Balneoprevention: New approaches

ARTICLE *in* INTERNATIONAL JOURNAL OF BIOMETEOROLOGY · OCTOBER 2010

Impact Factor: 2.1 · DOI: 10.1007/s00484-010-0377-2 · Source: PubMed

1 AUTHOR:

Csaba Varga
University of Pécs
47 PUBLICATIONS **229** CITATIONS

SEE PROFILE

Int J Biometeorol
DOI 10.1007/s00484-010-0377-2

SHORT COMMUNICATION

Balneoprevention: new approaches

Csaba Varga

Received: 30 August 2010 / Accepted: 27 September 2010

Abstract The present study outlines a strategy for studying application of balneotreatment in preventive medicine (balneoprevention). Prophylactic use of spa treatment and mineral water consumption can be studied using epidemiological methods in the involved population. Calculated toxicological risk of balneological treatment can be decreased by performing a complete chemical analysis (including high performance organic analyses) and specific toxicity tests of medicinal water and mud (peloid) samples.

Keywords Medicinal water · Spa · Peloid · Drinking cure · Organics · Toxicity · Epidemiological studies

Introduction

Balneological prevention (balneoprevention) can be considered a relatively new principle both in balneology and in public health. This discipline may involve two distinct fields. On the one hand, prophylactic aspects of balneotherapy—or crenotherapy as suggested by Vaccarezza and Vitale (2010)—(if it is therapy in this context) can be investigated primarily with (interventional or experimental) epidemiological methods. (Avoiding the expression "balneotherapy" in this context is essential, because "therapy" is rather used for curative purposes.) This aspect also involves epidemiological studies performed on populations consuming (i.e. drinking) mineral waters.

C. Varga (✉)
Department of Environmental Health,
Institute of Public Health Medicine, University of Pécs,
Szigeti 12,
Pécs 7624, Hungary
e-mail: chemsafety@freemail.hu

On the other hand, balneoprevention should also involve toxicity studies, on chemical (primarily organic) substances of medicinal waters and muds (peloids). These natural compounds may contain mutagenic, carcinogenic or other specific toxic components of mainly geochemical origin. This latter field requires high performance analytical methods and devices (DiGioia et al 2006; Gonzales-Barreiro et al. 2009), as well as in vitro and in vivo biological tests (Varga 2010). The aim of this activity is purely to decrease the risk of the use of medicinal waters and peloids in cases where one or more toxic fractions or components are present.

Possible aspects and approaches of balneoprevention

Prophylactic use of spas

Prophylactic use of taking baths in medicinal (thermal-, spa-) waters is a real opportunity in some European and Asian countries. Several studies have proven primary or secondary preventive action of different spa treatments on diseases with diverse pathology (Pittler et al. 2006; Verhagen et al. 2008). However, the effectiveness on health parameters of the population would require the possibility of spa use by high-risk groups. This is primarily a financial issue but is also affected by health attitudes, and would involve adequate health promotion strategies. Measurements of effectiveness would be characterized by changes in morbidity, mortality and life expectancy (Varga 2006).

Use of spas and the services they supply for recreational purposes is called as 'wellness' in the field of health tourism. These activities are not usually supported by health insurance companies. Neither is balneotherapy supported in

Published online: 22 October 2010

the vast majority of countries, thus precluding spa use even by the indigent, low-income population.

It would be very important to know which ingredients/fractions are responsible for the therapeutic/prophylactic effects. Knowing this, effective water concentrates could be prepared for home use. But it is also important to retain other parameters of the original medicinal waters in products intended for home use. This is particularly important because, besides the physical and chemical effects of medicinal waters, the psychic action of use of these waters is an additional important effect. This latter is closely attached to the spa (as a specific site) and probably plays an important role in the healing process. The efficiency of balneological cure involves rhythmic repetitive stimuli of the central nervous system with neurohumoral effects leading to formation of new reflex mechanisms (Schulhof 1976). Other possible factors related to healing are: the specific acoustics and illumination in the spa, as well as the calm and volatile (odour) substances, which come mainly from organic compounds. The physiological/therapeutic effect of odours, for example, can easily be studied by the methods of experimental neurology. Such aspects are especially important in the case of home "cures" because the spa experience may be recreated by mixing odour substances or other organic compounds into the bathwater. Reproduction of mineral composition alone is unable to imitate the original effects (Varga and Domahidi 2009).

