LITERATURE CITED

1. I. M. Belenkaya, I. L. Zarubina, and L. V. Spitkovskaya, Arkh. Anat., No. 1, 72 (1977).
2. L. I. Berezinskaya and L. S. Baiteryakova, Vestn. Oftal'mol., No. 1, 11 (1963).
3. V. F. Bogoyavlenskii, Kazan. Med. Zh., No. 4, 306 (1976).
4. É. I. Daktaravichene, in: Abstracts of Proceedings of a Scientific Conference of Cardiologists of Lithuania [in Russian], Kaunas (1964), p. 29.
5. I. M. Zaalishvili, "Investigations of the peripheral circulation in essential hypertension," Author's Abstract of Doctoral Dissertation, Tbilisi (1952).
6. D. M. Zubairov, I. V. Litvinov, I. V. Soboleva, et al., Kazan. Med. Zh., No. 3, 60 (1975).
7. N. D. Kitaeva and M. M. Porotikova, Kazan. Med. Zh., No. 4, 23 (1974).
8. F. Ya. Primak, Med. Zh., No. 1, 79 (1949).
9. Yu. D. Romanov, Klin. Med., No. 8, 39 (1958).
10. A. I. Strukov and A. M. Vorob'eva, Kardiologiya, No. 11, 8 (1976).
11. A. M. Chernukh, P. N. Aleksandrov, and A. V. Alekseev, The Microcirculation [in Russian], Moscow (1975).
12. A. M. Chernukh, P. N. Aleksandrov, and D. I. Shagal, Kazan. Med. Zh., No. 4, 302 (1976).
13. E. Maggio, Microhemocirculation: Observable Variables and Their Biologic Control, Springfield (1965).
14. T. Suzuki, S. Tominaga, and T. Nakamura, Microcirc. Res., 12, 319 (1976).
15. R. Wells (ed.), The Microcirculation in Clinical Medicine, New York (1973).

EFFECT OF ELECTROACUPUNCTURE ON MANIFESTATIONS OF EMOTIONAL STRESS DUE TO PAIN

B. V. Andreev, Yu. N. Vasil'ev, Yu. D. Ignatov, A. T. Kachan, and N. N. Bogdanov

UDC 615.814.1.015.4:613.863

KEY WORDS: acute emotional stress; electroacupuncture; diazepam.

An important factor in the search for methods of correcting emotional stress is the study of mechanisms of formation and triggering of endogenous stress-protective systems, to which, in the modern view, the positive-reinforcing and antinociceptive systems of the brain belong [4]. It can be tentatively suggested that one possible way of triggering these antistressor systems may be by acting on specific acupuncture points, for the data already obtained are evidence that the use of acupuncture, in certain situations, can abolish a state of distress [8].

The object of the present investigation was to study the stress-protective action of acupuncture and to compare it with the effect of a typical antistressor agent from the group of benzodiazepine tranquilizers, namely diazepam, which has a distinct action on positive reinforcement systems and on antinociceptive mechanisms [2, 5].

EXPERIMENTAL METHOD

Experiments were carried out on 73 male rats weighing 250-300 g. Stress was induced by a modified Zabrodin's [7] technique, under conditions of immobilization, by electrical stimulation of the base of the tail (20 Hz, 10 msec, 30 V) with needle electrodes for 3 h, for periods of 30 sec every 2.5 min.

Electroacupuncture was carried out by means of standard acupuncture needles corresponding to the Da-Chui (TM-14) acupuncture point, throughout the period of stressor stimulation. This point was chosen on

Department of Pharmacology, Academician I. P. Pavlov First Medical Institute, and Course in Reflex Therapy, S. M. Kirov Postgraduate Medical Institute, Leningrad.

(Presented by Academician of the Academy of Medical Sciences of the USSR V. G. Baranov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 91, No. 1, pp. 18-20, January, 1981. Original article submitted February 12, 1980.

