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Closure of chronic non healing ankle ulcer with low level laser therapy in a patient presenting with thalassemia intermedia: Case report

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Abstract

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In this single case study, the possible effect of low-level laser therapy (LLLT) was explored in the form of light emitting diodes on a chronic non-healing wound of 6 months duration in an 18-year-old male patient suffering from thalassemia intermedia. After irradiation, with LLLT dosage of 17.3 J/cm^2 for 8 min for 2 weeks duration followed by proliferative dosage of 8.65-4.33 J/cm^2 for 4 min from 3rd week to 6th week for 2 min along with antibiotics vancomycin (15 mg/kg) and a combination of amoxicillin and clavulanic acid (1 g). Proliferation of healthy granulation tissue was observed with decrease in score of pressure ulcer scale with complete re-epithelialization eventually LLLT irradiation could be a novel method of treatment for chronic non-healing wound in a thalassemia intermedia patient and an useful adjunct to standard care of treatment of pressure ulcers. It is postulated that LED irradiation augments wound healing with an early closure and no recurrence at the irradiated site even after follow up of 6 months.

KEY WORDS: Light emitting diodes, re-epithelialization, thalassemia, wound healing

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INTRODUCTION

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Delayed wound healing is a complex phenomenon. The pattern of wound healing may be affected by cytokines, endocrines or manipulation of wound environment. The circumstance, in which the wound is sustained, clearly influences wound bed infections with organisms.[1]

Occurrence of juvenile leg ulcers is relatively common in thalassemia intermedia.[2] Usually, these ulcers are slow to heal and tend to reoccur frequently and affect the individual's day to day activities.[3]

Low-level laser therapy (LLLT) or simply “laser therapy” augments wound closure by secondary intention. The mechanism of action of laser on wound healing is postulated as modulation of inflammation by reducing the levels of pro-inflammatory cytokines and increasing the levels of anti-inflammatory growth factors.[4]

CASE REPORT

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An 18-year-old male thalassemia intermedia patient presented with the history of chronic non-healing ulcer on the right ankle of 6 months duration, measuring 24 cm^2. At the time of admission, patient was having a score of 12 for pressure ulcer scale for healing (PUSH) with generalized lymphadenopathy. Slough was seen in the wound bed with no exudate. Moderate growth of methicillin-resistant *Staphylococcus aureus* (MRSA) was isolated from the wound swab. LLLT in the form of light emitting diodes (LEDs) was commenced with dosage of 17.3 J/cm^2 for 8 min for 2 weeks duration followed by proliferative dosage of 8.65-4.33 J/cm^2 for 4 min from 3^{rd} week to 6^{th} week for 2 min along with antibiotics vancomycin (15 mg/kg), and a combination of amoxicillin and clavulanic acid (1 g).

Pressure ulcer scale for healing score decreased from 3^{rd} week to 10^{th} with a score of 0 on 6^{th} week with complete closure of the wound [Figure 1–5]. There was no recurrence seen at the site of post-irradiation on 6 months of follow-up.

Investigations before the commencement of the therapy were as follows, the erythrocyte sedimentation rate was 9 mm/h, total white blood cells: 46,910/μL, platelet count 899,010/μL, haemoglobin (Hb): 7.8 g/dL, red blood cell (RBC) count 3.33×10^6/μL, red blood cell distribution width 27.8%, and haematocrit value were 25.2%; In peripheral smear report, RBC appeared microcytic hypochromic; anisopoikilocytosis and was positive for polychromatophils, spherocytes, schistocytes. The mean corpuscular volume was 75.8 fl/cell, mean corpuscular haemoglobin concentration 30.8 g/dL, mean corpuscular hemoglobin 23.3 pg/cell. Hb electrophoresis revealed Hb F-73%; Hb A2-3%; Hb A-24%; the electrophoresis was suggestive of thalassemia intermedia. Ferritin more than 2000 ng/mL, total iron binding capacity was 261 g/dL, total iron was 238 g/dL; folate more than 20 ng/mL, Vitamin B_{12} 388.6 pg/mL; MRSA pathogen was also isolated from the wound area.

