International Journal of Infection
ISSN 1972-6945 / 2024 vol. 8, ISSUE N. 3, September-December

COMPLETE INHALATION TREATMENTS WITH BICARBONATE-SULPHATE-ALKALINE-EARTHY MINERAL WATER IN THE TREATMENT OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE AGGRAVATED BY ALLERGIC RHINITIS

Giovanni Barassi[1,2*], Umberto Vincenzi[2], Maurizio Panunzio[1,2,3], Loris Prosperi[1], Celeste Marinucci[1], Vito Guglielmi[1], Giuseppe Luigi Matera[1] and Pier Enrico Gallenga[1]

[1] Center for Physiotherapy, Rehabilitation and Re-Education (Ce.Fi.R.R.), venue "G. d'Annunzio" University of Chieti-Pescara, Chieti, Italy;
[2] Castelnuovo della Daunia Thermal Medicine Center, Castelnuovo della Daunia, Italy;
[3] Responsible Research Hospital, Campobasso, Italy.

[*]*Correspondence to*:
Giovanni Barassi,
Center for Physiotherapy, Rehabilitation and Re-education (CeFiRR),
Venue "G. d'Annunzio" University of Chieti-Pescara,
66013 Chieti, Italy.
e-mail: coordftgb@unich.it

ABSTRACT

Chronic Obstructive Pulmonary Disease (COPD) is a fairly widespread disease, affecting approximately 300 million people worldwide. Although it may be a highly disabling disease in itself, COPD tends to manifest in an even more aggressive and uncomfortable way when associated with the presence of upper respiratory tract affections, as in the case of Allergic Rhinitis (AR). Therapeutically, thermal respiratory treatments would seem to possess anti-inflammatory and decongestant properties capable of improving health both in the presence of COPD and AR. Therefore, we aimed to study the efficacy of a protocol called Complete Inhalation Treatments (CIT), based on a combination of inhalations and aerosol with bicarbonate-sulphate-alkaline-earthy mineral water from the Castelnuovo della Daunia Thermal Medicine Center integrated with non-invasive mechanical ventilation. We recruited 24 patients (12 males and 12 females, mean age 63 years) affected by COPD aggravated by fall AR. Patients were evaluated before (T0) and after (T1) the execution of a protocol of 12 total CIT sessions carried out over the course of 2 weeks, using the Medical Research Council dyspnea scale (MRC) and COPD Assessment Test (CAT). At the end of the study, a significant reduction in MRC and CAT scores was detected, reaching mean values below the pathological cut-off of ≥2 for MRC and ≥10 for CAT respectively. Therefore, the CIT protocol is effective in improving the respiratory symptoms of patients with COPD aggravated by AR. New, broader and more in-depth studies on the topic are desirable.

KEYWORDS: *Rehabilitation, physical therapy, thermal care, balneotherapy, mineral water, chronic obstructive pulmonary disease, seasonal allergic rhinitis*

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a fairly common disease, affecting approximately 300 million people worldwide (1) and it is estimated that within 30 years it could become the third leading cause of death (2). It is also estimated that a percentage ranging from 70% to 80% of patients present the pathology in an insidious and/or

Received: 18 October, 2024
Accepted: 30 December, 2024
1972-6945 (2024)

undiagnosed form (3). COPD is a disease characterized by obstructed ventilatory patterns, often of a slowly progressive but partially reversible type, determined by environmental factors, in particular smoking, mixed with genetic factors that are not yet fully understood (1). Beyond its well-known symptomatology, it must be considered that an interaction between COPD and other pathologies capable of exacerbating its symptoms and severity is increasingly being observed; among these comorbidities, particular attention should be given to the presence of seasonal Allergic Rhinitis (AR) in patients affected by COPD (4). AR is one of the most frequent upper airway diseases: it is an immune and inflammatory reaction to exposure to pathogens of various nature (5) characterized, above all, by the presence of rhinorrhea and nasal congestion due to swelling of the nasal mucosa (5). More and more research is attributing to AR and other upper respiratory diseases, such as asthma and chronic rhinosinusitis, the ability to markedly worsen the quality of life and symptoms of patients affected by COPD (5,6). These pathological associations have led some authors to indicate the presence of rhinitis as a potential marker of COPD-Asthma Overlap Phenotype (7). Other research highlights how rhinitis could be part of a pathological vicious circle whereby COPD itself predisposes to the onset of rhinitis, at least in its non-allergic form (8), which in turn may worsen the symptoms of COPD.

