

Current Topics in Microbiology and Immunology

Volume 368

Series Editors

Klaus Aktories

Medizinische Fakultät, Institut für Experimentelle und Klinische Pharmakologie und Toxikologie, Abt. I Albert-Ludwigs-Universität Freiburg, Albertstr. 25, 79104 Freiburg, Germany

Richard W. Compans

Department of Microbiology and Immunology, Emory University, 1518 Clifton Road, CNR 5005, Atlanta, GA 30322, USA

Max D. Cooper

Department of Pathology and Laboratory Medicine, Georgia Research Alliance, Emory University, 1462 Clifton Road, Atlanta, GA 30322, USA

Jorge E. Galan

Boyer Ctr. for Molecular Medicine, School of Medicine, Yale University, 295 Congress Avenue, room 343, New Haven, CT, 06536-0812, USA

Yuri Y. Gleba

ICON Genetics AG, Biozentrum Halle, Weinbergweg 22, 06120 Halle, Germany

Tasuku Honjo

Department of Medical Chemistry, Faculty of Medicine, Kyoto University, Sakyo-ku, Yoshida, Kyoto 606-8501, Japan

Yoshihiro Kawaoka

School of Veterinary Medicine, University of Wisconsin-Madison, 2015 Linden Drive, Madison, WI 53706, USA

Bernard Malissen

Centre d'Immunologie de Marseille-Luminy, Parc Scientifique de Luminy, Case 906, 13288 Marseille Cedex 9, France

Fritz Melchers

Max Planck Institute for Infection Biology, Charitéplatz 1, 10117 Berlin, Germany

Michael B. A. Oldstone

Department of Immunology and Microbial Science, The Scripps Research Institute, 10550 North Torrey Pines Road, La Jolla, CA 92037, USA

Rino Rappuoli

Novartis Vaccines, Via Fiorentina 1, Siena, 53100, Italy

Peter K. Vogt

Department of Molecular and Experimental Medicine, The Scripps Research Institute, 10550 North Torrey Pines Road, BCC-239, La Jolla, CA 92037, USA

Honorary Editor: Hilary Koprowski

Biotechnology Foundation, Inc., 119 Sibley Avenue, Ardmore, PA 19003, USA

For further volumes:

<http://www.springer.com/series/82>

G. Singh Chhatwal
Editor

Host–Pathogen Interactions in Streptococcal Diseases

Responsible Series Editor: Klaus Aktories

 Springer

Editor

Prof. Dr. G. Singh Chhatwal
Department of Medical Microbiology
Helmholtz Centre for Infection Research
Braunschweig
Germany

ISSN 0070-217X

ISBN 978-3-642-36339-9

ISBN 978-3-642-36340-5 (eBook)

DOI 10.1007/978-3-642-36340-5

Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013932461

© Springer-Verlag Berlin Heidelberg 2013

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law. The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Streptococci are Gram-positive bacteria capable of causing a wide spectrum of diseases in humans and animals. Group A streptococci (*Streptococcus pyogenes*) are exclusively human pathogenic bacteria. Group C and group G streptococci, which were traditionally considered as animal pathogenic bacteria, are emerging as causative organisms of human diseases. The diseases caused by streptococci range from self-limiting manifestations such as pharyngitis or impetigo to life-threatening diseases such as necrotizing fasciitis and streptococcal toxic shock syndrome. The disease burden of streptococcal infections is extremely high worldwide. More than 600 million persons, mostly children, suffer from streptococcal pharyngitis every year. There are 600 thousand cases of invasive disease with high mortality. Another problem is the sequelae of streptococcal infections in the form of acute rheumatic fever and rheumatic heart disease. About 15 million children are suffering from rheumatic heart disease, and approximately one million new cases are registered every year. Streptococcal diseases are considered as one of the most important groups of neglected communicable diseases.

Antibiotics alone have not been able to reduce the disease burden and in spite of many efforts no effective vaccine is available. One reason for unsuccessful attempts to develop a vaccine is the complexity of pathogenic mechanisms of streptococci. To establish and maintain an infection, streptococci evade host-immune defenses through their heterogeneity, bind and exploit host proteins for their own advantage, trigger their own internalization by host cell in order to persist and evade action of antibiotics, express surface proteins with similarity to host proteins to cause autoimmune diseases. The list of perplexing properties is far from complete so that streptococci remain a major health hazard and a real challenge for scientists, clinicians, and public health workers.

A prerequisite to develop and design novel combat strategies is a complete understanding of the pathogenic mechanisms. In recent years, the host-pathogen interactions have been shown to play a key role in streptococcal diseases. These interactions therefore represent promising intervention targets. This volume is completely devoted to understand streptococcal diseases. The volume has

10 chapters starting with streptococcal diseases and burden and going on to epidemiology, adaptation and transmission, molecular mechanisms of different diseases as well as sequelae, and ending with vaccine development and clinical management. All the authors are well-known in this field and have contributed enormously to the knowledge beyond the state-of-the-art. This volume will be a useful reference work for clinicians, microbiologists, public health workers, students of medicine and microbiology as well as a large number of scientists working in this field. The volume would provide new avenues for the scientists to meet the challenge of streptococcal diseases and would contribute to developing novel control strategies. The volume will be dedicated to millions of patients who have experienced the streptococcal infections and their sequelae.

I am grateful to Prof. Dr. Klaus Aktories from University of Freiburg for encouraging me to edit this volume. A short while ago, I visited his institute to give a talk after which he thought that it would be an interesting volume for CTMI. I am also thankful to all the contributors to find time from their tight schedules and deliver excellent chapters. All chapters provide state-of-the-art information and there is hardly any overlap among the different chapters. I am grateful to Springer staff, especially Ms. Schlitzberger for their help and to Prof. Manfred Rohde, Dr. Patric Nitsche-Schmitz, and Helga Brink from the Department of Medical Microbiology of our center.

G. S. Chhatwal

Contents

Group A Streptococcal Diseases and Their Global Burden	1
Anna P. Ralph and Jonathan R. Carapetis	
Molecular Markers for the Study of Streptococcal Epidemiology	29
David J. McMillan, Martina L. Sanderson-Smith, Pierre Robert Smeesters and Kadaba S. Sriprakash	
Epidemiology and Pathogenicity of Zoonotic Streptococci	49
Marcus Fulde and Peter Valentin-Weigand	
Adherence and Invasion of Streptococci to Eukaryotic Cells and Their Role in Disease Pathogenesis	83
Manfred Rohde and G. Singh Chhatwal	
Common Regulators of Virulence in Streptococci	111
Nadja Patenge, Tomas Fiedler and Bernd Kreikemeyer	
Host–Pathogen Interactions in Streptococcal Immune Sequelae	155
D. Patric Nitsche-Schmitz and Gursharan S. Chhatwal	
Immunopathogenesis of Streptococcal Deep Tissue Infections	173
Linda Johansson and Anna Norrby-Teglund	
Modulation of the Coagulation System During Severe Streptococcal Disease.	189
Oonagh Shannon, Heiko Herwald and Sonja Oehmcke	
Group A Streptococcal Vaccine Candidates: Potential for the Development of a Human Vaccine	207
Anna Henningham, Christine M. Gillen and Mark J. Walker	

**Clinical Management of the Most Common Group A
β-Hemolytic Streptococcal Infections** 243
Edward L. Kaplan

Index 253