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Auditory Brainstem Response Study of Alcoholic Patients

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CHU, N-S. AND K. C. SQUIRES. *Auditory brainstem response study of alcoholic patients.* PHARMAC. BIOCHEM. BEHAV. 13: Suppl. 1, 241–244, 1980.—Auditory brainstem responses were obtained from 52 alcoholic patients with or without neurological complications of alcoholism. Almost half of the patients had abnormal auditory brainstem responses manifested by a prolonged central conduction time (Wave I to V interval) without significant alterations in morphology. The incidence of abnormal auditory responses was related to the type and the number of neurological complications. Patients with Wernicke-Korsakoff syndrome, dementia or cerebellar degeneration had high incidence of brainstem abnormalities. All patients with 3 or more neurological complications had abnormal auditory brainstem responses.

Auditory brainstem response Alcoholic patients Neurological complications of alcoholism

AUDITORY brainstem response (ABR) is the scalp-recorded "far field" potentials of the auditory pathway and consists of seven positive waves within the first 10 msec after acoustic stimulation [4]. The first of these waves represents the activity in the auditory nerve and the remaining waves have been attributed to subsequent activity in cochlear nucleus, superior olive, lateral lemniscus and inferior colliculus [1, 5, 11, 12]. The techniques for recording ABR are non-invasive and provide an objective evaluation of the sequential activation of neural structures along the auditory pathway.

Because of prominent brainstem symptoms in alcohol intoxication, we have used ABR to study the actions of alcohol during acute and chronic alcohol intoxication and alcohol withdrawal. We have demonstrated that acute administration of alcohol to humans and rats resulted in a progressive prolongation of the sequential waves of the ABR, thus providing an objective measure of the depressant effect of alcohol [8,9]. When tolerance to alcohol developed during chronic consumption in rats, the depressant action of alcohol became less [3]. Reverse effects on ABR wave latency were observed during alcohol withdrawal, correlating with the clinical manifestations of widespread CNS hyperexcitability [3]. These studies, therefore, provide quantitative electrophysiological data on the effects of acute alcohol intoxication, tolerance to alcohol and alcohol withdrawal.

Neurological diseases as complications of alcoholism are several, some of which involve the brainstem structures, such as Wernicke-Korsakoff syndrome, central pontine myelinolysis, and cerebellar degeneration [15]. It would, therefore, be interesting to extend our ABR study to alcoholic patients with or without alcohol-related neurological complications, to determine the prevalence of brainstem abnormalities.

METHOD

Techniques for recording ABR in our laboratory have been previously described [8,10]. In brief, recording was conducted on the patients in supine position in a quiet room. Monoaural acoustic stimuli consisting of 0.1 msec clicks were delivered at a rate of 10 per second through the earphones. Electrodes were placed at the vertex and mastoids with the ipsilateral mastoid as the reference and the contralateral mastoid as the ground. The routine click intensity was 65 dB above threshold for normal human hearing, but higher intensities of 75 dB and 85 dB were used when identification of the ABR components was not possible at 65 dB. The evoked brain electrical activity was amplified 100,000 times with a bandpass of 150 to 3 kHz, and was summed over 2000 click presentations for 10.24 msec post-stimulus.

Patients with history of chronic heavy drinking were selected for study when the following medical conditions were not present: (a) neurological diseases other than those associated with alcoholism, (b) severe bilateral hearing loss, (c) significant head trauma or anoxic brain damage, (d) cardiac diseases or hypertension with history of transient neurological symptoms, and (e) malignancy. All the patients had extensive medical and neurological work-ups. Recording of auditory brainstem response was not conducted during the acute stage of alcohol-related neurological diseases. In fact, most of the patients were studied because of histories of heavy drinking or alcohol-related neurological complications.

The primary measure of the ABR waveform used in the analysis was the central conduction time which is defined as the difference between wave I and V latencies and represents the time required for auditory electrical events to travel from the auditory nerve to midbrain region, thus traversing most of the brainstem. In normal subjects, the upper limit for

central conduction time is 4.4 msec [2, 7, 11, 12]. Previous studies have indicated that central conduction time is the most sensitive and reliable measurement to detect brainstem abnormalities when distortion of ABR wave morphology is not severe [2, 10, 12]. In this study, the ABR was considered abnormal when central conduction time was over 4.4 msec.

