Norepinephrine Levels in Rat Brain After Infrasound Exposure

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ONLY in recent years has it been recognized that infrasound (frequencies below 20 Hz) can affect human beings, and there is a general lack of knowledge of its prevalence and effects. It has been established that infrasonic noise might produce very serious physiological and psychological effects, including balance disturbances, vertical nystagmus, feelings of lethargy and euphoria [6]. Michael Bryan reported that infrasound can produce an increase in reaction time and can affect vigilance [4] and fatal injuries may also result [5]. In our previous studies, we reported that infrasounds produce a decrease in the exploratory activity of rats, suppression of locomotor activity, a sleep-like state and an inhibition of the acquisition and retention of a conditioned avoidance response [12,13]. According to the previous data infrasounds seem to produce a depression-like state. Although there is a lot of research work concerning this depressive reaction, little is known about the possible etiological biochemical factors. It is also known that substances that influence noradrenergic mechanisms cause changes in the animal's activity and the conditioned avoidance response. Many research workers suggest that the role of NE in such behavioural alterations is very important.

Based on this hypothesis, we determined the changes of NE levels in rat brain, after exposure to different infrasound frequencies.

METHOD AND MATERIALS

Animals

The experiments were carried out with fifty-three male Wistar rats, weighing on the average of 250 g. Four groups were formed: A) animals exposed to a normal environment; B) animals exposed to infrasound environment of 2 Hz and sound level of 105 dB; C) animals exposed to infrasound environment of 7 Hz and sound level of 122 dB; and D) animals exposed to infrasound environment of 26 Hz and sound level of 124 dB.

Apparatus

The apparatus used was an infrasound generation system, consisting of a low voltage supply and the infrasound chamber, described elsewhere [12].

Estimation of NE

NE was estimated fluorometrically by the method of Anton and Sayre [2], with slight modifications. Up to 2 g of tissue (immediately frozen until used) were homogenized in 10 ml 0.4 N perchloric acid. The formation of the fluorescent trihydroxyindole derivatives was made with 0.15% solution of potassium ferricyanide alkaline ascorbate solution. The Amino-Bowman Spectrofluorometer (A1C) was used to measure fluorescence using slit arrangement 0.2.

Procedure

The laboratory animals were tested between the hours of 15:00 and 19:00, in a room insulated from external noise, under constant light and a temperature of 22°C. The exposure to different infrasound treatments was made during the day and all biochemical assays were run under the same experimental conditions. Each animal was exposed to infrasound environment in a 1 hr session and then was immediately sacrificed by decapitation. Whole brains were removed as quickly as possible and the cerebellum was discarded. The brains were weighed and frozen on dry ice. The decay time of NE was controlled in a series of experiments and the chosen storage time (5 days) was the same for all the groups. The statistical analysis of the data was performed using the t test method.

1We appreciate the technical assistance of J. Kotsi.
Brain levels of NE were measured in rats exposed to a normal environment and in rats exposed for 1 hr to different frequencies of infrasound.

The results are presented in Fig. 1. Infrasounds decreased the brain levels of NE. The most significant differences from controls were obtained for the 7 Hz/122 dB and for the 16 Hz/124 dB.

DISCUSSION

It is clear from the above results that infrasounds affect brain NE levels in the rat. In previous publications we reported the effect of infrasound on exploratory and locomotor activity and the conditioned avoidance response in rats [12, 13]. Those data lead to the hypothesis that infrasounds exercise an inhibitory effect on behaviour by a decrease in NE brain concentrations.

Some parallelisms between the effects of infrasounds and those agents influencing the noradrenergic mechanism are possible. Drugs that increase NE levels in the brain such as amphetamine or DOPA [3, 10] augment locomotor activity. On the other hand drugs which decrease brain NE levels such as reserpine [7], α-methyltyrosine [9, 15], diethylidithiocarbamate and disulfiram [1, 2, 14] produce sedation in rats and disrupt conditioned avoidance responding. Great caution, however, should be exercised when attempting to relate behaviour to concentration of brain NE, because, as Goldstein and Muñoz point out, NE normally has dual actions on central receptors or acts on two types of receptors but with a predominant effect on one of them [8]. This work does not attempt to explicate the mechanism of action of infrasound, or even to correlate the changes of brain NE levels with the alterations in the behaviour observed, but to demonstrate that this alteration in behavior is an indication of biochemical disturbances following exposure to infrasound. Also, the observed decreases in brain norepinephrine levels of rats exposed to infrasound environment cannot be attributed solely to either frequency or intensity of infrasound, because in the present work we have used the same infrasound parameters as in our previous works. The possibility of varying frequencies independently of intensities of infrasounds will be the subject of our further investigation.

REFERENCES