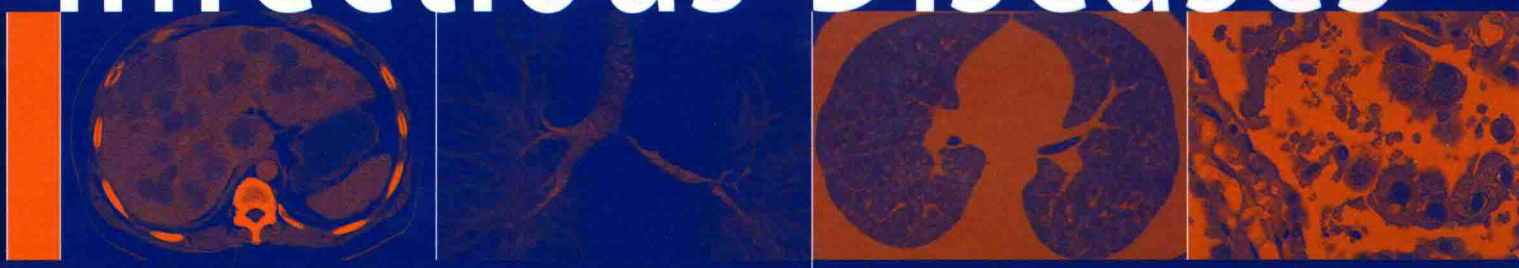
Diagnostic Imaging of Emerging Infectious Diseases



Pu-Xuan Lu
Bo-Ping Zhou
Editors

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Pu-Xuan Lu • Bo-Ping Zhou
Editors

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Foreword I

Epidemics of severe acute respiratory syndrome (SARS) in 2003 and sporadic prevalence of human avian influenza around 2006 make people fully realize the great threats of emerging infectious diseases (EIDs) on human health, society, and economy. In the coming twenty-first century, the prevention and treatment of EIDs are expected to remain a crucial task in public health for countries around the world.

Professor Lu Puxuan and Professor Zhou Boping are among the pioneers in China dedicated to clinical diagnosis and treatment of EIDs. Their remarkable exploration and contribution in imaging detection and diagnosis of EIDs have laid a solid foundation for this book entitled *Clinical Diagnostic Imaging of Emerging Infectious Diseases*. This book is the first monograph domestically and internationally on the clinics of EIDs. It compiled the valuable experience and research outcomes of over 80 clinical workers and researchers from frontline combat of EIDs that start in China and have heavy impacts around the world such as SARS and human avian influenza. This book details the pathological changes and clinical imaging diagnosis of EIDs and the imaging diagnosis and differential diagnosis of EID-related complications. Complete with detailed and authentic data, this book is focused and highly practicable,

which yields high academic value for clinical reference. It will serve well for basic, clinical, and preventive medical workers and relevant administrators, even the public. I am hereby very glad to recommend this book.

Beijing
March 2014

Hou Yunde
Academician of Chinese Academy of Engineering

Foreword II

Over the past 30 years, approximately 40 emerging infectious diseases (EIDs) have appeared, with at least one EID each year. Severe acute respiratory syndrome (SARS), type A (H1N1) influenza, and human avian influenza (H5N1, H7N9) are the most globally challenging EIDs in the past 10 years. Their uncertain and unpredictable etiology leaves us unable to launch specific preventive measures, derive early and accurate diagnosis, and realize effective control, thus resulting in wide prevalence and high mortality with serious impacts on social stability and economic development.

The *Clinical Diagnostic Imaging of Emerging Infectious Diseases* compiled by Professor Lu Puxuan and Professor Zhou Boping of Shenzhen Third People's Hospital is the first monograph domestically and internationally on EIDs. This book summarizes the valuable experience and research outcomes of clinical workers and researchers from frontline combat of EIDs that start in China and have great impacts around the world such as SARS and human avian influenza and elaborates the pathophysiological and pathological changes and clinical imaging diagnosis of EIDs and the imaging diagnosis and differential diagnosis of EID-related complications. Meanwhile, it also presents an introduction of the etiology, epidemiology, and clinical diagnosis of EIDs.

This book is rich, novel, focused, and highly practicable, which demonstrates great reference value for basic, clinical, and preventive medical staff, administrators, and medical students. It is of great significance for popularizing the clinical knowledge of examination, diagnosis, prevention, and treatment of EIDs among the public so as to improve the diagnosis and treatment of EIDs.

