

Pediatric Anesthesia Pearls, rev. 2023

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NORMAL RANGE VITAL SIGNS FOR AGE						
Age	HR (beats/min)	BP sys/dias (mmHg) ^a		RR (breaths/min)		
Preemie	120 – 170	55-75 / 35-45 ^b		40 – 70		
0-3 mo	110 - 160	65-85 / 45-55		30 – 60		
3-6 mo	100 – 150	70-90 / 50-65		30 – 45		
6-12 mo	90 – 130	80-100 / 55-65		25 – 40		
1-3 yr	80 – 125	90-105 / 55-70		20 – 30		
3-6 yr	70 – 115	95-110 / 60-75		20 – 25		
6-12 yr	60 – 100	100-120 / 60-75		14 – 22		
>12 yr	60 – 100	100-120 / 70-80		12 – 18		
^a BP varies by age, height, and sex. Values listed are approximations only.						
^b In premature infants, the gestational age approximates the normal MAP						
CALCULATIONS TO ESTIMATE BLOOD PRESSURE BY AGE						
	50 th %tile		5 th % tile			
Systolic BP	90 + (age x 2)		70 + (age x 2)			
MAP	55 + (age x 1.5)		40 + (age x 1.5)			
AVERAGE WEIGHTS						
Age	Preemie	NB	3 mo	9 mo	12 mo	2-10 yr
Wt(kg)	0.5-1.5	3.5	6	9	10	2 x (age+4)
INTRAVASCULAR CATHETER SIZES						
Arterial Catheter						
Weight		Arterial Catheter Size		Comments		
> 10 kg		24 g or 2.5 F, 2.5 cm		• Sterile prep and drape • If femoral, use 3 Fr, 5 cm for infants		
10-40 kg		22 g or 2.5 F, 2.5 - 5 cm				
> 40 kg		22g or 20 g				
Central Venous Catheter						
Weight		Catheter Size		Comments		
> 2-3 kg		3 Fr 5 cm		• Sterile prep, full barrier precautions • Post-insertion CXR to confirm placement before use • Catheter length calculation: Height < 100 cm=Height/10-1 Height > 100 cm=Height/10-2		
3-4 kg		4 Fr 5 or 8 cm				
5-10 kg		4 Fr 8 or 12 cm				
10-12 kg		5 Fr 8 or 12 cm				
12-40 kg		5 Fr 12 cm or 7 Fr 15 cm				
> 40 kg		7 Fr 15 cm				

PEDIATRIC AIRWAY				NG AND Chest Tube (Fr)	
Age	ETT	DL-Scope	LMA	NG	Chest Tube
Preemie	2.5-3	Mil 0	1	5	10-12
NB	3	Mil 0	1	8	10-12
6 mo	3-3.5	Mil 1 , Wis 1	1.5	8	12-18
1 y	3.5	Mil 1, Wis 1	2	10	16-20
2-3 y	4	Wis 1, Mac 2	2	10-12	16-24
4-6 y	4.5-5	Mil 2, Mac 2	2.5	12-14	20-28
7-10 y	5.5-6	Mil 2, Mac 3	2.5-3	12-14	20-32
11-15 y	6.5-7	Mil 2, Mac 3	3	14-18	28-38
≥ 16 y	7-7.5	Mil 2, Mac 3-4	4-5	14-18	28-42
ET Tube Position from Lip to Mid-Trachea					
Newborn 1-2-3 / 7-8-9 Rule 1 kg→7 cm; 2 kg→8 cm; 3 kg→9 cm			ETT Depth Formula = ETT I.D. x 3		
Initial Vent Settings					
F_IO₂: 0.5; certain cardiac lesions should receive room air Time-cycled/Pressure-limited ventilator: PIP 15-20 cm; higher if CLD Time-cycled/Volume-limited ventilator: Tidal volume: 7-9 mL/kg PEEP: 4-5 for nl lungs; higher for pneumonia, ARDS, pulm edema Rate: Adjust normal values for age and according to disease state I:E ratio: Normal 1:2. May need prolonged E phase in obstructive lung disease or prolonged I phase in ARDS, pneumonitis & pulmonary edema					
FLUID RESUSCITATION					
Hourly Maintenance: 4 mL/kg for first 10kg; 2 mL/kg for second 10kg; 1 mL/kg thereafter • Shortcut: if wt. > 20kg then = 40 mL + wt. • < 2 years of age may need dextrose (D2.5 or D5) • If on TPN/PAS, continue the infusion intraop; check glucose prn Fluid Resuscitation: 20 mL/kg, isotonic solution (LR, Plasmalyte, NS), no dextrose. Repeat as needed. Administer Albumin 5% 10 mL/kg, if appropriate. Fluid Resuscitation for Burns: 4 mL x weight (kg) x TBSA burned = total fluids for first 24 hr. Administer isotonic fluid; give 1/2 over the first 8 hr then the remaining 1/2 over the next 16 hr in addition to maintenance fluids.					

