

Contents

Foreword
Contributors
Preface

vii
ix
xiii

SECTION 1: Principles in Paediatric Anaesthesia

1. History of Paediatric Anaesthesiology	3	
<i>Namita Padvi, Varsha Gupta, Mahesh Baldwa</i>		
History of paediatric anaesthesiology in India		
Period before 2005		
Period after 2005		
History of paediatric anaesthesiology in Asia		
Primitive period of paediatric anaesthesia across the world		
Phase I: Progress of paediatric anaesthesia up to 1940		
Phase II: Emergence of Paediatric anaesthesia (1940–1960)		
Phase III: Era of nonflammable anaesthetics (1960–1980)		
Phase IV: Progress and Sophistication (1980 to present)		
New developments in anaesthesia		
2. Anatomical Considerations in Paediatric Anaesthesia	17	
<i>Amit Padvi, Namita Padvi, Bhvya Baldwa</i>		
Upper airway		
Lower airway		
3. Essentials of Cardiovascular System in Infants and Children	23	
<i>Chinmayi S Patkar, Namita Padvi</i>		
Foetal circulation and changes		
Abnormalities of transition from foetal to neonatal circulation		
Structural and functional development		
Autonomic regulation of cardiac function		
Preoperative assessment of cardiovascular system		
Effects of anaesthetic agents on cardiovascular system		
4. Essentials of Respiratory System in Infants and Children	34	
<i>Vaishali P Chaskar, Jalpa Arvind Kate</i>		
Development of lungs		
Control of breathing		
Mechanics of breathing		
		Lung volume
		Gas diffusion in neonates, infant and child
		Pulmonary surfactant
		Ciliary activity
		Oxygen transport
5. Essentials of Central Nervous System, in Infants and Children	44	
<i>Shrikanta P Oak, Anjana S Wajekar</i>		
Neural development		
Development of blood–brain barrier		
Central nervous system physiology		
Development of CSF circulation and volume		
Development of spinal cord		
Impact of maternal anaesthesia on foetal neurodevelopment		
Anaesthetic neurotoxicity		
6. Essentials of Liver Functions, Kidney Functions and GI and Endocrine System	53	
<i>Ashish Mali</i>		
Development of kidney and renal maturation of physiology		
Development of the liver and relevant metabolism		
Structural and functional development of the intestine		
Intestinal Malrotation and midgut volvulus		
Development of endocrine system congenital diseases		
Congenital malformations		
7. Essentials of Fluids, Electrolytes and Nutrition in Infants and Children	76	
<i>Mahesh Baldwa, Varsha Gupta, Sushila Baldwa</i>		
Normal physiology and anatomy of the body fluids		
Principles in the regulation of fluids and electrolytes		
Renal functions in children		
Fluid and electrolyte homeostatic mechanisms		
Acid–base balance		

Intraoperative fluid administration
Monitoring for ongoing fluid losses and excess
Diabetic ketoacidosis and hyperglycaemic hyperosmolar non-ketotic coma
Total parenteral nutrition
Refeeding syndrome
Elements and minerals

8. Thermoregulation in Neonates

93

Rachana Chhabaria

Physiology of thermal regulation
Thermal input and central regulation
Temperature monitoring
Heat loss mechanisms
Measures to prevent heat loss
Non-shivering thermogenesis
Shivering thermogenesis
Anaesthesia and hypothermia

9. Essentials of Haematology

106

Anjana Sahu

Physiology and metabolism of erythrocyte
Haemoglobin and oxyhaemoglobin dissociation curve
Haemolytic anaemia
Disorder of erythrocyte membrane protein, enzymes and haemoglobin
Anaesthesia consideration in thalassemia
Anaesthesia consideration in sickle cell anaemia
Coagulation system
Anaesthesia consideration in haemophilia
Disorder of platelets

