# EFFECT OF CHRONIC ELECTRICAL STIMULATION OF THE AMYGDALOID COMPLEX ON COLLAGEN METABOLISM

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Short-term stimulation of the amygdaloid complex is accompanied by the development of hemodynamic stasis and by a rise in the blood levels of catecholamines and corticosteroids [2, 3]. The role of these hormones in the metabolism of the molecular components of connective tissue has been mentioned in the literature [9, 11].

The object of this investigation was to study collagen metabolism in the wall of the aorta during repeated and prolonged electrical stimulation of the amygdaloid complex.

## EXPERIMENTAL METHOD

Experiments were carried out on 32 adult rabbits weighing 2-2.5 kg. Bipolar nichrome electrodes were inserted [1] into the lateral nucleus of the amygdaloid complex of the experimental and control animals at coordinates AP 0, V 7.5, S 16, taken from an atlas of the brain. Square pulses (3-4 V, 0.5 msec, 70 Hz, 1 h) were applied for electrical stimulation on alternate days for 30 days (eight rabbits) and 90 days (ten rabbits). The control series consisted of 14 rabbits with implanted electrodes, which were not electrically stimulated. The animals were used in the experiments 10-11 days after the operation. At the end of the experiment they were killed by air embolism under ether anesthesia. Accuracy of location of the electrodes in the appropriate structure of the limbic system was determined histologically. Concentrations of catecholamines [5], 11-hydroxycorticosteroids (11-HCS) [6], and free and bound hydroxyproline [7] were determined in blood taken 40 min after stimulation in the course of the experiment. Collagenolytic activity [10, 12] and the concentrations of free and total hydroxyproline [8] were studied in the aortic wall.

## EXPERIMENTAL RESULTS

As Table 1 shows, the concentrations of adrenalin and 11-HCS in the blood rose significantly during electrical stimulation of the amygdaloid complex until the 30th day of the experiments. Thereafter the adrenalin level fell gradually to normal and then remained virtually unchanged, but the 11-HCS concentration continued to fall and by the end of the experiment it was 67% of its initial value. The noradrenalin concentration was reduced by 49% by the end of the experiment. During prolonged stimulation of the amygdala two maxima of the free hydroxyproline concentration in the blood serum were observed: after 10-30 and 60-90 days. The bound hydroxyproline level was significantly raised after the 45th day. A significant increase in the concentration of free and a decrease in the concentration of total hydroxyproline in the aortic tissue were observed 30 days after stimulation. By the end of the 3rd month of the experiments the levels of both free and total hydroxyproline were raised. The collagenolytic activity in aortic tissue homogenates from the experimental animals was significantly increased only on the 30th day of stimulation.

Free hydroxyproline is known not to take part in collagen biosynthesis in the tissues, but is formed during breakdown of this protein [4]. Accordingly it can be postulated that the rise in the free hydroxyproline concentration in the blood serum and aorta of the animals during stimulation of the amygdaloid complex reflects acceleration of collagen catabolism. This

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TABLE 1. Biochemical Parameters during Chronic Electrical Stimulation of the Amygdaloid Complex (M ± m)

| Parameters | Control | Duration of stimulation, days | | | |
|---|---|---|---|---|---|
| | | 10 | 30 | 60 | 90 |
| **Blood** | | | | | |
| Adrenalin, mmoles/liter | 21,87±2,98 | 39,67±3,53* | 32,91±3,67* | 22,01±3,60 | 21,12±3,13 |
| Noradrenalin, mmoles/liter | 97,74±8,17 | 91,13±7,95 | 86,88±7,52 | 60,92±4,70* | 50,32±4,89* |
| 11-HCS, μg/liter | 119,40±8,11 | 169,80±7,90* | 177,10±8,44* | 80,72±6,11* | 80,14±6,04* |
| Free hydroxyproline, μ moles/liter | 9,41±0,86 | 12,84±0,87* | 13,65±0,96* | 11,03±1,02 | 15,77±1,07* |
| Bound hydroxyproline, μmoles/liter | 5,78±0,54 | 6,13±0,73 | 6.33±0,69 | 6,21±0,70 | 9,86±0,84* |
| **Aorta** | | | | | |
| Free hydroxyproline, dry defatted tissue, g/kg | 0,77±0,06 | — | 1,17±0,08* | — | 1,31±0,082 |
| Total hydroxyproline, defatted tissue, g/kg | 30,60±2,01 | — | 22,9±1,73* | — | 38,40±1,97* |
| Collagenolytic activity, mg hydroxyproline/g protein/g tissue | 0,52±0,06 | — | 0,79±0,07* | — | 0,59±0,06 |

*$P \leq 0.05$.

conclusion is confirmed by the decrease in the total hydroxyproline content and the increase in collagenolytic activity in the aortic wall on the 30th day of the experiment. However, a second increase in free and bound hydroxyproline in the blood serum and the parallel rise in the total hydroxyproline content in the aortic wall toward the end of the experiment indicate that collagen synthesis takes place more rapidly than its catabolism. During this period the collagenolytic activity was close to normal.

It is worth noting that the increase in the 11-HCS concentration in the experiments described above coincided with a decrease in the collagen content and, conversely, a fall in the concentration of these hormones corresponded to gradual accumulation of collagen in the aorta. This does not contradict data in the literature on the direction of action of these hormones on collagen metabolism [9, 12, 13]. No agreement was found between the direction of the changes in catecholamine concentration and the parameters of collagen metabolism in the present experiments.

It can thus be postulated that shifts in collagen metabolism during chronic electrical stimulation of the amygdaloid complex are connected with changes in the concentrations of corticosteroid hormones in the blood.

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