



Textbook of

**EMERGENCY &
TRAUMA CARE**

Editor-in-Chief

Devendra Richhariya

Co-Editors

Saleh Fares

Khusrav Bajan

Sudhir S Pawaiya

Forewords

Naresh Trehan

Yatin Mehta

Ravi R Kasliwal



JAYPEE

Textbook of **EMERGENCY AND TRAUMA CARE**

Editor-in-Chief

Devendra Richhariya

MBBS MD FICM
Senior Consultant

Department of Emergency and Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Co-Editors

Saleh Fares

MD MPH FRCPC(EM) FAAEM FACEP

Consultant (Emergency Medicine)

EMS and Disaster Medicine

Deputy Commander

Zayed Military Hospital

Founder and Chairman

Trauma System Initiative

Emirate of Abu Dhabi

Founder and President

Emirates Society of Emergency Medicine

Abu Dhabi, UAE

Khusrav Bajan

MD EDIC

Consultant (Critical Care) and Head

Department of Emergency

PD Hinduja National Hospital and

Medical Research Center

Mumbai, Maharashtra, India

Sudhir S Pawaiya

MBBS Diploma in Emergency Medicine

Consultant

Department of Emergency and Trauma Care

Medanta—The Medicity

Gurugram, Haryana, India

Forewords

Naresh Trehan

Yatin Mehta

Ravi R Kasliwal



The Health Sciences Publisher

New Delhi | London | Panama



Jaypee Brothers Medical Publishers (P) Ltd.

Headquarters

Jaypee Brothers Medical Publishers (P) Ltd
4838/24, Ansari Road, Daryaganj
New Delhi 110 002, India
Phone: +91-11-43574357
Fax: +91-11-43574314
E-mail: jaypee@jaypeebrothers.com

Overseas Offices

J.P. Medical Ltd
83, Victoria Street, London
SW1H 0HW (UK)
Phone: +44 20 3170 8910
Fax: +44 (0)20 3008 6180
E-mail: info@jpmedpub.com

Jaypee-Highlights Medical Publishers Inc.
City of Knowledge, Bld. 235, 2nd Floor, Clayton
Panama City, Panama
Phone: +1 507-301-0496
Fax: +1 507-301-0499
E-mail: cservice@jphmedical.com

Jaypee Brothers Medical Publishers (P) Ltd
17/1-B, Babar Road, Block-B, Shaymali
Mohammadpur, Dhaka-1207
Bangladesh
Mobile: +08801912003485
E-mail: jaypeedhaka@gmail.com

Jaypee Brothers Medical Publishers (P) Ltd
Bhotahity, Kathmandu
Nepal
Phone: +977-9741283608
E-mail: kathmandu@jaypeebrothers.com

Website: www.jaypeebrothers.com
Website: www.jaypeedigital.com

© 2018, Jaypee Brothers Medical Publishers

The views and opinions expressed in this book are solely those of the original contributor(s)/author(s) and do not necessarily represent those of editor(s) of the book.

All rights reserved. No part of this publication may be reproduced, stored or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission in writing of the publishers.

All brand names and product names used in this book are trade names, service marks, trademarks or registered trademarks of their respective owners. The publisher is not associated with any product or vendor mentioned in this book.

Medical knowledge and practice change constantly. This book is designed to provide accurate, authoritative information about the subject matter in question. However, readers are advised to check the most current information available on procedures included and check information from the manufacturer of each product to be administered, to verify the recommended dose, formula, method and duration of administration, adverse effects and contraindications. It is the responsibility of the practitioner to take all appropriate safety precautions. Neither the publisher nor the author(s)/editor(s) assume any liability for any injury and/or damage to persons or property arising from or related to use of material in this book.

This book is sold on the understanding that the publisher is not engaged in providing professional medical services. If such advice or services are required, the services of a competent medical professional should be sought.

Every effort has been made where necessary to contact holders of copyright to obtain permission to reproduce copyright material. If any have been inadvertently overlooked, the publisher will be pleased to make the necessary arrangements at the first opportunity. The **CD/DVD-ROM** (if any) provided in the sealed envelope with this book is complimentary and free of cost. **Not meant for sale.**

Inquiries for bulk sales may be solicited at: jaypee@jaypeebrothers.com

Textbook of Emergency and Trauma Care

First Edition: **2018**

ISBN: 978-93-5270-191-9

Printed at

Dedicated to

My parents for providing me best education and values, they always inspire me.

My sisters Arti, Jyoti, and brother Rajendra for endless support and encouragement.

My wife Bhawna and daughter Avighna for unconditional love and affection.

All my friends of "the class 89", who continuously pampered me and supported me, when I need them most.

—Devendra Richhariya

Contributors

Abdul Muniem DM (Neurology)

Consultant
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Adarsh Kumar MBBS MD (Forensic Medicine)

Professor
Forensic Medicine and Toxicology
All India Institute of Medical Sciences
New Delhi, India

Aditi Gupta MBBS MD

Senior Resident
Pediatric Cardiology
Medanta—The Medicity
Gurugram, Haryana, India

Aditya Aggarwal MBBS MS MCh

DNB (Plastic Surgery) MNAMS
Director
Department of Plastic, Aesthetic and
Reconstructive Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Ajeet Singh MD IDCCM EDICC

Senior Resident
Institute of Critical Care
Medanta—The Medicity
Gurugram, Haryana, India

Ali Zamir Khan MS FRCS (CTH) FRCS (Glasg)

Associate Director
Minimally Invasive and
Robotic Thoracic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Amit D Nayar MD DAECPS

Consultant (Critical Care)
Head, Department of Accident and
Emergency Medicine
SL Raheja Hospital
Mumbai, Maharashtra, India

Anand Jaiswal MBBS MD

Director
Respiratory and Sleep Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Anand Yadav MS

Fellow, Minimal Access Surgery (NBE)
Institute of Minimal Access
Metabolic and Bariatric Surgery
Sir Ganga Ram Hospital
New Delhi, India

Anil Bhan MBBS MS MCh

Vice Chairman
Cardiothoracic Surgery
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Anjan Shrestha MBBS MD

Consultant, Hemato-oncology and
Blood and Marrow Transplant
Rajiv Gandhi Cancer Institute and
Research Center
New Delhi, India

Archana Shrivastav MBBS MD

Associate Consultant Critical Care
PD Hinduja National Hospital and
Medical Research Center
Mumbai, Maharashtra, India

Arun Garg MD DM (Neurology)

Director
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Aseem K Tiwari MBBS MD (Pathology)

Associate Director
Transfusion Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Ashish Kumar Prakash MBBS DNB (Resp

Med) DTCO (European Diploma) FCCP (USA)
FAPSR MNCCP
Associate Consultant
Respiratory Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Ashish Nandwani DNB (Nephrology)

Consultant
Department of Nephrology
Medanta—The Medicity
Gurugram, Haryana, India

Ashok Mishra MBBS MD PhD FIAPSM

Professor
Department of Community Medicine
Gajra Raja Medical College
Gwalior, Madhya Pradesh, India

Ashok Kumar Puranik MBBS MS (Gen

Surgery) Fellowship Trauma (Aust)
Trauma Surgeon and Surgical Intervention
All India Institute of Medical Sciences
Jodhpur, Rajasthan, India

Ashok Vaid MD DM

Chairman
Division of Medical
Oncology and Hematology
Medanta Cancer Institute
Medanta—The Medicity
Gurugram, Haryana, India

Atma Ram Bansal MD DM (Neurology)

Neurologist and Epileptologist
Senior Consultant
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Atul Bansal MRCEM FRCEM

Consultant Emergency Department
Frimley Health NHS Trust
Wexham Park Hospital
Slough SL2 4HL UK

Basar Cander MD

Professor
Department of Emergency Medicine
Okmeydani Training and
Research Hospital
Okmeydani, Istanbul, Turkey

Beena Bansal MD (Medicine) DM (Endo)

Associate Director
Endocrinology and Diabetes
Medanta—The Medicity
Gurugram, Haryana, India

Bhanu Prakash Zawar MBBS MD

Associate Consultant
Cardiac Anesthesia
Medanta—The Medicity
Gurugram, Haryana, India

Bhawna Sharma DNB (Respiratory Medicine)

Specialist Critical Care
Artemis Hospital
Gurugram, Haryana, India

Bornali Datta MBBS MD CSST (UK) MRCP

Associate Director
Respiratory Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Brajesh Kumar Mishra MBBS MD (Med)

DNB (Cardio)
Fellowship in Cardiac
Electrophysiology and Intervention
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Chandrashekhar MBBS DA DNB

(Anesthesia) IDCCM
Consultant
Institute of Critical Care
Medanta—The Medicity
Gurugram, Haryana, India

Chitra Mehta DNB (Respiratory Medicine)

FNB (Critical Care Medicine)
Associate Director
Institute of Critical Care
Medanta—The Medicity
Gurugram, Haryana, India

Devendra Richhariya MBBS MD FICM

Senior Consultant
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Devender Sharma MD PGDCR

Fellowship in Pain and
Palliative Medicine
Associate Consultant
Division of Medical
Oncology and Hematology
Medanta Cancer Institute
Medanta—The Medicity
Gurugram, Haryana, India

Dheeraj Kapoor DM (Endocrinology)

Senior Consultant Endocrinology
Artemis Hospitals
Gurugram, Haryana, India

Dhiren Gupta MD

Senior Consultant
Department of Pediatrics
Institute of Child Health
Sir Ganga Ram Hospital
New Delhi, India

Dinesh Arora DCP

Consultant
Transfusion Medicine
Endocrinology and Diabetes
Medanta—The Medicity
Gurugram, Haryana, India

Dinesh Bhurani DM (Clinical Hematology)

FRCPA
Director
Hemato-oncology and BMT
Rajiv Gandhi Cancer Institute and
Research Center
New Delhi, India

Dinesh Chandra MCh

Associate Consultant
Cardiothoracic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Ganesh Jevalikar MD DNB PDCC

Senior Consultant
Pediatric Endocrinologist
Medanta—The Medicity
Gurugram, Haryana, India

HR Tomar DM (Cardiology)

Principal and Consultant
Department of Cardiology
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Hashim Moazzam MBBS

Attending Consultant
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Jamal Yusuf DM (Cardiology)

Professor
Department of Cardiology
Govind Ballabh Pant Institute of
Postgraduate Medical
Education and Research
New Delhi, India

JS Wasir MD (Medicine) DM (Endocrinology)

Consultant, Endocrinology and Diabetes
Medanta—The Medicity
Gurugram, Haryana, India

Jyoti Wadhwa MD DM (Medical Oncology)

Director
Division of Medical Oncology and
Hematology, Medanta Cancer Institute
Medanta—The Medicity
Gurugram, Haryana, India

Kalpesh Sanariya MD (Medicine) DNB
(Trainee)

Senior Resident
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Kartikeya Bhargava MD DNB (Cardiology)

FHRS FCSI
Associate Director—Cardiology (EPS)
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Keerti Khetan MS (Obs and Gyne)

Senior Consultant
Department of Obstetrics and Gynecology
BLK Superspecialty Hospital
New Delhi, India

Khusrav Bajan MD EDIC

Consultant (Critical Care) and
Head
Department of Emergency
PD Hinduja National Hospital and
Medical Research Center
Mumbai, Maharashtra, India

Kishalay Datta MD

Head
Department of Emergency
Max Super Speciality Hospital
New Delhi, India

Kulbir Ahlawat MD

Associate Director
Department of Radiology
Medanta—The Medicity
Gurugram, Haryana, India

Kushagra Mahansaria MD

Senior Resident
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Madhukar Shahi MBBS MD DM (Cardiology)

DNB (Cardiology)
Director, Interventional Cardiology
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Manish Vaish DNB (Neurosurgery)

International Fellow of American
Association of Neurological Surgeons
(IFAAANS)
Associate Director
Department of Neurosurgery
Max Healthcare
New Delhi, India

Manish Bansal MD (Medicine) (AIMS) DNB
(Cardiology) FACC FASE FISCU Fellowship in
Cardiac Imaging (Australia)
Associate Director
Department of Cardiology
Medanta—The Medicity
Gurugram, Haryana, India

Manish Garg MBBS (Dip Anaesthesia)
Senior Anesthetist and Intensivist
North Delhi Nursing Home
New Delhi, India

Manish Jain MBBS MD (Internal Medicine)
DM (Nephrology)
Senior Consultant
Department of Nephrology
Medanta—The Medicity
Gurugram, Haryana, India
Clinical Fellow, UBC, Vancouver, Canada

Mansi Kaushik MBBS PGDCC
Associate Consultant
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Manvendra Singh MCh
Consultant
Cardiac Thoracic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Mayank Jain MBBS MD
Attending Consultant
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Michael J Nolan MSc BSc (HONS) Dip IMC
RCS Ed
Search and Rescue Flight Paramedic
UAE Air Force and
Air Defence/Abu Dhabi Aviation
Abu Dhabi, UAE

Mona Dhingra MBBS MD
Senior Registrar
Endocrinology
Artemis Hospitals
Gurugram, Haryana, India

Mrinal Sircar MBBS DTCD MD DNB EDIC
EDRM
Director and Head
Pulmonology and Critical Care
Fortis Hospital
Noida, Uttar Pradesh, India

