

CONTRIBUTION OF PHOTOBIMODULATION WITH THE BLUE LIGHT ON DIABETIC FOOT ULCERS: CASE STUDIES

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INTRODUCTION:

There are chromophores in human tissues capable of absorbing specific light waves. By sending specific photonic energy to targeted chromophores it is possible to induce photochemical and photophysical phenomena at different biological scales functional to the healing of a wound. This process has been defined as Photobiomodulation. Photobiomodulation with Blue Light has an impact on reducing inflammation and producing faster and better tissue regeneration.

MATERIALS & METHODS:

Ten patients with Diabetes Foot Ulcer (DFU) were recruited from Hospital Serdang. A portable Medical Device (EmoLED) that employs LEDs sources emitting LED blue light was applied to the targeted wound, in addition to the primary dressing. The DFUs were irradiated once a week for 2 minutes on each wound area of 5cm² until all the surface was covered. Following that, a dressing and offloading were applied. We assessed the patient's wound bed tissue type; size reduction and wound healing weekly using the TIME framework and evaluated the VAS pain score. Sloughy wounds / non viable tissues were debrided before application of EmoLED Blue Light therapy.

RESULTS:

All ten subjects showed improvement in wound healing according to TIME wound assessment tool. The tissue bed looked healthier, free from infection and the surrounding tissues were no longer inflamed. The wound edge and moisture also showed significant improvement after 10 weeks of EmoLED treatment on top of standard therapy.

Most of the wound irradiated show accelerated wound healing and eventually healed with the exception of one due to further complication that warrants extra care on bioburden management.

DISCUSSIONS:

It is a well known fact that patients with one or more of the diabetes modifiable risk factors will have their skin decreased in modulus, tensile strength, and collagen deposition. This may later contribute to predisposition to injury and poor wound healing. There is a known colorations that poor diabetic wound healing presents tissue cell mitochondrial dysfunction with increased oxidative stress and aberrant inflammatory response.

EmoLED Photobiomodulation (LED 400-430nm spectrum) irradiation excites mitochondrion cell respiration and increase ATP production at cellular level. Flavin at the cellular level will absorb the blue light to produce Reactive Oxygen Species (ROS) to resolve inflammation, produce pro-healing macrophages, cytokines, nitrogen monoxide and growth factors triggering the chain reaction of healing.

Adjunctive use of EmoLED Photobiomodulation to the standard therapy helps address the issue of prolong inflammatory stage in wound healing for a diabetic subject. All wounds showed accelerated wound healing and better tissue granulation seen as early as the first 4 irradiation with EmoLED.

CONCLUSION:

The multidisciplinary approach to the treatment of DFU management is essential. Besides primary dressing and offloading interventions, Photobiomodulation with blue light can make the wound healing process faster.

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CASE 1:

A 57-year-old lady with underlying diabetes mellitus, hypertension, dyslipidemia, CVA and a history of left upper thigh abscess, presented with an infected surgical wound post left big toe ray amputation. The wound improved after two months of dressing and blue LED light therapy.



a. 29 April 2022
Size: 4 x 3cm

b. 20 May 2022
Size: 3 x 2cm

c. 17 Jun 2022
Size: 2 x 1 cm

CASE 2:

A 44-year-old gentleman with underlying diabetes mellitus, hypertension, IHD, and a history of right 5th toe ray amputation due to wet gangrene, presented with right DFU. The wound improved after two months of dressing and blue LED light therapy.



a. 29 April 2022
Size: 8 x 11cm

b. 24 Jun 2022
Size: 3 x 5 cm

c. 23 Sept 2022
Healed

CASE 3:

A 62-year-old gentleman with underlying hypertension and diabetes mellitus presented with infected wound over post ray amputation right big toe area. Post operative wound slightly sloughy with healthy granulation tissue seen. The blue light treatment started in April 2022. The wound was cover with bactigrass dressing.



a. 29 April 2022
Size: 5 x 3cm

b. 17 Jun 2022
Size: 2 x 1cm

c. 23 Sept 2022
Healed

CASE 4:

A 44-year-old gentleman with underlying diabetes mellitus and history of rays amputation over 3rd 4th and 5th toes, presented with right infected wound over the amputation side. The wound were exudative and macerated over the wound edges with moderate slough. The blue light therapy was started in April 2022 and bactigrass dressing was applied.



