Poliovirus

Methods and Protocols

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Humana Press
Preface

Polioviruses belong to the genus Enterovirus in the family Picornaviridae. Enteroviruses have been traditionally distinguished within the Picornaviridae family on the basis of their physical properties such as buoyant density in caesium chloride and stability in weak acid. However, recent advances in molecular and cell biology have changed the focus to the analysis of the genomic structure and nucleotide sequence, details of the viral replication cycle, and antigenic/immunogenic properties. The viral genome of poliovirus consists of a single RNA strand of positive polarity of about 7500 nucleotides in length containing the coding sequences for structural and nonstructural viral proteins flanked by 5′ and 3′ non-coding sequences that modulate RNA replication and translation. The virus particle consists of 60 protomers each containing a single copy of each of the four capsid proteins (VP1 to VP4) arranged in icosahedral symmetry. Poliovirus exists in three serotypes based on specific neutralization reactions with immune sera. Each serotype is defined by the inability of antisera raised against the other two serotypes to completely neutralize infectivity.

Polioviruses are also distinguished from other enteroviruses by neutralization with serotype-specific sera. However, the main distinctive properties of poliovirus are its ability to bind CD155, a member of the immunoglobulin superfamily, as a receptor for cell entry and the propensity to cause paralysis in humans. The most important route of transmission is fecal-oral, and the virus replicates efficiently in the intestinal tract with shedding in feces typically lasting for 2–4 weeks. The examination of stool samples from AFP patients for the presence of poliovirus has been the driving force of the GPEI allowing to link poliovirus isolates to specific individuals and to focus the investigations and public health interventions to particular communities. Large numbers of excreted poliovirus particles remain infectious in the environment for varying lengths of time depending on the immediate conditions. The presence of virus in samples from the wastewater system may be detected by a variety of laboratory methods for concentration, separation, and identification. Environmental surveillance has indeed proven to be very successful in detecting poliovirus circulation in specific populations even in the absence of associated poliomyelitis cases and is becoming a very useful supplementary tool for the surveillance for poliovirus.

The fact that only a fraction of poliovirus infections leads to paralytic disease reinforced the need to devise very sensitive and reliable laboratory techniques to isolate and identify poliovirus from samples of acute flaccid paralytic (AFP) cases, which is also associated with several other syndromes and diseases. This led to the establishment of strict quality criteria for AFP surveillance that included the detection of a minimal number of paralytic cases in children less than 15 years of age due to other causes but polio, the timely sampling of at least 80% of AFP cases, and the analysis of AFP samples in a fully accredited laboratory using standardized protocols. Poliovirus has also been and continues to be one of the most widely used viruses in research, and work in many laboratories worldwide has helped understanding many viral and biological processes such as virus cell entry, RNA replication and translation, and viral antigenicity.

The present book describes the most common laboratory procedures for isolation, identification, and characterization of polioviruses used in clinical and research laboratories.
Contents

Preface ................................................................. v
Contributors ......................................................... ix

1 An Introduction to Poliovirus: Pathogenesis, Vaccination, and the Endgame for Global Eradication. ..................................................... 1
   Philip D. Minor

2 Poliovirus Laboratory Based Surveillance: An Overview ...................... 11
   Syed Sohail Zahoor Zaidi, Humayun Asgbar, Salmaan Sharif, and Muhammad Masroor Alam

3 Isolation and Characterization of Enteroviruses from Clinical Samples. .... 19
   Soile Blomqvist and Merja Roivainen

4 Isolation and Characterization of Poliovirus in Cell Culture Systems ....... 29
   Bruce R. Thorley and Jason A. Roberts

5 Molecular Characterization of Polio from Environmental Samples:
   ISSP, The Israeli Sewage Surveillance Protocol .................................. 55
   Lester M. Shulman, Yossi Manor, Musa Hindiyeh, Danit Sofer, and Ella Mendelson

6 Quality Assurance in the Polio Laboratory. Cell Sensitivity and Cell Authentication Assays ......................................................... 109
   Glynis Dunn

7 A Transgenic Mouse Model of Poliomyelitis ...................................... 129
   Satoshi Koike and Noriyo Nagata

8 Standardized Methods for Detection of Poliovirus Antibodies ................. 145
   William C. Weldon, M. Steven Oberste, and Mark A. Pallansch

9 Molecular Properties of Poliovirus Isolates: Nucleotide Sequence
   Analysis, Typing by PCR and Real-Time RT-PCR .................................. 177
   Cara C. Burns, David R. Kilpatrick, Jane C. Iber, Qi Chen, and Olen M. Kew

10 Isolation and Characterization of Vaccine-Derived Polioviruses,
   Relevance for the Global Polio Eradication Initiative .......................... 213
    Wenbo Xu and Yong Zhang

11 Phylogenetic Analysis of Poliovirus Sequences .................................. 227
    Jaume Jorba

12 Generation of Infectious Poliovirus with Altered Genetic Information
   from Cloned cDNA ........................................................................... 239
    Erika Bujaki

13 A Rapid Method for Engineering Recombinant Polioviruses
   or Other Enteroviruses .................................................................... 251
    Maël Bessaud, Isabelle Pelletier, Bruno Blondel, and Francis Delpeyrroux
14 Methods to Monitor Molecular Consistency of Oral Polio Vaccine .............. 263
Konstantin M. Chumakov
15 Methods for the Quality Control of Inactivated Poliovirus Vaccines. ............. 279
Thomas Wilton
16 Measuring Poliovirus Antigenicity by Surface Plasmon Resonance. Application for Potency Indicating Assays ........................................... 299
Janny Westdijk, Larissa van der Maas, Rimko ten Have, and Gideon Kersten
17 Identification and Analysis of Antiviral Compounds Against Poliovirus ......... 325
Pieter Leyssen, David Franco, Aloys Tijsma, Céline Lacroix, Armando De Palma, and Johan Neyts

Index .................................................................................................................. 339
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