M Sai Surendar MD DEM FICM D (DIAB)
Head
Emergency Department
Chennai National Hospital
Chennai, Tamil Nadu, India

MS Kuchay MD (Medicine) DM (Endocrinology)
Associate Consultant
Endocrinology and Diabetes
Medanta—The Medicity
Gurugram, Haryana, India

Mukul Aggarwal MBBS MD
Consultant Hemato-oncology and
Blood and Bone Marrow Transplant
Rajiv Gandhi Cancer Institute and
Research Center
New Delhi, India

Mukund Khetan MS
Consultant
Institute of Minimal Access
Metabolic and Bariatric Surgery
Sir Ganga Ram Hospital
New Delhi, India

Munesh Tomar MD (Pediatrics) FNB
(Ped Cardio)
Associate Director
Pediatric Cardiology and
Congenital Heart Disease
Medanta—The Medicity
Gurugram, Haryana, India

Nagendra Singh Chouhan DM (Cardiology)
Associate Director
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Narendra Agarwal MBBS MD
Consultant Hemato-oncology and
Blood and Bone Marrow Transplant
Rajiv Gandhi Cancer Institute and
Research Center
New Delhi, India

Narendra Nath Jena MBBS MD
Consultant and Head
Emergency Medicine
Meenakshi Mission Hospital
Madurai, Tamil Nadu, India

Naval Mendiratta MD (Fellowship in
Rheumatology)
Associate Consultant
Department of Rheumatology
Medanta—The Medicity
Gurugram, Haryana, India

Neelam Sharma MD DM
Associate Director
Division of Medical Oncology and
Hematology
Medanta Cancer Institute
Medanta—The Medicity
Gurugram, Haryana, India

Neeraj Saraf DNB (Gastroenterology)
Fellowship in Advanced Clinical Hepatology
Director
Gastroenterology and Hepatology
Medanta—The Medicity
Gurugram, Haryana, India

Nishant Arora MD (Anesthesia) FIACIA
Specialist Cardiac Anesthesia
National Heart Center
Royal Hospital
Muscat, Oman

Nitin Sood MD DNB MRCP (UK) MRCPATH
(Pathology) CCT (Hemato-oncology)
Associate Director
Division of Medical Oncology and
Hematology
Medanta Cancer Institute
Medanta—The Medicity
Gurugram, Haryana, India

Omar Ghazanfar MBBS EBEM
Physician Emergency Medicine
Zayed Military Hospital
UAE

P Aggarwal MD Medicine
Fellow, Endocrinology and Diabetes
Medanta—The Medicity
Gurugram, Haryana, India

Pooja Kataria MBBS
Resident
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Poulomi Chatterji MD DNB (Respiratory
Medicine) FISDA NCCP
Associate Consultant
Department of Respiratory Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Prabhat Maheshwari MD (Pediatrics)
Senior Consultant
Artemis Hospital
Gurugram, Haryana, India

Pratibha Dhiman DM (Clinical Hematology)
Consultant
Division of Medical
Oncology and Hematology
Medanta Cancer Institute
Medanta—The Medicity
Gurugram, Haryana, India

Prattay Guhasarkar DM

Fellow of Cardiology
Govind Ballabh Pant Institute of
Postgraduate Medical
Education and Research
New Delhi, India

Praveen Chandra DM (Cardiology)

Chairman
Intervention Cardiology
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Puneet Ahluwalia MCh

Attending Consultant
Urology, Robotics and Kidney Transplant
Medanta—The Medicity
Gurugram, Haryana, India

Rachit Saxena MBBS MS MCh (CTVS)

Consultant
Cardiothoracic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Rahul Mehrotra MBBS MD DNB (Cardiology)

Principal
Consultant and Head
Noninvasive Cardiology
Max Super Speciality Hospital
New Delhi, India

Rahul Rai MD DM

Transplant Hepatology
Medanta Institute of Digestive and
Hepatobiliary Sciences and Medanta
Institute of Liver Transplantation and
Regenerative Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Rajani Yadav MBBS

Consultant Thyrocare Laboratory
Thyrocare Diagnostics
New Delhi, India

Rajeev Goyal MD (Medicine) DM (Neurology)

Fellow in Movement Disorders
Consultant
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Rajesh Chawla MD EDIC

Senior Consultant
Department of Respiratory and
Critical Care
Indraprastha Apollo Hospital
New Delhi, India

Rajesh Puri MBBS MD DNB (Gastro) MNAMS

Director
Gastroenterologist and Hepatologist
Institute of Digestive and
Hepatobiliary Sciences
Medanta—The Medicity
Gurugram, Haryana, India

Rajiva Gupta MD DNB MRCP (UK) FACR (US)

FRCP (Glas) FRCP (Edn)
Director and Head
Rheumatology and Clinical Immunology
Medanta—The Medicity
Gurugram, Haryana, India

Rajiv Yadav MCh

Associate Director
Uro-oncology and Robotic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Rajneesh Kapoor MD DNB (Cardiology)

Senior Director
Interventional Cardiology
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Rakesh Khera MBBS MS (Surgery) MCh

(Urology) DNB (Urology)
Director
Urology, Robotics and Kidney Transplant
Medanta—The Medicity
Gurugram, Haryana, India

Rakesh K Khazanchi MBBS MS MCh

(Plastic Surgery)
Chairman
Department of Plastic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Ramanjit Singh MD

Visiting Consultant
Department of Dermatologist
Medanta—The Medicity
Gurugram, Haryana, India

Ram NG MBBS

Junior Consultant
BGS Global Hospitals
Bengaluru, Karnataka, India

Randhir Sud MD DM (Gastroenterology)

Chairman
Institute of Digestive and
Hepatobiliary Sciences
Medanta—The Medicity
Gurugram, Haryana, India

Rashmi Xavier MD

Associate Consultant
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Ratandeep Bose MBBS MS MCh

(Neurosurgery)
Associate Consultant
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Ravi C Dara MD (Transfusion Medicine)

Attending Consultant
Transfusion Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Ravi R Kasliwal MD DM MNAMS FIMS

Chairman
Clinical and Preventive Cardiology
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Rayaz Ahmed MD

Consultant
Hemato-oncology and
Bone Marrow Transplantation
Rajiv Gandhi Cancer Institute and
Research Center
New Delhi, India

Ritabh Kumar MBBS MS (Ortho)

Senior Consultant Orthopedics
Indian Spinal Injuries Center
New Delhi, India

Rohit Goyal MD

Attending Consultant
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

Roop Sharma MD

Fellow in Pediatric Critical Care
Sir Ganga Ram Hospital
New Delhi, India

Ruchi Kapoor MD

Senior Consultant and
Chief of Lab Medicine
OnQuest Diagnostics
New Delhi, India

Sabhyata Gupta MD (Obs and Gyne)

Director and Head
Division of Gynecology
Gyne-Oncology and Robotic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Safal DM

Assistant Professor
Department of Cardiology
Govind Ballabh Pant Institute of
Postgraduate Medical
Education and Research
New Delhi, India

Saibal Mukhopadhyay DM (Cardiology)

Professor
Department of Cardiology
Govind Ballabh Pant Institute of
Postgraduate Medical
Education and Research
New Delhi, India

**Saleh Fares MD MPH FRCP (EM) FACEP
FAAEM**

Consultant, Emergency Medicine
EMS and Disaster Medicine
Deputy Commander
Zayed Military Hospital
Founder and President
Emirates Society of Emergency Medicine
Abu Dhabi, UAE

Salli Jain MD DNB (Nephrology)

Additional Director
Nephrology and Kidney Transplant
Fortis Hospital
Gurugram, Haryana, India
Clinical Fellowship (Nephro)
Toronto, Canada

Sandeep Jain MS FNB (Trauma Care)

PGDMLS MEM
Senior Consultant and Head
Department of Emergency and Trauma
Max Super Speciality Hospital
New Delhi, India

**Sangeeta Kaushik Sharma MS (Obs and
Gyne) FCGP FIAMS**

Senior Consultant Gynecologist
Director
Sharma Hospital
Bilaspur, Chattisgarh, India

Sanjiv Saigal MD DM MRCP

Director, Transplant Hepatology
Medanta Institute of Digestive and
Hepatobiliary Sciences and Medanta
Institute of Liver Transplantation and
Regenerative Medicine
Medanta—The Medicity
Gurugram, Haryana, India

Saurabh Mehra MBBS MD IDCC FNB FRC

Associate Consultant
Pulmonology and Critical Care
Fortis Hospital
Noida, Uttar Pradesh, India

Shaiwal Khandelwal MS (Surgery) FIAGES

FICS
Consultant
Minimally Invasive and
Robotic and Thoracic Surgery
Medanta—The Medicity
Gurugram, Haryana, India
Fellowship
Seoul National University
Seoul, South Korea

Sharad Manar MD (Physician)

Attending Consultant
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Shashank Chauhan MBBS MEM

(Masters in EM)
Associate Consultant
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Shradha Chaudhari MD (Obs and Gyne)

FCPS FICOG DGO
Consultant
Gyne-oncology and Robotic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Shruti Bajaj MD

Attending Consultant
Department of Rheumatology
Medanta—The Medicity
Gurugram, Haryana, India

Sinoy Jose RN RM

Training Co-ordinator
Medanta—The Medicity
Gurugram, Haryana, India

Sonal Krishan MBBS MD (Radiology) FRCR

MSc (Radiology)
Consultant
Department of Radiology
Medanta—The Medicity
Gurugram, Haryana, India

Sonom Kaushika MBBS MEM

Attending Consultant
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Sucheta Yadav MD DM (Nephrology)

Associate Consultant
Fortis Hospital
Gurugram, Haryana, India

Sudha Kansal MD IDCCM

Senior Consultant
Department of Respiratory and
Critical Care
Indraprastha Apollo Hospital
New Delhi, India

Sudhir BS MBBS (Dip Emergency Medicine)

Attending Consultant
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Sudhir Dubey MCh

Director
Minimally Invasive Neurosurgery
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Sudhir S Pawaiya MBBS Diploma in

Emergency Medicine
Consultant
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Sukhdeep Singh MBBS MS MCh

Consultant
Plastic, Aesthetic and
Reconstructive Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Sunil Dubey MD (Physician) MBA MHA

Head
Air Ambulance Services
Pre-Hospital Care
Department of Emergency and
Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Sunil Kumar Mishra MD DM

Associate Director
Endocrinology and Diabetes
Medanta—The Medicity
Gurugram, Haryana, India

Swarup S Padhi MBBS MD FNB

Senior Resident
Institute of Critical Care
Medanta—The Medicity
Gurugram, Haryana, India

Syed Ahmed Adil MD

Accident and Emergency
Consultant and Deputy Head
Department of Emergency
Dr Mehta's Multispecialty Hospital
Chennai, Tamil Nadu, India

Taif Nabi MD (Physician)
Clinical Associate
Emergency and Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Tamorish Kole MBBS Fellowship in
Emergency Medicine
Chairman
Emergency and Trauma Care
VPS Rockland Hospital
New Delhi, India

Tarannum MD DNB
Senior Resident
Department of Endocrinology
Medanta—The Medicity
Gurugram, Haryana, India

Tariq Ali MBBS MD EDIC
Director
Institute of Critical Care
Medanta—The Medicity
Gurugram, Haryana, India

Tarun S FNB (Critical Care)
Consultant
Department of Respiratory and
Critical Care
Indraprastha Apollo Hospital
New Delhi, India

TS Srinath Kumar MD
Head
Department of Emergency
Narayana Hrudayalaya
Bengaluru, Karnataka, India

Uday Aditya Gupta MBBS DTCD DNB
IDCCM FCCP(USA)
Associate Consultant
Max Super Speciality Hospital
Ghaziabad, Uttar Pradesh, India

Umang B Kothari MBBS MS
Senior Resident
Department of Plastic Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Varun Mittal MBBS MS (Surgery)
MCh (Urology) DNB (Urology)
Consultant
Urology, Robotics and Kidney Transplant
Medanta—The Medicity
Gurugram, Haryana, India

Vikas Mudgal MD (Physician) PGDCC FNIC
Associate Consultant
Department of Cardiology
Medanta—The Medicity
Gurugram, Haryana, India

Vimalendu Brajesh MBBS MS MCh
Consultant
Plastic, Aesthetic and Reconstructive Surgery
Medanta—The Medicity
Gurugram, Haryana, India

Vinayak Agarwal MD DNB (Cardiology)
Associate Director
Noninvasive Cardiology
Medanta—The Medicity
Gurugram, Haryana, India

Vishal Saxena MD DNB (Nephrology)
Senior Consultant
Nephrology and Kidney Transplant
Fortis Hospital
Gurugram, Haryana, India

Vivekanshu Verma MBBS
Diploma in Forensic Medicine and Toxicology
Attending Consultant
Department of Emergency and Trauma Care
Medanta—The Medicity
Gurugram, Haryana, India

Vijay Kumar Chopra MD DM (Cardiology)
Director
Heart Failure Programme
Medanta Heart Institute
Medanta—The Medicity
Gurugram, Haryana, India

VV Pillay MD DCL
Chief
Poison Control Centre and
Clinical Forensic Unit
Professor and Head
Forensic Medicine Toxicology
Amrita Institute of Medical
Sciences and Research
Kochi, Kerala, India

Yatin Mehta MD MNAMS FRCA FAMS
FIACIA FICCM FTEE
Chairman
Medanta Institute of
Critical Care and Anesthesiology
Medanta—The Medicity
Gurugram, Haryana, India

Yeeshu Singh Sudan MD Fellow in
Pediatric Neurology
Associate Consultant
Pediatric Neurologist
Medanta Institute of Neurosciences
Medanta—The Medicity
Gurugram, Haryana, India

Foreword

As I write the foreword for the first edition of his book, I cannot help but reminisce Dr Devendra Richhariya's humble beginnings as a good emergency physician, managing emergencies efficiently, making practical protocols and updated guidelines for doctors and nurses in emergency department and beyond. I have been closely associated with emergency department since my days as a novice surgeon, then as a cardiothoracic surgeon, and now as a Chairman and Managing Director of Medanta—The Medicity.



