Can We Beat MRSA by Shedding Light on It?

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THAT BLUE LIGHT KILLS methicillin-resistant Staphylococcus aureus (MRSA) was demonstrated in the article “Visible 405 nm SLD Light Photo-Destroys Methicillin-Resistant Staphylococcus aureus (MRSA) In Vitro,” in the December 2008 issue of Lasers in Surgery and Medicine. Concerns about the clinical safety of the wavelength used (405 nm, spectral width 390 to 420 nm), which contains traces of ultraviolet light, led Chukuka Enwemeka, PhD, and colleagues from the School of Health Professions, Behavioral and Life Sciences at New York Institute of Technology in Old Westbury, to recapitulate the experiment using a wavelength of 470 nm with similar results. Those findings were published ahead of print on January 28, 2009, in the online version of Photomedicine and Laser Surgery (Enwemeka CS, Williams D, Enwemeka SK, et al. Blue 470-nm light kills methicillin resistant Staphylococcus aureus [MRSA] in vitro).

The researchers irradiated the MRSA US-300 strain, responsible for community-associated infection, and the IS-853 strain, responsible for hospital-associated infection, using a 405-nm superluminous diode. A broad range of energy density doses (from 0 to 60 J/cm²) were tested. The irradiated in vitro specimens were incubated at 35°C (95°F) for 24 hours, and then colony counts and the aggregate area of the colonies were compared with baseline data. As in the previous study, a significant dose-dependent reduction in colony counts and the aggregate area of colonization was seen (P < .001). As little as 3 J/cm² eradicated nearly 30% of the bacteria. Higher doses were increasingly more effective: 55 J/cm² eradicated up to 90.4% of both the US-300 and IS-853 colonies, although the higher the energy density used, the longer the time required for the bactericidal effect. Enwemeka and colleagues are working toward using this technology in vivo. A British team from University College London has accomplished something similar. They demonstrated that laser light–activated methylene blue (360 J/cm², using the maximum wavelength absorbed by methylene blue, 665 nm) applied to MRSA-infected wounds is bactericidal in vivo. The team prepared mouse models of MRSA wound infections, using the epidemic MRSA (EMRSA)-16 strain, which is highly prevalent in the United Kingdom. After irradiating the wounds (at an energy density dose of 670 nm) in the presence of 100 µg/mL of methylene blue, a 25-fold reduction (1.40 log10 colony-forming units [CFUs] per wound) in the number of EMRSA organisms was seen in excision wounds and a 14-fold reduction (1.15 log10 CFU/wound) was seen in superficial scarified wounds. No collateral damage to host tissue occurred. The study authors commented that if this technology proves to be effective in humans, it could trump concern about antibiotic resistance of S aureus strains and other organisms under study, such as Pseudomonas aeruginosa, Porphyromonas gingivalis, and Escherichia coli. For more information about this study, see Zolfaghari PS, Packer S, Singer M, et al. In vivo killing of Staphylococcus aureus using a light-activated antimicrobial agent. BMC Microbiol. 2009;9:27.