Comparison of Hemoglobin Transmition Spectrums of Healthy Persons and Patients with Schizophrenia Disorders

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Received 29.05.2002

Abstract

The present paper is devoted to the study of human hemoglobin transmission spectrums that were divided into four groups: hemoglobin of healthy persons, patients with schizophrenia, persons and people with and without the prodrome of schizophrenia that are in genetic susceptibility with patients. The change of absorption spectrums of hemoglobin of these groups was determined. The shifting of transmission minimums of the hemoglobin that correspond to electronic transitions in the hemoglobin molecule and aromatic aminoacid of persons with schizophrenia and persons that are in genetic susceptibility with patients means that the optical spectroscopy method can be used as a method of determinating schizophrenia disorders.

Key words: transmission spectrum, hemoglobin, schizophrenia, genetic susceptibility.

PACS: 42.62.Be

Introduction

As it is known schizophrenia belongs to mental disorders that are characterized by a decrease of energetic potential, progressive introversion, emotional depletion and “discoordinatebility” - loss of the unity of psychical processes. Molecular mechanisms of schizophrenia include apoptosis oxidative stress (free radical production), immunological activation and others.

Many investigators have established a definite correlation between cellular ion metabolism and development of schizophrenia. A modulation of the ion-transporting function of the erythrocyte membrane contributes to primary changes of the microarchitecture of the cell and to its responses as a whole system [1].

There are many methods of investigating schizophrenia, such as magnetic resonance spectroscopy in schizophrenia (MRS) [2]. The MRS is a unique technique, which allows to estimate the concentrations of endogenous substances, which contain natural paramagnetic nuclei, such as phosphorus (31P) and hydrogen (proton or 1H).

Empirical studies related to membrane hypotheses of schizophrenia focus on: 1) assessment of prostaglandins (PG) and their essential fatty acid (EFA) precursors in the tissue of patients with schizophrenia; 2) evaluation of the niacin flush test as a possible diagnostic marker; 3) evaluation of phospholipase enzyme activity; 4) therapeutic trials of PG precursors for the treatment of schizophrenia [3].

This fact means that the changes in cases of schizophrenia take place in the biochemical processes that can result in the changing of chemical bonds and electronic system. Changes

in electronic levels can be determined by biooptical methods, particularly by studying and comparing the transmission spectrums of hemoglobin of healthy and diseased persons. From our point of view such a study of the different groups which include healthy people, diseased persons and people with and without the prodrome of schizophrenia that are in genetic susceptibility with patients, could help to find the answer to the problem of heredity of schizophrenia.

The present paper is devoted to the study and comparison of hemoglobin transmission spectrums of healthy people and persons with schizophrenia disorders.

Method and materials

26 probes of hemoglobin were investigated. Among them 2 probes taken from healthy people (first group), 13 probes taken from patients with schizophrenia (second group), 5 probes from persons, who have family links with patients with schizophrenia, with the prodrome of schizophrenia (third group) and 5 – from persons, who have a family links with patients with schizophrenia too, without the prodrome of schizophrenia (fourth group).

Samples of freshly drawn venous blood were collected in heparinized tubes, where they were centrifuged at 600g; for 10 minutes and the plasma and buffy coat were removed.

The transmission spectrums were studied by the spectrophotometer "Specord-M40" a spectral resolution higher than 0.06nm-0.12nm in the spectral range 200-900nm.

Results and discussion

Transmission spectrums in visible and ultraviolet ranges of the hemoglobin of the first group of samples consist on minimums of the wavelength 577.4 nm (16320 cm^{-1}) and 620.3 nm (17120 cm^{-1}) (Fig. 1).

Comparing these spectrums with the transmission spectrums of the second group of samples it is clear (Fig. 2) that minimums are shifted to the long wavelength range on 160 cm^{-1} and 120 cm^{-1}, respectively.

On studying the spectrums of the third group of samples it was found that shifting in transmition minimums also exists (Fig. 3) but it is less – 100 cm^{-1} and 80 cm^{-1}, respectively.

In the fourth group - the shift of the minimums (Fig. 4) was essentially smaller, 10 cm^{-1} and 20 cm^{-1}, respectively.

