

Investigation of pH variation of blood during peloidotherapy

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Background. The main aim of the study is to evaluate the variation of acid-base balance of human body during peloidotherapy. The secondary objective is balneal safety for the patient suffering of joint degenerative diseases and post-traumatic sequelae of the limbs, undergoing mud therapy. This paper work presents only the results obtained on pH variations. **Materials and methods.** The study plot was composed by forty three patients undergoing mud therapy for rehabilitation in Techirghiol Balneal and Rehabilitation Sanatorium. Daily therapeutic intervention consists in: thermoneutral bath (alternatively mud bath and salt bath), kinetotherapy, massage and electrotherapy. Proofs prelevations (capillary blood) were performed in four moments of the cure: at the beginning of the cure, immediately after first balneal application, at twenty four hours after first application and at the end of the cure of ten balneal application. Blood determinations were made using CCX Nova Biomedical 6 analyser for critical care. Results obtained were interpreted in correlation with the results of VIASAN 317/2004 study upon variations of biochemical composition of mud after therapeutic use. In order to use results of VIASAN study we asked and we received approval from the owner and incumbent of the study, Techirghiol Balneal and Rehabilitation Sanatorium. All patients get to know about the rhythm of blood prelevation and possibility of results publication and they signed the informed consent. Statistic analysis were made with the soft SPSS 12.0 upon which Constanța Ovidius University holds the licence of using. **Results.** Variations of blood pH in the four moments of cure were within physiological limits. They were statistically insignificant with one exception: immediately after first salt bath application pH increased statistic significant but within physiological limits ($p=0.02<0.05$). **Conclusions.** During peloidotherapy the acidity of blood measured through pH, varies within the frame of physiological limits. This variation might be correlated with the variation of mud bath solution's pH after application and possibly with skin's pH variation. Balneal application of mud and salt water of the lake is a safe procedure for patients. In order to establish the possible correlation between three medium implicated in the physiological answer to peloidotherapy, respectively: mud, skin and blood are needed more studies.

Key words: blood pH, acid-base balance, peloidotherapy, thermoneutrality.

Introduction

The normal biological functions of the body imply the keeping of some dynamic parameters in balance such as: body temperature, water distribution, ions quantity and distribution and pH. The last one, defines the body's internal environment acidity and represents the decimal logarithm of the hydrogen ions with the sign changed. The activity of enzymes, membranar channels through which is made the transport of molecules and ions, etc have an optimally function at a specific temperature and a certain pH.

Keeping almost constant the blood pH is achieved through the intervention of buffer systems: the inorganic carbonates, phosphates, hemoglobin, some organic acids. Adjusting the components of these systems is carried out quickly (some minutes) by respiratory mechanism whereby carbon dioxide is removed and by the renal mechanism, which is slower (some hours) whereby the bicarbonate is removed. [(1),(2),(3)]

One of the first studies on acid-base balance in healthy person belongs to American authors N. W. Shock and A. B. Hastings and was

published in the March 1934 issue of the journal „The Journal of Biological Chemistry” (4)
 Currently, most studies on the acid-base balance and fluid - electrolyte are related to post-traumatic, respiratory, renal and / or metabolic disorders. Although significant progress has been made in the study of acid-base balance, in the literature that I had access and I studied it, I didn't found studies to evaluate changes of this important balance parameters for the human body when applied in the external cure of mineral waters and / or mud, although balneotherapy is "disturbing" homeostasis parameters, at least, by:

- Increase skin temperature (due to thermopexic qualities of the mud and salt water used for bathing);
- Changing electrical charges of skin (due to biophysical properties and biochemical composition of the therapeutic environment that acts as an ion exchangers);
- change the pH skin (due to the different pH bath);

In this context I consider that I must study physiological and / or pathophysiological possible changes of the acid-base balance, as a step in the reliance on scientific basis of peloidotherapy (evidence based balneology), as a holistic and integrative medicine. This paper presents the variation of one parameter (pH of the blood) between the twenty-eight parameters determined with the analyzer CCX Nova Biomedical 6.

Materials and methods

Study of acid-base balance variation under the peloidotherapy impact was conducted in autumn season when the climate impact is reduced. I chose the thermoneutral application with minimum disturbance for the body functions. For the Techirghiol sapropelic mud the thermoneutral value is 38⁰C and 37⁰C for the saline water.

