Changes in Monoamine Oxidase Activity in Rat Liver during Stress

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ABSTRACT—Effects of some stresses on monoamine oxidase (MAO) activity in rat liver were investigated. Cold stress decreased MAO-A activity. Immobilization stress (IMMO) significantly decreased both MAO-A and MAO-B activities. The MAO-A/MAO-B ratio of the cold stress was significantly decreased, but IMMO was not significantly decreased. These results suggest that cold stress, but not IMMO may change the proportions of the multiple forms of MAO activity.

Keywords: Cold stress, Immobilization stress, Monoamine oxidase

Stresses inducing catecholamine biosynthetic enzymes include forced swimming, electroshock and insulin administration (1). Immobilization causes an increase in the plasma epinephrine and norepinephrine concentration in rat plasma (2). Some evidence indicate that stress can cause a reduction in monoamine oxidase (MAO, EC 1.4.3.4.) activity (3, 4). It is important to investigate the relationship between MAO activity and the condition of stress. MAO is divided into two subtypes, termed form A (MAO-A) and form B (MAO-B). At physiological concentrations, 5-hydroxytryptamine (5-HT) is metabolized by MAO-A alone and β-phenylethylamine (β-PEA) metabolized by MAO-B. The distributions of MAO-A and MAO-B are different among tissues of various species (5, 6). In this study, we examined the changes in MAO activity in rat liver subjected to cold stress or immobilization stress (IMMO).

Male Wistar rats weighing 200-250 g at the start of the experiment were kept at room temperature (control group) or −3℃ continuously for 7 days (cold-stress group). Rats from the IMMO group were immobilized for 2 hr after being kept under the same conditions as the control group. IMMO was carried out by taping all four limbs of the rat to metal mounts attached to a board (7). The rats were decapitated with a guillotine, and their livers were quickly removed and homogenized in 10 vol. of 10 mM phosphate buffer, pH 7.4 containing 0.25 M sucrose. MAO activities in the rat liver homogenates were assayed radiochemically with [^{14}C]5-hydroxytryptamine (5-HT) (substrate for type A MAO, final concentration of 100 μM) a [^{14}C]β-phenylethylamine (β-PEA) (substrate for type B MAO, final concentration of 10 μM) as described earlier (8). Protein concentration was determined by the method of Lowry et al. (9). The data are expressed as means±S.E. The mean values of the S.E.M. index were analyzed for significant differences by Student's *t*-test.

As shown in Table 1, the correlation of the activity of MAO-A and MAO-B in rat liver during the control, cold stress or IMMO was examined. Cold stress decreased MAO-A activity, but this change was not significant. However, cold stress changed the ratio of MAO-A/MAO-B in rat liver. The MAO-A/MAO-B ratio of the cold-stress group was significantly decreased from 1.21±0.12 to 0.86±0.12 ($P<0.05$). IMMO significantly decreased both MAO-A and MAO-B activity. The MAO-A/MAO-B ratio of the IMMO group was decreased to 0.90±0.08, but this change was not significant (Fig. 1). Cold stress, but not IMMO, may change the proportion

Table 1. Effects cold stress and immobilization stress (IMMO) on MAO activity in rat liver

Group	Specific MAO activity [nmole/min/mg protein]	
	5-HT	β-PEA
Control	2.26±0.24	1.88±0.04
Cold stress	1.81±0.27	2.10±0.12
IMMO	1.43±0.17*	1.59±0.11*

MAO activity was assayed radiochemically. Substrate concentrations used were: 100 μM 5-HT and 10 μm β-PEA, final concentration. MAO activity is expressed as nmole/min/mg protein. Each value represents the mean±S.E. from five animals. Significantly different from values of the control: *$P<0.05$.

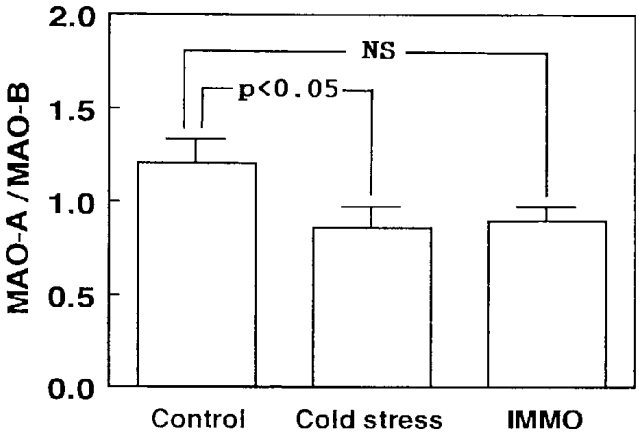

Fig. 1. Changes in the ratio of MAO-A/MAO-B in rat liver. Each column indicates the mean and S.E.M from five animals. IMMO: immobilization stress.

of the multiple forms of MAO activity in rat liver. It is known that stress causes increased activity of the endogenous MAO inhibitor (10). We have previously reported the existence of a thyroid hormone-inducible MAO inhibitor in rat liver (11). Further investigation is necessary to confirm the relationship between stress and the endogenous MAO inhibitor. These changes may account for the function of catecholamine degradation, at least in part. Because MAO has a high affinity for neurotransmitter monoamines such as norepinephrine (12), stress might influence the physiological function of the control and peripheral neuron systems by catalyzing the deamination of such neurotransmitter monoamines.

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