



Department of Anesthesia Techniques
Title of the lecture: - anesthesia for pediatric
and apgar score

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Anesthesia for pediatric and apgar score

(Practical Anesthesia)

3^{ed} stage

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Pediatric Anesthesia

Definitions:

- Neonate (0–1 months)
- Infant (1–12 months)
- Toddlers (12–24 months)
- young children (2–12 years of age)

differentiate between neonates and infants to adult patients

Physiological

1. Heart rate dependent cardiac output.
2. Reduced BP, Increase HR.
3. Reduced FRC, Increased RR
4. Increased metabolic rate
5. The neonate has limited responses to cold (vasoconstriction rather than shivering) and there is an increased propensity to bradycardia

Age	Respiratory Rate	Heart Rate	Arterial Blood Pressure	
			Systolic	Diastolic
Neonate	40	140	65	40
12 months	30	120	95	65
3 years	25	100	100	70
12 years	20	80	110	60

Anatomic

Larger head, shorter neck, Shorter trachea and larger tongue, High larynx, Noncompliant left ventricle, Difficult venous and arterial cannulation, Greater resistance to airflow, Thin skin, low fat content.

Pharmacological

1. Immature hepatic biotransformation
2. Decreased blood protein for drug binding
3. more rapid induction and recovery from inhaled anesthetic
4. Increased minimum alveolar concentration

Total body water:

1. 70% to 83% of weight in premature babies and neonates.
2. 60% of weight in infants.

Pediatric patient's weight can be approximated based on age:

- < 1 month ~ 3 kg
- 1-12 months ~ (0.5 x age in months) + 4
- 1-5 years ~ (2 x age in years) + 8
- 6-12 years ~ (3 x age in years) + 7
- >12 years ~ Highly variable

Analgesic drugs:

Paracetamol >2 years (15 mg / kg I.V)

Ketorolac (0.5-0.75 mg / kg I.V)

Opioids and Hypnotics:

Fentanyl (0.5-1.5 mcg / kg I.V)

Ketamine (1-2 mg / kg I.V induction dose), (2-4 mg / kg I.M induction dose)

Propofol (2-2.5 mg / kg I.V)

Remifentanyl (0.05- 0.3 mcg / kg / min I.V infusion)

Thiopental (3-6 mg / kg induction dose)

Muscle Relaxants: muscle relaxants are less commonly used during induction of anesthesia in children than in adults.

All muscle relaxants generally have a faster onset (up to 50% less delay) in pediatric patients because of shorter circulation times.

Atracurium: (0.5 mg / kg I.V)

Rocuronium (0.6 mg / kg I.V)

Succinylcholine (1-2 mg /kg I.V), (4 mg / kg I.M)

Children may have profound bradycardia and sinus node arrest following the first dose of succinylcholine without atropine pretreatment.

Atropine (10-20 mcg / kg I.V)

Midazolam: sedative and hypnotic (0.05 mg / kg I.V) (0.15-0.1 mg / kg I.M)

Ephedrine (0.1-0.3 mg / kg I.V)

Neostigmine (40-70 mcg / kg I.V)

Nitroglycerine (Angised) (0.5-3 mcg / kg)

Preoperative Assessment for pediatric**1. assessed respiratory symptoms:**

- a. nasal drainage (clear or discolored yellow/green) as well as cough (dry or productive and color of sputum).
- b. lethargy, and fever for correlation with respiratory complications, including bronchospasm and laryngospasm.

2. Neurological examination: should focus on the child's activity level and note any anomalies such as weakness of extremities, or abnormal appearance.

3. **The cardiovascular examination:** auscultation of the heart sounds, noting that heart murmurs are common in newborns (patent ductus arteriosus continuous murmur, patent foramen ovale, atrial septal defect, and ventricular septal defect).

4. **Pulmonary examination:** focuses on determining the presence of abnormal air movement, including absent breath sounds, wheezing, or coarse breath sounds.

Fasting Guidelines:

Clear liquids should be allowed up to 2 hours'	Breast milk 4 hours
Formula 6 hours	Solids about 8 hours or longer

Premedication

premedication with a benzodiazepine is an effective method to reduce anxiety.

Induction of Anesthesia: it is divided into three types:

1. Inhalation Induction of Anesthesia

inhaled induction of anesthesia has a number of advantages in children. It is painless and it is successful on the first attempt (whereas intravenous cannulation has an inherent failure rate).

2. Intravenous Induction

Is typically preferred in children who have established venous access.

3. Intramuscular Induction

IM injection of ketamine may be the best option in these circumstances.

Pediatric Airway Management

1. intubation of the trachea in children is performed following induction of anesthesia and administration of a non-depolarizing neuromuscular blocker.

2. Intubation for trachea under deep anesthesia without neuromuscular blockade. This can be done with deep sevoflurane anesthesia alone, but it is also often performed with a propofol or opioid, Insufficient depth of anesthesia without neuromuscular blockade may result in coughing, laryngospasm, oxyhemoglobin desaturation, and regurgitation.



Why prefer un-cuffed tube in Pediatric patients?

1. Because the airway and larynx in Pediatric are funnel-shaped and therefore the trachea is narrow and therefore it is difficult to enter the cuffed Tube
2. Because the trachea in Pediatric is soft tissue, it cannot bear the high pressure of the cuffed tube, and it can lead to ischemia or necrosis.