Injury and illness are universal healthcare problems. All over the world, efforts are being made to curb the preventable diseases, which have devastating consequences for society, economy, and country. There has been gradual recognition worldwide that managing illnesses and injuries as disease processes managed by trained and qualified emergency physicians, and not just a nocturnal activity of young, novice untrained resident doctors in casualty improves outcome. India has been late in recognition of emergency medicine as a specialty, and trauma is becoming subspecialty of surgical sciences. The arrival of *Textbook of Emergency and Trauma Care* developed specifically for India is long overdue.

I have closely observed the struggle and stress of DNB and MD students in emergency, who during their graduation, find it difficult to read and learn from bulky textbooks of foreign authors, unrelated to Indian emergency scenarios, which is very nicely covered in the textbook. It describes the *know-how* of managing emergencies in prescriptive format, to facilitate the primary intention to be a *ready-reckoner*, and to empower the first responder with confidence and clarity. Therapeutic regimen and infusion protocols are deliberately kept simple for realistic application in rustic conditions. It is a multi-authored book, written by the experienced and expert authorities in the field, both at national and international levels. Their vision, thought process and knowledge get reflected in their writings. In addition, each one of them has added a flavor of their individual writing style, so reading through different chapters of the book is an interesting journey. It is a *must-read* textbook for every healthcare provider, making his/her entry in multispecialty hospital, before embarking his clinical activities. It can ease the problems of young ones, and keep the senior doctors abreast with current trends in emergency medical services. However, it is not a book to be read in one sitting. I advise them read slowly, assimilate, reflect, shape their day-to-day clinical practice, and provide feedback to the editor for the next edition. In case anyone wishes to delve deeply into any of the interest area, the list of authentic references provided at the end of each chapter will guide them. Dr Richhariya has used his academic and research experience to edit the detailed views of the authors, and presented a reliable emergency handy guide with a problem-solving approach.

Naresh Trehan

Diplomate
American Board of Cardiothoracic Surgery
Chairman
Medanta Heart Institute
Chairman and Managing Director
Medanta—The Medicity
Gurugram, Haryana, India

Foreword

Emergency medicine is a fast-growing specialty still in its infancy in India. Mushrooming of secondary and tertiary care hospitals in India particularly in the metropolitan cities, exponential increase in the number of highways, and high-end speeding cars with drunken drivers has led to sharp increase in admissions in emergency room (ER) or triage or/casualties of hospitals.

Existence of age-old systems or complete absence of standard operating procedures (SOPs) in these cases leads to confusion, chaos, and delay in life-saving procedures with huge escalation in morbidity, mortality, increased length of stay, cost, and subsequent medicolegal implications.

Poor prehospital transport and interventions lead to loss of precious initial golden hours in trauma, acute stroke, and myocardial infarction with catastrophic results.

Initial prehospital management which may be remote monitoring, thrombolytic or antiarrhythmics, advance cardiac life support (ACLS), and advanced trauma life support (ATLS) can save a lot of lives. India is just catching up with all these with national board starting DNB in Emergency Medicine and Society of Emergency Medicine in India already having Masters in Emergency Medicine (MEM), but these are just drops in ocean for the trained manpower requirement of ER. Also, these structured courses will lead to original Indian data and research done in India, so that clinical pathways for patients in ER can be designed specifically for Indian conditions rather than using extrapolated SOPs from the West.

Early goal-directed therapy for severe sepsis or septic shock was started in a study in ER of Detroit. So, initial ER care can lay the foundation for management strategies in the critical care.

In this context, the *Textbook of Emergency and Trauma Care* is a timely welcome addition to the current literature. It has 100 chapters with a large number of authors covering the whole spectrum of emergency medicine. I congratulate Dr Devendra Richhariya and the team of M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India, for this commendable endeavor. This would be a valuable asset to any library of ER.



Yatin Mehta

MD MNAMS FRCA FAMS FIACIA FICCM FTEE

Chairman

Medanta Institute of Critical Care and Anesthesiology

Medanta—The Medicity

Gurugram, Haryana, India

Foreword

I, first congratulate Dr Devendra Richhariya, for an excellent book on emergency care. This is truly a *Textbook of Emergency and Trauma Care*. In this fast-moving world emergencies arise with alarming frequency—in the home, at the place of work and while travelling the busy highways not to mention natural disasters, calamities and accidents. To add to this burden of emergencies is the ever-increasing number of patients, who suffer from life style disease, and frequent the ERs with chest pain, strokes, uncontrolled hypertension to name a few.



In this background, the book is timely and much needed. With 100 chapters, it is also all encompassing and will be widely read and appreciated. In the plethora of books available in this field, it will stand out purely on the basis of the fact that its strength lies in that the authors are senior, savvy and seasoned professionals, who have spent hours working with their staff in the ER. Many of the authors are personally known to me, and I can say that they have impeccable credentials as authors and teachers. Hence, the strength of the book.

I have known Dr Devendra Richhariya from the past 8 years, and I can say that he is a sincere and dedicated individual, who cares for sick patients and above all as a team player.

Happy Reading!

Ravi R Kasliwal

MD DM MNAMS FIMS

Chairman

Division of Clinical and Preventive Cardiology

Medanta—The Medicity

Gurugram, Haryana, India

Preface

"The life so short, the craft so long to learn"

—Hippocrates

We have a passion for improving patient care. Our journey with *Textbook of Emergency and Trauma Care* began with superb mentors, who instilled in us a drive to become excellent clinicians and educators. We discovered imaging was a powerful tool to take the learner *to-the bedside* and establish permanence, in a fashion unlike any other didactic technique.

Emergency care is defined by time, and the emergency department is the most diverse melting pot of acute conditions in the hospital. Diagnostic accuracy, prognostic prediction, and the treatment pathways rely heavily on typical clues.

We also strongly believe the emergency experience, while sometimes downplayed within the hectic and time-pressured environment of modern medicine, is critical to ideal education.

How do we identify the scope of practice, and knowledge that is today's specialty of emergency medicine? Is it through paper books, blogs, social networking, Google, journals, or clinical practice? While e-information is perfectly suited for multitasking, frequent-attention shifts of the emergency medicine environment may make it unsuitable at times. E-information provides information about snippets of care, but not about the comprehensive knowledge set that is our specialty. The practice of emergency medicine continues to evolve, bringing greater expectations of the physicians, who provide field care in interhospital shifting by ambulance and medical oversight.

There have been many milestones along the road of development of the specialty. The breadth of knowledge and skills required to serve as a competent emergency physician is unique and rapidly expanding. The advent of MD in Emergency Medicine, start of DNB-accreditation of emergency medicine programs, and the continuous broadening of the clinical practice of emergency medicine has made the formal study of the art and practice even more essential than ever before.

Emergency medicine has taken its place in the *House of Medicine*. Now, it is our duty to ensure we show our worth by never-ending commitment to improving patient care across the entire scope of our practice as emergency physicians. Now is the time of our "Renaissance" and it is our most sincere hope that this text serves you well on your journey, wherever the practice of emergency medicine may take you.

The audience for this text is all who provide emergency medical care including clinicians, educators, MD and DNB residents, nurses, prehospital caregivers, and medical students. Many have also found it extremely useful as a review for written pre-graduation examinations containing pictorial questions. Other healthcare workers, such as internists, family physicians, pediatricians, nurse practitioners, and physician assistants, will find this textbook a useful guide in identifying and treating many acute conditions, where clinical clues significantly guide, improve, and expedite diagnosis as well as treatment.

We thank many contributors and readers who have helped make this edition possible. We are especially grateful to three great educators who share our passion: Dr Naresh Trehan, Dr Yatin Mehta, and Dr Ravi R Kasliwal.

Devendra Richhariya
Saleh Fares
Khusrav Bajan
Sudhir S Pawaiya

Acknowledgments

We are grateful to Dr Naresh Trehan, Dr Yatin Mehta, and Dr Ravi R Kasliwal, for showing trust on us and giving us the opportunity to work in the state-of-the-art institution, *Medanta—The Medicity*, Gurugram, Haryana, India, and also for providing the best infrastructure and facilities in emergency department for the patients.

We are thankful to each and every member of the Medanta family.

Especially thankful to Dr Sudhir Singh Pawaiya and Dr Sunil Dubey for giving us encouragement and support over the period of more than a decade and the journey still continues. We would like to acknowledge all our seniors and emergency department colleagues for supporting us during the project.

We would like to sincerely thank all the authors for providing manuscripts in spite of their busy schedules.

Special thanks to publisher Shri Jitendar P Vij (Group Chairman), Mr Ankit Vij (Group President), Ms Chetna Malhotra Vohra (Associate Director-Content Strategy), Ms Heena Gogia (Development Editor), Mr Binay Kumar (Proofreader), Mr Chandra Dutt (Typesetter), Mr Ram Singh Pundhir (Graphic Designer), and all members of M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India, for their invaluable contribution.

Contents

SECTION 1: ESSENTIALS FOR EMERGENCY PHYSICIAN

- 1. Essentials for Good Emergency Physician** **3**
Devendra Richhariya, Vivekanshu Verma
Good Emergency Physician Must Demonstrate 3
- 2. Emergency Design and Staffing** **6**
Saleh Fares, Omar Ghazanfar
 - Emergency Department Design 6 • Emergency Department Function 6
 - General Considerations for Designing an Emergency Department 6 • Patient Flow 7
 - Dedicated Areas within an Emergency Department 7 • New Concepts in Emergency Department Design 7 • Staffing Model 8 • Medical and Practitioner Staffing in Emergency Departments 8 • How to Staff an Emergency Department? 8
- 3. Triageing** **10**
Devendra Richhariya
 - Emergency Department Triageing 10 • Requirements for Triageing 10
 - Triageing Process 11 • Early Warning Score in Triage 12 • Triage in Mass Casualty Incident 13
- 4. Rapid Assessment and Treatment in Emergency** **17**
Devendra Richhariya
 - Benefits of Rapid Assessment 17 • Requirements for Rapid Assessment 17
 - Steps for Rapid Assessment and Treatment 17 • Components of Rapid Assessment and Treatment 18 • Clinical Quality Indicators for Rapid Assessment 19
 - Rapid Assessment, Early Interventions and Improving Outcome in Sepsis, Stroke and Trauma 19
- 5. Point of Care Testing** **22**
Shashank Chauhan, Rajani Yadav
 - Point of Care Testing: Need of the Hour 22 • Challenges in Effective Implementation of Point of Care Testing 24
- 6. Essentials of Medicolegal Case Writing** **25**
Vivekanshu Verma, Devendra Richhariya
 - Medicolegal Classification of Wounds 25 • Preparation of MLC Reports 27
 - Practical Tips for Medicolegal Case Writing 31
- 7. Medicolegal Issues in Emergency** **35**
Adarsh Kumar, Vivekanshu Verma
 - Doctor: Working for the Law or Against the Law? 35 • What is Duty of Care Towards Patient? 37
 - What is Doctrine of *Res IPSA Loquitur*? 37 • Why Medical Services are included Under Consumer Protection Act, 1986? 39 • What Constitutes Medical Negligence? 41

- What does not Constitute Medical Negligence? 41
- Mediclaims and Medicolegal Issues 43
- Medicolegal Tips for Emergency by Dr RK Sharma 44
- Medicolegal Queries Answered by Dr MC Gupta 53

8. Patient Safety and Quality in Emergency Department 72

Devendra Richhariya, Sudhir S Pawaiya

- Triage and Smooth Flow of Emergency Department 72
- Good Quality Trained Emergency Team 72
- Timely Support by Specialties 74
- Important Diagnostics Areas Near Emergency Department 74
- Observation Areas 74
- Medications and Sedation Safety 75

9. Standards of Care during Air Transfer 78

Saleh Fares, Michael J Nolan

- Pathophysiology 79
- Standards of Care 80
- Special Considerations 81
- Recent Advances 82

10. Standards of Care during Road Transfer 83

Sunil Dubey, Sudhir S Pawaiya, Vivekanshu Verma

- Standard ABCDE Approach 83
- What you Need to Know before You Go!! 85
- Factors Associated with Fewer Adverse Events during Ambulance Transfer 85
- Advantages of 'Specialized Teams' for Transportation 85
- Recommendations for the Transfer of Critically Ill Patients 85
- Clinical Handover Process for Ambulance Transfer 85
- National Standard for Ambulances in India 86
- Medicolegal Issues in Ambulance Transfer 86