Among the less invasive treatment methods in the field of upper respiratory tract pathologies, which can also include AR, we can identify thermal therapy and spa treatments (9,10). Thermal medicine has repeatedly proven useful in the treatment of various types of pathologies, by virtue of the specific properties of the waters from the various thermal environments, as well as the advances in technologies and therapeutic methods that fall within the scope of thermalism as a natural treatment method and synonymous with well-being (11). Also in our experiences, thermal medicine, in the form of Integrated Thermal Care (ITC) approach, has proven useful in multiple complex pathological contexts, from neurological and musculoskeletal disabilities (12,13) to the treatment of Long COVID-19 Syndrome (14).

Among the methods applicable in the field of thermal medicine, we often see the use of Complete Inhalation Treatments (CIT) which are based on assisted inhalations, insufflations, aersol and noninvasive ventilations which exploit the properties of thermal waters and their specific mineral compositions in the treatment of respiratory and otorhinolaryngologic disorders (9,15,16).

Therefore, based on what is highlighted in the literature on the topic and on our experiences in the field of thermal medicine, we decided to evaluate the effectiveness of the CIT protocol in improving the health status of patients affected by COPD aggravated by the presence of fall AR, typically associated with the presence of pollens (such as ragweed and wormwood), environmental molds and dust mites in the autumn period (17).

MATERIALS AND METHODS

The present research is a small clinical trial carried out at the Castelnuovo della Daunia Thermal Medicine Center (Castelnuovo della Daunia, Italy) from September to November 2023.

The rehabilitation protocol to which the patients were subjected is safe, as all the therapeutic procedures applied to patients comply with the safety regulations in force in the country where the study was carried out; the protocol is accessible to all patients who do not highlight specific contraindications to the initial clinical evaluation necessary for all patients who access the facility of the study. Clinical research was performed in accordance with the Helsinki Declaration and Good Clinical Practice standards (18). All participants signed the informed consent for the procedures. All the evaluation and treatment methods used for this study, as well as the actual application procedures, are commonly used in the clinical-rehabilitative practice of the rehabilitation center where the study was carried out, therefore, the normal ethics committee clearance was not required (19).

A total of 24 patients (12 males and 12 females, mean age 63 years) affected by COPD aggravated by fall AR were recruited. All patients presented clinical manifestations of dyspnea, cough, rhinorrhea and nasal congestion assessed by the medical doctors at the study site. Patients with severe cardiovascular diseases, neurological diseases and active infections were excluded from the study.

Patients were assessed, before the beginning (T0) and after the end (T1) of the CIT treatment cycle, using the following two COPD-specific rating scales:

- Medical Research Council dyspnea scale (MRC): a simple and valid method of categorizing patients with COPD and other respiratory diseases in terms of the influence of the respiratory deficit on their physical capacity (20). The scale measures the level of dyspnea perceived by the patient in a classification system divided into 5 levels of onset of breathing difficulties depending on the intensity of the activity performed (grade 0 = dyspnea after intense physical activity, grade 1 = dyspnea after walking at fast pace or uphill, grade 2 = dyspnea after walking at a slow pace on level ground, grade 3 = dyspnea after just 100 meters of walking, grade 4 = dyspnea when dressing/undressing) (20).

- COPD Assessment Test (CAT): used to evaluate the health status of patients with COPD and other respiratory diseases (21,22). Indeed, it contains items focused on respiratory symptoms and non-respiratory symptoms such as sleeping disturbance or limitations in activities at home. In particular, the rating scale is made up of 8 items that investigate various aspects related to the respiratory capacity of the patient, such as cough, mucus, chest tightness, physical resistance to walking, physical resistance to domestic activities, perceived safety in leaving the home environment, noise of the sleep and perceived energy level. Each item assesses the severity of the symptomatology with a score from 0 (no symptoms) to 5 (extremely present and disabling symptom) (21,22).