10. Essentials of Pharmacology in Infants and Children

129

Sushama Raghunath Tandale

Pharmacokinetics, half-life ($t_{1/2}$), clearance, absorption, distribution, metabolism, intravenous anaesthetic agents, propofol, thiopental, ketamine
Inhalational anaesthetic agents, nitrous oxide, sevoflurane, isoflurane, desflurane, halothane
Neuromuscular blockers, suxamethonium, non-depolarizers, aminosteroid compounds, benzylisoquinolinium compounds
Opioids, morphine sulphate, diamorphine, codeine phosphate, fentanyl citrate, remifentanyl
Non-steroidal anti-inflammatory drugs (NSAIDs), diclofenac sodium, ibuprofen, paracetamol
Local anaesthetics
Fluid and colloid administration during perioperative period and during resuscitation

11. CPR in Paediatrics

141

Minal Harde, Rakesh Bhadade

Causes of paediatric Cardiopulmonary Arrests
Guidelines in paediatric cardiopulmonary resuscitation (CPCR)
Recent guidelines in neonatal resuscitation
Paediatric basic life support
Paediatric advanced life support
Peripheral and central vascular, intraosseous, intratracheal access
Electrical interventions in arrest and pharmacology of resuscitation
Iatrogenic complications of CPR
Post resuscitation care

SECTION 2: Scientific Basis for Practice of Paediatric Anaesthesia

12. Preoperative Evaluation, Preparation and Psychological Aspects of Paediatric Anaesthesia

163

Neerja Bhardwaj

Preoperative evaluation
Preoperative investigations
Fasting guidelines
Psychological effects of hospitalization and surgery
Psychological preparation programs
Pharmacological premedication

13. Post-anaesthesia Care Unit Management

171

Archana C Prabhu, Pallavi L Butiyani

Identification and treatment of emergence delirium in postoperative period
Airway management and postoperative respiratory complications in PACU

Intravenous fluid therapy in postoperative period
Acute pain management approach in PACU
Thermoregulation and management of malignant hyperthermia
Malignant hyperthermia
Seizures in PACU
PONV postoperative period

14. Equipment

179

RD Patel, Amit Padvi, Namrata Padvi

Paediatric face masks
Oropharyngeal airways
Nasopharyngeal airways
Laryngeal mask airway, design, size
Laryngoscopes, design, size with curved blades and straight blades
Fibreoptic scopes and rigid bronchoscope

Endotracheal tubes, uncuffed ETT and cuffed ETT in different sizes
 Other varieties of paediatric endotracheal tubes, RAE preformed tubes, reinforced tubes, microcuff tubes
 Common paediatric breathing systems
 Circle system
 Self-inflating resuscitation bag

15. Blood Transfusion and Strategies for Blood Conservation in Infants and Children 193

Shruti Kamdi, Prashant Kamdi

Transfusion guidelines with lower perioperative haemoglobin
 Aiming for reduced blood loss
 Proactive hypotension with purpose
 Autologous blood transfusion
 Haemoglobin-based oxygen carriers, perfluorochemical solutions
 Blood component therapy, platelets, white cells and plasma, etc.

16. Acute and Chronic Pain Management in Infants and Children 201

Dinesh Kumar Sahu, Anjana Sahu

Acute postoperative pain management, NSAIDs, local anaesthesia, continuous intravenous opioids, epidural analgesia

Chronic postoperative pain management headache, chronic abdominal pain, myofascial pain/fibromyalgia, complex regional pain syndrome, sickle cell anaemia, cancer

17. Regional Blocks in Paediatrics 212

Pradnya Sawant

Anatomical and physiological differences
 Central neuraxial blockade, spinal anaesthesia, caudal anaesthesia, epidural anaesthesia
 Peripheral nerve blocks, upper extremity nerve blocks, lower extremity nerve blocks, ilioinguinal, iliohypogastric nerve block, penile nerve block, blocks of the face and scalp
 Regional anaesthesia safety measures

18. Ultrasound in Paediatric Anaesthesia 220

Rakesh Garg, Naveen Yadav

Introduction to machine
 Sonoanatomy and scanning
 Ergonomics
 Ultrasound guided peripheral nerve blocks, upper extremity nerve blocks, lower extremity nerve blocks, ilioinguinal/iliohypogastric nerve block
 Ultrasound guided central neuraxial blockade, caudal anaesthesia, epidural anaesthesia

