Preface

The use of viral vectors as gene transfer tools for the central nervous system has seen a significant growth in the last decade. The demonstration that a recombinant viral-based vector could efficiently infect mammalian cells [1–4] certainly predates the advent of transgenic and gene targeting technologies in the mouse [5–7], on one side, and gene therapy in humans [8, 9], on the other.

Indeed, recombinant viral vectors (mainly retrovirus based) became available in biomedical fields like cancer research and immunology as early as the mid-late 1980s [10–14]. However, a rapid search in Medline reveals that before the mid-1990s very little research had been published involving viral vectors in the mammalian nervous system. The reason for that is not only due to the general delay in the introduction of molecular genetic techniques in neuroscience but also due to the fact that the use of viral vectors in vivo, certainly the most interesting application in this field, has required the development of complex and safe surgical techniques.

In any case, currently available vectors, while deriving from natural viruses, are now versatile, safe, and highly sophisticated devices to transfer genetic material into a variety of host cells, thus allowing manipulation of either a single gene or entire classes of genes. Importantly, improvement in the safety, efficiency, and specificity of viral vectors for clinical applications has proven to be beneficial also for basic neuroscience research.

This book will cover most relevant aspects related to the use of viral vectors in neurobiology, with a major emphasis on basic mechanisms of synaptic plasticity, learning, and memory, as well as molecular neuropharmacology and experimental animal models of brain diseases.

In the first part, introductory chapters first discuss the features of all viral vectors currently available in neuroscience and their production methods. The three most used systems are lentiviral vectors, discussed by Papale and Brambilla (Chap. 1), recombinant adeno-viruses, described by Li and He (Chap. 2), and adeno-associated viral vectors (Dutheil and Bezard, Chap. 3). In addition, two chapters deal with two additional systems that are still in use in the field: herpes simplex virus 1 (HSV-1)-based vectors (Pourchet et al., Chap. 4) and alphavirus-based vectors (Lundstrom, Chap. 5).

In the second part, examples of successful applications of viral vector technology to psychiatric and memory research are examined. First, Marie (Chap. 6) examines the use of viral vectors to study synaptic functions, including long-term plasticity. Rashid et al. (Chap. 7) provide a method to investigate the molecular mechanisms associated with the allocation of the memory trace within distinct neuronal populations, a very exciting development in memory research. Ferguson and Neumaier (Chap. 8) and Furay and Neumaier (Chap. 9) provide interesting examples of a successful use of viral vector approaches on mechanisms of drug addiction and depression, respectively.

In the third part, current applications of viral vector technology are highlighted in the context of neurological disorders. Wettergren et al. (Chap. 10) provides an exhaustive and timely review of viral vectors used in the development of gene therapy for Parkinson’s disease. Delzor et al. (Chap. 11) deals with an in-depth analysis of viral approaches to study
Huntington’s Disease, while Dirren and Schneider’s chapter (Chap. 12) is about applications of viral vectors for motor neuron disorders. In the final part, various cutting-edge applications of viral vector technology to neuroscience will be considered. Different chapters will deal with the development of microRNA-based technology to inactivate gene functions (Gurevich et al., Chap. 13), neural stem cell manipulations (Iraci et al., Chap. 14), optogenetics (Chaps. 15 and 16), and applications to primate research (Gregory and Bezard, Chap. 17).

Altogether, this handbook provides a unique collection of state-of-the-art essays specifically focusing on the use of these viral approaches in neuroscience research. Previous publications, going back to more than 10 years, are obviously not only outdated but they also emphasize the clinical applications of viral vector technology in gene therapy rather than the technical development for research use. I believe that Viral Vector Approaches in Neurobiology and Brain Diseases will be useful not only to neurobiologists wishing to routinely use viral vectors in the laboratory but also to experienced scientists needing detailed new protocols for a variety of experimental applications.

Milan, Italy

Riccardo Brambilla

References

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