



PediCrisis



CRITICAL EVENTS CARDS

Call for help!

Code Team _____
 PICU _____
 Fire _____
 Overhead STAT _____
 ECMO _____

Notify surgeon.

Air Embolism	2
Anaphylaxis	3
Anterior Mediastinal Mass	4
Bradycardia	5
Cardiac Arrest	6-8
Difficult Airway	9
Fire: Airway / OR	10-11
Hyperkalemia	12
Hypertension	13
Hypotension	14
Hypoxia	15-16
Intracranial Pressure	17
Local Anesthetic Toxicity	18
Loss of Evoked Potentials	19
Malignant Hyperthermia	20
Myocardial Ischemia	21
Pulmonary Hypertensive Crisis	22
Tachycardia	23
Tension pneumothorax	24
Transfusion & Reactions	25-26
Trauma	27

Air Embolism

↓ EtCO₂ ↓ SaO₂ ↓ BP

- Stop nitrous oxide and volatile agents. Increase O₂ to 100%.
- Find air entry point, stop source, and limit further entry.
 - Tell surgeon to flood wound with irrigation AND turn off all pressurized gas sources, e.g. laparoscope, endoscope
 - Check for open venous lines or air in IV tubing
 - Lower surgical site below level of heart (if possible)
 - Perform Valsalva on patient using hand ventilation
 - Compress jugular veins intermittently if head or cranial case
- If hypotensive, consider:
 - Vasopressor infusion (epinephrine 0.02-1 MICROgrams/kg/min, norepinephrine 0.05-2 MICROgrams/kg/min)
 - Chest compressions: 100/min to force air through lock, even if not in cardiac arrest
- If available, call for transesophageal echocardiography



Anaphylaxis

Rash, bronchospasm, hypotension

- Increase O₂ to 100%
- Remove suspected trigger(s)
 - If latex is suspected, thoroughly wash area
- Ensure adequate ventilation/oxygenation
- If HYPOTensive, turn off anesthetic agents

Common causative agents:

- Neuromuscular blockers
- Latex
- Chlorhexidine
- IV colloids
- Antibiotics

Purpose	Treatments	Dosage and Administration
To restore intravascular volume	NS or LR	10-30 mL/kg IV/IO, rapidly
To restore BP and ↓ mediator release	Epinephrine	<ul style="list-style-type: none">• 1-10 MICROgrams/kg IV/IO, as needed, may need infusion 0.02-0.2 MICROgrams/kg/min• Additionally, can give 10 MICROgrams/kg IM for depo effect
To ↓ bronchoconstriction	Albuterol (Beta-agonists)	4-10 puffs as needed
To ↓ mediator release	Methylprednisolone	2 mg/kg IV/IO MAX 100 mg
To ↓ histamine-mediated effects	Diphenhydramine	1 mg/kg IV/IO MAX 50 mg
To ↓ effects of histamine	Famotidine or Ranitidine	0.25 mg/kg IV 1 mg/kg IV

- If anaphylactic reaction requires laboratory confirmation, send mast cell tryptase level within 2 hours of event

Anterior Mediastinal Mass

- Increase O₂ to 100%

Intra-operative Treatments

Airway collapse

- Increase FiO₂
- Add CPAP for spontaneous ventilation; add PEEP for controlled ventilation
- Reposition to lateral or prone
- Ventilate via rigid bronchoscope

Cardiovascular collapse

- Give fluid bolus
- Reposition to lateral or prone
- Ask surgeon for sternotomy and elevation of mass
- Consider ECMO

Preoperative Considerations

High Risk Factors

- Diagnosis: Hodgkin's and non-Hodgkin's lymphoma
- Clinical signs: orthopnea, upper body edema, stridor, wheezing
- Imaging findings: tracheal, bronchial, carinal, or great vessel compression; SVC or RVOT obstruction; ventricular dysfunction; pericardial effusion

Anesthetic Plan

- Perform surgery under local anesthesia, if possible
- Pre-treat with irradiation or corticosteroids
- Maintain spontaneous ventilation and avoid paralysis
- Ensure availability of:
Fiberoptic and rigid bronchoscope
- Cardiopulmonary bypass or ECMO

Bradycardia

Definition:

Age < 30 days	HR < 100
≥ 30 days < 1 yr	< 80
≥ 1 yr	< 60

- Unstable: If hypotensive or pulseless, start chest compressions
 - Give epinephrine 10 MICROgrams/kg IV
 - Call for transcutaneous pacer (see inset)
 - ◆ Start pacing, when available
- If NOT hypotensive or pulseless:

Etiology	Treatment
Hypoxia (most common)	<ul style="list-style-type: none"> ■ Give 100% O₂ ■ Good ventilation ■ See 'Hypoxia' card
Vagal	<ul style="list-style-type: none"> ■ Atropine 0.01-0.02 mg/kg
Surgical Stimulation	<ul style="list-style-type: none"> ■ Stop stimulation ■ If laparoscopy, de-sufflate
Beta-Blocker Overdose	<ul style="list-style-type: none"> ■ Glucagon 0.05 mg/kg IV, then 0.07 mg/kg/hour IV infusion
Ca-Channel Blocker Overdose	<ul style="list-style-type: none"> ■ Calcium chloride 10-20 mg/kg IV or ■ Calcium gluconate 50 mg/kg ■ If ineffective, Glucagon at above doses

Instructions for PACING

1. Place pacing ECG electrodes AND pacer pads on chest per package instructions
2. Turn monitor/defibrillator ON, set to PACER mode
3. Set PACER RATE (ppm) to desired rate/min. (Can be adjusted up or down based on clinical response once pacing is established)
4. Increase the milliamperes (mA) of PACER OUTPUT until electrical capture (pacer spikes aligned with QRS complex; threshold normally 65-100mA)
5. Set final mA to 10mA above this level
6. Confirm pulse is present

Cardiac Arrest: Asystole, PEA

Non-shockable and/or pulseless cardiac arrest

- Start chest compressions (100 chest compressions/min + 8 breaths/min)
 - Place patient on backboard, maintain good hand position; if prone, see 'Prone CPR' card
 - Maximize EtCO₂ > 10 mmHg with force/depth of compressions
 - Allow full recoil between compressions
 - Switch with another provider every 2 min, if possible
 - Use sudden increase in EtCO₂ for ROSC. Do NOT stop compressions for pulse check
- Give 100% O₂. Turn off all anesthetic gases and infusions
- Start timer. Designate team leader. Assign roles
- Obtain defibrillator. Attach pads
- Give epinephrine 10 MICROgrams/kg IV q 3-5 min
- Check pulse and rhythm (q 2 min during compressor switch)
- If no pulse and still not a shockable rhythm (asystole, PEA), resume CPR
- If a shockable rhythm (VF, VT): see next card 'Cardiac Arrest: VF/VT'
- Check for reversible causes (Hs and Ts) early and often (see table)

Hs and Ts: Reversible Causes

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none">• Hypovolemia• Hypoxemia• Hydrogen ion (acidosis)• Hyperkalemia• Hypoglycemia• Hypothermia | <ul style="list-style-type: none">• Tension Pneumothorax• Tamponade (Cardiac)• Thrombosis• Toxin (anesthetic, β-blocker)• Trauma (bleeding outside surgical area) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

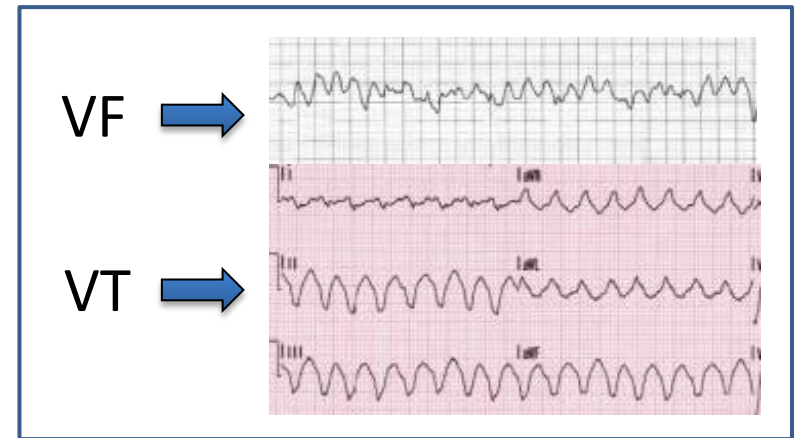
- If cardiac arrest > 6 min, activate ECMO (if available)

