Molecular pathogenesis of virus infections

Virus and prion diseases remain a major public health threat, in both developed and developing countries. The worldwide HIV pandemic is but one example of a newly emerged virus disease; other potential threats come from exotic viruses such as SARS, Ebola and Hantaan viruses. Older human viruses such as influenza, papilloma, herpes and the hepatitis viruses still cause major health problems. Furthermore, as well as causing acute infections, some viruses may also establish persistent infections which can lead to the development of chronic diseases, including cancer. This symposium book covers central factors that influence the pathogenicity of virus and prion infections. Topics range from innate and adaptive immune responses and virus evasion of host defences to details of selected virus–host interactions, including those involving dengue virus, HIV, influenza viruses, coronaviruses, hepatitis C virus, herpesviruses, papillomaviruses, African swine fever virus and poxviruses.

Paul Digard is a Lecturer in Virology in the Department of Pathology at the University of Cambridge, UK.

Anthony A. Nash is Professor of Veterinary Pathology in the Division of Veterinary Biomedical Sciences at the University of Edinburgh, UK.

R. E. Randall is Professor of Molecular Virology in the School of Biology at the University of St Andrews, UK.
Symposia of the Society for General Microbiology

Managing Editor: Dr Melanie Scourfield, SGM, Reading, UK
Volumes currently available:

14  Microbial behaviour
23  Microbial differentiation
32  Molecular and cellular aspects of microbial evolution
43  Transposition
45  Control of virus diseases
46  Biology of the chemotactic response
47  Prokaryotic structure and function – a new perspective
51  Viruses and cancer
52  Population genetics of bacteria
53  Fifty years of antimicrobials: past perspectives and future trends
54  Evolution of microbial life
55  Molecular aspects of host–pathogen interaction
56  Microbial responses to light and time
57  Microbial signalling and communication
58  Transport of molecules across microbial membranes
59  Community structure and co-operation in biofilms
60  New challenges to health: the threat of virus infection
61  Signals, switches, regulons and cascades: control of bacterial gene expression
62  Microbial subversion of host cells
63  Microbe–vector interactions in vector-borne diseases
SIXTY-FOURTH SYMPOSIUM OF THE
SOCIETY FOR GENERAL MICROBIOLOGY
HELD AT HERIOT-WATT UNIVERSITY APRIL 2005

Edited by
P. Digard, A. A. Nash & R. E. Randall

molecular pathogenesis of virus infections

Published for the Society for General Microbiology
CONTENTS

Contributors vii

J. L. Whitton
Adaptive immune responses 1

G. Screaton and J. Mongkolsapaya
T-cell responses and dengue haemorrhagic fever 15

E. Turnbull and P. Borrow
The immune response to human immunodeficiency virus type 1 (HIV-1) 23

C. M. Dixon, L. Breakwell, G. Barry and J. K. Fazakerley
Persistent RNA virus infections 91

A. L. Hartman, J. S. Towner and S. Nichol
Pathogenesis of Ebola and Marburg viruses 109

C. Dye and S. Siddell
Molecular approaches to the pathogenesis of feline coronaviruses 125

J. C. Manson and R. M. Barron
The transmissible spongiform encephalopathies 137

R. G. Webster, A. S. Lipatov and E. Hoffmann
Influenza virus pathogenicity 159

R. P. van Rij and R. Andino
RNAi as an antiviral mechanism and therapeutic approach 179

M. L. Freeman, V. Decman and R. L. Hendricks
Neurons and host immunity conspire to maintain herpes simplex virus in a latent state 203

S. M. Lemon and K. Li
Hepatitis C virus disruption of interferon signalling pathways and evasion of innate intracellular antiviral defences 215

L. Gray, C. Jolly and C. S. Herrington
Human papillomaviruses and their effects on cell cycle control and apoptosis 235

O. Haller, F. Weber and G. Kochs
Intracellular antiviral defence mechanisms: the power of interferon-regulated restriction factors 253