RESULTS

The ABR was obtained from 52 alcoholic patients. Thirty-nine patients were males and thirteen were females. Patients' age ranged from twenty to seventy-five with a mean of forty-seven. Eight patients had no history of neurological complications of alcoholism, twenty-six patients had one neurological complication, and the remaining eighteen patients had more than one neurological disease. Bilateral ABRs were obtained from forty-five patients and unilateral auditory responses from seven patients. In the latter cases, three patients had severe unilateral hearing loss and in four patients identification of auditory response components was unsatisfactory.

The most common neurological complication was alcohol withdrawal seizure. The alcohol-related neurological complications in the order of frequency were: alcohol withdrawal seizures, twenty-five patients; dementia, thirteen; delirium tremens, eleven; cerebellar degeneration, nine; peripheral neuropathy, seven; hepatic encephalopathy, seven; Wernicke-Korsakoff syndrome, four; myopathy, one; and hepato-cerebral degeneration, one. It should be noted that eighteen patients had more than one neurological complication. Therefore, the number of patients presenting with only one neurological complication (Table 1) was lower than the total number of patients with that particular complication.

Twenty-four patients (46%) had abnormal ABRs as determined by prolonged central conduction time of waves I to V interval. Although some alterations in the wave morphology of the ABR were noted, identification of each ABR component presented no difficulty in most of the cases. Examples of normal auditory responses in cerebellar degeneration and Wernicke-Korsakoff syndrome are presented in Fig. 1. Twenty-one patients had unilateral abnormal ABRs while in three patients the abnormality was bilateral. Thirteen abnormal ABRs were obtained from right side, and fourteen from the left.

The incidence of abnormal auditory response with respect to individual neurological complications of alcoholism is presented in Table 1. Twelve percent of patients without neurological complications had abnormal ABRs. Patients with alcohol withdrawal seizures or delirium tremens had similar incidence of abnormal ABRs, which was approximately 25%. Patients with dementia, Wernicke-Korsakoff syndrome or cerebellar degeneration had a much higher occurrence of abnormalities in ABRs with cerebellar degeneration the highest. Further analysis of the data indicated that the incidence of abnormal ABRs was related to the number of neurological complications (Table 2). There was a progressive increase in abnormal auditory responses when patients had more alcohol-related neurological complications. All the patients with three or more neurological diseases had abnormal ABRs.

DISCUSSION

The selection of our patients reflects the patient population seen in the University Hospital. It is obvious that the