Hematology and Transfusion Pearls	
Total Blood Volume (TBV) = weight (kg) x blood volume per kg	
Age	Blood Volume per kg
Preemie	100 mL/kg
Term NB	90 mL/kg
6-month	80 mL/kg
1-year	75 mL/kg
Adolescent	65-70 mL/kg
Allowable Blood Loss (ABL) = (Hb pre – Hb post) x TBV (Hb pre + Hb post) / 2	
- Immunosuppressed or transplant pts: irradiate to ↓ risk of GVHD - Pt likely to undergo BMT (AML, aplastic anemia, neuroblastoma, high risk ALL) use CMV negative products until CMV status is known - Sickle cell or thalassemia pt: Phenotypically matched products; true for any pt requiring long-term transfusion support	
Cryo-precipitate	- Dose: 1 unit / 5-10 kg - Increases fibrinogen by 50 mg/dL - Contains von Willebrand (vW) factor, Factor 8, 13, fibrinogen Indications: fibrinogen replacement, bleeding due to vW disease, Factor 8 or 13 deficiency
Plasma (FFP)	- Dose: 10-15 mL/kg - Replaces 20-30% of factors - Contains plasma proteins from 1 unit whole blood Indications: Coumadin reversal, vit K deficiency, ↓ multiple coagulation factors (DIC, liver disease)
Red blood cells (RBC)	- Dose: 10-20mL/kg 10mL/kg ↑ Hct by 10% and ↑ Hgb by 2-3 g/dl - To calculate amount needed: (Desired Hb – Actual Hb) x (wt in kg) x 4
Platelets (Pit)	< 20 kg: ½ unit single donor platelet pheresis (SDPP) > 20 kg: 1 unit SDPP 1 SDPP = 6-8 random donor units 1 random donor unit / 10 kg ↑ plt count by 50K

Malignant Hyperthermia
Signs: Tachycardia, arrhythmias, ↑ETCO ₂ , ↑temp, hypoxia, fasciculations, rigidity, hyperK ⁺ , myoglobinuria, acidosis Treatment: CALL FOR HELP; Hotline (800) MH-HYPER; MHAUS.org - Hyperventilate with 100% oxygen, stop surgery and anesthesia - Dantrolene 2.5 mg/kg as needed, 1 mg/kg q6h when stable - Cool to < 38°C: Iced IVF, lavage stomach/rectum, ice packs - Labs: ABG, Na, K, iCa, glucose, CPK, DIC profile - Treat acidosis and hyperkalemia (hyperventilation, NaHCO₃) - Maintain urine output > 2 mL/kg/h with hydration and diuretics - Avoid calcium channel blockers
Local Anesthetic Systemic Toxicity (LAST)
BOLUS 1.5 mL/kg Lipid Emulsion 20% (Intralipid) <i>rapidly over 2-3 min</i> INFUSION: 0.25 mL/kg/min Lipid Emulsion 20% <i>*Re-bolus and/or double infusion if necessary; dosing limit 12 mL/kg</i> Reduce epinephrine boluses to ≤ 1 mcg/kg; avoid large doses of propofol; control seizures w/ BZDs; treat hypotension/bradycardia and start CPR if necessary; avoid hyperventilation; alert nearest CPB team.
SBE Prophylaxis
Indications: 1. Prosthetic or bioprosthetic valve, shunt or conduit 2. Previous history of endocarditis 3. Congenital Heart Disease (CHD): unrepaired or palliated CHD; repaired CHD within the past 6 months; repaired CHD with residual defects 4. Heart transplant recipients with documented valvulopathy Indicated for dental procedures involving manipulation of gingival tissue or perforation of oral mucosa; respiratory tract procedures involving incision or biopsy of respiratory mucosa.
Regional Anesthesia Pearls
Generally use 0.2% ropivacaine, with or without 1:200,000 epinephrine Caudal: For procedures below umbilicus, 0.5 – 1 mL/kg Epidural: Test dose 0.1 mL/kg (max 3 mL) of lidocaine with epi + Test dose: ↑HR ≥ 10 bpm, ↓SBP ≥ 15 mmHg, or ↑ T wave amplitude ≥ 25% with epi - Infusion: ropivacaine 0.8-1.6 mg/kg/h Adjuncts: clonidine (1-2 mcg/kg), fentanyl (1-2 mcg/kg)



