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## Preface

The development of treatment strategies that can help patients with spinal cord injury to regain lost functions and an improved quality of life is a major medical challenge. Extensive experimental research at the molecular, cellular, and systems level has opened up new and promising avenues towards meeting this challenge. Translation of some of this research to clinical trials for spinal cord injury is already underway, and the results of these trials can be expected to, first of all, provide answers as to the feasibility and safety of the interventions. Indication of potential efficacy may also emerge, although this information is likely to have to wait until sufficient data have been collected and analyzed from ongoing and forthcoming trials. The continued rapid progress in basic spinal cord injury research will most likely also provide foundations for routes to spinal cord repair which are not yet envisioned. In addition, and perhaps most importantly, clinical trials will raise issues which will need to be dealt with by refined experimental research before subsequent possible translations into modified clinical management strategies can be considered. Experimental spinal cord research has to meet these challenges by resolving fundamental problems, establishing a basis for possible novel treatment strategies of spinal cord injury, and motivating their clinical translation.

To place animal models of spinal cord repair in its “human” context, the book features thorough overviews of the anatomy, physiology, and pathophysiology of clinical spinal cord injuries (Chaps. 1, 2). With this background, the reader is subsequently introduced to a broad range of experimental models for research on spinal cord injury, how they have contributed to our current state of knowledge, and what their advantages are in the further advancement towards spinal cord repair. The information presented is intended to guide the implementation of animal models for spinal cord repair, as well as to raise the awareness of the relevance of experimental models which may not be in the current mainstream of this research. There are numerous striking examples on how the choice of a specific, and not always the most obvious, experimental model has been instrumental in the progress of biomedical research. Studies on less-complex systems of spinal cord injury, such as *in vitro* (Chap. 3) and lamprey (Chap. 4), provide insights into basic mechanisms of neurodegeneration and regeneration, which offer clues to how the injured mammalian spinal cord injury can be repaired. In the other end, a broader use of larger mammalian species, particularly for preclinical assessments, could be of great predictive value and thereby accelerate the development of clinically useful treatment options (Chaps. 7, 8, 10). In this context, veterinarian medicine can also make a significant contribution as a clinical research setting in the care of pets which have suffered accidental spinal cord injury where the pathology is likely to mimic many aspects of human spinal cord injury (Chap. 9).

The rat has been by far the most popular species for *in vivo* experimentation with mouse now catching up as a result of the development of the transgenic technology, and the preferences for these species are likely to prevail for a foreseeable future. Rat and mouse offer considerable practical advantages for spinal cord injury research. Several well-characterized spinal cord injury models and the principles for their outcome assessment are

described for these species (Chaps. 5, 13), including a recently developed mouse injury model, which circumvents the need for laminectomy (Chap. 6). Animal models of spinal cord ischemia, a condition of increasing clinical importance and also highly relevant for spinal cord pathophysiology in general, are extensively covered in Chaps. 6 and 11. In the context of assessment tools, an update is provided of the increasingly important role of magnetic resonance imaging (MRI) for monitoring and assessing pathophysiology and repair of experimental spinal cord injury (Chap. 12).

The final chapter (Chap. 14) places the current state of experimental research in spinal cord repair in a clinical perspective. Major progress has been made over the last decades in the clinical management of patients with spinal cord injury, but despite promising experimental data, no effective clinically applicable therapies exist that are able to significantly counteract secondary injury processes and repair functional circuitry. The gap from the many times promising outcome of experimental research to successful clinical translation is still large. However, through the background information and hands-on methods descriptions, as well as the basic and clinical issues presented in this book, it is hoped to stimulate and guide researchers with different backgrounds towards the development of improved strategies for functionally relevant repair of the injured human spinal cord.

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