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4th Edition



Pediatric and Neonatal Mechanical Ventilation

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CHAPTER 3

Pediatric Intensive Care Unit Algorithms

Mukul Pandey

INTRODUCTION

Time is of essence while treating a child with respiratory distress or respiratory failure to prevent cardiorespiratory arrest due to severe hypoxemia or hypercarbia. For any child with respiratory distress or failure, a quick algorithmic approach is important for effective and safe outcome. Initial approach, a rapid cardiopulmonary assessment to reach a clinical diagnosis, and further interventions including endotracheal intubation (rapid sequence intubation) and initiation of mechanical ventilation for patients with acute respiratory failure are lifesaving interventions.

Common pediatric intensive care unit algorithms as they relate to children with life-threatening respiratory distress or failure requiring mechanical ventilatory support have been shown in **Flowcharts 1 to 3**.

CHECKLIST FOR RAPID SEQUENCE INTUBATION[3]

SOAP ME:[3]

SOAP ME is mnemonics for

S - SUCTION
O - OXYGEN
A - AIRWAY EQUIPMENT
P - PHARMACY
ME - MONITORING EQUIPMENT

- *SUCTION (S):* Should be tested and readily available at the bedside Suction pressure < 200 mm Hg
- *OXYGEN (O):* High-flow O_2 mask and bag-valve ventilation
- *AIRWAY EQUIPMENT (A):* Laryngoscope handle, blade (straight and curved), endotracheal (ET) tube, stylet

  ET size formula:
  - *<1 year:* 3.5 mm
  - [Age (Years)/4] + 4 for uncuffed tube
  - [Age (Years)/4] + 3.5 for cuffed tube
- *PHARMACY (P):* Working IV line, all medicines to be used in rapid sequence intubation (RSI) with proper dosing and sequence of administration should be determined

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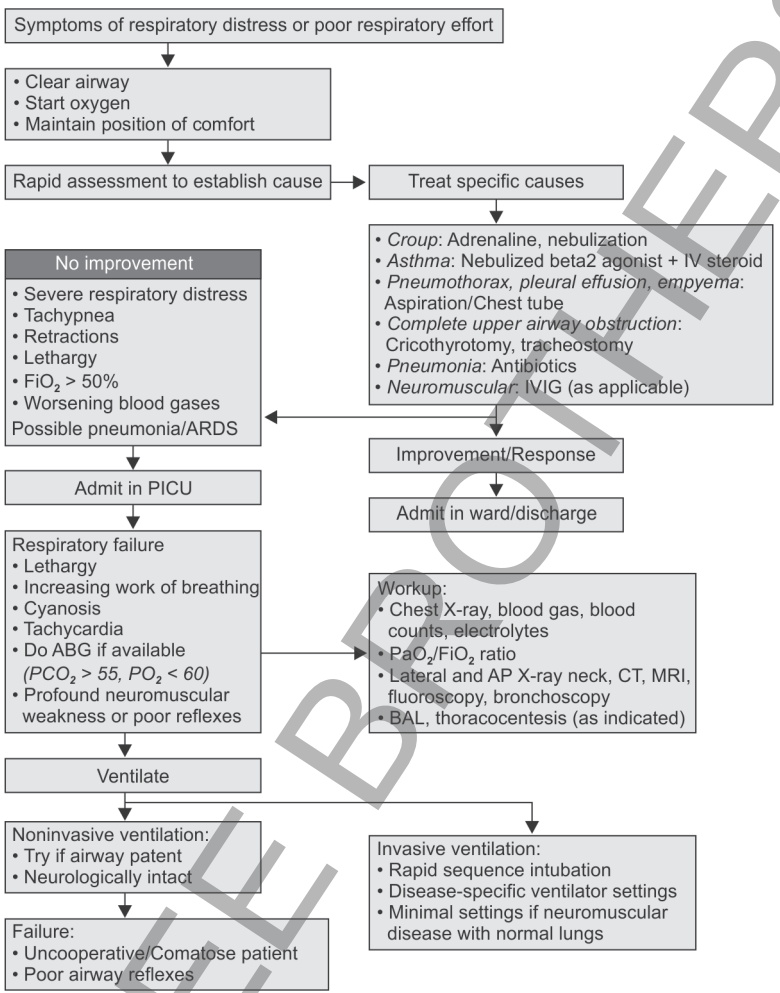
Flowchart 1: Management algorithm of respiratory distress/failure.[1]