M. B. Ruiz-Argüello, A. Alejo and A. Alcami
Secreted tumour necrosis factor inhibitors encoded by poxviruses 269
L. K. Dixon  
Evasion of host defence systems by African swine fever virus  

J. P. Stewart, D. Hughes, L. Roaden and B. Ebrahimi  
Murid herpesvirus 4 as a model for gammaherpesvirus pathogenesis  

Index

vi  Contents
CONTRIBUTORS

Alcami, A.
Department of Medicine, University of Cambridge, Addenbrooke's Hospital, Cambridge, UK, and Department of Molecular and Cellular Biology, Centro Nacional de Biotecnología (CSIC), Campus Universidad Autónoma, Cantoblanco 28049 Madrid, Spain

Alejo, A.
Department of Medicine, University of Cambridge, Addenbrooke's Hospital, Cambridge, UK, and Department of Molecular and Cellular Biology, Centro Nacional de Biotecnología (CSIC), Campus Universidad Autónoma, Cantoblanco 28049 Madrid, Spain

Andino, R.
Department of Microbiology and Immunology, University of California, San Francisco, CA 94143-2280, USA

Barron, R. M.
Institute for Animal Health, Neuropathogenesis Unit, Ogston Building, West Mains Road, Edinburgh EH9 3JF, UK

Barry, G.
Centre for Infectious Diseases, College of Medicine and Veterinary Medicine, University of Edinburgh, Edinburgh EH9 1QH, UK

Borrow, P.
Viral Immunology Group, The Edward Jenner Institute for Vaccine Research, Compton, Newbury RG20 7NN, UK

Breakwell, L.
Centre for Infectious Diseases, College of Medicine and Veterinary Medicine, University of Edinburgh, Edinburgh EH9 1QH, UK

Decman, V.
Department of Ophthalmology and Graduate Program in Immunology, University of Pittsburgh School of Medicine, Pittsburgh, PA 15213, USA

Dixon, C. M.
Centre for Infectious Diseases, College of Medicine and Veterinary Medicine, University of Edinburgh, Edinburgh EH9 1QH, UK

Dixon, L. K.
Institute for Animal Health, Pirbright Laboratory, Ash Road, Pirbright, Woking GU24 0NF, UK

Dye, C.
Department of Molecular and Cellular Medicine, University of Bristol, Bristol BS8 1TD, UK
Contributors

Ebrahimi, B.
Centre for Comparative Infectious Diseases, University of Liverpool, Duncan Building, Daulby Street, Liverpool L69 3GA, UK

Fazakerley, J. K.
Centre for Infectious Diseases, College of Medicine and Veterinary Medicine, University of Edinburgh, Edinburgh EH9 1QH, UK

Freeman, M. L.
Department of Ophthalmology and Graduate Program in Molecular Virology and Microbiology, University of Pittsburgh School of Medicine, Pittsburgh, PA 15213, USA

Gray, L.
Bute Medical School, University of St Andrews, Bute Medical Buildings, Westburn Lane, St Andrews, Fife KY16 9TS, UK

Haller, O.
Abteilung Virologie, Institut für Medizinische Mikrobiologie und Hygiene, Universität Freiburg, D-79008 Freiburg, Germany

Hartman, A. L.
Special Pathogens Branch, Division of Viral and Rickettsial Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30306, USA

Hendricks, R. L.
Departments of Ophthalmology, Immunology and Molecular Genetics and Biochemistry, University of Pittsburgh School of Medicine, Pittsburgh, PA 15213, USA

Herrington, C. S.
Bute Medical School, University of St Andrews, Bute Medical Buildings, Westburn Lane, St Andrews, Fife KY16 9TS, UK

Hoffmann, E.
Division of Virology, Department of Infectious Diseases, St. Jude Children’s Research Hospital, 332 North Lauderdale St, Memphis, TN 38105, USA

