Algorithms *in* PEDIATRICS

Editors
Anand S Vasudev • Nitin K Shah

Foreword
Pramod Jog

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Editors

Anand S Vasudev DNB D Ped DCP MNAMS MICP (USA) FIAP FIMSA
Senior Consultant, Pediatric Nephrologist
Indraprastha Apollo and Max Hospital
New Delhi, India

Nitin K Shah MD DCH DNB
Professor and Consultant Pediatrician
PD Hinduja National Hospital and
Medical Research Centre
Honorary Hematoncologist
BJ Wadia Hospital for Children
Lions Hospital
Mumbai, Maharashtra, India

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Pramod Jog

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Jaypee Brothers Medical Publishers (P) Ltd

Headquarters

Jaypee Brothers Medical Publishers (P) Ltd
4838/24, Ansari Road, Daryaganj
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Fax: +91-11-43574314
Email: jaypee@jaypeebrothers.com

Overseas Offices

J.P. Medical Ltd
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Phone: +44 20 3170 8910
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Jaypee-Highlights Medical Publishers Inc
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Panama City, Panama
Phone: +1 507-301-0496
Fax: +1 507-301-0499
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Jaypee Brothers Medical Publishers (P) Ltd
17/1-B Babar Road, Block-B, Shaymali
Mohammadpur, Dhaka-1207
Bangladesh
Mobile: +08801912003485
Email: jaypeedhaka@gmail.com

Jaypee Brothers Medical Publishers (P) Ltd
Bhotahity, Kathmandu, Nepal
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Contributors

EDITORS

Anand S Vasudev DNB D Ped DCP MNAMS MICP (USA) FIAP FIMSA
Senior Consultant, Pediatric Nephrologist
Indraprastha Apollo and Max Hospital
New Delhi, India

Nitin K Shah MD DCH DNB
Professor and Consultant Pediatrician
PD Hinduja National Hospital and Medical Research Centre
Honorary Hematoncologist
BJ Wadia Hospital for Children
Lions Hospital
Mumbai, Maharashtra, India

SECTION EDITORS

Piyali Bhattacharya DCH MD FCCM PGDMLS
Specialist
Sanjay Gandhi Post Graduate Institute of Medical Sciences
Lucknow, Uttar Pradesh, India

Amar J Chitkara MD DNB
Head
Department of Pediatrics
Max Superspeciality Hospital
New Delhi, India

Rajesh R Chokhani MD DCH FRCPCH
Consultant
Mumbai, Maharashtra, India

Jaydeep Choudhury DNB MNAMS
Associate Professor
Department of Pediatrics
Institute of Child Health
Kolkata, West Bengal, India

Neelu A Desai MD DNB
Consultant
Department of Pediatric Neurology
PD Hinduja National Hospital and Medical Research Centre
Mumbai, Maharashtra, India

Pankaj V Deshpande MRCP MD DCH FCPS
Consultant
Department of Nephrology
PD Hinduja National Hospital and Medical Research Centre
Mumbai, Maharashtra, India

Anaita Udwadia Hegde MD MRCPCH
Consultant
Department of Pediatric Neurology
Jaslok Hospital and Research Center
Breach Candy Hospital Trust
Bai Jerbai Wadia Hospital for Children
Mumbai, Maharashtra, India

Vaman V Khadilkar MD DNB MRCP DCH
Pediatric Endocrinologist
Jehangir Hospital
Pune, Maharashtra, India
Bombay Hospital
Mumbai, Maharashtra, India

Praveen Khilnani MD FICCM FSICCM FAAP FCCM
Director
Pediatric Critical Care Services and Fellowship Program
BLK Superspeciality Hospital
New Delhi, India
PICU Mediclinic City Hospital
Dubai, UAE

Vikas Kohli MD FAAP FACC
Fetal, Neonatal, Pediatric Cardiologist
Director
Delhi Child Heart Center
New Delhi, India

Anurag Krishna MCh FAMS
Director
Department of Pediatrics and Pediatric Surgery
Max Institute of Pediatrics,
Max Healthcare
New Delhi, India

Shyam Kukreja
Head
Department of Pediatrics
Max Superspeciality Hospital
New Delhi, India

Anjali Kulkarni MD FRCPCH
Head
Department of Pediatrics and Neonatology
Sir HN Reliance Foundation Hospital
Mumbai, Maharashtra, India

Ashish Mehta MD DCH
Consultant and Director
Arpan Newborn Care Centre Pvt Ltd
Ahmedabad, Gujarat, India

Rujuta Mehta MS DNB
Consultant
Balabhai Nanavati Hospital
Jaslok Hospital and Research Centre
Shushrusha Hospital
Head
Department of Pediatric Orthopedics
Bai Jerbai Wadia Hospital for Children
Mumbai, Maharashtra, India

Vibhu Mendiratta MD
Consultant and Professor
Department of Dermatology and STD
Lady Hardinge Medical College and
Associated Hospitals
New Delhi, India

Taral V Nagda MS DNB DOrth
Consultant
Department of Pediatric Orthopedics
PD Hinduja National Hospital and
Medical Research Centre, Saifee
Hospital, Jupiter Hospital
Mumbai, Maharashtra, India

MKC Nair
Professor and Vice Chancellor
Kerala University of Health Sciences and
Founder Director
Child Development Centre
Thrissur, Kerala, India

Priyankar Pal MD
Associate Professor and Head
Department of Pediatrics
Institute of Child Health
Kolkata, West Bengal, India

Usha Pratap MD MRCP
Senior Consultant
Department of Pediatric Cardiology
Deenanath Mangeshkar Hospital
Pune, Maharashtra, India

Girish Raheja MS
Senior Consultant and Academic
Coordinator
Indraprastha Apollo Hospital
New Delhi, India

ATK Rau MD DHA
Professor and Incharge
Department of Pediatrics
MS Ramaiah Medical College
Bangalore, Karnataka, India

GR Sethi MD
Formerly Head
Department of Pediatrics
Maulana Azad Medical College
New Delhi, India

Rasik S Shah MCh
Section Incharge
Department of Pediatric Surgery
PD Hinduja National Hospital and
Medical Research Centre
Mumbai, Maharashtra, India

Anand K Shandilya MD DCH FRCPCH
Consultant
Department of Pediatrics
Dr Anand's Hospital For Children
Mumbai, Maharashtra, India

Anupam Sibal MD FIMSA FIAP FRCP FRCP
Senior Consultant
Department of Pediatric
Gastroenterology and Hepatology
Indraprastha Apollo Hospitals
New Delhi, India

Varinder Singh MD FRCPCH
Director Professor
Department of Pediatrics
Lady Hardinge Medical College and
Kalawati Saran Children's Hospital
New Delhi, India

Tanu Singhal MD MSc
Consultant, Department of Pediatrics
Kokilaben Dhirubhai Ambani Hospital
Mumbai, Maharashtra, India

Soonu Udani MD
Pediatric Intensivist
Section Head Pediatrics
PD Hinduja National Hospital and
Medical Research Centre
Mumbai, Maharashtra, India

Vrajesh Udani MD
Consultant
Department of Pediatric Neurology
PD Hinduja National Hospital and
Medical Research Centre
Mumbai, Maharashtra, India

Shashi Vashisht MS
Professor and Head
Department of Ophthalmology
Dr Ram Manohar Lohia Hospital
New Delhi, India

Anju Virmani MD DNB
Senior Consultant, Apollo, Max,
Pentamed and Sundar Lal Jain Hospital
New Delhi, India

Surender K Yachha MD DM
Professor and Head
Department of Pediatric Gastroenterology
Sanjay Gandhi Postgraduate Institute of
Medical Sciences
Lucknow, Uttar Pradesh, India