Cardiac Arrest: VF/VT

Shockable, pulseless cardiac arrest

7

- Start chest compressions (100 chest compressions/min + 8 breaths/min)
 - Place pt on backboard, maintain good hand position; if prone, see 'Prone CPR' card
 - Maximize EtCO₂ > 10 mmHg with force/depth of compressions
 - Allow full recoil between compressions
 - Switch compressor every 2 min
 - Use sudden increase in EtCO₂ for ROSC
 - Do NOT stop compressions for pulse check
- Give 100% oxygen. Turn off anesthetics
- Start timer. Designate team leader. Assign roles
- Obtain defibrillator. Attach pads. Shock 2-4 joules/kg
- Resume chest compressions immediately
- Epinephrine 10 MICROgrams/kg IV q 3-5 min while in arrest
- Check pulse & rhythm q 2 min during compressor change
- Check for reversible causes (Hs and Ts) early and often (see previous 'Cardiac Arrest' card)
- If VF/VT continue:
 - Shock 4 joules/kg
 - Resume chest compressions for 2 min regardless of rhythm
 - Check pulse & rhythm q 2 min during compressor switch
 - Repeat epinephrine 10 MICROgrams/kg IV q 3-5 min if VF/VT continue
 - If VF/VT continue 2 min after previous defib attempt, shock 4-10 joules/kg and resume chest compressions for 2 min; check pulse with compressor change; repeat sequence until ROSC
- Lidocaine 1 mg/kg bolus OR amiodarone 5 mg/kg bolus; may repeat (total of 2 doses)
- If cardiac arrest > 6 min, activate ECMO (if available)



Cardiac Arrest: Prone CPR

Chest compressions for patient in prone position

Children/Adolescents

- **If no midline incision:**

Compress with heel of hand on spine and second hand on top

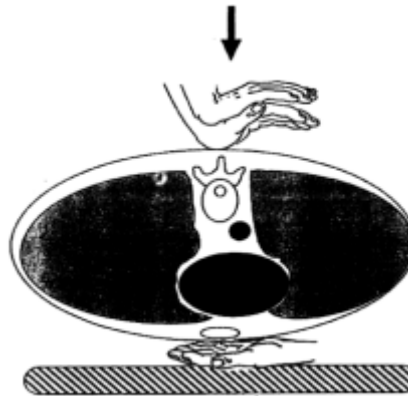


Figure 1

- **If midline incision:**

Compress with heel of each hand under scapula



Figure 2

Infants

Compress with encircling technique:

- **If no midline**

incision: thumbs midline

- **If midline incision:**

thumbs lateral to incision



Figure 3

Figure 1: From Dequin P-F et al. Cardiopulmonary resuscitation in the prone position: Kouwenhoven revisited. Intensive Care Medicine, 1996;22:1272

Figure 2: From Tobias et al, Journal of Pediatric Surgery, 1994;29, 1537-1539

Figure 3: Original artwork by Brooke Albright Trainer-Trainer, MD

Difficult Airway: After Induction

Unable to intubate or ventilate

- Increase O₂ to 100% and maintain continuous oxygen flow during airway management
- Call for airway cart, including surgical airway equipment
- Call for airway surgeon and HELP
- If unable to mask ventilate, ask for 2-handed assistance and:
 - Insert oral and/or nasal airway;
 - If unsuccessful, insert supraglottic airway (e.g., LMA)
- If able to re-establish pt spontaneous ventilation:
 - Consider reversing neuromuscular blocker
 - Consider awakening pt if surgery not started
- Consider alternative approach for intubation; limit to 2 attempts per operator (see table)



Alternative Approaches for Intubation	
<ul style="list-style-type: none">• Different blade• Re-position head• Different operator• Video-laryngoscope• Intubating LMA	<ul style="list-style-type: none">• Fiberoptic scope• Intubating stylet• Blind oral• Blind nasal

- If still unable to ventilate:
 - Emergency non-invasive airway (rigid bronchoscopy)
 - Emergency invasive/surgical airway

Fire: Airway

Fire in tracheal tube, circuit, canister

- Simultaneously:
 - Disconnect circuit from tracheal tube and remove tracheal tube
 - Stop all gas flow (O₂, N₂O)
 - Remove sponges and other flammable materials from airway
 - Pour saline into airway
- Re-intubate and re-establish ventilation
 - If intubation difficult, don't hesitate to obtain surgical airway
- Consider bronchoscopy to assess for thermal injury
 - Look for tracheal tube fragments
 - Remove residual material
- Impound all equipment and supplies for later inspection



