Zoonoses

Infectious Diseases Transmissible Between Animals and Humans
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Rolf Bauerfeind
Institute for Hygiene and Infectious Diseases of Animals
Justus Liebig University Giessen
Giessen, Germany

Alexander von Graevenitz
Department of Medical Microbiology
University of Zurich
Zurich, Switzerland

Peter Kimmig
Department of Parasitology
University of Hohenheim
Stuttgart, Germany

Hans Gerd Schiefer
Medical Microbiology
Justus Liebig University Giessen
Giessen, Germany

Tino Schwarz
Central Laboratory and Vaccination Center
Stiftung Juliusspital,
University of Wuerzburg,
Wuerzburg, Germany

Werner Slenczka
Institute for Virology
University Hospital of Marburg and Giessen
Marburg/Lahn, Germany

Horst Zahner
Institute for Parasitology
Justus Liebig University Giessen
Giessen, Germany
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Preface

Zoonoses are infectious diseases transmissible from vertebrate animals to humans and vice versa under natural conditions. They comprise a complex spectrum of diseases due to the diversity of pathogenic agents involved. They may confront veterinarians as well as general practitioners, pediatricians, infectious disease specialists, and microbiologists with special diagnostic and therapeutic problems. While we did not intend to write a handbook of zoonoses, we wanted to cover not only well-known diseases but also rare ones that may be of importance to physicians active in developing countries and to travelers going to distant or rarely visited areas.

Our book is based on the 4th German edition of Zoonosen: Zwischen Tier und Mensch übertragbare Infektionskrankheiten which was published in 2013 by Deutscher Ärzte-Verlag, Cologne, Germany. It has been thoroughly revised, updated, and amended.

We have tried to present the most significant aspects of the great variety of zoonotic diseases in a concise manner. However, in some cases readers may even need more detailed information.

We express our appreciation to Christine Charlip, Director, and Larry Klein, Production Manager of ASM Press for their constant encouragement, assistance and advice. We are indebted to Professor Gaby Pfyffer von Altishofen, Lucerne, for helpful suggestions and constructive criticism of the chapter on mycobacterioses, and Dr Tanja Matt, Zürich, for technical help with the figures on transmission chains. We also want to thank Prof. Peter Mayser, Giessen, for valuable advice on the chapter on fungal zoonoses and Prof. Brigitte Frank, Hohenheim, for her support in the translation. And all of us, particularly those involved in translating the German text into English, are deeply grateful to our families for their patience, tolerance, and support.

Finally it is the particular concern of the authors to commemorate our co-author Hans Gerd Schiefer who unfortunately died shortly before completion of this edition. His work and participation had been extremely important for this book.
Numerous human infectious diseases are caused by agents that are directly or indirectly transmissible from various animal species to humans. Today, more than 200 diseases occurring in humans and animals are known to be mutually transmitted. They are caused by prions, viruses, bacteria (including rickettsiae and chlamydiae), fungi, protozoa, and helminths, as well as arthropods. An Expert Committee of the World Health Organization defined zoonoses in 1958 as “diseases and infections which are naturally transmitted between vertebrates and humans.” This definition is still valid.

Originally, zoonoses were regarded as animal diseases (in Greek zoon means “animal”). In the 19th century, the meaning of the word changed. Thus, in 1855, R. Virchow included in his book, Handbuch der Speziellen Pathologie und Therapie, the chapter “Infectionen durch contagiöse Thiergifte” (“Infections Caused by Animal Contagious Poisons”) with the subtitle “Zoonosen” (“Zoonoses”). Shortly after this, the word “zoonoses” received a double meaning for the first time. W. Probstmayer (1863) stated in the Etymologisches Wörterbuch der Veterinärmedizin und ihrer Hilfswissenschaften (Etymological Dictionary of Veterinary Medicine and its Auxiliary Sciences) “zoonoses are (i) animal diseases and (ii) diseases of humans transmitted from animals by means of a vector or contact.” Today, no difference is made with regard to the direction of transmission, that is, animal to human or human to animal, although attempts exist to describe precisely the direction of transmission. The term “zooanthroponoses” referred to diseases transmitted from animals to humans, and the term “anthropozoonoses” referred to diseases transmitted from humans to animals. However, the latter play only a minor role in the epidemiology of zoonoses. The term “zoonosis” still underlies conceptual changes. For instance, increasing epidemiological knowledge has put into doubt the traditional associations of some infectious diseases with zoonoses. Diseases that do not require a vertebrate reservoir because of their occurrence in water, in soil, on plants, or in food or fodder, whence they are transmitted to vertebrates (including humans), are also called sapronoses, saprozoonoses, or geonoses.

