.com, for detailed information on medicine books, visit our website www.ejaypee.com, for detailed information on medicine books,

Textbook of
Em
M
Inclu
De
Volume 2

.com, for detailed information on medicine books, visit our website www.ejaypee.com, for detailed information on medicine books,

Textbook of Emergency Medicine

Including Intensive Care & Trauma

Editor
Devendra Richhariya

3rd Edition

Volume 1

JAYPEE

CONTENTS

VOLUME 1

SECTION 1: BASICS OF EMERGENCY MEDICINE

1. Triaging **1**

Devendra Richhariya

• Triaging in Emergency Department *1* • Triaging Scales *2* • Triaging Process *3* • Early Warning Scores *5* • Triage in Mass Casualty Incident *7* • Reverse Triaging *7* • Triaging in Highly Infectious Patient *7* • Rapid Assessment and Early Treatment in Emergency Department *8* • Clinical Decision Rules *11* • Key Performance Indicators of Emergency Department *12*

2. Designing and Staffing **14**

Saleh Fares, Devendra Richhariya

• Challenges for Emergency Department in India *14* • Functions of Emergency Department *14* • Requirements for Creating New Infrastructure as the Emergency Department *14* • General Considerations for Designing the Emergency Department *15* • Other Requirements *16* • Patient Flow *16* • Dedicated Area Within Emergency Department *18* • New Concepts in Emergency Department Design *18* • How to Plan Staffing of an Emergency Department *19* • Staffing Requirments for Emergency Department on the Basis of Patient Visit *20* • Ideal Staffing Model for Emergency Department *21*

3. Observation and Isolation Unit **23**

Devendra Richhariya

• Observation Unit Design and Layout *23* • Protocol Development *24* • Observation Unit Management *25* • Quality Assurance Process and Metrics *26* • Guidelines for Setting Up Isolation Unit *26* • Setting Up Isolation Unit/Ward *27* • Classification of Isolation Rooms *28* • Transport of Infectious Patients *28* • Wearing (Donning) and Removing (Doffing) Personal Protective Equipment *29*

4. Infection Prevention and Personal Protective Equipment **31**

TV Ramakrishnan

• Standard Infection Control Precautions *31* • Transmission-based Precautions *33* • Device-associated Infections *34* • Education and Training *34* • Personal Protective Equipment *34* • Donning (Wearing) and Doffing (Removal) of Personal Protective Equipment *35* • Limitations of Personal Protective Equipment *41*

5. Hazardous Material **42**

Megha Richhariya

• Classes of Hazardous Materials *42* • Degree of Hazard Identification *42* • Hospital Plan *42* • Department Responsibilities *44* • Storage of Hazardous Materials *44*

• Transportation *44* • Chemical Spills *44* • Blood Spill Management *44*
• Decontamination *45* • Hazardous Waste and Segregation *45*
• Personal Protective Equipment in Hazardous Materials Incidents *45*

6. Safety and Quality **48**

Saravana Kumar

• Background of Emergency Department *48* • Approach to Quality Issues in the Emergency Department *49* • Adverse Events in the Emergency Department *49* • Safety Practice and Strategy Implementation *50* • Infrastructure Requirements *50* • Patient Flow Management *50* • Clinical Management Process and Protocols for Quality Care *51*
• Establishing a Unit of Quality Department *51* • Quality Control of Medical Equipments *52* • Measuring Quality of Performance (Quality Indicators) *53*
• Nonconformance Control and Management *53* • Adapting to Changing Realities *53*
• Clinical Audit *54* • Fishbone Analysis for Quality Improvement *55*

7. Medicolegal Cases and Medicolegal Report **56**

Devendra Richhariya

• How Does the Law Protect the Victim in Medicolegal Cases? *56* • Medicolegal Cases *56* • Medicolegal Reports *57* • Sexual Assault—Rape *60* • Medical Negligence *61* • Do Not Attempt Resuscitation Guidelines *62* • Euthanasia *62*
• Discharge Against Medical Advice *63* • Medicolegal Implications of a Prisoner Absconding *63* • Declare a Patient Brought Dead *63*

8. Difficult Situations **65**

AN Venkatesh

• Difficult Situations *65* • Types of Difficult Patients *66*
• How to Deal with Difficult Situations *66*

9. Overcrowding Management **68**

MI Nizami, Ashima Sharma

• Definition of Overcrowding *68* • Causes of Overcrowding *69* • Interventions *71*

10. Disaster Management **73**

Ives Hubloue

• Definitions *73* • Features of Disaster *73* • Classification of Disasters *74*
• Disaster Management Cycle *74* • Disaster Response Management *75* • Multiagency Coordination during Response *75* • Early Warning System for Disaster *76* • Role of Technology as Decision Support Tools *76* • Humanitarian Consideration in Disaster Response *76* • Conducting Exercise for Disaster Management *76* • Role of Incident Command System *77*

11. Preparedness for CBRNE Disaster **79**

Shaza Karrar, Mohammad Anzal Rehman, Saleh Fares

• Chemical, Biological, Radiological, and Nuclear Preparedness Among Emergency Providers *79* • Approach to the Chemical, Biological, Radiological, and Nuclear/Energetics Incident *79* • Chemical, Biological, Radiological, and Nuclear Scene Management *80*
• Chemical, Biological, Radiological, and Nuclear Scene Management Zones *80* • Mass Casualty Management *81* • Chemical Agents *82* • Biological Agents *82* • Radiation/Energetics *85*

12. Military Medicine **88**

Ahmed Humaid, Abdulla Alhmoudi, Saleh Fares

• Tactical Combat Casualty Care Principles *88* • Field Triage *89* • Approach to the Injured Soldier *89* • Medical Evacuation *91* • Challenges and Innovations *91*

13. Ground Medical Transfer **95**

GV Ramana Rao

• Historical Milestones *95* • Current Context *95* • Principles Guiding the Ground Medical Transfers *96* • Models of Ground Medial Transfers *96* • Basic Tasks and Tenants *96* • Types of Road Ambulances *97* • Planning and Coordination *97* • Training for Emergency Medical Technicians *98* • Quality Assurance *98*

14. Air Medical Transfer **99**

Saleh Fares, Devendra Richhariya

• Decision for Air Medical Transfer *99* • Flight Physiology *100* • Standards of Care: Air Medical Transfer *100* • Special Considerations *102* • Recent Advances *102*

15. Clinical Research Methodology **104**

Sarman Singh

• Objectives of Research *104* • Types of Research *104* • Stages of Clinical Research *104* • Classification of Clinical Research *105* • Randomized Controlled Trials *107* • Steps in Research Process *109* • How to Read a Scientific Paper *111*

16. Simulation-based Education **113**

Asit Misra, Brad Gable

• History of Simulation *113* • Educational Theory *113* • Simulation Types and Methods *115* • Planning a Simulation Case *115* • Use of Simulation in Emergency Medicine *116* • How to Integrate Simulation Education into an Emergency Medicine Curriculum *116*

17. Artificial Intelligence and Recent Advances **119**

Devendra Richhariya

• Artificial Intelligence in Healthcare *119* • Applications of Artificial Intelligence *122*
• Other Recent Advanced Technology *124*

SECTION 2: RESUSCITATION

18. Basic Airways **130**

Meghna Thakur

• How to Recognize Airway Obstruction? *130* • Airway Positioning Maneuvers *131*
• Airway Adjuncts *131* • Suctioning *132* • Bag-valve-mask Ventilation *132*
• Supraglottic Airway Devices *134*

19. Advanced Airway Management **137**

Venugopalan PP

• Applied Anatomy *137* • Approach to Airway *138* • Difficult Airway *139*
• Airway Assessment *139* • Laryngoscopic Grading for Difficult Intubation *141* • Position and Technique for Intubation *141* • Rapid-sequence Intubation *142* • Capnography *145*

20. Cardiopulmonary Resuscitation **149**

Mabel Vasnaik

• Step I: Assessment of Responsiveness *149* • Step II: Cardiopulmonary Resuscitation *150*
• Step III: Defibrillation *150* • Step IV: Intravenous Access and Drugs *152*
• Step V: Advanced Airway *152* • Postcardiac Arrest Care *152* • Cardiopulmonary Resuscitation in Children—How is it Different? *153* • Defibrillation *154* • Monophasic and Biphasic Defibrillators *156* • Cardioversion *156* • Recent Advances *157* • Double Sequential External Defibrillation *158* • Recent Updates on Cardiopulmonary Resuscitation *158* • Cardiopulmonary Resuscitation in Special Situations *159*

21. Extracorporeal Cardiopulmonary Resuscitation **162**

Sandeep Gore

• Concept and Definition of Extracorporeal Cardiopulmonary Resuscitation *162*
• Procedure of Extracorporeal Life Support System *163* • Monitoring *164*
• Optimization of System *164* • Current Evidence *165*

22. Point-of-Care Ultrasound in Cardiac Arrest **166**

Prithwiraj Saha, Gunjan Chanchalani

• Ultrasound in Cardiac Arrest *166* • Technical Aspects of Point-of-Care Ultrasound *167* • Objectives of Point-of-Care Ultrasound in Cardiac Arrest *168*

23. Postcardiac Arrest Syndrome **175**

Devendra Richhariya

• Pathophysiology *175* • Airway and Breathing *175* • Circulation *177* • Disability-optimizing Neurologic Recovery *177* • Targeted Temperature Management *178*
• Prognostication *179* • Rehabilitation *181* • Organ Donation *181*

24. End of Life and Palliative Care **182**

Naeem Toosy

• The Trajectory of Dying and End-of-Life Decision-making *182* • Palliative Care and Bioethics *183* • Communication at the End of Life *184* • End-of-Life Symptoms Management *184*

25. Death Declaration **186**

Rammohan Radhakrishnan, Sahanya Shetty

• Possible Circumstances of Death *186* • Effect of Death on Survivors *186* • Effect on Emergency Physicians *187* • A Six-step Strategy for Breaking Bad News *187* • Grief Counseling *187* • Communication Strategies Prior to Death *188*
• After Death: If Family is Not Present *189* • Viewing of the Body *189* • Medical Examination: Autopsy *189* • Organ Donation *189* • Organ Donation: Death of a Child *189*

26. Brain Death and Organ Transplant **191**

Pradeep Rangappa, Devendra Richhariya

• Pathophysiology of Brain Death *191* • Anzics Recommendation *191* • Definition *192*
• Prerequisities *192* • Documentation of Absence of Brainstem Reflexes *192*
• Documentation of Apnea *193* • Additional Tests *193* • Brain Death Mimic *194*
• Movement Observable after Brain Death *195* • Brain Death Declaration *195*
• Care of the Potential Organ Donor *195* • Organ Transplantation *197*

SECTION 3: INTENSIVE CARE

27. Anaphylaxis **201**

Fantin Joel Calingarayar

• Triggers *201* • Immunopathogenesis *201* • Pathophysiology of Anaphylaxis *202*
• Persistent, Refractory, and Biphasic Anaphylaxis *202*
• Diagnostic Criteria for Anaphylaxis *204* • Treatment of Anaphylaxis *204*

28. Sepsis **207**

Ravi Jain, Yash Javeri

• Definition *207* • Epidemiology *207* • Pathophysiology *207*
• Screening and Diagnosis of Sepsis *208* • Management *209*
• Other Supportive Therapies *214* • Disposition *215* • Code Sepsis *215*

29. Shock **216**

Khusrav Bajan

• Pathophysiology of Shock *216* • Clinical Presentation *217* • Use of Point of Care Ultrasound in Evaluation and Diagnosis of Shock *218* • Approach to a Patient in Shock *218* • Management of Shock *219* • Specific Measures *220* • Perfusion Endpoint in Resuscitaion of Shock *221*

30. Vascular Access **225**

Devendra Richhariya

• Pathophysiology *225* • How to Choose Appropriate Vascular Device? *226*
• Peripheral Access *226* • Central Venous Catheters *228* • Midline Catheters *230*
• Peripherally Inserted Central Catheters *230* • Use of Ultrasound for Central Venous Catheter Insertion *231* • Removal of Catheter *231* • Arterial Access *231*
• Arterial Blood Pressure *232* • Emergency Conditions Where Femoral Artery Access is Recommended *233* • Intraosseous Device *234* • Complications *236*

31. Intravenous Fluids **237**

Ripenmeet Salhotra, Supradip Ghosh

• Crystalloids *237* • Colloids *238* • Maintenance Fluids *239*

32. Vasopressors and Inotropes **242**

Manish Mehta

• Mechanisms of Action: Receptors *242* • Common Pharmacologic Agents *243*
• Clinical Application of Vasopressors and Inotropes *245* • Fundamental Concept for Use and Practical Issues *246* • Complications *247*

33. Massive Transfusion Protocol **248**

Devendra Richhariya

• Responsibility of Emergency and Blood Bank Team *248* • Massive Transfusion Protocol *249* • Role of Specific Blood Components *250* • Adverse Effect of Blood Transfusion *252* • Management of Adverse Transfusion Reaction *252* • Hemovigilance *252* • Therapeutic Plasmapheresis *253*