Picture from ECRI: www.ecri.org

OR Fire (non-airway)

Fire in OR, equipment smoke, fumes, flash/fire on patient

11

- Simultaneously:
 - Stop flow of medical gases
 - Remove drapes and all burning and flammable material from patient
 - Make one attempt to extinguish fire by pouring saline on fire
- If fire not extinguished on 1st attempt, use CO₂ fire extinguisher
- If fire persists:
 - **Activate fire alarm**
 - Remove patient from OR
 - Confine fire by closing all OR doors
 - Turn off O₂ gas supply to OR
- Impound all equipment and supplies for later inspection



Picture from ECRI: www.ecri.org

Hyperkalemia

Serum K⁺ > 6 mEq/l

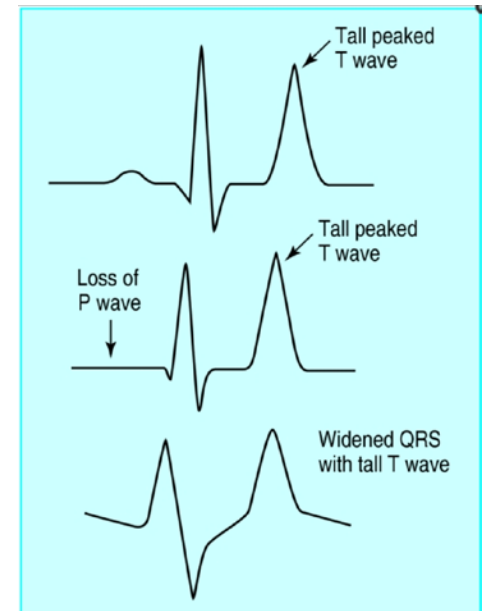
12

Treatment:

- If hemodynamically unstable, initiate CPR/PALS
- Hyperventilate with 100% O₂
- IV calcium gluconate 60 mg/kg or calcium chloride 20 mg/kg
- Flush tubing after calcium administration
- Stop K⁺ containing fluids (LR/RBC); switch to NS
- Sodium bicarbonate IV 1-2 mEq/kg
- Albuterol puffs or nebulized, once cardiac rhythm stable
- Dextrose IV 0.25-1 g/kg and insulin IV 0.1 Unit/kg
- Furosemide IV 0.1 mg/kg
- Terbutaline 10 MICROgrams/kg load, then 0.1-10 MICROgrams/kg/min
- If cardiac arrest > 6 min, activate ECMO (if available)
- Dialysis if refractory to treatment
- If transfusion required, use washed or fresh RBC

Manifestations:

- Tall peaked T wave
- Heart block
- Sine wave
- V fib or asystole



From: Slovis C, Jenkins R. BMJ 2002

Causes of Hyperkalemia:

- Excessive intake: massive or “old” blood products, cardioplegia, KCl infusion
- Shift of K⁺ from tissues to plasma: crush injury, burns, succinylcholine, malignant hyperthermia, acidosis
- Inadequate excretion: renal failure

Acute Hypertension

Sustained high blood pressure refractory to treating reversible causes

- In pediatrics, hypertension is almost always treated by addressing likely causes such as light anesthesia or measurement error:
 - Ensure correct BP cuff size: cuff bladder width ~ 40% of limb circumference
 - Ensure arterial line transducer is at level of heart
 - Consider placing arterial line if not already present

Hypertensive Blood Pressure Range*		
Age (yr)	Systolic	Diastolic
newborn	97-100	70
1-3	105-120	61-75
4-12	113-135	86-91

***CAUTION:** Anti-hypertensive drugs are almost never needed for routine pediatric cases. These medications are almost exclusively used for specialized cardiac, neurosurgical, or endocrine (pheochromocytoma) cases. Consult an expert before use.