The CIT protocol applied in the study consists of the administration of the following respiratory stimulation techniques:

- Inhalations: steam inhalations with direct warm humid jets placed in front of the face of the patient. The jets are carried out through proprietary individual devices from which the bicarbonate-sulphate-alkaline-earthy mineral water comes out from a nozzle in the form of a homogeneous mist at a pressure of 1.5 atmospheres and at a temperature of 37°C-38°C, lasting about 20 minutes. This phase of the CIT treatment is dedicated to the stimulation of the very upper airways.
- Aerosol: it applies the same jet as the inhalation phase but focused through a nose-mouth mask directed only to the respiratory tract, integrating a system of micronization of the bicarbonate-sulphate-alkaline-earthy mineral water vapor jets, lasting around 20 minutes. This phase is dedicated to a deeper stimulation of the upper respiratory tract.
- Noninvasive mechanical ventilation: produced through a Bird Mark 8 instrumentation (Bird Products 3M, Palm Springs, California, U.S.A.). The treatment, consisting of ad-ministering pressurized purified air to the patient through the use of a positive pressure mouthpiece, was applied with an automatic frequency of no more than 14 breaths per minute (according to specialist medical indication) for a total of 15 minutes. This phase aims to stimulate the respiratory system at depth, involving also direct pulmonary involvement.

Each patient underwent 6 weekly sessions of CIT for 2 weeks, for a total of 12 treatment sessions lasting around 1 hour each.

At the end of the study, statistical analysis was carried out on collected data using the Wilcoxon Signed Rank test for dependent samples, performed through the Statistics Kingdom online calculator (https://www.statskingdom.com, Melbourne, Australia).

RESULTS

At the end of the study (T1), a significant reduction in the MRC score value was observed ($p < 0.001$) which went from 1.54 ± 0.88 to 0.83 ± 0.64, for an overall reduction of 45.9% (Fig.1).

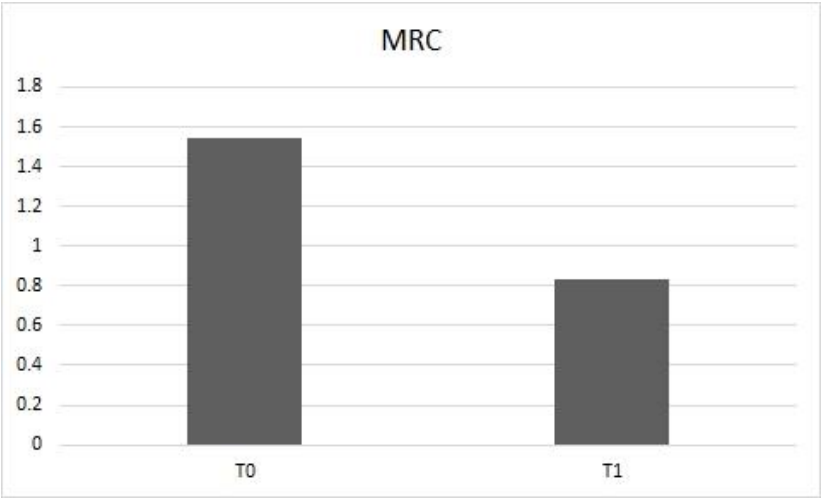

Fig. 1. *Change in MRC values between T0 and T1.*

Similarly, at time T1, a significant reduction in the CAT value was observed ($p < 0.001$) which went from 17.83 ± 7.47 to 9.29 ± 5.01, for an overall reduction of 47.9% (Fig.2).