34. Oxygen Therapy **255**

Bhawana Sharma

• Indications *255* • Classification of Oxygen Delivery System *256* • Components of Oxygen Devices *256* • Low-flow System *256* • High-flow System *257* • Selection of Oxygen Delivery System *258* • Initiation of Oxygen Therapy in Emergency Department *258* • Long-term Oxygen Therapy *258* • Oxygen Toxicity *259* • High-flow Nasal Cannula *259* • Medical Oxygen Cylinders: Types, Capacity, and Estimation of Running Time *260* • Hyperbaric Oxygen Therapy *262*

35. Noninvasive Ventilation **264**

Kishalay Datta

• Modes of Noninvasive Ventilation *264* • Physiologic Changes with Noninvasive Ventilation: How Does Noninvasive Positive Pressure Ventilation Work? *265* • Selection Criteria for Noninvasive Positive Pressure Ventilation *265* • Interface or Mask for Noninvasive Positive Pressure Ventilation *265* • Circuits for Noninvasive Positive Pressure Ventilation *266*
• How to Initiate Noninvasive Positive Pressure Ventilation in Patients? *266* • Monitoring of Patients on Noninvasive Positive Pressure Ventilation *266* • Predictors of Success of Noninvasive Positive Pressure Ventilation *267* • What Type of Ventilators can be Used for Noninvasive Positive Pressure Ventilation? *268* • What Modes of Ventilator can be Used for Noninvasive Ventilation? *268* • How to Set the Ventilator for Noninvasive Positive Pressure Ventilation? *268* • Weaning *269* • Complications of Noninvasive Positive Pressure Ventilation *269* • High-flow Nasal Cannula *269*

36. Mechanical Ventilation **270**

Neeraja Nair, Vimal Krishnan

• Physiology of Breathing *270* • Indications of Mechanical Ventilation *271* • Types of Mechanical Ventilation *271* • Modes of Ventilation *271* • Initiation of Ventilation *274* • Monitoring after Initiating Ventilation *275* • Complications of Intubation and Ventilation *275* • Airway Pressures, Alarms, and Troubleshooting *276* • Mechanical Ventilation in Special Conditions *277* • Transporting a Mechanicaly Ventilated Patient *280*

37. Sedation and Analgesics for Mechanically Ventilated Patients **281**

Manish Garg

• Goals and Principles *281* • Medications *281* • Assessment *283* • Special Situation *284*

38. Extubation **286**

Devendra Richhariya

• Patient Selection and the "ABC" Procedural Consideration *286* • Postextubation Complications and Management *288* • Palliative Extubation in Emergency Department *289*

39. Extracorporeal Membrane Oxygenation **291**

Basar Cander

• Historical Development of Extracorporeal Membrane Oxygenation *291* • Extracorporeal Membrane Oxygenation Techniques *291* • Venovenous Extracorporeal Membrane Oxygenation *291* • Venoarterial Extracorporeal Membrane Oxygenation *291* • Extracorporeal Membrane Oxygenation Components *292* • Weaning *293* • Indications *293* • Contraindications *293* • Complications *293* • Extracorporeal Membrane Oxygenation in Special Patient Groups *293* • Future Projections *295*

40. Arterial Blood Gas Analysis **296**

Nipun Agrawal

• Basics of Pulmonary Gas Exchange *296* • Disorders of Gas Exchange *297* • Basics of Acid–base Balance *298* • Concepts in Acid–base Disorders and Formulae *298* • Stepwise Approach to Blood Gas Analysis *299* • Strong Ion Difference Approach versus Traditional Approach *302* • Arterial Blood Gas Sampling Technique *302*

41. Electrolyte Imbalances **306**

Devendra Richhariya, Jyoti Goyal

• Hypernatremia *306* • Hyponatremia *308* • Hyperkalemia *310* • Hypokalemia *312* • Hypercalcemia *313* • Hypocalcemia *314* • Hypermagnesemia *315* • Hypomagnesemia *315*

42. Pain Management **317**

Devendra Richhariya

• Pathophysiology and Mechanism of Pain *317* • Assessment of Acute Pain *318* • Assessment of Chronic Pain *318* • Assessment Tools for Pain *319* • Pharmacologic Therapy for Pain *319* • Nonpharmacologic Therapy for Pain *324* • Anesthetic Agents in Pain Management *324*

43. Procedural Sedation and Analgesia **329**

Behcet Al

• Level of Sedation *329* • Indications in Emergency Department *330* • Presedation Patient Evaluation *330* • Preparation *330* • Technique for Procedural Sedation and Analgesia *331*

44. Cricothyrotomy **334**

Sanjay Shah

• Applied Anatomy *334* • Indications and Contraindications *334* • Position of the Patient *335* • Needle Cricothyroitomy *335* • Percutaneous Cricothyroidotomy (Seldinger Technique) *335* • Surgical Cricothyroidotomy *336* • Complications *337* • Decannulation *337* • Tracheostomy-related Emergencies *337* • Emergent Life-threatening Complications *339* • Urgent Complications *340* • Myiasis (Maggots) of Tracheostomy Wound *341*

45. Volume Status Assessment and Hemodynamic Monitoring **343**

Himanshu Dewan

• Static Methods of Volume Assessment and its Limitations *344* • Dynamic Methods of Volume Assessment and its Limitations *345* • Devices for Hemodynamic Monitoring *347* • Invasive Hemodynamic Monitors *347* • Noninvasive Hemodynamic Monitors *348*

46. Point-of-Care Ultrasound in Shock **350**

Won-Jun Kuk, Tiffany Fong

• Step 1: Pump *350* • Right Ventricular Strain *352* • Step 2: Tank *353* • Compromise of the Tank *356* • Step 3: Pipes *356*

47. Ultrasound-guided Procedures **359**

Richa Manglorkar, Tiffany Fong

• Physics of Ultrasound *359* • Transducers *360* • Knobology *360* • Technique *360* • Peripheral Venous Catheter Placement with Ultrasound Guidance *360* • Central Venous Catheter Placement with Ultrasound Guidance *361* • Ultrasound-guided Peripheral Nerve Blocks *371* • Specific Blocks *373*

SECTION 4: CARDIAC EMERGENCIES

48. Chest Pain **378**

Devendra Richhariya

• Causes of Chest Pain *378* • Evaluation and Diagnostic Approach *380* • Risk Stratification for Chest Pain *382* • Electrocardiogram *382* • Cardiac Biomarkers *383* • Echocardiography Evaluation of Chest Pain *384* • Coronary CT Angiography in Chest Pain Evaluation *385*

49. Syncope **387**

Brajesh Kumar Mishra

• Epidemiology *387* • Pathophysiology *387* • Classification *387* • Life-threatening Causes of Syncope *388* • Common Causes of Syncope *388* • Other Causes of Syncope *389* • Objectives for Evaluation *389* • Evaluation of Syncope *389* • Investigation *390* • Treatment *392* • Risk Stratification for Syncope *393* • Future Perspective *393*

50. Palpitation **394**

Devendra Richhariya

• Etiology *394* • Pathophysiology *394* • Clinical Presentation *395* • Evaluation *397* • Investigations *398* • Treatment *398* • Postprocedure Care *401*

51. Electrocardiogram **403**

Devendra Richhariya

• Basic of Electrocardiogram *403* • Systematic Approach for Interpretation of Electrocardiogram *406* • Stepwise Approach to Electrocardiogram Interpretation *407* • Cardiac Arrhythmias *407* • Tachyarrhythmias *407* • Bradyarrhythmia *411* • ST-T Changes *412* • QRS Morphology Amplitude Duration and Axis Pattern *415* • Miscellaneous ECG Findings in Emergency *418*

52. Arrhythmias **419**

Jamal Yusuf

• Conducting System of the Heart *419* • Mechanism of the Cardiac Arrhythmias *419* • Bradyarrhythmia *420* • Tachyarrhythmias *423* • Supraventricular Tachycardias *424* • Ventricular Tachycardias *425* • Atrial Fibrillation *427*

53. Acute Coronary Syndrome **431**

Naveen Bhamri, Devendra Kumar Agarwal, Sudhanshu Sekhar Parida

• Etiopathogenesis, Risk Factors *431* • Clinical Presentation *431* • Management of Acute Coronary Syndrome *433* • Common Strategies for STEMI and NSTEMI Management *435*
• Non-ST Elevation: Acute Coronary Syndrome Management *435* • STEMI Management *435*
• Special Consideration in STEMI/NSTEMI Management *437* • Disposition *437*

54. Cardiogenic Shock **439**

Devendra Richhariya

• Definition *439* • Etiology *439* • Pathophysiology *439* • Diagnosis *440*
• Management *441* • Critical Care Support *442* • Revascularization Support *443*
• Mechanical Support *444* • Special Situation *445*

55. Acute Heart Failure **447**

Neeraj Jain

• Precipitating Factors *447* • Pathophysiology *447* • Classification *448*
• Clinical Features *448* • Diagnosis *449* • Treatment *449* • Hemodynamic Monitoring *449* • Pharmacologic Therapy *449* • Mechanical Assistance *451*
• Mechanical Circulatory Support *452* • Sympathetic Crashing Acute Pulmonary Edema *453* • Disposition *454*

56. Hypertensive Emergency **456**

Anas Salih, Devendra Richhariya

• Definition and New Terminology *456* • Pathophysiology *456*
• Clinical Presentation *456* • Factors Influencing the Blood Pressure Measurements *457* • Evaluation of Elevated Blood Pressure *458*
• Management of Elevated Inpatient Blood Pressure *459*
• Disposition after Hospital Admission *462*

57. Acute Aortic Dissection **465**

Devendra Richhariya

• Risk Factors *465* • Pathogenesis *465* • Classification of Acute Aortic Dissection *466*
• Clinical Presentation *466* • Diagnostic Strategies *467* • Medical Management *468*

58. Peripheral Artery Disease **472**

Prasad Rajhans

• Etiology *472* • Pathophysiology *472* • Clinical Presentation *472*
• Diagnostic Strategies *474* • Management *474* • Disposition *475*

59. Pulmonary Embolism **477**

Ashima Sharma

• Risk Factors *478* • Pathophysiology and Clinical Presentation *478*
• Pretest Probability, Scoring System, and Pulmonary Embolism Rule Out Criteria *479*
• Diagnostic Workup *479* • Treatment *483* • Disposition *485*

60. Antithrombotic Therapy **487**

Santosh Pandey

• Overview of Hemostasis *487* • Oral Anticoagulants *488* • Adverse Effects *490*

61. Antithrombotic Reversal Agents **493**

Devendra Richhariya

• The Clotting/Coagulation Cascade *493* • Reversal of Warfarin *494* • Reversal of Direct Oral Anticoagulants *495* • Reversal of Heparin and Low-molecular-weight Heparins *496*

SECTION 5: RESPIRATORY EMERGENCIES

62. Dyspnea **499**

Devendra Richhariya

• Pathophysiology *499* • Etiology *500* • Diagnostic Evaluation of Dyspnea *500* • Management *504*

63. Hemoptysis **505**

Krishna Shukla

• Pulmonary Circulation *505* • Etiology of Hemoptysis *505* • Grading of Hemoptysis *506* • Evaluation of Patient with Hemoptysis *506* • Approach to Patient with Massive Hemoptysis *507* • Management of Patient with Hemoptysis *507* • Bronchoscopy *509* • Surgical Management *511* • Radiation Therapy *511*

64. Acute Severe Asthma **512**

Devendra Richhariya

• Definition *512* • Acute Asthma *512* • Pathophysiology *512* • Clinical Evaluation *513* • Severity of Asthma *513* • Investigations *513* • Treatment *514* • Status Asthmaticus *517* • Spirometry *517* • Disposition *518*

65. Acute Exacerbation of Chronic Obstructive Pulmonary Disease **520**

KPP Abhilash

• Risk Factors *520* • Etiology of Acute Exacerbations *520* • Clinical Presentation *520* • Investigations and Diagnosis *521* • Management of Acute Severe Exacerbation *521* • Advice on Discharge *523* • Prevention *523* • Prognosis *524*

66. Pneumonia **525**

Subhash Giri

• Classification of Pneumonia *525* • Pathophysiology *526* • Clinical Evaluation *526* • Diagnosis *527* • Indications of Hospitalization *527* • Treatment of Pneumonia *529* • Special Treatment Considerations *529* • Prevention *531*

67. Acute Respiratory Distress Syndrome **532**

Devendra Richhariya

• Pathogenesis *532* • Definition and Classification *532* • Imaging *534* • Management *534*

68. Pneumothorax **539**

Devendra Richhariya

• Pathophysiology *539* • Clinical Features *540* • Primary Spontaneous Pneumothorax *540* • Secondary Spontaneous Pneumothorax *540* • Catamenial Pneumothorax *540* • Tension Pneumothorax *540* • Pneumothorax and Air Travel *541* • Radiological Evaluation of Pneumothorax *541* • Diagnosing Pneumothorax with Bedside Ultrasound *541* • Management of Pneumothorax *542* • Intercostal Chest Drain Insertion *543* • Pneumomediastinum (Mediastinal Emphysema) *548* • Subcutaneous Emphysema *549*