CONTRIBUTING AUTHORS

Kochurani Abraham DCH
Senior Registrar
Department of Pediatrics
Jehangir Hospital
Pune, Maharashtra, India

Mohan K Abraham MS MCh
Professor and Head
Department of Pediatric Surgery
Amrita Institute of Medical Sciences
Kochi, Kerala, India

Bharat Agarwal MD DCh
Head
Department of Hemato-Oncology
BJ Wadia Children Hospital
Mumbai, Maharashtra, India

Gautam S Agarwal MCh
Principal Consultant
Department of Pediatric Surgeon
Max Super Speciality Hospital
New Delhi, India

Manjari Agarwal MD
Attending Consultant
Department of Pediatric Rheumatology
Institute of Child Health
Sir Ganga Ram Hospital
New Delhi, India

Mridul Agarwal MD FNB
Consultant
Department of Pediatric Cardiac Sciences, Sir Ganga Ram Hospital
New Delhi, India

Mandar Agashe MS
Consultant, Centre for Pediatric Orthopedic Care, Dr Agashe's Hospital
Mumbai, Maharashtra, India

Anju Aggarwal MD FIAP
Associate Professor
Department of Pediatrics
University College of Medical Sciences and Guru Tegh Bahadur Hospital
New Delhi, India

Neeraj Aggarwal MD FNH
Consultant, Department of Pediatric Cardiac Sciences, Sir Ganga Ram Hospital
New Delhi, India

Satish K Aggarwal MS MCh
Senior Consultant
Department of Pediatric Surgery
Sir Ganga Ram Hospital
New Delhi, India

Atul Ahuja MS
Senior Consultant
Department of ENT and Head and Neck Surgery
Indraprastha Apollo Hospital
New Delhi, India

Ira E Almeida DCH MD DNB PG-DAP
Senior Pediatrician
Department of Pediatrics
Hospicio Hospital
Margao, Goa, India

Parmanand GK Andankar DCH DNB
Pediatric Intensivist
Wadia Children Hospital
Consultant Pediatric and Neonatal Intensivist
Jupiter and Bethany Hospital
Thane, Maharashtra, India

Alaric J Aroojis MS DNB FCPS
Consultant
Department of Pediatric Orthopedics
Kokilaben Dhirubhai Ambani Hospital and Bai Jerbai Wadia Hospital for Children
Mumbai, Maharashtra, India

Priyanka Arora MS
Assistant Professor
Department of Ophthalmology
Dayanand Medical College and Hospital
Ludhiana, Punjab, India

Shreedhara Avabratha K MD DNB
Professor
Department of Pediatrics
Father Muller Medical College
Mangalore, Karnataka, India

Sanjay M Bafna MD
Senior Consultant and Head
Department of Pediatrics
Jehangir Hospital
Pune, Maharashtra, India

Vibha S Bafna MD DCH
Senior Consultant
Department of Pediatrics
Jehangir Hospital
Pune, Maharashtra, India

Arvind S Bais MS FIMSA
Senior Consultant
Department of ENT
Indian Spinal Injury Hospital
New Delhi, India

Naveen Bajaj DM MD
Consultant, Department of Neonatology
Deep Hospital
Ludhiana, Punjab, India

Anurag Bajpai MD FRACP
Consultant, Department of Pediatric and Adolescent Endocrinology
Regency Hospital Limited
Kanpur, Uttar Pradesh, India

Minu Bajpai MS MCh PhD FRCS
Professor
Department of Pediatric Surgery
All India Institute of Medical Sciences
New Delhi, India

Chandra S Bal
Professor
Department of Nuclear Medicine
All India Institute of Medical Sciences
New Delhi, India

Padma Balaji MD
Junior Consultant
Kanchi Kamakoti Childs Trust and Childs Trust Medical Foundation
Chennai, Tamil Nadu, India

Suma Balan MD MRCP CH CCST
Consultant
Department of Pediatrics
Amrita Institute of Medical Sciences
Kochi, Kerala, India

Indira Banerjee MD DNB MRCPCH
Trainee, Department of Pediatric Cardiology, Rabindranath Tagore International Institute of Cardiac Sciences
Kolkata, West Bengal, India

Sushmita Banerjee DCH MSc MRCPI FRCPCH
Consultant
Department of Pediatric Nephrology
Calcutta Medical Research Institute
Kolkata, West Bengal, India

Rahul P Bhamkar DNB DCH MNAMS
Associate Consultant
Department of Pediatrics
Sir HN Reliance Foundation Hospital
Mumbai, Maharashtra, India

Vidyut Bhatia MD
Consultant
Department of Pediatric
Gastroenterology and Hepatology
Indraprastha Apollo Hospitals
New Delhi, India

Veereshwar Bhatnagar MS MCh
Professor
Department of Pediatric Surgery
All India Institute of Medical Sciences
New Delhi, India

Sagar Bhattad MD
Senior Resident
Department of Pediatrics
Postgraduate Institute of
Medical Education and Research
Chandigarh, India

Reeta Bora MD DM
Associate Professor and Incharge of
Neonatal Unit
Department of Pediatrics
Assam Medical College
Dibrugarh, Assam, India

Sudha R Chandrashekhar MD ESPE
Professor
Department of Pediatrics
Bai Jerbai Wadia Hospital for Children
and Seth GS Medical College
Mumbai, Maharashtra, India

Anirban Chatterjee MS DNB MNAMS
Senior Consultant
Department of Orthopedics
Medica Superspecialty Hospital
Kolkata, West Bengal, India

Jasodhara Chaudhuri MD MRCPCH
RMO-cum-Clinical Tutor
Department of Pediatric Medicine
Medical College
Kolkata, West Bengal, India

Hitesh B Chauhan MS
Pediatric Orthopedic Surgeon
Department of Pediatric Orthopedic
Rainbow Superspeciality Hospital and
Children's Orthopedic Centre
Ahmedabad, Gujarat, India

Deepak Chawla MD DM
Associate Professor
Department of Pediatrics
Government Medical College Hospital
Chandigarh, India

Harshika Chawla MBBS
Postgraduate Resident
Department of Ophthalmology
Postgraduate Institute of Medical
Education and Research and
Dr Ram Manohar Lohia Hospital
New Delhi, India

Dinesh K Chirla MD DM MRCPCH
Consultant
Department of Neonatology
Rainbow Children's Hospital
Hyderabad, Telangana, India

Sushma P Desai DCH MD PGDAP
Counseller
Gopi Children and Orthopedic Hospital
and Adolescent Speciality Clinic
Surat, Gujarat, India

Vaishali R Deshmukh DCH DNB PGD-AP
Consultant and In-Charge
Nine-to-Nineteen Clinic
Deenanath Mangeshkar Hospital and
Research Center
Pune, Maharashtra, India

Taru Dewan MS FRCSEd
Associate Professor
Department of Ophthalmology
Postgraduate Institute of Medical
Education and Research and
Dr Ram Manohar Lohia Hospital
New Delhi, India

Arjun A Dhawale MS DNB MRCSEd
Surgeon, Department of Orthopedics
and Spine Surgery
Sir HN Reliance Foundation Hospital and
BJ Wadia Hospital For Children
Mumbai, Maharashtra, India

Dhulika Dhingra MD
Assistant Professor
Department of Pediatrics
Chacha Nehru Bal Chikitsalaya
New Delhi, India

Vinod Gunasekaran MD FIAP
Clinical Assistant, Institute of Child Health
Sir Ganga Ram hospital
New Delhi, India

