

Hydrobalneological methods in modern medical treatment

Metody hydrobalneologiczne we współczesnym leczeniu

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Studia Medyczne 2015; 31 (1): 1–5

DOI: 10.5114/ms.2015.49945

Key words: hydrobalneological methods, treatment.

Słowa kluczowe: metody hydrobalneologiczne, leczenie.

Abstract

Introduction: Therapeutic methods combining balneology and hydrotherapy have been used in treatment and prevention for a long time. Their influence on the skin, based on mechanical, thermal, and hydrostatic stimuli, results in a reaction of the internal organs as well as the whole body. The most important effects of such procedures are changes within the cardiovascular system.

Aim of the research: The use of hydrobalneological methods in modern medical treatment.

Material and methods: The analysis focused on the influence of water jets at alternating temperatures in the treatment of functional cardiovascular disturbances with the use of non-invasive methods of autonomic nervous system function work-up based on the analysis of heart rate variability. The effect of the jets on heart rate and blood pressure was observed in 50 patients with first-degree hypertension, which was accompanied by radioelectrocardiographic (RECG) assessment of the influence of underwater massage and carbonic acid baths on the cardiovascular system in patients undergoing these procedures due to Da Costa's syndrome.

Results: Water jets at alternating temperatures successfully modulate the tension within the autonomic nervous system and stimulate its parasympathetic part. Underwater massage is a gentle procedure and does not cause significant changes in heart rate and RECG tracing. Carbonic acid baths decrease autonomic nervous system excitability.

Conclusions: The study results show a possibility of regulating autonomic nervous system function with the use of selected balneological and hydrotherapeutic methods, and thus influencing the functional level of the human body which is most appropriate for the requirements created by the internal and external environment of the body.

Streszczenie

Wprowadzenie: Metody hydrobalneologiczne są stosowane w leczeniu i profilaktyce od dawna. Wykorzystuje się ich bodźcowe, tj. mechaniczne, termiczne i hydrostatyczne, oddziaływanie na skórę, wyzwalające odczyn w narządach wewnętrznych i reakcje całego organizmu. Organizm poddany tym zabiegom reaguje przede wszystkim zmianami w układzie krążenia.

Cel pracy: Zastosowanie metod hydrobalneologicznych we współczesnej medycynie.

Materiał i metody: Analizie poddano wpływ natrysków zmiennocieplnych w leczeniu zaburzeń czynnościowych układu krążenia przy wykorzystaniu nieinwazyjnych metod diagnostyki funkcji autonomicznego układu nerwowego na podstawie analizy zmienności rytmu zatokowego. Obserwowano wpływ natrysków na czynność serca i ciśnienie tętnicze u 50 chorych z nadciśnieniem tętniczym pierwszego stopnia. Przeprowadzono również za pomocą oceny radioelektrokardiograficznej badanie wpływu masażu podwodnego i kąpeli kwasowęglowej na stan układu krążenia u chorych korzystających z tych zabiegów z powodu dystonii neurovegetatywnej.

Wyniki: Natryski zmiennocieplne doskonale modulują stan napięcia w obrębie autonomicznego układu nerwowego i powodują zwiększenie napięcia jego części przywspółczulnej. Masaż podwodny jest zabiegiem łagodnym i nie powoduje istotnych zmian w czynności serca i zapisie radioelektrokardiograficznym. Kąpiel kwasowęglowa obniża pobudliwość autonomicznego układu nerwowego.

Wnioski: Możliwa jest regulacja czynności autonomicznego układu nerwowego z zastosowaniem wybranych metod hydrobalneologicznych i oddziaływanie w ten sposób na poziom czynnościowy organizmu, tak aby był on najbardziej odpowiedni dla wymagań stawianych przez środowisko wewnętrzne i zewnętrzne.

