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Expert commentary: role of oxygen role in wound healing

American Indians have believed for centuries that their wounds would heal quicker if they hiked down into the 'richer' air of the valleys[1]. Modern hyperbaric wound therapy began in the 1960s, when famous oceanographer Jacques-Yves Cousteau built a village under the Mediterranean sea. In 1962, Conshelf[1] was set up off the coast of Marseille, France at a depth of ten metres. Cousteau and his team noticed that small scratches and wounds seemed to heal faster in the humid and oxygen-rich environment of the underwater houses. This discovery led to the development and proliferation of modern hyperbaric chambers and hyperbaric medicine.

Treating patients in hyperbaric chambers is costly and is associated with a number of risks. With that in mind, American neurosurgeon Boguslav H. Fischer began using a miniature version of a hyperbaric chamber that provided oxygen topically onto the wound[2]. First results were published in 1966 and three years later. *The Lancet* printed a report on 56 patients treated successfully with topical wound oxygen[3].

Oxygen is one of the major prerequisites for life. In mammals, all processes at the cellular level require oxygen, which is chiefly provided via the adenosine triphosphate (ATP) pump. ATP cannot be stored and its synthesis requires oxygen and glucose. Interestingly the molecular mechanism and the ATP pump were only clarified in the 1980s. The scientist Paul D. Boyer und John E. Walker received the Nobel Prize in 1997 for their elucidation of the enzymatic mechanism underlying the synthesis of ATP. Most human organs receive required oxygen via the blood circulation and the lungs. However, the largest human organ — the skin — is partly supplied with oxygen by diffusion directly with the atmosphere[4]. The border between external and internal supply seems to be the stratum corneum of the skin.

In all phases of wound healing oxygen is also needed as a substrate for essential enzymatic processes. In the first (inflammatory) phase, neutrophils and macrophages build reactive oxygen species (ROS) which are important in fighting infection. When infected, the NADPH-linked oxidase ((nicotinamide adenine dinucleotide phosphate-oxidase, a membrane-bound enzyme complex) can increase oxygen consumption by as much as 50-fold. Up to 98% of the oxygen consumption of neutrophils is needed for ROS production. Newer research indicates that free oxygen radicals are important for cell signaling to stimulate cell migration, cell proliferation and neovascularisation[5,6].

Oxygen delivery is a critical element in the healing of wounds. The pathophysiology of lack of oxygen in wounds is proven with a high evidence level. However, there is a lower level of clinical evidence, which may lead to a lack of topical oxygen use in wound care. Further clinical research in this area is therefore needed, so this case study by Hitomi and Shigeru is welcomed. WINT

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