Original articles

The percentage of nerve cell bodies arranged in clusters decreases with age in the spinal ganglia of adult rabbits

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Abstract. In the spinal ganglia of the rabbit the nerve cell bodies, which in early developmental stages are mutually in contact, come to be completely isolated from each other by a satellite cell sheath and by a connective envelope before birth. The present study demonstrates that in the early postnatal months some nerve cell bodies are still arranged in clusters, and that the percentage of these decreases progressively throughout adult life. This decrease probably arises because in some of the ganglion neurons the process of envelopment of the perikaryon by an individual sheath begins later, or takes place more slowly, than in the majority of cases. Therefore, the relationship between neurons and between neurons and satellite cells may change in certain clusters of nerve cell bodies under normal circumstances during adult life.

Key words: Spinal ganglia – Sensory neurons – Clusters of nerve cell bodies – Development of the spinal ganglion – Rabbit (New Zealand White)

Introduction

In the course of development of the spinal ganglia, the nerve cell bodies, which initially are in mutual contact, are progressively enveloped by a satellite cell sheath, which in turn comes to be surrounded by connective tissue (see Pannese 1974 and 1981 for details). This process results in the complete isolation of each nerve cell body from every other. However, occasional pairs or triplets of nerve cell bodies enclosed within a common connective tissue envelope have been observed in the spinal ganglia of various species, not only in newborn or young subjects (Fraenkel 1867; De Castro 1921; Mannu 1935; McCracken and Dow 1973), but also in adults (Hossack and Wyburn 1954; Wyburn 1958; Pannese 1981; Pannese et al. 1991).

However, as far as we know, no author has investigated the frequency with which nerve cell bodies occur arranged in clusters at various stages of postnatal life. We have carried out such a study not only to fill this gap in knowledge, but also in the hope of obtaining information able to provide clues to the mechanisms underlying this particular arrangement of sensory neurons.

Materials and methods

Eight New Zealand White rabbits of either sex and of ages 2 months, 5 months, 1 year and 5½ years (two animals of each age) were used. The animals were perfused transcardially with a solution containing 2% formaldehyde, 2% glutaraldehyde and 0.1 M sodium cacodylate buffer (pH 7.3) under general anaesthesia with Nembutal. After fixation for about 3 h, the thoracic spinal ganglia were removed, washed in cacodylate buffer (0.2 M, pH 7.3) for 2 h, and then postfixed at 0°C for 1.5 h in 2% OsO4, buffered with 0.1 M sodium cacodylate. The specimens were washed in distilled water, stained with 2% aqueous uranyl acetate, dehydrated in alcohol and embedded in Epon-Araldite resin.

In single sections, the clusters of nerve cell bodies escape identification as such in cases where the section passes through only one nerve cell body of the cluster. For this reason, a serial-section technique was used. Each ganglion was trimmed so as to eliminate the periphery containing the connective tissue capsule. A block with cutting surface of about 0.35 x 0.25 mm was thus obtained. Serial semithin sections (1 μm thick) were cut from this block with a diamond knife. Each section was inspected by light microscopy before cutting the next. After resin removal with sodium methoxide (Mayor et al. 1961), each semithin section was stained with gentian violet and basic fuchsin and then examined in the light microscope.

The first section of the series typically contained from 40 to 60 neuronal body profiles. Each section was carefully examined for nerve cell bodies arranged in clusters. Where it seemed that such an arrangement might be present (Fig. 1 A), thin sections immediately adjacent to the semithin one were cut. These thin sections were examined under the electron microscope to establish whether those previously identified in the light microscope were indeed clusters of nerve cell bodies (Fig. 1 B). When present, such clusters were photographed at a magnification of x10000. Subsequently, the next semithin section was taken and examined similarly. This procedure continued until the block had been consumed. Overall, 16 ganglia from 2-month-old rabbits, 11 ganglia from 5-month-old...
Fig. 1. A Light micrograph of a semithin section in which two nerve cell bodies appear organized in a cluster. Spinal ganglion of a 5½-year-old rabbit; x 550. B Electron micrograph of the thin section immediately adjacent to the semithin section shown in A. It can be seen that the two nerve cell bodies are indeed enclosed within a common sheath; v, blood vessel. x 6500