Proceedings World Geothermal Congress 2005
Antalya, Turkey, 24-29 April 2005

The Geothermal Waters of Oradea – A Cardiovascular Approach

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Keywords: geothermal, cardiovascular rehabilitation

ABSTRACT

It is known that geothermal waters from Felix Spa have been used for decades in cardiovascular rehabilitation based on thermal, mechanical and chemical factors.

The chemical composition of geothermal waters from Oradea is quite similar to geothermal waters from Felix Spa.

We studied the possibilities to use these waters for long-term treatment of cardiovascular patients, not only because of the water's thermal factor, but also for its chemical composition.

This will allow us to use low temperature waters, which result from industrial use.

1. INTRODUCTION

The history of thermal spas in Romania, mostly those from Oradea neighborhood is very impressive. The first historical documentation about utilization in therapeutically meanings of this water is from XIII century. Eight hundred years later, modern science is still trying to explain how these waters exercise their amazing effects on human body.

Contemporary medicine frequently contradicted these waters' efficacy. Some believe that radioactivity and high temperature of these waters should prohibit their utilization in medical rehabilitation, especially on patients with cardiovascular diseases.

Our purpose is to demonstrate the efficacy of these waters in medical rehabilitation of patients with cardiovascular diseases. We intend to do this by correlating the biochemical composition of geothermal waters from Oradea with the physiopathology of cardiovascular diseases. We also compared the chemical composition of Oradea thermal waters with the thermal waters from Felix Spa, which, as we already know, is very useful in medical rehabilitation. In addition, the aim of our article is to evaluate the possibility and the necessity to build medical rehabilitation clinics for cardiovascular patients.

Our intention is not to transform the thermal water in a universal panacea, but there exist illnesses for which thermal water may contribute in their rehabilitation or may ameliorate chronic disease evolution.

2. PHYSIOPATHOLOGICAL ASPECTS

The medical effect of thermal waters is demonstrated by three factors: thermal factor, mechanical factor and chemical factor.

2.1 The thermal factor

The thermal factor is useful for patients with high blood pressure on which the thermal water have the following effects:

- decreased the diastolic blood pressure at 55-60 mm Hg;
- decreased the systolic blood pressure by 10-20 mm Hg;
- decreased the peripheral resistance of the vessels through vasodilatation as well as blood fluidization thus reducing the friction forces.
- increased the speed of blood flow in blood vessels.

Waters with temperature of 37^{o}C are used for all patients with high blood pressure without any complications, whereas warm waters with temperature of 38-39^{o}C are useful only for patients with border blood pressure, moderate-high blood pressure, oscillating blood pressure, or for young patients.

The thermal factor has a beneficial effect in rebalancing the nervous system, which is the regulatory factor for cardiovascular system.

The thermal factor also increases the cardiac frequency and cardiac output. At temperatures around 37^{o}C, the cardiac supply of oxygen is increased by 10%, which is insignificant considering the benefits of thermal waters.

2.2 The mechanical factor.

The mechanical factor is useful in medical rehabilitation for diseases that make physical exercise difficult for patients, this helps since it's already known that the effort necessary for exercise is considerably low in the water. The waters with lowest temperature, which doesn't have the thermal factor and thus, eliminates the supplementary needs for oxygen of heart, make exercises possible on patients in the early stages of rehabilitation or in advanced stages of diseases. Also, on patients with peripheral vessel diseases, the mechanical factor improves the return of the blood to the heart, which ameliorates the evolution of illnesses.

Theoretically, the Pascal's principle favors the return of the blood to the heart; the push-up force according to the Archimedes' Law makes the effort necessary for exercises lesser.

Most patients with cardiovascular diseases are obese, and physical exercise under water makes starting the practice easier and can lead patients to a more compliable attitude for treatment.

2.3 The chemical factor.

While mechanical and thermal factors are not specific for for Oradea thermal waters in particular, the chemical properties differentiate the thermal waters and give them specific curative abilities.

The chemical factor exercises its effect on medical rehabilitation via a transmineralization process of ionic substances, through the skin. The presence of radioactive radon in thermal waters accelerates this transmineralization process.