Introduction

Therapeutic methods combining balneology and hydrotherapy have been used in treatment and prevention for a long time. Hippocrates recommended the therapeutic use of water as early as in the 4th century BC. Josephus Struthius, a personal doctor of Polish king Sigismund II Augustus, greatly supported these methods of treatment. In 1578, Wojciech Ocellus published a treatise titled "Cieplice", presenting bath recipes as well as first indications and contraindications for their use. In the 19th century, the development of hydrotherapy was significantly influenced by the observations of Priessnitz and the scientific studies of Winternitz. In Poland, these methods were developed further thanks to J. Dietl, M. Zieleniewski, L. Korczynski, and A. Glinski. These scientists set up the Polish Balneological Society in 1905 in Cracow, and Professor Ludomil Korczynski, a Jagiellonian University rector, became its first president. The Society conducted studies on the use of combined hydrotherapeutic and balneological methods. The results were published in the Society's scientific journal "Acta Balneologica".

In the 20th century, the methods of hydrotherapeutic and balneological treatment were further developed thanks to Dr Jan Zniniewicz and Professor Józef Jankowiak. The development of research methods in the second half of the 20th century allowed specialists to partially explain the mechanism of action of the treatment on the human body. The use of half-sitting warm water baths recommended by Sebastian Kneipp

in patients with symptoms of angina turned out to be scientifically justified. The baths cause increased secretion of the atrial natriuretic peptide, which has a vasodilatory effect [1, 2].

Hydrotherapeutic and balneological procedures result mainly in changes in blood circulation. Studies on the influence of these procedures on the autonomic nervous system have been conducted for a long time, but it was the technological advances of the second half of the 20th century that allowed scientists to create diagnostic methods assessing their influence on the human body [1, 3–5].

Aim of the research

The use of hydrobalneological methods in modern medical treatment.

Material and methods

Studies conducted at the Department of Rehabilitation with the Division of Physical Medicine (Military Medical Institute) on the influence of selected hydrotherapeutic and balneological methods on the human body showed a positive influence of water jets of alternating temperatures in the treatment of functional disturbances of the cardiovascular system.

Water jets

The analysis focused on the influence of water jets at alternating temperatures in the treatment of functional cardiovascular disturbances with the use of non-invasive methods of autonomic nervous system function work-up based on the analysis of heart rate variability (HRV). The effect of the jets on heart rate and blood pressure was observed in 50 patients with first-degree hypertension, which was accompanied by radioelectrocardiographic assessment of the influence of underwater massage and carbonic acid baths on the cardiovascular system in patients undergoing these procedures due to Da Costa's syndrome.

The use of non-invasive diagnostic methods of assessment of autonomic nervous system function, including an analysis of HRV, revealed a statistically significant increase in the HF, r-MSSD, and pNN50 indices after a series of procedures, indicating increased activity of the parasympathetic part of the autonomic nervous system.

Results

The procedures resulted in increased HF and HRV. Blood pressures in the patients presented in Figure 1.

Before the procedures, the mean blood pressure in the study group was 160–180 ±10 mm Hg and the diastolic pressure was 105–115 mm Hg. After 15 treatment sessions, the respective values were 145 ±10 mm Hg and 85 ±9 mm Hg.

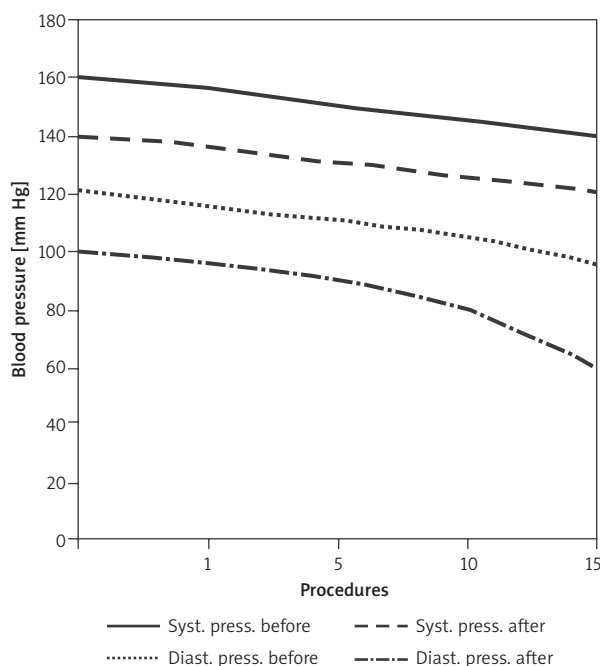


Figure 1. Blood pressures before and after procedures

Zung anxiety level assessment revealed increased anxiety in all the patients before treatment and a significant decrease in the scores after treatment with water jets of alternating temperatures, which confirms that they have a very positive influence on the psychosomatic status.