SECTION 6: GASTROINTESTINAL EMERGENCIES

69. Acute Abdominal Pain **551**

Ravi Teja

• Etiology *551* • Pathophysiology *551* • Clinical Presentation *552* • Evaluation *554* • Investigations *555* • Treatment *556*

70. Gastrointestinal Symptoms **559**

Devendra Richhariya

• Nausea and Vomiting *559* • Dyspepsia and Peptic Ulcer Disease *562* • Hiccups *564* • Constipation *567*

71. Esophageal Emergencies **570**

M Rajadurai

• Atypical Chest Pain *570* • Acute Dysphagia and Odynophagia *571* • Pill Injury *571* • Esophageal Foreign Body *571* • Caustic Injury to Esophagus *572* • Esophageal Injury and Perforations *574* • Mallory–Weiss Syndrome *574* • Boerhaave's Syndrome *574*

72. Gastrointestinal Bleeding **576**

Ramit Singh Sambyal

• Occurrence and Frequency *576* • Causes and Presentation *577* • Initial Assessment and Prognostication *578* • Treatment *580*

73. Diarrhea Associated Diseases **584**

Sanjay Kumar

• Pathophysiology *584* • Approach to Acute Diarrhea *584* • Traveler's Diarrhea *586* • Persistent and Chronic Diarrhea *586* • *Clostridium difficile* Induced Diarrhea *587* • Inflammatory Bowel Disease *588* • Celiac Disease *590*

74. Acute Pancreatitis and Cholecystitis **591**

Sanjay Kumar

• Definition *591* • Etiology *591* • Pathophysiology *591* • Clinical Features *591* • Diagnosis *591* • Management of Acute Pancreatitis *592* • Complications *595* • Acute Cholecystitis *595*

75. Acute Appendicitis **597**

Anshuman Kaushal

• Anatomy *597* • Etiopathogenesis *597* • Clinical Features *598* • Evaluation—History and Physical Examination *599* • Investigations *599* • Risk Stratification of Suspected Acute Appendicitis *600* • Appendicitis in Special Population *602* • Treatment *602* • Special Considerations during Appendectomy *603*

76. Acute Liver Failure **605**

Priyanka MK

• Etiology *605* • Pathophysiology *605* • Clinical Presentation *606* • Evaluation *606* • Investigations *607* • Treatment *608* • Monitoring in Acute Liver Failure *609* • Complications *609*

77. Chronic Liver Disease—Complications **611**

Ravindra Kale

• Definitions *611* • Malnutrition *612* • Infections *612* • Gastrointestinal Bleeding *613* • Ascites *613* • Pulmonary Complications *615* • Hepatorenal Syndrome *615* • Hepatic Encephalopathy *616* • Hepatocellular Carcinoma *617* • Liver Transplant *618*

78. Anorectal Diseases **620**

Ramya Ramakrishnan, TV Ramakrishnan

• Anatomy *620* • Hemorrhoids *620* • Anal Fissure *623* • Anorectal Abscess *624* • Anal Fistula *625* • Pilonidal Disease *627* • Rectal Prolapse *628* • Rectal Trauma/Foreign Body *628* • Proctitis *629* • Pruritis ANI *629* • Proctalgia Fugax *629*

79. Abdominal Vascular Emergencies **631**

Shweta Ashok

• Vascular Abdominal Anatomy *631* • Abdominal Vascular Thromboses *632* • Ischemic Bowel *633* • Aneurysm *635*

80. Bowel Obstruction **637**

Jesús Daniel López Tapia

• Etiology *637* • Pathophysiology *637* • Clinical Presentation *638* • Evaluation *638* • Investigations *639* • Treatment *640*

SECTION 7: RENAL AND GENITOURINARY EMERGENCIES

81. Hematuria **642**

Puneet Ahluwalia

• Classification of Hematuria *642* • Etiology *642* • History and Initial Evaluation *642* • Stepwise Approach for Evaluation *644* • Unexplained Hematuria *646* • Follow-up after Initial Negative Evaluation *647* • Treatment *647*

82. Acute Urinary Retention **648**

Puneet Ahluwalia

• Etiopathogenesis *648* • Categories of Urinary Retention *650* • Clinical Presentation *650* • Evaluation *651* • Initial Management of Acute Urinary Retention *652*

83. Acute Kidney Injury **654**

Devendra Richhariya

• Functional Unit of Kidney *654* • Terminology *654* • Pathophysiology *655* • Acute Kidney Injury *655* • Risk Factors and Causes for Acute Kidney Injury *656* • Clinical Evaluation *659* • Diagnostic Testing *659* • Management of Acute Kidney Injury in Emergency Department *660* • Sodium Bicarbonate Therapy *661* • Rhabdomyolysis *663* • Disposition *665*

84. End-stage Renal Disease **666**

Devendra Richhariya

• Chronic Kidney Disease *666* • End-stage Renal Disease *667* • Hemodialysis *669* • Peritoneal Dialysis *671* • Renal Transplant *672*

85. Kidney and Ureteral Stones **675**

Devendra Richhariya

• Risk Factors *675* • Causes *676* • Clinical Presentation *676* • Emergency Department Evaluation *677* • Imaging Modalities *677* • Management and Treatment *678* • Complications *679* • Special Population *679*

86. Urinary Tract Infection **681**

Krunal Desai

• Definitions and Classification *681* • Pathophysiology *681* • Risk Factors and Uropathogens *682* • Clinical Features *682* • Differential Diagnosis *683*
• Diagnostic Evaluation *683* • Treatment *684* • Special Population *686* • Disposition *687*

87. Penile Emergencies **688**

Puneet Ahluwalia

• Anatomy *688* • Priapism *688* • Zipper Injury and Penile Entrapment *690* • Balanitis and Posthitis *691* • Peyronie's Disease *691* • Penile Calciphylaxis *691* • Phimosis *692* • Paraphimosis *695* • Penile Fracture *696*

88. Scrotal Emergencies **700**

Devendra Richhariya

• Anatomy *700* • Etiology of Acute Scrotum *700* • Painful Scrotum *701* • Painless Swollen Scrotum *703* • Erythematous Scrotum *703* • Traumatic Scrotum *704* • Treatment *705*

89. Imaging Modalities in Genitourinary Disease **708**

Aman Gupta

• Conventional Plain Film Radiography *708* • Intravenous Urography *708* • Retrograde Urography *709* • Cystography *709* • Retrograde Urethrography and Voiding Cystourethrogram *710*
• Percutaneous Nephrostomy and Antegrade Pyelography *710* • Ultrasound *710*
• Doppler Sonography *711* • Computed Tomography *712* • Magnetic Resonance Imaging *713*
• Nuclear Medicine *713*

SECTION 8: NEUROLOGICAL EMERGENCIES

90. Headache **714**

Hanish Gupta

• Etiology *714* • Pathophysiology *714* • Clinical Presentation *715* • Evaluation *715*
• Interpretation of Findings *715* • Investigations *715* • Treatment *716* • Tension Headache *717*
• Cluster Headache *717* • Migraine *717* • Disposition *717*

91. Dizziness and Vertigo **720**

Ramyajit Lahiri, Subhra Choudhury

• Definition *720* • Etiology *720* • Physiology *721* • Pathophysiology *722* • Clinical Features *723*
• History and Physical Examination *723* • Hints Examination *725* • Dix–Hallpike Test *726*
• Supine Roll Test (Pagnini-McClure Maneuver) *727* • Videonystagmography *727*
• Caloric Testing *727* • Posturography *728* • Investigations *728* • Management *728*
• Maneuvers for Recurrent Positional Dizziness *729* • Disposition *731*

92. Altered Mental Status **734**

Gautam Sharma

• Definition *734* • Subtypes of Delirium *734* • Clinical Presentation *735*
• Pathophysiology of Delirium *735* • Etiology *735* • Evaluation *736*
• Management *737* • Disposition *738* • Recent Advances *738*

93. Acute Ischemic Stroke **741**

Devendra Richhariya, Kunal Bahrani

• Cerebral Circulation *741* • Epidemiology and Risk Factors *742* • Ischemic Stroke Classification *742* • Clinical Presentation *742* • Assessment of Stroke *742* • Radiological Investigations in Acute Stroke *742* • Management of Acute Stroke *746* • Medical Management of Ischemic Stroke *747* • Acute Stroke Pathway for Emergency Room *750* • Cryptogenic Stroke *750* • Cerebral Venous Thrombosis *750* • Transient Ischemic Attack *754*

94. Intracranial Hemorrhage **755**

Saifa Latheef

• Types of Intracranial Hemorrhage *755* • Etiology of Various Types of Intracranial Hemorrhage *755* • Causes *756* • Pathophysiology *757* • Clinical Presentation *757* • Evaluation *757* • Investigations *757* • Treatment *758* • Disposition *761* • Cerebral Herniation Syndromes *762*

95. Status Epilepticus **764**

Gouri Ranade

• Definition *764* • Causes *764* • Stages of Status Epilepticus *764* • Management *765* • Phasewise Management of Status Epilepticus *767* • Refractory Status Epilepticus *767* • Malignant/Super-refractory Status Epilepticus *768* • Reasons for Failure of Treatment in Status Epilepticus *768* • Special Situations in Status Epilepticus *768* • Febrile Convulsion *768* • Systemic Complications of Status Epilepticus *769* • Electroencephalogram Monitoring in Patient with Status Epilepticus *769*

96. Meningitis **771**

Priyanka Mahale

• Causative Agents and Risk Factors *771* • Clinical Presentation and Evaluation *771* • Investigations *772* • Cerebrospinal Fluid Analysis *772* • Management of Meningitis *773* • Encephalitis *774* • Meningiococcal Meningitis *776* • Brain Abscess *776*

97. Acute Flaccid Paralysis **778**

Nandha Kumar Selvam

• Anatomy of Neuromuscular Junction *778* • Pathophysiology *779* • Etiology and Differential Diagnosis of Acute Onset Flaccid Paralysis *779* • Guillain–Barré Syndrome *780* • Myasthenia Gravis *781* • Myasthenic Crisis *782* • Transverse Myelitis *783* • Botulism *784* • Inflammatory Myopathy *784* • Systemic or Metabolic Disorders Causing Acute Flaccid Paralysis *785* • Neuromuscular Weakness Associated with Critical Illness *785* • Trauma-induced Acute Flaccid Paralysis *785* • Lathyrism *785* • Evaluation of Acute Flaccid Paralysis *786*

98. Coma **788**

Noel Fernando

• Pathophysiology *788* • Differential Diagnosis *788* • Evaluation *788* • Clinical Examination *779* • Grading *790* • Investigations *790* • Treatment *791*

VOLUME 2

SECTION 9: ENDOCRINAL EMERGENCIES

99. Diabetes Mellitus **795**

Amit Gupta, Vinod Kumar

• Classification *795* • Diagnosis *796* • Insulin *796* • Management of Type *2* Diabetes Mellitus *798* • Oral Hypoglycemic Agents *798* • Nonpharmacologic Therapy *799*

100. Hypoglycemia **801**

Jugal Kishor Sharma, Dinesh Sharma

• Etiology *801* • Pathophysiology *801* • Clinical Features *802* • Diagnosis *802* • Treatment *803* • Prevention *803*

101. Diabetic Ketoacidosis **805**

Rajeev Chawla, Shalini Jaggi, Sidhant Trehan

• Epidemiological Aspect *805* • Pathogenesis of Diabetic Ketoacidosis *805* • Evaluation of Patients of Diabetes Ketoacidosis *807* • Treatment Goals for Diabetic Ketoacidosis *807* • Complications of Diabetic Ketoacidosis *810* • Preventive Measures for Diabetic Ketoacidosis *810* • Euglycemic Diabetic Ketoacidosis *810*

102. Hyperosmolar Hyperglycemic Syndrome **813**

Dheeraj Kapoor

• Diabetes Overview *813* • Etiology *813* • Pathophysiology *813* • Diagnosis *815* • Prognosis *816*

103. Hyperthyroidism and Thyroid Storm **818**

Dheeraj Kapoor, Abhishek Goyal

• Epidemiology *818* • Clinical Presentation *818* • Pathogenesis *818* • Diagnosis *819* • Treatment *819* • Thyroid Storm *821*

104. Hypothyroidism and Myxedema Coma **825**

Ajay Agarwal, Danendra Sahu, Rupak Wadhwa

• Etiopathogenesis and Classification *825* • Myxedema Coma *826*

105. Acute Adrenal Crisis **831**

Dheeraj Kapoor, Abhishek Goyal

• Anatomy and Physiology of the Adrenal Gland *831* • Classification *832* • Pathophysiology *833* • Causes *834* • Clinical Presentation *834* • Diagnosis *834* • Management of Acute Adrenal Crisis *835* • Prevention and Patient Education *836*

SECTION 10: EYE, EAR, NOSE, THROAT, AND ORAL EMERGENCIES

106. Eye Emergencies **838**

Devendra Richhariya

• Eye Anatomy *838* • Eye Examination *839* • Topical Ophthalmologic Medications *839* • Red Eye *840* • Classification of Ocular Emergencies *840* • Eye Infection and Inflammation *840* • Traumatic: Penetrating Ocular Injuries *844* • Traumatic: Blunt Ocular Injuries *844* • Treatment of Blunt Eye Trauma in an Emergency Department *846* • Contact Lens-related Emergencies *847* • Chemical Injuries to the Eye *847*