Vikram Gagneja DNB FNB FCCM
Consultant Pediatrician and Intensivist
Gagneja Speciality Clinic
New Delhi, India

Suma Ganesh MS DNBE
Consultant and Head
Department of Pediatric Ophthalmology
and Strabismus
Dr Shroff's Charity Eye Hospital
New Delhi, India

Niti Gaur MD
Senior Resident
Department of Dermatology
Lady Hardinge Medical College and
Associated Hospitals
New Delhi, India

Paula Goel MD PGDAP PGDMLS
Consultant and Director
Fayth Clinic
Mumbai, Maharashtra, India

Anju Gupta MD
Associate Professor
Department of Pediatrics
Postgraduate Institute of Medical
Education and Research
Chandigarh, India

Sailesh G Gupta MD DCH
Consultant
Department of Pediatrics and
Neonatology, Ashna Childrens Hospital
and Arushee Childcare Hospital
Mumbai, Maharashtra, India

Shalu Gupta MD
Professor, Department of Pediatrics
Lady Hardinge Medical College and
Kalawati Saran Children's Hospital
New Delhi, India

Supriya Phanse Gupte MD PDCC
Leeds Royal Infirmary
United Kingdom

Omkar P Hajirnis MD DNB MRCPCH
Pediatric Neurologist
Department of Pediatric Neurology
Bhaktivedanta Hospital and Research
Centre, Dr LH Hiranandani Hospital
Rajiv Gandhi Medical College and
CSM Hospital
Mumbai, Maharashtra, India

Manisha Halkar MD DNB
Consultant, Department of Neonatology
Meenakshi Hospitals
Bangalore, Karnataka, India

Aru C Handa
Senior Consultant
Department of ENT and Head Neck
Surgery Medanta Medicity
Gurgaon, Haryana, India

Kumud K Handa MS DNB MNAMS
Director and Head
Department of ENT and Head Neck
Surgery
Medanta Medicity
Gurgaon, Haryana, India

Rashna D Hazarika MD
Senior Consultant and Chief
Department of Pediatrics, Pediatric and
Neonatal Intensive Care
Midland Hospital and Rigpa Children's
Clinic
Guwahati, Assam, India

Ira J Holla MBBS
Junior Resident
Department of Pediatrics
Lok Nayak Jai Prakash Narayan Hospital
New Delhi, India

Ram G Holla MD DM
Senior Consultant
Department of Neonatology and
Pediatrics, Adiva Hospitals
New Delhi, India

Aspi J Irani MD DCH
Pediatrician, Department of Pediatrics
Nanavati Super Speciality Hospital
Mumbai, Maharashtra, India

Nurul Islam MD DNB
Consultant, Pediatric Cardiology
Mission Hospital
Durgapur, West Bengal, India

Barath Jagadisan MD PDCC
Associate Professor
Department of Pediatrics
Jawaharlal Institute of Postgraduate
Medical Education and Research
Pondicherry, India

Ashish Jain MD DNB DM
Assistant Professor
Department of Neonatology
Maulana Azad Medical College
New Delhi, India

Naveen Jain DM
Coordinator, Department of Neonatology
Kerala Institute of Medical Sciences
Trivandrum, Kerala, India

Shikha Jain MS
Medical Officer
Department of Ophthalmology
Dr Ram Manohar Lohia Hospital
New Delhi, India

Manisha Jana
Assistant Professor
Department of Radiodiagnosis
All India Institute of Medical Sciences
New Delhi, India

Kana R Jat MD FCCP MNAMS
Assistant Professor
Department of Pediatrics
All India Institute of Medical Sciences
New Delhi, India

Nameet Jerath MD
Senior Consultant, Department of
Pediatric Critical Care and Pulmonology,
Indraprastha Apollo Hospital
New Delhi, India

Ganesh S Jevalikar MD DNB PDCC
Consultant, Department of
Endocrinology and Diabetes
Medanta The Medicity
Gurgaon, Haryana, India

Nachiket M Joshi MBBS
Resident
Department of General Surgery
PD Hinduja National Hospital and
Medical Research Centre
Mumbai, Maharashtra, India

Nandkishor S Kabra DM MD DNB MSc
Director, Department of Neonatology
Surya Mother and Child Care
Mumbai, Maharashtra, India

Veena Kalra
Consultant
Department of Pediatric Neurology
All India Institute of Medical Sciences
New Delhi, India

Akshay Kapoor MD
Consultant
Department of Pediatric
Gastroenterology and Hepatology
Indraprastha Apollo Hospitals
New Delhi, India

Gauri Kapoor MD PhD
Director
Department of Pediatric Hematology
Oncology
Rajiv Gandhi Cancer Institute and
Research Centre
New Delhi, India

Dasmit S Khokar MS MCh FIAPS
Professor
Department of Pediatric Surgery
BJ Medical College and
Sassoon General Hospitals
Pune, Maharashtra, India

Vinayan KP MD DCH DNB DM
Professor and Head
Department of Neurology
Amrita Institute of Medical Sciences
Kochi, Kerala, India

Venkatadass Krishnamoorthy MS DNB
Consultant, Department of Orthopedics
Ganga Hospital
Coimbatore, Tamil Nadu, India

Rakesh Kumar
Professor
Department of Nuclear Medicine
All India Institute of Medical Sciences
New Delhi, India

Rashmi Kumar
Professor and Head
Department of Pediatrics
King George Hospital
Lucknow, Uttar Pradesh, India

Sathish Kumar MD DCH
Professor and Consultant
Department of Pediatrics
Christian Medical College
Vellore, Tamil Nadu, India

Ritabrata Kundu MD FIAP
Professor, Department of Pediatrics
Institute of Child Health
Kolkata, West Bengal, India

PA M Kunju MD DM
Professor and Head
Department of Pediatric Neurology
Government Medical College
Trivandrum, Kerala, India

Lokesh Lingappa MD DM MRCPCH
Consultant, Department of Pediatric
Neurology, Rainbow Children's Hospital
Hyderabad, Telangana, India

Gaurav Mandhan MD FIAP
Associate Consultant
Department of Neonatology
Max Super Specialty Hospital
New Delhi, India

Mamta V Manglani MD DCH
Professor and Head
Department of Pediatrics
Lokmanya Tilak Municipal Medical
College and General Hospital
Mumbai, Maharashtra, India

Mukta Mantan MD DNB
Professor, Department of Pediatrics
Maulana Azad Medical College
New Delhi, India

Manoj G Matnani MD PGDVES PGDMDPN
PGDVIH PGDCH
Consultant
Department of Pediatric Nephrology
KEM Hospital, Jehangir Hospital
Pune, Maharashtra, India
Bombay Hospital
Mumbai, Maharashtra, India

John Matthai DCH MD FAB FIAP
Professor and Head
Department of Pediatrics
PSG Institute of Medical Sciences
Coimbatore, Tamil Nadu, India

Puthezhath SN Menon MD MNAMS
FIAP FIMSA
Consultant and Head
Department of Pediatrics
Jaber Al-Ahmed Armed Forces Hospital
Kuwait, Kuwait

Bhavesh M Mithiya MD
Dip (Pediatrics)
Consultant
Department of Pediatrics
Jupiter Hospital
Kotagiri Medical Fellowship Hospital
Thane, Maharashtra, India

Aparajita Mitra MCh
Senior Resident
Department of Pediatric Surgery
All India Institute of Medical Sciences
New Delhi, India

Monjori Mitra DCH DNB FIAP
Associate Professor
Department of Pediatrics Medicine
Institute of Child Health
Kolkata, West Bengal, India

Rakesh Mondal MD DNB PDSR MNAMS
MRCPCHI
Professor
Department of Pediatric Medicine
Medical College Kolkata
Kolkata, West Bengal, India

