Changes in the Sensitivity of the Carotid Sinus Receptors during Aging

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Reflexes from the carotid sinus receptors play an important role in the regulation of various vital functions. The pattern of formation of reflexes from the carotid sinus region in early ontogenesis has been studied in detail [3, 4, 9], yet, so far as we know, no experimental investigation of these reflexes during aging has been undertaken. We can cite only clinical observations concerning the changes in Czermak's sinus reflex in elderly and old people [10, 11].

It was considered important to study the changes in the reflexes from the pressure and chemical receptors of the carotid sinus region at this age period in response to the action of mechanical and chemical stimuli.

Experimental Method

Investigations were conducted on 80 rabbits and 25 cats in acute and chronic experiments under chloral hydrate or urethane anesthesia. Fifty of the animals were young (1-1½ years) and 55 were old (rabbits aged 3½-4 years, cats aged 8-10 years). The blood pressure in the carotid artery (by means of a mercury manometer) and the respiration (by means of a tracheal cannula or a cannula connected to the nasal cavity) were recorded in these animals. The mechanoreceptors of the carotid sinus were stimulated by compressing the common carotid artery and by orthostatic tests, and the chemoreceptors were stimulated by injecting chemical stimuli into the isolated carotid sinus and by means of the technique used in S. V. Anichkov's laboratory. This method consists of the intravenous injection of substances which act reflexly on the respiration and circulation, by stimulating the chemoreceptors of the carotid region [1, 2, 6, 7]. As chemical stimuli we used nicotine and cytisine (cholinomimetic substances) and sodium sulfide (an anoxic agent).

Experimental Results

The experiments showed that the sensitivity of the mechanoreceptors of the carotid sinus undergoes various changes during aging.

The pressor reflexes caused by compression of the common carotid arteries were smaller in magnitude in the old animals than in the young. In the young rabbits, for instance, the elevation of the arterial pressure after compression of the carotid arteries was 30-60 mm Hg (20 experiments), and in the old rabbits 15-85 mm Hg (25 experiments). Similar results were described by V. V. Prol'kis [8].

An indirect idea of the change in sensitivity of the mechanoreceptors of the carotid sinus was given by experiments involving orthostatic tests, in which the animals were transferred into a vertical position — with the head downward or upward. When the head was turned downward the pressure measured in the carotid artery rose, and when the head was turned upward, the pressure fell. Reflexes from the mechanoreceptors of the carotid sinus are known to play an important part in the restoration of the initial level of the blood pressure during orthostatic tests. The experiments showed that the rise and fall of the general arterial pressure in the old animals during the orthostatic tests were more marked than in the young, which indicates that the reflexes from the mechanoreceptors of the carotid region become weaker during aging. This was confirmed by experiments in which the orthostatic tests were studied before and after denervation of the carotid sinuses. These showed that after denervation more marked changes in the blood pressure were observed in the young animals than in the old.
In the next series of experiments we studied the sensitivity of the glomus to the action of various chemical stimuli — sodium sulfide, cytisine, and nicotine.

These experiments showed that the old animals were more sensitive to the action of chemical stimuli than the young. For instance, after the intravenous injection of sodium sulfide into the old rabbits, marked dyspnea developed in response to a dose of 0.25 ± 0.015 mg/kg (27 experiments), and in young rabbits in a dose of 0.47 ± 0.031 mg/kg (30 experiments). The threshold doses of cytisine for the young cats (9 experiments) varied from 1.4 to 5 µg/kg, with an average value of 3.15 ± 0.47 µg/kg, and for the old cats (12 experiments) it varied from 0.4 to 1.8 µg/kg, with an average value of 0.81 ± 0.13 µg/kg.