The mineral substances from thermal water are very important in cardiovascular rehabilitation, these are as follows:

- Ca^{2+} contributes to maintain vessel walls' tonicity, and helps with regulation of cardiac electric activity;
- Mg^{2+} is a key component of our nervous autonomic system which controls the cardiac activity and vascular tonus;
- Sulfate ion is recently proved very important for the rehabilitation of patients with peripheral vessel diseases. Measurement of blood flow (by Doppler method), before and after external cure in pools with sulfurous water, shows an amazing improvement on it.
- K^+ has two major roles in cardiovascular system. First, K^+ stabilizes cardiac muscle membrane, protecting heart from arrhythmia and from possible toxic effects of some drugs. Its second function, which is not directly involved in the regulation of cardiovascular system, is that high concentration of K^+ in thermal waters allows an exchange through the skin of K^+ for the Na^+ ions. High concentration of Na^+ ions in the body is needed for the body to retain water. Increasing Na^+ concentration in blood is the compensatory mechanism during heart failure episodes, this occurs during the chronic evolution of any cardiac disease. K^+ helps heart to maintain normal values of cardiac outflow, but on the other hand, it increases heart travail and leads to water accumulation on extravascular compartment (edema) and creates a vicious cycle. Decreasing of Na^+ concentration in blood, and water elimination from the body are the major objectives in heart failure treatment.
- Li ion also has an important role in autonomic nervous system and psychical mood rebalancing. We do not know precisely, today, how Li ions works, but it is very important in treatment of anxiety generated by cardiovascular diseases (a major source of anxiety).

The medical applications of mineral and thermal waters in cardiovascular rehabilitation are as follows:

- chronic ischemic heart disease, (except major coronary events and acute myocardial infarction which benefits more from intensive, emergency, cardiological treatment);
- high blood pressure in low, medium, oscillatory forms and mostly on that which occur on young patients;
- peripheral vessel diseases: venous peripheral insufficiency and ischemic artheriopathy in initial phases;
- arrhythmia caused by autonomic nervous system dysfunction. (Zdrenghea, 1995)

The geothermal water has effects on metabolism in human body. This is due to alphatherapy, which is brought about by radioactive Radon from thermal waters. Radon is gaseous, dissolved in thermal waters, and absorbed trough skin or by respiration to the lung and eliminated only by respiration. Its disintegration time is about three hours, which avoids radioactive accumulation in the human body, which may lead to some negative effects for long-term treatment. (Rosca and Farcas, 1993)

Therefore, treatment with thermal waters also allows amelioration of some metabolic illnesses, which are major risk factors for cardiovascular diseases:

- Amelioration of diabetes mellitus that will lead to patients' glycemic values getting closer to the normal range. High values of glycemia destroy small and very small vessels that assure the nutrition of nerves, and this leads to diabetic neuropathy. Additionally, high glycemic values contribute to obstruction of small vessels of the heart, kidney and retina, the target organs of diabetes mellitus. Diabetes mellitus has these devastating effects because the high glycemic values accelerate atherosclerosis of the small vessels and deposition of some pathological substances in the target organs.
- Amelioration of purins' metabolism: increases the elimination of uric acid and prevent gout arthropathy;
- Amelioration of lipids metabolism: decreases cholesterol fractions that causes atherogenesis and increase fractions of those with protector effects. The process that leads to atherogenesis is still subject of controversies in these days. We only know for certain that high values of some cholesterol fractions (LDL-low density lipoprotein and VLDL-very low density lipoprotein) lead to atherosclerotic plaque. Whereas another fraction of cholesterol (HDL-high density lipoprotein) offer certain protection against atherogenesis.
- Rebalances autonomic nervous system and neurohormonal axis dysfunction, improving cardiovascular control. (L. Lazar, Dorina Farcas, 1999)

All disorders mentioned above, along with obesity are part of X metabolic syndrome. This is the major risk factor for cardiovascular diseases and is the consequence of smoking, sedentarism, alcohol consumption and inappropriate diet. Unfortunately, X metabolic syndrome is so frequent in our days that we consider it almost normal.

2. CHEMICAL PROPERTIES OF ORADEA THERMAL WATERS.

2.1 Comparison between Felix Spa thermal waters and Oradea thermal waters

The qualities of geothermal waters from Felix Spa are well known and appreciated. These waters have been analyzed from a chemical point of view and medical applications have been found using them. Felix Spa is recognized today for treatments applied to locomotor system illness, and it is the number one, at least in Romania, for tetraplegic and paraplegic patients rehabilitation. These waters were less utilized in cardiovascular rehabilitation.