Water jets of alternating temperatures are useful in modulating the activity within the autonomic nervous system and increase its parasympathetic activity.

Main indications for their use: functional disturbances of the cardiovascular system, hypertension (stage I/II), Da Costa's syndrome, mental and physical exhaustion, biological regeneration.

Underwater massage

This is conducted in special bathtubs with regulated pressure and temperature of the water used in the procedure, which is taken from the bathtub in which the patient is lying. Underwater massage causes muscle relaxation, tissue hyperaemia, and increased lymphatic drainage.

Studies conducted at the Department of Rehabilitation with the Division of Physical Medicine (MMI), consisting of continuous radioelectrocardiographic monitoring of the blood pressure and heart rate before the procedure, during the procedure, and over 15 min after the procedure, have revealed that underwater massage is gentle and does not cause significant changes in heart rate, results in a mild blood pressure decrease (systolic and diastolic), and does not cause significant changes in the ECG tracing.

Main indications: muscle atrophies due to disuse (after long-term immobilisation), fatigue after intensive muscle effort, pareses, spastic paralyses, selected neurological disorders, biological regeneration programme.

Hydro-electric baths

These are conducted in special bathtubs made of insulating material or organic glass. The procedures take place in a water environment and have a very strong stimulating influence on the human body, using the following: galvanic currents, mechanical stimuli connected with hydrostatic pressure, thermal stimuli connected with water temperature, chemical stimuli of therapeutic waters.

Eight electrodes built into the bathtub walls allow the current to flow through the patient's body in several dozen directions.

Indications

Indications: circulation disturbances, including Raynaud's disease, selected neurological disorders: neuralgia, polyneuropathies, radicular syndromes, pareses, selected rheumatic diseases: osteoarthritis, ankylosing spondylitis, rheumatoid arthritis, arthropathies,

osteoporosis, delayed bone union, post-traumatic conditions, muscle strain and psychosomatic exhaustion, biological regeneration programmes in athletes.

Hydro-electric baths should be applied according to the indications specified by a doctor and conducted under strict control.

Carbonic acid baths

These may be conducted with the use of natural waters – acidulous mineral waters with natural carbon dioxide or prepared by saturating water with carbon dioxide. Their chemical effects are connected with CO₂ penetrating the skin and mucous membranes and depend on the amount of carbon dioxide dissolved in the water. Having a chemical effect on the thermal receptors in the skin, carbon dioxide decreases the threshold of the excitability of warm receptors and increases that of cold receptors. This leads to a decrease in the subjective “neutral” temperature of the carbonic acid water to 32–34°C.

Its direct influence on capillaries and indirect effects through histamine and acetylcholine cause capillary and arterial dilation in the skin. The baths increase the number of active capillaries; the blood supply to the skin increases several times. Carbonic acid baths cause an increase in the stroke volume and cardiac output; the latter increases by 30–50%. Coronary blood flow is intensified, and there is an increase in diuresis as well as sodium and potassium excretion with simultaneous decreased activity of renin and aldosterone in the plasma. Carbonic acid baths decrease the excitability of the autonomic nervous system. The influence on the metabolism is reflected by decreased plasma lactic acid and α -ketoglutaric acid levels, decreased cholesterol and glucose levels, decreased glycolysis, and increased glycogenesis.

Main indications for the use of carbonic acid baths: hypertension (stage I/II according to WHO), functional disturbances of arterial circulation, Raynaud's disease, disturbances of capillary and venous circulation, Da Costa's syndrome, narrowing inflammation of the vessels, polyneuropathies, scleroderma, complex regional pain syndrome.