Electrical Countershock

Defibrillation: 1st shock 2 J/kg, 2nd shock 4J/kg, repeat up to 10 J/kg per shock	Synch cardioversion: 1st shock 0.5-1 J/kg; 2nd shock 2 J/kg
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Electrolyte Abnormalities

	Treatment	Work-Up
↑Ca	- Loop diuretics - IV fluids at 2-3x maintenance - Bisphosphonates + calcitonin	CMP, PO, Mg, PTH, Vit D, urine Ca, Cr, PO ₄ , EKG
↑K	- Dextrose: 1-2 g/kg IV (neonates 10%; pediatric 25%) - Insulin: 0.1 Unit/kg IV - CaCl₂ : 10-20 mg/kg IV - NaHCO₃: 1-2 mEq/kg IV - Kayexalate:1-2 g/kg/dose NG/PR	CMP, ABG, CK, UA, urine electrolytes (Na, K, Cl), EKG
↑Na	- NS bolus if severely dehydrated - Correct Free Water Deficit (FWD) over 24-48 h with D5 ¼ or ½ NS; Goal=10-15 mEq/L per 24h	4 mL FW/kg = Na 1 mEq/L; FWD = 0.6 x wt x ([current Na/140] – 1)
↓Ca	- CaCl: 10-20 mg/kg q10 min; max 500 mg/dose - Ca Gluconate: 100 mg/kg q10 min (max 4 g/dose) - Mag Sulfate: 25-50 mg/kg (max 2.5 g/dose)	CMP, PO ₄ , Mg, iCa, Vit D, PTH, urine protein/ Ca/ Cr/ PO ₄ EKG, L wrist Xray
↓Glu	- Peripheral: 5 mL/kg D10 - Central: 2 mL/kg D25 or 1 mL/kg D50 - Infusion: 6-8 mg/kg/min of D10 (= 3.6-4.8 mL/kg/min) - If requiring >10-15 mg/kg/min consider hyperinsulinemia & start either diazoxide: 3-8 mg/kg/day PO div q12 h, or octreotide: 10 mcg/kg IV or SQ q 6-8 h	Draw critical labs when glu ↓ : insulin, C-peptide, cortisol, GH, free fatty acids, lactate, serum acetone, LFTs, ammonia, & urine glucose, ketones

IMPORTANT PHONE NUMBERS			
OR Coordinator	72777	Crit Care Lab	56171
Charge Nurse	667-776-6801	OR 401	75122
OR Front Desk	56520	OR 402	27779
CCT Emergency	443-301-8291	OR 403	74134
Pre-Op	25890	OR 404	75123
PACU	55722	OR 405	74138
PICU	55260	OR 406	75121
NICU	55255	OR 407	73870
MRI	73415	OR 408	73873
CT	73393	OR 409	52781
IR	45094	OR 410	73876
Blood Bank	56580	OR 411	73288
Peds Pharmacy	55926	OR 412	72762

