Pacinian corpuscles in rats with carbon disulphide neuropathy

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Summary. Adult Wistar rats were exposed to carbon disulphide vapours at a concentration of 2.4 mg/l of air for 5 days a week (6 h a day), and the ultrastructure of Pacinian corpuscles and their nerve supply was investigated after 6 months of exposure. Both degenerative and regenerative changes were observed in sensory axons and the corpuscles. In a sample of corpuscles examined, 30% were denervated and about 60% showed clear signs of reinnervation. Some of the reinnervated corpuscles were supplied by unmyelinated axons. In others, one to three myelinated axons were already found at the nerve entry. The axons branched and formed three to eight terminals in the inner core. Due to continuous intoxication, most regenerated terminals were again undergoing degeneration. In peripheral nerves, the evidence of axonal regeneration has been reported in various toxic distal axonopathies. However, the reinnervation of Pacinian corpuscles has not been described before. It can be expected that reinnervation of Pacinian corpuscles and other end-organs also occurs in other axonopathies, if not during continuous poisoning, then at least after its cessation.

Key words: Carbon disulphide neuropathy — Pacinian corpuscles — Denervation and reinnervation — Electron microscopy

Carbon disulphide (CS₂) induces peripheral distal axonopathy characterized by the formation of multifocal filamentous axonal swelling with concomitant nerve degeneration (Szendzikowski et al. 1973, 1974; Linnoila et al. 1975; Seppäläinen and Haltia 1980; Colombi et al. 1981; Jirmanová and Lukáš 1984). During axonopathy, both motor and sensory axons are damaged as is indicated by the clinical symptomatology of the disease (Vigliani 1954) and decreased conduction velocities of motor as well as sensory nerves (Lukáš 1969; Manu et al. 1970; Seppäläinen et al. 1972; Vasilescu 1972, 1976). As can be expected, not only axons but also their terminals are affected. So far, the formation of filamentous swelling and degeneration of motor nerve terminals resulting in denervation of muscle fibres have been described in CS₂-treated rats (Juntunen et al. 1977; Jirmanová and Lukáš 1984). The present paper extends the earlier findings and deals with changes induced by CS₂ in sensory axons and their end-organs. Pacinian corpuscles — encapsulated mechanoreceptors — localized on the crural interosseous membrane of the rat were chosen for the study. In peripheral nerves of rats exposed to CS₂ not only degeneration but also regeneration occurs during ongoing intoxication (Jirmanová and Lukáš 1984). Nerve regeneration following surgical injury results in an altered innervation pattern of Pacinian corpuscles (Zelená 1984). In our experiment, therefore, we mainly examined whether in neuropathic animals continuously exposed to CS₂ Pacinian corpuscles would also become reinnervated and, if so, whether their innervation pattern is changed.

Material and methods
Adult Wistar rats 2–3 months old at the beginning of the experiments, were exposed to CS₂ vapour at an average concentration of 2.4 mg/l of air for 6 h a day. After exposure for 6 months (5 days a week), rats intended for electron microscopic evaluation were anaesthetized and perfused, via the left ventricle, with a solution of 1% paraformaldehyde and 1% glutaraldehyde in a phosphate buffer, pH 7.3. After perfusion, the right and left posterior tibialis muscles were removed together with the interosseous nerve and Pacinian corpuscles; the nerves and corpuscles were dissected out and kept in a fresh fixative overnight. Then the specimens were rinsed in a sucrose solution, postfixed with a 2% solution of osmium tetroxide for 2–3 h, dehydrated and embedded in Durcupan. For embedding, each group of Pacinian corpuscles was cut into several pieces and the corpuscles were oriented for transverse sectioning. Semithin sections 1 μm...
Fig. 1. A degenerating and swollen axon (A) seen in the capsular channel (c) of a Pacinian corpuscle is filled with amorphous material. Myelin sheath (m) is thinned. Ingrowth of adaxonal Schwann cell cytoplasm is indicated by arrow. dm: Degenerated mitochondria, db: dense bodies, n: nuclei, col: collagen fibrils, cap: capillary. × 6,600

Fig. 2. A degenerating and swollen Pacinian axon terminal filled with granular material is seen in the axial space of the inner core. The axoplasm of the terminal is vacuolated (va) and the axolemma (a) is discontinuous (asterisk). dm: Degenerated mitochondria, ic: inner-core lamellae. × 48,000

Fig. 3. Only a folded basal lamina (bl) is present at the entry into a denervated Pacinian corpuscle. col: Collagen fibrils, c: capsular layer, n: nucleus. × 9,900