

Neurohumoral Regulation in Children with Idiopathic Scoliosis

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Abstract. Biotesting of blood serum in children aged 8-15 with adolescent idiopathic scoliosis (0°-60° by Cobb) showed the change of neurohumoral regulation in comparison with the age norm. The degree and direction of changes in the biotesting give the indication of the progression of spinal deformity. The effectiveness of treatment can be judged by control biotesting.

Keywords: scoliosis, neurohumoral regulation, biotesting

Introduction

The appearance and development of Adolescent Idiopathic Scoliosis (AIS) is considered as the result of inequality of a spinal column and spinal cord longitudinal growth [4,5]. As a result, even a slight stretching of the spinal cord changes the normal afferent input from spinal cord elements to the highest parts of the central nervous system. Malafferentation leads to forming a hyperactive deterministic structure and inadequacy of neurohumoral processes of regulation in thalamus – hypothalamus – hypophysis [2,5]. Originating neurohumoral disturbances could be detected in experimental biological models (laboratory animals) via patients blood serum (BS) testing [3].

The aim of our work is to investigate neurohumoral background (neuroproteins) in children with AIS. Specific neuroproteins have not been examined in this study, but previously it has been shown that one of these factors is the arginine-8-vasopressin [7].

1. Materials and Methods

120 children aged 8-15 with AIS at various stages of its development (preclinical, clinical and the 'vicious circle' [5] stages) were examined in our clinic. The bimestrial course of conservative treatment (therapeutic exercises, massage, swimming, physiotherapy such as pulsed magnetic therapy, iontophoresis, short-wave therapy) was carried out. The patients BS was examined by biotesting method before and after treatment course. Healthy children (n = 30) BS was tested as a control.

1.1. Methods of children examination

Moire topography (back surface optical topography), clinical examination, venous blood sampling before and after treatment.

1.2. The method of biotesting

The biotesting was performed on white rats (Wistar line male of 180-200 g) spinalised in thoracic part. All animals were on the same diet (briquetted food, vegetables and water). All the animals were treated according to the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Strasbourg, 1986).

The rate of spontaneous and evoked by electro excitation electromyographic (EMG) activity of the both hind limbs muscles (mm. gastrocnemius, mm. tibialis anterior) was registered in 30 minutes after the cross-section of rats spinal cord in the thoracic part (Rausch-anesthesia). After that the patients BS was administered to spinalised rats at a dose of 0.1 ml into the spinal canal at the level of lumbar segments through a catheter. The control EMG activity tests of the recipient muscles were registered in 20 and 40 min. after the BS administration. The EMG registration was carried out in accordance to a previously developed method [1]. The coefficient of movement disorders (CMD) was determined in each experiment by double blind method in accordance to these conditions: increasing or decreasing of the spontaneous and evoked EMG activity rate more than 30-50%, differing vectors of these changes, the asymmetry of the EMG responses in the muscles of the right and left hind limbs, caused by disturbances in the reciprocal EMG responses. The severity of each violation was evaluated on a scale (0-3). The CMD was consisted of the total score. The total CMD more than 5-6 provided the evidence of the the donor motor system violations [3]. In addition to it the asymmetry coefficient (AC) indicating preferential infringement side was calculated. The coefficients obtained before and after treatment were compared [8].

2. Results

The CMD in healthy children is 2-5 points (Figure 1) as was found previously. The CMD with non-progressive scoliosis corresponds to 11.9 points. The CMD with slowly progressing scoliosis corresponds to 12-14 points. The CMD of 15-25 points corresponds to a progressive disease [6].

BS biotesting in children with an initial stage of scoliosis (preclinical and clinical stage corresponding to 0°-15° deformity in Cobb) before treatment showed the rate of CMD at 10±2.4 points. In this case the impact of patients BS caused primarily an increase of reflex EMG responses in the direct stimulation of the recipient muscles, as well as a violation of reciprocity antagonist muscle excitation and irradiation in the muscles of opposite limbs. The majority of patients indicators of spontaneous EMG responses correspond to the indicators of healthy children.

BS biotesting in children with deformity of more than 35° in Cobb showed a marked change of neurohumoral background with CMD rate more than 15 points (Figure 1b).

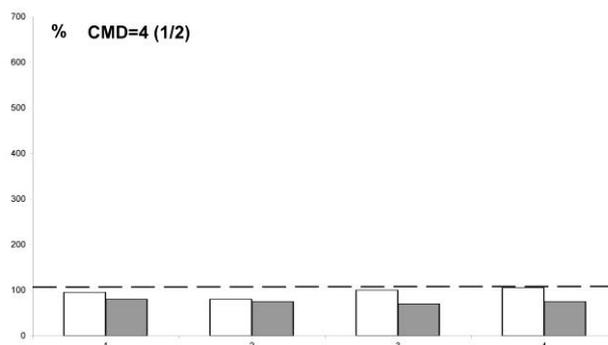


Figure 1a. The rate of spontaneous and evoked EMG responses of the recipient hind limbs muscles after BS administration of a healthy 13 years girl

Legend: 1,3 – mm. tibialis anterior; 2,4 – mm. gastrocnemius; white – left side; grey – right side; dashed line – initial recipient EMG activity rate before BS administration; CMD - coefficient of movement disorders (right side/left side violations).

