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Light on the Wound: The Possibilities of Low Intensity Phototherapy

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Short Communication

In the last years, researches on clinical application of low intensity phototherapy have been gaining strength, especially considering the versatility of its use and the possibility of using modern technologies such as Light Emitting Diodes (LED), which enable the construction of effective and low-cost equipment.

Different health professionals use low-intensity phototherapy nowadays. That happens because one of the most common clinic use of its application is the red, near-infrared (NIR) or Infrared (IR) light (wavelength range ~600 nm to 1000 nm, power <500 mW) on tissue repair in diverse kinds of wounds [1-4].

The use of phototherapy in open wounds might be affected in cases of infections. In a recent past, due to the lack of scientific knowledge of its eventual side effects, phototherapy had its use in open infected wounds interrupted, what became a common procedure. However, the most recent studies have shown that, not only this interruption of procedure might harm the patient, but also phototherapy can represent a new possibility of antimicrobial therapy, especially at entry sites of infectious agents [5-9].

Apart from the fear that many health professionals have over the effect of phototherapy on infectious agents, most of recent researches have shown that neither the red, nor the NIR or the IR light increases the bacterial proliferation. On the other hand, in some cases, it has even harmful effects on certain bacteria [5-7].

However, considering this specific light band, studies focused on tissue repair observations of superficial infected wounds on *in vivo* models bring even more promising results. There are indications that wounds show optimized tissue repair due to phototherapy, and the light used does not present important effects on infections. Besides that, phototherapy does not only speed up the process of wound tissue repair, but also increases local immune response and might empower the fight against an infectious agent [8-9]. Thus, phototherapy on the common band of lights used on tissue repair, as the literature has indicated, would not necessarily have harmful effects on infected wounds [5,6,8,9]. On the other hand, it may actually help in resolving superficial infections (especially combined with conventional antimicrobial methods), at the same time as it repairs present wounds. In this sense, contraindicating the use of red/NIR/IR light on infected wounds is not a necessary procedure, as it has been shown by recent literature.

The use of phototherapy itself as an antimicrobial method goes beyond what has been cited so far in this paper. In fact, the idea of using light as an antimicrobial method is not new, once the ultraviolet light (UV) is known for its powerful bactericidal action [10]. However, the clinic use of UV light (on infected wounds) is not practical, since its cytotoxic action affects negatively human tissues [11].

Therefore, many researchers have tried to include the possibility of using light as an antimicrobial method by testing different wavelengths and different light emission methods. *In vitro* studies have shown an important antimicrobial action over some different infectious agents using a light band between blue and violet (405 nm to 490 nm) [12-15]. Various kinds of works focusing on this theme present diverse protocols, such as the use of different irradiances and fluencies values or different light emission sources. Even though the blue light antimicrobial action shows up present, indicating that, in fact, the most crucial factor of its action is the wavelength.

Besides that, *in vivo* studies report that blue light moderated fluencies decrease the bacterial proliferation on infected wounds in the same way as they do not cause harmful effects on host tissue

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[16-18]. Nevertheless, it is known that high-level parameters on blue light application may cause cytotoxic effects on certain human cells [19], which re in forces the importance of continuous studies on this phototherapy modality.

Recently, several researchers have tried to clarify the blue light antimicrobial action mechanism, which represents a crucial step in this study line by better substantiating its clinical use [18,20,21].

Given its great worldwide impact and its capacity on developing resistance over different antibiotics, *Staphylococcus aureus* bacteria represent the biggest target on these studies. In short, researches indicate that blue light would change the membrane integrity from *S. aureus* at the beginning of its proliferation, decreasing the membrane polarization and, consequently, changing the bacteria vital functions and resulting in decreased colony [20]. There are indications that blue light would have the capacity to activate latent prophages and actions from the phage activated would lead to *S. aureus* destruction [18]. Furthermore, a report shows that there is genetic damage associated to oxidative stress, which is the result of actions from oxygen reactive species created by blue light emission on *S. aureus*, although the way it happens still needs to be clarified [21].

Elucidating these action mechanisms may enable testing this therapeutic method in humans, which represents a decisive step in this research line. These mechanisms must also be studied in other bacteria and fungi species, especially those in urgent need of new antibiotics [22].

Considering these recent and promising findings, it is likely that constructing an effective treatment protocol using this phototherapy modality might be about to happen. This protocol not only brings a new possibility of infection treatment on superficial spots, but also represents a possible creation of another attribution to professionals that currently use phototherapy. If this comes to occur, curricular contents could be added to these professionals' formation, in order to increase their knowledge over infectious agents. The existence of complementary formations focused on phototherapy, which includes its use on accessible infections to light emitters would also be desirable.

In conclusion, phototherapy, in addition to being an important tissue repair method, currently appears as an important antimicrobial method to be used mainly in superficial entry sites such as open wounds and soft tissues such as skin, mucosa and muscle tissue. Nowadays, with the existence many infectious agents becoming resistant to the most potent antibiotics on the market, this therapy may become important to infection prevention started in open wounds, which shows how promising the continuity of this line of research is.

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