

ORIGINAL PAPER

The Use of Mineral Therapeutic Waters in Metabolic Disorders - a Review of the Literature

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Abstract

The ongoing concern regarding the management of the metabolic syndrome and its complications requires the permanent approach of therapeutic solutions. Balneotherapy has been used for much time for treatment of different illness. The most common uses of mineral therapeutic waters are represented by drinking or bath cures. The positive influence of this form of therapy can be attributed to the water composition and its physical chemical properties of the water firstly, and second to the climatic, nutritional and social factors that are specific to the balneary resort. The aim of the study was to express our current experience regarding the impact that balneary support has in managing different metabolic conditions. We performed a review using online databases, and also hand research of the available studies regarding the subject, in order to acquire more information regarding the research that was conducted on this field. The analysis indicates a significant amount of data regarding the use of mineral therapeutic waters, resulting that through their specific composition it can provide a modulation of the parameters that define the metabolic syndrome.

Keywords: mineral therapeutic waters, metabolic syndrome, diabetes mellitus

Rezumat

Sindromul metabolic și complicațiile acestuia necesită furnizarea continuă a unor soluții terapeutice. Terapia balneară este utilizată în diferite segmente de patologie atât în cura internă cât și externă. Influența pozitivă poate fi atribuită, pe de o parte compoziției apei, respectiv proprietăților fizice și chimice ale acesteia, iar pe de altă parte factorilor de natură climatică, nutrițională și socială specifice stațiunii balneare. Scopul studiului este acela de a exprima experiența actuală cu privire la efectul realizat de către apele minerale terapeutice în tratamentul diferitelor afecțiuni metabolice. Am realizat o analiză folosind bazele de date online privind studiile disponibile pe acest subiect, pentru a obține mai multe informații legate de cercetările efectuate în acest domeniu. Analiza indică un număr semnificativ de studii privind utilizarea apei minerale terapeutice, rezultând posibilitatea modulării anumitor parametrii responsabili pentru apariția sindromului metabolic în cazul utilizării acestei forme de tratament.

Cuvinte cheie: ape minerale terapeutice, sindrom metabolic, diabet zaharat

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BACKGROUND

Metabolic Syndrome (MetS) represents a group of clinical and biological criteria that when combined can become a potential threat for the development of severe pathologies –diabetes mellitus, cardiovascular disease, obesity. The *International Diabetes Federation* (IDF) defines the presence of MetS when 3 or more of the following criteria are detected: **1.** raised triglycerides ≥ 150 mg/dL (1.7 mmol/L) or specific treatment for this lipid abnormality; **2.** reduced HDL cholesterol < 40 mg/dL (1.03 mmol/L) in males < 50 mg/dL (1.29 mmol/L) in females or specific treatment for this lipid abnormality; **3.** raised blood pressure systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg or treatment of previously diagnosed hypertension; **4.** raised fasting plasma glucose, (FPG) ≥ 100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes; **5.** central obesity (defined as waist circumference* with ethnicity specific values) (IDF guidelines)¹⁻³.

The cause of MetS is not singular, central obesity and insulin resistance representing the core factors for its individual components⁴. Because of the epidemic of overweight and sedentary lifestyle worldwide, the metabolic syndrome is more frequently being diagnosed. The prevalence increases with age, especially during the six decade of life the estimated risk of further developing diabetes being 5 to 7 times higher in these patients compared to patients absent of the pathology⁵.

The presence of MetS not only increases the risk of developing diabetes but can be highly predictive regarding the new-onset of the disease. Also, increased cardiovascular and overall mortality, are associated with MetS even when in patients without diabetes or cardiovascular disease. The *International Diabetes Federation* (IDF) according to *2017 Diabetes Atlas* expresses the fact the global prevalence of diabetes in the population aged 20-79 years is 8.8% and is estimated to increase to 9.9% until 2045⁶.

The prevalence of metabolic pathologies according to PREDATORR study that evaluated the prevalence of diabetes mellitus and prediabetes, and their association with cardiometabolic, sociodemographic, and lifestyle risk factors in the Romanian population aged 20-79 years and included 2278 participants evidenced that impaired glucose regulation was found in 28.1% of the studied population, while the prevalence of diabetes mellitus was 11.6%, increased with age and was higher in men than in women⁷.

