.

To our knowledge, this the first study to apply sequential PDL and Nd-YAG lasers using Cynergy-Multiplex inside the oral cavity (sandwich technique), in spite of the encouraging results and less number of sessions needed for complete resolution in comparison to skin lesions, as we can use higher energies (the maximum of our energy range) in mucous membrane without fearing of side effects that may occurs in skin as scar formation or hyper or hypo pigmentations and as healing in the mucous membrane is much faster than skin. Also the penetration of laser through mucous membrane is higher than skin and reaches deeper layers as the thickness is less. But the problem was in the hand piece that could not be used easily in all intra-oral sites, so it is recommended to create a special hand piece with different angle tips to be more suitable for inaccessible intra-oral areas for easier attack of these lesions which are not uncommon.

**Conclusion:**

Our study using the sequential PDL followed by Nd-YAG laser showed that this combination can be regarded as one of the superior methods for management of infantile hemangiomas specially in the head and neck region. Acceptable cosmetic results and decreased number of treatment sessions are the main advantages of this combination.

**References**