This shifting can be connected with the changing of the relation between hemoglobin ligand forms as well as in the visible spectrum range the electronic transitions in the hem and

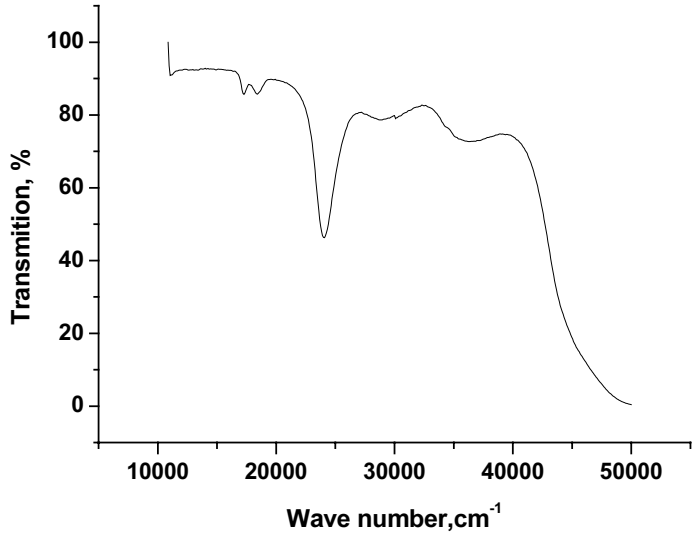

Fig.1. Transmittian spectrums in visible and ultraviolet ranges of the hemoglobin of first group (healthy people)

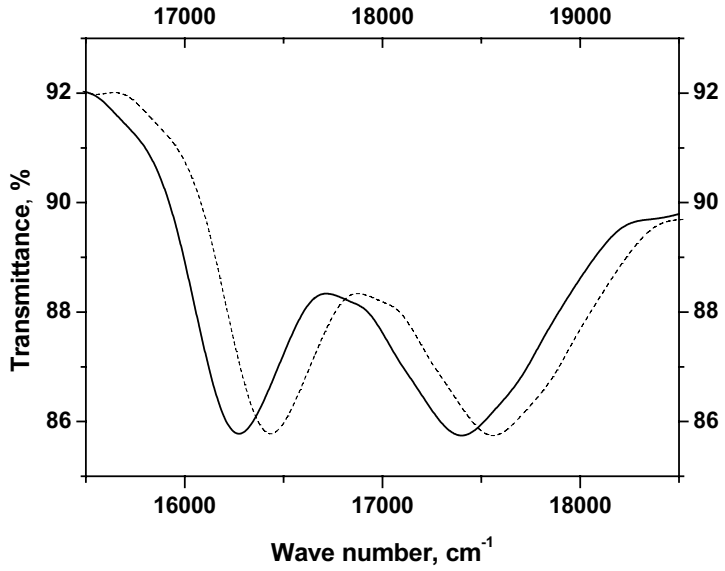

Fig.2. Comparison of the transmition spectrums of the hemoglobin of the first group (doted curve) with the second groups (solid curve)

nature of ligand is manifested. Therefore, it is possible to make the conclusion that in cases of schizophrenia the hemoglobin molecules undergo the change. Besides, in the spectrums of the first and fourth group of samples the small minimum was found at the wavelength 500 nm (20000 cm^{-1}) that suggests the presence of the ligand form MetHb.

The change could also undergo in the protein parts of the hemoglobin. Transmission spectral minimums of hemoglobin proteins belong to the ultraviolet range and correspond to the peptide groups and aromatic aminoacid. Transmission lines of the aromatic acids Phe, Tyr, Trp as well as collateral chains – His and disulfide bridge (Cys) belong to the spectrum range 230nm-300nm. In the first group of samples, three minimums were found (Fig. 1) at the wavelength 39400 cm^{-1} (253.75nm) (1-st maximum), 31735cm^{-1} (315.1nm) (2-nd maximum) and 2919cm^{-1} (342.5nm) (3-rd maximum). In the first group, a shifting of the

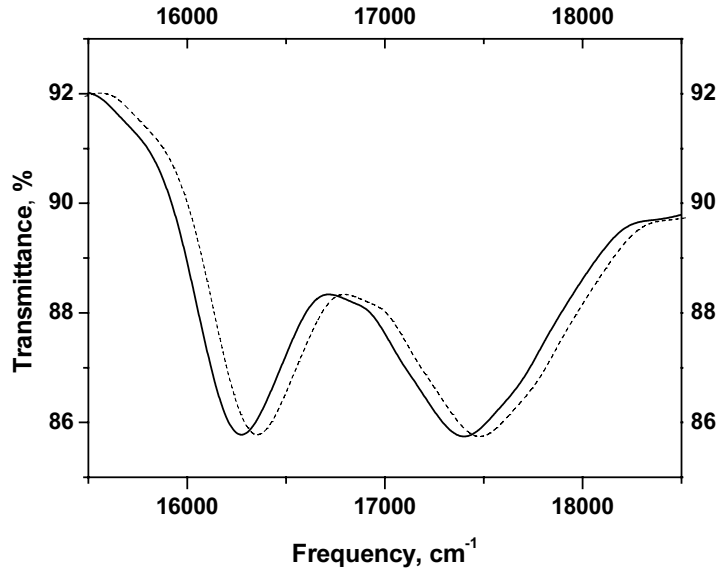

Fig.3. Comparison of the transmition spectrums of the hemoglobin of the first (doted curve) group with the third group (solid curve)

