Using the Method of Evoked Short-Latency Brainstem Potentials in Asthmatic Patients with Hyperventilation Syndrome

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UDC 616-056:43-06

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 117, № 2, pp. 138-139, February, 1994
Original article submitted August 2, 1993

The method of evoked short-latency brainstem potentials in a group of patients with bronchial asthma attended by hyperventilation syndrome demonstrates disturbances of the functional activity of the brainstem structures, this attesting to dysfunction of the mesencephalic and cerebropontine zones. No changes are observed in a group of patients without hyperventilation syndrome.

Key Words: *hyperventilation syndrome; evoked short-latency brainstem potentials; bronchial asthma*

The course of bronchial asthma (BA) which is attended by hyperventilation syndrome (HVS) is particularly severe, because such disorders complicate the course of the main disease and reduce the efficacy of basic treatment. Reportedly, the rhythm of respiration is determined by a periodicity of neuronal activity of certain structures in the medulla oblongata and pons. Pathological effects in the ventilation-controlling system may be produced by the cerebral cortex, reticular formation of the brainstem, and other structures. It thus seemed worthwhile to study the functional state of the brainstem.

One informative neurophysiological method making it possible to assess the functional state of the brainstem structures is the method of acoustic stimulation-evoked short-latency brainstem potentials (ASESLBP). The method is based on summation of the submicrovoltage potentials evoked by acoustic stimulation of neuronal structures of the auditory analyzer.

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The aim of the present study was to analyze the state of the brainstem structures in patients with BA and HVS.

MATERIALS AND METHODS

Forty patients with infectious-allergic and noninfectious-allergic BA during the stage of relative remission were examined at the Department of Bronchial Asthma: 14 men and 26 women aged 18-61 with a 1-25-year history of the disease.

Two groups of patients were distinguished: patients with BA attended by HVS (16 women and 4 men) and patients with BA but without hyperventilation disorders (10 women and 10 men).

We performed the general clinical, allergological, and neurophysiological (ASESLBP) examination.

The function of external respiration was studied on a Fucuda ST-460 spiroanalyzer (Japan). Hyperventilation (HV) was recognized from an increase of the minute respiration volume to 300% of the normal value in not less than 3 independent examinations. The diagnostics of HVS was based on reported tests [2,5,7,8].

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TABLE 1. Latencies of Peaks II, III, and V of ASESLBP in Patients with BA ($M \pm m$)

Group of examinees (n=20)	Latency, msec		
	peak II	peak III	peak V
Healthy subjects	2.77±0.03	3.84±0.03	5.69±0.04
Patients with BA + HVS	2.70±0.05*	3.94±0.05*	5.79±0.04*
Patients with BA without HVS	2.69±0.09	3.80±0.04	5.64±0.06

Note. Here and in Table 2: an asterisk denotes reliability (p<0.01) of differences from healthy subjects.

TABLE 1. Amplitudes of Peaks II, III, and V of ASESLBP in Patients with BA ($M \pm m$)

Group of examinees (n=20)	Amplitude, μV		
	peak II	peak III	peak V
Healthy subjects	0.19±0.02	0.23±0.02	0.43±0.03
Patients with BA + HVS	0.21±0.04	0.24±0.02	0.22±0.04*
Patients with BA without HVS	0.18±0.03	0.21±0.03	0.40±0.02

ASESLBP was studied using an OTE Biomedica multipurpose neurophysiological analyzer (Italy). Routine monoaural stimulation was used to record ASESLBP [6]. Peaks I, II, III, and V are the most stable in the curve of evoked short-latency brainstem potentials (ESLBP) [3]. The state of the peripheral regions of the auditory analyzer (the auditory nerve) is reflected by peak I, of the caudal structures of the brainstem by peak II, of the pons by peak III, and of the midbrain by peak V [3]. According to Avakyan [3], the latencies and the interspike intervals are the most informative for assessing ASESLBP. Suppression of the amplitude of peak V is also one of the parameters indicating a deviation from the normal state. We analyzed the latency and the amplitude of peaks II, III, and V.

The results were processed using standard statistics software.

RESULTS

Analysis of the latency of peaks II, III, and V is presented in Table 1. Monoaural stimulation of the *auriculus sinister* and *auriculus dexter* failed to reveal any asymmetry between the corresponding curves. The latencies of peaks III and V in the patients with BA and HVS are reliably unchanged from those in healthy subjects and constituted 3.94±0.05 msec (p<0.01) and 5.79±0.04 msec (p<0.01), respectively. In the group of asthmatics without HVS the latencies of peaks II, III, and V did not markedly differ from those in the groups of healthy subjects and patients with BA and HVS.

The amplitudes of peaks II, III, and V are presented in Table 2. In the group of patients with BA in the absence of HVS the amplitude of peak V reliably (p<0.01) dropped as compared to the group of healthy subjects. In this group the amplitudes of peaks II and III did not reliably differ from those in the group of healthy subjects. The amplitudes of peaks II, III, and V in asthmatics without HVS exhibited no statistically reliable differences from the corresponding parameters in the other groups of patients.

Our findings attest to disturbed functional activity of the brainstem structures in the group of patients with BA and HVS and to the absence of changes in the group of patients with BA and without HVS, this being indicative of dysfunction of the mesencephalic and cerebropontine structures in the group of patients with BA and HVS. The quantitative characteristic of the state of neuronal structures of the brainstem yields additional diagnostic criteria for assessing HVS in patients with BA, allowing for the correct choice of follow-up tactics and of treatment of such patients, and for the proper administration of vertebrobasilar preparations.

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