Action	Drug (IV Dosing)
Direct smooth muscle relaxation	<ul style="list-style-type: none"> ■ Sodium nitroprusside 0.5-10 MICROgrams/kg/min ■ Hydralazine 0.1-0.2 mg/kg (adult dose 5-10 mg)
β-Adrenergic blockade	<ul style="list-style-type: none"> ■ Esmolol 100-500 MICROgrams/kg over 5 min, then 25-300 MICROgrams/kg/min ■ Labetalol (also α effect) 0.2-1 mg/kg q 10 min; 0.4-3 mg/kg/hour (infusion) ■ Propranolol 10-100 MICROgrams/kg slow push (adult bolus dose 1-5 mg)
α ₂ -Agonist	<ul style="list-style-type: none"> ■ Clonidine 0.5-2 MICROgrams/kg
Calcium channel blockade	<ul style="list-style-type: none"> ■ Nicardipine 0.5-5 MICROgrams/kg/min ■ Clevidipine 0.5-3.5 MICROgrams/kg/min
D1-dopamine agonist	<ul style="list-style-type: none"> ■ Fenoldopam 0.-0.5 MICROgrams/kg/min (MAX 2.5 MICROgrams/kg/min)

Hypotension

Sustained low blood pressure with patient at risk for end-organ hypoperfusion, typically > 20% below baseline

- Ensure oxygenation/ ventilation
- Turn anesthetic agents down or off
- Check cuff size and transducer position
- Consider placing arterial line if not already present
- Give appropriate treatment (see table below)

Age	< 5 th % Systolic BP (mmHg) *
Preemie	47– 57
0 – 3 mo	62 – 69
3 mo – 1 yr	65 – 68
1 – 3 yr	68 – 74
4 – 12 yr	70 – 85
> 12 yr	85 – 92

* Numbers are only a guide and vary for individual patients and situations

	↓ Preload	↓ Contractility	↓ Afterload
Causes	<ul style="list-style-type: none"> ▪ Hypovolemia ▪ Vasodilation ▪ Impaired venous return ▪ Tamponade ▪ Pulmonary embolism 	<ul style="list-style-type: none"> ▪ Negative inotropic drugs (anesthetic agents) ▪ Arrhythmias ▪ Hypoxemia ▪ Heart failure (ischemia) 	<ul style="list-style-type: none"> ▪ Drug-induced vasodilation ▪ Sepsis ▪ Anaphylaxis ▪ Endocrine crisis
Treatment	<ul style="list-style-type: none"> ▪ Expand circulating blood volume (administer fluids rapidly) ▪ Trendelenberg position ▪ Place or replace IV; consider intraosseous line 	<ul style="list-style-type: none"> ▪ Start inotrope infusion (dopamine, epinephrine, milrinone), as needed ▪ Review ECG for rhythm disturbances or ischemia ▪ Send ABG, Hgb, electrolytes 	<ul style="list-style-type: none"> ▪ Start vasopressor infusion: phenylephrine, norepinephrine ▪ Go to 'Anaphylaxis' card, if appropriate. ▪ Administer steroids for endocrine crisis

All Patients	Additional Items for Intubated Patients
<ul style="list-style-type: none"> ▪ Increase O₂ to 100% ▪ Check: <ul style="list-style-type: none"> • Oxygen flow • Airway patency • Breathing circuit connected and patent • Ventilation rate and depth adequate • Breath sounds: <ul style="list-style-type: none"> ◆ Wheezing ◆ Crackles ◆ Diminished or absent • Pulse oximeter working correctly • Presence of cardiac shunt • Possibility of embolus 	<p>Dislodged: Check ETT position</p> <ul style="list-style-type: none"> ▪ Mainstem ▪ Not in trachea <p>Obstructed: Suction ETT</p> <ul style="list-style-type: none"> ▪ Kinked ▪ Mucus plug <p>Pneumothorax: Listen to breath sounds</p> <ul style="list-style-type: none"> ▪ Decompress with large-bore angiocatheter in midclavicular line at 2nd or 3rd intercostal space. <p>Equipment</p> <ul style="list-style-type: none"> ▪ Check from patient to wall: <ul style="list-style-type: none"> • Oxygen flow • Valves • CO₂ canister • Inspect for disconnections and obstructions

Hypoxia with ↓ EtCO₂

↓ EtCO₂ ↓ SpO₂ ↓ BP

Respiratory Etiology	Low Cardiac Output State
<ul style="list-style-type: none">▪ Increase O₂ to 100%▪ Check:<ul style="list-style-type: none">• Airway patency• Breathing circuit connections:<ul style="list-style-type: none">◆ Check for kinked endotracheal tube• Breath sounds and chest excursion:<ul style="list-style-type: none">◆ Bilateral sounds and chest movement◆ Quality of breath sounds◆ Presence of wheezing or crackles• Gas analyzer connections; ensure power on• Excessive ventilation rate	<ul style="list-style-type: none">▪ Increase O₂ to 100%▪ Embolus: air, blood, fat<ul style="list-style-type: none">• See 'Air Embolism' card• Ask surgeon to flood surgical field with saline• Lower surgical site below heart▪ Low cardiac output or cardiac arrest<ul style="list-style-type: none">• If cardiac arrest, follow PALS algorithm• Support ventilation• Support blood pressure with IV saline (10-20 mL/kg bolus)• Turn off anesthetic agents