INTRAOPERATIVE ANTIOTBIOTIC GUIDELINES		
Please consult Intranet for specific antibiotic selection & dosing regimens.		
COMMON PEDIATRIC DRUGS AND DOSES		
Drug	Route	Dose
Acetaminophen	PO	10-15 mg/kg q 4-6h
	PR	20-40 mg/kg
	IV	10-15 mg/kg q 6H <i>Neonates <28 days: 10mg/kg q 6H</i>
Adenosine	IV (<i>rapid</i> push with flush)	0.1 mg/kg, ↑ by 0.05 mg/kg to 0.25 mg/kg, MAX 12 mg or 0.3 mg/kg total dose
Albumin 5%	IV	10 mL/kg bolus (fluid resuscitation)
Albumin 25%	IV	1 g/kg (= 4 mL/kg)
Albuterol	Neb Continuous	0.15 mg/kg in 2 mL NS 0.5 mg/kg/hr; MAX 20-30 mg/hr
Aminocaproic Acid	IV Load Infusion	100-200 mg/kg over 30 min 10-33 mg/kg/hr thereafter
Amiodarone	IV Bolus Infusion	5 mg/kg over 5 min; MAX15mg/kg (300mg) 5-15 mcg/kg/min
Atropine	IV IM, PO	10-20 mcg/kg/dose 20-30 mcg/kg

Bupivacaine 0.25% + 1:200,000 epi	Caudal Lumbar Thoracic Regional Re-dose Epid infusion	1 mL/kg (MAX 15 mL) 0.5 mL/kg 0.3 mL/kg 0.5-1 mL/kg 2/3 initial volume every 90 min 0.2-0.4 mL/kg/h
	Butorphanol	IV, IM, IN 10-20 mcg/kg
	Calcium Chloride	IV 10-20 mg/kg; MAX 1g (<i>central line ONLY</i>)
	Calcium Gluconate	IV 30-100 mg/kg; MAX 3g
	Cisatracurium	IV Infusion Initial: 0.1-0.2 mg/kg; re-dose 0.03 mg/kg 0.06-0.24 mg/kg/h
	Clonidine	PO Epidural IV 4-5 mcg/kg 0.5 mcg/kg/h OR 1-3 mcg/kg bolus 1-2 mcg/kg (pain); 2 mcg/kg (PONV); 3 mcg/kg (shivering)
	Dantrolene	IV 2.5 mg/kg q 5 min, repeat PRN to max 10 mg/kg
	DDAVP	IV 0.3 mcg/kg
	Dexamethasone	IV Stridor: 0.2-0.5 mg/kg PONV: 0.1-0.4 mg/kg ↑ ICP: 1-2 mg/kg (MAX 25 mg)
	Dexmedetomidine	IV IN 0.5-2 mcg/kg load over 10 min, then 0.2-2 mcg/kg/h 2-3 mcg/kg
	Dextrose (25%)	IV 0.5 gm/kg = 2 mL/kg
	Dextrose/Insulin	HyperK+ Dextrose 2 mL/kg + insulin 0.1 U/kg
	Diazepam	PO IV 0.2-0.3 mg/kg 0.05-0.1 mg/kg
	Diphenhydramine	PO IV 1-2 mg/kg 0.25-1 mg/kg (MAX 50 mg/dose)
	Dobutamine	Infusion 2-20 mcg/kg/min
	Dopamine	Infusion 2-20 mcg/kg/min
	Enalapril	IV 5-10 mcg/kg q 8-24 hr
	Ephedrine	IV 0.2-0.3 mg/kg
	Epinephrine	IV, IO IV, IO ETT Infusion 1-10 mcg/kg (vasopressor) 10 mcg/kg (arrest) 100 mcg/kg 0.01-1 mcg/kg/min
	Epinephrine, racemic (2.25% sol)	Nebulizer <2 years/age: 0.25 mL in 3 mL NS ≥2 years/age: 0.5 mL in 3 mL NS

DISCLAIMER: This card is a guide only and is not intended to replace primary sources of information.

