TESTICULAR ENDOCRINE FUNCTION IN BABOONS (*Papio hamadryas*) UNDER CHRONIC EMOTIONAL STRESS

G. V. Katsiya, A. M. Chirkov, and N. P. Goncharov

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The attention of research workers has recently been drawn to the character of changes in testicular endocrine function during stress. A considerable fall in the blood testosterone level of men has been found during attacks of angina [3], and in myocardial infarction [1], diabetes [4], burns [7], after surgical operations [13], and in terminal states [6]. Inhibition of testicular endocrine function in baboons (*Papio hamadryas*) during acute stress has been shown to be more intensive and of longer duration than the rise in blood levels of cortisol and its precursors [2]. Some workers suggest that regressive changes in the testes and the fall in testosterone concentration are adaptive reactions to stress of the same kind as catecholamine release and the rise in the blood glucocorticoid level [8]. There is also evidence of increased nonspecific resistance of experimental animals to stress after castration [5]. Meanwhile there have been very few experimental studies of blood testosterone levels in stress. In the great majority of such investigations small laboratory animals, differing considerably from man in the spectrum of steroids they produce, including androgens, have been used as test objects [11, 14].

The object of this investigation was to study the character of changes in testicular endocrine function in monkeys during intermittent immobilization stress.

EXPERIMENTAL METHODS

Experiments were carried out on intact mature male baboons (*P. hamadryas*) of two groups (with five animals in each group), born and reared at Sukhumi Primatologic Center. The body weight of the baboons varied from 25 to 35 kg and their age from 8 to 10 years. Emotional stress was produced by strict immobilization for 2 h, which is a powerful psychoemotional stimulus for monkeys of this species [10]. In the experiments of series I the animals were immobilized for 2 h daily for 6 days; in series II the animals were exposed to a similar cycle of stress, but after preliminary (3 days beforehand) immobilization for 2 h. Throughout the experiment the animals were kept in individual metabolic cages, equipped with a semiautomatic compressing device, enabling the length of time spent by the monkeys in the experiments to be considerably reduced. Arranging the metabolic cages in a special room, at a distance from the communal open-air cage eliminated the action of additional stress factors and enabled audiovisual contact to be preserved between the monkeys within the group. Immediately before the experiments began the baboons of each group were adapted to the situation and to the experimental conditions for 3 weeks (long enough for steroid equilibrium to be established in monkeys of this species kept in individual cages [9]). Blood was taken from the cubital vein in a volume of 2 ml, centrifuged at 1000g, and kept at −20°C. Blood was taken before immobilization (0) and 2-6 h after the beginning of each immobilization. During repeated exposure to immobilization the blood sample taken 24 h after the beginning of the previous immobilization acted as zero (0) for the next. During preliminary immobilization and after completion of the stress cycle, further blood samples were taken after 24, 48, and 72 h. Testosterone was determined by direct radioimmunoassay using antiserum obtained in the Laboratory of Experimental Endocrinology, Research Institute of Experimental Pathology and Therapy, Academy of Medical Sciences of the USSR (Technical Instruction No. 42.14336). The sensitivity of the method is 6.25 mg per sample. The volume of plasma used for determination was 10 µl.

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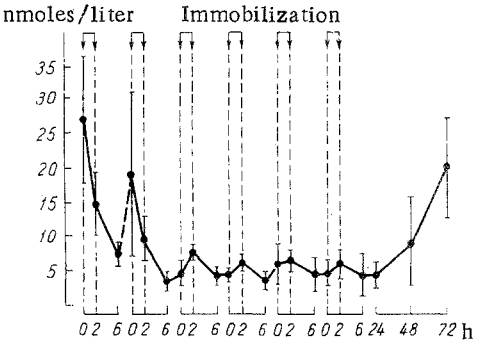

Fig. 1. Plasma testosterone concentration in baboons during intermittent immobilization stress. Abscissa, time (in h); ordinate, testosterone concentration (in nmoles/liter). Arrows and broken lines indicate periods of immobilization.

