

ABSTRACT

Background:

Chronic obstructive pulmonary disease (COPD), characterised by progressive airflow limitation which is not fully reversible and associated with pulmonary and systemic inflammatory processes, is largely associated with smoking and is classified as a disease of lifestyle. Other factors related to the incidence of COPD are passive smoking, the inhalation of gases from biomass fuels and the genetic absence of the protease α_1 -antitrypsin in some people. COPD is found in all sectors of society and is not dependent on level of income or on the global location of a population. Compounding the incidence of COPD in Africa is the human immunodeficiency virus/ acquired immunodeficiency syndrome (HIV/AIDS) that predisposes patients to the development of COPD. Hydrotherapy has been used since ancient times as a preventative and/or therapeutic form of treatment. Physiotherapists have used hydrotherapy alone or as a useful adjunct to other treatment options for years. Today aquatic therapy is practised in many centres where a multi-disciplinary approach to this form of treatment is offered. There are a number of methodologies of application of the therapy. Among these are Ai Chi, Halliwick, Watsu and Bad Ragaz. The treatment takes place in thermoneutral water between 29 degrees centigrade ($^{\circ}\text{C}$) and 34°C where use is made of the buoyancy and/or resistance created by the aquatic medium. Musculoskeletal conditions, including pre-operative total hip and knee replacements; osteoarthritis and rheumatoid arthritis can be treated with this modality. Hydrotherapy affords athletes a non-weightbearing rehabilitative environment to enable a quicker recovery and also enables cardiovascular reconditioning to commence sooner than would be afforded by a land-based rehabilitation programme. Many chronic conditions, including cardiac failure, stroke and metabolic disorders have benefited from a hydrotherapy intervention. COPD has been shown to have an inflammatory component. Exercise on land has been shown to have an anti-inflammatory effect in healthy individuals but increased levels of tumour necrosis factor- α (TNF- α), known to be associated with inflammation, has resulted from moderate intensity land-based exercise in patients with COPD.

Aim and objectives of the research:

The aim of this study is to systematically review the evidence related to the role of hydrotherapy in the management of patients with COPD. The research objectives of this study are: to determine, from the literature, whether water temperature and depth of immersion influences cardiopulmonary function in patients with COPD; to determine, from the literature, whether

hydrotherapy increases endurance, function and quality of life (QoL) in patients with COPD and to determine, from the literature, whether the anti-inflammatory effects of water-based exercise in patients with COPD have been documented.

Method:

The study design is a qualitative systematic review. A search was made for relevant journal articles in the PUBMED, SCOPUS, CINAHL, MEDLINE, SPORTSDiscus and Cochrane review databases. Google scholar was perused in order to find any grey literature pertaining to the population under review. The review of the literature was from 1996 until 2009. This protracted period of 13 years was needed to insure that all leading articles on the subject under review were included in the review. There were too few articles available from 2000 onwards to produce a valid review of the topic. The words and/or phrases used in the search were: hydrotherapy, Halliwick, Ai Chi, Watsu, Bad Ragaz, chronic obstructive pulmonary disease (COPD), pulmonary rehabilitation, emphysema, chronic bronchitis and the anti-inflammatory effects of exercise. Articles in the form of systematic reviews, randomised controlled trials, clinical trials and case studies pertaining to adult patients with non-acute, non-terminal COPD and the use of hydrotherapy were included in this review. No articles based on animal studies were included. No articles on Kneipp therapy were included as hydrotherapy in this format does not include the immersion of the patient in water. The LOW (Lewis, Olds and Williams, 2007) critical appraisal tool was used to evaluate the articles included in the systematic review.

Results:

Thirty-seven studies were sourced and nine studies were included in the qualitative systematic review. A total of 35 outcomes measures were reported within the nine included studies. They were of a varied nature and therefore were grouped into the following categories: cardiovascular; pulmonary; muscle strength/weakness; endurance and power, QoL and activities of daily living (ADL). Beneficial results were found in relation to heart rate (HR) with a regime of upper limb exercises performed in water. Following an upper body and upper limb 15 minute land-based exercise programme and subsequent 10-15 minute rest period on land, systolic blood pressure (SBP) was decreased by 14mmHg and diastolic blood pressure (DBP) by 6 mmHg (compared to resting land values) when patients with COPD were immersed in 32 °C water. Ejection fraction (EF) improved significantly at the end of a two month breathing exercise programme in water. A water-based intervention period of 120 minutes (20 minutes, six days/week for two months) decreased left ventricular end –diastolic (LV_d) and left ventricular

end-systolic (LV_s) dimensions ($p < 0.01$). Exhaling into water, during an aquatic breathing exercise regimen lasting 30 minutes/day, six days/week for two months, was demonstrated to significantly increase percentage predicted forced expiratory volume in one second ($FEV_{1\%}$). Arterial concentration of carbon dioxide ($PaCO_2$) levels were decreased significantly due to the breathing exercise with exhalation into water regimens and during the breathing out into water intervention for 20 minute /day for six days the arterial concentration of oxygen (PaO_2) levels were increased. Peak flow (PF) was improved in all the breathing programmes where the patient exhaled into water. Improvement in respiratory rate (RR) and oxygen saturation (SaO_2) were seen, in patients with COPD, who performed weight -resisted upper limb exercises in water once a week with a twice weekly pulmonary rehabilitation programme (PRP) on land as opposed to a land-based PRP three times per week. Two of the included studies recorded improvement in the incremental shuttle walk test (ISWT) following exercise in water and one noted a greater improvement in the endurance shuttle walk test (ESWT) than in the ISWT after hydrotherapy. Maximal dynamic flexion showed marked improvement after an aquatic programme. Physical and cardiopulmonary improvements, including reduced levels of dyspnoea in some instances, were reported and these were linked to increased levels of physical conditioning, better QoL and improved ability to undertake ADL in the patients with COPD.

Conclusion:

Breathing exercises, where the patients exhale into the water, appear to have a beneficial effect on pulmonary outcomes particularly when the programme is of a duration of 120 minutes per week or more and the exercise is performed on six days / week. The physical exercise hydrotherapy programmes address some of the muscular weaknesses resulting from the systemic effects of COPD. Both the cardiopulmonary benefits and physical benefits seem to result in a general improvement in the QoL of the patients and their greater ability to perform ADL. Social interaction and psychological well-being seem to be factors related to increased compliance in hydrotherapy exercise programmes when compared to compliance in land-based programmes. No information was retrieved from the included studies relating to the anti-inflammatory effects of hydrotherapy exercise programmes. No randomised controlled trials were sourced on the subject under review. The overall evidence was of variable quality, with three studies above average, two average and four below average, according to the LOW critical appraisal tool. From the results obtained in the review it became apparent that there is an urgent need for a number of randomised controlled trials to investigate the role of breathing

exercises in combination with physical exercise programmes of hydrotherapy in the management of COPD so that this form of therapy can be utilised to its full capacity.