TABLE 1. Effect of Electroacupuncture and Diazepam in a Dose of 2.5 mg/kg on Manifestations of Pain-Induced Emotional Stress in Rats (M ± m)

Experimental conditions	No. of expts.	No. of erosions	Emotional reactivity, points	Aggressiveness, points
Control	10	0	1,20±0,13	1,20±0,20
Stress	10	8,6±1,0 $P_{1-2}<0,001$	0.10±0,10 $P_{1-2}<0,001$	0,50±0,17 $P_{1-2}<0,05$
Stress + diazepam	10	2,80±0,53 $P_{1-3}<0,001$ $P_{2-3}<0,001$	0,60±0,22 $P_{1-3}<0,05$	2,40±0,27 $P_{1-3}<0,01$ $P_{2-3}<0,001$
Stress + electroacupuncture at acupuncture point	10	3,00±0,75 $P_{2-4}<0,001$	0,70±0,21 $P_{2-4}<0,05$	2,70±0,30 $P_{2-4}<0,001$
Stress + electroacupuncture outside acupuncture points	5	14,00±2,09 $P_{1-5}<0,001$ $P_{2-5}<0,05$	1,20±0,73	1,80±0,73

the basis of clinical data on the broad spectrum of effects (including sedative) which can be obtained by activation of this point, and its high efficacy for the treatment of neuroses. The median location of this point in the "portal zone," with extensive reflex connections [6], also was taken into account. The parameters of stimulation were 1 Hz, 1 msec; the intensity of stimulation was chosen individually for each animal depending on the appearance of small fibrillations of the muscles in the region of the needle.

The after-effects of stressor stimulation were assessed on the basis of the appearance of erosions and ulcers in the stomach [7] and also of changes in emotional reactivity and aggressiveness to being held in the hand and to the bringing up of a metal rod, respectively, in accordance with the techniques described previously [1, 9].

The nociceptive response to stimulation of the base of the tail, of gradually increasing intensity, was assessed in freely behaving rats, by means of a scale devised by the authors themselves from the frequency of appearance of the corresponding components of the complex nociceptive response [3]. The base of the tail was stimulated by bipolar electrodes in the elastic membrane, by short series of pulses (10 Hz, 1 msec, 1 sec, 30-100 V). Diazepam was injected intraperitoneally in a dose of 2.5 mg/kg 30 min before the experiment began. The results were subjected to statistical analysis by Student's t-test.

EXPERIMENTAL RESULTS

Stress induced a significant change in the emotional and physical state of the animals. As Table 1 shows, erosions and ulcers appeared in the gastric mucosa and emotional reactivity and aggressiveness diminished.

Diazepam reduced the pathological effects of the stress situation. This was manifested as a statistically significant decrease in the number of erosions. At the same time, the emotional response to external stimuli was significantly reduced compared with animals exposed to stress without preliminary diazepam premedication. Moreover, in the animals of this group aggressiveness was increased, as shown by the more frequent deliberate attacks on the provocative object.

Emotional reactivity was assessed in points: 0) no response, 1) squeaks softly or tries to get away, 2) squeaks more loudly and tries to get away, 3) squeaks and tries to bite the hand. Aggressiveness also was assessed in points: 0) no response, 1) turns away, 2) sniffs at the rod, 3) single bites, 4) attack and multiple bites.

Electroacupuncture had a distinct stress-protective action, comparable with the effect of diazepam (Table 1). In rats exposed to stress against the background of electroacupuncture, the number of gastric ulcers was significantly less than in control animals subjected to stress only. At the same time emotional reactivity was depressed and aggressiveness was increased, just as in the series with diazepam premedication.

A series of special experiments showed that diazepam in a dose of 2.5 mg/kg caused no significant changes in the structure of the nociceptive response, whereas after electroacupuncture at the Da-Chui point, a comparatively small increase was observed in the threshold of appearance of individual components of the response, reflecting the emotional-behavioral reaction to intensive nociceptive stimulation.

The results of these investigations thus indicate that electroacupuncture has a stress-protective action comparable with the effects of diazepam. The results showing the absence of any marked analgesia under the influence of diazepam and of electroacupuncture lead to the conclusion that the stress-protective effect was not entirely associated with the pain-relieving action of the latter.

