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The Effect of Near-Infrared between 1100-1800 nm Together with a Water-filter and a Contact Cooling

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Background

Numerous studies have proven the effects of sun and ultraviolet (UV) exposure on human skin, and various kinds of UV blocking materials are often used to prevent skin damage from UV exposure. Despite the world-wide use of these blocking materials, unwanted biological influences such as long-lasting vasodilation, muscle thinning, and skin laxity still occur [1-3]. Over half of solar energy consists of near-infrared (NIR), and a wide range of preventative mechanisms have been evolutionarily maintained in organisms to protect against effects of NIR [3]. In addition to natural NIR, human skin is also increasingly exposed to artificial NIR from medical devices and everyday electrical appliances. Interactions between NIR and tissues, optical and thermal responses of the tissues have been optically reviewed [4,5], and results of many studies emphasize the necessity of further evaluation [6] as NIR possesses high permeability, and can induce various biological effects [1-3,7].

As solar NIR is filtered by atmospheric water [8,9], in order to experimentally simulate solar NIR that reaches the skin, a water filter is required [1-3]. Wavelengths below 1100 nm will be absorbed by melanin in the skin, and wavelengths between 1400 and 1500 nm and those above 1850 nm will be absorbed by water in the skin, which results in heating and possible induction of painful sensations and burns. Contact cooling is also required to pursue the properties of NIR, due to the fact that NIR increases the surface temperature and induces thermal effects [1-3].

We would like to emphasize that the biological effects of NIR between 1100-1800 nm together with the water-filter and the contact cooling have both beneficial applications and deleterious effects. Have you considered the effect of NIR in your field?

Results

These specific wavelengths and the contact cooling enabled NIR to be delivered to the deeper tissues without pain or epidermal burns, and allowed for the investigations of properties of NIR. We reported that NIR penetrates deep into human tissue and is absorbed by water in the skin, hemoglobin in dilated vessels, myoglobin, bone cortical mass, and hydrogen bonds in lamin and DNA, and is scattered by adipose cells [1-3].

Discussion

NIR is used as a therapeutic option for the treatment of wound healing disorders [10-12] and malignant tumors [13-16]. NIR induces long-lasting vasodilation for an increase in blood circulation by causing apoptosis of vascular smooth muscle cells [1-3], which may prevent vasospasm and may be beneficial for ischemic disorders and flap surgeries [2,3]. NIR induces dermal heating and non-thermally induces collagen and elastin stimulation, which results in skin tightening [1-3]. NIR also non-thermally relaxes and weakens dystonic or hypertrophic muscles to reduce wrinkles and myalgia, which might have an application for treating muscle disorders, and causes long-lasting induction of subcutaneous adipocytes, which may have an application for volume augmentation [1-3]. Further, NIR irradiation might be beneficial for regenerative medicine based on its stimulation of stem cells [1-3]. Due to cancer's high sensitivity to NIR, cancer detection and imaging may gain from NIR. NIR is also able to induce non-thermal DNA damage of mitotic cells due to the absence of nuclear lamin protection, which may have a potential application in the treatment of cancer [1-3,7]. These new techniques using NIR may be beneficial in many medical fields, as the schedule reduces discomfort and side effects, deep subcutaneous tissues are accessible, and facilitates repeated irradiations.

NIR is easily absorbed by water, since water molecules are resonated by NIR due to the O-H intramolecular hydrogen bonds and electrical dipole moment [1-3]. NIR increases the amount of water retained in the dermis by inducing vasodilation and the expression of collagen, elastin, and water-binding proteins. Both collagen and elastin possess hydrogen bonds and helical structures. These findings suggest that we have acquired biological defense mechanisms in which induced hydrogen bonds and helical structures are resonated by NIR and absorb NIR to protect the subcutaneous tissues from this type of radiation [1-3].

Other than the skin, optic nerve which is the only central nervous system exposed to the surface has a defence mechanism against NIR in many layers; rich blood flow in the retina, hyaluronic acid in the lens, tears in sclera, fat in the eyelids, because water, hemoglobin, and fat is an ideal material to NIR block [2,3]. NIR is transmitted through the ocular media with little loss of intensity, damages the retina, and contributes to cataracts [4].