107. Ear Emergencies **849**

Shaarang Sachdev, Salil Malik

• Anatomy of the Ear *849* • Common Symptoms of Ear Problems *850* • Outer Ear Infections *851* • Middle Ear Infection *852* • Inner Ear Infections *853* • Trauma to Ear *854* • Procedures Related to Ear *854* • Foreign Body Removal *856* • Complications of Cochlear Implantation *856*

108. Nasal Emergencies **858**

Harshil Mehta

• Epistaxis *858* • Nasal Fracture *861* • Nasal Septal Hematoma *862*

109. Face and Jaw Emergencies **864**

Devendra Richhariya

• Facial Swelling *864* • Facial Cellulitis *866* • Jaw Dislocation *868*

110. Neck, Throat, Oral, and Dental Emergencies **871**

Aman Sharma

• Pharyngitis *871* • Epiglottitis *873* • Peritonsillar Abscess *874* • Retropharyngeal Abscess *875* • Ludwig's Angina *876* • Infectious Mononucleosis *877* • Oral Candidiasis *878* • Oral Herpes Simplex *879* • Dental Pain *880* • Bleeding after Dental Surgery *880* • Dental Trauma *881* • Classification and Management of Traumatic Dental Injuries *882* • Classification and Management of Tooth Fractures *883*

111. Foreign Bodies of Ear, Nose, and Throat **885**

Mohammad Anzal Rehman, Neha Hudlikar, El Rasheed Salih

• History Taking and Presentation *885* • Approach and Management *885*
• Foreign Bodies of the Ear *886* • Foreign Bodies of the Nose *888* • Foreign Bodies of the Throat *890*

SECTION 11: HEMATOLOGY, ONCOLOGY, DERMATOLOGY, RHEUMATOLOGY, AND PSYCHIATRY

112. Anemia **893**

Devendra Richhariya

• Pathophysiology *893* • Types of Anemia *893* • Classifications *893*
• Clinical Presentation *894* • Evaluation of Anemia *894* • Approach to Anemia *895* • Treatment *895* • Pancytopenia *897* • Aplastic Anemia *898*
• Sickle Cell Anemia *899* • Methemoglobinemia *901* • Sulfhemoglobinemia *903*

113. Thrombocytopenia **905**

Devendra Richhariya

• Thrombocytopenia *905* • Approach to Thrombocytopenia *905* • Thrombotic Thrombocytopenic Purpura *906* • Hemolytic Uremic Syndrome *907* • Immune Thrombocytopenic Purpura *908* • HELLP Syndrome *909* • Disseminated Intravascular Coagulation *910* • Heparin-induced Thrombocytopenia *912*

114. Hemostasis and Bleeding Disorders **916**

Devendra Richhariya

• Primary Hemostasis *916* • Coagulation Cascade *916* • The Process of Coagulation Cascade *917* • New Model of Coagulation System *917* • Basic Tests of Coagulation *918* • Thromboelastography *918* • Disorders of Coagulation *918*

115. Oncological Emergencies **922**

Sumant Gupta, Devendra Richhariya

• Superior Vena Cava Syndrome *922* • Tumor Lysis Syndrome *922*
• Hypercalcemia *924* • Febrile Neutropenia *925* • Hyperviscosity Syndrome *926*
• Cytokine Release Syndrome *926* • Leukemia *927*

116. Rheumatological Disorders **930**

Neeraj Jain, Amit Dua

• Classification and Definition *930* • Etiology *930* • Evaluation *930*
• Diagnosis *932* • Treatment *935*

117. Psychiatric Emergencies **938**

Mohammad Anzal Rehman, Mansoor Masarrat Husain

• Evaluation of Mental Health *938* • Investigations *939* • Agitation *941*
• Delirium *941* • Catatonia *941* • Self-harm *942* • Mood Disorders *942*
• Depressive Disorders *942* • Bipolar Disorder *943* • Anxiety Disorders *944*
• Panic Disorders *944* • Thought Disorders *945* • Psychosis *945* • Schizophrenia *945*

118. Dermatologic Conditions **947**

Ramanjit Singh, Nidhi R Sharma

• Evaluation *947* • Major Cutaneous Presentation of Infectious Diseases *950*
• Major Cutaneous Presentation of Noninfectious Disease *950* • Diagnostic Tests *951*
• Bedside Tests in Dermatological Conditions *951* • Drug Rash with Eosinophilia and Systemic Symptoms (DRESS) *951* • Urticaria and Angioedema *952* • Necrotizing Fasciitis *952*
• Stevens–Johnson's Syndrome and Toxic Epidermal Necrolysis *952* • Pemphigus Diseases *953* • Pyoderma Gangrenosum *953* • Acute Skin Failure *953*

SECTION 12: OBSTETRICS AND GYNECOLOGICAL EMERGENCIES

119. Acute Pelvic Pain **955**

Dolly Yadav

• Anatomy, Pathophysiology, and Etiology *955* • Emergency Department Evaluation *955*
• Investigation *957* • Diagnosis *958* • Specific Diagnoses in Nonpregnant Females *960*

120. Abnormal Uterine Bleeding **965**

Sanjukta Dutta, Mainak Majumdar

• Basic Physiology *965* • Etiology *965* • Approach to Abnormal Uterine Bleeding *966*
• Evaluation *967* • Investigations *968* • Management *968* • Disposition *970*

121. Ectopic Pregnancy **972**

Sonal Parihar

• Causes *972* • Types of Ectopic Pregnancy *972* • Clinical Presentation *973* • Evaluation *974*
• Investigations *974* • Treatment *975* • Special Cases *976*

122. Emergencies during Pregnancy **978**

Devyani Misra, Mariyum Faruqi

• Pregnancy and Immunization *978* • Anatomical and Physiological Changes in Pregnancy *979* • Hyperemesis Gravidarum *980* • Spontaneous Abortion *981* • Hypertension in Pregnancy *983* • Preeclampsia *984* • Eclampsia *985* • HELLP Syndrome *985* • Placenta Previa *986* • Prelabor Rupture of Membranes *987* • Preterm Labor *987* • Amniotic Fluid Embolism *987* • Maternal Cardiac Arrest *988*

123. Emergency Delivery **990**

Sangeeta Kaushik Sharma

• Prehospital Care 990 • Emergency Department Care 990 • Emergent Vaginal Delivery 991 • Placenta Delivery 993 • Episiotomy 993 • Complicated Delivery 993 • Umbilical Cord Prolapse 993 • Postpartum Complications 994 • Cesarean Section 994 • Resuscitative Hysterotomy 995

124. Pregnancy and Xenobiotics **997**

Devendra Richhariya

• Physiologic Changes and Drug Pharmacokinetics in Pregnancy *997* • Blood Placental Barrier and Drug Transfer *997* • Fetal Toxicology *997* • Teratogenesis *998* • Approach to Xenobiotic Exposure in Pregnant Women *998* • Over the Counter Medications *998* • Cardiovascular Drugs *1001*

125. Trauma in Pregnancy **1002**

Priyadarshini Borah

• Anatomical and Physiological Changes of Pregnancy *1002* • Injuries during Pregnancy *1004* • Clinical Presentation *1004* • Evaluation *1004* • Investigations *1006* • Cardiotocographic Monitoring *1007* • Disposition and Monitoring *1007* • Intimate Partner Violence during Pregnancy *1007* • Specific Trauma and Management *1007*

SECTION 13: PEDIATRIC EMERGENCIES

126. Newborn and Common Presentation **1009**

Devendra Richhariya

• General Evaluation *1009* • Systemic Examination *1010* • The Crying Infant *1012* • Jaundice *1014* • Cyanosis *1014* • Cyanotic Spell *1014* • Cardiovascular Collapse *1016* • Congestive Heart Failure *1017* • Arrhythmias *1017*

127. Acute Febrile Illness in Children **1019**

Rajiv Kumar Jain

• Causes *1019* • Pathophysiology *1019* • Clinical Presentation *1020* • Evaluation *1020* • Management *1021* • Antipyretics *1021* • Urinary Tract Infection *1022* • Occult Bacteremia *1022* • Pneumonia *1022* • Acute Rheumatic Fever *1022* • Multisystem Inflammatory Syndrome in Children *1023* • Pediatric Antibiotic Prophylaxis *1024* • Pertussis Exposures *1026* • Influenza Exposures *1027*

128. Respiratory Emergencies in Children **1029**

Akhand Pratap Singh

• Anatomical Difference of Child and Adult Airway *1029* • Etiology *1029* • Clinical Presentation *1030* • Evaluation *1031* • Investigations *1032* • Treatment *1033*

129. Abdominal Pain in Children **1034**

TT Jaiganesh

• Pathophysiology of Abdominal Pain *1034* • Causes of Acute Abdominal Pain in Children *1034* • Clinical Presentation *1035* • Evaluation of Acute Abdominal Pain in Children *1035* • Investigations *1035* • Treatment *1036* • Surgical Causes of Acute Abdominal Pain *1036*

130. Diarrhea and Dehydration in Children **1045**

Deepak Goyal

• Etiology *1045* • Assessment of Child with Vomiting and Diarrhea *1045* • Dehydration in Diarrhea *1046* • Treatment *1046*

131. Fluid and Electrolyte Therapy **1049**

Amritesh Ranjan

• Physiologic Differences *1049* • Maintenance Fluids *1049* • Fluid Deficit *1050* • Maintenance Electrolytes *1051* • Electrolyte Abnormalities *1051* • Monitoring Fluid and Electrolyte Therapy *1051*

132. Pediatric Trauma **1054**

Anshul Jain

• Anatomical and Physiological Differences *1054* • Evaluating Pediatric Trauma *1055* • Primary Survey *1055* • Secondary Survey *1057* • Tertiary Survey *1059* • Disposition *1059*

SECTION 14: GERIATRIC EMERGENCIES

133. Geriatric Assessment **1060**

Devendra Richhariya

• Components of Geriatric Emergency Department *1060* • Leadership—People *1060* • Geriatric Care Education *1060* • Patient Flow in Geriatric Emergency Department—Processes *1061* • Comprehensive Geriatric Assessment *1062* • Medical Assessment *1062* • Psychological Assessment *1064* • Functional Assessment *1064* • Social and Environmental Assessment *1065* • Pain Assessment in Geriatric Patients *1065* • Pain Assessment *1065* • Assessment for Elder Abuse *1067*

134. Geriatric Syndrome **1071**

Jiraporn Sri-on

• Falls *1071* • Urinary Incontinence *1072* • Pressure Ulcers *1073* • Delirium *1073* • Functional Decline *1074*

135. Polypharmacy in Geriatric Patient **1076**

Phraewa Thatphet

• Physiologic Changes *1076* • Polypharmacy *1077* • Adverse Drug Event *1077* • Prescribing Inappropriate Medications *1077* • Principles of Geriatric Drug Use *1078*

136. Geriatric Trauma **1080**

Sanjay V Patane, S Senthilkumaran

• Geriatric Anatomy and Physiology *1080* • Mechanism of Injury *1081* • Clinical Work-up *1081* • Initial Management and Resuscitation *1082* • Diagnostic Evaluation *1083* • Special Situations *1084* • Disposition *1084*

SECTION 15: INFECTIOUS DISEASES

137. Adult Immunization **1085**

Vishal Marwaha

• Vaccines *1085* • Emerging Infectious Diseases *1088* • Re-emerging Infectious Diseases *1088* • Influenza *1088* • Pertussis *1088* • Diphtheria *1088* • Tetanus *1088* • Pneumococcus *1089* • Meningococcus *1089* • Herpes Zoster (Varicella) *1089* • Human Papillomavirus *1090* • Tuberculosis (Bacillus Calmette–Guérin) *1090* • Measles/Mumps/Rubella *1090* • Chickenpox *1090* • Hepatitis A *1090* • Hepatitis B *1090* • Yellow Fever *1090* • Polio *1090* • Typhoid *1091* • Japanese Encephalitis *1091* • Rabies *1091* • Smallpox *1092* • Anthrax *1092*

138. Tropical Infections **1095**

Vishal Marwaha

• Causes *1095* • Evaluation: History and Physical Examination *1095*
• Clinical Presentation *1096* • Tropical Infection: Undifferentiated Fever *1098*
• Tropical Infection Presenting as Diarrhea *1100* • Tropical Infections with Dermatological Presentation *1100* • Other Tropical Infections *1101*

139. Dengue **1104**

Sahanya Shetty, Neeraj Mangla

• Epidemiology *1104* • Transmission *1104* • Pathogenesis *1104* • Clinical Manifestations *1105* • Severe Dengue *1106* • Diagnosis *1106* • Management *1107*
• Fluid Therapy in Dengue *1108* • Dengue with Hemorrhagic Complications *1109*