SECTION 3: Anaesthesia for Special Surgical Procedure

19. Anaesthesia for Foetal Intervention and Surgery 235

Swati R Daftary, Rajen Y Daftary

Foetal access for surgery
 Maternal, placental and foetal physiology
 Foetal response to anaesthesia, foetal monitoring, Physiologic and pharmacologic consequences of Pregnancy
 Physiologic changes of pregnancy
 Tocolysis and tocolytic agents
 Open foetal surgery, mid-gestation hysterotomy, ex-utero intrapartum therapy (EXIT), foetal endoscopic surgery, foetal image guided surgery

20. Premature Infants and Micropremies 244

Vidhya N Deshmukh

General considerations
 Problems associated with premature infants
 Anatomical and physiology considerations in premature infants
 Guidelines for admission and discharge of premature infants
 Expremature infants or micropremies
 Necrotizing enterocolitis
 Retinopathy of prematurity

21. Anaesthesia for the Full-term Neonate 267

Ekta Rai

General considerations during anaesthesia for the full-term neonate
 Diaphragmatic hernia
 Oesophageal atresia and tracheoesophageal fistula
 Gastroschisis
 Omphalocele

22. Anaesthesia for Paediatric Cardiovascular Surgery 282

Prasanna Salvi

General consideration
 Classification of congenital heart defects
 Anaesthesia considerations during paediatric cardiovascular surgery
 Cardiopulmonary bypass
 Deep hypothermic circulatory arrest
 Minimally invasive cardiac surgeries
 Fast tracking in paediatric cardiac surgery
 Anaesthesia for closed heart procedures like patent ductus arteriosus, blalock-taussig shunt, bidirectional Glenn shunt, pulmonary artery (Pa) banding

Anaesthesia for open heart procedures like atrial septal defect, ventricular septal defect, tetralogy of Fallots, total anomalous pulmonary venous connection, transposition of great arteries, congenitally corrected transposition of great arteries and tricuspid atresia

23. Anaesthesia for Paediatric Interventional Cardiology 316

Manish Kela

General considerations
Device closure of ASD, VSD, PDA

24. Anaesthesia for Children with Congenital Heart Disease Undergoing Non-cardiac Surgery 328

Raveendra US

General considerations
Embryology and pathophysiology of CHD
Associated problems like arrhythmia, hypoxia and cyanosis, pulmonary artery hypertension, shunting, ventricular dysfunction, ventricular outflow obstruction myocardial ischaemia, congestive cardiac failure, end organ pathology and extracardiac anomalies
Anaesthesia considerations preanaesthetic assessment, investigations, risk stratification
Severe PHT left ventricular outflow obstruction
Single ventricle physiology dilated cardiomyopathy
Management of "Tet spells"
Procedural sedation in children with CHD
Specific defects like aortic stenosis (AS), atrial septal defect, coarctation of aorta, transposition of great arteries, single ventricle physiology (including HLHS), tetralogy of Fallots and ventricular septal defect

25. Paediatric Neuroanaesthesia 347

Anita Shetty, Ruchi Jain, Jimmy John

General considerations
Pre-operative evaluation and anaesthesia management
Monitoring and positioning
Venous air embolism
Specific procedures in neurosurgery like meningocoele or meningomyelocoele, craniosynostosis, brain tumours, hydrocephalus, traumatic brain injury, vascular anomalies and moya moyo disease

26. Paediatric Thoracic Anaesthesia 359

Sandeep Sahu, Hemlata, Indu Lata

General anaesthetic considerations
Ventilation and perfusion during thoracic surgery
Physiology of lateral decubitus position and single lung ventilation
Techniques of single lung ventilation in Infants and children: Single-lumen ETT, balloon-tipped bronchial blockers, Fogarty embolectomy catheter, armdt bronchial blocker, double-lumen tubes and univent tubes