Jayashree A Mondkar MD DCH
Professor and Head
Department of Neonatology
Lokmanya Tilak Municipal General
Hospital and Lokmanya Tilak
Municipal Medical College
Mumbai, Maharashtra, India

Anil K Monga MS DORL FCPS
Senior Consultant
Department of Otorhinolaryngology
and Head Neck Surgery
Sir Ganga Ram Hospital
New Delhi, India

Uday Monga MS FAGE
Senior Resident
Department of Otorhinolaryngology
and Head Neck Surgery
Uday ENT Hospital
New Delhi, India

Sangeeta S Mudaliar DNB MRCPCH
Consultant
Department of Hemato-Oncology
B J Wadia Children Hospital
Mumbai, Maharashtra, India

Surpreet BS Nagi DCH
Consultant
Department of Pediatrics
Dr Anands Hospital for Children
Mumbai, Maharashtra, India

Premal Naik MS DNB
Hon. Orthopedic Surgeon
NHL Municipal Medical College
Director, Rainbow Superspeciality
Hospital
Ahmedabad, Gujarat, India

Ruchi Nanawati MD
Professor and Head, Department iof
Neonatology, Seth GS Medical College
and KEM Hospital
Mumbai, Maharashtra, India

Narendra R Nanivadekar MD DCH DNB
Consultant, Department of Pediatrics
Aster Aadhar Hospital
Kolhapur, Maharashtra, India

Nikita MD DNB
Senior Resident
Department of Dermatology and STD
Lady Hardinge Medical College and
Associated Hospitals
New Delhi, India

Somashekhar M Nimbalkar MD
Professor
Department of Pediatrics
Pramukhswami Medical College
Karamsad, Gujarat, India

Raghupathy Palany BSc MD DCH FRCP
Professor
Indira Gandhi Institute of Child Health
Bangalore, Karnataka, India

Nitin Pant MS MCh
Assistant Professor
Department of Pediatric Surgery
Kalawati Saran Children's Hospital
Lady Hardinge Medical College
New Delhi, India

Ankit Parakh MD DNB MNAMS
Consultant
Department of Pediatric Pulmonology
Dr BL Kapur Memorial Hospital
New Delhi, India

Ketan P Parikh MS MCh
Consultant Pediatric Surgeon
Department of Pediatric Surgery
Jaslok Hospital
Mumbai, Maharashtra, India

Mandar B Patil DCH DNB
Assistant Professor
Dr DY Patil Medical College
Kolhapur, Maharashtra, India

Sandeep A Patwardhan MS Orth D Orth
Professor
Department of Pediatric Orthopedics
Sancheti Institute
Pune, Maharashtra, India

Sarah Paul DCH MD
Professor
Department of Pediatrics
PSG Institute of Medical Sciences
Coimbatore, Tamil Nadu, India

Ranjan K Pejaver FRCP FRCPCH FIAP FNNF
Professor, Department of Neonatology
Kempegowda Institute of Medical Sciences
Chief Neonatologist, Meenakshi Hospitals
Bangalore, Karnataka, India

Preetham K Poddutoor Dch DNB
Consultant, Department of Intensive Care, Rainbow Children's Hospital
Hyderabad, Telangana, India

Suhas V Prabhu MD DCH MNAMS
Visiting Consultant
Department of Pediatrics
PD Hinduja Hospital and Medical Research Centre
Mumbai, Maharashtra, India

Baldev S Prajapati MD DPed FIAP FICMCH MNAMS
Professor
Department of Pediatrics
GCS Medical College, Hospital and Research Centre
Ahmedabad, Gujarat, India

Rajal B Prajapati MD DPed
Professor
Department of Pediatrics
Sheth V S General Hospital and AMC MET Medical College
Ahmedabad, Gujarat, India

Prema Raghunathan DNB PGDAP
Professor
Department of Pediatrics
Rajarajeswari Medical College
Bangalore, Karnataka, India

Sarbani S Raha MD
Consultant
Child Neurology and Epilepsy Clinic
Vadodara, Gujarat, India

Devinder Rai MS
Vice Chairman
Department of ENT
Sir Ganga Ram Hospital
New Delhi, India

Anand P Rao MD DNB
Consultant
Department of Pediatric Rheumatology
Manipal Hospital
Bengaluru, Karnataka, India

Narendra Rathi MD DNB MNAMS FIAP
Consultant, Department of Pediatrics
Smile Institute of Child Health
Akola, Maharashtra, India

Aarathi R Rau MD
Professor, Department of Pathology
MS Ramaiah Medical College
Bangalore, Karnataka, India

Suyodhan A Reddy MCh DNB
Associate Professor
Department of Pediatric Surgery
BJ Wadia Hospital for Children
Mumbai, Maharashtra, India

Arun G Roy MD DM
Professor
Department of Neurology
Amrita Institute of Medical Sciences
Kochi, Kerala, India

Tapas K Sabui MD
Professor
Department of Pediatric Medicine
RG Kar Medical College
Kolkata, West Bengal, India

Anupam Sachdeva MD DCH
Chariman, Institute of Child Health
Sir Ganga Ram Hospital
New Delhi, India

Abhijeet Saha MD IMS BHU
Associate Professor
Department of Pediatrics
Post Graduate Institute of Medical Education and Research
Dr Ram Manohar Lohia Hospital
New Delhi, India

Bhaskar Saikia MD
Consultant
Max Superspeciality Hospital
New Delhi, India

VK Sairam AB (Ped) AB (Ped. Neph)
Pediatric Nephrologist
Kanchi Kamacoti Childs Trust Hospital
Chennai, Tamil Nadu, India

Dilip Samal
Senior Resident, Department of ENT and Head Neck Surgery Medanta Medicity
Gurgaon, Haryana, India

Jayanth S Sampath MSc FRCSEd
Consultant and Director
Bangalore Institute of Movement Research and Analysis
Bangalore, Karnataka, India

Viraj V Sanghi MD DNB
Consultant, Department of Neurology
Bombay Hospital and Medical Research Centre
Saifee Hospital
Ika Children's Centre
Mumbai, Maharashtra,India

Sarita Sanke MD
Postgraduate
Department of Dermatology and STD
Lady Hardinge Medical College
New Delhi, India

Naveen Sankhyan
Assistant Professor
Department of Pediatric Neurology
Postgraduate Institute of Medical Education and Research
Chandigarh, India

Vijaya Sarathi MD DM
Assistant Professor
Department of Endocrinology
Vydehi Institute of Medical Sciences and Research Center
Bengaluru, Karnataka, India

Moinak S Sarma MD DM
Senior Research Associate
Department of Pediatric Gastroenterology
Sanjay Gandhi Postgraduate Institute of Medical Sciences
Lucknow, Uttar Pradesh, India

Kiran P Sathe DCH DNB
Associate Consultant, Department of Pediatrics and Pediatric Nephrology
Sir HN Reliance Foundation Hospital
Mumbai, Maharashtra, India

Veeraraja B Sathenahalli MD
Assistant Professor
Department of Pediatrics, Jagadguru Jayadeva Murugarajendra Medical College
Davanagere, Karnataka, India

Malathi Sathiyasekaran MD DCH MNAMS DM
Consultant
Department of Gastroenterology
Kanchi Kamakoti CHILDS Trust Hospital and Sundaram Medical Foundation
Chennai, Tamil Nadu, India

Tulika Seth MD ABP
Additional Professor
Department of Hematology
All India Institute of Medical Sciences
New Delhi, India

