

Principles and working mechanisms of water-filtered infrared-A (wIRA) in relation to wound healing

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GMS Krankenhaushygiene Interdisziplinär 2007, Vol. 2(2), ISSN 1863-5245

Abstract

The experience of the pleasant heat of the sun in moderate climatic zones arises from the filtering of the heat radiation of the sun by water vapor in the atmosphere of the earth. The filter effect of water decreases those parts of infrared radiation (most parts of infrared-B and -C and the absorption bands of water within infrared-A), which would cause by reacting with water molecules in the skin – only an undesired thermal load to the surface of the skin. Technically water-filtered infrared-A (wIRA) is produced in special radiators, whose full spectrum of radiation of a halogen bulb is passed through a cuvette, containing water, which absorbs or decreases the described undesired wavelengths of the infrared radiation. Within infrared the remaining wIRA (within 780-1400 nm) mainly consists of radiation with good penetration properties into tissue and therefore allows – compared to unfiltered heat radiation – a multiple energy transfer into tissue without irritating the skin, similar to the sun's heat radiation in moderate climatic zones. Typical wIRA radiators emit no ultraviolet (UV) radiation and nearly no infrared-B and -C radiation and the amount of infrared-A radiation in relation to the amount of visible light (380-780 nm) is emphasized. Water-filtered infrared-A as a special form of heat radiation with a high tissue penetration and with a low thermal load to the skin surface acts both by thermal (related to heat energy transfer) and thermic (temperature depending, with a relevant change of temperature) as well as by non-thermal (without a relevant transfer of heat energy) and nonthermic (not depending on temperature, without a relevant change of temperature) effects. wIRA produces a therapeutically usable field of heat in the tissue and increases tissue temperature, tissue oxygen partial pressure, and tissue perfusion. These three factors are vital for a sufficient tissue supply with energy and oxygen. As wound healing and infection defense (e.g. granulocyte function including their antibacterial oxygen radical formation) depend decisively on a sufficient supply with energy and oxygen, one explanation for the good clinical effect of wIRA on wounds and wound infections can be the improvement of both the energy supply per time (increase of metabolic rate) and the oxygen supply. In addition wIRA has non-thermal and non-thermic effects, which are based on putting direct stimuli on cells and cellular structures. wIRA can considerably alleviate the pain (with remarkably less need for analgesics) and diminish an elevated wound exudation and

inflammation and can show positive immunomodulatory effects. wIRA can advance wound healing or improve an impaired wound healing both in acute and in chronic wounds including infected wounds. Even the normal wound healing process can be improved. wIRA is contact-free, easily applied, without discomfort to the patient, with absent consumption of material and with a good effect in the depth. The irradiation of the typically uncovered wound is carried out with a wIRA radiator.