

Therapeutic gases in medical rehabilitation and balneotherapy - medical relevance and scientific new data



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Balneo and PRM Research Journal

DOI: <http://dx.doi.org/10.12680/balneo.2021.452>

Vol.12, No.3 September 2021

p: L51

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Abstract

Background. The discovery of gaseous signalling molecules such as Hydrogen Sulfide (H₂S), Nitric Oxide (NO), Hydrogen peroxide (H₂O₂) and Carbon monoxide (CO) has added a new era in biomedical science, as these molecules are of great importance in mammalian physiology. They have been called "gas transmitters" because they are produced internally or synthesized (endogenously) in the body or are received from the atmosphere and transmit chemical signals promoting or inducing various physiological changes inside the mammalian body. Gas transmitters are permeable through the cell membranes, but their functions inside the body depend on their concentration. The importance of the topic is underlined by the numerous physiological and pathophysiological processes that different therapeutic gases can influence in multiple ways. Synaptic transmission and neuroplasticity, inhibition of extracellular matrix degradation, inhibition of neutrophil infiltration, anti-oxidative and anti-inflammatory processes, cell plasticity and viability, ionic balance at the cellular level, physiology of anti-apoptotic mechanisms are intimately and substantially modulated and influenced by molecules of therapeutic gases.

Objective. This synthetic review aims to rigorously select related articles and identify within their content the main possible uses of therapeutic gases and physiological mechanisms. The objective of this article is to present the various therapeutic mechanisms that have been proposed in the current literature and the medical relevance of various therapeutic gases used in balneotherapy or medical rehabilitation.

Methods. To elaborate our synthesis review, we have searched for relevant *open access* articles in 6 international databases: Cochrane¹, Elsevier¹, NCBI/PubMed¹, NCBI/PMC¹, PEDro¹, and ISI Web of Knowledge/Science¹, published from January 2011 until December 2020. The eligible articles were analyzed in detail regarding pathologies addressed by therapeutic gases. All articles with any design (reviews, randomized controlled trials, non-randomized controlled trials, case-control studies, cross-sectional studies), if eligible according to the above-mentioned selection methodology, containing in the title or abstract the above-mentioned combinations, were included in the analysis.

Results. Our search identified, first, **225** articles. After eliminating the duplicates, remained **180** articles. In the second phase, we applied a relevance criterion. **63** articles passed the relevance criterion and were included in this synthetic review.

Conclusions. The medical relevance of therapeutic gases can range from use in burns and stroke victims to hypoxia therapy in children. However, medical gases such as oxygen, hydrogen, helium and xenon have recently come under increased exploration for their potential therapeutic use on various brain disease states, including traumatic brain injuries, hypoxia-ischemia and, cerebral hemorrhages.

Keywords: "Therapeutic gas"/ "Oxygen therapy"/ "Carbon dioxide"/ "CO₂ therapy"/ "Carbon monoxide"/ "Mofette"/ "Hydrogen Sulfide"/ "H₂S"/ "Helium"/ "Xenon"/ "Ozone therapy"/ "Radon"/ "Hydrogen therapy"/ "Nitric oxide"/ "Heliox" AND "Rehabilitation".