

Preface

Schwann cells, named in honor of the German scientist Theodore Schwann (1810–1882), are recognized as glial cells in the peripheral nervous system and play major roles in development, maturation, and axonal regeneration and remyelination after injury. During the development and regeneration of peripheral nerves such as sciatic nerves, Schwann cells proliferate and migrate along the axons to their final destinations, where they eventually wrap around individual axons to form the myelin sheaths. Over time, myelin sheaths can grow to be more than 100 times larger than the collective surface area of premyelinating Schwann cell plasma membranes. The myelin sheath insulates axons to increase the nerve conduction velocity, which is termed saltatory conduction. It also protects axons from various physical stresses. In addition to the myelinating Schwann cells, Schwann cells are further categorized into three groups: nonmyelinating Schwann cells, perisynaptic Schwann cells, and satellite cells. All these cells are derived from neural crest cells. Although myelination by the Schwann cell is the event that occurs in both large-diameter ($A\alpha/\beta$) and small-diameter ($A\delta$) axons, the nonmyelinating Schwann cell can surround the small-diameter (C) axons, which originate from peripheral ganglia and consist of sympathetic and sensory neurons. The perisynaptic Schwann cell structurally and functionally helps to bridge the nerve terminal with its peripheral tissue to form the tripartite structures such as neuromuscular junctions. The satellite cell primarily associates with neuronal cell bodies positioned in the peripheral ganglia and appears to play a role in separating the respective cell body units. Considering these key functions of Schwann cells in the development and homeostasis of the peripheral nervous system, it is likely that the abnormalities of Schwann cells and their cross-talk with neurons lead to various critical peripheral nerve disorders, such as Charcot-Marie-Tooth diseases, amyloid polyneuropathy, immune-mediated neuropathy, and diabetic neuropathy.

The rapid progress of molecular biological techniques in past decades, especially for RNA techniques and gene modification technologies, has allowed us to investigate the pathobiology of Schwann cells *in vivo* and *in vitro*. Studies combining recent stem cell biology with recent biotechnology, which is now closely linked to physico-chemical fields, further explain how Schwann cell lineages develop, a process that

has long been thought to be very complicated *in vivo*. The findings contribute to the elucidation of fundamental mechanisms during development and under pathological conditions. We now know that these are closely tied to each other.

Despite such biological significance, neuroscientists and neurologists have paid less attention to Schwann cells than to glial cells in the central nervous system, and very few technical books on Schwann cells are currently available. This book presents recent topics on development, differentiation, and myelination of Schwann cells, as well as pathological mechanisms and therapeutic approaches for the peripheral neuropathies just described. The book also introduces unique co-culture systems to reproduce the neuron–Schwann cell interplay during development, degeneration and regeneration. As an original contribution, we fully describe spontaneously immortalized Schwann cell lines from normal adult mice (IMS32) and rats (IFRS1), and murine models of neurodegenerative disorders (e.g., lysosomal storage diseases, neurofibromatosis, and CMT1B). These cell lines are valuable tools for exploring neuron–Schwann cell interactions, the pathobiology of axonal degeneration and regeneration, and novel therapeutic approaches against neurological disorders in patients with relevant diseases.

We are confident that up-to-date research topics with high-quality immunofluorescence and electron micrographs introduced by young and energetic contributors will arouse the interest of readers in Schwann cell biology. Discussion from the point of view of basic and clinical neuroscience makes the book educational for medical students and young clinicians. As editors, we give thanks to all the authors and dedicate this book to the late Kyoko Ajiki, who continuously provided us excellent light and electron micrographs at the Tokyo Metropolitan Institute for Neuroscience but unfortunately died of cancer in 2011.

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