Strategies for avoiding and treating hypoxemia during single lung ventilation

Monitoring and Pain management

Thoracoscopic surgeries, lung cyst excision, lobectomy and pneumonectomy

27. Anaesthesia for General Abdominal and Urosurgical Procedures 373

Rakesh Garg, Uma Hariharan

General considerations
Abdominal emergencies
Abdominal endoscopic and laparoscopic surgeries
Anaesthesia for paediatric liver transplantation
Anaesthesia for common surgical problems: Herniotomy, orchidopexy, appendicectomy, Hirschsprung disease, cholecystectomy, pyloromyotomy
Anaesthesia for surgery on abdominal solid organs: Biliary atresia-kasai procedure, hepatic resection, splenectomy
Congenital anomalies, Wilms' tumour and other abdominal tumours
Anaesthesia for paediatric renal transplantation
Anaesthesia for robotic surgeries in paediatric patients

28. Anaesthesia for Plastic and Reconstructive Surgery 386

Vibhavari Naik

General consideration
Cleft palate, lip and reconstruction
Syndactyly
Craniofacial surgery
Post burns reconstruction
Temporomandibular joint ankylosis

29. Anaesthesia for Paediatric Orthopaedic and Spine Surgery 399

Amit Padvi, Deepa Kane, SK Srivastva

General considerations in paediatric orthopaedic surgery
Congenital malformations: Amniotic band constriction (ABS), congenital talipes equinovarus and developmental dysplasia of the hip: Open reduction of dislocated hip, femoral osteotomy and pelvic osteotomy
Anaesthesia for scoliosis surgery
Anaesthesia for fractures in children
Fat embolism syndrome (FES)

30. Anaesthesia for Paediatric Ear, Nose and Throat Surgery 408

Nirav Kotak

General anaesthetic considerations
Anaesthesia for adenotonsillectomy, bleeding tonsil
Special considerations in obstructive sleep apnoea
Anaesthesia for ear surgery like mastoidectomy, tympanoplasty, myringotomy and grommet insertion, myringoplasty

Anaesthesia for cochlear implant surgery
Ludwig's angina, oesophagoscopy and bronchoscopy
Microlaryngeal surgery

31. Anaesthesia for Paediatric Ophthalmic Surgery 420

Namita Padvi, Amit Padvi, Nitin Padvi

General consideration and associated syndromes, oculocardiac reflex
Cataract
Squint
Blockage of punctum of nasolacrimal duct
Retinopathy of prematurity
Enucleation
Glaucoma
Vitreotomy

32. Anaesthesia for Paediatric Dentistry 429

Indrani Hemantkumar Chincoli

History
Perception of pain in children and surgical factors
Local anaesthesia, maxillary anaesthesia, complications of local anaesthesia
Conscious sedation, deep or procedural sedation and current sedation guidelines
Dental chair anaesthesia and complications like hypoxaemia, arrhythmias, subcutaneous emphysema, dislocation of temporo-mandibular joint, operating room pollution and hyperthermia

33. Paediatric Burn Injury 440

Rochana G Bakhshi

Epidemiology
Initial management of paediatric burn injury
Fluid calculation in paediatric burns
Pathophysiology of burns in children: Airway problems, scalds and inhalation injury
Chronic airway problems
Carbon monoxide poisoning
Pain management

34. Perioperative Management of Paediatric Trauma Patient 450

Sandeep Sahu, Prem Raj Singh, Indu Lata

Resuscitation of paediatric trauma
Organization of a trauma system
Rehabilitation
Damage control resuscitation (DCR)
Special trauma situations

35. Anaesthesia for Procedures Outside the Operating Theatre 460

Sona Dave

General consideration
Anaesthesia for MRI
Gastrointestinal endoscopies in paediatric patients
Interventional radiological procedures in paediatric patients
PET scan in paediatric patients
External beam radiation therapy (XRT)
Bone marrow aspiration and lumbar puncture

36. Office-based Paediatric Anaesthesia 472

Anita Malik, Namisha Malik

Guidelines for office-based anaesthesia
Preoperative fasting guidelines
Equipment and monitoring
Emergence agitation
Postoperative pain
Discharge criteria
Common procedures performed in office-based setup
Core principles for office-based surgery