SECTION 2: RESUSCITATION AND CRITICAL CARE IN EMERGENCY

11. Management of Cardiac Arrest in Adults 91

Uday Aditya Gupta, Sinoy Jose

- Pathophysiology 91
- Chain of Survival 91

12. Airway Management 99

Amit D Nabar

- Applied Anatomy 99
- Causes of Airway Obstruction in Emergency Department 100
- Objective Signs of Airway Obstruction 100
- Clinical Assessment of the Airway 101
- Preparation 101
- Management 102

13. Management of Critically Ill Patient in Emergency 110

Chandrashekhar, Swarup S Padhi, Ajeet Singh, Tariq Ali, Yatin Mehta

- Body Fluid Compartments 110
- Principles of Fluid Therapy in Critically Ill 110
- Vasoactive Agents 113
- Assessment 115

14. Overview of Shock 117

Khusrav Bajaj, Archana Shrivastav

- What is Shock? 117
- Etiopathophysiology of Shock 117
- Clinical Presentation 118
- Management of Shock 118

15. Sepsis and Septic Shock 122

Chandrashekhar, Swarup S Padhi, Ajeet Singh, Tariq Ali, Yatin Mehta

- Clinical Criteria for Sepsis 122
- Tool for Screening Out Sepsis 124
- Management of Septic Shock and Sepsis Protocols 125
- Fluid Therapy of Sepsis: Use of Vasopressors, Inotropes and Corticosteroids 129
- Supportive Therapy 130

16. Noninvasive Ventilation	135
<i>Kishalay Datta</i>	
<ul style="list-style-type: none"> • Noninvasive Positive-Pressure Ventilation 135 • How does NIPPV Work? 136 • What Type of Ventilators can be used for NIPPV? 137 • What Modes of Ventilator can be used for Noninvasive Ventilation? 137 • How to Set the Ventilator for NIPPV? 137 • Selection Criteria for NIPPV 137 • Contraindications for NIPPV 137 • How to Initiate NIPPV in Patients? 137 • Monitoring of Patients on NIPPV 138 • Predictors of Success of NIPPV 138 • Weaning 138 • Complications of NIPPV 138 	
17. Mechanical Ventilation	142
<i>Mrinal Sircar, Saurabh Mehra</i>	
<ul style="list-style-type: none"> • Physiology of Breathing 142 • Mechanical Determinants of Patient-Ventilator Interactions 143 • Indications of Mechanical Ventilation 143 • Types of Mechanical Ventilation 144 • Modes of Ventilation 144 • Initiation of Ventilation 147 • Ventilation in Special Conditions 148 • What to do after Initiating Ventilation? 150 • Transporting Intubated Patients 150 • Complications and Side Effects of Intubation and Ventilation 150 	
18. Use of Blood and Blood Products in Emergency	153
<i>Aseem K Tiwari, Ravi C Dara, Dinesh Arora</i>	
<ul style="list-style-type: none"> • Responsibility of Emergency and Blood Bank Team 153 • Transfusion Approach in Emergency and Massive Transfusion Protocol 154 • Role of Specific Blood Components 155 	
19. Arterial Blood Gas Analysis	158
<i>Sudha Kansal, Rajesh Chawla, Tarun S</i>	
<ul style="list-style-type: none"> • Indications 158 • Absolute Contraindications 158 • Definitions of Acid-base Disorders 158 • Nomenclature 159 • pH and Partial Pressure of Carbon Dioxide Relationship in Respiratory Disorders 159 • Equations for Analysis of Acid-base Disorders—Compensations 159 • Anion Gap Concept 160 • Interpretation of Arterial Blood Gas 160 • Seven Steps of Analysis of Arterial Blood Gas 160 • Strong Ion Difference versus Traditional Approach 162 	
20. Oxygen Therapy	164
<i>Poulomi Chatterji, Bhawna Sharma</i>	
<ul style="list-style-type: none"> • Indications 164 • Types of Hypoxia 164 • Oxygen Devices 164 • Long-term Oxygen Therapy 169 • Hyperbaric Oxygen Therapy 169 • Which Oxygen Delivery System to Use? 169 • Goals of Oxygen Therapy 169 • Monitoring 169 • Oxygen Toxicity 169 	
21. Acute Pain Management in Emergency Department	172
<i>Sonam Kaushika, Devendra Richhariya, Manish Garg</i>	
<ul style="list-style-type: none"> • Pain Categories 172 • Mechanism Involved in Nociceptive Pain 172 • Assessment of Pain in Emergency Department 173 • Indications of Urgent Pain Management in Medical Emergencies 173 • Potential Causes for Pain Control Failure 174 • Treatment of Pain in Emergency Department 174 	

SECTION 3: CARDIAC EMERGENCIES

22. Chest Pain	183
<i>Rohit Goel, Rashmi Xavier, Nagendra Singh Chouhan, Praveen Chandra</i>	
<ul style="list-style-type: none"> • Causes of Chest Pain 183 • Evaluation 185 • Diagnostic Approach 188 • Evaluation of Chest Pain of Cardiac Origin 188 • Evaluation of Chest Pain of Various Causes 188 	

23. Palpitations	193
<i>Shashank Chauhan, Ram NG, HR Tomar</i>	
• Etiology 193 • Differential Diagnosis of Palpitations 193 • Managing Palpitations 194	
• Management Pearls 195	
24. Syncope	196
<i>Brajesh Kumar Mishra</i>	
• Epidemiology 196 • Pathophysiology or Mechanism 196 • Classification 196	
• Management 198 • Investigation 199 • Treatment 201	
• Future Perspective and Advancement 203	
25. Acute Coronary Syndrome: Risk Stratification	205
<i>Mayank Jain, Rajneesh Kapoor</i>	
• Risk Stratification after ST-elevation Myocardial Infarction 205 • Risk Stratification of Unstable Angina and Non-ST-segment Elevation Myocardial Infarction 207	
26. Cardiogenic Shock	216
<i>Devendra Richhariya, Vikas Mudgal, Madhukar Shahi</i>	
• Definition 216 • Etiology 216 • Pathophysiology 217 • Diagnosis 216	
• Management 219 • Intensive Care Unit Support 220 • Special Situation 223	
27. Heart Failure	226
<i>Vijay Kumar Chopra</i>	
• Initial Clinical Assessment 226 • Specific Agents used during Hospitalization 228	
• Escalating Support 230	
28. Bradyarrhythmias	233
<i>Jamal Yusuf, Safal, Saibal Mukhopadhyay</i>	
• Etiology 233 • Symptoms 233 • Classification 233 • Management 236	
29. Tachyarrhythmia	238
<i>Jamal Yusuf, Pratty Guhasarkar, Saibal Mukhopadhyay</i>	
• Electrocardiographic Features 238 • Supraventricular Tachycardias 239	
• Ventricular Tachycardias 240	
30. Temporary Pacing	244
<i>Kartikeya Bhargava</i>	
• Types of Temporary Pacing 244 • Indications of Temporary Pacing 245	
• Temporary Pacing Procedure 245 • Complications of Temporary Pacing 246	
• Post-Procedure Care 247	
31. Hypertensive Emergency	248
<i>Ravi R Kasliwal, Kushagra Mahansaria</i>	
• Classification 248 • Epidemiology 249 • Pathogenesis 249 • Clinical Presentation 249	
• Assessment 249 • Initial Therapeutic Approach 250 • Pharmacological Therapy for Hypertensive Crisis 250	

32. Aortic Dissection	256
<i>Rachit Saxena, Manvendra Singh, Dinesh Chandra, Anil Bhan</i>	
<ul style="list-style-type: none">• Definition 256 • Classification 256 • Pathophysiology 257 • Clinical Implications 257• Clinical Features 258 • Symptoms 259 • Clinical Signs 259 • Investigations 260• Diagnostic Strategy 262 • Aims of Treatment 263 • Exceptions 263• Management of Type A Aortic Dissection 263 • Management of Type B Aortic Dissection 263	
33. Care of Patient on Anticoagulation	266
<i>Vinayak Agarwal, Devendra Richhariya</i>	
<ul style="list-style-type: none">• Types of Anticoagulants 266 • Advantages 266 • Disadvantages 266 • Medicines that Increase the Risk of Bleeding in Patients on Oral Anticoagulants 267 • Heparin and Low Molecular Weight Heparin 267 • Monitoring Anticoagulation Therapy: Target INR 267• Blood Tests used in Emergency Department to Monitor Anticoagulants 267• Management of Over Anticoagulation 267 • Education to Patient about Anticoagulation 267	
34. Cardiac Biomarkers	269
<i>Rahul Mehrotra</i>	
<ul style="list-style-type: none">• The Ideal Cardiac Biomarker 269 • Acute Coronary Syndrome 270 • Deep Vein Thrombosis and Pulmonary Embolism 270 • Cardiac Biomarkers in Heart Failure 271• Multimarker Strategy 271 • Summary and Future Perspective 271	
35. Electrocardiogram Interpretation in Emergency	273
<i>Kartikeya Bhargava</i>	
<ul style="list-style-type: none">• Cardiac Arrhythmias 273 • ST-Segment Deviation 277 • T Wave Changes 278• QRS Morphology, Amplitude and Duration and Axis Patterns 279• Miscellaneous Electrocardiogram Findings in Emergency 280	
36. Role of Echocardiography in Emergency Room	281
<i>Mansi Kaushik, Manish Bansal, Ravi R Kasliwal</i>	
<ul style="list-style-type: none">• Patients Presenting with Acute Chest Pain 281 • Dyspnea/Shortness of Breath 285• Hypotension and Hemodynamic Instability 287 • Echocardiography in Stroke Patients 289• Syncope 290 • Fever of Unknown Origin 291	
37. Coronary Computed Tomography in Emergency	294
<i>Kulbir Ahlawat, Devendra Richhariya</i>	
<ul style="list-style-type: none">• Indications of Coronary Computed Tomography Angiography (CT Angiography of Heart) 294• Contraindications for Coronary CT in the ED 295 • Preparation for Coronary CT 295• Interpretation and Reporting of Coronary CT 296 • Factors Affecting the Quality of Coronary CT Images 297 • Advantages of Coronary CT in Emergency Department 297• "Triple Rule Out" Protocol 297	
38. Precardiac Surgery Evaluation	299
<i>Bhanu Prakash Zavar, Yatin Mehta</i>	
<ul style="list-style-type: none">• Physical Examination 299 • Investigations 300• Risk Assessment and Stratification 300	

39. Postcardiac Surgical Emergencies 301*Nishant Arora, Yatin Mehta*

- Postcardiac Surgical Emergencies 301
- Immediate Postoperative Complications 301
- Early Postoperative Complications 304

SECTION 4: RESPIRATORY EMERGENCIES**40. Hemoptysis 315***Poulomi Chatterji, Bhawna Sharma*

- Massive Hemoptysis 315
- Pulmonary Circulation 316
- Evaluation 316
- Risk Factors 316
- Family History 316
- Physical Examination 316
- Investigations 316
- Initial Resuscitation 317
- Localization of Site 318
- Topical Bronchoscopic Therapy 318
- Medical Treatment 319
- Bronchial Artery Embolization 319
- Surgery 319
- Clinical Pearls 320

41. Acute Respiratory Failure 322*Chitra Mehta, Yatin Mehta*

- Definition 322
- Epidemiology 322
- Classification 322
- Pathophysiology 323
- Clinical Presentation 324
- Diagnostic Approach 324
- Management 325

42. Acute Exacerbation of Asthma and Chronic Obstructive Pulmonary Disease 328*Ashish Kumar Prakash, Bornali Datta, Anand Jaiswal*

- Bronchial Asthma 328
- Chronic Obstructive Pulmonary Disease 328
- Acute Exacerbation of COPD and Acute Asthma in Emergency 329

43. Pneumonia 336*Ashish Kumar Prakash, Bornali Datta, Anand Jaiswal*

- Pneumonia in Emergency 336
- Clinical Evaluation 336
- Diagnostic Approach 337
- Treatment of Pneumonia 337
- Initial Empiric Antimicrobial Therapy for Cap 338

44. Pneumothorax and Insertion of Chest Tube 340*Shaiwal Khandelwal, Ali Zamir Khan*

- Classification and Etiology 340
- Pathophysiology 340
- Clinical Features 340
- Imaging Modalities 341
- Treatment of Pneumothorax 341
- Chest Drain Insertion 342

45. Pulmonary Embolism 345*Saleh Fares, Omar Ghazanfar*

- Pathophysiology of Pulmonary Embolism 345
- Clinical Signs and Symptoms 345
- Scoring Systems for Risk Stratifying Pulmonary Embolisms 347

SECTION 5: NEUROLOGICAL EMERGENCIES**46. Vertigo 353***Kalpesh Sanariya, Abdul Muniem*

