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Effect of Tyrosine on Cognitive Function and Blood Pressure Under Stress

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DEIJEN, J. B. AND J. F. ORLEBEKE. *Effect of tyrosine on cognitive function and blood pressure under stress.* BRAIN RES BULL **33**(3) 319–323, 1994.—The effects of tyrosine on mood, performance, heart rate and blood pressure of 16 healthy young subjects were assessed. Subjects were tested on two separate days, one test session after ingestion of 100 mg/kg tyrosine and the other test session after placebo, in random order. While performing a number of stress sensitive tasks, subjects were exposed to a stressor consisting of 90 dB noise. Tyrosine was found to improve the performance on two cognitive tasks, which were performed 1 h after administration of the medication and which could be characterized as highly sensitive to stress. In addition, tyrosine decreased diastolic blood pressure 15 min after ingestion, while 1 h after ingestion diastolic blood pressure was the same with tyrosine and placebo. No effects on mood, systolic blood pressure and heart rate were found.

Tyrosine Cognitive performance Stress Blood pressure Heart rate Mood

IN animal studies "stress-induced" depression was found to coincide with depletion of norepinephrine (NE) in specific brain regions (28). Stressful events cause an increase in transmission of noradrenergic neurons, particularly in the frontal cortex, because these neurons are activated by stress (17,7,11). A main innervation to the frontal cortex is produced by noradrenergic projections from the locus coeruleus (LC). This structure shows an increased electrical activity during stress (1,24). The activity of noradrenergic neurons within the LC is thought to influence attention, alertness, motor activity and anxiety (22). Indeed, stress-induced NE depletion was found to impair performance. For instance, in animal studies it was found that explorative and motor behavior was impaired after NE depletion caused by cold-swim stress (5,19). In humans NE depletion caused irrepressible eye movements during smooth pursuit and visual search. The finding that catecholamine depletion increased the amplitude and frequency of saccadic intrusions during fixation and pursuit implied that brainstem neurones use catecholamines to suppress saccades (27). However, no other effects of NE depletion on human behavior are known. In addition, it is unclear if stressful events cause NE depletion in human brain. Apart from this, behavioral effects of stress in humans are well documented. The main cognitive effects of stress can be summarized as being (a) attentional narrowing, (b) increased speed in information processing paired with less accuracy and (c) a decrease in the capacity of short-term memory (14). Whether these behavioral stress effects are associated with NE depletion is still unclear. On the peripheral nervous system the physiological effects of stress can be summarized as being increased heart rate, blood pressure, muscle tonus, skin conductance and respiration rate. In addition biochemical changes take place, that is, increases in the concentration of catecholamines (12,9,13).

The precursor of norepinephrine, dopamine and epinephrine is the large neutral amino acid tyrosine, which is present in dietary proteins. Tyrosine reaches its maximum concentration in mice brain 1 h after oral ingestion, while 4 h after administration the baseline concentration is present again (26). There is evidence that tyrosine enhances catecholamine synthesis in particular noradrenergic neurons, when these neurons are physiologically active and firing frequently (10,21). With respect to dopamine, supplemental tyrosine in anaesthetized rats was found to enhance dopamine concentrations in the extracellular fluid of corpus striatum and nucleus accumbens. Thus, supplemental tyrosine increased dopamine release, even when the animals did not receive treatment to accelerate the firing of dopaminergic neurons (8,30).

In animal studies tyrosine was shown to prevent NE depletion and negative behavioral effects after stress induction (5,19). The possible beneficial effect of tyrosine on humans who are exposed to acutely stressful conditions was studied quite recently (4). Young male subjects were supplemented with 100 mg/kg tyrosine before exposure to cold and hypoxia. Tyrosine reduced stress-symptoms like headache, tension and fatigue and decreased performance impairments in subjects who were adversely affected by these environmental conditions. Performance measurements consisted of the assessment of vigilance, pattern recognition, choice reaction time and arithmetic skills.

It is clear that only limited evidence of the stress reducing effects of tyrosine in humans exist. Therefore, the present study was designed to investigate whether tyrosine reduces cognitive

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