Case report

A 55-year-old male patient had aortobifemoral bypass due to obliterating arterial sclerosis of lower limbs and Leriche's syndrome. The surgery was complicated by an embolism in the peripheral arteries of the right lower limb. The patient underwent embolectomy of the right femoral artery and foot arch with thrombus removal from the anterior and posterior tibial artery with open fasciotomy. There was right peroneal nerve palsy in the postoperative period. Between 1 August and 12 September 2010, the patient stayed at the Department of Rehabilitation of the MMI, where a clini-



Figure 2 A–B. Status before treatment

cal examination revealed the following: swollen right shin and foot, tense skin, bruising in the distal part of the foot, dry gangrene of the toes, paresis of the peroneal muscles, trace of dorsiflexion and plantar flexion of the foot, weak pulse on the dorsal artery of the foot, weakened superficial sensation, hyperaesthesia on the external surface of the foot, weak Achilles reflex, a wound after fasciotomy with exudate permeating to the dressing on the lateral side of the shin, and flexion contracture in the right knee – an approx. 10-degree extension deficit (Figures 2 A, B).

The physical therapy and rehabilitation conducted at the Department of Rehabilitation included: laser therapy, electrical stimulation, low frequency alternating magnetic fields, and proprioceptive neuromuscular facilitation (PNF) exercises, achieving partial improvement of blood supply and warmth of the foot. The necrotic lesions within the toes decreased.

After being discharged from the Department, the patient continued the programme of physical therapy and rehabilitation at the Day Care Rehabilitation Unit.

The physical therapy included: whirlpool massage of lower limbs, carbonic acid baths, lidocaine and calcium iontophoresis, low frequency alternating magnetic fields, laser therapy, and extended kinesiotherapy.



Figure 3. Status after treatment

We observed a dramatic effect of carbonic acid baths on the improvement of blood supply to the limb (Figure 3).

The patient ambulates freely, unassisted, the limbs are symmetrically and equally supplied with blood, necrotic lesions within the foot have resolved, and muscle strength and limb function are equal and symmetrical.

Accessory investigations: computed tomography (CT) angiography of lower limb arteries (9 June 2011) revealed status post implantation of aortobifemoral bypass. The graft was patent and the distal connection was widened to 19 mm on the right and 16 mm on the left.

On the right, the deep femoral artery and the end section of the common femoral artery were patent. The superficial femoral artery, popliteal artery, anterior tibial artery, peroneal artery, and posterior tibial artery were patent.

Discussion

Hydrotherapeutic and balneological procedures are used due to their multi-directional stimulating influence on the body, i.e. mechanical, thermal, and hydrostatic influence of water on the skin, which results in further responses of the body. The stimulation of skin receptors causes a reaction of skin blood vessels and influences the entire body by abdominal reflexes, leading to a reaction in the internal organs. Acting on large areas of skin, they cause the vessels in the chest and abdominal cavity to react in the opposite way to the skin vessels [1–3, 5].

The skin, with its receptors, a double artery system, and arteriovenous communication, is an appropriate area for the influence of thermal and mechanical stimuli. Thermal stimuli cause vasodilation in the skin, open inactive capillaries, and lead to secondary changes in the volume of blood circulating in various organs. Warm baths decrease blood pressure, accelerate breathing, and increase lung ventilation and renal secretion [1, 5, 6].

Cold baths influence the neuroendocrine system, causing increased corticosteroid, 17-ketosteroid, thyrotropic hormone (THS), and thyroxine secretion. Cold activates the adrenergic system and increases metabolism. Alternating temperatures increase local release of noradrenalin, 5-hydroxytryptamine, acetylcholine, and histamine in the skin, which influences vital organs. Hydrotherapeutic and balneological procedures also have an effect on the conduction and its velocity in motor and sensory nerve fibres.