I had the privilege of reading this book in advance. Deeply impressed by its academic significance and value, I hereby strongly recommend it.

Beijing
March 2014

Zeng Yixin
President of Peking Union Medical College
Academician of Chinese Academy of Sciences

Preface

Emerging infectious diseases (EIDs) comprise new, emerging, or drug-resistant infectious diseases; its incidence in human populations is found on continual rise or indicated likely to further increase. Over the past 30 years, approximately 40 EIDs have appeared, with at least one EID occurring each year. Fifty percent of these infections are viral, and 75 % are of animal origin. In the past 10 years, SARS and highly pathogenic avian influenza EIDs have cast the greatest threats around the world. Due to the uncertainty and unpredictability of EIDs, people cannot immediately reach decisions and take measures for specific prevention, early diagnosis, and effective control, thus resulting in high mortality and severe impacts on social stability and economic development. EIDs have become a major global public health concern.

At present, the predominant emerging infectious diseases have not been fully elucidated. Therefore, for healthcare professionals, particularly those dedicated to clinics, pathology, and medical imaging of infectious diseases, it is of great importance to understand and study the clinics, pathology, imaging diagnosis, and differential diagnosis of emerging infectious diseases. Besides, radiographic examinations have great values in EID diagnosis, differential diagnosis, treatment efficacy assessment, and prognostic evaluation. Hence, based on the clinical experience and research outcomes from first-line combat of EIDs, we compile this *Clinical Diagnostic Imaging of Emerging Contagious Diseases*.

This book is divided into 8 chapters with 51 sections. It covers seven emerging infectious diseases with high incidence and mortality that pose enormous effects on human, including severe acute respiratory syndrome (SARS), human avian influenza (H5N1, H7N9), hand-foot-mouth disease, type A (H1N1) influenza, acquired immune deficiency syndrome (AIDS), viral hepatitis and tuberculosis (TB). This book elaborates the pathogenesis and pathology of emerging infectious diseases (EIDS), imaging techniques and rational selection of these techniques for EIDS, EID'S presentations and characteristics on imaging, and diagnosis and differential diagnosis of EID-related complications with imaging techniques. Meanwhile, considering that EIDs are special and partly unknown, some sections are devoted to the introduction of etiology, epidemiology, pathophysiology, clinical symptoms and signs, laboratory tests, clinical diagnosis, and differential diagnosis, as well as prevention, treatment, and prognosis of EIDs. In this way, we hope readers may understand relevant clinical knowledge of EIDs besides the pathological changes, imaging

examinations, and diagnosis of EIDs, thus popularizing knowledge about EID examinations and diagnosis among the extensive healthcare professionals.

The content of this book is rich, novel, focused, and well illustrated. Besides, the over 600 precious pathological and imaging pictures make it more informative and unique. With high practical value, this clinical monograph on EIDs boasts reference value for both staff in basic medicine, clinical medicine, preventive medicine, administrators, and medical students.

We would like to express our sincere gratitude to Professor Zeng Yixin, President of Peking Union Medical College and academician of Chinese Academy of Sciences (CAS), and Professor Hou Yunde, academician of Chinese Academy of Engineering (CAE), for their great support and concern on this book. It is our honor to invite both of them to preface this book.

In light of the extensive coverage of this book, many problems of EIDs in basic, clinical, and preventive medicine still remain unresolved. Though this book has been carefully compiled by more than 80 professors and experts engaged in EID frontline clinics and researches, there may still be some omission. Along with lapse of time, researches about EIDs will go deeper, and some scientific problems will be gradually unveiled and solved. Meanwhile, new infectious diseases may occur or break out. Therefore, we gratefully welcome any critique, correction, addition, and improvement.

Shenzhen, China — Pu-Xuan Lu
Shenzhen, China — Bo-Ping Zhou

Editors

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The Shenzhen No. 3 People's Hospital, Guangdong Medical College, Shenzhen, China
Shenzhen City People's Hospital
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Contact address: No. 19, Pan Jia Yuan Nan Li, Chaoyang District, Beijing 100021, P.R. China, phone/fax: 8610 5978 7236, E-mail: pmph@pmph.com