(AP: anteroposterior; ARDS: acute respiratory distress syndrome; BAL: bronchoalveolar lavage; PICU: pediatric intensive care unit)

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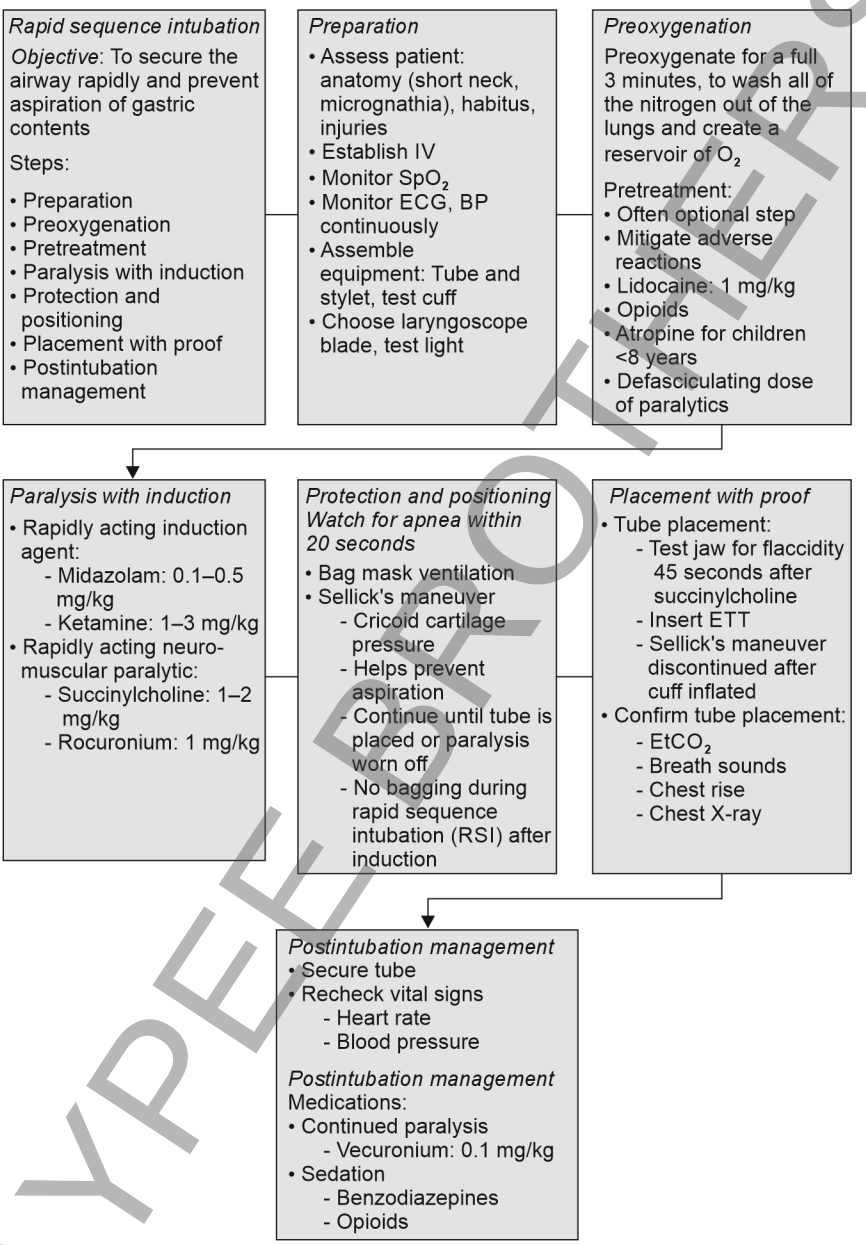
Flowchart 2: Rapid sequence intubation.[2]



