Chapter 1

Normal Parameters for Pediatric Anesthesia

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As compared to adults, the "normal values" for a variety of physiologic measurements change throughout development. Listed in this chapter is a rough guide to be used in the anesthesia care of children. As always, the patients' baseline and co-existing illness should be carefully considered when choosing a baseline.

Table 1.1 What are the normal values for heart rate in children?

Age	Awake heart rate	Asleep heart rate
Neonates <1 month	100–125	90–160
Infants (1–12 months)	100–180	90–160
Toddlers (1–2 years)	100–140	80–120
Preschool aged (3–5 years)	80–120	65–100
School aged (6–12 years)	75–120	60–90
Adolescents (12–15 years)	60–100	50–90

Table 1.2 What are the normal values for blood pressure in children?

Age	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)	Mean arterial pressure (mmHg)
Birth (LBW)	40–60	15–35	30–40
Birth (3 kg, term)	60–75	31–45	45–60
Neonates	65–85	35–55	45–60
Infants (1–12 months)	70–105	35-55	50–65
Toddlers (1–2 years)	85–105	40–65	50–60
Preschool aged (3–5 years)	90–110	45–70	60–70
School aged (6–12 years)	95–115	55–75	65–70
Preadolescents (10–12 years)	100–120	60–80	70–80
Adolescents (12–15 years)	110–130	65–85	75–85

Table 1.3 What are the normal values for respiratory rate in children?

Age	Respiratory rate (breaths/min)
Infants	30–55
Toddlers	22–35
Preschool aged	20–28
School aged	18–25
Adolescents	12–20

Table 1.4 What are normal values for estimated blood volume in children?

Age	Estimated blood volume (mL/kg)
Premature infants	**100**
Term neonates (<1 month)	**90**
1–12 months	**80**
Older children	**75**
Adolescents/Adults	**70**

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Table 1.5 Basic equipment sizes in children

Age	ETT size	Laryngoscope	Oral airway	Mask size	BP cuff size
<1 month 3–5 kg	3.0	Miller 0–1	40	1	Neonate/#5
1–5 months 6–7 kg	3.0/3.5	Miller 1–1.5	40/50	1,2	Pediatric
6–11 months 10–11 kg	3.5/4.0	Miller 1–1.5	50/60	2	Pediatric
1–3 years 12–14 kg	4.0/4.5	Miller 1–1.5	60	3	Pediatric
4–5 years 15–18 kg	5.0/5.5	Miller 1.5–2	60	3,4	Pediatric
6–7 years 15–18 kg	5.5/6.0	Miller 1.5–2	60	4	Pediatric
8–9 years 19–23 kg	6.0/6.5	Miller 2, MAC 2	60/70	4	Pediatric
10–12 years 24–29 kg	6.0/6.5	Miller 2, MAC 2	70/80	4,5	Pediatric
>12 years 30–35 kg	5.5/6.0/6.5	Miller 2, MAC 3	70/80	5	Pediatric/small adult

Table 1.6 Perioperative NPO guidelines

Clear liquids	**2 hours**
Breast milk (nonfortified)	**4 hours**
Nonhuman milk	**6 hours**
Light meal	**6 hours**
Full meal	**8 hours**

Table 1.7 Minimum alveolar concentration of anesthetic agents

	Infant	Child	Adult
Isoflurane	1.6	1.3–1.5	1.1
Desflurane	9.2	8.1	6.0
Sevoflurane	3.3	2.5	2.0

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Table 1.8 Analgesics

Agent	Oral dose	IV dose	Continuous infusion
Morphine	0.2 mg/kg	0.1–0.2 mg/kg	0.01–0.05 mg/kg/h
Hydromorphone	-	0.01–0.03 mg/kg	0.25–6 mcg/kg/h
Fentanyl	-	1–2 mcg/kg	0.25–2 mcg/kg/h
Sufentanil	-		0.2–1 mcg/kg/h
Remifentanil	-	-	0.05–0.2 mcg/kg/min
Hydrocodone	0.1–0.15 mg/kg	-	-
Methadone	-	0.05–0.1 mg/kg	-
Acetaminophen	10–15 mg/kg		
Ibuprofen	5–10 mg/kg		
Codeine	**Not recommended for use in children**		
Ketorolac	0.5 mg/kg Max 30 mg	0.5 mg/kg Max 30 mg	-
Ketamine	-	0.5–2 mg/kg	5–20 mg/kg/h