37. Paediatric Intensive Care 481

Preetha Joshi, Vinay Joshi

Transportation and receiving
Emergence agitation and delirium
Vascular access and PICU procedures
Monitoring in the PICU
Fluid and electrolytes
Mechanical ventilation
Postoperative nausea and vomiting
Cardiac intensive care
Respiratory failure
Neurointensive care
Liver failure
Renal failure
Nutrition
Transfusion practices in the paediatric intensive care unit
GI prophylaxis
Preventive practices and infection control

38. Anaesthesia for the Patient with a Genetic Syndrome 497

Gayathri Bhat, Tushar Patel

General consideration and approach
Down syndrome (DS)
CHARGE syndrome
Cri du chat syndrome
Hurler's syndrome
Treacher Collins syndrome (TCS)
Pierre Robin syndrome
Goldenhar syndrome

Velocardiofacial syndrome
Epidermolysis bullosa
Williams syndrome
Wilson's disease (WD)
Noonan syndrome
Arthrogryposis multiplex congenital (AMC)
Marfan syndrome
Klippel-Feil syndrome

39. Hospital Acquired Infection in Operating Theatre 516

Roopali Telang, Rahul Bhamkar

General considerations
Surgical site infections
Preventive strategies for surgical site infections
Prevention of infections in healthcare workers

SECTION 4: Special Considerations: Complications of Anaesthesia, Medicolegal, Ethical Aspects of Paediatric Anaesthesia

40. Clinical Complications in Paediatric Anaesthesia 527

Pradnya Bhalerao

Introduction
Respiratory events like laryngospasm, laryngeal oedema or postextubation croup bronchospasm, respiratory depression and hypoxaemia
Cardiovascular events like arrhythmias
Postoperative nausea and vomiting (PONV)
Thermoregulatory and metabolic events
Hypoglycaemia
Other complications like emergence delirium and anaphylaxis

41. Evidence Based Paediatric Anaesthesia Guidelines for Practice and Psychology, Anxiety and Preoperative Preparation 536

Jayashree Sood, Deepanjali Pant, Archana Koul

Evidence based medicine (EBM)
Clinical guidelines
Purpose of guidelines
Guideline development process
Grading of evidence
Limitations of guidelines
Evidence based paediatric anaesthesia guidelines for practice
Interpreting guidelines recommendations
Prerequisites for safe paediatric anaesthesia practice
Evidence based guideline for cuffed/non-cuffed ETT
Recent equipment developments in paediatric anaesthesia
Evidence based practice to reduce the risk of medication errors
Evidence based guidelines to make paediatric anaesthesia safe
Guidelines for placement of central venous catheter
Evidence based practice in postoperative and procedural pain management
Guidelines for use of IV cannulae
Guidelines for the management of postoperative nausea and vomiting

Psychology, anxiety, and preoperative preparation
Parental presence during induction of anaesthesia (PPIA)

42. Medicolegal and Ethical Aspects of Paediatric Anaesthesia 546

Mahesh Baldwa, Sushila Baldwa, Varsha Gupta

Ethical aspects
Medical negligence and malpractice
Doctor-patient relationship
Medicolegal aspects of consent and risk explanation

43. Medicolegal Aspects of Record Keeping and Operation Table Death during Anaesthesia 552

Mahesh Baldwa, Sushila Baldwa, Varsha Gupta

Medical record keeping
Sudden operation table death during anaesthesia covering resorting to violence, extortion, defamation by patient party
Medicolegal aspects of difficult situations, declaration of death and communication with patient party
Medicolegal aspects of vicarious liability
Medicolegal aspects of euthanasia, DNR, vegetative life and active and passive withdrawal of life support systems
Medicolegal aspects of blood transfusion
Medicolegal aspects of operating theatre mishaps not causing death
Medicolegal aspects of medical indemnity

44. Infection Control in Operating Room and Safe Practice of Anaesthesia and Quality Management 557

Harshwardhan A Tikle

Infection control policy
Current recommendations for operating room infection control
Cleaning and sterilization of anaesthesia equipment
Properties of an ideal disinfectant
Factors affecting the efficacy of disinfection and sterilization
The concept of team work
Communication with patients and relatives