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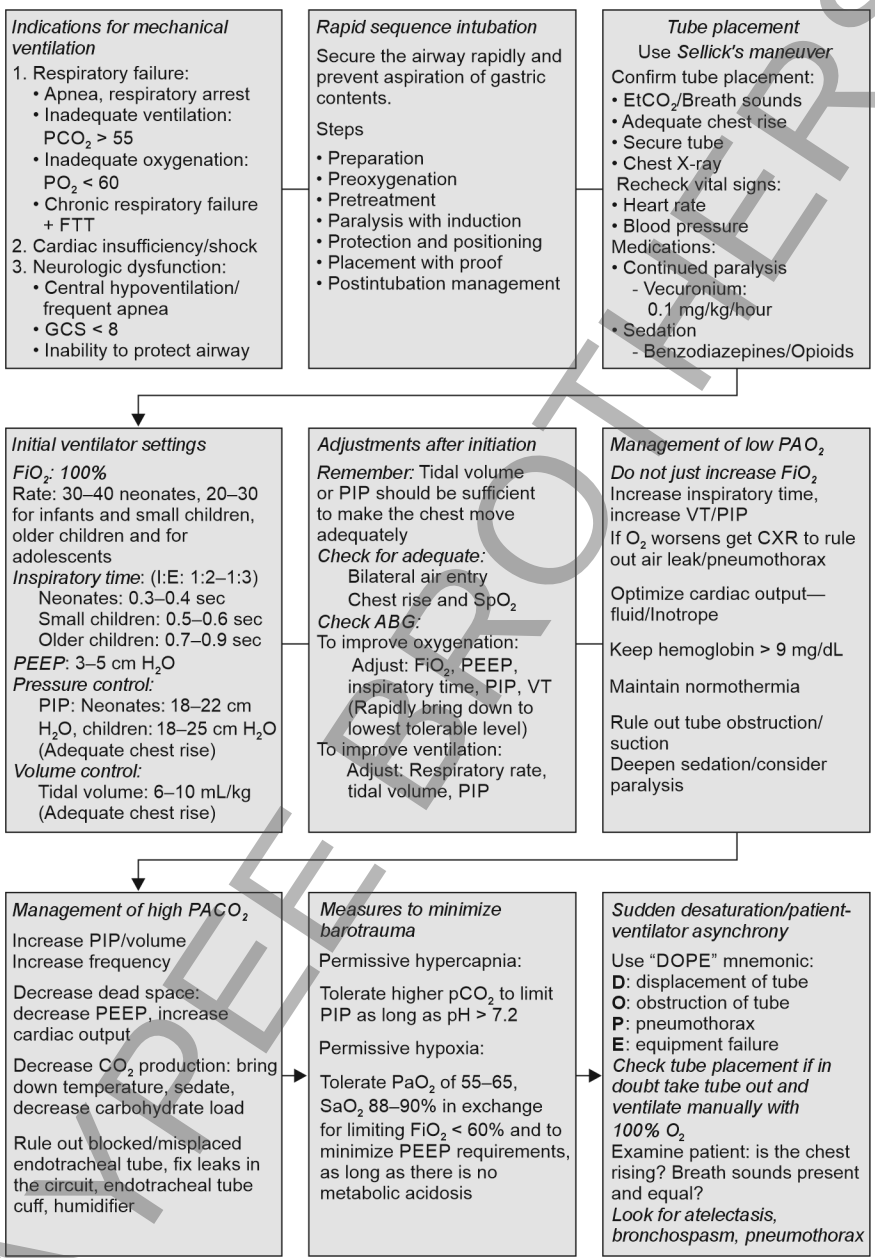
Flowchart 3: Respiratory failure—mechanical ventilation.[4]



($EtCO_2$: end-tidal CO_2; FTT: failure to thrive; GCS: Glasgow coma scale; PaO_2: partial pressure of oxygen; pCO_2: partial pressure of CO_2; PIP: peak inspiratory pressure; SaO_2: arterial oxygen saturation; V_T: tidal volume)

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Medicines:

- *Fentanyl:* 1–2 µg/kg
- *Midazolam:* 0.1–0.2 mg/kg
- *Vecuronium:* 0.15 mg/kg
- *Atracurium:* 0.5 mg/kg (in case of hepatic dysfunction)
- *Ketamine:* 1–2 mg/kg (in case of asthma)
- *Lignocaine:* 1 mg/kg (in case of raised intracranial pressure)

- *MONITORING EQUIPMENT (ME):* Cardiac monitor, pulse oximeter, BP monitor, $EtCO_2$ monitor

