

THIRD EDITION

MEDICAL MICROBIOLOGY

INTERNATIONAL EDITION • NOUVEAU
• INTERNATIONAL



Cedric Mims
Hazel M Dockrell
Richard V Goering
Ivan Roitt
Derek Wakelin
Mark Zuckerman

Contents

Preface ix

Acknowledgements x

Contributors x

A contemporary approach to microbiology

Microbes and parasites 1

The context for contemporary
medical microbiology 1

Microbiology past, present and future 2

The approach adopted in this book 4

SECTION 1 THE ADVERSARIES: MICROBES

1. Microbes as parasites

The varieties of microbes 7

Living inside or outside cells 8

Systems of classification 9

2. The bacteria

Structure 11

Nutrition 13

Growth and division 13

Gene expression 14

Extrachromosomal elements 17

Mutation and gene transfer 19

Survival under adverse conditions 24

The genomics of medically important bacteria 24

3. The viruses

Infection of host cells 29

Replication 31

Outcome of viral infection 33

Major groups of viruses 35

4. The fungi

Major groups of disease-causing fungi 39

5. The protozoa 43

6. The helminths and arthropods

The helminths 47

The arthropods 49

7. Prions

'Rogue protein' pathogenesis 53

Development and transmission of prion
diseases 54

Medical problems posed by prion disease 54

8. The host-parasite relationship

The normal flora 57

Symbiotic associations 60

The characteristics of parasitism 62

The evolution of parasitism 63

SECTION 2 THE ADVERSARIES: HOST DEFENSES

9. The innate defenses of the body

Defense against entry into the body 72

Defenses once the microorganism penetrates the
body 72

10. Adaptive responses provide a 'quantum leap' in effective defense

The role of antibodies 87

The role of T lymphocytes 89

Extracellular attack on large infectious agents 93

Local defenses at mucosal surfaces 94

11. The cellular basis of adaptive immune responses

B and T cell receptors 100

Clonal expansion of lymphocytes 102

The role of memory cells 103

Stimulation of lymphocytes 104

Cytokines 104

Regulatory mechanisms 106

Tolerance mechanisms 106

INFECTIONS

12. Background to the infectious diseases

- Host-parasite relationships 117
- Causes of infectious diseases 118
- The biologic response gradient 120

13. Entry, exit and transmission

- Sites of entry 123
- Exit and transmission 130
- Types of transmission between humans 132
- Transmission from animals 137

14. Immune defenses in action

- Complement 143
- Acute phase proteins and pattern recognition receptors 144
- Fever 144
- Natural killer cells 144
- Phagocytosis 145
- Cytokines 147
- Antibody-mediated immunity 148
- Cell-mediated immunity 151
- Recovery from infection 154

15. Spread and replication

- Features of surface and systemic infections 157
- Mechanisms of spread through the body 159
- Genetic determinants of spread and replication 162
- Other factors affecting spread and replication 163

16. Parasite survival strategies and persistent infections

- Parasite survival strategies 167
- Concealment of antigens 169
- Antigenic variation 172
- Immunosuppression 173
- Persistent infections 176

17. Pathologic consequences of infection

- Pathology caused directly by the microorganism 184
- Pathologic activation of natural immune mechanisms 187
- Pathologic consequences of the immune response 189
- Skin rashes 193
- Viruses and cancer 194

CLINICAL MANIFESTATION AND DIAGNOSIS OF INFECTIONS BY BODY SYSTEM

- Introduction to Section 4: The Clinical Manifestations of Infection 199

- Treatment 247
- Prevention 248

18. Upper respiratory tract infections

- The common cold 201
- Pharyngitis and tonsillitis 202
- Parotitis 210
- Otitis and sinusitis 211
- Acute epiglottitis 213
- Oral cavity infections 213
- Laryngitis and tracheitis 214
- Diphtheria 214

19. Lower respiratory tract infections

- Acute infections 217
- Chronic infections 232
- Parasitic infections 237

20. Urinary tract infections

- Acquisition and etiology 241
- Pathogenesis 242
- Clinical features and complications 244
- Laboratory diagnosis 245

21. Sexually transmitted diseases

- STDs and sexual behavior 251
- Syphilis 251
- Gonorrhea 256
- Chlamydial infection 258
- Other causes of inguinal lymphadenopathy 261
- Mycoplasmas and non-gonococcal urethritis 262
- Other causes of vaginitis and urethritis 262
- Genital herpes 263
- Human papillomavirus infection 264
- Human immunodeficiency virus 264
- Opportunistic STDs 273
- Arthropod infestations 275

22. Gastrointestinal tract infections

- Diarrheal diseases caused by bacterial or viral infection 277
- Food poisoning 292
- Helicobacter pylori* and gastric ulcer disease 293

Parasites and the gastrointestinal tract 293
 Systemic infection initiated in the gastrointestinal tract 300