Esmolol	IV Infusion	0.5-1 mg/kg 25-300 mcg/kg/min
Etomidate	IV	0.3 mg/kg (0.2-0.6 mg/kg) induction dose
Fentanyl	IV, IN Infusion	1-2 mcg/kg increments 1-2 mcg/kg/h analgesia; 3-5 mcg/kg/h anesthesia
Flumazenil	IV	1-10 mcg/kg q 1 min (max 1 mg)
Fosphenytoin	IV	10-20 mg/kg load over 10-20 min
Furosemide (Lasix)	IV Infusion	0.5-2 mg/kg (give slow, ototoxic) 0.05 mg/kg/h, titrate to clinical effect
Gabapentin (Neurontin)	PO	5 mg/kg q day (day 1), 5 mg/kg BID (day 2), 5 mg/kg TID (day 3). Effective range 8-35 mg/kg/day. MAX 3.6 g/day
Glucagon	IM, IV	0.5 mg (<20 kg) or 1 mg (>20 kg)
Glycopyrrolate	IV, IM PO	10-15 mcg/kg dose q4h 40-100 mcg/kg/dose q6-8h
Haloperidol	IV, IM	10-30 mcg/kg
Heparin	IV Infusion	50-100 U/kg; CPB empiric load 350 U/kg 10-25 U/kg/hour; <i>follow ACT/PTT</i>
Hydralazine	IV	0.1-0.3 mg/kg q0.5-4hr; MAX 20 mg/dose; MAX 3.5 mg/kg/day
Hydromorphone	IV PO	10-30 mcg/kg q 3-6 h 50-80 mcg/kg q 3-6 h
Hypertonic Saline 2% via PIV 3% via CVC only	IV	Maintenance: ½ – ⅓ normal saline rate Bolus: 1-3 mL/kg over 20 min Monitor Na q1h
Ibuprofen (Motrin)	PO	10 mg/kg q 6h
Insulin	DKA Basal	0.1 U/kg/hr, add D10 when glucose<300 mg/dL 0.03-0.05 U/kg/h with D10 at 1xM, titrate 0.005-0.1 U/kg/h; hourly blood glucose
Ipratropium	Neb	250-500 mcg/dose q4-6h
Isoproterenol	Infusion	0.05-10 mcg/kg/min
	IV IM PO	0.5-2 mg/kg; dilute to 10 mg/mL for IV 2-3 mg/kg sedation; 5-8 mg/kg for GA 6 mg/kg May need atropine to ↓ secretions; midazolam to ↓ hallucinations
Ketorolac	IM, IV	0.5 mg/kg q6h; MAX 30 mg per dose

Labetolol	IV	0.1-1 mg/kg over 2 min; MAX 20mg; repeat q10 min or infuse at 0.4-3 mg/kg/h
Levetiracetam	IV	10 mg/kg
Lidocaine	IV, ETT Infusion	1 mg/kg, MAX 100 mg/dose; repeat 0.5-0.75 mg/kg q15 min to MAX 3mg/kg 10-50 mcg/kg/min; MAX 1-4mg/min MAX dose: 5 mg/kg plain; 7 mg/kg with epi
Lipid Emulsion 20% (Intralipid)	IV Infusion	Bolus: 1.5 mL/kg <i>rapidly</i> over 2-3 minutes Maintenance: 0.25 mL/kg/min *Dosing limit 12 mL/kg*
Lorazepam	IV, IM	0.03-0.15 mg/kg/dose; max 5 mg
Magnesium Sulfate	IV	25-50 mg/kg (over 10-30 min); MAX 2 g
Mannitol	IV	0.25-1 g/kg slow infusion for ↑ ICP 1-2 g/kg slow infusion for diuresis
Methadone	PO, IV	0.1-0.2 mg/kg q6h; MAX 10 mg/dose
Methyl- prednisolone	IV	Asthma: 1-2 mg/kg then 0.5-2 mg/kg q6h Spine: 30 mg/kg over 15 min, then 5.4 mg/kg/h Adrenal suppression: 1-2 mg/kg
Metoclopramide	IV, PO	0.1-0.2 mg/kg; 0.1-0.5 mg/kg/h
Midazolam	PO, PR IN IV	0.5-1 mg/kg; max 20 mg 0.2-0.3 mg/kg (undiluted) 0.05-0.1 mg/kg; 0.05-0.4 mg/kg/h
Milrinone	IV Load Infusion	25-50 mcg/kg over 20-60 min 0.25-1 mcg/kg/min thereafter
Morphine	IV Spinal/Epid	0.05-0.1 mg/kg increments 10-30 mcg/kg preservative-free
Naloxone	IV, IM, SQ	1-10 mcg/kg q2-3min
Neostigmine	IV	0.03-0.07 mg/kg, MAX 5 mg
Nicardipine	Infusion	0.5-5 mcg/kg/min
Nitroglycerin	Infusion	0.5-20 mcg/kg/min
Nitroprusside	Infusion	0.5-10 mcg/kg/min; caution cyanide toxicity
Norepinephrine	Infusion	0.05-2 mcg/kg/min
Ondansetron	IV, PO	0.15 mg/kg q4h; MAX 8 mg
Oxybutynin	PO	0.1 mg/kg/dose up to 3x/day
Oxycodone	PO	0.05-0.15 mg/kg q 4-6 hr; MAX 5 mg/dose
Phenylephrine	IV Infusion	1-10 mcg/kg; up to 30 mcg/kg for Tet spell 0.5-2 mcg/kg/min