Hughes, D.
Centre for Comparative Infectious Diseases, University of Liverpool, Duncan Building, Daulby Street, Liverpool L69 3GA, UK

Jolly, C.
Bute Medical School, University of St Andrews, Bute Medical Buildings, Westburn Lane, St Andrews, Fife KY16 9TS, UK

Kochs, G.
Abteilung Virologie, Institut für Medizinische Mikrobiologie und Hygiene, Universität Freiburg, D-79008 Freiburg, Germany
Lemon, S. M.
Department of Microbiology & Immunology, Institute for Human Infections & Immunity, University of Texas Medical Branch, Galveston, TX 77555-0428, USA

Li, K.
Department of Microbiology & Immunology, Institute for Human Infections & Immunity, University of Texas Medical Branch, Galveston, TX 77555-0428, USA

Lipatov, A. S.
Division of Virology, Department of Infectious Diseases, St. Jude Children's Research Hospital, 332 North Lauderdale St, Memphis, TN 38105, USA

Manson, J. C.
Institute for Animal Health, Neuropathogenesis Unit, Ogston Building, West Mains Road, Edinburgh EH9 3JF, UK

Mongkolsapaya, J.
Department of Immunology, Hammersmith Hospital, Imperial College, Du Cane Road, London W12 0NN, UK

Nichol, S.
Special Pathogens Branch, Division of Viral and Rickettsial Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30306, USA

Roaden, L.
Centre for Comparative Infectious Diseases, University of Liverpool, Duncan Building, Daulby Street, Liverpool L69 3GA, UK

Ruiz-Argüello, M. B.
Department of Medicine, University of Cambridge, Addenbrooke's Hospital, Cambridge, UK, and Centro de Investigación en Sanidad Animal (INIA), Valdeolmos, Madrid, Spain

Screaton, G.
Department of Immunology, Hammersmith Hospital, Imperial College, Du Cane Road, London W12 0NN, UK

Siddell, S.
Department of Molecular and Cellular Medicine, University of Bristol, Bristol BS8 1TD, UK

Stewart, J. P.
Centre for Comparative Infectious Diseases, University of Liverpool, Duncan Building, Daulby Street, Liverpool L69 3GA, UK

Towner, J. S.
Special Pathogens Branch, Division of Viral and Rickettsial Diseases, Centers for Disease Control and Prevention, Atlanta, GA 30306, USA
Contributors

Turnbull, E.
Viral Immunology Group, The Edward Jenner Institute for Vaccine Research, Compton, Newbury RG20 7NN, UK

van Rij, R. P.
Department of Microbiology and Immunology, University of California, San Francisco, CA 94143-2280, USA

Weber, F.
Abteilung Virologie, Institut für Medizinische Mikrobiologie und Hygiene, Universität Freiburg, D-79008 Freiburg, Germany

Webster, R. G.
Division of Virology, Department of Infectious Diseases, St. Jude Children's Research Hospital, 332 North Lauderdale St, Memphis, TN 38105, USA

Whitton, J. L.
Department of Neuropharmacology, CVN-9, The Scripps Research Institute, 10550 N Torrey Pines Rd, La Jolla, CA 92037, USA
Because their pathogenesis and pathophysiology are better understood than in many virus infections, and because very striking rashes are produced, rickettsial diseases will also be considered. Some aspects of the pathogenesis of virus-induced skin lesions have already been discussed in Platt's excellent short review (108). Virus route to skin—primary. Lesion. Dengue virus infection: Pathogenesis. Substantial gaps remain in the comprehensive understanding of the pathogenesis of dengue virus infections. In large part, this limitation is related to the lack of a suitable animal model of disease [1]. Rhesus monkeys develop viremia similar in pattern to humans after dengue virus challenge but do not develop clinical disease. Careful epidemiologic and experimental challenge studies in humans have provided valuable information on dengue virus infection, but detailed data on virus distribution in vivo are available only from small numbers of patients with more severe disease, unusual manifesta