Conclusion

Continuous solar NIR radiation may cause unexpected photo aging, muscle thinning and stimulation of cancer stem cells, in areas of the body exposed to the sun. Fair skin with lower concentrations of melanin and a thin dermis might allow deeper penetration of NIR into human tissue, and damage superficial muscles compared to darker skin with dense melanin and a thick dermis. Furthermore most sunscreens only block UV, but not visible light and NIR, and sunglasses and glasses are unable to block NIR exposure. Thus, individuals using sunscreens and glasses should further equip themselves for NIR protection to prevent photoaging, skin ptosis, cataracts, and oncogenicity.

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We believe these findings indicate that NIR has a wide range of biological effects, and future studies are warranted to develop these findings into potentially useful and beneficial techniques and applications.

References

1. Tanaka Y (2012) The impact of near-infrared radiation in dermatology. Review. World Journal of Dermatology 1: 30-37.
2. Tanaka Y, Tsunemi Y, Kawashima M, Nishida H (2013) The impact of near-infrared in Plastic Surgery. Plastic Surgery: An International Journal.
3. Tanaka Y, Gale L (2013) Beneficial Applications and Deleterious Effects of Near-infrared From Biological and Medical Points of View. Optics and Photonics Journal.
4. Niemz MH (2007) Laser-tissue interactions fundamentals and applications. (Biological and medical physics, biomedical engineering). (3rdedn). Springer.
5. Welch AJ, van Gemert MJC (2012) Optical-Thermal Response of Laser-Irradiated Tissue(2nd edn). New York: Plenum Press.
6. Tuchin V (2000) Tissue optics: light scattering methods and instruments for medical diagnosis. Bellingham, Wash.: SPIE Press.
7. Tanaka Y, Tatewaki N, Nishida H, Eitsuka T, Ikekawa N, et al. (2012) Non-thermal DNA damage of cancer cells using near-infrared irradiation.Cancer Sci 103: 1467-1473.
8. Anderson RR, Parrish JA (1983) Selective photothermolysis: precise microsurgery by selective absorption of pulsed radiation. Science 220:524-527.
9. Gates DM (1966) Spectral distribution of solar radiation at the earth's surface. Science 151: 523-529.
10. Danno K, Mori N, Toda K,Kobayashi T, Utami A (2001) Near-infrared irradiation stimulates cutaneous wound repair: laboratory experiments on possible mechanisms. PhotodermatolPhotoimmunolPhotomed 17: 261-265.
11. Horwitz LR, Burke TJ, Carnegie D (1999) Augmentation of wound healing using monochromatic infrared energy. Exploration of a new technology for wound management. Adv Wound Care 12: 35-40.
12. Schramm JM, Warner D, Hardesty RA, Oberg KC (2003) A unique combination of infrared and microwave radiation accelerates wound healing. Plast Reconstr Surg 111: 258-266.
13. Bäumler W, Abels C, Karrer S, Weiss T, Messmann H, et al. (1999) Photo-oxidative killing of human colonic cancer cells using indocyanine green and infrared light. Br J Cancer 80: 360-363.
14. Kelleher DK, Thews O, Rzeznik J, Scherz A, Salomon Y, et al. (1999) Hot topic. Water-filtered infrared-A radiation: a novel technique for localized hyperthermia in combination with bacteriochlorophyll-based photodynamic therapy. Int J Hyperthermia 15: 467-474.
15. Dees C, Harkins J, Petersen MG, Fisher WG, Wachter EA, et al. (2002) Treatment of murine cutaneous melanoma with near infrared light. PhotochemPhotobiol 75: 296-301.
16. Orenstein A, Kostenich G, Kopolovic Y, Babushkina T, Malik Z (1999) Enhancement of ALA-PDT damage by IR-induced hyperthermia on a colon carcinoma model. Photochem Photobiol 69: 703-707.