Table 1.9 Commonly used drugs

Medication	Dose	Notes
Adenosine	0.1 mg/kg	May repeat × 2 at 0.2 mg/kg
	Maximum 6 mg	Maximum 12 mg
Amiodarone	5 mg/kg	Bolus for VF or pulseless VT
		Over 30–60 min for stable SVT/VT
Atropine	0.02 mg/kg	
Calcium chloride	10–50 mg/kg	
Cisatracurium	0.1–0.2 mg/kg	
Dexamethasone	0.5 mg/kg PO/IM/IV	Max 16 mg
Dexmedetomidine	0.2–0.5 mg/kg/h	0.25–1 mcg/kg bolus
Diazepam	0.05–0.1 mg/kg q6–8 hrs	
Epinephrine	0.01 mL/kg	Anaphylaxis
	0.1 mg/kg	Cardiac arrest
Furosemide	0.5–2 mg/kg	
Glycopyrrolate	0.01–0.02 mg/kg	
Hydrocortisone	100 mg/m^2 BSA	Adrenal insufficiency
Insulin	0.05–0.1 Units/kg bolus	0.05–0.1 Units/kg/h
Magnesium sulfate	25–50 mg/kg	
Methylprednisolone	1–2 mg/kg	
Metoclopramide	0.1 mg/kg q 6 hrs	
Midazolam IV	0.02–0.1 mg/kg/h	0.1–0.2 mg/kg bolus
Midazolam PO	0.5–1.0 mg/kg	15–20 mg/kg Max
Nicardipine	0.5–4 mcg/kg/min	
Ondansetron	0.1 mg/kg q 6 hrs prn	
Sodium bicarbonate	0.5–1 mEq/kg	
Rocuronium	0.5–1.2 mg/kg	
Vecuronium	0.05–0.2 mg/kg	

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Table 1.10 Antibiotics (defer to institutional dosing for perioperative antibiotic administration)

	Dose	Max dosing	Redosing schedule
Ampicillin	50 mg/kg*	2 grams	q2 hrs × 2 then q6 hrs
Cefazolin	25–30 mg/kg	2 grams	q4 hrs × 2 then q8 hrs
Cefoxitin	30–40 mg/kg	2 grams	q2 hrs × 2 then q6 hrs
Clindamycin	10 mg/kg	900 mg	q6 hrs × 2 then q8 hrs
Gentamicin	2.5 mg/kg	120 mg	per institutional protocol
Piperacillin-Tazobactam	100 mg/kg	3 grams	q2 hrs × 2 then q6 hrs
Vancomycin	10–15 mg/kg over 60 minutes	1 gram	per institutional protocol

* **50 mg/kg for infective endocarditis prophylaxis**

Table 1.11 Commonly used doses of blood, fluid, and factors

	Dose
Packed red blood cells	10–20 cc/kg
Platelets	10–20 cc/kg
Plasma	10–20 cc/kg
Factor 7 concentrate	90 mcg/kg/dose may repeat twice
Vitamin K	Adults 10 mg IM, infants 1 mg IM
Albumin 5%	5–10 cc/kg
Lactated Ringer's, 0.9% saline	10–30 cc/kg initial bolus

Table 1.12 Commonly used doses for neurologic surgery

	Dose
Phenytoin	15–20 mg/kg IV loading dose over 15 minutes
Levetiracetam (Keppra)	10 mg/kg IV loading dose over 15 minutes
Mannitol	0.5–1 g/kg
Furosemide	1–2 mg/kg
3% Saline – Hypertonic Saline	3 cc/kg over 30 minutes – with Na^+ monitoring following

Table 1.13 Commonly used doses of cardiovascular drugs

	Dose
Atropine	0.02 mg/kg
Alprostadil	0.01–0.1 mcg/kg/min
Calcium chloride	10–50 mg/kg
Dopamine	1–10 mcg/kg/min
Epinephrine	0.01–0.5 mcg/kg/min
Esmolol	50–1000 mcg/kg/min
Lidocaine	10–50 mcg/kg/min
Milrinone	0.25–1 mcg/kg/min
Nicardipine	0.5–4 mcg/kg/min
Nitroglycerin	0.5–20 mcg/kg/min
Nitroprusside	0.3–10 mcg/kg/min
Norepinephrine	0.01–2 mcg/kg/min
Phenylephrine	0.1–10 mcg/kg/min
Vasopressin	0.1–0.5 milli-Units/kg/min

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Table 1.14 Patient controlled analgesia

	Morphine	Fentanyl	Hydromorphone
Loading dose	0.1 mg/kg	0.5–1 mcg/kg (max 25 mcg)	5–15 mcg/kg
Continuous infusion	0.01–0.03 mg/kg/h	0.1 mcg/kg/h	1.5 mcg/kg/h
Bolus dose (PCA)	0.015–0.025 mg/kg	0.14–0.28 mcg/kg	3–5 mcg/kg
Lockout interval	6–12 minutes	6–10 minutes	6–15 minutes
4-hour max dose	0.25–0.35 mg/kg	2.8 mcg/kg	50–60 mcg/kg

Suggestions for opioid naïve patients
Bolus dosing should be adjusted for degree of pain reduction with bolus
Lockout interval should be adjusted for duration of pain control following bolus
Nalbuphine: 10–20 mcg/kg IV every 6 hrs for opioid induced pruritus
Naloxone infusion: for opioid induced pruritus 0.1–0.25 mcg/kg/h; consider switching opioid
Naloxone bolus: for respiratory depression 0.01 mg/kg – stop opioid infusion – continuous SpO_2 monitoring.

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