Ira Shah MD DCH FCPS DNB DPID
Associate Professor
Bai Jerbai Wadia Hospital for Children
Consultant, Department of Pediatric Infectious Diseases and Pediatric Hepatology, Nanavati Hospital
Mumbai, Maharashtra, India

Mehul A Shah MD DCH MD DABPN
Consultant, Department of Pediatric Nephrology, Apollo Health City
Hyderabad, Telangana, India

Raju C Shah MD DPed FIAP
Professor, Department of Pediatrics
Ankur Institute of Child Health
Ahmedabad, Gujarat, India

Jyoti Sharma MD DNB
Consultant
Department of Pediatric Nephrology
King Edward Memorial Hospital
Pune, Maharashtra, India

Pradeep K Sharma MD
Consultant
Sri Balaji Action Medical Institute
New Delhi, India

Sangeetha Shenoy MD
Associate Professor
Department of Pediatrics
MS Ramaiah Medical College
Bangalore, Karnataka, India

Viraj Shingade MS DNB
Director
Children Orthopedic Care Institute
Pravira Hospital
Nagpur, Maharashtra, India

Roli M Srivastava DCH PGDAP
Research Officer
Department of Obstetrics and Gynecology
Ganesh Shankar Vidyarthi Memorial Medical College
Kanpur, Uttar Pradesh, India

Poonam Sidana MD
Senior Consultant
Department of Pediatrics
Max Super Specialty Hospital
New Delhi, India

Sirisharani Siddaiahgari MD DNB MRCPCH
Consultant, Department of Pediatric Hematology Oncology
Rainbow Children's Hospital
Hyderabad, Telangana, India

Aashim Singh MBBS
Junior Resident
Department of Dermatology
Lady Hardinge Medical College and Associated Hospitals
New Delhi, India

Manav D Singh MS
Associate Professor
Department of Ophthalmology
Postgraduate Institute of Medical Education and Research and Dr Ram Manohar Lohia Hospital
New Delhi, India

Preeti Singh MD
Assistant Professor
Department of Pediatrics
Lady Hardinge Medical College and associated Hospitals
New Delhi, India

Noopur Singhal MD
Senior Resident
Department of Pediatrics
Post Graduate Institute of Medical Education and Research
Dr Ram Manohar Lohia Hospital
New Delhi, India

Pratibha D Singhi MD
Professor, Department of Pediatrics
Post Graduate Institute of Medical Education and Research
Chandigarh, India

Anshu Srivastava MD DM
Additional Professor
Department of Pediatric Gastroenterology
Sanjay Gandhi Postgraduate Institute of Medical Sciences
Lucknow, Uttar Pradesh, India

Anurag M Srivastava MS
Consultant, Rockland Hospital
New Delhi, India

Nidhi Sugandhi MS MCh
Assistant Professor
Department of Pediatric Surgery
Dr Ram Manohar Lohia Hospital and
Post Graduate Institute of Medical
Education and Research
New Delhi, India

Balasubramanian Sundaram MD DCH
MAMS FIAP FRCPCH
Senior Consultant, Department of
Pediatrics, Kanchi Kamakoti Childs Trust
Hospital and The Child's Trust Medical
Research Foundation
Chennai, Tamil Nadu, India

Deepti Suri MD DNB
Associate Professor
Department of Pediatrics
Postgraduate Institute of Medical
Education and Research
Chandigarh, India

Rhishikesh P Thakre DM MD DNB DCH
FCPS
Professor
Department of Pediatrics
MGM College and Hospital
Director, Neonatology Division
Neo Clinic and Hospital
Aurangabad, Maharashtra, India

S Thangavelu MD DCH DNB MRCP
Senior Consultant and Director
Department of Pediatrics
Mehta Children's Hospitals
Chennai, Tamil Nadu, India

Soumya Tiwari MD
Assistant Professor
Department of Pediatrics
Kalawati Saran Children's hospital
Lady Hardinge Medical College
New Delhi, India

Alpana A Utture Dch MD DM
Associate Professor
Department of Neonatology
Seth Gordhandas Sunderdas Medical
College and King Edward Memorial
Hospital
Mumbai, Maharashtra, India

Jayakumar Vaikundam MD DCH DM
Senior Consultant and Chairman
JK Institute of Neurology
Madurai, Tamil Nadu, India

Kiran SK Vaswani MD DCH PGD-AP Dip
counselling
Consultant
PULSE Child Care Clinic
Mumbai, Maharashtra, India

Anoop K Verma MD FIAP FIAMS
Pediatrician
Swapnil Nursing Home
Raipur, Chhattisgarh, India

Madhava Vijayakumar MD DCH DNB
Additional Professor
Department of Pediatrics
Government Medical College
Kozhikode, Kerala, India

M Vijayakumar MD DCH DM FIAP
Consultant
Department of Pediatric Nephrology
Mehta Children's Hospital
Chennai, Tamil Nadu, India

Vijay Viswanathan DNB DCH
Consultant, Sandhi Children's Clinic
Jupiter Hospital
MGM Hospital
Dr Yewale's Multispecialty Centre
Mumbai, Maharashtra, India

V Viswanathan DCH MRCP PhD
Senior Consultant
Department of Pediatric Neurology
Kanchi Kamakoti Childs Trust Hospital
Apollo Children's Hospital
Chennai, Tamil Nadu, India

Sanjay Wazir DM
Director - NICU, Department of Pediatrics
Cloudnine Hospital
Gurgaon, Haryana, India

Pravesh Yadav MD
Senior Resident
Department of Dermatology and STD
Lady Hardinge Medical College and
Associated Hospitals
New Delhi, India

M Zulfikar Ahamed MD DM
Professor and Head
Department of Pediatric Cardiology
Government Medical College
Thiruvananthapuram, Kerala, India

Foreword

Pramod Jog MD DNB FIAP
Professor of Pediatrics
DY Patil Medical College
President, Indian Academy of Pediatrics (IAP), 2016
Member, Standing Committee, International Pediatric Association (IPA)
Pune, Maharashtra, India

Publication of any book is a process as laborious as the process of delivering a baby. Maturity (contents and the quality), weight gain (number of pages), and intact survival (final copy) all have to be carefully looked after. More so for a book with 156 chapters running in 19 sections with every chapter having at least one algorithm!

Algorithms in Pediatrics have gone through all these laborious processes and have come out as an exclusive book for pediatricians, giving instant guidelines for treatment, bringing uniformity in management, and training minds for protocolized thinking. With each protocol, the book provides concise, precise, and up-to-date information which shall help standardize care in pediatric practice.

When a practitioner is confronted with a clinical problem, he can rarely turn to a textbook for help. What he needs at that time is not a recounting of a long list of differential diagnosis, but practical guidelines as to how to arrive at a particular diagnosis and how to proceed further.

This book on algorithms intends to enable the pediatrician to recognize many disorders in a simplified manner and give practical suggestions in their management, a learning experience in a structured manner.

To put it in the words of Henry David Thoreau, "Our lives are frittered away by detail; simplify, simplify".

Practicing pediatricians are often faced with clinical problems for which they have been rather inadequately trained during their medical curriculum. Textbooks published from the medically advanced countries do not focus enough attention on the prevailing problems and circumstances in the developing countries such as India. The algorithms in this book have been formed keeping in mind the situations prevailing in India, especially the constraints under which the clinicians here have to practice. The main emphasis has been to provide clear-cut guidelines as to how to make a diagnosis on clinical grounds with minimal investigations and to choose the most rational therapy.

