

Original Article - Clinical Trial

The impact of CO₂ dry baths on subpopulations of NK and NK-T lymphocytes, cytotoxic activity, level of inflammation and pain management in elderly with musculoskeletal syndromes - a pilot study

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ABSTRACT

Background - Aim of the study

The effects of carbon dioxide-rich water bathing have been investigated in clinical research; CO₂ is assumed to exert a direct action on vascular smooth muscles, induce vasodilatation and activate thermoreceptors of the skin. Our overall aim is to test our hypothesis that dry CO₂ treatment's rehabilitative effect is achieved by using its immune boosting, anti-inflammatory and anti-depressive elements to engage the elderly's pathophysiologic mechanisms capable of supporting a repaired and significantly improved function. In particular, the present study compared the post-therapy effects with pre-therapy baseline of the treatment measuring immune mediated response, the levels of biochemical markers for chronic inflammatory conditions and assessing clinically the short-term effectiveness of pain management in a group of elderly with musculoskeletal syndromes.

Material and Methods

Repeated artificial CO₂ dry treatments were performed on 37 volunteers with musculoskeletal pain disorders. Group A (intervention) comprised 27 patients (12 men and 15 women) and group B (placebo) tracked 10 patients (5 men and 5 women). Each patient was covered with a specific plastic hypoallergic bag up to neck level and underwent the treatment for 45 min. In group A the bag was filled with CO₂ gas and in the placebo group B the bag was filled with fresh air only. The DCDB (Dry Carbon Dioxide Bath) treatment was performed for 17 consecutive days. Blood samples were drawn before and after the intervention period. The selected parameters included white blood cells, cytotoxicity, lymphocytes, NK, NK-T cells, β-endorphin, substance P and neurokinin A. Repeated measurements were made in heart frequency, arterial blood pressure and body temperature at the beginning and after all sessions.

Results

In the intervention group, a significant decrease was detected in the diastolic arterial pressure (only in women) and in the heart rate. Significant increase was measured in the white blood cells count, lymphocytes count (in men), NK-T cells count, the cytotoxicity measurements, β-endorphin and substance P levels as well as the neurokinin A levels in men. Interestingly, the intervention group members reported a kind of profound euphoria which remained during the intervention period and lasted for at least one month. The increase of Substance P and neurokinin A in the intervention group was not followed by any increase of pain

intensity. In the control group, the parameters related to the arousal of the immune system remained unaffected but the levels of substance P and neurokinin A rose more sharply than in group A.

Conclusions

Dry CO₂ bath seems to stimulate short-term immune-boosting responses that last during and after the intervention period. The rise in the endorphin levels explains the euphoric sensation reported by the intervention group patients. The effects of dry CO₂ on the parasympathetic nervous system are induced probably via hemodynamic mechanisms; for the hemodynamic responses triggering, a direct action of dry CO₂ on specific CO₂-receptors in the skin is a possible physiologic pathway.

Keywords: CO₂, carbon dioxide, dry baths, leukocytes, cytotoxicity, NK cells, β-endorphin, substance P, neurokinin A

Introduction

The use of carbonated water in the form of carbon dioxide baths is based on traditional therapeutic methods and is currently limited in the area of "Medical Spa treatments" or "Balneo-therapeutics". CO₂ treatment can be applied with two different ways; with carbon dioxide enriched water and with dry carbon dioxide bath (DCDB). It has to be mentioned that there are essential differences between the two CO₂ bath methods, which differentiates them completely. In carbon dioxide bath (CDB), CO₂ gets in contact with the human body via its dilution in water and in this way it is possible for an individual to inhale the gas. In addition, the immersed body is affected by water buoyancy, hydrostatic pressure and water temperature. In DCDB, the body comes in contact only with CO₂. Most studies focus more on the effect of CDB and less of DCDB. DCDB is thought to be effective mainly in the treatment of peripheral vascular diseases, however, the mechanism(s) underlying this traditional therapy remain(s) poorly defined.

In a recent study of 2009, Gapon and Ignatov reported that the therapy with the use of DCDB after acute myocardial infarction, decreases systolic and diastolic arterial pressure and generally reduces cardiovascular complications.¹ Seven years earlier, Abramovich had observed that in elderly patients with hypertension dry carbon dioxide baths rehabilitate skin thermoreactivity and improve microcirculation.² Decrease of arterial pressure is mentioned in other studies also.^{3,4} The application of DCDB in pa-

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