Zoonoses are a persisting threat to the human society. Classical infectious diseases, such as rabies, plague, and yellow fever, well known for centuries, are zoonoses that have not been eradicated despite major efforts. And the importance of zoonoses still increases. In recent years, new zoonotic entities, for example, Lyme borreliosis, ehrlichiosis, infections with enterohemorrhagic Escherichia coli, cryptosporidiosis, and hantavirus pulmonary syndrome, have been detected.

The steadily increasing threat that zoonoses pose to humans have many causes that differ from country to country. Overpopulation, wars,
and progressive deterioration of living conditions may cause migration of countless people into slums of large cities, with a subsequent breakdown of hygiene and public health care. The proximity of their dwellings to huge garbage dumping grounds and their dependence on water contaminated with sewage facilitate contact with rodents, stray animals, and their parasites.

Scarcity of food forces millions of humans to clear woodlands for cultivation and to produce new settlements in areas where animal populations and their pathogenic agents were formerly separated from humans. Humans may participate unwittingly in unknown parasite-host cycles and become a new link in an infectious chain. In many of these cases, humans, as accidental hosts, are in no way adapted to the new pathogenic species, which may result in high mortality.

Artificial irrigation changes the ecology of whole countries. Artificial lakes and ponds attract animals and their parasites over vast distances and provide optimal breeding grounds, especially for mosquitoes. Increasingly warm and moist winters in the Northern Hemisphere favor the propagation of parasites, especially ticks. Stray animals, usually infected with various pathogens, are reservoirs for infectious agents, not only in developing countries, but also in developed countries.

Worldwide tourism, especially trekking tours to remote areas and so-called adventure challenges (e.g., “survival training” with camping in open areas and consumption of raw or insufficiently cooked food) has encouraged contact of humans from industrialized countries who grew up under nearly aseptic conditions and agents and vectors that they have never encountered before.

Zoonotic agents of low virulence may cause fatal infections in immunosuppressed humans (e.g., patients infected with HIV).

A further potential source of infection is transport of breeding and slaughter animals over vast distances and across borders, often with insufficient inspection for disease control. New disease agents may be introduced to a country by legal, or, even worse, illegal importation of exotic animals for zoos, research purposes, or private homes. Isolated animal organs (xenotransplants) and cultures of animal cells may contain dangerous zoonotic agents. Furthermore, several zoonotic pathogens, for example, Francisella tularensis, Yersinia pestis, Brucella spp., Bacillus anthracis, Coxiella burnetii, and hemorrhagic fever viruses, are considered possible bioterrorism weapons.

The problem of diseases transmitted between animals and humans has many aspects, especially as it is not uncommon for animals serving as reservoir or intermediate hosts to be clinically inapparent carriers and/or excreters of an agent. Undoubtedly, currently unknown zoonoses will emerge in future. New methods for direct or indirect detection of microorganisms contribute to the detection of new zoonoses. When human invasion of hitherto uninhabited areas results in voluntary or involuntary environmental changes, new and potentially dangerous zoonoses may become evident. Severe acute respiratory syndrome, caused by a newly emerged coronavirus, is one of the latest examples of the threat of dangerous infections, although its possible zoonotic background has not yet been clarified.

In the study of zoonoses, medical experts and veterinarians should cooperate closely to study the etiology, epidemiology, and frequently complex developmental cycles and modes of transmission of pathogens and their vectors, as well as the clinical presentation, diagnosis, differential diagnosis, therapy, and prophylaxis of the attendant diseases. Our book is based on such cooperation, which since recently, is also postulated under the concept “One World – One Health.”

REFERENCES

Abbreviations

ACA Acrodermatitis chronica atrophicans
AIDS Acquired immunodeficiency syndrome
ARDS Acute respiratory distress syndrome
a.s.l. Above sea level
AV Atrioventricular
BSL Biosafety level
CD4 Cluster of differentiation 4 (glycoprotein on the surface of several immune cells)
CDC Centers for Disease Control and Prevention
cDNA Complementary DNA
CF test Complement fixation test
CFU Colony forming units
CIN Agar cefsulodin-irgasan-novobiocin agar
CMV Cytomegalovirus
CNS Central nervous system
CPK Creatine phosphokinase
CSD Cat scratch disease
CSF Cerebrospinal fluid
CT Computed tomography
DNA Deoxyribonucleic acid
EDTA Ethylenediaminetetraacetate/etylenediaminetetraacetic acid
EHEC Enterohemorrhagic Escherichia coli
EIA Enzyme immunoassay
ELISA Enzyme linked immunosorbent assay
EPEC Enteropathogenic Escherichia coli
ETB Ethambutol
FDA US Food and Drug Administration
HAART Highly active antiretroviral therapy
HACCP Hazard analysis critical control point
HAT Human African trypanosomiasis
HE Hektoen enteric (agar)
ABBREVIATIONS