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Contents

Introduction of Emerging Infectious Diseases

1

Pu-Xuan Lu, Bo-Ping Zhou, Yang Gui-Lin, and An Qi

1.1 Definition of Emerging Infectious Diseases (EIDs)

Emerging infectious diseases (EIDs) refer to contagious diseases newly appeared, or with drug resistance, whose incidences have been rapidly increasing and are likely to further rise in the future. EIDs are usually discovered in three ways. Firstly, some existing diseases are ascertained as EIDs due to the recent discovery of pathogens. Secondly, previously considered noninfectious diseases are identified contagious as a result of new etiological findings. Thirdly, new infectious diseases are incurred by various complicated reasons such as evolution of pathogens. Due to their uncertainty and unpredictability, EIDs could result in high mortality and great impacts on social stability and economic development as people are unable to react immediately and take specific preventive or control measures. Therefore, EIDs have become a major public health problem worldwide. Cases in point are the epidemics of SARS in 2003 and H7N9 avian influenza around 2006, which have eloquently demonstrated their great threats to human health, society, and economy. In the coming twenty-first century, contagious diseases are expected to remain as a crucial public health concern for countries around the world.

Pu-Xuan Lu (✉)
Department of Radiology, Shenzhen Third People's Hospital Guangdong, Shenzhen, China
e-mail: lupuxuan@126.com

Bo-Ping Zhou
Department of Infection, Shenzhen Third People's Hospital Guangdong, Shenzhen, China
e-mail: zhoubp@hotmail.com

Yang Gui-Lin • An Qi
The Shenzhen No.3 People's Hospital, Guangdong College, Shenzhen, China

1.2 Classification of EIDs

At present, more than 40 kinds of EIDs have been found worldwide, and over 30 kinds have been reported successively in China. EIDs can be classified into the following five categories.

1.2.1 EIDs Caused by New Pathogens

Such contagious diseases did not exist in the past and newly emerge due to new pathogens such as AIDS, severe acute respiratory syndrome (SARS), human infection with highly pathogenic avian influenza H5N1, influenza A (HlN1), and human infection with avian influenza H7N9.

1.2.2 EIDs Caused by New Variant Strains

Such diseases are caused by new variants mutated from existing pathogenic microorganisms. For example, current study suggests that *Vibrio cholera* O_{139} may be the result of genetic mutation of O_1 serogroup.

1.2.3 Newly Acknowledged EIDs

Some existing diseases are not recognized as EIDs until recently, such as hepatitis D and E, legionnaire's disease, and Lyme disease.

1.2.4 Existing Noncontagious Diseases Redefined as EIDs

Some existing diseases considered noninfectious are found contagious in recent years, such as peptic ulcer caused by *H. pylori* and T-cell leukemia.

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1.2.5 EIDs Endemic in Some Places

Contagious diseases endemic in some places become prevalent in new places and then are generally considered as EIDs, such as West Nile virus (WNV) that was once popular in Middle East and Europe and broke out in the USA in 2012.

1.3 Epidemiology of EIDs

1.3.1 Prevalence Characteristics

Pandemic and subject to multiple influential factors. For example, diseases like Lyme disease, Legionnaires' disease, and peptic ulcer disease are globally distributed, SARS appears in 32 countries and regions, and BSE rages over 22 European countries.

Highly contagious and complex in dissemination routes. EIDs like Ebola hemorrhagic fever, SARS, West Nile encephalitis, and mad cow disease are all highly contagious through various channels.

Fast transmission with severe damages. AIDS, described as super cancer and the top killer in twentieth century, has been spreading across the world in an astonishing speed since diagnosed in 1981. In 2003, both the outbreak of SARS in spring and the highly pathogenic avian influenza H5N1 after mid-December caused casualties and huge economic losses. SARS, human avian influenza, and influenza HlN1 have all become rampant worldwide in a short time. Besides, convenient transportation and close international contacts also facilitate their spread.

Zoonotic. More than three quarters of EIDs are zoonotic and closely related to animals. Researches by *Jones et al.* revealed that 60.3 % EIDs were zoonotic, with 71.8 % caused by wild animals, such as human avian influenza and Ebola virus.

Difficult to prevent, diagnose, and treat due to the varied pathogens. Pathogens of EIDs mainly encompass viruses, bacteria, rickettsia, and chlamydia, predominantly viruses which are highly elusive and infectious.

Free of natural immunity in human populations. With strong variability, the viruses of EIDs are able to escape the immune barrier and develop resistance to drugs in new hosts as the environment changes. Therefore, people have no immunity to EIDs.

1.3.2 Influential Factors

Biological factors. Pathogenic microorganisms may mutate to adapt new environment. Therefore, nonpathogenic strains may become pathogenic, and attenuated strains become virulent, or evolve into new pathogens, thus giving rise to EIDs. Pathogens may generate numerous mutant strains by acquisition, recombination, or transfer of genes in a short time, part of which may develop into new pathogens of contagious diseases.