- Approach to the Patient with Acute Vertigo 354

47. Acute Headache	360
<i>Devendra Richhariya, Rajeev Goyal</i>	
<ul style="list-style-type: none"> • Objectives for Emergency Physician in Acute Headache Patients 360 • Primary Headache 360 • Secondary Headache 362 • Approach to Acute Headache in Emergency Department 362 • Alarming Signs and Symptoms in Acute Headache 363 • Neuroimaging in Acute Headache 363 • Laboratory Investigations 363 • Disposition 363 	
48. Acute Confusional State	364
<i>Devendra Richhariya, Rajeev Goyal</i>	
<ul style="list-style-type: none"> • Risk Factors for Acute Confusional State/Delirium 364 • Etiology of Acute Confusional State/Delirium 365 • Life-threatening Causes of Acute Confusional State/Delirium 365 • Clinical Presentation of Acute Confusional State/Delirium in Emergency Department 365 • Pathophysiology: Acute Confusional State/Delirium 365 • Differential Diagnosis 365 • Workup for Acute Confusional State/Delirium in Emergency Department 365 • Acute Confusional State/Delirium Assessment Tools 367 • Management of Agitation in Emergency Department 367 • Effects of Acute Confusional State/Delirium 369 	
49. Acute Stroke	370
<i>Arun Garg, Devendra Richhariya</i>	
<ul style="list-style-type: none"> • Risk Factors 370 • Ischemic Stroke 370 • Presentation of Acute Stroke in Emergency Department 371 • Types of Stroke Syndromes and their Symptoms 372 • Approach to Stroke Patient in Emergency Department 372 • Transient Ischemic Attack 374 • Radiological Investigations in Acute Stroke 375 • Treatment of Acute Stroke in Emergency Department 376 • Concept of Thrombolysis 377 • Types of Hemorrhagic Stroke 380 • Cryptogenic Stroke 383 	
50. Status Epilepticus and Refractory Status Epilepticus	386
<i>Atma Ram Bansal, Yeeshu Singh Sudan</i>	
<ul style="list-style-type: none"> • Definition of Status Epilepticus 386 • Diagnosis of Status Epilepticus 386 • Management of Status Epilepticus 387 • How to do Electroencephalogram Monitoring in a Patient with Status Epilepticus? 388 • Reasons for Failure of Treatment in Status Epilepticus 389 • Clinical Tips in Managing Status Epilepticus 389 	

SECTION 6: GASTROINTESTINAL EMERGENCIES

51. Gastrointestinal Bleed in Emergency	393
<i>Neeraj Saraf</i>	
<ul style="list-style-type: none"> • Approach to the Patient 393 • Diagnostic Testing 395 • Upper Gastrointestinal Bleed 395 • Lower Gastrointestinal Bleed 395 	
52. Hepatic Encephalopathy	399
<i>Rahul Rai, Sanjiv Saigal</i>	
<ul style="list-style-type: none"> • Pathophysiology 399 • Clinical Presentation 400 • Diagnosis 400 • Management 401 • Treatment 401 • Intensive Care Management 401 • Management of Precipitating Factors 402 • Reduction of the Nitrogenous Load from the Gut 402 • Modulation of Fecal Flora 402 • Long-term Management of Hepatic Encephalopathy 402 • Liver Transplantation 402 	

53. Acute Pancreatitis	404
<i>Rajesh Puri, Randhir Sud</i>	
• Etiology, Pathophysiology, and Definition 404 • Clinical Presentation 405	
• Risk Factors to Consider 405 • Assessing Severity of Acute Pancreatitis 405	
• Management of Acute Pancreatitis 407	
54. Acute Appendicitis	410
<i>Mukund Khetan, Anand Yadav</i>	
• Anatomy 410 • Etiology and Pathophysiology 411 • Presentation 412	
• Diagnosis 412 • Special Considerations 413 • Differential Diagnosis 414	
• Treatment 415 • Postoperative Care 415 • Special Considerations during Appendectomy 415	
• Recent Advances 416	
55. Perforation Peritonitis	419
<i>Sharad Manar, Hashim Mozzam, Sudhir BS</i>	
• Classifications 419 • Stages of Perforation Peritonitis 419 • Clinical Manifestation of Perforation Peritonitis 420 • Physical Examination 420 • Investigation and Radiological Imaging in Patient with Perforation Peritonitis 420 • Differential Diagnosis 420 • Treatment 420	
56. Intestinal Obstruction	423
<i>Ashok Kumar Puranik, Devendra Richhariya</i>	
• Definition 423 • Classification 423 • Pathophysiology 424 • Investigations 425	
• Treatment of Acute Intestinal Obstruction 427	
SECTION 7: RENAL AND GENITOURINARY EMERGENCIES	
57. Electrolyte Imbalance	431
<i>Vishal Saxena</i>	
• Hyponatremia 431 • Hypernatremia 432 • Hyperkalemia 432 • Hypokalemia 433	
• Hypercalcemia 434 • Hypocalcemia 434 • Hypophosphatemia 438 • Hyperphosphatemia 438	
58. Acute Kidney Injury in Sepsis	441
<i>Manish Jain, Ashish Nandwani</i>	
• Sepsis 441 • Incidence 441 • Risk Factors 441 • Pathophysiology 442	
• Diagnostic Markers 442 • Treatment 442	
59. Emergencies in Renal Failure and Dialysis Patients	445
<i>Sall Jain, Sucheta Yadav</i>	
• No Known Renal Dysfunction in Past 445 • Chronic Kidney Disease/On Hemo/Peritoneal Dialysis 450 • Renal Allograft Recipients 451	
60. Urinary Tract Infections	452
<i>Ashish Nandwani, Manish Jain</i>	
• Incidence and Epidemiology 452 • Classification and Definitions of Urinary Tract Infections 452	
• Pathogenesis 453 • Microbiology 453 • Host Factors Predisposing for Urinary Tract Infection 453	
• Clinical Manifestations of Urinary Tract Infection 453 • Management of Urinary Tract Infections 454	

61. Hematuria	456
<i>Puneet Ahluwalia, Varun Mittal, Rajiv Yadav</i>	
<ul style="list-style-type: none"> • Definition of Hematuria 456 • Confirmation of Hematuria 456 • History and Initial Evaluation 457 • Some Clues 458 • Stepwise Approach for Evaluation 458 • Role of Cystoscopy 459 • Follow-up after Initial Negative Evaluation 459 	
62. Acute Urinary Retention	463
<i>Rakesh Khera, Varun Mittal, Puneet Ahluwalia</i>	
<ul style="list-style-type: none"> • Epidemiology 463 • Etiopathogenesis 463 • Clinical Presentation 466 • Evaluation 466 • Initial Management of Acute Urinary Retention 467 • Label Acute or Acute on Chronic Retention 467 • What to do Next? 467 	
SECTION 8: ENDOCRINAL EMERGENCIES	
63. Hypoglycemia	473
<i>JS Wasir, MS Kuchay, P Aggarwal</i>	
<ul style="list-style-type: none"> • Pathophysiology 473 • Clinical Presentation 475 • Management 475 • Treatment in Emergency Settings 476 • Preventing Future Hypoglycemia 477 	
64. Diabetic Ketoacidosis in Adults	478
<i>Beena Bansal, Tarannum</i>	
<ul style="list-style-type: none"> • Epidemiology 478 • Precipitating Factors 478 • Pathogenesis 479 • Clinical Presentation 479 • Treatment 481 • Complications 482 	
65. Thyroid Emergencies	483
<i>Dheeraj Kapoor, Ruchi Kapoor, Mona Dhingra</i>	
<ul style="list-style-type: none"> • Thyroid Storm 483 • Hypothyroid Coma (Myxedema Coma) 486 • Hashimoto's Encephalopathy 488 	
66. Acute Adrenal Crisis	490
<i>Devendra Richhariya, Sunil Kumar Mishra</i>	
<ul style="list-style-type: none"> • Basic Anatomy and Physiology of Adrenal Gland 490 • Factors Contributing to Shock in Acute Adrenal Crisis 491 • Diagnosis 492 • Treatment 493 • Differential Diagnosis 493 	
SECTION 9: OBSTETRICS AND GYNECOLOGY	
67. Vaginal Bleeding	497
<i>Sabhyata Gupta, Shraddha Chaudhari</i>	
<ul style="list-style-type: none"> • Initial Assessment 497 • Initial Assessment 498 • Blood Investigations 499 • Imaging Studies 499 • Treatment 499 • Therapeutic Measures 500 • Treatment of Bleeding Per Vaginum in Hemodynamically Stable Patients 501 	
68. Ectopic Pregnancy	502
<i>Sabhyata Gupta</i>	
<ul style="list-style-type: none"> • Etiology and Risk Factors 502 • Signs and Symptoms of Ectopic Pregnancy 503 • Differential Diagnosis of Ectopic Pregnancy 503 • Diagnosis of Ectopic Pregnancy 503 	

- Management of Ectopic Pregnancy 503 • Surgical Management for Ectopic Pregnancy 503
- Medical Management for Ectopic Pregnancy 504 • Ovarian Pregnancy 505
- Cervical Pregnancy 506 • Interstitial Pregnancy 506

69. Emergency Delivery 508

Sangeeta Kaushik Sharma, Keerti Khetan

- Prehospital Care 508 • Emergency Department Care 508 • Medicolegal Issues in Emergency Obstetric Care 517

SECTION 10: PEDIATRIC EMERGENCIES

70. Fever in Children 521

Dhiren Gupta, Roop Sharma

- The Age Groups 521 • Presentation 522 • Physical Examination 522 • Management 523
- Treatment of Fever 524

71. Vomiting, Diarrhea and Dehydration in Children 526

Prabhat Maheshwari, Devendra Richhariya

- Common Causes of Vomiting 526 • Diarrhea 526 • Management of Diarrhea and Dehydration 528
- Persistent Diarrhea 529

72. Febrile Seizure and Status Epilepticus in Children 531

Yeeshu Singh Sudan, Devendra Richhariya

- Classification 531 • Febrile Seizure 532 • Status Epilepticus 532
- Localization Features and Common Causes of Seizures 534 • Antiepileptic Drugs 534

73. Central Nervous System Infections in Children 536

Yeeshu Singh Sudan

- Clinical History, Approach, and Initial Management in Emergency 536
- Acute Bacterial Meningitis 536 • Subacute Meningitis 537 • Chronic Meningitis 537
- Adjunctive Corticosteroid Therapy 538 • Repeat Cerebrospinal Fluid Analysis 538
- Differential Diagnosis 540 • Recommended Diagnostic Studies for Viral Meningitis 540
- Recommendations for Initial Empiric Therapy of Meningitis in the Neonate 540

74. Diabetes Management in Children 541

Ganesh Jevalikar

- Diagnosis and Classification 541 • Management of Type 1 Diabetes 542
- Management of Type 2 Diabetes 548

75. Pediatric Cardiac Emergencies: Evaluation and Management 552

Aditi Gupta, Munesh Tomar

- Cardiac Diseases Presenting as Emergency 552 • Neonatal Cardiac Emergencies: an Overview 552
- Pediatric Cardiac Emergencies 557 • Commonly used Drugs in Cardiac Emergencies 562

SECTION 11: DERMATOLOGICAL EMERGENCIES

76. Dermatologic Emergencies 567*Ramanjit Singh, Devendra Richhariya*

- Acute Skin Failure 567
- Stevens-Johnson Syndrome and Toxic Epidermal Necrolysis 568
- Pyoderma Gangrenosum 569
- Staphylococcal Scalded Skin Syndrome 570
- Necrotizing Fasciitis 570
- Urticaria (Hives), Angioedema, and Anaphylaxis 570
- Pemphigus Vulgaris 570
- Vasculitis 571
- Lepra Reaction 571

SECTION 12: RHEUMATOLOGICAL EMERGENCIES

77. Rheumatological Emergencies 575*Shruti Bajad, Naval Mendiratta, Rajiva Gupta*

- Pathogenesis 575
- When to Suspect? 575
- How to Evaluate and Manage? 576
- Treatment Guidelines 577

SECTION 13: HEMATOLOGIC AND ONCOLOGICAL EMERGENCIES

78. Evaluation and Management of Oncological Emergencies 581*Devender Sharma, Pratibha Dhiman, Nintin Sood, Neelam Sharma, Jyoti Wadhwa, Ashok Vaid*

- Superior Vena Cava Syndrome 581
- Spinal Cord Compression 582
- Hyperviscosity Syndrome 583
- Cardiac Tamponade 583
- Malignant Pleural Effusion 584
- Brain Metastasis 584
- Tumor Lysis Syndrome 584
- Hypercalcemia of Malignancy 584
- SIADH 585

79. Care of Patients with Hematological Malignancies and Bone Marrow Transplantation 587*Mukul Aggarwal, Anjan Shrestha, Narendra Agrawal, Rayaz Ahmed, Dinesh Bhurani*

- Neutropenic Care 587
- Tumor Lysis Syndrome and Dyselectrolytemia 588
- Leukostasis 588
- Bleeding (Thrombocytopenic and Coagulopathy) 589
- Cord Compression 590
- Graft Versus Host Disease 590
- Graft Failure and Relapse 590

SECTION 14: TRAUMA

80. Basics of Trauma System 595*Sandeep Jain*

- Definition 595
- System 595
- Mechanism of Injury 596
- Trauma Scoring System 599

81. Code Trauma 601*M Sai Surendar*

- Statistics 601
- What is Golden Hour? 601
- Code Trauma 602
- Advantages of Code Trauma 604
- Goals to Keep in Mind in Code Trauma 604