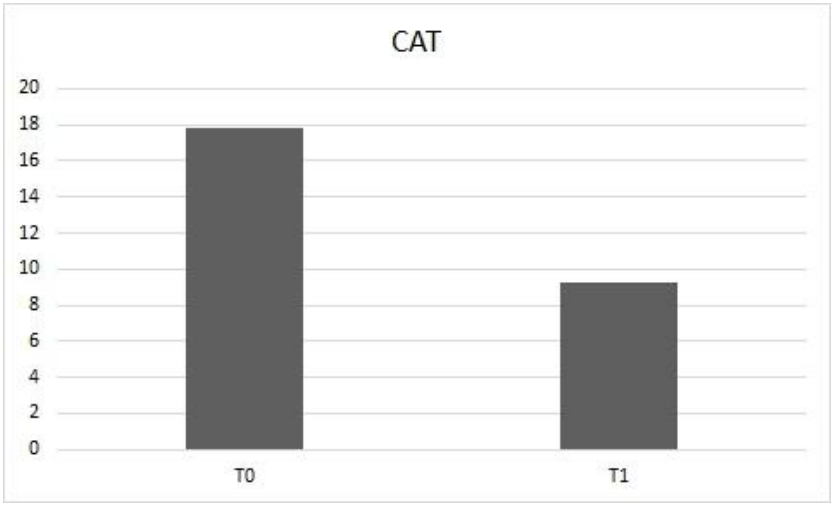

Fig. 2. *Change in CAT values between T0 and T1.*

DISCUSSION

The application of a CIT protocol in the group of patients selected for the study significantly reduced, after 2 weeks of treatment, both the MRC and CAT scores in the presence of COPD aggravated by AR.

Current literature suggests that AR is a pathological condition frequently associated with chronic respiratory diseases such as asthma (23,24); however, a growing body of evidence is now demonstrating that the nasal and upper respiratory tract symptoms typical of AR and other forms of rhinitis could have a strong pathological influence even in association with the presence of COPD (25,26). This could be due primarily to a mutually exacerbating and cumulating effect of the inflammatory and possibly infectious processes that characterize both the upper and lower respiratory tract, as in the case of AR associated with COPD (26,27). Furthermore, it is assumed that nasal affections, such as AR, have a direct influence on the reduction of respiratory flow already compromised downstream in the presence of COPD (28). In fact, nasal obstructions due to rhinitis contribute markedly to the reduced airflow in COPD patients, to the point of allowing the identification of pan-airway involvement in COPD (28). By virtue of this, clinical practice could benefit from the treatment of upper respiratory tract symptoms, such as nasal symptoms of AR, in the presence of COPD, in order to also bring improvements to the latter condition (26). Typically, this is done through drug therapies which have been shown to be effective in improving the quality of life of COPD patients through treatment dedicated to nasal symptoms (29,30).

What has been observed so far would appear to be consistent with the improvements observed in terms of MRC and CAT scores in COPD+AR patients treated in our study through a 2-week CIT cycle. The fact that both scores showed improvement with the CIT approach reinforces the idea discussed so far that therapy dedicated to upper respiratory tract conditions, such as fall AR, is able to produce benefits that are directly reflected also on COPD-induced respiratory dysfunction. This is particularly relevant if we consider that, in addition to a significant reduction between T0 and T1, both the mean MRC and CAT values detected at the end of the CIT protocol fell below the scores pathological cut-off typically recognized in the literature, corresponding to ≥2 for MRC and ≥10 for CAT (31). The positive effects of the CIT treatment are most likely attributable to the well-known anti-inflammatory and decongestant effects of thermal mineral waters, particularly of the sulfurous type, which are especially evident in the upper respiratory tract and nasal mucosa (32,33). The anti-inflammatory effect of thermal mineral waters on the upper respiratory tract was also confirmed for the bicarbonate-sulphate-alkaline-earthy mineral water used for the first two phases of the CIT protocol administered to the study patients (34).

Despite the broad consistency of the results obtained with what is known in the literature regarding the curative potential of thermal mineral waters and the efficacy of CIT protocols in conditions such as AR and COPD, it is necessary to underline some limitations of this study. First of all, the observed sample is relatively small compared to the wide diffusion that AR and COPD have in the general population: this is due to the selection methods of the subjects studied, who were taken from users who typically turn to the study center for recreational spa treatments (35), without resorting to targeted and organized recruitment a priori. Furthermore, the study, for the same reasons mentioned above, did not include a control group or a follow-up. Therefore, given the excellent results obtained, in order to clearly validate the efficacy of CIT for patients affected by COPD aggravated by AR, it would be appropriate to make new studies on the topic, larger and better structured, possibly with a control group and follow-up. It would also be important to take into consideration, for any new studies on the topic, the use of biochemical markers and instrumental and laboratory analyses

among the evaluation methods, so as to have a clearer picture of the actual existence of anti-inflammatory mechanisms underlying the therapeutic effects of CIT.