Natural factors. Global warming has changed the geographical distribution of vector insects and increased their reproduction speed and invasiveness. As a result, breeding time of pathogens outside human bodies is curtailed, making insect-borne contagious diseases more frequent.

Social factors. Deforestation, construction of dams, and other human activities can change the ecological environment. Additionally, population movement, sexual promiscuity, drug abuse, and other bad behaviors may cause and spread contagious diseases.

1.4 Clinical and Imaging Characteristics of EIDs

1.4.1 Clinical Signs of Infectious Diseases

Similar to other contagious diseases, EIDs progress through four periods: incubation period, prodromal period, period of apparent manifestation, and convalescent period.

1.4.1.1 Incubation Period

This period commences from the invasion of pathogens into human body and ends upon the appearance of clinical symptoms.

1.4.1.2 Prodromal Period

This period spans from onsets to manifestation of evident symptoms. Clinical manifestations are usually nonspecific and shared by all EIDs, such as headache, fever, fatigue, and muscle soreness. It commonly lasts 1–3 days.

1.4.1.3 Period of Apparent Manifestation

After prodromal period, some patients with acute contagious diseases enter the period of apparent manifestation. During this period, all the signs and symptoms of the infectious diseases usually fully manifest.

1.4.1.4 Convalescent Period

When human immunity grows to a certain extent, the pathophysiological changes would come to an end, and patients' symptoms and signs basically disappear, which is clinically called convalescent period. Some diseases can reoccur, and some may cause sequelae.

1.4.2 Clinical Imaging Characteristics of EIDs

Clinical imaging diagnosis is of great significance for the diagnosis, differential diagnosis, and efficacy evaluation of EIDs.

1.4.2.1 Necessary Imaging Examinations and Protection Should Be Carried Out for EIDs

In light of the strong infectiveness and variability of EIDs, imaging data are needed for their clinical diagnosis, differential diagnosis, treatment evaluation, and prognosis.

1.4.2.2 Basic Imaging Presentations of EIDs Are Ground-Glass Opacity and Pulmonary Consolidation Shadows

Mostly caused by viruses, EIDs have mainly such pulmonary imaging changes as rapid occurrence of ground-glass opacity and (or) pulmonary consolidation. Cavity and cystic changes can also be seen in some cases.

1.4.2.3 Dynamic Imaging Visualizes Rapid Changes of Lesions

For some patients, imaging presentations and clinical symptoms and signs are not consistent. For example, the imaging findings may be serious, while clinical symptoms are mild.

1.4.2.4 Lesion Absorption Is Slow

For example, the pulmonary interstitial fibrosis lesions of patients with human avian influenza H5N1 may procrastinate for several years.

1.4.2.5 Complications May Occur

During convalescent period, absorption of lesions is slow and imaging changes such as interlobular septal thickening and interstitial hyperplasia may be observed. For example, pulmonary fibrosis may be left in some SARS patients with severe pulmonary injuries after recovery as the absorption of pulmonary lesions take a long time. Moreover, patients with SARS or avian influenza H7N9 may be complicated with avascular necrosis of femoral head.

1.5 Measures and Strategies Against EIDs

1.5.1 A Disease Surveillance Network Should Be Erected and Ameliorated

Efforts shall be made to strengthen the surveillance of EIDs from organization system, personnel, equipment, and technological competence. By monitoring and investigation, we could timely detect new sources of infection or new pathogens and influential factors and take prompt and effective measures to rein in their spread and contagion. A global coordinated information platform for EIDs prevention and control shall be established and improved where countries shall timely communicate epidemic situation of EIDs and share experience for EIDs prevention and control so as to block large-scale spreading.

1.5.2 Improvement of Public Health Infrastructure and Training of Relevant Personnel

Public health infrastructure is fundamental to support public health preventive measures and to assess public health status. The high quality training of public health practitioners plays an vital role for the control of infectious diseases. Faced with the threats of emerging infectious, public health professionals should strengthen their training, and establish team culture to evaluate epidemiology of infectious diseases, thereby in the face of emerging infectious diseases outbreaks reasonable measures can be taken in an orderly manner to control the situation.