Toxicology and chemical analysis

The ultimate aim of toxicology and chemical analysis of medicinal waters and muds (peloids) is to reveal the relationship between possible toxic features and specific components or ingredients. The most important benefit of such analysis would be the accumulation of essential, and as yet lacking, basic information on the specific toxicity of medicinal and mineral waters and muds, or lack of it. This information could help to assess the risk of use or expected benefit from both a preventive and therapeutic point of view. We are not aware of such study in the literature. Any study with this aim should be based on precise qualitative and quantitative chemical (especially organic) analysis. A battery of toxicological tests based on the following specific points would provide invaluable data:

The simplest but strategically perhaps the most important tools are ecotoxicity tests. Their advantage is the possibility of direct application of an environmental matrix (water, mud) to a simple in vivo system (seedling-, Eisenia-test, etc.). The ultimate advantage of such direct exposure is the lack of a requirement for sample pretreatment (complicated extraction procedures can sometimes cause artefacts or loss of active ingredients). The disadvantage of ecotoxicity tests is, however, the use of lower organisms, which yields only limited and indirect information on actual toxicity risks as compared to mammalian toxicity data (Gerencsér et al. 2010).

Bacterial mutagenicity tests (e.g. Salmonella/Ames test) are methods also frequently applied to environmental samples. However, the necessary concentration or isolation procedure of water samples and solvent extraction of peloid samples leads to inevitable losses and artefact formation. Nevertheless, the extreme sensitivity, selectivity and specificity are well-known advantages of these tests, which are suitable to detect not only mutagenicity but also (indirectly) other genotoxic, indeed, carcinogenic effects as well. Hidden effects can be studied using combinations of different chemical fractions and highly selective alternate strains sensitive to specific toxicity mechanisms (Szendi et al. 2009).

Several toxicity and genotoxicity endpoints can be studied in experimental animals (rodents). Besides the basic toxicity parameters (e.g. LD_{50}, NOAEL, LOAEL), urinary mutagenicity (in the Ames test) or bone marrow cytogenetics may also be performed (Varga et al. 1995). In vitro tests can also be applied to cell cultures. Carcinogenic action can be detected in cell transformation assays, and genotoxicity in in vitro cytogenetics or single-cell microgel electrophoresis (comet assay) (Varga 1991; Varga et al. 1999; Szendi et al. 2009).

In brief, by using a methodological repertoire of state-of-art analytics and toxicology, mapping of the most popular medicinal waters and peloids seems to be possible, not to mention highly necessary.

Mineral water consumption

Since many people still do not believe in the safety of tap water, we have developed a culture of mineral water (or bottled water) consumption nowadays. Of course, drinking cures with highly mineralized waters should not be confused with popular consumption of mineral waters. Therapeutic, low volume consumption of highly mineralized waters has a great influence on the activity of the gastrointestinal system, ionic balance of the organism, and excretion. A series of clinical trials has been published on the preventive action of mineralized waters in several diseases (Worwood et al. 1996; Rodgers 1997; Bohmer et al. 2000). The everyday mineral water consumption of the population, however, can also be viewed as a preventive measure. Several dissolved salts can substitute for severe natural shortages but, unfortunately, mineral composition does not play a major role in consumers' selection of water. Consumption of a particular mineral water can supply iodide, fluoride or many trace elements. High bicarbonate content can decrease the strong acidity of gastric juice,

preventing its long-term consequences. Consumption of certain mineral waters, however, is not advised in cases of renal stone disease. Communication of hazards and risks is also an important task of health promotion, but it is unnecessary to overemphasize some facts. The consumption of sodium-rich water cannot be considered as a real risk factor even in case of hypertonic patients; indeed, sodium-rich carbonated water can play a beneficial role in the prevention of CVD (Pérez-Granados et al. 2009). Daily consumption of 10 l (!) water of a relatively high, 200 mg/L Na^+ content would mean only 2 g intake. This quantity is equivalent to the WHO proposal for daily nutritional intake of sodium (Varga 2006; WHO 2009).

The organic fraction may have great impact on the dissolution or absorption properties of mineral waters, but no data are available in this regard. It is important to note, however, that toxic micropollutants are present not only in chlorinated tap water, but also in bottled mineral waters. Chlorination by-products are detected in drinking waters, while in mineral waters originating from deep strata, aromatic substances, e.g. BTEX, can be detected (IARC 1991; Varga 2010). Another hazard concerns the bottling process. Effects of water consumed in situ, at the spring may differ significantly from those of stored, bottled water. During storage, essential substances may be precipitated upon changes in temperature and/or photochemical reactions. Other components, e.g. phthalates, may be leached from packaging materials. Such leaching can be very intensive when the bottled water is aggressive or has higher concentration of carbon-dioxide (Varga 2009). In ozonated bottled waters, aldehydes and ketones could be produced from organic precursors (Varga 1991).