EXPERIMENTAL RESULTS

It will be clear from Fig. 1 that 2 h after the beginning of the first immobilization there was a significant ($P < 0.02$) decrease in the blood testosterone concentration which continued for, and after 6 h was 7.8 ± 0.1 nmoles/liter, or 70% below the initial level. After 24 h the testosterone level rose to 17.9 ± 5.4 nmoles/liter and did not differ significantly from that observed before the beginning of exposure to stress. The second immobilization led to an even greater fall in the blood androgen level, and it remained extremely low throughout the subsequent immobilization. Against the background of low testosterone concentration the dynamics of its response began to change after the 3rd immobilization. A brief rise of the blood androgen level was observed 2 h after the beginning of stress, and this increase remained significant ($P < 0.01$) for the 3rd and 4th immobilizations.

The results of this series of experiments thus showed that immobilization of the baboons for 2 h daily for 6 days leads to profound and stable inhibition of testicular endocrine function, which continues throughout the cycle of stress and for 2 days after its end.

The dynamics of the blood testosterone level in the course of a similar stress cycle, but preceded (3 days beforehand) by immobilization, is shown in Fig. 2. The dynamics of the fall of the testosterone level in response to preliminary immobilization was similar to that of the testosterone level after the first immobilization in the animals in the experiments of series I. Minimal values of testosterone concentration were observed 6 h after the beginning of exposure to stress and amounted on average to 30% of the initial level. On the 2nd day the testosterone concentration returned to its initial value. During subsequent immobilization of the 6-day stress cycle the curve reflecting the dynamics of the testosterone level showed a sharp drop for 2 h after the beginning of immobilization (by 70% on average), followed by rapid and complete recovery of the androgen concentration 6 h after the beginning of exposure to stress. On the 2nd-3rd day after the stress cycle in monkeys of the experiments of series II the blood testosterone level rose sharply to 2.6 times above the normal level.

As a result of these experiments two types of testicular endocrine response were discovered in the baboons to intermittent immobilization stress: prolonged depression of secretory activity, and a daily transient decline of secretory activity lasting 2 h. Since the only difference in the conditions of these experiments was the addition of preliminary immobilization of the animals in series II it can be postulated that preliminary immobilization is the factor responsible for the differences in the dynamics of the testosterone response.

During repeated exposure to stress, adaptation of another stage of hormonal regulation is known to develop — the pituitary–adrenal system. Under these circumstances the rate of adaptation depends on the conditions of exposure to stress [12]. On the basis of the results obtained a similar rule can be considered to apply to the response of the pituitary–gonadal system. Preliminary immobilization is a form of training and ensures high reactivity of the hypothalamo–hypophyseo–gonadal system during subsequent exposure to stress. Reducing the degree of inhibition of testicular endocrine function during chronic stress by preliminary exposure of monkeys to stress is an experimental basis for the elaboration of

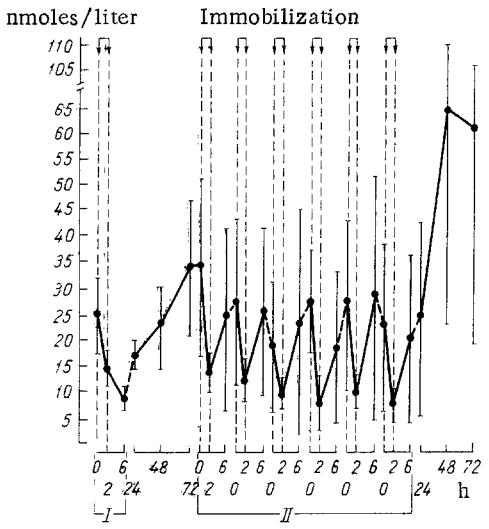

Fig. 2. Dynamics of plasma testosterone concentration of baboons during intermittent immobilization stress after preliminary immobilization. I) Preliminary immobilization, II) cycle of daily immobilizations. Remainder of legend as to Fig. 1.

rational programs of application of stress stimuli in order to increase the anabolic reserves of the body in man and animals exposed to prolonged psychoemotional loads.

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