In accordance with the methodology approved by National Institute of Rehabilitation, Physical Medicine and Balneology, therapeutic

application consists in alternative use of mud and salt water of the lake. Specific working methodology of Rehabilitation Sanatorium Techirghiol is balneotherapy (peloide bath alternative with salt bath), physical therapy, electrotherapy and masotherapy, prescribed and applied in accordance with the therapeutic targets required by each patient suffering. Daily therapeutic program of patients was achieved in the working diagram of the sanatorium. Thus some patients began therapy with saline bath and other with peloide bath. Due to the alternation of the applications, at the end of the cure all patients accumulate the same number of baths: five salt bath and five mud bath.

In the study group were included forty-three adult patients: twenty-eight women and fifteen men, twenty-four began therapy with peloide bath and nineteen with saline bath. The average age of patients in the study group was 52.27 ± 13.04 years (table 1).

Table I average age of patients by type of the first applications and sex

Parameter	Age
The average age group	52.27 ± 13.04
The average age subgroup inaugural mud bath	54.27 ± 12.27
The average age subgroup inaugural saline bath	51.11 ± 13.40
The average women's age	51.86 ± 11.38
The average men's age	58.40 ± 11.11

Criteria for inclusion in the study group were:

- patients suffering from degenerative rheumatic diseases and with posttraumatic sequelae of limb which had the correct indication of balnear treatment, apparently healthy based on clinical examination and commonly, generally laboratory tests.

Table II PH variation during peloide cure

pH	before the cure (in)	immediately after the first application (im)	at 24 hours after the first application (24)	at the end of the cure (fin)
average group±DS	7.40±0.03	7.42±0.04	7.40±0.03	7.41±0.03
average subgroup BN±DS	7.41±0.04	7.43±0.04	7.41±0.03	7.42±0.02
average subgroup BS ±DS	7.39±0.03	7.41±0.03	7.39±0.03	7.41±0.03
t-test p<0.05				
BN/BS		0.26	0.13	0.16
BN in/BN im, 24, fin		0.09	0.53	0.26
BS in/BS im, 24,fin		0.02	0.85	0.23

Exclusion criteria:

- any of the situations described as contraindications for balnear cure;
- presence or inflammatory phenomena joint appearance, decompensation of cardiac and / or blood pressure during treatment;
- skin lesions that contraindicate the balnear applications and adjuvant procedures;
- respiratory, endocrine, neurological sufferings, spinal static disorder that can change blood gas homeostasis;
- cortisone medication or any other type of medication known to interfere with the determined parameters (diuretics, supplements containing minerals or carbohydrates in composition).

Patients were asked if they want to participate in the study and were informed about the collection of biological samples, that the results will be published in various scientific publications and they received assurances of confidentiality of personal data. All patients signed the informed consent.

Biological sampling was carried out in the morning before breakfast and before starting the treatment, in four moments of cure:

- ⇒ before the cure (noted „in”);
- ⇒ immediately after the first application and we called it the inaugural / initiate application (noted „im”)
- ⇒ at twenty-four hours after the first application, but before the second one (noted „24”);

⇒ at the end of 10 applications cure (noted „fin”).

Blood samples did not require any further processing, the determination being done on capillary whole blood, with the analyzer „CCX 6 Nova Biomedical” offered by the "Center for Scientific Research in Stress" of the "Faculty of Pharmacy" from "Ovidius University of Constanta". Analyzer was installed in the laboratory of Techirghiol Balneal and Rehabilitation Sanatorium respecting technical conditions required in the technical documentation.

Results

In accordance with the requirements of evidence-based medicine after tabled the results I calculated the average and standard deviation and then I applied multiple comparison tests (t-test) to assess the statistical significance of the results. (table 2).

Table II PH variation during peloide cure

In mathematical processing of data obtained for the parameter pH I found a normal distribution and uniform values for both types of application, for all moments in time and for all analyzed groups. Test comparison between groups showed variation in the physiological limits and insignificant statisticall for blood pH during cure, except pH measured immediately after the first saline application, which had a statistically significant increase, but the physiological limits.

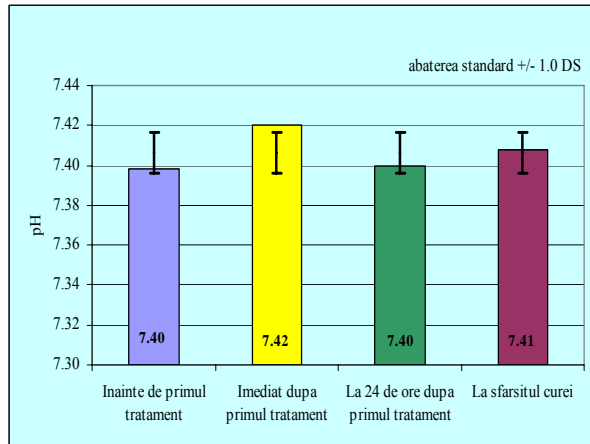


Figure 1 PH variation during peloid cure

It should be emphasized homogeneity distribution and very small standard deviation value, which shows the gentleness application and fine, precise control mechanisms.