Although, prepared specifically to meet the needs of practicing doctors or those who intend to practice in near future, even pediatric residents would find the book extremely useful while preparing for their viva voce at the diploma or MD exams. The book covers most of those aspects which are practically never taught in the curriculum but are nevertheless expected to be known by pediatric postgraduates. It will also assist the students, house officers, and clinicians in the evaluation of common pediatric signs and symptoms in clinical practice.

With the help of history, focused examination, and minimum investigations, pediatricians in office practice can reach a working diagnosis and lay down immediate priorities in management.

There is rarely a single acceptable approach to any given problem, and not all diagnoses can fit neatly into an algorithm. Even though the protocols cannot be considered all-inclusive, the goal is to facilitate a logical and efficient stepwise approach to reasonable differential diagnoses for the common clinical problems. The algorithmic format provides a rapid and concise stepwise approach to a diagnosis. Moreover, it would train the brain to approach a problem.

The explosion of knowledge in pediatrics is phenomenal and fast. If the medical advances and good clinical practice get coupled with effective advocacy, our increasing knowledge will benefit child care in our country.

I am sure that the algorithms will enhance the capabilities of pediatricians, guiding them towards optimal utilization of available investigative and therapeutic resources.

Preface

It gives us immense pleasure to present to you the 1st edition of "Algorithms in Pediatrics". Pediatrics is rapidly advancing with the growth of its subspecialties. At times, it becomes difficult for busy pediatricians, whether in practice, in teaching institutions, or pursuing their postgraduation, to read through lengthy texts of different subspecialties. Keeping this in mind, we thought of bringing forth this concise book on algorithms, which deals with common and practical topics of everyday requirements in different pediatric specialties.

The book has been designed with a practical approach in mind, with an algorithm for each topic, along with a concise text to use the algorithms. The text has been kept simple and easily comprehendible. The book can be consulted rapidly in the emergency room, wards, outpatient departments, or in busy clinics.

The book contains 19 subspecialty sections, with 8–10 chapters in each, a total of 156 chapters. This was an immense work, which could not have been possible without the help and coordination of the section editors. We are very thankful to all the section editors.

A large number of luminaries and experts in the field of pediatrics and its subspecialties have contributed their mind and might in bringing out this book. We are thankful to all these contributors.

We are also thankful to Jaypee Brothers Medical Publishers (P) Ltd. for publishing this book.

We are also grateful to our respective spouses for being tolerant and supportive of us in this endeavor.

Anand S Vasudev
Nitin K Shah

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SECTION 1: NEONATOLOGY

CHAPTER 1

Neonatal Resuscitation

Rhishikesh P Thakre

INTRODUCTION

Birth of newborn is a potential medical emergency. Up to half of newborns who require resuscitation have no identifiable risk factors before birth. Preparation and anticipation is the key. All babies need assessment for resuscitation at birth. Up to 10% of babies need some resuscitation and less than 1% need major resuscitation.

STANDARD PRECAUTIONS

All resuscitation should be conducted under strict asepsis. All resuscitation apparatus should be clean and sterile, and where indicated, disposable. Suction catheters, mucus extractor, umbilical catheters, syringes, needles, endotracheal (ET) tubes, feeding tubes should be single use, sterile, and disposable.

PREPARATION PRIOR TO BIRTH

Equipment Check

- All equipment should be available in various sizes for different gestation
- A checklist should be used to ensure that the equipment is functional
- Following equipment are "desirable" for resuscitation: compressed air, blender, continuous positive airway pressure (CPAP), pulse oximeter + probe and plastic wrap.

Personnel

- At every delivery, there should be at least one person whose primary responsibility is the baby and who is capable of initiating resuscitation positive pressure ventilation (PPV) and chest compression (CC). Skilled personnel for complete resuscitation be readily available, if needed
- Two persons or more are required in "high risk" delivery.

Identifying High Risk Delivery

Focused questions (help prepare and anticipate problems during resuscitation) include: (1) What is the gestational age? (2) Is the amniotic fluid clear? (3) How many babies are expected? (4) Are there any additional risk factors?

ASSESSMENT AT BIRTH

Need for resuscitation can generally be identified by a rapid assessment by asking "Is the infant breathing or crying?" If the baby is breathing or crying, the newborn does not require any further resuscitation. Early skin-to-skin contact with mother be practiced and newborn assessed for breathing, color, and activity.

If the baby is not breathing or crying, a series of steps may be needed to establish breathing sequentially performing initial steps, PPV, CC, intubation, and/or administration of drugs.

Assessing the breathing is by observing the baby's chest movements. Breathing is adequate if a baby is vigorously crying or has good regular chest movements with no pauses or indrawing with associated good tone. Gasping or labored breathing should not be mistaken for normal breathing.

CORD CLAMPING

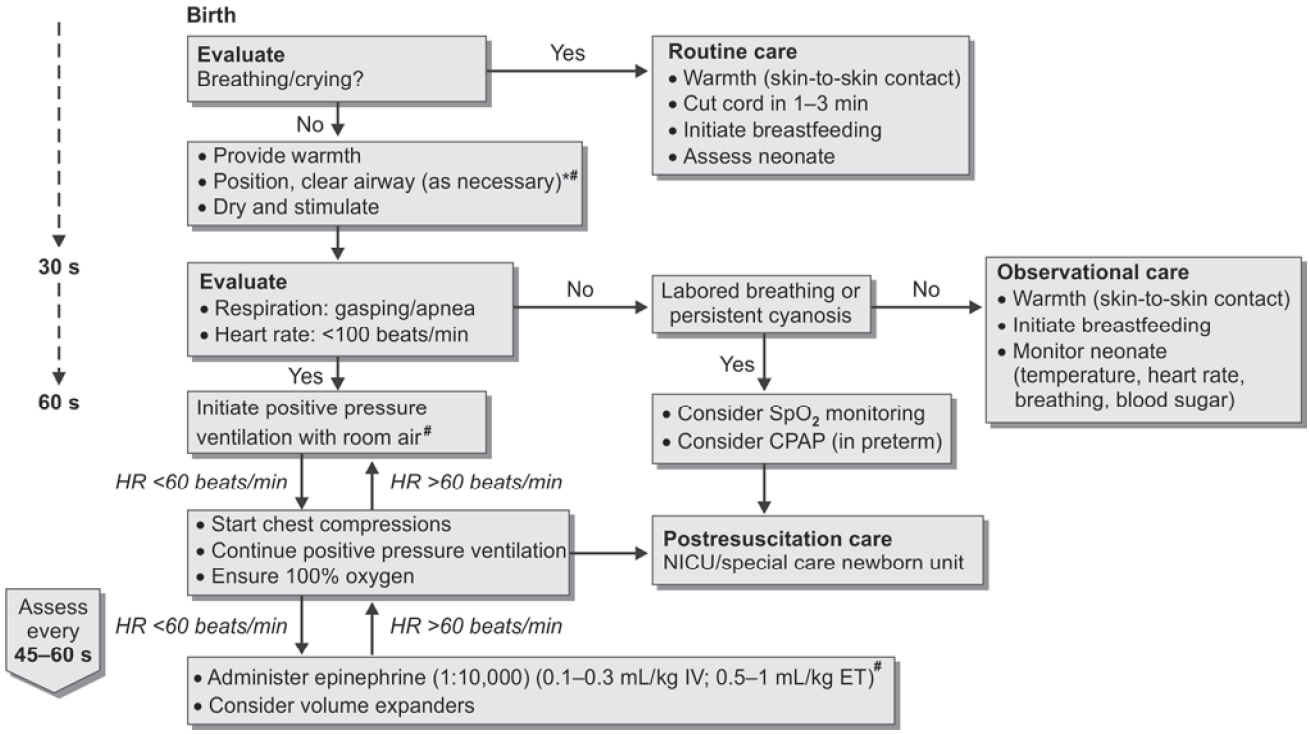
All babies who establish spontaneous respiration at birth should have cord clamping delayed for more than 1 minute. It is a safe procedure in term, preterm, and low birth weight (LBW) babies with improved iron status, higher blood pressures during stabilization, and a lower incidence of intraventricular hemorrhage (IVH) and fewer blood transfusions in preterms.