1.5.3 Scientific Research About EIDs Should Be Reinforced and Research and Development of Vaccines and New Drugs Accelerated

1. Conduct epidemiological studies to clarify the epidemic stages, characteristics, and influential factors of EIDs, so as to provide scientific evidences for formulation of prevention countermeasures
2. Accelerate the research and development of vaccines
3. Speed up the research of diagnostic reagents to form experimental methods for rapid diagnosis of EIDs
4. Carry out studies on pathogenic mechanism and early warning techniques for EIDs
5. Accelerate the research and development of new drugs, especially antiviral drugs
6. Build a strain resource bank of pathogenic microorganisms

1.5.4 Relevant Laws and Regulations Targeted at EIDs Should Be Promulgated

Prevention and treatment in line with laws should be geared up and relevant laws and regulations be enacted.

1.5.5 Attention Should Be Paid to Public Education and Information Communication

Multidisciplinary studies in public health and journalism and communication should be launched to address social panics caused by the outbreak of contagious diseases.

1.5.6 The Ecological Balance Between Nature and Human Beings Should Be Maintained

Preservation of ecological balance and natural environment is the fundamental way to control and reduce zoonotic contagious diseases, therefore precluding EIDs from the source.

Further Reading

1. Shao JS, Lu HZ. Overview of EIDS researches [in Chinese]. J Diagn Concepts Pract. 2011;10(3):293–6.
2. Guan Y, Zheng BJ, He YQ, et al. Isolation and characterization of viruses related to the SARS coronavirus from animals in southern China. Science. 2003;302:276–8.
3. Liu DW, Zhang LM. Research contents and methods of EIDS [in Chinese]. Chi J Prev Med. 2007;8(4):478–80.
4. Lu PX, Zhou BP, Yuan MY, et al. Chest X-ray manifestations of SARS [in Chinese]. Chin J Radiol. 2003;37(8): 682–5.
5. Lu PX, Zhou BP, Yang GD, et al. Clinical characteristics and chest X-ray manifestations of severe SARS [in Chinese]. Chin J Emerg Med. 2003;12(7):437–9.
6. Cao Y, Zheng GP, Lu PX, et al. Study about indicators for beside radiogram and protection principles of influenza A (H1N1) [in Chinese]. Chin J Med. 2012;47(10):81–3.
7. Ma DQ. Role of imaging in diagnosis of human avian influenza [in Chinese]. Chin J Radiol. 2006;40(3):230.
8. Zhou BP, Tang XP, Lu PX, et al. SARS [in Chinese]. People's Medical Publishing House, Beijing; 2004.
9. Zhou BP, Li YM, Lu PX, et al. Human avian influenza [in Chinese]. Beijing: Science Press; 2007. p. 180–9.
10. Lu PX, Deng YY. Epidemiological characteristics and pulmonary imaging findings of human avian influenza [in Chinese]. Chin J Med Imag. 2010;16(5):431–4.
11. Lu PX, Zhou BP, et al. Chest clinical imaging diagnosis of AIDS [in Chinese]. Beijing: Science Press; 2012.
12. Zhou BP, Chun YT, et al. Viral hepatitis. People's Medical Publishing House, Beijing; 2011.
13. Zhou BP, Li CR, et al. EV-71Hand-foot-mouth disease. People's Medical Publishing House, Beijing; 2009.
14. Sun XD, Wang HY. The epidemic situation and t prevention and treatment strategies for EIDS [in Chinese]. Shanghai J Preventive Med. 2009;2l(9):461–5.
15. Lin JD, Yang BB. The epidemic characteristics and countermeasures of EIDS [in Chinese]. China Trop Med. 2007;7(4):597–8.
16. Lu PX, Deng YY, Liu ST, Liu Y, Liu YX, Wang YX, Zhu WK, Le XH, Yu WY, Zhou BP. Correlation between imaging features of Pneumocystis Jiroveci Pneumonitis (PCP), CD(4) (+) T lymphocyte count, and plasma HIV viral load: a study in 50 consecutive AIDS patients. Quant Imaging Med Surg. 2012;2(2):124–9.
17. Lu PX, Deng YY, Yang GL, Liu WL, Liu YX, Huang H, Wang YX. Relationship between respiratory viral load and lung lesion severity: a study in 24 cases of pandemic H1N1 2009 influenza A pneumonia. J Thorac Dis. 2012;4(4):377–83.
18. Lu PX, Wang YX, Zhou BP, Ge Y, Zhu WK, Chen XC, Ran XG. Radiological features of lung changes caused by avian influenza subtype A H5N1 virus: report of two severe adult cases with regular follow-up. Chin Med J (Engl). 2010;123(1):100–4.