The patient was on vancomycin (15 mg/kg) and amoxicillin with clavulanic acid (1gm twice daily), and folate (5 mg). Dressings were done with betadine and mupirocin (2% [15 g]). The patient was examined for any possible absolute and relative contraindications with laser therapy

at baseline. A written informed consent was obtained before starting laser therapy. The accuracy for the output dosage of the laser machine was tested prior to irradiation using specialized photodiode equipment (dosimeter). Due protection of the eyes with wavelength-specific goggles and a comfortable semi reclining posture were maintained. Before beginning with the irradiation, the surrounding skin surface along the wound area was cleaned with betadine solution to enhance the absorption of laser in the wound area. The frequency of the irradiation was kept to once a day for 3 days/week until 6 weeks, and the dose was 17.3 J/cm^2 for 8 min for 2 weeks duration followed by proliferative dosage of 8.65-4.33 J/cm^2 for 4 min from 3rd week to 6th week for 2 min.[4]

A hand-held class 4 LEDs (gallium aluminium arsenide; LX 2 model, manufactured by Thor) was used at a distance of 1 cm from the ulcer. The probe was a collection of 69 such LEDs, of which 34 LEDs were of a wavelength of 660 nm and had a spectral width of 50 nm at 50% intensity, the average power of 10 mW, a spot size of 0.2 cm^2 and a power density (irradiance) of 50 mW/cm^2. The remaining 35 LEDs were of wavelength of 950 nm with a spectral width of 50 nm at 50% intensity, generating a total power of 865 mW and a frequency of 156 Hz.

The dosage for irradiation was decided according to the formula: D = $P \times$ T/A,[4,5] where D is the dose in J/cm^2; P is the laser power output in watts, T is the irradiation time in seconds and A is the area of the wound measured in cm^2. LEDs were used for 8 min, yielding an energy density for an antibiotic dosage of 17.3 J/cm^2 for 2 weeks followed by proliferative dosage of 8.65-4.33 J/cm^2 from 3rd week (4 min) to 6th (2 min) week respectively.

DISCUSSION

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It is now established that such clinical phenotypes lie in severity between those of thalassemia minor (clinically silent, mildly hypochromic and microcytic anaemia) and transfusion-dependent thalassemia major, are termed as thalassemia intermedia. Although it is often seen that there is substantial clinical overlap between the 3 conditions.[6] Wound healing in thalassemia is a complex situation where dehiscent wounds are common.[6] In the present case, a chronic wound of 6 months duration which was not responding to the standard medical care was irradiated using LEDs.

The PUSH tool is a quick, reliable tool to monitor the changes in pressure ulcer status over time.[7] The patient was assessed according to PUSH and post-irradiation, there was a marked decrease in the score after 3rd week with full closure by 6th week.

Irradiation with laser therapy involves stimulation of certain growth factors and cytokines that orchestrate various stages of wound healing, resulting in an accelerated rate of granulation and re-epithelisation [Figure 1–5]. LEDs are postulated to generate both red and infrared laser radiations causing reduction in inflammation, increase blood flow to the tissues leading to the proliferation of endothelial cells thereby increasing the formation of new blood capillaries and hence faster granulation.[4]

Light-emitting diodes need to be differentiated from LLLT as beams generated by them are neither monochromatic nor coherent, but they

have an advantage of treating a larger area using varying wavelengths in wound healing.[8] LEDs are postulated to stimulate basic energy processes in the mitochondria (energy compartments) of each cell, particularly when near-infrared light is used to activate the wavelength-sensitive constituents inside the cell (chromophores, cytochrome systems). It has also been established in earlier studies that LEDs accelerate the process of wound healing.[5,9] Though the exact mechanism responsible for wound closure in thalassemia still remains elusive. Still, lasers can be extremely cost effective and didactic in approach as a therapy towards chronic wounds in thalassemia as they induce healing in a short span of time and further elude patients from coming under tremendous economical obligation which is commonly seen with surgical alternatives.

CONCLUSION

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Irradiation with LED is a novel method of treatment of chronic wound in thalassemia intermedia, as irradiation with LED can result in complete healing in six weeks with no recurrence at the irradiated site even after follow-up of 6 months.

Footnotes

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Conflict of Interest: None declared.

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Figures and Tables

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Figure 1

Wound at baseline

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Figure 2

Wound bed after 1st week of irradiation

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Figure 3

Changes in the wound bed after 3rd week of irradiation

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Figure 4

Contraction of wound bed after 4th week of irradiation

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Figure 5

Complete closure at 6th week of irradiation