Variability of electric skin conductivity on selected points as a potential diagnostic and prognostic test in asthmatic children

Artur Fedorowski*, Andrzej Steciwko* and Edward Ziobro**

*Dept. of Family Medicine, Medical University of Wroclaw, Ul.Syrokomli 1, 51-141 Wroclaw, Poland (E-mail: art.fed@pwr.wroc.pl)

**Dept. of Ergonomics, Technical University of Wroclaw, Poland

ABSTRACT: Diagnostic measurement of electric skin conductivity (ESC) called the Ryodoraku system was introduced in mid 1950s by Nakatani. As has been shown by Ziobro et al. in case of infantile cerebral palsy, changes of ESC may provide a valuable electrophysiological parameter for monitoring a therapy. In this study ESC was measured in asthmatic children treated with a bioelectronic unit VEGA-SELECT. Analysis of results was performed using the Pareto method and an artificial neural network. Significant changes of ESC values were observed, both before and after therapy. We suggest that measurement of ESC at Nakatani's points might serve as a useful method for early diagnosis as well as for monitoring a bioelectronic therapy.

1. INTRODUCTION

In the beginning of 1950s Nakatani and Yamashita worked out the basis for the diagnostic Ryodoraku system, comprising 24 symmetrically situated low-resistance points on the skin [1]. In mid 1980s the measurement of electric skin conductivity (ESC) was further elaborated by Bergsmann and Heine who presented the principles of electrodiagnostics based on the theory of Pischinger's control system [2,3]. The structure of the system - also identified with the extracellular matrix (ECM) of the connective tissue - is formed by inter- and extracellular spaces and the substance filling them, containing water, electrolytes, fatty acids and glycoproteins. Various hormones, humoral mediators, large and small reticular cells, and neurofilaments (Dogiel cells of the 2nd type) penetrate into the fluid of matrix. In this way all the main control systems of the organism (i.e. neural, hormonal and immune) are present and cooperate within the ECM. This basic control system is considered to play a crucial role in transferring information between sensors and effectors, and in the formation of negative or positive feedback between individual cells and organs. As proposed by Bergsmann and Heine, ESC of selected points may reflect discrete changes in the status of the ECM. The diagnostic value of the Ryodoraku method was confirmed by Ziobro et al. in children with cerebral palsy [4]. In case of infants with motor delay significant deviations of ESC changes were found at Nakatani's points H6, F4, F5 (see: Fig.1).

In the last two decades a number of complementary bioelectronic therapy techniques using endogenous electromagnetic oscillations have been developed. It is believed that idea of registration and processing human skin potentials comes from the German physician, F.Morrell whose works date back to the 1970s. The more recent System Information Therapy (SIT) is based on the same principle and its application in various allergic diseases, especially in bronchial asthma, have been reported. Theoretical explanations of the therapy have been presented in works of Popp, Smith and Ludwig [5,6], however, there have been no basic clinical reports in this field so far. It seems that significant changes of the physiological parameters - both during and after the treatment - may appear in two main cooperative networks of the living organism: neuro-endocrine and immune systems. In view of the above we decided to study ESC variability in children with asthma, both before and after the bioelectronic therapy.

2. MATERIAL AND METHOD

A group of 45 children, between 5 and 15 years old, with ambulatory or clinically diagnosed bronchial asthma (in a few cases also with other allergic disorders) were treated with the SIT method using bioelectronic unit VEGASELECT 709.50 healthy children in the age of 12 to 18 were selected and examined as the control group. ESC was measured before and after each therapy (once a week). According to Nakatani, 12 symmetrical points were localized (Fig.1) in the vicinity of the left and right wrists (designated in reflexotherapy as follows: L9, P7, H7, Si4, T4, Li5) and 12 symmetrical points in the vicinity of the left and right feet (Sp3, Liv3, K3, UB65, GB40, S42) - giving a total number of 24 points, identified by resistance measurements (points of decreased resistance with respect to the surrounding).

Figure 1. Nakatani's points.

Conductivity measurements were performed with the use of a Diastym 190 apparatus that detects the amount of current proportional to the electric conductivity at the
tested skin point. The measuring electrode - made of stainless steel in the form of a cylindrical pin - has a cavity of 6 mm diameter into which a cotton-wool swab moistened with a 0.9% NaCl was inserted before measurement. Results were read out on a digital measuring instrument in the range 0 to 200 μA. ESC measurements were conducted in correlation with standard ambulatory observations of the children (dyspnea, prolonged coughing episodes, respiratory infections, medicament intake).

As the quantity differences of the measurement values were relatively small as compared to distinct qualitative differentiation on particular points we decided to verify the usefulness of artificial neuron network in estimation of results.

3. RESULTS

Standard indicators (I = [x_i - x_{mean}] /σ, where σ = standard deviation) were calculated initially and comparison of results can be seen in Fig. 2. Dominating deviations in the children with asthma include a decrease in the value of ESC at points H_3, F_2, F_3 and F_6 and an increase of conductivity at points H_1, H_5 and H_6. In healthy children the standard indicators are lower and do not exceed 0.4 except for point F_2.

![Fig.2 ESC in children with asthma (black) vs. healthy children (white). H_1 (left and right) = 1-2, H_2 = 3-4 etc.](image)

Under the influence of SIT treatment (it brings subjective and objective improvement in about 70% of children) ESC has been found to decrease at points H_3, F_3, F_6, and F_5. In the case of H_3, F_3 and F_5 that means normalization in regard to the group of healthy children. On the other hand a significant increase of ESC value has been observed at points H_4 (normalization) and H_6 (large intestine meridian). In regard to H_6 it is worth mentioning that stimulation of this point is applied routinely in asthmatic patients by various experts of reflexotherapy.[7]

In order to obtain a hierarchy of particular diagnostic points, on which the value of deviation from the physiological zone is the largest and variability - the smallest, the Pareto analysis was applied. After initial recognition points H_1, H_5 and H_6 seem to be recommended.

Having the aim of utilizing the test of electric skin conductivity for computer-aided early diagnostics of bronchial asthma, we decided to use the artificial neural network method for defining the state of a given child, characterized by 24 parameters. It turned out that application of this type of network presents a useful method for classification of the examined children to one of the two groups: to the group of healthy children or to the group of children with skin conductivity changes found in bronchial asthma. The accuracy of this method is approx. 0.03 (mean square error).

4. DISCUSSION

As we can see from the analysis of the measurements, it appears that affected children show a difference in ESC at selected points described by Nakatani.

Values of ESC measurement on specific points, namely H_1, H_5, H_6, F_2, F_3 and F_6 seem to distinguish affected children from healthy ones. Further studies are required to determine whether this pattern is characteristic only for asthma, and whether ESC changes are proportional to the degree of asthma.

Characteristic changes of ESC in course of SIT treatment seem to indicate that the therapy produces changes at the level of a hypothetical basic control system, in the ECM.

We cannot exclude that changes of conductivity at these points might be used as a diagnostic and possibly prognostic test, in support of standard clinical estimation.

5. REFERENCES