The geothermal waters from Oradea were less evaluated from a medical perspective. We have information about the chemical composition and radioactivity of these waters.

Table 1 illustrates the chemical composition of thermal waters from Felix Spa and Oradea. We included here all the eight wells from Felix Spa used in present and eight out of eleven wells used in Oradea. We excluded three wells from Oradea, because two of them are already used as recreational pools and the other one is impossible to use for medical purposes because of its location.

The mineralization of the waters from Oradea wells is obviously higher then that of Felix Spa waters. Concentration of Ca^{2+}, Mg^{2+} and sulfate ions is also higher in Oradea waters. Concentration of Na^{+} ions is basically the same, even lower in some Oradea's wells. Although we can not clearly illustrate the comparison among K^{+} and Li ions in these two locations, our sources specified that the concentrations of these ions are substantially higher in Oradea waters.

The thermal waters from Felix Spa are classified as low mineralized waters with mineral concentration under 1 mg/L, and are framed as highly bicarbonate, low sulfurous, highly calcic and low magnesian waters. On the other hand, Oradea's waters have higher mineralization that is above 1 mg/L, and these waters are classified as highly sulfurous, highly calcic, medium magnesian and low bicarbonate.

Comparing the chemical properties between Felix Spa waters and Oradea waters and considering the physiopathology of the cardiovascular diseases described above, it is obvious that thermal waters from Oradea's wells are suitable for medical rehabilitation of cardiovascular patients, just like Felix Spa waters.

Table 1. Chemical properties of Felix Spa and Oradea thermal waters.

Felix Spa wells (C. Anghelopol, 1984)

Well	Mineralization Mg/L	Cl^{-} Mg/L	HCO_3^{-} Mg/L	SO_4^{2-} Mg/L	Na^{+} Mg/L	Ca^{2+} Mg/L	Mg^{2+} Mg/L
412	643.34	3.5	370.8	51.4	76.8	42.8	20.6
402	792.54	8.9	464	102	15.4	142.6	22.7
4011	803.46	5.3	370.8	171.8	51.7	115.9	22.1
4003	809.34	8.9	417.2	187.7	45.1	120.9	21.3
4087	813.55	10.6	440.4	136.2	51.8	126.6	19.2
Felix Spring	953.85	3.6	417.2	255.1	66.2	149.8	23.2
Balint Spring	978.25	7.1	405.7	251.7	55.3	147.2	26.9
Breiner Spring	986.7	7.1	405.7	265.1	49.9	151.9	28.6

Oradea wells (Albu, 1985)

Well	Mineralization Mg/L	Cl^{-} Mg/L	HCO_3^{-} Mg/L	SO_4^{2-} Mg/L	Na^{+} Mg/L	Ca^{2+} Mg/L	Mg^{2+} Mg/L
4797	1048	10.5	200.5	515.3	45	191.6	26.9
4006	1109	24.2	231.4	571.5	30	223.5	43.3
4795	1182	39.4	258.6	508.4	100	194.2	25.1
1716	1188	36.8	196.8	584.2	45	201.6	47.9
1717	1210	22.2	300.1	507.3	75	210.1	28.1
4796	1246	26.6	198.1	651.4	29.5	229.9	47.1
4005	1313.7	15.8	203.3	692.5	30	234.7	64.3
4081	1383	14.2	144.3	823.8	18	250.4	73.2

Regarding radioactivity of the waters, the Felix Spa water have a radioactivity around 10^{-12} mg Radium and 16.5 nCi/L Radon. Therefore, it can not be classified as radioactive water because the threshold concentration to be classified as highly radioactive is 10^{-8} mg Radium and 18 nCi/L Radon. (A. Szabo, 1987)

Although the Oradea's thermal water has a higher concentration of Radon, around 26.5 nCi/L, studies demonstrates that these values are not toxic for human body, unless the water is used for drinking or cooking for a long time. It was also demonstrated that, at this concentration, Radon is more effective for the transmineralization process through the skin. (Dinca et al, 1980)

2.2 Review about thermal waters of Oradea

We have to mention that right now, there were exploited wells from the west and south of the Oradea, but these are all for industrial purposes.

The two swimming pools supplied with thermal water are only for recreational purposes and there are no possibilities for medical rehabilitation with these.

Among thermal waters of Oradea, those with highest mineralization is observed on the south of the perimeter. Unfortunately, in this place, there was no issue about medical utilization of these waters, which in turn are used only for heating houses. Wells from the east of the city have water with a lower concentration of mineral substances than wells from south and west.