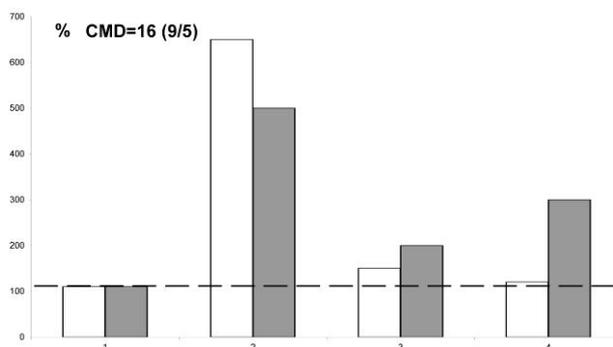


Figure 1b. The rate of spontaneous and evoked EMG responses of the recipient hind limbs muscles after BS administration of a 12 years girl with right hand thoracic scoliosis (deformity more then 45° in Cobb

Legend: 1,3 – mm. tibialis anterior; 2,4 – mm. gastrocnemius; white – left side; grey – right side; dashed line – initial recipient EMG activity rate before BS administration; CMD - coefficient of movement disorders (right side/left side violations).

The follow-up biotesting of children showed neurohumoral regulation changes depend on the type of treatment (Figure 2). The most of the patients had positive results (reduction of CMD and AC). The biotesting data corresponded to normalization or improvement of clinical parameters [6].

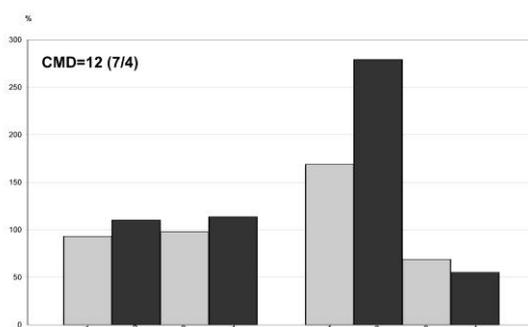


Figure 2a. The rate change of spontaneous (in the left) and evoked (in the right) EMG responses of the recipient hind limbs muscles after administration of BS of ten years girl with right hand thoracolumbar scoliosis (deformity 15° in Cobb) before the treatment.

Legend: 1 – right m. tibialis anterior; 2 – right m. gastrocnemius; 3 – left m. tibialis anterior; 4 – left m. gastrocnemius; dashed line – initial recipient EMG activity rate before BS administration; CMD - coefficient of movement disorders (right side/left side violations).

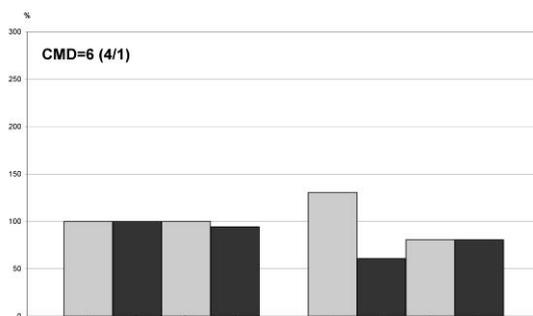


Figure 2b. The rate change of spontaneous (in the left) and evoked (in the right) EMG responses of the recipient hind limbs muscles after administration of BS of ten years girl with right hand thoracolumbar scoliosis (deformity 15° in Cobb) after pulsed magnetic therapy course.

Legend: 1 – right m. tibialis anterior; 2 – right m. gastrocnemius; 3 – left m. tibialis anterior; 4 – left m. gastrocnemius; dashed line – initial recipient EMG activity rate before BS administration; CMD - coefficient of movement disorders (right side/left side violations).

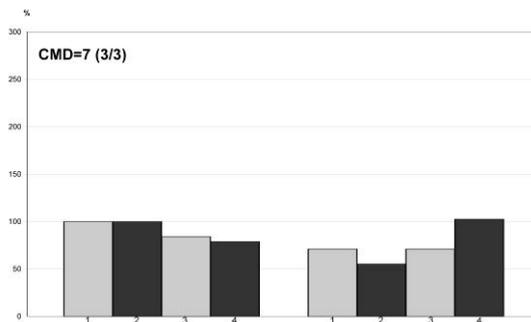


Figure 2c. The rate change of spontaneous (in the left) and evoked (in the right) EMG responses of the recipient hind limbs muscles after administration of BS of ten years girl with right hand thoracolumbar scoliosis (deformity 15° in Cobb) after iontophoresis course.

Legend: 1 – right m. tibialis anterior; 2 – right m. gastrocnemius; 3 – left m. tibialis anterior; 4 – left m. gastrocnemius; dashed line – initial recipient EMG activity rate before BS administration; CMD - coefficient of movement disorders (right side/left side violations).

3. Conclusions

1. Just at the early stage of scoliosis children BS biotesting reveals the neurohumoral regulation changes in comparison with the age norm.
2. The CMD values and programmatically relevant biotesting indicators are revealed for each type of scoliosis (non-progressive, slowly progressing, progressive).
3. Using the biotesting in this group of patients has a prognostic value, which is important for early diagnosis of AIS.
4. These results provide new opportunities for understanding the pathogenesis of AIS and finding adequate methods of its treatment.

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