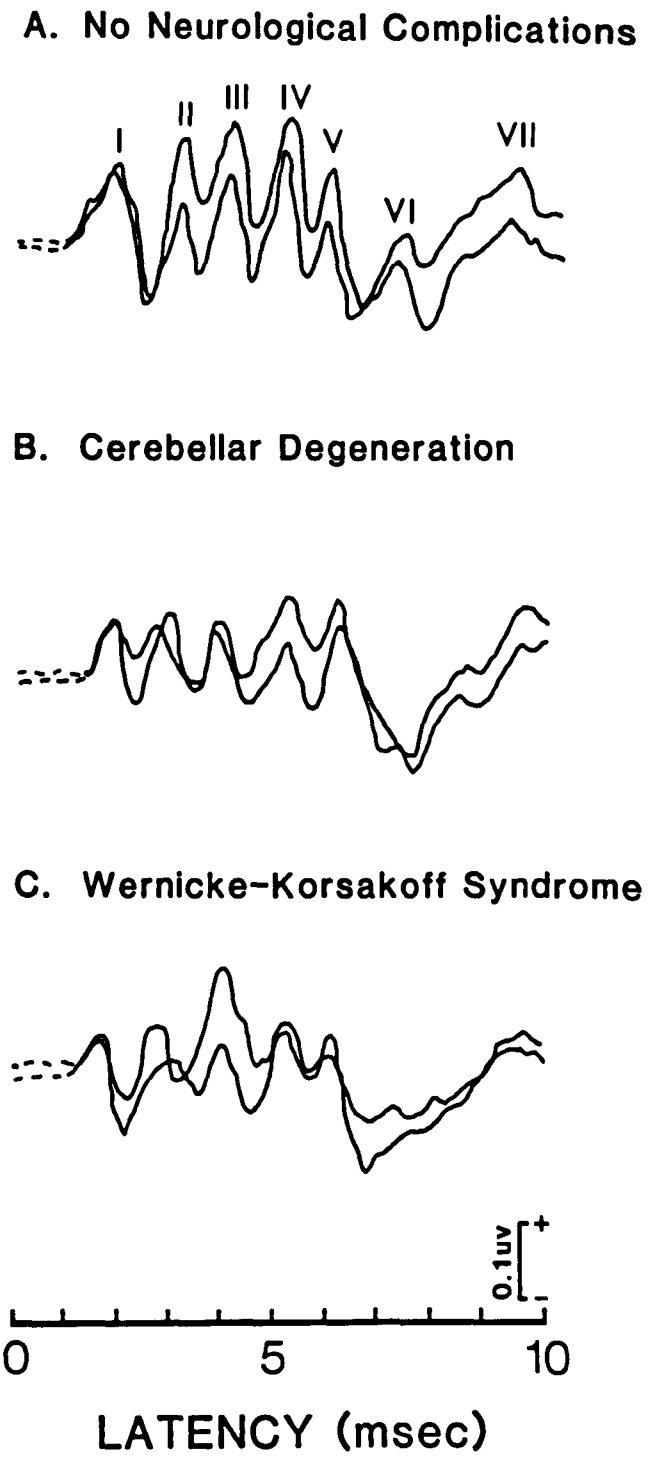

FIG. 1. Auditory brainstem responses in patients (A) without neurological complication, (B) with cerebellar degeneration, and (C) with Wernicke-Korsakoff syndrome. The click stimulation was presented at time 0. Stimulus artifacts were removed and replaced by dash lines.

TABLE 1

AUDITORY BRAINSTEM RESPONSE (ABR) AND NEUROLOGICAL COMPLICATIONS OF ALCOHOLISM

Neurological Complications	ABR*		Percentage of Abnormal ABR
	Normal	Abnormal	
No Neurological Complications	7	1	12%
Alcohol Withdrawal Seizures	11	4	25%
Delirium Tremens	3	1	25%
Dementia	2	2	50%
Wernicke-Korsakoff syndrome	1	2	66%
Cerebellar Degeneration	1	6	85%

*The numbers indicate the numbers of patients.

TABLE 2

RELATIONSHIP BETWEEN AUDITORY BRAINSTEM RESPONSE (ABR) AND THE NUMBER OF NEUROLOGICAL COMPLICATIONS OF ALCOHOLISM

Number of Associated Neurological Complications	ABR*		Pecentage of Abnormal ABR
	Normal	Abnormal	
0	7	1	13%
1	17	9	37%
2	4	3	43%
3	0	5	100%
4	0	5	100%
5	0	1	100%

*The numbers indicate the numbers of patients.

proportion of patients with acute neurological complications of alcoholism was relatively high. For example, alcohol withdrawal seizure was the most common neurological illness. Furthermore, the sample of the study is small and the patients tend to come from middle and lower sections of the community. Thus, the incidence of abnormal ABRs in alcoholic population in the community is not known without further study. However, our data indicated that the incidence of abnormal auditory responses was related to the type and the number of alcohol-related neurological complications.

The incidence of abnormal ABRs in patients without neurological complications was not negligible, suggesting that a small but significant number of alcoholic patients had asymptomatic brainstem abnormalities even without previous history of alcohol-related neurological diseases. Among the neurological complications, patients with dementia, Wernicke-Korsakoff syndrome or cerebellar degeneration tended to have considerably higher incidence of abnormal ABRs than those with alcohol withdrawal seizures or delirium tremens. Pathological studies on Wernicke-Korsakoff syndrome and cerebellar degeneration revealed widespread lesions in brainstem, diencephalon, cerebellum and cerebral cortex, while in delirium tremens gross or microscopic lesions were absent [13, 14, 15]. The pathological findings may account for the higher incidence of abnormal auditory brainstem responses in patients with Wernicke-Korsakoff syndrome or cerebellar degeneration. Detailed autopsy study on alcoholic patients with dementia only is not available, although mild to moderate cerebral cortical atrophy is not infrequently seen in routine neuropathological examination of alcoholic patients [15]. Our result on the incidence of abnormal ABRs in cerebellar degeneration agrees well with that of Rosenhamer and Silfveskiold who observed that about 80% of their patients had a significant increase in central conduction time of the ABR [6].

This study shows that the more neurological complications the patients have, the higher is the incidence of brainstem abnormalities. Alcoholic patients with three or more neurological complications will have very high incidence of abnormal auditory responses. Clinically this finding has an important predictve value. Our data also indicate that caution is needed to interpret abnormal brainstem responses if the patients have a history of excessive drinking, and particularly of alcohol-related neurological complications.

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