Photomedicine and Laser Surgery
Volume 24, Number 6, 2006

Pp. 680–683
DOI: 10.1089/PHO.2006.1028

Effects of Combined 405-nm and 880-nm Light on *Staphylococcus aureus* and *Pseudomonas aeruginosa in Vitro*

J. STEPHEN GUFFEY, Ed.D.,[1] and JAY WILBORN, M.Ed.[2]

ABSTRACT

Objective: **The aim of this study was to determine the effect of a combination of 405-nm blue light and 880-nm infrared light on *Staphylococcus aureus* and *Pseudomonas aeruginosa in vitro. Background Data:* Reports indicate that certain wavelengths and treatment parameters of light promote the growth of bacteria, but our earlier study indicates that light at specific wavelengths and intensities are bactericidal for specific organisms (1). *Methods:* Two common aerobes, *Staphylococcus aureus* and *Pseudomonas aeruginosa* were tested because of their frequent isolation from skin infections and wounds. Each organism was treated simultaneously with a combination of 405-nm and 880-nm light emitted by a cluster of Super Luminous Diodes (SLDs). Doses of 1, 3, 5, 10, and 20 Jcm^{-2} were used. Colony counts were performed and compared to untreated controls using Student *t* tests and one-way ANOVA with Tukey and Scheffe *post hoc* analyses. *Results:* The results revealed significant dose-dependent bactericidal effects of the combined blue and infrared light on *Staphylococcus aureus* ($F_{4,94} = 5.38$, $p = 0.001$) and *Pseudomonas aeruginosa* ($F_{4,95} = 21.35$, $p < 0.001$). With *P. aeruginosa,* the treatment reduced the number of bacteria colonies at all doses, achieving statistical significance at 1, 3, and 20 J cm^{-2} doses and reducing bacterial colony by as much as 93.8%; the most effective dose being 20 J cm^{-2}. Irradiation of *S. aureus* resulted in statistically significant decreases in bacterial colonies at all dose levels; the most decrease, 72%, was also achieved with 20 Jcm^{-2}. *Conclusion:* Appropriate doses of combined 405-nm and 880-nm phototherapy can kill *Staphylococcus aureus* and *Pseudomonas aeruginosa in vitro,* suggesting that a similar effect may be produced in clinical cases of bacterial infection.**

INTRODUCTION

LIGHT THERAPY has been suggested as a potentially effective treatment for a variety of human conditions. Suggested amenable conditions range from sleep disorders,[2] photoaged facial skin,[3] depression in the elderly,[4] and treatment of acne vulgaris[5] to a variety of neuromusculoskeletal conditions such as peripheral neuropathy,[6] second degree ankle sprains,[7] and osteoarthritis of the knee[8] and cervical spine.[9]

Papageorgiou, Katsambas and Chu[10] reported a significant improvement in the condition of patients suffering from acne vulgaris when treated with a combination of red (660-nm) and blue (415-nm) light. They postulated that this combination provided both an anti-inflammatory benefit (red light) and an antibacterial effect (blue light). Blue light has been shown to kill bacteria in tissue.[17] Studies[11,12] have demonstrated bactericidal results using light therapy at 810 and at 630 nm. Phototherapy at 685 and 830 nm has recently been shown to increase collagen production and organization resulting in improved wound repair.[13]

Not all studies dealing with the application of light therapy have demonstrated a bactericidal effect. The results seem to be associated with both specific wavelengths and type of organism. Nussbaum et al.,[14] while reporting a bactericidal effect at 630 nm for *Pseudomonas aeruginosa* and *E. coli*, also found that a wavelength of 810 nm facilitated growth of *E. coli.*

[1]Physical Therapy Plus, Bauxite, Arkansas.
[2]National Park Community College, Hot Springs, Arkansas.