140. Malaria **1112**

Sahanya Shetty, Neeraj Mangla

• Life Cycle of Causative Agent *1112* • Pathophysiology *1112* • Clinical Features *1114* • Investigation and Diagnosis *1115* • Treatment of Uncomplicated Malaria *1115* • Radical Treatment *1117* • Drug Resistance *1117* • Malaria Chemoprophylaxis *1117* • Treatment of Severe Malaria *1117* • Cerebral Malaria *1118*

141. Tuberculosis **1120**

Vivek Chauhan

• Pathophysiology *1120* • Clinical Presentation *1120* • Evaluation *1121*
• Investigations *1121* • Treatment *1122* • Disposition *1123*

142. Zoonotic Infections **1124**

Olita Shilpakar

• Tick-borne Infections *1124* • Zoonotic Meningitis and Encephalitis *1127* • Zoonotic Respiratory Infection *1128* • Zoonotic Dermatologic Infection *1128* • Zoonotic Infections from Pets *1129* • Emerging Zoonotic Viruses of Bat Origin *1129* • Emerging Zoonotic Viruses from Other Sources *1129* • Prevention and Control of Emerging Zoonotic Diseases *1130*

143. Skin and Soft Tissue Infections **1131**

Nilanka Mudithakumara

• Microbiology *1132* • Impetigo *1132* • Abscess *1133* • Purulent Cellulitis *1134*
• Nonpurulent Cellulitis *1135* • Erysipelas *1135* • Necrotizing Soft Tissue Infections *1135*

144. Bone and Joint Infections **1138**

Devendra Richhariya

• Osteomyelitis *1138* • Vertebral Osteomyelitis *1140* • Spinal Epidural Abscess *1141*
• Septic Arthritis *1141* • Periprosthetic Joint Infection *1144*

145. Tetanus **1146**

Jidhin Janardhanan

• Pathophysiology of Tetanus Toxin *1146* • Clinical Features of Tetanus *1146*
• Diagnosis *1147* • Treatment of Tetanus *1147* • Botulinum Toxin in Tetanus *1148*

146. Rabies **1150**

Ashok Mishra

• Causative Agent *1150* • Reservoirs of Infection *1151* • Mode of Transmission *1151* • Incubation Period *1151* • Pathogenesis *1151* • Clinical Presentation *1152* • Diagnosis *1152* • Management of Human Rabies (Hydrophobia) *1153*

• Prevention of Human Rabies *1153* • Modern Antirabies Vaccine *1154* • Rabies Immunoglobulin for Passive Immunization *1155* • Specific Situation *1155* • Control of Rabies *1156*

147. Sexually Transmitted Infection **1157**

Shahbaz Anees, Durre Aden

• Role of the Emergency Department *1157* • Chlamydia *1157* • Gonorrhea *1158*
• Trichomonas Vaginitis *1158* • Syphilis *1158* • Herpes Simplex Virus *1158*
• Pelvic Inflammatory Disease *1159* • Special Scenarios *1159*

148. Human Immunodeficiency Virus Infections **1161**

Susmeet Mishra, Ushirin Bose

• Risk Factors *1161* • Pathophysiology *1161* • Clinical Presentation *1162*
• Evaluation *1163* • Investigations *1163* • Nucleic Acid Tests *1163* • Treatment *1163*
• Immune Reconstitution Inflammatory Syndrome *1164* • Postexposure Prophylaxis *1164*

SECTION 16: TOXICOLOGY

149. General Management of Poisoning **1167**

VP Chandrasekaran, Balaji Muruga B

• Primary Toxicology Survey and Stabilization *1167* • Secondary Toxicology Survey *1169* • Antidotes *1169* • Toxidromes *1169* • Management of Poison Specific Situations *1170* • Removal of Poisoning *1174* • Pediatric Poisoning *1176*
• Disposition and Medical Toxicologist Consultation *1178*

150. Antidotes and Toxidromes **1179**

Devendra Richhariya

• Mechanism of Action: Antidotes *1179* • Multidose Activated Charcoal *1181*
• Methylene Blue *1181* • N-Acetylcysteine *1181* • Fomepizole *1181* • Intravenous Lipid Emulsion *1182* • Toxidromes *1182* • Anticholinergics *1183* • Nonbenzodiazepines *1185*
• Opioids *1185* • Sympathomimetics *1187*

151. Antidepressant **1189**

Devendra Richhariya

• Monoamine Oxidase Inhibitors *1189* • Tricyclic Antidepressants *1190* • Atypical Antidepressants *1190* • Selective Serotonin Reuptake Inhibitors *1190* • Serotonin/Norepinephrine Reuptake Inhibitors *1191* • Treatment of Antidepressant Toxicity *1191*
• Serotonin Syndrome *1192* • Antipsychotics *1192* • Extrapyramidal Symptoms *1193*
• Drug-induced Heatstroke *1193* • Neuroleptic Malignant Syndrome *1193*

152. Cardiovascular Drug Overdose **1195**

Rahul Solanki

• Clinical Features of Overdose *1196* • Management *1196* • Specific Treatment *1196*
• Other Therapies *1198* • Digoxin *1198* • Antihypertensive *1200* • Antiarhythmics *1201*
• Potassium Channel Blockers *1202*

153. Acetaminophen Toxicity **1205**

Ajay K Mishra, Jitendra Chandrakar

• Acetaminophen *1205* • Salicylates *1207* • Nonsteroidal Anti-inflammatory Drugs *1208*

154. Organophosphate and Carbamate Poisoning **1210**

Nayan Sriramula

• Epidemiology *1210* • Pharmacology *1210* • Mechanism of Toxicity *1211* • Carbamates *1211* • Routes and Dynamics of Exposure *1212* • Pharmacokinetics in Self-poisoning *1212* • Pathophysiology *1213* • Clinical Manifestations *1214* • Chronic Toxicity of Organophosphorus Compounds *1215* • Cholinergic Crisis in Organophosphate Poisoning *1215* • Diagnostic Modalities in Organophosphate Poisoning *1216* • Emerging Diagnostic Modalities *1217* • Differential Diagnosis *1217* • Management of Acute Organophosphate Exposure *1218* • Decontamination *1218* • Antimuscarinic Therapy in Organophosphate Poisoning *1219* • Oxime Therapy in Organophosphate Poisoning *1220* • Diazepam in Organophosphate Poisoning *1221* • Disposition *1221*

155. Aluminum Phosphide Poisoning **1223**

Devendra Richhariya, Nayan Sriramula

• Mechanism of Action *1223* • Clinical Features *1223* • Management *1224*

156. Paraquat Poisoning **1228**

Raja Ganesan

• Epidemiology *1228* • Chemistry and Mechanism of Toxicity *1228* • Pathophysiology *1228* • Clinical Manifestations *1229* • Diagnosis *1230* • Treatment *1230* • Prognosis *1231* • Prevention *1231* • Future Directions and Research *1231*

157. Alcohol **1232**

Ajay Singh Thapa

• Alcohol Intoxication *1232* • Alcohol Withdrawal Syndrome *1234* • Methanol Poisoning *1236*

158. Hydrocarbons **1238**

Atanu Bhattacharya

• Classification and Properties *1238* • Pathophysiology *1239* • Clinical Presentation *1239* • Evaluation *1240* • Investigation *1240* • Treatment *1241* • Disposition *1241*

159. Inhaled Toxins **1243**

S Senthilkumaran, Ponniah T

• Etiology *1243* • Pathogenesis *1243* • Clinical Features *1244* • Investigations *1244* • Diagnosis *1244* • Management *1244* • Asphyxiants *1246* • Carbon Monoxide Poisoning *1246* • Cyanide Poisoning *1247*

160. Heavy Metals **1248**

Narendra Nath Jena, Subbulakshmi Dhanabal

• Lead *1248* • Mercury *1249* • Arsenic *1251* • Iron *1252* • Other Metal Intoxication *1253*

161. Plant Toxins **1256**

TV Ramakrishnan

• Yellow Oleander (*Thevetia Peruviana*) *1256* • Pink Oleander (*Nerium Odorum*) *1256* • *Datura Metel* *1256* • Nutmeg (*Myristica Fragrans*) *1257* • *Nicotiana Tabacum* *1257* • *Strychnos Nux Vomica* *1257* • *Gloriosa Superba* *1257* • Castor Oil Plant (*Ricinus Communis*) *1258* • *Abrus Precatorius* *1258* • Milkweed (*Calotropis*) *1258* • *Cannabis Sativa* *1258* • *Cleistanthus Collinus* *1258*

162. Mushroom Poisoning **1260**

Devendra Richhariya

• Pathophysiology and Clinical Syndromes *1260* • Clinical Syndromes of Mushroom Toxins *1262* • Diagnosis *1262* • Management *1262*

163. Scorpion Stings **1264**

Devendra Richhariya

• Scorpion Venom *1264* • Other Arthropods and Insects *1265*

164. Snake Envenomation **1273**

Jaideep C Menon, Joseph K Joseph

• Epidemiology *1273* • Snakes *1273* • Snake Venom *1274* • Management of Snake Envenomation *1275* • Specific Treatment for Snake Envenomation *1278* • Special Situations *1279* • Complications *1279* • Disposition *1280*

165. Marine Envenomation **1281**

Navin Puttum, Devendra Richhariya

• Sponges *1282* • Hydroids and Fire Coral *1282* • Jellyfish *1282* • Sea Anemones *1283* • Box-shaped Jellyfish *1283* • Annelid Worms *1283* • Starfish and Sea Urchins *1283* • Mollusks *1284* • Scorpionfish *1284* • Stingrays *1284* • Sea Snakes *1284* • Treatment and Complications *1285*

166. Analytical Toxicology **1287**

VV Pillay

• Approach to Toxicologic Analysis in Poisoning *1287* • Biochemical and Hematological Tests Useful in Toxicology *1288* • Analytical Methods Used in Toxicology *1288* • Qualitative Assays *1289* • Quantitative Assays *1290*

SECTION 17: TRAUMA

167. Trauma Systems **1293**

Prasad Rajhans, Devendra Richhariya

• Concept of Trauma System *1293* • Prehospital Trauma Care *1293* • Trauma Center and Trauma Team *1296* • Pathophysiology of Trauma *1297* • Trauma Resuscitation *1298* • Rehabilitation *1304* • Injury Prevention *1304* • Trauma in Observation Unit *1304*

168. Systematic Assessment and Management of Trauma **1306**

Sanjay Shah

• Trimodal Distribution Trauma Mortality *1306* • Primary Survey and Initial Resuscitation *1307* • Secondary Survey *1312*

169. Focused Assessment with Sonography in Trauma **1317**

Devendra Richhariya

• Evolution of Fast *1317* • Accuracy of Fast and Clinical Decision-making *1317* • Technique and Interpretation *1318* • Newer Protocols and Extended Fast *1319* • Heart *1319* • Hemothorax or Pleural Effusion *1320* • Pneumothorax *1320* • Inferior Vena Cava *1322* • Serial Fast *1323* • Solid Organ Evaluation *1323* • Bowel and Mesenteric Injury *1323* • Pregnant Patients *1324* • Fast and Pediatric Patients *1324* • Training and Experience *1324* • Future Applications *1324*

170. Facial Trauma **1326**

Safdar Hashmi, Devendra Richhariya

• Approach and Management *1326* • Temporomandibular Joint Dislocation *1331* • Lacerations *1331* • Imaging Studies *1331*

171. Head Trauma **1333**

Prasad Rajhans

• Cerebral Blood Flow and Autoregulation *1333* • Pathophysiology of Traumatic Brain Injury *1333* • Mechanism of Injury *1334* • Consequences of Traumatic Brain Injury *1334* • Pattern of Brain Injuries *1335* • Traumatic Brain Injury *1337* • Clinical Features of Traumatic Brain Injury *1337* • Management of Head Injuries *1337* • Traumatic Brain Injury in Children *1340*

172. Neck Trauma **1344**

Lokendra Gupta, Ravi Ranjan

• Anatomy *1344* • Pathophysiology *1345* • Clinical Presentation *1345* • Evaluation of Neck Trauma *1346* • Management *1346* • Prognosis *1348*

173. Spine Trauma **1350**

Devendra Richhariya

• Applied Anatomy of Spine *1350* • Mechanisms of Injury *1351* • Primary and Secondary Spinal Cord Injury *1351* • Level and Severity of Injury *1351* • Clinical Grading *1351* • Spinal Cord Syndromes *1352* • Upper Cervical Injuries *1353* • Lower Cervical Spine Injuries *1355* • Thoracolumbar Spine *1355* • Radiology in Spinal Trauma *1357* • Initial Assessment and Management *1357* • Evaluation of Neurological Status *1358* • Management *1359* • Adjunct Therapy *1361* • Emerging Therapies *1361* • Pediatric Age and Spinal Cord Injury *1361*