The antistressor effect of diazepam has been explained on the grounds of its effect on the positive–negative reinforcement systems and the antinociceptive systems of the brain [4]. It has now been shown that the antinociceptive effect is not only a mechanism of central analgesia, but also an operant method of self-regulation and self-protection from the effects of stress, and it is realized both by a decrease in the intensity of the ascending nociceptive flow and by correction of the emotional-behavioral response [5]. Characteristically diazepam, through its action on antinociceptive systems, modulates exclusively the emotional-behavioral components of the response to stressor stimulation and depresses the activity of the negative reinforcement systems, while at the same time activating the zones of "positivity" [2].

LITERATURE CITED

1. L. Kh. Alikmets and A. M. Zharkovskii, Zh. Vyssh. Nerv. Deyat., No. 6, 1284 (1975).
2. B. V. Andreev, E. Sh. Arshanskii, É. G. Galust'yan, et al., in: Neuropharmacological Aspects of Emotional Stress and Drug Dependence [in Russian], Leningrad (1978), pp. 56-60.
3. B. V. Andreev, Yu. N. Vasil'ev, V. P. Kosinskii, et al., in: Neuropharmacological Aspects of Emotional Stress and Drug Dependence [in Russian], Leningrad (1978), pp. 38-48.
4. A. V. Val'dman, N. M. Kozlovskaya, and O. S. Medvedev, Pharmacological Regulation of Emotional Stress [in Russian], Moscow (1979).
5. Yu. N. Vasil'ev, A. V. Dmitriev, and Yu. D. Ignatov, in: Neuropharmacological Aspects of Emotional Stress and Drug Dependence [in Russian], Leningrad (1978), pp. 27-38.
6. V. G. Vogralik and M. V. Vogralik, Needle Reflex Therapy (Puncture Reflex Therapy) [in Russian], Gor'kii (1978).
7. O. N. Zabrodin, Farmakol. Toksikol., No. 1, 32 (1978).
8. I. A. Sytinsky and L. V. Galebskaya, Addict. Behav., 4, 97 (1979).
9. T. Yamamoto and S. Ucki, Physiol. Behav., 19, 105 (1977).

EFFECT OF CHRONIC STRESS ON BEHAVIOR, PHYSICAL STATE, AND BRAIN TYROSINE HYDROXYLASE ACTIVITY OF EMOTIONAL AND UNEMOTIONAL RATS

N. A. Bondarenko, V. A. Kamysheva, M. F. Mineeva, and A. V. Val'dman

UDC 612.821.3-06:613.863]:612.6.051

KEY WORDS: chronic stress; emotionality; tyrosine hydroxylase; ulcers.

The role of genetic factors in responses of animals to stress has been established. High reactivity of "emotional" BALB/cI mice correlates with lower activity of the benzodiazepine receptors of the brain. In mice of "unemotional" lines (C57BL/10I, C57BL/6I) the affinity and density of the benzodiazepine receptors are significantly higher [11]. Differences have been found in the predisposition of rats of the August, Wistar, and Wag lines to emotional stress [7], but within each line animals predisposed and resistant to stress, with differences in their brain biogenic amine metabolism, can be distinguished [4]. Among populations of noninbred animals (cats, rats, mice) it is also possible to distinguish groups which differ considerably in their response to a stress situation and in their sensitivity to psychotropic drugs [2, 6].

On the basis of existing data showing the leading role of the brain catecholamine systems in the dynamics of the stress reaction [12], it was decided to estimate the activity of tyrosine hydroxylase (TH) in the brain, as a key component in catecholamine biosynthesis, together with behavioral and physical manifestations of exposure to chronic stress in rats with different levels of initial emotional and behavioral reactivity.

Institute of Pharmacology, Academy of Medical Sciences of the USSR, Moscow.

Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 91, No. 1, pp. 20-22, January, 1981. Original article submitted June 20, 1980.