HGA  Human granulocytic anaplasmosis
HGE  Human granulocytic ehrlichiosis
HIV  Human immunodeficiency virus
HLA  Human leukocyte antigen
HME  Human monocytic ehrlichiosis
HUS  Hemolytic-uremic syndrome
IARC International Agency for Research on Cancer (WHO)
ICU  Intensive care unit
IF(A) Immunofluorescence (assay)
Ig(A,G,M) Immunoglobulin(A,G,M)
IGR  Insect growth regulator
IHA  Indirect hemagglutination assay
IIFT Indirect immunofluorescence test
IL   Interleukin
i.m. Intramuscular
INH  Isonicotinic acid hydrazide/isoniazide
i.p. Intraperitoneal
i.v. Intravenous
kbp Kilobase pairs
kDa Kilodalton
LAMP Loop-mediated isothermal amplification
LEE  Locus of enterocyte effacement
LPS  Lipopolysaccharide
MAA  Mycobacterium avium subsp. avium
MAH  Mycobacterium avium subsp. hominissuis
MAI  Mycobacterium avium-intracellulare
MALDI-TOF Matrix-assisted laser desorption ionization-time-of-flight mass spectrometry
MAP  Mycobacterium avium subsp. paratuberculosis
MAT  Microagglutination test
mb   Megabases
MHC  Major histocompatibility complex
MID  Minimum infective dose
mio  Million
MPS  Mononuclear phagocytic system
MRI  Magnetic resonance imaging
mRNA Messenger RNA
MMT  Mendel-Mantoux test
MOMP Mitochondrial outer membrane protein
MRSA Methicillin-resistant Staphylococcus aureus
NSF  National Science Foundation
NNN  Novy-McNeal-Nicolle medium
NTM  Non-tuberculous mycobacterium
PAHO Pan American Health Organization
PCR  Polymerase chain reaction
PFGE Pulse field gel electrophoresis
PFU  Plaque forming unit
p.i. Post infection
PI-IBS Post infectious irritable bowel syndrome
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tr>
<td>p.o.</td>
<td>Peroral</td>
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<tr>
<td>p.p.</td>
<td>Post partum</td>
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<tr>
<td>RES</td>
<td>Reticuloendothelial system</td>
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<tr>
<td>RFLP</td>
<td>Restriction fragment length polymorphism</td>
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<tr>
<td>RMP</td>
<td>Rifampicin</td>
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<td>RMSF</td>
<td>Rocky Mountain spotted fever</td>
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<tr>
<td>RNA</td>
<td>Ribonucleic acid</td>
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<tr>
<td>rRNA</td>
<td>Ribosomal RNA</td>
</tr>
<tr>
<td>RT-PCR</td>
<td>Reverse transcription PCR</td>
</tr>
<tr>
<td>SAF</td>
<td>Sodium acetic acid formaldehyde</td>
</tr>
<tr>
<td>s.c.</td>
<td>Subcutaneous</td>
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<tr>
<td>SCV</td>
<td>Small cell variant</td>
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<tr>
<td>SIRS</td>
<td>Systemic inflammatory response syndrome</td>
</tr>
<tr>
<td>s.l.</td>
<td>Sensu lato</td>
</tr>
<tr>
<td>SMAC</td>
<td>Sorbitol-MacConkey agar</td>
</tr>
<tr>
<td>spf</td>
<td>Specific pathogen free</td>
</tr>
<tr>
<td>SS</td>
<td>Salmonella-Shigella (agar)</td>
</tr>
<tr>
<td>s.s.</td>
<td>Sensu stricto</td>
</tr>
<tr>
<td>SSG</td>
<td>Sodium stibogluconate</td>
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<tr>
<td>STEC</td>
<td>Shiga toxin producing \textit{Escherichia coli}</td>
</tr>
<tr>
<td>STx</td>
<td>Shiga toxin</td>
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<td>Th (1,2)</td>
<td>T helper cell (1,2)</td>
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<tr>
<td>Tir</td>
<td>Translocated intimin receptor</td>
</tr>
<tr>
<td>TNF</td>
<td>Tumor necrosis factor</td>
</tr>
<tr>
<td>Tris</td>
<td>Tris(hydroxymethyl)aminomethane</td>
</tr>
<tr>
<td>TTP</td>
<td>Thrombotic thrombocytopenic purpura</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
<tr>
<td>UV</td>
<td>Ultraviolet</td>
</tr>
<tr>
<td>VSG</td>
<td>Variant surface glycoprotein(s) of African trypanosomes</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>XLD</td>
<td>Xylose-lysine-deoxycholate (agar)</td>
</tr>
</tbody>
</table>