Potassium	IV	0.5-1 mEq/kg over 1-2 h
Prednisone	IV Infusion	2-6 mg/kg q 5min up to 15 mg/kg 20-80 mcg/kg/min (watch QRS)
Promethazine (Phenergan)	IV Intra-op IV, IM, PR	0.1-0.15 mg/kg single dose 0.25-1 mg/kg q 4-6 h (nausea)
Propofol	IV Infusion	2-5 mg/kg (induction dose) 75-300 mcg/kg/min
	IV	Tet spell: 0.15-0.25 mg/kg Dysrhythmia: 0.01-0.1 mg/kg/dose
Propranolol	PO	0.5-1 mg/kg/day divided q6-8h
Prostaglandin E ₁	Infusion	0.05-1 mcg/kg/min (monitor for apnea)
Protamine	IV	1 mg per 100 Units heparin for reversal
Ranitidine (Zantac)	PO IV	2 mg/kg BID, MAX 300 mg/day 1 mg/kg q6-8h, MAX 50 mg/dose
Recombinant Factor VIIa (Novoseven)	IV	90 (35-120) mcg/kg over 2-5 min 15-30 mcg/kg Factor VII deficiency
Remifentanyl	IV bolus Infusion	1-4 mcg/kg Sedation: 0.02-0.1 mcg/kg/min Gen Anesthesia: 0.2-0.8 mcg/kg/min
Rocuronium	IV, IM Infusion	0.5-1.2 mg/kg RSI: 1.2 mg/kg IV or 1.8 mg/kg IM 0.16-1.2 mg/kg/hour
Ropivacaine 0.2% +1:200,000 epi	Epidural Regional	0.5-1 mL/kg; repeat ⅔ dose q 90-120 min 0.5-1 mL/kg; MAX dose 3.5 mg/kg +/- epi
Scopolamine	IV, IM	6 mcg/kg, MAX 0.4 mg
Sodium Bicarbonate	IV	1-2 mEq/kg
Succinylcholine	IV, IM	1-2 mg/kg; 4 mg/kg IM laryngospasm
Sufentanyl	IV Infusion	0.1-1 mcg/kg bolus 0.1-1 mcg/kg/hour
		≥ 2 twitches on TOF: 2 mg/kg
Sugammadex	IV	1-2 post-tet twitches, no TOF: 4 mg/kg Rescue after 1.2 mg/kg roc: 16 mg/kg
Terbutaline	SQ IV	5-10 mcg/kg q15min x2, MAX 250 mcg Load 10 mcg/kg; Inf 0.2-10 mcg/kg/min
Tranexamic Acid	IV load Infusion	10-50 mg/kg over 15 min 1-10 mg/kg/hr thereafter
Vasopressin	IV, IO Infusion	0.5 units/kg/dose 0.3-2 milliUnit/kg/min
Vecuronium	IV bolus Infusion	0.1 mg/kg 0.06-0.18 mg/kg/hr
Verapamil	IV	0.1-0.2 mg/kg