CONCLUSIONS

The CIT approach can determine a significant improvement, at least in the short term, of MRC and CAT parameters of patients affected by COPD aggravated by AR. Given the non-invasiveness of the treatment and the relatively simple and safe application of the studied protocol, this method could be configured as a complementary or alternative therapeutic tool in the rehabilitation of complex and widespread respiratory disorders such as COPD and AR.

Conflict of interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Ruvuna L, Sood A. Epidemiology of chronic obstructive pulmonary disease. *Clinics in Chest Medicine*. 2020; 41(3):315-327.
2. Kahnert K, Jörres RA, Behr J, Welte T. The diagnosis and treatment of COPD and its comorbidities. *Deutsches Ärzteblatt International*. 2023; 120(25):434.
3. Lin CH, Cheng SL, Chen CZ, Chen CH, Lin SH, Wang HC. Current progress of COPD Early detection: key points and novel strategies. *International Journal of Chronic Obstructive Pulmonary Disease*. 2023; 18:1511-1524.
4. Al-Hadrawi Z, Giezeman M, Hasselgren M, et al. Comorbid allergy and rhinitis and patient-related outcomes in asthma and COPD: a cross-sectional study. *European Clinical Respiratory Journal*. 2024; 11(1):2397174.
5. Bernstein JA, Bernstein JS, Makol R, Ward S. Allergic rhinitis: a review. *JAMA*. 2024; 12;331(10):866-877.
6. Arndal E, Sørensen AL, Lapperre TS, et al. Chronic rhinosinusitis in COPD: a prevalent but unrecognized comorbidity impacting health related quality of life. *Respiratory medicine*. 2020; 171:106092.
7. Figueira Gonçalves JM. Reflexiones sobre la rinitis como un marcador clínico de fenotipo EPOC-asma / Rhinitis: A clinical marker of COPD-asthma overlap phenotype? *Arch. bronconeumol. (Ed. impr.)*. 2016; 52(6):343-343.
8. Bergqvist J, Andersson A, Olin AC, Murgia N, Schiöler L, Bove M, Hellgren J. New evidence of increased risk of rhinitis in subjects with COPD: a longitudinal population study. *International Journal of Chronic Obstructive Pulmonary Disease*. 2016; 19:2617-2623.
9. Simões JF, Castro H, Martins MJ, Miguéis A. Thermal Waters in Otorhinolaryngology. In Mineral Water. Editors: Maria João Martins. 2022 Nova Science Publishers, Inc.
10. Passali D, De Corso E, Platzgummer S, et al. Spa therapy of upper respiratory tract inflammations. *European Archives of Oto-Rhino-Laryngology*. 2013; 270:565-570.
11. Gómez Pérez CP, González Soutelo S, Mourelle Mosqueira ML, Legido Soto JL. Spa techniques and technologies: from the past to the present. *Sustainable Water Resources Management*. 2019; 5:71-81.
12. Barassi G, Obrero-Gaitan E, Irace G, et al. Integrated thermal rehabilitation: a new therapeutic approach for disabilities. Trends in Biomedical Research; 2020:29-38.
13. Barassi G, Panunzio M, Di Iulio A, et al. Integrated Thermal Rehabilitation Care: An Intervention Study. *Healthcare (Basel)*. 2023; 11(17):2384.
14. Barassi G, Prosperi L, Pellegrino R, et al. Integrated Thermal Care and Bio-Physico-Metric Approach for the Treatment of Long-Covid Patients. *Eur J Musculoskel Dis*. 2024; 13(3): Ahead of Print.
15. Elshof J, Vonk JM, van der Pouw A, et al. Clinical practice of non-invasive ventilation for acute exacerbations of chronic obstructive pulmonary disease. *Respiratory Research*. 2023; 24(1):208.
16. Gomes BM. Upper Airway Disorders and Noninvasive Mechanical Ventilation: Rationale and Approaches. In Upper Airway Disorders and Noninvasive Mechanical Ventilation: Rationale and Approaches. A.M. Esquinas, A. De Vito, N. Barbetakis, Springer International Publishing. New York, 2023; pp. 191-194.
17. Candice Jones MD, Lakiea Wright MD, MAT M. Seasonal allergies. *Contemporary Pediatrics*. 2021; 38(3):22-5.

18. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA*. 2013; 310(20):2191-2194.
19. Winter EM, Maughan RJ. Requirements for ethics approvals. *Journal of Sports Sciences*. 2009; 27(10):985.
20. Bestall JC, Paul EA, Garrod R, Garnham R, Jones PW, Wedzicha J. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. *Thorax*. 1999; 54(7):581-586.
21. Jones PW, Harding G, Berry P, Wiklund I, Chen WH, Kline Leidy N. Development and first validation of the COPD assessment test. *Eur Respir J*. 2009; 34:648–654.
22. Houben-Wilke S, Janssen DJA, Franssen FME, Vanfleteren LEGW, Wouters EFM, Spruit MA. Contribution of individual COPD assessment test (CAT) items to CAT total score and effects of pulmonary rehabilitation on CAT scores. *Health and Quality of Life Outcomes*. 2018; 16:1-8.
23. Compalati E, Ridolo E, Passalacqua G, Braido F, Villa E, Canonica GW. The link between allergic rhinitis and asthma: the united airways disease. *Expert Rev Clin Immunol*. 2010; 6(3):413-423.
24. Corren J. The connection between allergic rhinitis and bronchial asthma. *Curr Opin Pulm Med*. 2007; 13(1):13-18.
25. Hurst JR, Wilkinson TM, Donaldson GC, Wedzicha JA. Upper airway symptoms and quality of life in chronic obstructive pulmonary disease (COPD). *Respir Med*. 2004. 98(8):767-770.
26. Hurst JR. Upper airway. 3: Sinonasal involvement in chronic obstructive pulmonary disease. *Thorax*. 2010; 65(1):85-90.
27. Bafadhel M, Criner G, Dransfield MT, et al. Exacerbations of chronic obstructive pulmonary disease: time to rename. *The Lancet Respiratory Medicine*. 2020; 8(2):133-135.
28. Hurst JR, Kuchai R, Michael P, Perera WR, Wilkinson TM, Wedzicha JA. Nasal symptoms, airway obstruction and disease severity in chronic obstructive pulmonary disease. *Clinical physiology and functional imaging*. 2006; 26(4):251-256.
29. Calabrese C, Costigliola A, Maffei M, et al. Clinical impact of nasal budesonide treatment on COPD patients with coexistent rhinitis. *International Journal of Chronic Obstructive Pulmonary Disease*. 2018; 27:2025-2032.
30. Callebaut I, Hox V, Bobic S, Bullens DM, Janssens W, Dupont L, Hellings PW. Effect of nasal anti-inflammatory treatment in chronic obstructive pulmonary disease. *American Journal of Rhinology & Allergy*. 2013; 27(4):273-277.
31. Ertan Yazar E, Niksarlioglu EY, Yigitbas B, Bayraktaroglu M. How to utilize CAT and mMRC scores to assess symptom status of patients with COPD in clinical practice? *Medeniyet Medical Journal.* 2022; 37(2).
32. Passali D, De Corso E, Platzgummer S, et al. Spa therapy of upper respiratory tract inflammations. *Eur Arch Otorhinolaryngol*. 2013; 270(2):565-570.
33. Keller S, König V, Mösges R. Thermal Water Applications in the Treatment of Upper Respiratory Tract Diseases: A Systematic Review and Meta-Analysis. *Journal of Allergy*. 2014; 2014(1):943824.
34. Cristalli G, Abramo A, Pollastrini L. Treatment of chronic inflammation of the upper respiratory airways by inhalation thermal therapy with sulfur-sulfate-bicarbonate-carbonate-alkaline earth mineral water: a study of nasal cytology. *Acta Otorhinolaryngologica Italica: Organo Ufficiale Della Societa Italiana di Otorinolaringologia e Chirurgia Cervico-facciale*. 1996;16(6 Suppl 55):91-94.
35. Valeriani F, Margarucci LM, Romano Spica V. Recreational use of spa thermal waters: criticisms and perspectives for innovative treatments. *International Journal of Environmental Research and Public Health*. 2018; 15(12):2675.