KEY MESSAGES

- *Time is critical in pediatric respiratory distress and respiratory failure.* Early recognition and a structured algorithmic approach can prevent progression to hypoxaemia, hypercarbia, and cardiorespiratory arrest.
- *A rapid cardiopulmonary assessment should guide immediate management.* Identify the severity and likely cause of respiratory compromise while initiating appropriate supportive interventions without unnecessary delay.
- *Preparation is the cornerstone of safe rapid sequence intubation (RSI).* Use a systematic *SOAP-ME checklist* to ensure availability of suction, oxygen, airway equipment, medications, and monitoring before intubation.
- *Appropriate airway equipment, drug selection, and weight-based dosing are essential for pediatric RSI.* Anticipate difficult airway scenarios and ensure all required equipment and medications are prepared before proceeding.
- *Mechanical ventilation should be initiated promptly and individualised according to the underlying respiratory failure.* Ventilatory strategies should aim to achieve adequate oxygenation and ventilation while minimising ventilator-induced lung injury.

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Pediatric and Neonatal Mechanical Ventilation

This book is intended to be a practical resource for pediatric residents, pediatricians, intensivists, anesthesiologists, neonatologists, and other healthcare professionals involved in the care of critically ill children and newborns requiring respiratory support.

It provides a clear and structured approach to the principles and practice of pediatric and neonatal mechanical ventilation. The book covers essential topics including respiratory physiology, assessment of respiratory failure, indications for ventilation, ventilator modes, initial ventilator settings, monitoring, troubleshooting, and strategies for lung-protective ventilation. This edition covers new chapters of algorithms for frequently faced situations in the Pediatric ICU in an easy-to-understand language.

Special emphasis is placed on the practical management of commonly encountered clinical situations, including acute respiratory distress, obstructive and restrictive lung diseases, postoperative respiratory care, ventilation in preterm and term neonates, noninvasive ventilation, high-frequency ventilation, and extracorporeal support. The text also discusses oxygenation and ventilation targets, weaning, extubation, prevention of ventilator-associated complications, and the interpretation of ventilator graphics and respiratory mechanics.

Written in a concise and clinically relevant style, this book combines fundamental concepts with bedside applications. It is designed to support decision-making in the intensive care unit, neonatal intensive care unit, emergency department, operating room, and other settings where respiratory support is required.

The book will be useful for trainees preparing for postgraduate and fellowship examinations, as well as for practicing clinicians seeking to strengthen their understanding and application of mechanical ventilation in children and neonates.

Praveen Khilnani MD FICCM FAAP (USA) FCCM (USA) MCCM (USA) American Board Certification in Pediatrics and Pediatric Critical Care Medicine is the Chairman, Department of Pediatrics, Pediatric Pulmonology, and Critical Care, Medanta—The Medicity, Gurugram, Haryana, India. He is a pioneer of pediatric critical care in India with over four decades of experience. He is an Expert in Pediatric Pulmonology, Neonatal and Pediatric Bronchoscopy, and specialized care of critically ill infants. He graduated from Maulana Azad Medical College, University of Delhi in 1978, obtained MD (Anesthesiology) from All India Institute of Medical Sciences, New Delhi, India. He is a Recipient of Vishisht Chikitsa Ratan Award from the Indian Medical Association and did his Pediatrics Residency Training followed by Fellowship in Pediatric Critical Care, Cardiac Critical Care and Newborn Intensive Care from the Harvard Medical School (Massachusetts General Hospital and Boston Children's Hospital), Boston, MA, USA. He has established many tertiary care—pediatric intensive care units (PICUs) in USA, Dubai and India including Apollo, MAX, BLK, Rainbow and Medanta—The Medicity hospitals. He is a US board-certified Pediatrician and Pediatric Intensivist. He is the only Indian to receive MCCM a prestigious award (Master of Critical Care Medicine) by American College of Critical Care Medicine. He has authored *Practical Approach to Pediatric Intensive Care, IAP Protocols for Pediatric Intensive Care, Step by Step Pediatric Bronchoscopy*, in addition to *Pediatric and Neonatal Mechanical Ventilation*. In December 2024, he has received distinguished services award by IMA for contribution to pediatric emergencies, intensive care and conducting ventilation workshops in the entire country.

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