Treatment options of metabolic syndrome include lifestyle changes, which requires the adoption of a healthy diet, increased physical activity, smoking cessa-

tion plan and maintenance of a healthy body weight, physical exercise and pharmacological treatment of its different components if attempts to lifestyle changes are not adequate.

Balneotherapy has been used for much time for treatment of different illness. The most common uses of mineral therapeutic waters are represented by drinking or bath cures. The positive influence of this form of therapy can be attributed to the water composition and its physical chemical properties of the water firstly, and second to the climatic, nutritional and social factors that are specific to the balneary resort⁸.

MATERIAL AND METHOD

We performed a review using online available database – Cochrane, Pubmed/Medline (1966 - present), Pedro, Science direct Embase/ Elsevier (1980 - present) – and also hand research of the available studies regarding the subject, in order to acquire more data regarding the research that was conducted on this field. The following search terms were used: crenotherapy, mineral therapeutic waters, balneotherapy, metabolic syndrome, thermalism, obesity, diabetes.

RESULTS AND DISCUSSIONS

The search strategy evidenced encouraging results regarding the use of mineral therapeutic waters in this chapter of pathology.

The results of PRISME, a French cohort study⁹ sustained by AFRETh which investigated the multidisciplinary care on the one year care of the metabolic syndrome during 2008-2009 followed the use of spa therapy combined with multidisciplinary management using NCEP-ATP III criteria and concluded that a quarter of the patients included in the study (from a total of 63/143 followed) presented a reduction of the criteria that were used to diagnose MetS.

Maathermes study¹⁰ (AFRETH, 2011) evaluated the efficacy of thermalism and its impact in patients with obesity. The study observed the effect of a 3 week cure in French balneoclimateric resorts, in which patients benefited from crenotherapy with mineral therapeutic waters, hydrokinetotherapy, mud wraps, and dietary counseling. The results show a comparable efficacy of a thermal cure compared to the single use of pharmacological treatment with agonists of 2C receptors of serotonin – Lorcacerin – and lifestyle modifications.

Drobnik M et al. express a reduction of total cholesterol and total lipids from the blood serum, in a study in which they analyzed the functioning biological activity of mean mineralized sodium bicarbonate in water

from the „Pitoniakówka” source in Szczawnica outflow B + C + D + G.11, while Yamamoto N. (2007) provides additional information in which he states that immersion in CO₂-rich water containing NaCl diminishes blood pressure fluctuation in anesthetized rats¹².

Oláh M et.al studies the effect of balneotherapy on C-reactive protein, serum cholesterol, triglycerides and total antioxidant status, on a group of 42 ambulatory patients that benefited from external cure with mineral therapeutic waters for 15 days, in which reduced values of triglycerides and cholesterol were observed at the end of the cure and maintained until the 3 month follow-up¹³.

The use of bicarbonate mineral therapeutic waters have been proven efficient in type 2 diabetes treatment. In study that used blood metabolome analysis in order to observe the effect of MTW on glycemic control, it was shown modifications on 19 metabolites including glycolysis related metabolites and 3 amino acids, and also a reduction of the glycoalbumin levels, suggesting that the administration of MTW could prevent or improve the status in patients with type 2 diabetes¹⁴.

Other studies express favorable results in managing patients with diabetes and obesity in case of using balneotherapy, with a diminish of body mass index and biological parameters including glycaemia, total cholesterol, and c reactive protein, the authors expressing that balneary programs associated with controlled diet could offer a risk reduction in metabolic patients¹⁵.

In a study that developed in the balneary resort which evaluated the development of selected cardiovascular parameters in patients with type II diabetes, the authors used different sources of mineral waters that include free CO₂ dissolved in water in a dissociated form, both internally and also associated with other balneary forms of treatment and dietary interventions, the authors observed a reducing of the sympathoadrenal system activity in patients with poorly controlled diabetes type II, associated with an improvement of the electrical stability of the myocardium and heart rate variability without an overload of the cardiovascular treatment¹⁶.

Sulphurous mineral water have been shown to provide an effect over the oxidative stress in patients with diabetes, the author suggesting crenotherapy associated with antidiabetic medication, may be useful in type 2 diabetes mellitus for the improvement redox state of the organism¹⁷.

Other studies suggest a possible effect of balneotherapy on platelet glutathione metabolism in type II diabetic patients, the authors expressing the fact that balneotherapy can be beneficial for patients whose platelet

antioxidative defense system is damaged, such as those with diabetes mellitus and coronary heart disease¹⁸.

