Role of Low-Level Laser Therapy (LLLT) in Wound Bed Preparation in Necrotizing Fasciitis

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How to cite this article:
Deepak Sharma, Ravi Kumar Chittoria et. al./Role of Low-Level Laser Therapy (LLLT) in Wound Bed Preparation in Necrotizing Fasciitis/RFP Journal of Dermatology 2022;8(1):108–112.

ABSTRACT

Necrotizing fasciitis is an infection of subcutaneous tissue and fascia which may spread rapidly to deeper tissue and surrounding tissue which may cause damage to the tissue and present as a localized infection and fulminant septic shock with high mortality rate. Low-Level Laser therapyhas been found to be effective in wound bed preparation. This study highlights our experience in wound bed preparation using Low- Level Laser therapy (LLLT) as an adjuvant in a case of necrotizing fasciitis.

Keywords: low level laser therapy (LLLT), wound bed preparation, necrotizing fasciitis.

INTRODUCTION

Necrotizing soft tissue infections (NSTIs) include necrotizing forms of fasciitis, myositis, and cellulitis. These infections are characterized clinically by fulminant tissue destruction, systemic signs of toxicity, and high mortality.[1] Accurate diagnosis and appropriate treatment must include early surgical intervention and antibiotic therapy. Several different names have been used to describe the various forms of necrotizing infections; this is related in part to naming based on clinical features rather than surgical or pathologic findings. The degree of suspicion should be high since the clinical presentation is variable and prompt intervention is critical. The lay press has referred to organisms that cause NSTI as flesh-eating bacteria.[2] There is sufficient evidence to conclude that healing of necrotizing fasciitis is accelerated by LLLT. Though it is well-established therapy in the armamentarium of wound management, its role in wound bed preparation before cover by skin graft or flap has not been studied well. LLLT has been found to be effective in wound bed preparation but has not been reported in literature for necrotizing fasciitis. This study highlights our experience in wound bed preparation using Low-level Laser therapy in a case of necrotizing fasciitis.

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Received on: 21.11.2022

Accepted on: 22.12.2022

Materials and Methods

This study was conducted in the department of plastic surgery in a tertiary care center after obtaining the departmental ethical committee approval. Informed written consent was taken from the patient. The study is a prospective observational type done on a 60-year-old male with known co-morbidities including hypertension & coronary artery disease with ejection fraction of 25%. Patient presented with raw area (figure 1) over left lower limb & perineum of one month

duration. He was apparently well one month back when he developed multiple blebs over left lower limb & perineum which ruptured leaving raw area with rapid progression of wound infection with foul smelling discharge. He was diagnosed with clinically as a case of necrotizing fasciitis. He underwent multiple debridement in referral surgery department after that he was referred to department of plastic surgery for further wound care. There are various modalities of regenerative wound care out of which here we used low level laser therapy (figure 2) as a regenerative modality for wound care. We used gallium arsenide (gas) diode red laser of wavelength 650nm, frequency 10khz and output power 100mw, which was a continuous beam laser with an energy density of 4 j/cm^2. Machine delivers laser in scanning mode (non-contact delivery) with 60 cm distance between laser source and raw area. Raw wound area was given laser therapy (figure 3) for duration time for 15 minutes twice weekly for 3 consecutive cycles. Till wound bed got ready cadaveric human skin (allograft) was used as biological dressing. Wound bed was reassessed every weekly till wound bed got ready for cover by skin graft or flap.

Results

After 3 weeks, the wound bed got ready with appearance of healthy granulation tissue (figure 4). The future plan is to cover the

Figure 1: At admission with extensive necrotizing fasciitis of left lower limb & perineum

Figure 2: Low-Level Laser machine

Figure 3: Application of Low-Level Laser Therapy

Figure 4: Wound bed with healthy granulation tissue with allograft in position

raw area with skin grafting once patient becomes fit for anesthesia.