- 82. Trauma: Initial Assessment and Management** 605
Khusrav Bajan, Archana Shrivastav
• Trauma Mortality: A Trimodal Distribution 605 • Systematic Approach for Management of Trauma Patient 606
- 83. Facial Trauma** 612
Syed Ahmed Adil
• Approach and Management 612 • Investigation 619
- 84. Head Trauma** 622
Devendra Richhariya, Manish Vaish
• Epidemiology 622 • Pathophysiology of Traumatic Brain Injury 622 • Modes of Trauma and Pattern of Brain Injuries 623 • Head Trauma According to Severity 623 • Resuscitation and Management of Head Trauma in Emergency Department 624 • Guidelines for Management of Head Injuries 626
- 85. Spinal Trauma** 629
Sudhir Dubey, Ratandeep Bose, Devendra Richhariya
• Modes of Spinal Injuries 629 • Various Syndromes in Spinal Cord Injury 629
• Types of Fractures 630 • Prehospital Care and Spine Immobilization 632
• Management in Emergency Department 634 • Treatment 635
- 86. Thoracic Trauma** 637
Shaiwal Khandelwal, Ali Zamir Khan
• Chest X-ray 637 • Computerized Tomography Scan 637 • Focused Assessment with Sonography for Trauma 638 • Angiography 638 • Chest Wall Injuries 638
• Lung Injuries 639 • Cardiac Injuries 640 • Esophageal Injuries 641
• Diaphragmatic Injuries 641 • Pneumothorax 642 • Hemothorax 642
• Emergency Department Thoracotomy 643
- 87. Abdominal Trauma** 646
Ashok Kumar Puranik, Devendra Richhariya
• Penetrating Abdominal Trauma 646 • Blunt Abdominal Trauma 648 • Management of Abdominal Trauma 653 • Laparoscopy in Penetrating and Blunt Abdominal Traumas 653
- 88. Extremity Trauma and Management of Fractures in Emergency** 656
Ritabh Kumar
Fracture Care 656
- 89. Emergency Wound Management and Closure** 670
Aditya Aggarwal, Vimalendu Brajesh, Sukhdeep Singh, Umang B Kothari, Rakesh K Khazanchi
• What is a Wound? 670 • Initial Assessment of the Patient 671 • Investigations 672
• Pain Relief 672 • Wound Management Plan 673 • Specific Wound Sites 674
• Bites 681 • Wound Care 684 • Summary Wound Triage 689

- 90. Radiology in Emergency and Trauma** **692**
Sonal Krishan
- Abdominal Emergencies 692 • Ultrasound and Plain Abdominal Radiographs 694
 - Chest and Cardiovascular Emergencies 697 • Neurologic and Spinal Emergencies 698
 - Abnormal Vaginal Bleeding 698 • Multidetector Computed Tomography in a Polytrauma Patient 699
 - Plain Radiography in Common Fractures: Must for Every Trauma Physician 700

- 91. Disaster and Mass Casualty Management in Emergency** **704**
Devendra Richhariya, TS Srinath Kumar, Tamorish Kole
- Definitions 704 • Examples of Disasters 704 • Classification of Disasters 704
 - Terminology Related to Disaster 704 • Factors Contributing to Disaster 705
 - Disaster Management Cycle 706 • Disaster Management 706 • Incident Command System 707
 - Mass Casualty 709 • Emergency Department Preparedness for Chemical and Radiological Disaster 710

SECTION 15: TOXICOLOGY

- 92. Assessment and Management of Poisoning** **717**
VV Pillay
- Diagnostic Considerations 717 • General Management of Poisoning 720 • Stabilization 721
 - Evaluation 727 • Decontamination 734 • Elimination 740 • Alkaline Diuresis 740
 - Extracorporeal Techniques 741 • Antidote Administration 746 • Nursing and Psychiatric Care 748
 - Special Precautions in Poisoned Pregnant Patient 750 • Glasgow Coma Scale 752

- 93. Organophosphate and Carbamate Insecticides Poisoning** **753**
VV Pillay
- Pesticides 753 • Classification 753 • Organophosphorus Insecticide Poisoning 753
 - Carbamates 765

- 94. Aluminum Phosphide Poisoning** **771**
Vivekanshu Verma, Devendra Richhariya
- Peculiar Features 771 • Mechanism 772 • Clinical Features 772 • Diagnosis 772
 - Laboratory Investigations in Aluminum Phosphide Poisoning 774 • Management 774
 - Intra-aortic Balloon Pump in Aluminum Phosphide Poisoning 775

SECTION 16: ENVIRONMENTAL EMERGENCIES

- 95. Management of Animal Bite Cases** **779**
Ashok Mishra
- Current Scenario 779 • Pathophysiology of the Condition 780 • Clinical Presentation 781
 - Rabies in Dogs 783 • Management of a Case of Human Rabies (Hydrophobia) 783
 - Control of Rabies 785

- 96. Snake Bite** **788**
Narendra Nath Jena, Devendra Richhariya
- Facts about Snake Bite 788 • Identification of Venomous and Nonvenomous Snake 788
 - Classification of Venomous Snake 788 • Components of Snake Venom 788

- Clinical Features of Snake Bite 790 • Management of Snake Bite 790 • Specific Treatment 791
- Recent Advances in Snake Bite Management 792

97. Heat Stroke 793

Sharad Manar, Taif Nabi, Pooja Kataria

- Classical Heat Stroke 793 • Exertional Heat Stroke 793 • Risk Factors for Heat Stroke 793
- Pathophysiology 793 • Laboratory Findings 794 • Complications 794 • Treatment 794
- Heat Exhaustion 795 • Prognosis 795 • Prevention 795

98. Drowning 797

Vivekanshu Verma, Atul Bansal, Devendra Richhariya

- Stages in Drowning 798 • Symptoms in Drowning 798 • Complications of Drowning 798
- Management of Drowning 798 • Prevention of Drowning 799

99. Emergency Management of Burns 801

*Aditya Aggarwal, Vimalendu Brajesh, Sukhdeep Singh,
Umang B Kothari, Rakesh K Khazanchi*

- Classification 801 • Assessment and Management 802
- Criteria for Referral to a Specialized Burn Center 809

100. Electrical Injuries 811

Basar Cander

- Pathophysiology of the Condition or Description 811 • Clinical Presentation 812
- Management 813

Index 817

Aortic Dissection

Rachit Saxena, Manvendra Singh, Dinesh Chandra, Anil Bhan

INTRODUCTION

There is no cardiovascular pathology which is more life-threatening than an acute aortic dissection to the extent that the nearest comparison which can be made is only to a volcano waiting to erupt. If untreated it has an extremely high mortality of about 1% per hour during the first 48 hours and hence lies the importance of its early identification and urgent surgical intervention. The aim of this chapter is to describe the entity of aortic dissection and help the emergency physician team to clinically differentiate acute aortic dissection from other sinister causes of chest pain especially acute myocardial infarction (AMI), the management of which is absolutely opposite.

DEFINITION

The wall of the aorta is made up of three layers namely, tunica interna (endothelium), tunica media (smooth muscle cells and connective tissue) and tunica externa (collagen fibers). The three layers together give tremendous tensile strength to the aorta to bear the continuous stress of the cardiac output. Acute aortic dissection is an entity wherein there is a breach in the continuity of the tunica intima thereby resulting in formation of another lumen called the false lumen within the layer of tunica media (Fig. 1). The blood now flows both within the actual lumen of the aorta as well as within the layers of the aortic wall. Therefore, the tensile strength of the disintegrated aortic wall is greatly reduced and there is very high risk of free aortic wall rupture resulting in exsanguinating hemorrhage. This condition differs from aortic aneurysm wherein there is increase in the luminal diameter of the aorta but the structural integrity of the aortic wall is well maintained.

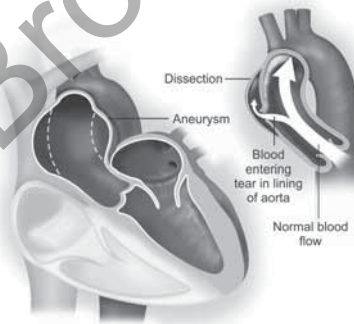


Fig. 1 The first picture shows dilatation of the aorta but with all layers intact whereas the second picture shows an intimal tear leading to formation of a false lumen

CLASSIFICATION

Anatomically, there are two classification systems for aortic dissection (Fig. 2):

1. **DeBakey classification:** It is based upon the location of intimal tear and the extent of dissection.
 - **DeBakey type A:** When the intimal tear is in the ascending aorta but the false lumen extends into the arch and often beyond it.

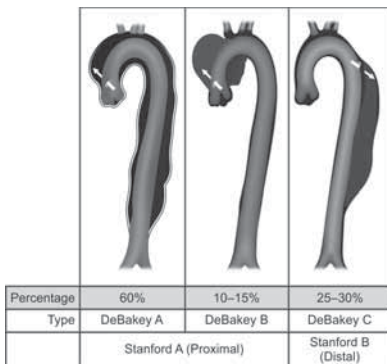


Fig. 2 Classification of aortic dissection (the arrowheads show the proximal intimal tear)

- **DeBakey type B:** When the intimal tear is in the ascending aorta and the false lumen is limited only to the ascending aorta.
 - **DeBakey type C:** When the intimal tear is in the descending thoracic aorta and the false lumen extends distally.
2. **Stanford classification:** It is based solely on the location of intimal tear and is more commonly used as it is more pertinent in planning the management strategy:
- **Stanford type A:** When the intimal tear is located in the ascending aorta or the arch of aorta.
 - **Stanford type B:** When the intimal tear is located in the descending thoracic aorta.

Aortic dissection can also be classified on the basis of duration of symptoms which help to decide the urgency with which intervention should be sought:

- **Acute aortic dissection:** Duration of symptoms less than 2 weeks. It requires urgent intervention.
- **Subacute aortic dissection:** Duration of symptoms from 2–4 weeks.
- **Chronic dissection:** Duration of symptoms more than 4 weeks and intervention can be planned electively.

PATHOPHYSIOLOGY

Aortic dissection can occur in a variety of clinical settings:

- **Connective tissue disorders:** In patients with connective tissue disorders, e.g., Marfan syndrome, Ehlers-Danlos syndrome, the aortic wall has inherent structural weakness

due to pathological arrangement of the smooth muscle cells in the arterial wall. Therefore due to the continuous hemodynamic stress in these patients the aortic wall is predisposed to intimal tear and formation of false lumen within the tunica media of the aortic wall.

- **Bicuspid aortic valve:** Patients with a structural bicuspid aortic valve have inherent pathological distribution of smooth muscle cells in the tunica media. This structural abnormality exists even if the bicuspid aortic valve is functionally normal.
- **Aortic valvular heart disease:** The proximal aorta in patients with aortic valve regurgitation or stenosis is under constant hemodynamic stress and if the valve is unaddressed for a long time the proximal aorta is liable to aneurysmal dilatation which further increases the stress and weakens the aortic wall leading to intimal tear progressing to aortic dissection.
- **Atherosclerotic aneurysm:** This usually occurs in elderly patients with atherosclerotic aortic wall with uncontrolled hypertension which results in a continuous stress to the aortic wall leading to aneurysmal dilatation and ultimately culminating into aortic dissection.
- **Trauma:** Blunt thoracic injury, sudden deceleration injury, and seat belt injury can lead to intimal tears at the aortic isthmus because this is the most fixed part of the aorta. Traumatic dissections are usually associated with chest polytrauma and hemothorax and it is important to differentiate whether the hemothorax is because of chest wall trauma or it is a result of aortic dissection and contained rupture of the aorta.
- **Inflammatory disease of the aorta (aortoarteritis):** Relatively uncommon but aortoarteritis can manifest with aortic dissection.
- **Post-cardiac surgery:** Again an uncommon cause of aortic dissection usually secondary to clamping of the aorta or dissection arising from aortic suture line or aortic cannulation site.

CLINICAL IMPLICATIONS

Aortic Rupture

The tensile strength of the aortic wall is severely compromised and therefore there is very high risk of fatal aortic wall rupture leading to exsanguination hemorrhage either in the pleural cavity or the pericardial cavity. If there is a communication with the tracheobronchial tree as in cases of long standing aortic aneurysm, it can manifest as massive hemoptysis.

Aortic Valve Regurgitation

Proximal extension of the dissection flap into the aortic root leads to loss of suspension of the aortic valve cusps leading acute severe aortic valve regurgitation (**Fig. 3**).

Coronary Insufficiency

Extension of the dissection flap into the coronary ostia more commonly the right coronary ostium can lead to myocardial infarction (Fig. 3). Patient may present with all clinical signs and symptoms of inferior wall myocardial infarction if the blood flow to the right coronary ostium is jeopardized.

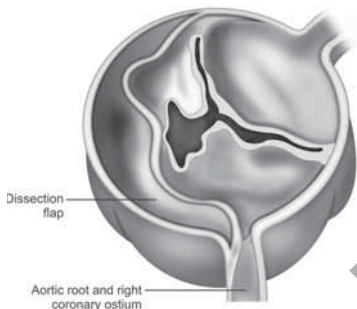


Fig. 3 Extension of dissection flap into the aortic root and the right coronary ostium. The aortic valve cusps have been avulsed from their attachment with the aortic wall thereby leading to severe aortic regurgitation

Cerebral Malperfusion

Dissection flap may compromise the blood flow to any of the carotid arteries and the patient may present with features of complete spectrum of neurological deficit ranging from transient ischemic attack to dense hemiplegia or brain death.