174. Thoracic Trauma **1363**

Awaneesh Katiyar

• Primary Survey and Immediate Life-saving Interventions *1364* • Chest Examination in the Emergency Department *1364* • Extended Focused Assessment with Sonography in Trauma Examination in Chest Trauma *1365* • Imaging in Thoracic Trauma *1366* • Emergency Procedures in Chest Trauma *1366* • Chest Wall Injuries *1368* • Rib Fractures *1368* • Flail Chest *1368* • Sternal Fracture *1369* • Clavicular Fracture *1370* • Open Chest Wall Injury *1371* • Lung and Pleural Injuries *1371* • Pulmonary Contusion *1372* • Pneumothorax *1372* • Hemothorax *1374* • Chylothorax *1375* • Bronchopleural Fistula *1375* • Tracheobronchial Injuries *1376* • Aortic Injury and Its Management *1377* • Blunt Cardiac Injury *1378* • Cardiac Rupture *1379* • Esophageal Injury *1380* • Diaphragmatic Injury *1380*

175. Abdominal Trauma **1383**

Sanjay Shah, Chintan Thanki

• Etiology *1383* • Pathophysiology *1383* • Clinical Presentation *1384* • Evaluation *1384* • Investigations *1385* • Treatment *1386* • Resuscitative Endovascular Balloon Occlusion of the Aorta *1390* • Disposition *1391*

176. Genitourinary Trauma **1393**

Rajashekar Mohan, Lancelot Lobo, Nawin Kumar

• Mechanisms of Injury *1393* • Evaluation and Clinical Features *1393* • Investigations *1394* • Treatment Options *1394*

177. Orthopedic Injuries **1398**

Sandeep Jain

• Etiology of Orthopedic Injuries *1398* • Classification of Orthopedic Injury *1398* • Fracture Healing *1400* • Initial Care of Orthopedic Injury *1400* • Evaluation of Orthopedic Injury *1401* • Investigations *1402* • Initial Management *1402* • Compartment Syndrome *1406* • Applied Anatomy *1406*

178. Extremity Trauma and Management **1409**

Devendra Richhariya

• Upper Limb Trauma *1409* • Lower Limb Trauma *1411* • Fracture Management: Splinting and Casting *1412* • Types of Splints *1412* • Upper Extremity Immobilization *1414* • Lower Extremity Immobilization *1414* • Joint Dislocation: Reduction Techniques *1415* • Local Anesthesia and Blocks *1417*

179. Vascular Injury **1419**

Ramya Ramakrishnan, TV Ramakrishnan

• Etiology and Incidence *1419* • Pathophysiology *1420* • Clinical Presentation *1420*
• General Principles for Vascular Trauma Care *1420* • Diagnosis *1420*
• Management *1421* • Complications *1422*

180. Basic Wound Management **1424**

Devendra Richhariya

• What is a Wound? *1424* • Classification of Wound *1424* • Laceration *1426* • Assessment of the Wound *1426* • Wound Preparation *1427* • Materials Used for Closure of Lacerations *1428* • Wound Closure *1429* • Antibiotic in Wound Care *1431* • Aftercare Instruction *1431*

181. Advanced Laceration **1434**

Devendra Richhariya

• Initial Management *1434* • Diagnostic Work-up *1435* • Selection of Sutures and Suturing Methods *1435* • Periorbital Wound *1435* • Nasolacrimal Duct Injuries *1436* • Cheek Lacerations (Zygoma) *1436* • Ear Lacerations *1436* • Nose Lacerations *1436* • Scalp Laceration *1436* • Lip Laceration *1436* • Tongue Laceration *1436* • Face Laceration *1436* • Human Bites *1437* • Animal Bites (Dog and Cat) *1437* • Limb Injuries *1437* • Crush Injuries *1438* • Compartment Syndrome *1439*

182. Burns **1441**

Gaurav B Shetty, Sahanya Shetty

• Determining Severity of Burn: Classification *1441* • Burn Care in Prehospital Setting *1443*
• Burn Care in Emergency Department *1444* • Investigations *1446* • Supportive Therapy *1446* • Nutrition in Burns *1446* • Wound Care *1447* • Indication of Hospitalization for Burn Patient *1447* • Criteria for Referral to a Burn Unit/Specialist *1448* • Prognostication of the Burn Patient *1449* • Child Abuse *1449*

183. Electrical and Lightning Injuries **1451**

Neeraj Mangla, Sahanya Shetty

• Etiology *1451* • Pathophysiology *1451* • Clinical Manifestations *1452* • Evaluation of Electrical Injuries *1454* • Treatment *1455* • Taser Injuries *1456* • Injuries Caused By Lightning Strikes *1456* • Disposition *1457*

SECTION 18: ENVIRONMENTAL EMERGENCIES

184. Heat Illnesses **1459**

Arjun James

• Mechanisms of Heat Transfer *1459* • Regulation of Body Temperature *1459*
• Pathophysiology *1459* • Classification of Heat Illness *1459* • Heat Cramp *1460*
• Heat Edema *1461* • Heat Rash *1461* • Heat Tetany *1461* • Heat Syncope *1461*
• Heat Exhaustion *1462* • Heat Stroke *1462*

185. Drowning **1465**

Devendra Richhariya

• Definition and Terminology *1465* • Risk Factors for Drowning *1465* • Pathophysiology and Staging of Drowning *1465* • Prehospital Care *1466* • Treatment in Intensive Care Unit *1468* • Complications *1469* • Prognosis *1469* • Prevention *1470*

186. Decompression Illness **1471**

Ohmar Pradhan

• Diving Physics *1471* • Developing Decompression Sickness *1471* • Signs and Symptoms *1472* • Medical Assessment of the Injured Diver *1472*
• Diagnostic Work-up *1473* • Differential Diagnosis of Decompression Illness *1473*
• Treating Decompression Illness *1473* • Hyperbaric Oxygen Therapy *1474*
• Adjunctive Therapies *1474* • Alternative Treatment Technique: In-water Recompression *1474*

187. High-altitude Emergencies **1476**

Sona Pradhan

• Pathophysiology of Acclimatization *1476* • Acute Mountain Sickness *1476* • High-altitude Cerebral Edema *1478* • High-altitude Pulmonary Edema *1478* • Prevention of High-altitude Illness *1478* • Additional High-altitude Conditions *1478* • Special Populations *1479* • Technology Integration *1479* • Evacuation and Disposition Criteria *1479*

188. Accidental Hypothermia **1481**

Rahul Solanki

• Pathophysiology *1481* • Clinical Features and Classification *1482* • Diagnosis *1482*
• Prehospital Management *1483* • In-hospital Management *1484* • Hypothermia of Extremities *1485* • Avalanche *1486*

189. Preparation for International Travel **1487**

Neeraj Mangla, Sahanya Shetty

• Pretravel Immunization *1487* • Arthropod Specific Protection *1490* • Malaria—Chemoprophylaxis *1490* • Traveler's Diarrhea *1490* • Prevention of Injury *1492* • Travel With Children *1492* • Jet Lag *1492* • Insurance of Travel *1493* • Healthcare Personnel *1493* • Sports Recreation *1493* • Thrombosis *1493* • Acute Altitude Illness *1493* • Terrorism/Unstable Political Situations *1494*

190. In-flight Medical Emergencies **1496**

Shalini Nalwad

• The Flight Environment, Cabin Altitude, and Cabin Air *1496* • Pressure and Dysbarism *1497* • On-board Medical Resources *1497* • Automated External Defibrillators *1497* • On-board Medical Oxygen (Portable Oxygen Bottles) *1498* • Specific Medical Conditions *1499* • Approach to Patient Care during in-flight Emergencies *1501*
• Death Onboard *1502* • Future Challenges *1502*

Index **1503**

CHAPTER 62

Dyspnea

Devendra Richhariya

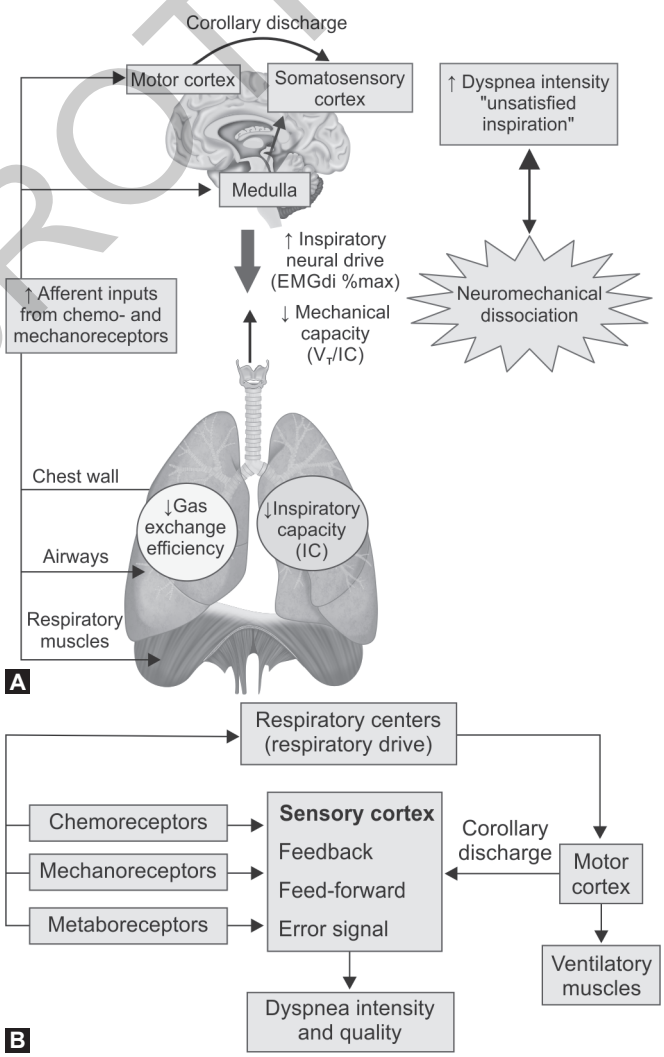
JAYPEE BROTHERS

INTRODUCTION

Dyspnea or shortness of breath is one of the most common presenting symptoms to the emergency department (ED). It has been observed to be reported in 50% of patients admitted in tertiary acute care hospitals. It is one of the most dreaded symptoms to evaluate in ED. It needs to be worked up in a matter of minutes as it may depict a potentially life-threatening event. It has been defined by the American Thoracic Society as "*a subjective experience of breathing discomfort* that consists of qualitatively distinct sensation that varies in intensity". It has a lot of subjective overlays. So, it becomes really challenging to make a rapid and accurate diagnosis and differentiate it from the objective component. *Assessment of severity of dyspnea is very crucial* as it shows the acuteness of situation and also aids in triaging of patients to appropriate destination. Various validated dyspnea scales are available, which are easy to use and are general or disease specific. Most popular is the New York Heart Association *(NYHA) classification,* which is specific for chronic congestive heart failure. Another clinical scale "Modified Medical Research Council" scale is also commonly used for the assessment of dyspnea in patients with chronic lung disease. Other scales are descriptions of intensity based such as *Visual Analog scale and Borg scale.* There is another multidimensional questionnaire-based scale, i.e., "*Multidimensional Dyspnea Profile*" scale. These scales aid physicians in understanding life-threatening or benign nature of the presenting dyspnea.

PATHOPHYSIOLOGY

Dyspnea is usually the end result if a stimulus activates the respiratory center beyond a certain threshold **(Fig. 1A)**. Hypoxemia stimulates the carotid receptors; hypercapnia stimulates the medullary chemoreceptors; decreased compliance results in stimulating the mechanoreceptors in the diaphragm, chest wall, and airway; and airway resistance stimulates the airway receptors **(Fig. 1B)**.



FIGS. 1A AND B: Pathophysiology of dyspnea.
(EMGdi: diaphragm electromyography)

ETIOLOGY

The first step while evaluating dyspnea is to understand whether it is a new or preexistent problem, or it is an exacerbation of a chronic lung disease, or maybe a combination of both. Urgent decisions are needed in the presence of acute dyspnea, especially if severe. **Table 1** enlists the most common causes of acute dyspnea in ED.

DIAGNOSTIC EVALUATION OF DYSPNEA

Acute dyspnea in ED is the most worrisome and needs a quick workup. After ensuring airway, breathing, and circulation of the patient, proceed to evaluation of dyspnea by taking a good history, and by performing clinical examination. Most common etiologies of acute dyspnea should be kept in mind. The key to diagnosis lies in the corroboration of findings on *history, physical examination, and chest X-ray* **(Tables 2 and 3)**. After drawing a *differential diagnosis*, various diagnostic tests can be performed in order to establish the definite cause **(Flowchart 1)**. There are some basic investigations, which are suggested for all dyspneic patients in ED. They are hemogram, D-dimer, pulse oximetry, renal function test, liver function test, electrolytes, chest X-ray, arterial blood gas (ABG) analysis, electrocardiogram (ECG), and echocardiography. These help in narrowing down the diagnosis and focusing on only some specific differential causes. Some people like to measure biomarkers right at the admission like procalcitonin and brain-type natriuretic peptide (BNP). Need for various investigations is dictated by the clinical context. Combining physical examination and chest X-ray with history has been found to increase the accuracy to about 66% for all causes, and in 27% of cases the chest X-ray reveals a serious finding.

TABLE 1: Common causes (differential diagnosis) of acute onset dyspnea.