Discussion

Necrotizing fasciitis is a life-threatening condition, with a high mortality rate (median mortality 32.2%) that approaches 100% without treatment. Numerous conditions are associated with this pathology, such as diabetes mellitus, immunosuppression, chronic alcohol disease, chronic renal failure, and liver cirrhosis, which can be conductive to the rapid spread of necrosis, and increase in the mortality rate. The diagnosis of NF is difficult and the differential diagnosis between NF and other necrotizing soft tissue infections. The delay in diagnosis can be fatal, and septic shock is inevitable if the disease remains untreated. The characteristic of NF is the clinical status change over time. The early clinical picture includes erythema, swelling, tenderness to palpation, and local warmth; once the infection develops, the infection site presents skin ischemia with blisters and bullae. The diagnosis of NF can be secured faster with the use of laboratory- based scoring systems, such as the LRINEC score or the FGSI score, especially in cases of Fournier's gangrene. However, the diagnosis is definitely established by performing explorative surgery at the infected site.[1]

Management of the infection begins with antibiotic treatment. In the majority of cases with NF (70–90%) the reasonable pathogens are two or more, suggesting the use of broad-spectrum antibiotics. The value of antibiotic treatment in NF is relatively low, and early and aggressive drainage and debridement is required. In NF of the extremities, the clinician should consider amputating the infected limb, although this will not reduce the risk of mortality. Finally, postoperative management of the surgical wound is important, along with proper nutrition of the patient.[2]

The use of LLLT therapy in wound management has greatly improved the results of postoperative management. LLLT helps in take up of FTSG and thus decreases morbidity related to necrotizing fasciitis. The acronym LASER abbreviated as "light amplification by stimulated emission of radiation", are defined by a power density at <l500 mW/cm2.3 Energy used in LLLT is much less than the one used for cutting, and ablation therapy. LLLT is a form of phototherapy that employs electromagnetic radiation, that is capable of generating enough energy for interacting with living tissues. It produces photochemical and photophysical effects without generation of heat, with consideration of re-establishing cell homeostasis. Essentially, light energy is delivered topically in controlled way which is absorbed by photo-absorbers (chromophores) that transform it into chemical energy.[4]

Positive effects include increased formation of granulation tissue and acceleration of tissue repair, wound contraction, inflammation, modulation, and pain reduction.As per literature, low-energy photo-emissions given at a wavelength range of 600nm to 900nm accelerate cell proliferation and promote wound healing.[5] Its action is thought to:

- Stimulate respiratory chain components promoting ATP synthesis,6 and hence increase rate of mitoses and fibroblast numbers.6
- Stimulate collagen and elastin production.7
- Stimulate microcirculation with dilatation of the capillaries and neovascularisation.8,9
- Liberate mediator of inflammation- histamine, serotonin and bradykinin and hence activate macrophages.
- Regenerate lymphatic vessels.In our study we found Low level Laser therapy(LLLT) as an effective adjuvant therapy in the wound bed preparation.

Conclusion

In our study we found that LLLT was useful in promoting granulation and Wound bed preparation. The limitation of the study includes that it is a case report with a single center study with no statistical analysis. Further randomized controlled studies are required to validate the efficacy of the LLLT in the Wound bed preparation of necrotizing fasciitis wound.

Conflicts of interest: None

Authors' contributions: All authors made contributions to the article

Availability of data and materials: Not applicable.

Financial support and sponsorship: None.

Consent for publication: Not applicable

References

1. Bonne SL, Kadri SS. Evaluation and Management of Necrotizing Soft Tissue Infections. Infect Dis Clin North Am 2017; 31:497.
2. Dennis L. Stevens et al, Practice Guidelines for the Diagnosis and Management of Skin and Soft-Tissue Infections. Clinical Infectious Diseases, Infectious Diseases Society of America. 2005; 41:1373–406.
3. Karu TI. Low-power laser therapy. In: Vo-Dinh T, editor. Biomedical photonics handbook, vol. 48. London: CRC Press, 2003. p. 7–20.
4. Baxter CD. Therapeutic lasers. Theory and practice. Churchill, Livingstone, 1994.
5. Andrade FSSD, Clark RMO, Ferreira ML. Effects of low-level laser therapy on wound healing. Rev ColégioBrasileiroCirurgiões. 2014;41(2):129–33.
6. Lichtenstein D, Morag, B. Low-level laser therapy in ambulatory patients with venous stasis ulcers. Laser Therapy 1998; 11: 71-78.
7. Karu T. Molecular mechanism of therapeutic effect of low intensity laser irradiation DoklAkadNauk SSSR 1986; 291:1245-1249.
8. Saperia D, Glassberg E, Lyons R.F. et al. Demonstration of elevated type I and type III procollagen mRNΛ levels in cutaneous wounds treated with helium-neon laser. Proposed mechanism for enhanced wound healing. BiocheBiophys Res Commun 1986; 138:1123-1128.
9. Schindl A, Schindl M, Schindl L. et al. Increased dermal angiogenesis after low-intensity laser therapy for a chronic radiation ulcer determined by a video measuring system. JamAcadDermatol 1999;40: 481-484.