The impact of hypersaline sodium-rich naturally mineral water with high concentration of potassium, calcium, and magnesium over the metabolic syndrome has been evaluated in a study on metabolic syndrome induction in fructose-fed sprague-dawley rats. The authors analyzed a large scale of metabolic parameters including plasma concentrations of glucose, triacylglycerols, total cholesterol, HDL-cholesterol, LDL-cholesterol, C-reactive protein (CRP), glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), total bilirubin, uric acid, urea, creatinine, total proteins, albumin, ferritin, sodium, potassium, chloride, magnesium, calcium, and phosphorus, observing that the ingestion of the mineral water reduced not only the fructose-induced increase of heart rate, plasma triacylglycerols, insulin and leptin levels, hepatic catalase activity, and organ weight to body weight ratios (for liver and both kidneys) but also the decrease of hepatic glutathione peroxidase activity and oxidized glutathione content implying that natural mineral waters could have the potential to prevent metabolic syndrome induction by fructose¹⁹.

In a study regarding the effect of an intervention with sodium-bicarbonated mineral water on cardiometabolic risk biomarkers, the authors observed a reduction of total cholesterol, LDL cholesterol, and glucose, and a decrease in urinary potassium and creatinine concluding that mineral waters did not affect blood pressure and exerted a moderate alkalizing effect in the body²⁰.

Sodium-bicarbonated mineral waters have been reported to reduce gallbladder emptying and postprandial lipaemia in a study which monitored postprandial serum triacylglycerols, cholecystokinin and gallbladder volume the authors observing a reduction of these parameters of the administration of bicarbonate mineral water²¹.

Other authors have analyze the effect of a strongly bicarbonated mineral water on lipoprotein levels during fasting and postprandial state, reporting a significant decrease in triglyceridemia and tendency to a decrease of VLDL cholesterol at fasting state²².

Crenotherapy may provide a modulation of the parameters that define obesity and diabetes, due to the fact that these conditions can occur as a result of the interference of gastric pathology, associated with hepato-biliary, and pancreatic manifestations. In a study that evaluated the effect of sulphate-bicarbonate-calcium water on risk factors for atherosclerosis, weight control, and gallstone disease over a 12 day cycle in patients with functional dyspepsia and constipation,

in which the authors evaluated total/low density lipoprotein and high density lipoprotein, bile acid, and the fasting gallbladder volume using the ellipsoid formula on the average of 2 sonographical gallbladder measurements, the authors observed an improvement intestinal transit and allows maintenance of a stable body weight despite a high food intake. Fasting gallbladder volume was significantly smaller at the end of the study than at baseline in the mineral water group (15.7 ± 1.1 mL vs 20.1 ± 1.7 mL) compared to tap water group (19.0 ± 1.4 mL vs 19.4 ± 1.5 mL). There were no significant difference regarding total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides at the end of the cure compared to baseline²³.

Additional, hand research was conducted in order to further evaluate the impact exercised on the metabolic functions by different categories of mineral waters. Stoicescu et al study the influence of Lipova bicarbonate calcic water on experimental models with alloxan induced diabetes. The authors observed a lower increase of the glycemic level (42% increase in alloxan group compared with alloxan and mineral water which presented statistical significance)²⁴.

Regarding the lipid metabolism, the mineral therapeutic water from Slanic Moldova, source 2 was studied, the authors expressing reduced levels of plasmatic fatty acids with 16% in the studied lot, while the cholesterol levels remains without and significant differences between the two groups). Similar results were found with Bilbor water source⁵. The authors also ex-

plored the modifications of the serum lipid fractions in mice, and although the differences do not present significant values the author suggest an improvement of the reports of these fractions after the administrations of bicarbonate water²⁵.

The role of the hydrogen sulfide from the composition of the sulphurous mineral waters may be reconsidered from the light of new researches. Yang et al provides evidence that H₂S represents a physiologic vasodilator and regulator of blood pressure²⁶, while Zhang L *et al.* suggest that the interaction of H₂S and insulin in liver plays a pivotal role in regulating insulin sensitivity and glucose metabolism²⁷.

CONCLUSIONS

Mineral therapeutic waters though their specific physical and chemical composition can provide a modulation of the parameters that define the metabolic syndrome. Although our review indicates a significant amount of data on this subject, new research studies are required in order to observe the effect of mineral therapeutic waters in managing metabolic conditions.

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