❖ Straight blade is better to use than curved blade for children, because:

- ✓ epiglottis (may be large and floppy and difficult to pull out of view).
- ✓ Larynx higher in neck.
- ✓ Un-cuffed tubes are commonly used for long-term ventilation in the neonatal intensive care unit (NICU).

❖ The advantages of cuffed endotracheal tubes are:

- a) Allows for lower fresh gas flows.
- b) Improves ventilator performance, and may offer greater protection from macro aspiration.

❖ The modified Cole's formula is used for estimating endotracheal tube sizes over 1 year

- a) for un-cuffed ETT = $(4 + \text{age} / 4)$
- b) for cuffed ETT = $(4 + \text{age} / 4) - 0.5$

❖ Depth:

- a) Neonate <1500 g = 2.5 mm
- b) 1500-3000 g = 3 mm
- c) over 3000 g = 3.5 mm.
- d) Depth of ETT in CM is given by the formula $(6 + \text{weight in kg})$.

Laryngeal mask airway (LMA): They are useful in short procedures with spontaneous ventilation. Approximate sizes are:

- (1) for less than 6.5 kg.
- (2) for 6.5-20 kg.
- (2.5) for 20-30 kg.
- (3) for 30 kg and above.

Fluid and Blood Management:

A. Intravenous Fluid Requirements: in fasting children are usually determined using the 4-2-1 rule, the hourly infusion rate is calculated as:

- ✓ 4 mL/kg for the first 10 kg
- ✓ 2 mL/kg for the second 10 kg
- ✓ 1 mL/kg for each additional kilogram

B. Blood Loss Replacement and Transfusion

Blood loss is replaced with crystalloids (without glucose). Red blood cell transfusion is indicated when the hemoglobin is below 7 g/dL and is often indicated sooner depending on the age of the patient and clinical scenario.

Table 33-6 Pediatric Blood Component Administration

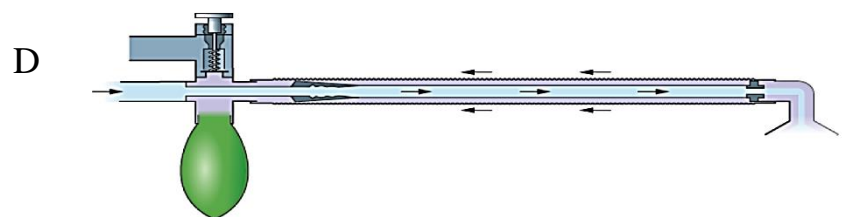
Component	Dosing Guideline	Comments
PRBCs	5–10 mL/kg	Expected hemoglobin increase of 1–1.5 g/dL for every 5 mL/kg. Infants/small children at risk of hyperkalemia with rapid infusion of PRBCs with prolonged storage during hypovolemia. Consider fresh/washed PRBCs when anticipated.
FFP	10–15 mL/kg	During massive hemorrhage dilutional coagulopathy of soluble clotting factors develops after >1 blood volume of loss; FFP treatment recommended.
Platelets	10–15 mL/kg	Usually indicated for platelet counts <50,000/ μ L; higher thresholds may be used for certain procedures (e.g., neurosurgery).
Cryoprecipitate	0.1 units/kg	Indicated for fibrinogen levels <80–100 mg/dL.

PRBC, packed red blood cells; FFP, fresh frozen plasma.

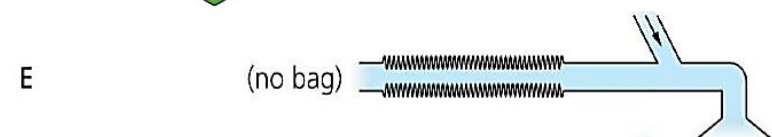
Breathing system used in pediatric

Common breathing systems used in pediatric practice include Ayre's T-piece (Mapleson E), Jackson-Rees modification (Mapleson F), Bain systems and circle. The Mapleson F system remains the mainstay of pediatric anesthesia.

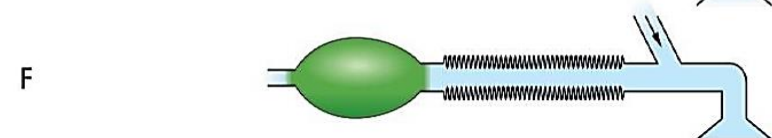
Bain system



Ayre's T-piece



Jackson-Rees modification



Important Notes: Laryngospasm can usually be avoided by extubating the patient either:

1. during awake.
2. deeply anesthetized; both techniques have advocates.

Extubation during light anesthesia is generally recognized as more hazardous.

Apgar score in pediatric

The Apgar score is a quick way for doctors to evaluate the health of all newborns at 1 and 5 minutes after birth and in response to resuscitation.

		0 point	1 point	2 points	
A	Appearance (Skin color)	blue or pale	blue at extremities, body pink	no cyanosis and body pink	Appearance
P	Pulse rate	absent	< 100 bpm	≥ 100 bpm	Pulse
G	Grimace (Reflex irritability)	no response to stimulation	Minimal response to stimulation	cry on stimulation	Grimace
A	Activity (Muscle Tone)	absent	some flexion	flexed arms and legs that resist extension	Activity
R	Respiratory effort	absent	weak, irregular, gaspings	strong, robust cry	Respiration