In the table above, we can observe the well 4081 from Oradea, presently used for industrial purposes. This water have a ph close to that of human body, 7.4, a mineral concentration of 1383 mg/L, Ca^{2+} concentration of 250 mg/l, Mg^{2+} concentration of 73.2 mg/L, sulfates ions concentration 823.8 mg/L and Na^{+} concentration of 18 mg/L. The proportion of ion concentrations in this water makes it perfect for therapeutic use.

3. SOCIAL AND MEDICAL ISSUES

Regarding medical assistance, we do not intend to argue the necessity to build a new spa 14 kilometers far from Felix Spa, which already have a tourist and rehabilitation potential that are absolutely remarkable.

This study attempts to show the possibility of establishing cardiovascular rehabilitation clinics in the city of Oradea, where we already have thermal wells which are used nowadays only for heating houses.

The low temperatures required for rehabilitation of patients with chronic cardiovascular diseases (maximum 35-38^{o}C), allow reutilization of thermal waters initially used in industrial proposes.

Statistics from developed countries shows the cardiovascular diseases are on the second place with regard to cause of morbidity and mortality, after neoplasias. This is in general for population aged between 45-65 years. For men on the same age bracket, cardiovascular disease is on the first place.

In Romania, cardiovascular disease is on the first place for population aged 40-65 years. This group of population, between 40 and 65 years, is considered as economically active.

Cardiovascular diseases treatment is not an expensive, exclusive treatment, and is accessible for all patients from all socio-economic status. This treatment, although can not be regarded as a single definite cure for patients, is still beneficial if it is corroborated with an appropriate diet, and a rehabilitation plan after the remission of acute phase of the disease. This is different from the neoplasias treatment, which may be sometimes very expensive and allows social reintegration of financially able patients.

There is a high incidence of cardiovascular diseases, which limits physical effort and leads to social deintegration and psychical disturbances. At the same time, there are not much cardiovascular rehabilitation clinics in proportional to the high incidence of these diseases. These are arguments for the necessity to establish cardiovascular rehabilitation clinics.

These clinics may permit the rehabilitation of patients with thefollowing cardiovascular illnesses:

- chronic cardiopathy in all stable forms;
- after myocardial infarction;
- high blood pressure;
- peripheral circulatory system illness.(Zdrenghea, 1995)

The benefits of thermal waters on rebalancing of autonomic nervous system may help in the rehabilitation of patients with arrhythmia caused by autonomic nervous system disturbances.

Prevention goals in medicine are to promote health, preserve health, restore health when it is impaired, and minimize suffering and stress. The medicine considers three types of prevention (or prophylaxis) as follows:

- primary prevention is the promotion of health at both individual and community levels by facilitating health enhancing behaviors, preventing of onset of risk behaviors, and diminishing exposure to environmental hazards;
- Secondary prevention is the screening for risk factors and early detection of asymptomatic or mild disease, permitting timely treatment and effective intervention and curative treatment;
- Tertiary prevention is the reduction of long term impairments and disabilities and prevention of repeated episodes of clinical illness. The goals of tertiary prevention are to prevent recurrence and to slow progression. (Zdrenghea, 1995)

Medical rehabilitation is a part of tertiary prevention. Therefore, presence and use of geothermal waters in rehabilitation clinics do not have the goal of totally curing the patients. Its objective is to help in recuperation of the patients' capacity and become economically and socially reintegrated.

Unfortunately, Romanian health and insurance system, which is practically governmental, doesn't permit, at least for the moment, such objectives.

4. CONCLUSIONS:

The geothermal waters of Oradea have the physical and chemical properties necessary for the use of this waters for medical proposes, specifically for cardiovascular rehabilitation.

The high incidence of cardiovascular diseases and the absence of a real tertiary preventing program, leads to an imperative need for cardiovascular rehabilitation clinics, which will help on the economical and social rehabilitation of cardiovascular patients.

In rehabilitation of cardiovascular patients, thermal water at relatively low temperature may be used, which can be thermal water that results after industrial use (heating houses).

According to these three conclusions we may say that the presence of geothermal wells in Oradea, the possibility to use relatively cold water resulting from industrial heating process, and the necessity of cardiovascular rehabilitation clinics, lead to new possibilities in reutilization of thermal waters according to medical needs in our city.

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