Visceral Malperfusion

The abdominal viscera may have malperfusion leading to mesenteric ischemia which if unattended can lead to massive bowel gangrene.

Limb Ischemia

Limb ischemia compromised flow to any of the limbs can lead to critical limb ischemia progressing to gangrene.

CLINICAL FEATURES

In order to clinically differentiate aortic dissection from other non-aortic pathologies it is important to critically examine patient's habitus, clinical signs, and symptoms.

Patient Profile

- **Connective tissue disorder:** A patient with connective tissue disorder, e. g. Marfan's syndrome, is easily identified by the body habitus and the various skeletal abnormalities (Fig. 4).
- Elderly patient with history of hypertension and dyslipidemia.

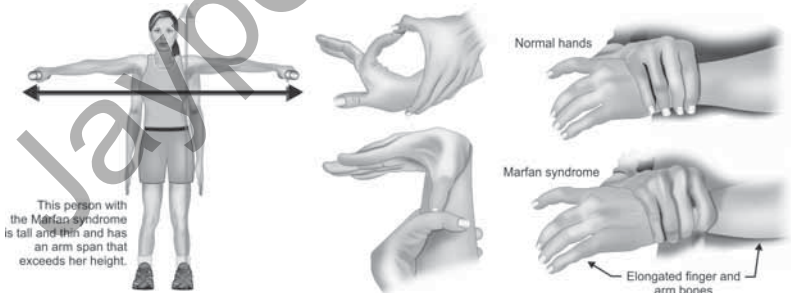


Fig. 4 Marfan's patient is tall and thin and arm span is more than the height. There is extreme laxity in the movement of the thumb and fingers. The fingers are long and the arm circumference is less

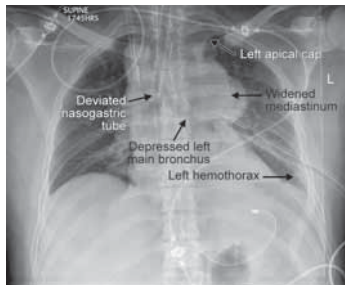


Fig. 5 Chest roentgenogram in a polytrauma patient with left hemothorax (left intercostal tube in situ) with widened mediastinum suggestive of traumatic aortic dissection

- **Polytrauma patient:** In a patient with history sudden deceleration injury with chest roentgenogram suggestive of widened mediastinum should be suspected to have traumatic aortic dissection (**Fig. 5**).

SYMPTOMS

Pain

History of chest pain is the most common symptom. It is of utmost importance for an emergency physician to differentiate it from chest pain resulting from myocardial infarction. Chest pain in acute aortic dissection is usually sudden onset, localized, severe, sharp, tearing with radiation to interscapular area. Patients with acute type B dissection usually complain of a similar type of back pain or flank pain. Whereas a patient of AMI usually has diffuse precordial heaviness as if a huge weight has been placed on his chest with radiation to left arm or ipsilateral jaw. Unlike acute aortic dissection, patients with AMI may give history of previous episodes of precordial discomfort.

Dyspnea

Patients with acute type A dissection can have acute onset dyspnea of varying severity secondary to acute aortic regurgitation, coronary insufficiency or cardiac tamponade. Patients with acute type B dissection can have dyspnea secondary to massive hemothorax due to leak from the dissected aorta.

Neurological Symptoms

Neurological symptoms can be very variable from mild confusion and irritability secondary to cerebral hypo-

perfusion to dense neurological deficits like hemiparesis or hemiplegia or even coma. This type of neurological deficits (hemiplegia) is usually not seen in AMI.

Hypertensive Crisis

It is secondary to renal malperfusion.

Abdominal Pain

Abdominal pain can be secondary to progression of dissection flap in the abdominal aorta or a manifestation of mesenteric ischemia. Patients with mesenteric ischemia are "toxic looking" in hypovolemic shock and have all clinical signs of acute abdomen. The prognosis of mesenteric ischemia is extremely poor.

Acute Limb Ischemia

Many a times limb ischemia is the only clinical manifestation of aortic dissection and is secondary false lumen obstructing the flow of blood into the femoral artery.

Asymptomatic

Although uncommon but sometimes patient might not have any symptom at all and these patients are usually elderly.

CLINICAL SIGNS (TABLE 1)

General Physical Examination

There is a wide range of presentation ranging from an absolutely asymptomatic individual to one who is confused, agitated or with varying degree of mental deficits.

Blood Pressure

Hypertension

Hypertensive response could be a part of preexisting hypertension or sympathetic response to pain or systolic hypertension consequent to severe aortic regurgitation. This can be a feature of AMI as well as acute aortic dissection.

Hypotension

Hypotension again can be a feature of AMI as well as acute aortic dissection. In AMI the cause is myocardial dysfunction whereas in aortic dissection the cause is hemopericardium and cardiac tamponade.

Wide Pulse Pressure

It is due to severe aortic regurgitation and is typical of acute aortic dissection.

Table 1 Clinical differentiation of acute aortic dissection versus acute myocardial infarction

	Aortic dissection	Acute myocardial infarction
History	Connective tissue disorder Marfans syndrome	Angina pectoris
Pain: Character	Sharp, excruciating	Heaviness, crushing
Pain: Localization/radiation	Well localized Typical propagation pattern	Vague chest pain-radiating left upper limb
Examination:		
Blood pressure differential (arms)	Present	Absent
Pulse differentials (limbs, carotids)	Present	Absent
Aortic regurgitation	Wide pulse pressure Murmur	Absent
Pericardial effusion	Muffled heart sounds	Absent
Malperfusion	Pain/paresthesia limbs Pain abdomen	Absent

Pulse Differential

Interarm differential of more than 20 mm Hg is significant and is a characteristic feature of aortic dissection.

Jugular Venous Pressure

Jugular venous pressure (JVP) can be raised in aortic dissection.

Auscultation

Muffled heart sounds is typical of aortic dissection. Cardiac murmur of aortic regurgitation is typical of aortic dissection.

INVESTIGATIONS

The aims of investigating in a suspected aortic dissection patient are:

- Confirm diagnosis
- Ascending aorta involved or not (type A or type B)
- Site of proximal intimal tear
- Extent of dissection
- Diameter of aorta
- Involvement of coronary ostia, arch vessels, and visceral arteries
- Pericardial effusion
- Left ventricular function
- Valve function (especially aortic valve regurgitation).

Chest Roentgenogram

A routine chest X-ray posteroanterior view has a low sensitivity (67%) and specificity to show any abnormal

finding. In about 12–20% cases the chest X-ray may be absolute normal. Findings suggestive of aortic dissection are:

- **Mediastinal widening:** In aortic dissection due to the presence of false lumen the combined aortic diameter is increased which manifests as widened mediastinum on chest roentgenogram (**Fig. 6**).
- **Calcium sign:** In the elderly many a times the aortic intima has calcific deposits which are seen at the outer margin of the aorta on chest roentgenogram. In presence of aortic dissection this calcific intima gets deviated medially due to propagation of the false lumen (**Fig. 7**).
- Tracheal deviation.
- Pleural effusion.

Electrocardiogram

In a patient with severe chest pain but a normal electrocardiogram (ECG), always keep a possibility of aortic dissection in mind. About 1–2% patients with acute aortic dissection can actually have ST elevation myocardial infarction due to the involvement of coronary artery [right coronary artery (RCA) > left coronary artery (LCA)]. If thrombolytic therapy is mistakenly administered to these patients there is a risk of 70% mortality.

Transthoracic Echocardiography

A transthoracic echocardiography (TTE) can provide us the following details:

- Presence of dissection flap
- Site of entry point
- Aortic arch vessel occlusion
- Dilatation of aorta

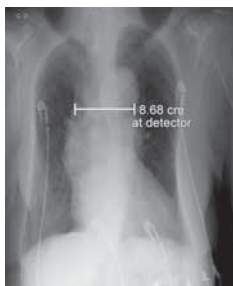


Fig. 6 Mediastinal widening

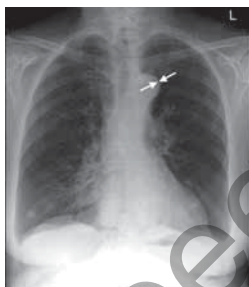


Fig. 7 The intimal calcification gets displaced medially (arrows)

- Aortic valve regurgitation, other valve status
- Pleural or pericardial effusion.

Disadvantages of TTE

- Low sensitivity and specificity (59% and 83%).
- Difficulty due to technical problems, narrow intercostal spaces, obesity and emphysematous chest.

Transesophageal Echocardiography

Transesophageal echocardiography (TEE) can be performed rapidly and is relatively noninvasive and can provide better details as compared to TTE (Figs 8 and 9).

- Pericardial effusion
- Pericardial tamponade

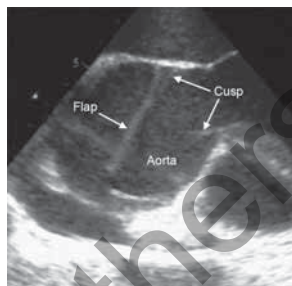


Fig. 8 Transesophageal echocardiographic image showing presence of an intimal flap in the ascending aorta

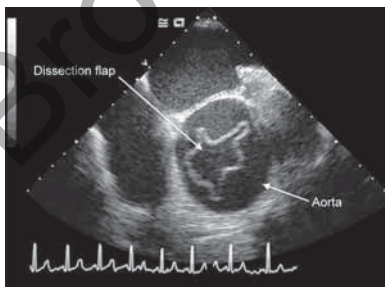


Fig. 9 Transesophageal echocardiographic image showing a circumferential intimal flap in the ascending aorta diagnostic of aortic dissection

- Aortic regurgitation or other valve status.
- Involvement of proximal coronary artery
- Left ventricular (LV) function/RWMA (regional wall motion abnormalities).

Computed Tomography

Contrast enhanced tomography is perhaps the most relevant investigation modality to fulfill most of the aims of investigation mentioned above except that it fails to provide a functional assessment of the heart and valves. It is rapid, minimally invasive and less operator-dependent. 3D reconstruction can visualize entire course of dissection. It can identify entry point, dissection membrane, true and the false lumen, extent of dissection, arch involvement and perfusion of major aortic branches (Figs 10 to 12). It delineates the

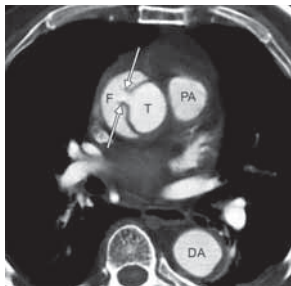


Fig. 10 Computed tomography angiographic cross-section showing aortic dissection. The arrowheads show the proximal intimal tear which is the entry point for dissection. The intima has separated from the aortic wall leading to a false lumen (F) and a true lumen (T)
Abbreviations: PA, pulmonary artery; DA, descending thoracic aorta.

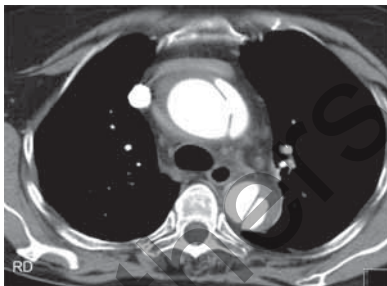


Fig. 12 Computed tomography angiographic cross-section showing dissection flap in both the ascending as well as the descending thoracic aorta with proximal intimal tear in the ascending aorta



Fig. 11 Computed tomography angiographic cross-section at T4 level showing dissection flap in the arch of aorta

coronary artery anatomy. Its sensitivity is around 82–100% and specificity around 90–100%. The disadvantages are:

- Dissection obscured by complete thrombosis of false lumen
- May not identify proximal intimal tear
- Aortic regurgitation
- Use of contrast
- Movement of patient creates inferior quality of the scan.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) has some advantages over other imaging modalities like:

- Localize proximal intimal tear, extent of dissection
- Identifies arch vessels involvement

- Severity of aortic regurgitation or flow patterns in true lumen and false lumen
 - Can evaluate LV functions
 - No contrast material or no radiation hazard
 - Sensitivity and specificity in the range of 95–100%.
- But the major draw back of an MRI is the time it takes to acquire the images which is a major concern when the patient is sick and needs immediate surgical intervention. MRI can be considered to be a better imaging modality for follow-up of these patients (**Fig. 13**).

Aortography

This is of historical interest and the findings suggestive of dissection are (**Fig. 14**):

- Double lumen or intimal flap
- Compressed true aortic lumen
- Aortic regurgitation
- Occlusion of branch vessels.

Disadvantages

- Invasive procedure
- Harmful effect of contrast material
- Iatrogenic propagation of dissection.