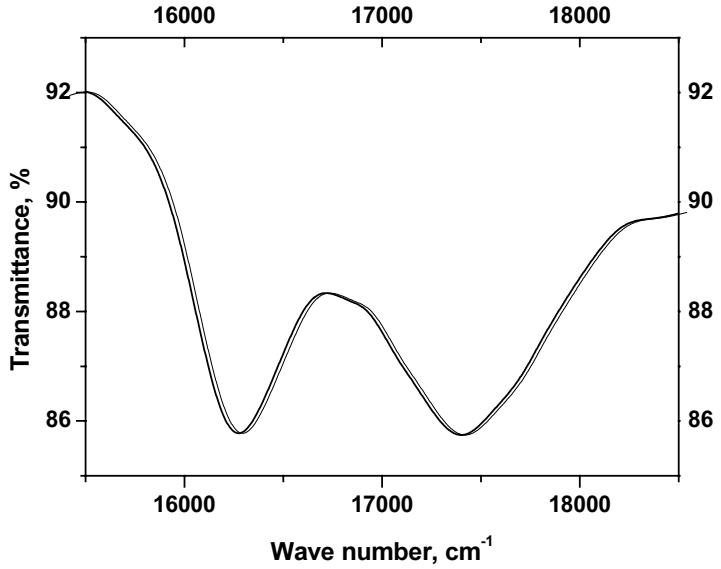

Fig.4. Comparison of the transmition spectrums of the hemoglobin of the first (doted curve) group with the fourth groups (solid curve)

first maximum to the short wavelength range on 400cm^{-1} (2.5nm) was found. In one of the cases, this maximum was shifted to 900cm^{-1} (1.11nm). The second and third maximum were shifted to 179cm^{-1} (5.6 nm) (in one of the cases – to 300cm^{-1} (3.1nm)) and 179cm^{-1} (5.6nm) respectively, to the short wavelength range (Fig. 5).

In the third group all shifting was the same and the transmission spectrums in the fourth group were the same as in the first group.

Conclusions

As a result of the conducted experiments, it is possible to come to the following conclusions:

1.The change of transmission spectrums of hemoglobin was found for four groups of persons - healthy people, on persons with schizophrenia and peoples with and without of a prodrome of schizophrenia that are in genetic susceptibility with patients.

2.The shifting of transmission minimums of

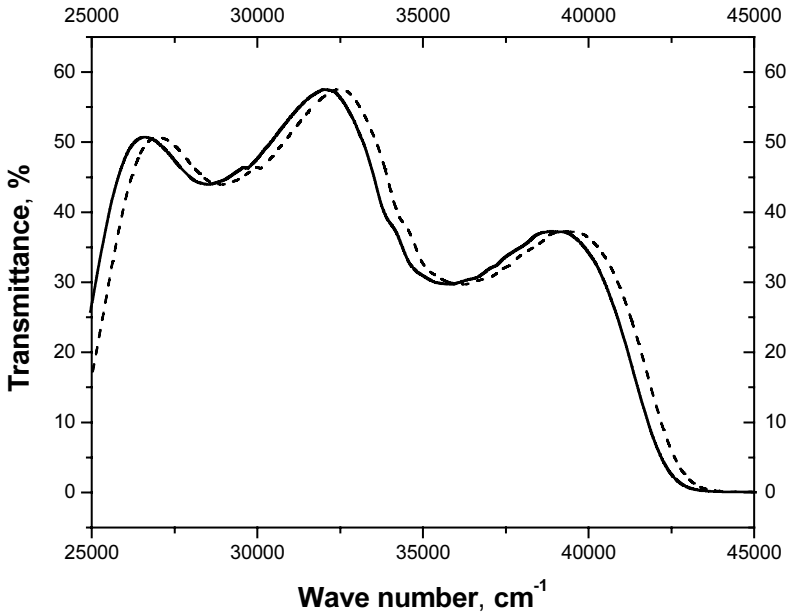

Fig.5. Comparison of the transmition spectrums of the hemoglobin of the first (dash curve) and second (solid curve) groups in the ultraviolet spectrum range.

hemoglobin that correspond to electronic transitions in hemoglobin molecules and aromatic aminoacid vestiges schizophrenia patients and persons that are in genetic susceptibility with patients means that the optical spectroscopy method can be used as a method of determination of schizophrenia disorders.

Acknowledgement

The present study was conducted due to the DFFD grant N.Ф7/501-2001 The authors thank I. Trach for the helping in the experimental measuring.

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