STEPS IN NEONATAL RESUSCITATION

A baby who is not breathing or crying at birth should undergo following steps of resuscitation with ongoing assessment and reassessment at every step (Algorithm 1).

ALGORITHM 1

Indian Academy of Pediatrics Neonatal Resuscitation Program First Golden Minute algorithm for neonatal resuscitation



*In meconium stained depressed neonates after oral suction, endotracheal suction may be considered.
#Endotracheal intubation may be considered at several steps.
CPAP, continuous positive airway pressure, HR, heart rate; ET, endotracheal; IV, intravenous; NICU, neonatal intensive care unit.

Initial Steps

A baby who is not breathing or crying should be received in dry, prewarmed cloth with immediate cord clamping and placed under a heat source. The head, trunk, and the limbs should be dried firmly and quickly. Suction of mouth followed by nose may be done if there is obvious obstruction to airway. Stimulation is done by rubbing the back or flicking the soles. The newborn is repositioned and simultaneous assessment of respiration and heart rate (HR) is done.

Response to resuscitation is best judged by increasing HR and later by establishment of spontaneous breathing. The HR is easiest and quickest assessed by palpating at the base of umbilical cord, but auscultation of precordium is most reliable.

Positive Pressure Ventilation

Positive pressure ventilation is indicated if the newborn has apnea or gasping respiration, HR less than 100 beats per minute or SpO_2 below target values despite supplemental oxygen being increased to 100%. A flow-inflating bag, a self-inflating bag, or a pressure-limited T-piece resuscitator can be used for PPV. Call for help and ask assistant to apply pulse oximeter, if available, to right hand/wrist of the newborn. In all newborns (term or preterm), PPV should be started with room air. Provide breaths at a rate of 40–60 per minute using "breathe–two-three" and assess for efficacy after 5–10 breaths. Check for rise in HR and oximetry. If there is no HR rise, check for air entry and chest movement. If not, take corrective measures for ventilation—mask reposition, reposition airway, suction, open mouth and ventilate, pressure increase, and consider alternate airway measures (MRSOPA). Heart rate is assessed every 30 seconds. Consider inserting orogastric tube if ventilation is prolonged.

Positive pressure ventilation is discontinued if there is rise in HR greater than 100 beats per minute and onset of spontaneous respiration. If despite adequate PPV, there is no desired response, one may consider intubation or initiate CC if HR is less than 60 beats per minute.

Intubation

Intubation is considered if ventilation is ineffective, newborn is nonvigorous with meconium stained liquor, need for CC, administration of drugs, or suspected congenital diaphragmatic hernia. Intubation is performed in time limit of 30 seconds. There is no role of cuffed ET tubes. Two common and serious errors of ET intubation are malplacement of the ET tube and the use of the wrong sized tubes.

Chest Compression

Heart rate less than 60 beats per minute despite adequate ventilation is indication to start CC. One should ensure that assisted ventilation is being delivered optimally before starting CCs. Consider intubation if CC is to begin. The

CHAPTER 13

Neonatal Seizures

Sanjay Wazir

INTRODUCTION

Neonatal seizures represent one of the major challenges for the clinician working in nursery because of difficulty in diagnosis and lack of effective evidence based treatment scheme. Incidence of neonatal seizures is inversely proportional to the birthweight with incidence of approximately 60 per 1,000 at less than 1,500 g and 3 per 1,000 at more than 2,500 g at birth.

RISK FACTORS FOR NEONATAL SEIZURES

Maternal

- Advancing maternal age more than 40 years
- Preexisting/gestational diabetes mellitus
- Intrapartum evidence of fetal distress
- Placental abruption, cord prolapse, prolonged second stage
- Maternal pyrexia, chorioamnionitis.

Infant

- Lower gestational age
- Low birthweight
- Post-term more than 42 weeks
- Male sex.

Clinical Pearl

- Half of the seizures in newborns are subclinical and one-third of seizures do not have an electroencephalogram correlate.

ETIOLOGY OF NEONATAL SEIZURES (TABLE 1)

First four causes constitute approximately 85% of all causes of neonatal seizures. It is important to find out the cause as the prognosis is dependent on the etiology of seizure.

TABLE 1: Etiology of neonatal seizures based on timing after birth

Age	Etiology
First 24 h	• Hypoxic ischemic encephalopathy • Meningitis/sepsis • Subdural/subarachnoid/interventricular hemorrhage intrauterine infection • Trauma • Pyridoxine dependency • Drug effect/withdrawal
24–72 h	• Meningitis/sepsis • In premature infants: intraventricular hemorrhage • In full-term infants: infarction, venous thrombosis • Cerebral dysgenesis
72 h to 1 week	• Above causes • Inborn errors of metabolism • Hypocalcemia • Familial neonatal seizures
1 week to 4 weeks	• Above causes • Herpes simplex virus

1. Hypoxic ischemic encephalopathy
2. Intracranial infections: bacterial, viral, fungal, intrauterine
3. Cerebral malformations
4. Intracranial hemorrhage
5. Metabolic: hypocalcemia, hypomagnesemia, hypoglycemia, hypo- or hypernatremia
6. Bilirubin encephalopathy
7. Drug withdrawl: chronic maternal use of drugs
8. Inborn errors of metabolism: nonketotic hyperglycinemia, pyridoxine-dependent epilepsy, folinic acid-responsive seizures, pyruvate dehydrogenase deficiency, glucose transporter deficiency, biotinidase deficiency, Leigh disease, sulfite oxidase deficiency

9. Epilepsy syndromes: benign idiopathic neonatal convulsions, benign familial neonatal seizures, benign nonfamilial (idiopathic) neonatal seizures, early infantile epileptic encephalopathy with burst suppression pattern (Ohtahara syndrome), early myoclonic encephalopathy.

Clinical Pearl

- Sixty percent of the causes of seizures are due to hypoxic ischemic encephalopathy and 20% are related to stroke.

TYPES OF SEIZURES

Types of seizures are given in table 2.

TABLE 2: Types of seizures

Apnea	Pedaling
Subtle	• Eye deviation (term) • Blinking, fixed stare (preterm) • Repetitive mouth and tongue movements • Apnea pedaling, tonic posturing of limbs
Tonic	• Maybe focal or generalized • Tonic extension or flexion of limbs (often signals severe intracranial hemorrhage in preterm infants)
Clonic	• Maybe focal or multifocal • Clonic limb movements (synchronous or asynchronous, localized or often with no anatomic order to progression) • Consciousness maybe preserved • Often signals focal cerebral injury
Myoclonic	• Focal, multifocal, or generalized • Lightning-like jerks of extremities (upper > lower)

DIFFERENTIAL DIAGNOSIS OF MOVEMENT DISORDERS IN NEONATES

Differential diagnosis of movement disorders in neonates is given in table 3.

INVESTIGATIONS

- Clinical history and examination
- Blood sugar
- Serum calcium and magnesium
- Blood gas
- Urea and electrolytes
- Blood culture
- Cerebrospinal fluid
- Electroencephalogram (EEG): Obtain EEG if possible
- Ultrasonography.

ANTIEPILEPTICS AND THEIR DOSES

List of antiepileptics and their doses is given in table 4.