a. 29 April 2022
Size: 10 x 10cm

b. 6 May 2022
Size: 10 x 9cm

c. 16 May 2022
Size: 10 x 9cm

CASE 5:

A 39-year-old lady with underlying subclinical hypothyroidism, nephrotic syndrome, hypertension and diabetes mellitus presented with infected right diabetic foot ulcer. She underwent wound debridement of right foot in April 2022. The wound was clean, granulation tissue seen with minimal slough and noted discoloration over 2nd and 3th toe. She was started blue light therapy with foam dressing at the same time. After 9 weeks of treatment, the wound size was well reduced with slight hypergranulation over the toes.



a. 29 April 2022
Size: 14 x 6cm

b. 13 May 2022
Size: 10 x 4cm

c. 24 Jun 2022
Size: 8 x 2cm

CASE 6:

A 45-year-old gentleman with underlying diabetes mellitus, hypertension and dyslipidemia presented with disarticulation wound over the right big toe at the lever of metatarsophalangeal joint. The wound was 3x2 cm with minimal slough and no exudate seen. Blue light therapy was started in May 2022 in addition to Foam and bactigrass dressing. After 5 weeks of treatment, the wound margin had been reduced by 30%.



a. 6 May 2022
Size: 3 x 2cm

b. 27 May 2022
Size: 2 x 1cm

c. 3 Jun 2022
Size: 2 x 1cm

CASE 7:

A 44-year-old gentleman with underlying diabetes mellitus and history of necrotizing fasciitis (NF) of the left leg in November 2021. Multiple extensive wound debridement was performed. The left leg wound was highly exudative despite of granulation tissue seen. Blue light therapy was started in May 2022 in addition to RTD Foam and zinc oxide barrier cream. After 7 weeks of treatment, the wound was clean with good granulation tissue. The wound margin had been reduced in size by 10%. VAS score was 0.



a. 13 May 2022
Size: 36 x 10cm

b. 3 Jun 2022
Size: 34 x 10cm

c. 24 Jun 2022
Size: 32 x 9cm

CASE 9:

A 59-year-old gentleman with underlying diabetes mellitus presented in May 2022 with infected left DFU. Wound debridement and Ray's amputation of left 4th toe was performed. The left foot wound measuring 10x8 cm, with exposed EDL tendon and minimal slough. Blue light therapy was started in May 2022 in addition to gel and bactigrass dressing. After 5 weeks of treatment, healthy granulation seen. The wound margin had been reduced in size by 36%. VAS score was 0.



a. 13 May 2022
Size: 10 x 3cm

b. 3 Jun 2022
Size: 8 x 3cm

c. 24 Jun 2022
Size: 2 x 1cm

CASE 8:

A 56-year-old gentleman with underlying diabetes mellitus complicated with right eye cataract. He presented in April 2022 with NF of right foot and wet gangrene of 5th toe. Extensive wound debridement and ray's amputation of 5th toe was performed. The right foot wound measuring 10x8cm with exposed of extensor digitorum longus (EDL) tendon. Blue light therapy was started in May 2022 in addition to gel and bactigrass dressing. Healthy granulation tissue was seen after 7 weeks of treatment. The wound margin had reduced in size by 40%. VAS score was 0.



a. 13 May 2022
Size: 10 x 8cm

b. 3 Jun 2022
Size: 8 x 6cm

c. 24 Jun 2022
Size: 7 x 5cm

CASE 10:

A 43-year-old lady with underlying diabetes mellitus, hypertension and hypertensive cardiomyopathy presented in December 2021 for left foot NF and wet gangrene of 4th and 5th toes. Extensive wound debridement and ray's amputation of 4th and 5th toe was performed. The left foot wound measuring 6x4 cm, well defined margin with granulation tissue and no exudate. Blue light therapy started in May 2022 in addition to gel and bactigrass dressing. After 7 weeks of treatment, healthy granulation tissue was seen with reduction of wound margin by 50%. VAS score was 0.



a. 13 May 2022
Size: 6 x 4cm

b. 24 Jun 2022
Size: 3 x 3cm

c. 23 Sept 2022
Healed



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