DIAGNOSTIC STRATEGY (FLOW CHART 1)

Diagnostic strategy includes:

- High index of suspicion
- Suspect aortic dissection if:
 - Young patient with connective tissue disorder (Marfan's syndrome)
 - Old patient less than 60 years with history of hypertension

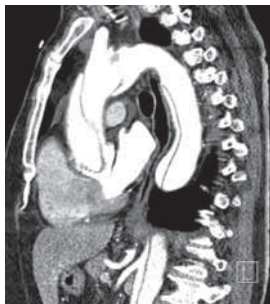


Fig. 13 Magnetic resonance imaging sagittal section showing dissection flap extending from the root of aorta across the arch of aorta and extending into the descending thoracic aorta

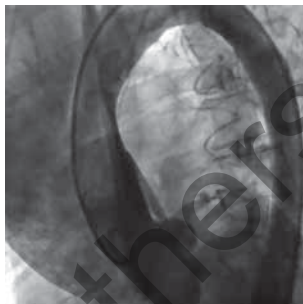
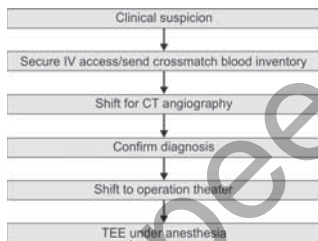


Fig. 14 Aortography showing a large (poorly opacified) false lumen and a much smaller (densely opacified) true lumen

Flow chart 1 Management of type A dissection



Abbreviations: CT, computed tomography;
TEE, transesophageal echocardiography

- Unexplained syncope
- *Pain*: Severe, excruciating, well localized pain with history of typical radiation pattern
- Unexplained stroke
- Acute congestive heart failure
- Pulse differential
- Evidence of malperfusion—lower limb ischemia:
 - Mesenteric ischemia
 - Renal ischemia.

AIMS OF TREATMENT

- Prevent death
- Prevent irreversible end-organ damage

- Surgical repair of ascending aorta precedes percutaneous or vascular surgical interventions addressing peripheral vascular complications.

EXCEPTIONS

- Irreversible stroke
- Advanced debilitating systemic illness
- More than 80 years with multiple major complications
- New onset hemiplegia—not an absolute contraindication
- Paraplegia—chances of spinal cord deficit improvement are low.

MANAGEMENT OF TYPE A AORTIC DISSECTION

Acute type A aortic dissection is always to be managed surgically. The procedure involves replacement of the entire dissected ascending aorta and at least the undersurface of the aortic arch. The aortic valve has to be replaced simultaneously if it is morphologically diseased but if the aortic valve per se is normal it can be repaired.

MANAGEMENT OF TYPE B AORTIC DISSECTION

The optimal treatment strategy for type B dissection is still debated. Medical treatment prevents death in majority of cases and the operative mortality of type B dissection is high. The long-term outcome of surgically and medically managed patients is similar. Hence, a “complication specific” approach for type B dissection is preferred.

The medical management is called as the anti-impulse therapy which was proposed by Wheat and associates in 1965.

It is based on the observation that factors responsible for progression of aortic dissection are change in pressure over time (dP/dT). Neither high blood pressure nor high blood flow alone governs the rate of progression. The backbone of the anti-impulse therapy is a combination of vasodilator therapy along with the sympathetic control by β -blockade.

- **Target:** Mean arterial pressure = 60–75 mm Hg
 - Systolic pressure = 100–110 mm Hg
 - Heart rate = 60–80 bpm
- **Eliminate pain:** Morphine
- **Beta blockade:**
 - *Esmolol:* 500 μ g/kg IV bolus; 50 μ g/kg/min infusion (max 200 μ g/kg/min)
 - *Propranolol:* 1 mg every 5 minutes to achieve target heart rate (HR) (max 10 mg)
- **Sodium nitroprusside (SNP):** 20 μ g/min (max 800 μ g/min)
- **Refractory hypertension:** Angiotensin-converting enzyme inhibitor (ACEI)—enalapril.

Indication for intervention in type B aortic dissection:

- Persistent pain
- Refractory arterial hypertension
- Progression or expansion of dissection
- Aortic rupture or impending rupture
- Impaired distal organ perfusion
- Sizable localized false aneurysm
- Young with connective tissue disorder—Marfan syndrome without complications.

Surgical Management of Type B Aortic Dissection

Surgical intervention for type B aortic dissection includes replacement of the entire descending thoracic aorta along with the diseased segment of the abdominal aorta with reimplantation of the mesenteric vessels.

CONCLUSION

Diagnosing the aortic dissection in emergency department is a challenge. Chest pain and associated clinical features and investigation do not always diagnose this condition. Understanding the potential risk factors of aortic dissection, typical and atypical presentation, high index of suspicion, advanced imaging technique reliably includes or excludes the condition. After diagnosing the condition, the management of pain, heart rate and blood pressure and hemodynamic stability is important.

BIBLIOGRAPHY

1. Ando M, Okita Y, Tagusari O, et al. A surgically treated case of Takayasu's arteritis complicated by aortic dissections localized in the ascending and abdominal aorta. *J Vasc Surg.* 2000;31:1042-5.
2. Ankel F. Aortic dissection. In: Marx JA, Hockberger RS, Walls RM, et al, editors. *Rosen's emergency medicine: concepts and*

clinical practice. 7th edition. Philadelphia: Mosby Elsevier Publishing; 2010. p. 1088-92. Chapter 83.

3. Babatasi G, Masetti M, Bhojroo S, et al. Pregnancy with aortic dissection in Ehler-Danlos syndrome. Staged replacement of the total aorta (10-year follow up). *Eur J Cardiothorac Surg.* 1997;12:671-4.
4. Beach C, Manthey D. Painless acute aortic dissection presenting as left lower extremity numbness. *Am J Emerg Med.* 1998;16:49-51.
5. Bushnell J, Brown J. Clinical assessment for acute thoracic aortic dissection. *Ann Emerg Med.* 2005;46:90-2.
6. Chen K, Varon J, Wenker OC, et al. Acute thoracic aortic dissection: the basics. *J Emerg Med.* 1997;15:859-67.
7. Chew HC, Lim SH. Aortic dissection presenting with atrial fibrillation. *Am J Emerg Med.* 2006;24:379-80.
8. Choi JB, Yang HW, Oh SK, et al. Rupture of ascending aorta secondary to tuberculous aortitis. *Ann Thorac Surg.* 2003;75:1965-7.
9. Daily PO, Trueblood HW, Stinson EB, et al. Management of acute aortic dissections. *Ann Thorac Surg.* 1970;10(3):237-47.
10. DeBakey ME, McCollum CH, Crawford ES, et al. Dissection and dissecting aneurysms of the aorta: 20-year follow-up of 527 patients treated surgically. *Surgery.* 1982;92:1118.
11. Demiroyuran NS, Karcioğlu O, Topacoglu H, et al. Painless aortic dissection with bilateral carotid involvement presenting with vertigo as the chief complaint. *Emerg Med J.* 2006;23:e15.
12. Den Uil GA, Caliskan K, Bekkers JA. Intractable supra-ventricular tachycardia as a first presentation of thoracic aortic dissection: case report. *Int J Cardiol.* 2010;144:e5-7.
13. Fisher A, Holroyd BR. Cocaine-associated dissection of the thoracic aorta. *J Emerg Med.* 1992;10:723-7.
14. Gallagher EJ. Clinical utility of likelihood ratios. *Ann Emerg Med.* 1998;31:391-7.
15. Greenwood WR, Robinson MD. Painless dissection of the thoracic aorta. *Am J Emerg Med.* 1986;4:330-3.
16. Halfner JW, Parrish SE, Hubler JR, et al. Risk factor documentation for life-threatening disease in the US emergency department patients [abstract 209]. *Ann Emerg Med.* 2006;48:S65.
17. Hagan PG, Neinaber CA, Isselbacher EM, et al. The International Registry of Acute Aortic Dissection (IRAD)—new insights into an old disease. *JAMA.* 2000;283:897-903.
18. Hiratazka LF, Bakris GL, Beckman JA, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM guidelines for the diagnosis and management of patients with thoracic aortic disease. *Circulation.* 2010;121:e266-369.
19. Hsu YC, Lin CC. Paraparesis as the major initial presentation of aortic dissection: report of four cases. *Acta Neurol Taiwan.* 2004;13:192-7.
20. Huang SM, Du F, Wang CY, et al. Aortic dissection presenting as isolated lower extremity pain in a young man. *Am J Emerg Med.* 2010;28:1061.e1-3.
21. Joo JB, Cummings AJ. Acute thoracoabdominal aortic dissection presenting as painless, transient paralysis of the lower extremities: a case report. *J Emerg Med.* 2000;19:333-7.
22. Karascostas D, Anthomelides G, Ioannides P, et al. Acute paraplegia in painless aortic dissection. Rich imaging with poor outcomes. *Spinal Cord.* 2010;48:87-9.
23. Kim TE, Smith DD. Thoracic aortic dissection in an 18-year-old woman with no risk factors. *J Emerg Med.* 2010;38:e14-44.

24. Kimura N, Yamaguchi A, Noguchi K, et al. Type B aortic dissection associated with *Salmonella* infection. *Gen Thorac Cardiovasc Surg.* 2007;55:212-6.
25. Klompas M. Does this patient have an acute thoracic aortic dissection? *JAMA.* 2002;287:2262-72.
26. Knaut AL, Cleveland JC. Aortic emergencies. *Emerg Med Clin North Am.* 2003;21:817-45.
27. Lakhi NA, Jones J. Takayasu's arteritis in pregnancy complicated by peripartum aortic dissection. *Arch Gynecol Obstet.* 2010;282:103-6.
28. Larson EW, Edwards WD. Risk factors for aortic dissection: a necropsy study of 161 patients. *Am J Cardiol.* 1984;53:849-55.
29. Lee CC, Chang WT, Fang CC, et al. Sudden death caused by dissecting thoracic aortic aneurysm in a patient with autosomal dominant polycystic kidney disease. *Resuscitation.* 2004;63:93-6.
30. Liu JF, Ge QM, Chen M, et al. Painless type B aortic dissection presenting as acute congestive heart failure. *Am J Emerg Med.* 2010;28:646.e5-7.
31. Liu WP, Ng KC. Acute thoracic aortic dissection presenting as sore throat: report of a case. *Yale J Biol Med.* 2004;77:53-8.
32. Madu EC, Shala B, Baugh D. Crack-cocaine-associated aortic dissection in early pregnancy—a case report. *Angiology.* 1999;50:163-8.
33. McDermott JC, Schuster MR, Crummy AB, et al. Crack and aortic dissection. *Wis Med J.* 1993;92:453-5.
34. Meron G, Kurkciyan I, Sterz F, et al. Non-traumatic aortic dissection or rupture as a cause of cardiac arrest: presentation and outcome. *Resuscitation.* 2004;60:143-50.
35. Nadour W, Goldwasser B, Beiderman RW, et al. Silent aortic dissection presenting as transient locked-in syndrome. *Tex Heart Inst J.* 2008;35:359-61.
36. Palmiere C, Burkhardt S, Staub C, et al. Thoracic aortic dissection associated with cocaine abuse. *Forensic Sci Int.* 2004;141:137-42.
37. Perron AD, Gibbs M. Thoracic aortic dissection secondary to crack cocaine ingestion. *Am J Emerg Med.* 1997;15:507-9.
38. Ragucci MV, Thistle HG. Weight lifting and type II aortic dissection. A case report. *J Sports Med Phys Fitness.* 2004;44:424-7.
39. Risk identification for all physicians – thoracic aortic dissections: “tearing” apart the data. *CPMA bulletin R10812E* 2008. Available at: https://www.cmpa-acpm.ca/cmpapd04/docs/resource_files/risk_id/2008/com_r10812-e.cfm. Accessed October 8, 2008.
40. Rogers RL, McCormack R. Aortic disasters. *Emerg Med Clin North Am.* 2004;22:887-908.
41. Schorr JS, Horowitz MD, Livingstone AS. Recreational weight lifting and aortic dissection: case report. *J Vasc Surg.* 1993;17:774-6.
42. Shihata M, Preforius V, MacArthur R. Repair of an acute type A aortic dissection combined with an emergency cesarean section in a pregnant woman. *Interact Cardiovasc Thorac Surg.* 2008;7:938-40.
43. Stout CL, Scott EC, Stokes GK, et al. Successful repair of a ruptured Stanford type B aortic dissection during pregnancy. *J Vasc Surg.* 2010;51:990-2.
44. Sung PS, Fang CW, Chen CH. Acute aortic dissection mimicking basilar artery occlusion in a patient presenting with sudden coma. *J Clin Neurosci.* 2010;17:952-3.
45. Suzuki T, Mehta RH, Ince H, et al. Clinical profiles and outcomes of acute type B aortic dissection in the current era: lessons from the International Registry of Acute Aortic Dissection (IRAD). *Circulation* 2003;108(Suppl 1):11312-7.
46. Thoracic aortic dissection: Medicolegal difficulties. *CPMA Bulletin JS0768-E* 2008. Available at: https://www.cmpa-acpm.ca/cmpapd04/docs/resource_files/infosheets/2007/com_is0768-e.cfm. Accessed March 11, 2011.
47. Von Koloditsch Y, Schwartz AG, Nienaber CA. Clinical prediction of acute aortic dissection. *Arch Intern Med.* 2000;160:2977-82.
48. Vuckovic SA. An unusual presentation of ascending aortic arch dissection. *J Emerg Med.* 2000;19:149-52. *Acute Aortic Dissection* 325
49. Woo K, Schneider JI. High-risk chief complaints I: chest pain – the big three. *Emerg Med Clin North Am.* 2009;27:685-712.
50. Young J, Herd AM. Painless acute aortic dissection and rupture presenting as syncope. *J Emerg Med.* 2002;22:171-4.