TABLE 3: Differential diagnosis of movement disorders in neonates

Phenomenon	Characteristics
Jitteriness	• Rhythmic character with equal forward and backward movement • Can be restrained and is stimulus sensitive • No eye movements
Benign sleep myoclonus	• Myoclonic activity confined to sleep • Occurs in the first few weeks of life • Spontaneous resolution by 2–3 months • No autonomic movements or eye movements
Hyperekplexia (stiff baby syndrome)	• Triad of generalized stiffness while awake, nocturnal myoclonus and exaggerated startle reflex • Resolved by manual flexion of the neck or hips • Clonazepam is helpful
Nonconvulsive apnea	• Not associated with eye movements • Tachycardia is not seen
Sandifer syndrome	• Caused by acid reflux • Intermittent paroxysmal spells of generalized stiffness and opisthotonic posturing • Usually occur within 30 min of meal
Neonatal dystonia	• Fixed contraction of muscles • Usually in severe brain lesion or in drug overdose like metoclopramide

TABLE 4: List of antiepileptics and their doses

Drug	Loading dose	Maintenance dose
Phenobarbital	20 mg/kg IV maximum 40 mg/kg	3–5 mg/kg per 24 h IV or PO
Phenytoin	20 mg/kg IV (infusion rate 1 mg/kg/min)	3–4 mg/kg per 24 h IV
Midazolam	0.05 mg/kg IV (in 10 min)	0.15 mg/kg/h
Lidocaine	2 mg/kg IV	• 6 mg/kg/h IV • After 24 h of treatment: 4 mg/kg/h • After 36 h: 2 mg/kg/h • After 48 h: Stop
Clonazepam	0.15 mg/kg IV repeat 1x or 2x	0.1 mg/kg per 24 h
Pyridoxine	50–100 mg	50–100 mg

IV, intravenous; PO, per os.

Clinical Pearl

- The data regarding the efficacy of older antiepileptics is not very convincing but newer drugs have hardly any; hence, phenobarbitone remains the first choice in neonatal seizures.

PROGNOSIS

Dependent on the cause of seizures, e.g., in case of late-onset hypocalcemia, the outcome is 100% normal and in case of cerebral malformation, nearly all would have a bad prognosis. Some of the outcomes are listed in table 5.

Predictive Variables

Multiple rather than single factors appear to be most accurate in predicting outcome. However, all these variables ultimately are related to the degree of brain injury at the time of seizure occurrence, and, in turn, the seizure etiology.

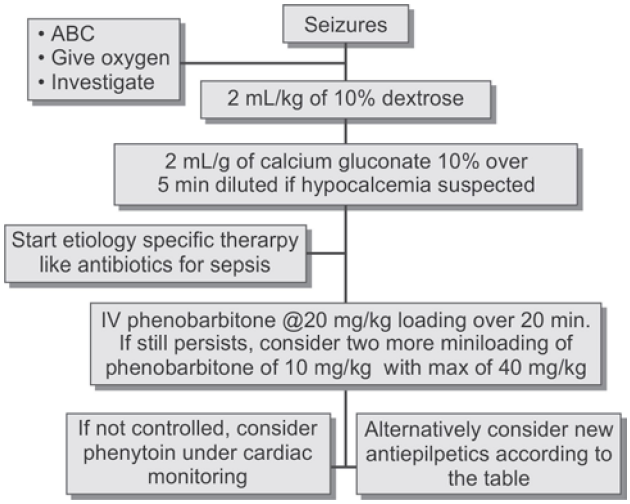
- Features of the interictal EEG from one or serial recordings
- Features of the ictal EEG
- Seizure burden, including the number of sites of seizure onset and seizure duration
- Status epilepticus
- Neurologic examination at the time of seizures
- Number of drugs required to treat seizures
- Findings on neuroimaging
- Conceptional age (term versus preterm)
- Birthweight.

TABLE 5: Long term outcome of neonatal seizures

Outcome	Incidence (%)
Early death	20–30
Developmental delay	55
Mental retardation	20–40
Cerebral palsy	25–40
No neurological abnormalities	22–35
Postnatal epilepsy	20–30

ALGORITHM 1

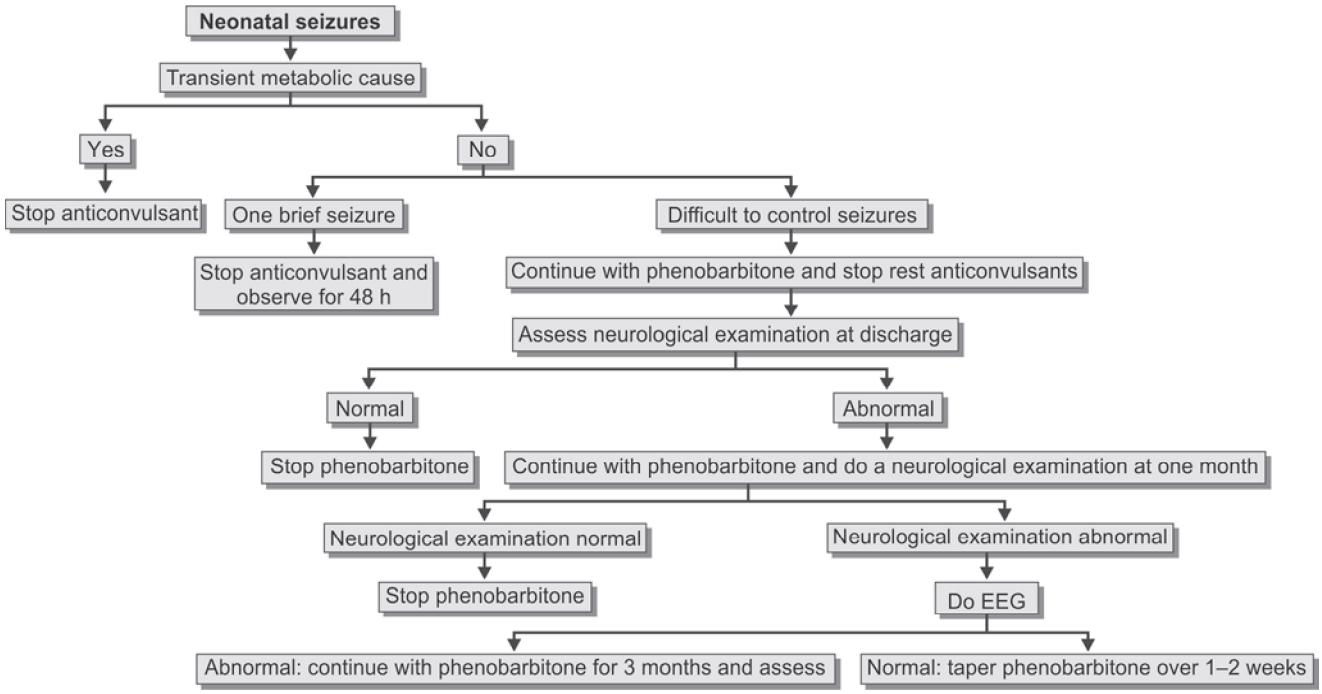
Treatment for neonatal seizures



ABC, airway, breathing, and circulation.

ALGORITHM 2

Weaning protocol for neonatal seizures



EEG, electroencephalogram.

KEY POINTS

- ☞ Neonatal period is the most common time in one's life to get seizures
- ☞ Preferably, all neonatal seizures should have an EEG record available to differentiate between the nonepileptic phenomenon and seizures
- ☞ Antiepileptics may have toxic effects on the brain; hence, one should try to stop as soon as possible
- ☞ Further studies are needed regarding new and more efficacious treatments and their impact on the outcome of different neonatal seizure types.

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