Acid-base homeostasis is maintaining in the first line of action by the buffer systems of plasma, followed by respiratory mechanism, completed and corrected by the renal mechanism. Slightly increased pH value obtained after the first application (figure 1) suggests the involvement of the respiratory mechanism that prompt removes carbon dioxide by hyperventilation.

Comparing the reactivity of the body expressed in blood pH parameter with the method used in the group therapy (figure 2), we can summarized that although the two therapeutic applications used (saline bath and mud bath) have different biophysical properties: the temperature of thermal neutrality, hydrostatic pressure, osmotic pressure, the body reacts similarly:

- slight increase of pH after the first application skin, possible caused by the change of the temperature;
- return to values close to the initial ones during next hours by entering in action the corrective mechanisms.

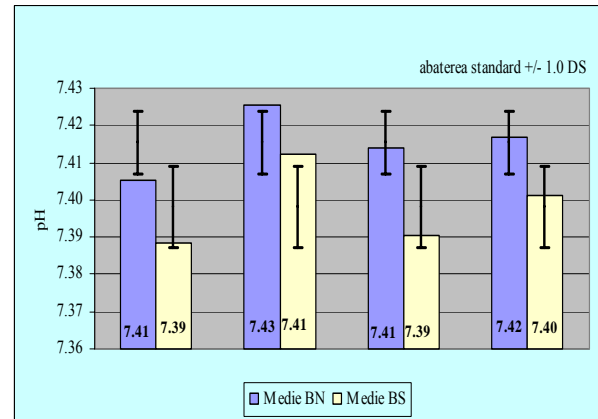


Figure 2 PH variation during the cure depending on application type

During application the pH of plasma and the maintenance mechanisms are "threatened" by increasing temperature of the internal environment and the increasing lung ventilation. So:

- skin temperature may increase by 1 - 2⁰C while the temperature of the bath is kept constant. In the working protocol of Rehabilitation Sanatorium Techirghiol maintain the average temperature bath almost constant is done by adding a quantity of heated water to ½ length of proceedings;
- increasing temperature of the central area (core) is only 0.1 - 0.2⁰C. In these conditions warm-blooded and pH are not threatened, and thermoregulatory function and acid-base homeostasis are maintained easily by the body;
- respiratory function is required at minimum because the relaxant effect (muscle and general) of the application produces decrease respiratory rate and increased breath amplitude with minimum consequences: both the saline bath and the peloid one.

The body responds to this request with the appropriate functional adjustments that do not exceed physiological limits. Intensity of the response depends on the inaugural application: peloid application is more demanding than the saline one.

Interface of the biological system body - peloid environment is represented by the skin.

One of the most important functions of the skin is the physical-chemical barrier performed by the corneum stratum (metabolical inactive) and hydro-lipid film ("biochemical sponge"), that regulate skin homeostasis and by the consequence the body's internal environment. Skin coating acts as a osmotic membrane.

Lipid film formation and maintenance of skin pH is influenced by climatic factors (wind, sun, which can have different values compared with the residence town of the patient) or chemical factors (substances acting like detergents, solvents, soaps, which can be found in mud composition), that disrupts homeostasis and can reduce skin acid mantle of skin formation. (5)

Studies about the effect of mud therapy on skin pH and seborrheic secretory status showed normalization of skin pH after fourteen mud applications (6).

Analyzing the interaction between skin and bath environment showed a lower pH value of peloide solution at the end application, statistically insignificant. (7).

Comparative changes in peloide environmental of the pH measured before and after therapeutic treatment and variations of blood pH during peloidotherapy it can be assumed biological interaction between skin and mud:

- blood pH increased slightly;
- mud solution pH decreased.

Interface of two media, the skin, reacted by normalization of pH.

Conclusions.

Systematized these results we can say:

1. during peloidotherapy pH variations in the internal environment is in physiological limits, connected with changes in environmental pH bath and pH of the skin;
2. peloide application does not disrupt the acid-base balance (investigated by the parameter pH) above physiological limits, so it's a safe application.

The results obtained allow us to suggest that further studies will be required concomitant evaluation of the interaction between environment and body bath by researching environmental parameters involved: the mud, blood, etc.

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