Frequency of spontaneous impulsation in rat cervical sympathetic nerve preganglionic fibres after chemical sympathectomy

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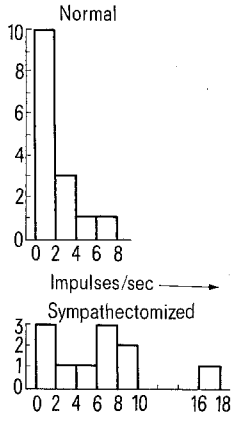
Summary. The frequency of spontaneous activity of single preganglionic fibres in the cervical sympathetic nerve of sympathectomized and intact animals was compared, and was found to be higher in the sympathectomized group, averaging 5.9±1.4 pulses per sec, compared with 2.3±0.5 in the control group.

After chemical sympathectomy, a number of changes take place in the chromaffin tissue of adrenal glands and in the sympathetic cells not destroyed by sympathectomy. These changes which may be considered as adaptive, aimed at compensating for the insufficiency of the sympathetic system, consist in the hypertrophy of the adrenal medulla, and increased activity of the enzymes synthesizing catecholamines in the adrenal glands and sympathetic ganglia[1–4]. There are also reasons to assume an active growth of axones in the differentiated sympathetic neurons that have survived sympathectomy, namely: 1. the ultrastructural changes observed in these neurons correspond to those accompanying the growth of axones in the neurons of intact animals; 2. in sympathectomized animals pressor reflexes to blood pressure are depressed at the age of 1.5 months but reestablished at 3 months; 3. responses of blood pressure to tyramine, a sympathomimetic of indirect action, are diminished at 1.5 months and restored at the age of 3 months, and 4. no adrenergic endings could be revealed in the arteries of the heart by the fluorescent histochemical method, at 1.5 months, but they were clearly distinguishable at 3 months (for greater detail[5,6]). In all the works referred to[1–6], the changes described above are assumed to be caused by an increase in the frequency of impulsation transmitted by the preganglionic fibres. As far as we know, this assumption has never been experimentally verified. The objective of our work was to investigate the frequencies of single preganglionic fibres in rats with a partially destroyed sympathetic system.

Methods. Chemical sympathectomy was performed with guanethidine[7,8]. The drug (guanethidine Pliva, Yugoslavia) was injected s.c. to newborn rats daily, for 2 weeks, beginning with the 1st day of life, in doses of 25 mg/kg. The effectivity of sympathectomy was evaluated by the decrease in number of stellate ganglia neurons in histological sections. The histological method of determination has been described elsewhere[9].

In the experiments, chemically sympathectomized rats aged 1.5–2 months were used, anaesthetized with urethane (500 mg/kg, i.p.). The skin of the neck was incised along the median line and its edges extended so as to form a pocket which, then, was filled with warmed vaseline oil. The sheath of the cervical nerve was removed and samples of nerve tissues were taken with electrolitically sharpened hooks. The activity of the fibres in the samples was investigated and the impulsation registered on a pen recorder. The average frequency of impulsation in each fibre was calculated for time intervals of not less than 2–3 min. Statistical significance of the difference between the control and experimental data was estimated using the Student t-test.

Results. For histological control, 2 sympathectomized and 2 intact 2-month-old animals were used. Guanethidine treatment was found to reduce the number of neurons in the stellate ganglia to 14–15% of control. Spontaneous activity of single fibres was investigated in 10 control rats, and in 9 rats with a partially destroyed sympathetic system. In the control group, impulsation was registered in 15 single fibres. As amplitudes for higher than the noise level were recorded from relatively thick filaments, all these fibres should be assigned to the category of myelinated preganglionic ones. Sometimes the pulses were grouped in packets of 2 or 3 in the cardiac or respiratory rhythm, sometimes no groupings were observed. The frequencies recorded in the fibres ranged from 0.4 to 7.8 pulses per sec with an average of 2.3±0.9 for the entire group of control animals. In the experimental group, spontaneous impulsation was registered in 11 single fibres. The frequencies ranged from 0.5 to 16.4 pulses per sec, with an average of 5.9±1.4 for the entire group of experimental animals. The difference is statistically significant ($p < 0.05$). It was also found that, in sympathectomized animals, the activity of single fibres is distinctly recorded from finer filaments than in intact animals; this fact propably indicates a higher value of active/inactive fibres ratio in sympathectomized animals. A histogram showing the distribution of fibres according to frequency of impulsation, is given in the figure. The fact that the frequency of spontaneous impulsation is higher in the preganglionic fibres of sympathectomized animals, provides additional evidence in favour of the suggestion that the enzymatic and plastic changes in the cells of the adrenal medulla, and the neurons of sympathetic ganglia that have survived sympathectomy, are caused by the increased impulsation transmitted by the preganglionic sympathetic fibres.



Histogram of frequency distribution of the impulsation in preganglionic fibres from cervical sympathetic nerve, in intact and sympathectomized rats.

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