Morphology of the rat carotid sinus nerve. 
II. Number and size of axons

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Summary

Ten carotid sinus nerves from five rats were examined by electron microscopy at a level of 0.5 mm from the glossopharyngeal nerve (nerve IX). The sinus nerves were found to contain from 455 to 757 (mean 625) axons per nerve, of which an average of 86.3% were unmyelinated. The unmyelinated axons had a size distribution that fitted a Gaussian distribution with a mean diameter of 0.78 μm and a variance of 0.013 μm. Such axons ranged in size from 0.17 to 1.7 μm. The myelinated axons had a unimodal size distribution skewed to the right, with a median total fibre diameter of 2.49 μm. Although total diameter of myelinated fibres ranged from 1.5 to 5.3 μm, 96% of such fibres were smaller than 4 μm. Axon diameter of myelinated fibres averaged 64% of the total diameter, but this proportion tended to increase with the size of the axon. Some 68% of myelinated fibres had axons with a diameter within the range of sizes of unmyelinated axons.

The number of axons varied along the length of the sinus nerve, but no consistent pattern of change was found among different rats. The two nerves examined at 0.1 and 0.5 mm from nerve IX had 8-10 more myelinated axons at the more distal level, and the number of unmyelinated axons increased by four in one nerve but decreased by 26 in the other nerve. In three nerves examined at 0.5 and 2.0 mm from nerve IX, the number of unmyelinated axons increased from proximal to distal by 11 (2%) to 220 (43%), whereas the number of myelinated axons increased by 20 (48%) in one nerve but decreased by 7-10 (13-21%) in the others.

One day after nerve IX was cut distal to the petrosal ganglion, most myelinated axons in the sinus nerve were degenerating and only 109 unmyelinated axons were still present. By four days all but two myelinated axons were gone and the normal complement of unmyelinated axons was replaced by more than 1800 rounded profiles, most of which probably were pseudopodia of reactive Schwann cells. Transection of nerve IX central to the petrosal ganglion did not produce such ultrastructural changes in Schwann cells, nor did it reduce the number of axons in the sinus nerve to a degree sufficient to be detected by the counting procedure. Although these results indicate that most axons in the sinus nerve are sensory, some nonsensory axons undoubtedly are present too. The sensory and nonsensory axons in the nerve apparently are closely associated with one another and in some cases might be enveloped by the same Schwann cells.
Introduction

The carotid sinus nerve is a thoroughfare for chemoreceptive axons from the carotid body, baroreceptive axons from the carotid sinus, and autonomic axons from several sources. Midway along its length, the cat sinus nerve contains an estimated 2000 axons, of which some 68% are unmyelinated (de Castro, 1951; Eyzaguirre & Uchizono, 1961). Based on evidence from neurophysiological studies, Fidone & Sato (1969) estimated that in the cat two-thirds of the myelinated axons are chemoreceptors and the remainder are baroreceptors. Among the unmyelinated axons, an estimated 17% are chemoreceptors, 29% are baroreceptors, and 54% are sympathetics and other types of axons (Fidone & Sato, 1969).

Less is known about axons in the sinus nerve of the rat. An abstract by Mishra & Hess (1978) and a preliminary report of my own (McDonald, 1981, p. 111) are the only descriptions of the number of axons in the nerve, and the size of the axons has not been analysed in detail heretofore. The preceding paper (McDonald, 1983) presents a description of the course, connections, dimensions and ultrastructure of the rat sinus nerve. The present paper reports the results of a morphometric study in which: 1. the number and size of myelinated and unmyelinated axons in the sinus nerve were analysed; 2. the number of axons present at various levels of the nerve was determined; and 3. the number of axons present in the nerve was determined after the glossopharyngeal nerve (nerve IX) was cut central or peripheral to its sensory ganglia.

Methods

Ten female rats of the Long-Evans strain weighing 200–250 g were used in the study. Rats were anaesthetized, ventilated with oxygen and perfused with fixative, and the sinus nerves were removed and prepared for electron microscopy as described previously (McDonald, 1983).

Nerve Lesions

In axonal degeneration experiments, rats underwent a surgical procedure 1, 4 or 10 days before the tissues were prepared for electron microscopy. In three rats the right nerve IX was transected extracranially at a level between the petrosal ganglion and the origin of the sinus nerve. In two additional rats the roots of the right glossopharyngeal and vagus nerves were cut intracranially near the surface of the brain stem. The surgical approaches used were identical to those used in an earlier study (McDonald & Mitchell, 1975).

Quantitative methods

The number and size of axons were determined in cross-sections of sinus nerves prepared at specified levels with respect to nerve IX by using the method described previously (McDonald, 1983). Cross-sections (50–60 nm in thickness) of sinus nerves were mounted on single slot grids, and each nerve cross-section was photographed in its entirety by electron microscopy. Micrographs used for analysing the number and size of axons were made with a total magnification of approximately ×5000. The electron microscope was calibrated with a ruled diffraction grating (E. F. Fullman, Inc., Schenectady, New York).

Axons were counted in electron micrographs of the sinus nerves, and the size of axons in the micrographs was measured with a digitizer (Talos Model 614B, Scottsdale, Arizona) interfaced