23. Obstetric and perinatal infections

Infections occurring in pregnancy 313
 Congenital infections 313
 Infections occurring around the time of birth 318

24. Central nervous system infections

Invasion of the central nervous system 323
 The body's response to invasion 324
 Meningitis 325
 Encephalitis 331
 Neurologic diseases of possible viral etiology 337
 Spongiform encephalopathy caused by scrapie-type agents 337
 CNS disease caused by parasites 338
 Brain abscesses 339
 Tetanus and botulism 339

25. Infections of the eye

Conjunctivitis 343
 Infection of the deeper layers of the eye 345

26. Infections of the skin, soft tissue, muscle and associated systems

Bacterial infections of skin, soft tissue and muscle 350
 Mycobacterial diseases of the skin 357
 Fungal infections of the skin 359
 Parasitic infections of the skin 264
 Mucocutaneous lesions caused by viruses 366
 Smallpox 373
 Measles 374
 Rubella 375
 Other infections producing skin lesions 376
 Kawasaki syndrome 377
 Viral infections of muscle 377
 Parasitic infections of muscle 377

Joint and bone infections 378
 Infections of the hemopoietic system 380

27. Vector-borne infections

Arboviruses infections 383
 Infections caused by Rickettsiae 386
 Borrelia infections 389
 Protozoal infections 391
 Helminth infections 397

28. Multisystem zoonoses

Arenavirus infections 401
 Korean hemorrhagic fever 402
 Marburg and Ebola hemorrhagic fevers 402
 Q fever 403
 Anthrax 404
 Plague 405
Yersinia enterocolitica infection 407
 Tularemia 407
Pasteurella multocida infection 407
 Leptospirosis 407
 Rat bite fever 408
 Brucellosis 409
 Helminth infections 410

29. Fever of unknown origin

Definitions of fever of unknown origin 413
 Causes of FUO 413
 Investigation of classical FUO 414
 Treatment of FUO 415
 FUO in specific patient groups 415
 Infective endocarditis 416

30. Infections in the compromised host

The compromised host 423
 Infections of the host with deficient innate immunity due to physical factors 426
 Infections associated with secondary adaptive immunodeficiency 429
 Other important opportunist pathogens 431

PART 5 DIAGNOSIS AND CONTROL

31. Strategies for control: an introduction

Epidemiologic considerations 441
 Detection and diagnosis 447
 Chemotherapy versus vaccination 447
 Control versus eradication 450

32. Diagnosis of infection and assessment of host defense mechanisms

Aims of the clinical microbiology laboratory 453
 Specimen processing 453
 Non-cultural techniques for the laboratory diagnosis of infection 455
 Cultivation (culture) of microorganisms 462

CONTENTS

Identification of microorganisms grown in culture 464

Antibody detection methods for the diagnosis of infection 466

Assessment of host defense systems 468

Protocols for specimen processing 471

33. Attacking the enemy: antimicrobial agents and chemotherapy

Selective toxicity 473

Discovery and design of antibacterial agents 473

Classification of antibacterial agents 474

Resistance to antibacterial agents 475

Classes of antibacterial agents 477

Inhibitors of cell wall synthesis 478

Inhibitors of protein synthesis 485

Inhibitors of nucleic acid synthesis 492

Antimetabolites affecting nucleic acid synthesis 494

Other agents that affect DNA 496

Inhibitors of cytoplasmic membrane function 496

Urinary tract antiseptics 496

Antituberculous agents 496

Antibacterial agents in practice 497

Antibiotic assays 499

Antiviral therapy 499

Antifungal agents 504

Antiparasitic agents 505

Use and misuse of antimicrobial agents 507

34. Vaccination

The aims of vaccination 513

Requirements of a good vaccine 514

Types of vaccine 516

Special considerations 520

Community-based control by vaccination 524

Factors influencing the success of vaccination 527

Current vaccine practice 528

35. Passive and non-specific immunotherapy

Passive immunization with antibody 539

Non-specific cellular immunostimulation 542

Correction of host immunodeficiency 543

36. Hospital infection, sterilization and disinfection

Common hospital-acquired infections 546

Important causes of hospital infection 546

Sources and routes of spread of hospital infection 548

Host factors and hospital infection 549

Consequences of hospital infection 551

Prevention of hospital infection 551

Investigating hospital infection 555

Sterilization and disinfection 556

Appendix – Pathogen parade 567

Answers 631

Index 640

Medical microbiology , the large subset of microbiology that is applied to medicine, is a branch of medical science concerned with the prevention, diagnosis and treatment of infectious diseases. In addition, this field of science studies various clinical applications of microbes for the improvement of health. There are four kinds of microorganisms that cause infectious disease: bacteria, fungi, parasites and viruses, and one type of infectious protein called prion.