The reaction of the body to thermal and hydrodynamic stimuli depends on the condition of the skin and subdermal tissue, body weight, age, gender, and the condition of the autonomic nervous system. Functional antagonism between parts of the autonomic system is visible on the level of innervated organ structures as well as the central nervous system. There is a mutually inhibitory influence of neurons, consisting of the modulation of the release of final mediators in postganglionic sympathetic and parasympathetic neurons. Vagus nerves and acetylcholine released by postganglionic neurons of the parasympathetic system decrease cell excitability. Sympathetic nerves and noradrenalin, which is a mediator in the synapses of postganglionic neurons of the sympathetic system, cause increased cell excitability in the innervated organs. Respiratory neurons regularly change central sympathetic and parasympathetic tone, thus significantly influencing the systems' activity [6–10].

Thermoregulation involves a local and a systemic response. Skin receptor outflow is transmitted by autonomic afferent pathways to the central nervous system. The type of response and its complexity depend on the central nervous system level on which the peripheral signals are integrated. Connections between somatic and autonomic parts of the nervous system on the spinal cord level are the basis for abdominal reflexes. Reflex arcs of somatic autonomic reflexes intertwine, and the stimuli from internal organ receptors reach the same ganglionic neurons that receive signals from the skin receptors.

This study presents the possibilities of regulating the function of the autonomic nervous system under the influence of selected methods of hydrotherapeutic and balneological treatment, thus influencing the functional level of the body, best adjusted to the requirements of the internal and external environment. Our management is aimed at maintaining an appropriate functional level through regulation of the activity of autonomic system parts. As the autonomic nervous system supplies all organs except for skeletal muscles, hydrotherapeutic and balneological methods may greatly influence body functions.

Conclusions

Water jets at alternating temperatures successfully modulate the tension within the autonomic ner-

vous system and stimulate its parasympathetic part. Underwater massage is a gentle procedure and does not cause significant changes in heart rate and radioelectrography (RECG) tracing. Carbonic acid baths decrease autonomic nervous system excitability. The study results show a possibility of regulating autonomic nervous system function with the use of selected balneological and hydrotherapeutic methods, thus influencing the functional level of the body, which is most appropriate for the requirements created by the internal and external environment.

Conflict of interest

The authors declare no conflict of interest.

References

1. Kuliński W. Kontrola radioelektrokardiograficzna niektórych zabiegów hydro-balneologicznych. Praca doktorska CKP WAM, Warsaw 1977.
2. Kuliński W. Ocena wykorzystania zabiegów hydroterapeutycznych w leczeniu zaburzeń czynnościowych układu krążenia. *Post Rehab* 1997; 11: 51-7.
3. Budd GM, Brotherhood JR, Beasley FA. Effect of acclimatization to cold baths on men's response to whole-body cooling in air. *Eur J Appl Physiol Occup Physiol* 1999; 67: 438-49.
4. Gillman H. *Physikalische Therapie*. G Thieme Verl, Stuttgart 1975.
5. Kuliński W, Mróz J. Wykorzystanie metod hydro-balneologicznych w procesie rehabilitacji kardiologicznej. *Baln Pol* 1996; 38: 77-81.
6. Sorokina EJ, Jachmenev NV, Goncharova OJ. The effect of contrast baths on physical work capacity and autonomic regulation in hypertension patients. *Vopr Kurortol Fizioter Lech Fiz Kult* 1994; 5: 4-7.
7. Floras JS. Clinical aspects of sympathetic activation and parasympathetic withdrawal in heart failure. *J Am Coll Cardiol* 1993; 22: 72A-84A.
8. Pomeranz B, Macanlay RJB, Candill MA. Assessment of autonomic function in humans by heart rate spectral analysis. *Am J Physiol* 1985; 248: H151-3.
9. Straburzynska-Lupa A, Straburzyński G. *Fizjoterapia z elementami klinicznymi*. PZWL, Warsaw 2008.
10. Winslow EM, Smith J. Effects of basin baths, tub baths and showers on cardiovascular responses in 51 health men and women. *Cardiovasc Nurs* 1991; 27: 25-30.

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