Upper airway	• Foreign body • Laryngeal edema • Laryngospasm • Anaphylaxis • Epiglottitis
Lower respiratory tract	• Acute asthma • Acute exacerbation of chronic obstructive pulmonary disease (COPD) • Pulmonary embolism • Pneumonia • Pneumothorax • Massive pleural effusion • Interstitial lung disease, especially acute interstitial pneumonia • Acute hypersensitivity pneumonitis • Drug-induced lung disease • Acute aspiration • Acute respiratory distress syndrome (ARDS)
Cardiac	• Acute coronary syndrome • Cardiac tamponade • Arrhythmias • Valvular heart disease • Heart failure with reduced ejection fraction
Others	• Metabolic acidosis • Severe pain • Myasthenic crisis • Neuromuscular disorders like Guillain–Barré syndrome • Amniotic fluid embolism • Fat embolism • Chest trauma • Drug reaction • Carbon monoxide poisoning • Anxiety and panic attacks

Pulse Oximetry

This allows detection of hypoxemia and presence of respiratory failure. Oxygen saturation may be normal in patients with anxiety; pulmonary embolism (PE) is common among the acute causes.

Arterial Blood Gas Analysis

This is another important investigation for dyspnea, which serves various purposes. Firstly, it aids in defining the type of respiratory failure; secondly, it gives an idea about the severity; thirdly, it defines presence of acidemia or alkalemia, assisting in narrowing the differential list; and last but not the least, it sometimes may clinch the diagnosis

TABLE 2: Correlating breath sound (BS) with causes of acute dyspnea.

Breath sound	***Associated conditions***
Wheeze or rhonchi (whistling/sibilant, musical)	Caused by narrowing of airways, such as in asthma, chronic obstructive pulmonary disease, and foreign body
Stridor (whistling/sibilant, musical)	Epiglottitis, foreign body, laryngeal edema, and croup
Crackles (cracking/clicking/rattling)	Pneumonia, pulmonary edema, interstitial lung disease, and heart failure
Hamman's sign (mediastinal crunch), crunching, and rasping	Pneumomediastinum and pneumopericardium
Silent chest, decreased or no breath sound	Acute severe asthma, bilateral (B/L) emphysema or bullous lung
• Unilateral decreased BS • BS decreased or absent on one side	Pleural effusion (dull percussion note) and pneumothorax (hyperresonant percussion note)

JAYPEE BROTHERS

TABLE 3: History, clinical examination, and X-ray findings of the most common etiologies of acute dyspnea.

Disease	*History*	*Clinical examination*	*Chest X-ray*
Acute coronary syndrome	Pericardial chest pain, palpitations, feeling of impending doom, radiation of pain to left arm, diabetes, and history of stroke	Cold clammy extremities, hypotension, S_3 or S_4 gallop rhythm, bilateral crepitations, and ejection systolic murmur	Bilateral diffuse infiltrates, batwing appearance
Pulmonary embolism	Sudden onset dyspnea, chest pain, hemoptysis, prolonged immobilization, neoplastic disease, injury to leg, and pregnancy or childbirth	Hypotension, tachycardia, neck vein engorgement, lower extremity edema, and calf tenderness	Normal or Hampton's hump, Westermark sign, and prominent pulmonary arteries
Chronic obstructive pulmonary disease	Chronic productive cough, chronic dyspnea, exposure to smoke, occupational exposure to fumes and chemicals, recent history of fever, sore throat, increase in sputum, and change in color of sputum	Facial plethora, pursed lip breathing, tripod position, diffuse wheezing, pulsus paradoxus, altered mentation, cyanosis, barrel-shaped chest, silent chest, and tachypnea	Hyperinflated chest, flattened diaphragms in emphysema
Asthma	Episodic seasonal wheezing, family history may be positive, history of recent viral infection, fever, sore throat, and exposure to allergens	Diffuse wheezing, silent chest, tachycardia, tachypnea, and cyanosis	Hyperinflated chest
Pneumonia	Fever, chills, cough with sputum, pleuritic chest pain, may be of 2–3 weeks duration, especially in tuberculosis or fungal pneumonia, and hemoptysis	Bronchial breathing, inspiratory crepitations, cyanosis, and altered mentation	Lobar consolidation with air bronchogram, or bilateral diffuse infiltrates
Pulmonary edema	Orthopnea, paroxysmal nocturnal dyspnea, chest pain, ankle swelling, end-stage renal and liver disease	Bilateral fine rales, distended neck veins, S_3 gallop rhythm, cyanosis, and altered mentation	Bilateral diffuse infiltrates, batwing appearance
Acute respiratory distress syndrome	Acute-onset dyspnea, history of febrile illness, trauma, near drowning, aspiration, smoke inhalation from house fire, burns, blood transfusion reactions, medication reactions, radiotherapy	Tachycardia, tachypnea, cyanosis, bilateral crepitations, and hypotension	Bilateral diffuse lung infiltrates
Pneumothorax	Sudden onset dyspnea with unilateral chest pain, retroviral positive, and history of cocaine use	Unilateral absence of breath sounds, tympanic note on percussion, and distended neck veins	Collapsed lung and unilateral lucidity +/– mediastinal shift to contralateral side
Anxiety and panic attacks	Most commonly seen in young females, both sexes can be involved, previous history of anxiety or antidepressants or phobias and discomfort in various locations	Tachycardia, tachypnea, normal oxygen saturation, sweating, frequent sighs, and Chvostek sign and Trousseau sign may be present	Normal
Pulmonary contusion	History of blunt or penetrating trauma, hemoptysis	Focal decreased breath sounds, chest tenderness, and paradoxical breathing	Focal in homogenous opacity, with or without hemothorax
Alveolar hemorrhage	History of cough, fever, hemoptysis, anemia, and history of mitral valve disease	Tachypnea, tachycardia +/– diastolic murmur of mitral stenosis, and bilateral crepitations	Bilateral alveolar infiltrates

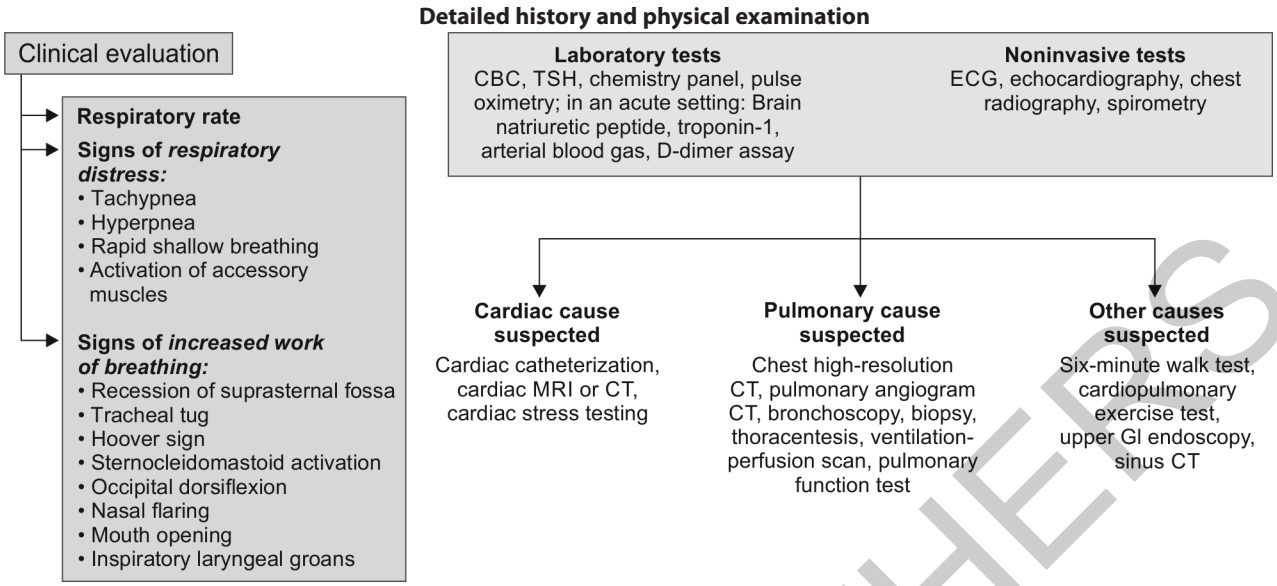
of methemoglobinemia by either depicting a mismatch between the partial pressure of oxygen in the blood and oxygen saturation by pulse oximetry, or by directly measuring the methemoglobin levels.

Hypocapnia is present in acute respiratory distress syndrome (ARDS), PE, interstitial lung disease, pneumonia, and asthma. It basically indicates hyperventilation. Metabolic acidosis may point toward renal failure, sepsis, poisoning, and cyanide toxicity to name a few **(Box 1)**.

Hypercapnia may point toward diseases like chronic obstructive pulmonary disease (COPD), asthma, obstructive sleep apnea, upper airway obstruction, or neuromuscular disease **(Box 2)**.

Arterial blood gas proves sometimes invaluable for suspecting PE in a patient with near normal oxygen saturation by pulse oximetry. In the presence of near normal oxygen saturation, elevated alveolar–arterial oxygen gradient ($A–aO_2$) may be the first clue pointing toward PE.

JAYPEE BROTHERS



FLOWCHART 1: Diagnostic evaluation of dyspnea in emergency department.

(CBC: complete blood count; CT: computed tomography; ECG: electrocardiogram; GI: gastrointestinal; MRI: magnetic resonance imaging; TSH: thyroid-stimulating hormone)

BOX 1 **Causes of hypoxemic respiratory failure type 1.**

- *Low FiO_2*: High altitude
- *Airways*: COPD, asthma, postintubation laryngeal edema, mucus plug, bronchiectasis, and vocal cord paralysis
- *Lung parenchyma*: Pulmonary edema, ARDS, pulmonary hemorrhage, lung contusion, pneumonia, alveolar proteinosis, hypersensitivity pneumonitis, transfusion-related lung injury, lung resection, aspiration, and radiation injury
- *Interstitial*: Pulmonary fibrosis, viral or atypical pneumonia
- *Pulmonary vasculature*: Pulmonary veno-occlusive disease, pulmonary embolism, and intracardiac or intrapulmonary shunt
- *Pleural*: Pneumothorax, pleural effusion
- *Chest wall*: Kyphoscoliosis, thoracoplasty, massive obesity, chest wall trauma—flail chest and burns

(ARDS: acute respiratory distress syndrome; COPD: chronic obstructive pulmonary disease; FiO_2: fraction of inspired oxygen)

BOX 2 **Causes of hypercapnic respiratory failure type II.**

- *Respiratory drive (reduced)*: Drug overdose, obesity hypoventilation syndrome, traumatic brain injuries, carotid body resection, and metabolic alkalosis
- Neural transmission (reduced)
- *Spinal cord*: Cervical spine injury and tumor
- *Anterior horn cells*: Poliomyelitis and amyotrophic lateral sclerosis
- *Peripheral nerves*: Phrenic nerve injury, Guillain–Barré syndrome, critical illness polyneuropathy, Lyme disease, beriberi, and diphtheria
- *Neuromuscular junction*: Neuromuscular blocking agents, tick paralysis, organophosphorus poisoning, botulism, tetanus, myasthenia gravis, and Lambert–Eaton syndrome
- *Respiratory muscles*: Muscular dystrophy, polymyositis, malnutrition, dyselectrolytemia, and hypothyroidism
- *Chest wall*: Kyphoscoliosis, thoracoplasty, fibrothorax, flail chest, ankylosing spondylitis, and asphyxiating thoracic dystrophy

Multiple Marker Approach

In the emergency setting, it is often necessary to differentiate diverse clinical conditions having similar clinical presentation but markedly different treatment and prognosis. There is thus a need to test for the possibility of multiple clinical conditions rapidly and accurately in order to diagnose and institute appropriate therapy at the earliest. In view of this need, several biomarkers are used together according to the clinical scenario and several point-of-care kits incorporating these multiple markers have also been made available. For example, in a patient who presents with acute-onset dyspnea where it is necessary to differentiate between acute PE and acute myocardial infarction (AMI), the use of D-dimer along with troponin could be useful. Also, multiple biomarkers could be used to provide additional information related to prognosis and timing of the event. The disadvantage of this approach is the increased cost and sometimes leading to inappropriate management. Besides, these have not been recommended as a preferred strategy and exercising clinical judgment in choosing the appropriate biomarkers in a given clinical situation is recommended.

Point-of-care Ultrasound (POCUS)

Recent times have seen a prominent role of ultrasound **(Fig. 2)** in the evaluation of dyspnea in ED by using Bedside Lung Ultrasound in Emergency (*BLUE) Protocol*

JAYPEE BROTHERS

(Flowchart 2). *Presence of B lines, lung sliding, pleural effusion, lung point, and inferior vena cava (IVC) diameter help in establishing the definitive diagnosis*. Coupled with echocardiography, it may help physicians to arrive at the primary cause (pulmonary or cardiac) in most cases.