Conclusion

In summary, balneoprevention may become a newly (re)discovered, popular tool in the armament of prevention. In other words, it is rather a renaissance of an ancient culture. Several countries have their own excellent facilities in this field but they should also be made available to the average or high-risk population in order to achieve measurable public health benefits. This field of prevention needs a massive change of approach and attitude, e.g. use of alternate methods such as home cures based on concentrates of spa waters, to meet the needs of the twenty-first century. Creating a new, exact balneology also requires research on preventive measures involving epidemiological as well as analytical and toxicological methods.

Acknowledgements This work was supported by the Faculty of Medicine (No. 34039), University of Pécs, Hungary.

References

Bohmer H, Müller H, Resch KL (2000) Calcium supplementation with calcium-rich mineral waters: a systematic review and meta-analysis of its bioavailability. Osteoporos Int 11(11):938–943

DiGioia ML, Leggio A, LePera A, Liguori A, Perri A (2006) Occurrence of organic compounds in the thermal sulphurous waters of Calabria, Italy. Chromatographia 63:585–590

Gerencsér G, Szendi K, Murányi E, Varga C (2010) Ecotoxicological studies on Hungarian peloids (medicinal muds) Appl Clay Sci 50:47–50. doi:10.1016/j.clay.2010.06.022

Gonzales-Barreiro C, Cancho-Grande B, Araujo-Nespereira P, Cid-Fernández JA, Simal-Gándara J (2009) Occurrence of soluble organic compounds in thermal waters by ion trap mass detection. Chemosphere 75:34–47

IARC (1991) Monographs on the Evaluation of Carcinogenic Risks to Humans. 52 Chlorinated drinking water. IARC, Lyon, pp 1–359

Pérez-Granados AM, Navas-Carretero S, Schoppen S, Vaquero MP (2009) Reduction in cardiovascular risk by sodium-bicarbonated mineral water in moderately hypercholesterolemic young adults. J Nutr Biochem 21:948–953. doi:10.1016/j.jnutbio.2009.07.010

Pittler MH, Karagülle MZ, Karagülle M, Ernst E (2006) Spa therapy and balneotherapy for treating low back pain: meta-analysis of randomized trials. Rheumatol Oxf 45(7):880–884

Rodgers AL (1997) Effect of mineral water containing calcium and magnesium on calcium oxalate urolithiasis risk factors. Urol Int 58(2):93–99

Schulhof Ö (1976) Balneotherapia. In: Bozsóky S, Irányi J (eds) Physiotherapia. Medicina, Budapest, pp 225–259

Szendi K, Murányi E, Gerencsér G, Varga C (2009) Genotoxicity studies on Hungarian peloids using Ames test and comet assay. FEMTEC 62:74–75

Vaccarezza M, Vitale M. Crenotherapy: a neglected resource for human health now re-emerging on sound scientific concepts. Int J Biometeorol 54:491–493. doi:10.1007/s00484-010-0311-7

Varga C (1991) Genotoxicologic evaluation of ozonated/chlorinated drinking water: cytogenetic effects of XAD-fractions on cultured human cells. Environ Toxicol Chem 10:1029–1035

Varga C (2006) On the scientific bases of balneology. Lege Artis Med 16:391–392

Varga C (2009) www.pote.hu/pubhealth Bottled waters. Lecture5, Credit course on Mineral and Spa Waters/Balneology, Faculty of Medicine, University of Pécs

Varga C (2010) Problems with classification of spa waters used in balneology. Health 2(11). in press

Varga C, Domahidi J (2009) Preventive chemical and toxicological investigations of medicinal waters and muds in Hungary and Transylvania. Hung Epidemiol 7(1):S113–114

Varga C, Pocsai Z, Kertai P (1995) Genotoxicity studies on urine and bone marrow samples of rats bearing transplanted nephroma. Mutagenesis 10:253–255

Varga C, Horváth G, Timbrell V (1999) On the mechanism of cogenotoxic action between ingested amphibole asbestos fibres and benzo(a)pyrene: II. Tissue specificity studies using comet assay. Cancer Lett 139:173–176

Verhagen A, Bierma-Zeinstra S, Lambeck J, Cardoso JR, de Bie R, Boers M, de Vet HC (2008) Balneotherapy for osteoarthritis. A cochrane review. J Rheumatol 35(6):1118–1123

WHO (2009) http://www.who.int/nutrition/topics/5_population_nutrient/en/

Worwood M, Evans WD, Villis RJ, Burnett AK (1996) Iron absorption from a natural mineral water (Spatone Iron-Plus). Clin Lab Haematol 18(1):23–27