Echocardiography

Acute-onset dyspnea can be due to cardiac or noncardiac conditions. Echocardiography is very helpful in distinguishing between the two and in providing detailed description of the *underlying cardiac pathology* when such a condition is found. Dyspnea is therefore a class I indication for performing echocardiography. There are a number of cardiac conditions that can result in acute dyspnea. The common ones include:

- *Predominant left ventricular (LV) systolic dysfunction*: It may occur due to myocardial infarction (MI), dilated cardiomyopathy, stress cardiomyopathy, etc.
- *Predominant LV diastolic dysfunction*: It may occur due to long-standing hypertension, hypertrophic cardiomyopathy, restrictive cardiomyopathy, aortic stenosis, etc.
- *Valvular heart diseases*: They may occur due to mitral stenosis, mitral regurgitation (MR), aortic stenosis, aortic regurgitation, prosthetic heart valve (PHV) malfunction, etc.
- *Pericardial diseases* such as cardiac tamponade and constrictive pericarditis.
- *Cardiac tumors* such as left atrial (LA) myxoma, etc.
- *Pulmonary embolism*, idiopathic pulmonary hypertension, etc.

In all the above conditions, echocardiography is able to demonstrate the underlying structural abnormality in detail. In addition, it also permits comprehensive assessment of intracardiac hemodynamics, which helps in determining the role of these abnormalities in causation of dyspnea and in planning appropriate treatment strategies.

Predominant LV diastolic dysfunction has recently emerged as an important cause of dyspnea. It is estimated that almost half of all patients presenting with heart failure have a normal or near normal left ventricular ejection fraction (LVEF) with LV diastolic dysfunction being the dominant abnormality. *This entity is termed as "heart failure with preserved* ejection fraction *(EF)" or HFpEF*. Assessment

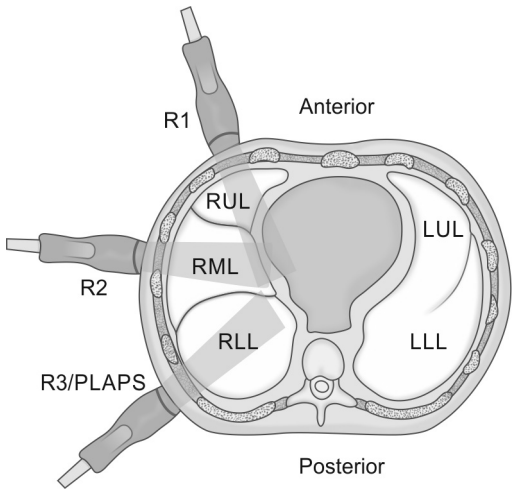
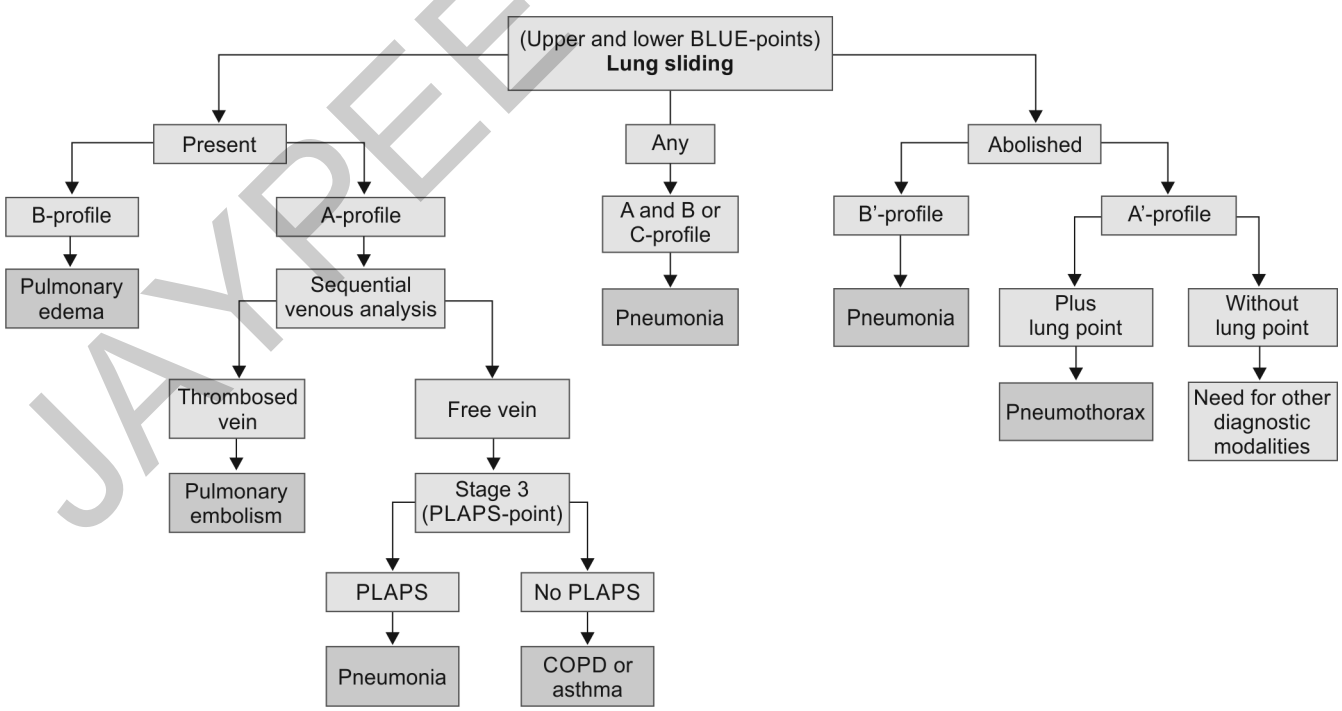


FIG. 2: Position of probe.

[LLL: left lower lobe (of the lung); LUL: left upper lobe (of the lung); PLAPS: posterolateral alveolar and/or pleural syndrome; POCUS: point-of-care ultrasound; RML: right middle lobe (of the lung); RUL: right upper lobe (of the lung)]



FLOWCHART 2: Bedside Lung Ultrasound in Emergency (BLUE) protocol for the evaluation of dyspnea.

(COPD: chronic obstructive pulmonary disease; PLAPS: posterolateral alveolar and/or pleural syndrome)

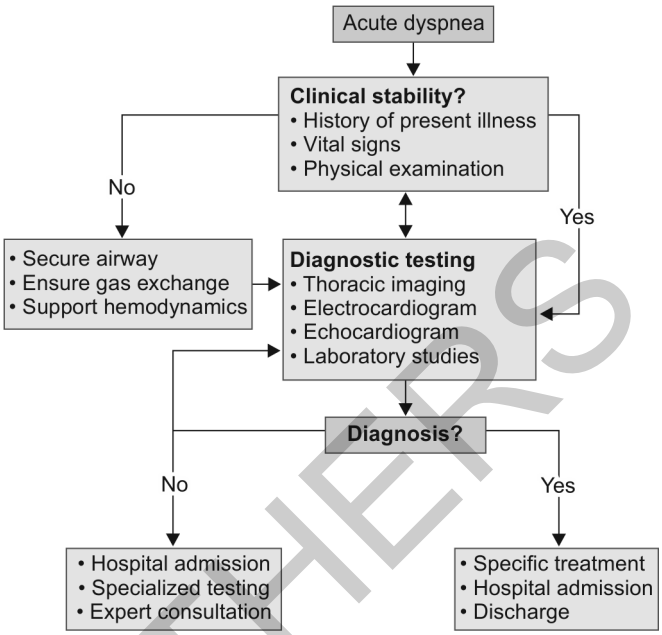
JAYPEE BROTHERS

of LV diastolic function is central to the recognition of this entity and echocardiography is the most commonly utilized modality for this purpose. The American Society of Echocardiography has recommended algorithms for the stepwise *assessment of LV diastolic function and LV filling pressure* in different patient populations. Estimation of LV filling pressure is of paramount importance even in patients with frank LV systolic dysfunction. In these patients, elevated LV filling pressure is not only an adverse prognostic marker but also has major therapeutic implications. The need for diuretics, intravenous fluids, inotropes, vasodilators, etc.; timing of introduction of beta-blockers; timing of coronary intervention; ambulation and mobilization of patients after AMI; etc., are all influenced by the status of LV filling pressure.

Among valvular lesions, mitral stenosis is the most common condition that presents with acute shortness of breath. Development of atrial fibrillation is the usual culprit in these patients. In contrast, acute shortness of breath in other valvular heart diseases generally occurs due to worsening LV systolic dysfunction, development of infective endocarditis (IE), or traumatic disruption of valvular apparatus. Aortic stenosis may result in acute dyspnea even in absence of LV systolic dysfunction because of LV hypertrophy with consequent LV diastolic dysfunction.

Other Investigations

Leukocytosis points toward an underlying infection most of the times. Eosinophilia may be observed in asthmatics, parasitic infections, and certain vasculitis. Anemia may be suspected as the primary cause. Thrombocytopenia generally indicates viral infections, thrombotic thrombocytopenic purpura, and adverse drug reaction. Deranged liver function tests may be seen in congestive heart failure, dengue, liver failure, atypical pneumonia (especially legionella pneumonia), AMI, viral infection, etc. Deranged kidney function test may be the end result of primary pathology, or renal failure may be the primary cause of dyspnea. Elevated Troponin I/T and creatine kinase-MB (CK-MB) may be present in myocarditis and takotsubo cardiomyopathy apart from AMI. Generally, in these conditions elevated BNP levels are also seen. Elevated serum procalcitonin levels in the presence of leukocytosis increases the confidence in sepsis as the primary etiology. After the trimming of the differential list is done with the help of history, examination, chest X-ray, and basic investigations, definitive tests are ordered. The list is long and may include high-resolution computed tomography (HRCT) of the chest, CT pulmonary angiography, venous Doppler of the limbs, ventilation perfusion scan, Holter monitoring, bronchoalveolar lavage, lung biopsy, and chest fluoroscopy to demonstrate diaphragmatic paralysis and sleep study to name a few.



FLOWCHART 3: Approach to dyspnea.

MANAGEMENT

Treatment is directed toward the underlying cause. Adequate oxygenation should be ensured, and noninvasive or invasive ventilatory support should be started in the presence of excessive work of breathing when appropriate. Bronchodilators and steroids with or without antibiotics are indicated in the presence of acute asthma or acute exacerbation of COPD. Diuretics and antihypertensives should be started in the presence of pulmonary edema. Antibiotics should be prescribed in case pneumonia or any other infection is suspected. Patients with pneumothorax or pleural effusion need a tube thoracotomy. Anticoagulants should be started in case of PE. Majority of patients presenting with acute dyspnea require hospitalization and disposition decision taken as per **Flowchart 3**.

SUMMARY

Acute dyspnea is one of the most challenging conditions in ED. A thorough history, good clinical examination, appropriate laboratory investigations, and proper triaging are essential for its prudent evaluation and management.

FURTHER READINGS

1. Berliner D, Schneider N, Welte T, Bauersachs J. The Differential Diagnosis of Dyspnea. Dtsch Arztebl Int. 2016;113(49):834-45.
2. Rosset-Zufferey S, Ramlawi M. Dyspnée aiguë aux urgences: de la physiopathologie à l'échographie [Acute dyspnea in the emergency room: from pathophysiology to ultrasonography]. Rev Med Suisse. 2015;11(482):1469-73.
3. Parshall MB, Schwartzstein RM, Adams L, Banzett RB, Manning HL, Bourbeau J, American Thoracic Society Committee on Dyspnea, et al. An official American Thoracic Society statement: update on the mechanisms, assessment, and management of dyspnea. Am J Respir Crit Care Med. 2012;185(4):435-52.

JAYPEE BROTHERS

for detailed information on medicine books, visit our website www.ejaypee.com, for detailed information on medicine books, visit ou

Textbook of
Emergency Medicine

Textbook of Emergency Medicine, 3rd edition is a comprehensive emergency medicine book covering all aspects of emergency medicine such as prehospital care, in-hospital care, intensive care, infectious disease, toxicology, trauma, and management of mass casualty. This textbook is beneficial not only for postgraduates of emergency medicine but also for critical care physicians, general practitioners, and emergency medical technicians and is a forever companion to every physician.

Salient Features

- Basics of emergency such as triaging, infection, and quality control
- Special situations such as managing overcrowding medicolegal cases
- Prehospital care of patient during transfer
- Point-of-care laboratory testing and point-of-care ultrasound
- Intensive care of critically ill patients in the emergency department
- Respiratory, cardiac, neurological, and gastrointestinal pediatric emergencies
- Geriatric emergencies
- Management of time-bound emergencies such as stroke and acute coronary syndrome
- Infectious disease and immunization
- Complete guide of trauma management
- Comprehensive knowledge of toxicology
- Disaster management including mass casualties
- Recommended for students of postgraduate courses in emergency medicine, critical care, family medicine, emergency nursing, and emergency medical technicians

Devendra Richhariya MBBS MD FICM PGDMT MBA CEO Program IIM-Lucknow is presently Consultant, Emergency and Trauma Care, Disaster Medicine and Healthcare Management in Delhi-NCR, India. He has been a practicing emergency physician for the last 25 years. He is a mentor for emergency medicine postgraduate students and fellowship programs and a faculty speaker for various national and international platforms. Dr Richhariya is also author and co-author of various textbooks, handbooks, and articles in national and international journals.

Buy from ejaypee

JAYPEE BROTHERS

Shelving Recommendation
MEDICINE

ISBN 978-93-7202-991-8