Increased Intracranial Pressure

- If GCS < 9, respiratory distress, hemodynamic instability:
 - Secure airway
 - Provide sedation prior to transport
 - Keep PaCO₂ 30-35 mmHg and PaO₂ > 60 mmHg
- Maintain cerebral perfusion pressure (CPP) > 50 mmHg
- Use vasopressors (phenylephrine or norepinephrine) as needed to maintain BP and CPP
- HOB at 30°
- Consider TIVA for anesthesia maintenance
- Give steroids as indicated
- Hypertonic saline (3% saline via central venous catheter) 1-3 mL/kg over 20 min, then 0.1-1 mL/kg/hour
 - Monitor serum sodium
 - Keep osmolarity < 360 mOsm/L
- Give mannitol 0.25-1 g/kg, to decrease ICP
- Consider seizure prophylaxis: Keppra (levetiracetam) 10 mg/kg IV
- **AVOID:**
 - Compression of neck vessels
 - Hyperthermia
 - Hyperglycemia & dextrose containing solutions (maintain glucose level < 200 mg/dL)
- Refractory elevated ICP treatment, consider:
 - Hyperventilation (PaCO₂ 28-35 mmHg)
 - Barbiturate coma
 - Paralysis with non-depolarizing agent

Local Anesthetic Toxicity

Hypotension, rhythm disturbance,
altered consciousness, seizures

- Stop local anesthetic
- Request Intralipid kit
- Secure airway and ventilation
- Give 100% O₂
- Confirm or establish adequate IV access.
- Confirm and monitor continuous ECG, BP, and SaO₂
- Seizure treatment:
 - Midazolam 0.05-0.1 mg/kg IV
 - Be prepared to treat resultant hypoventilation
- Treat hypotension with small doses of epinephrine 1 MICROgram/kg
- Start Intralipid therapy (see inset box)
- If cardiac instability occurs:
 - Start CPR/PALS
 - ◆ Continue chest compressions (lipid must circulate)
- Avoid vasopressin, calcium channel blockers and beta blockers
- Monitor and correct acidosis, hypercarbia and hyperkalemia
- Consider alerting nearest cardiopulmonary bypass/ECMO center and ICU if no ROSC after 6 min

Intralipid Dosing

- Bolus Intralipid 20% 1.5 mL/kg over 1 min
- Start infusion 0.25 mL/kg/min
- Repeat bolus every 3-5 min up to 3 mL/kg total dose until circulation is restored
- Increase the rate to 0.5 mL/kg/min if BP remains low or declines
- Continue infusion for 10 min after hemodynamic stability is restored.
- MAX total Intralipid 20% dose: 10 mL/kg over first 30 min

Loss of Evoked Potentials

Management of signal changes
during spine surgery

- Notify all members of health care team. Call a "time out"
- Loss of evoked potentials (EP) requires definitive steps to re-establish perfusion/remove mechanical cause; MEP loss for > 40 min may increase possibility of long term injury
 - Assure the presence of attending surgeon, attending anesthesiologist, senior neurologist or neurophysiologist, and experienced nurse
 - Each service: review situation, report on management and corrective actions taken
 - ◆ Surgeon: rule out mechanical causes for loss/change
 - ◆ EP technologist: rule out technical causes for loss/change
 - ◆ Anesthesiologist: assure no neuromuscular blockade is present; reverse NMB if necessary
- Check patient positioning (neck, upper and lower extremities)
- Review the anesthetic and consider improving spinal cord perfusion by modifying:
 - Mean arterial pressure: maintain MAP > 65 mmHg using ephedrine 0.1 mg/kg IV and/or phenylephrine 0.3 - 10 MICROgrams/kg IV, with repeated doses as needed
 - Hemoglobin: if anemic, transfuse RBC to improve oxygen delivery
 - pH and PaCO₂: ensure normocarbica or slight hypercarbia (↑ I/E ratio, ↓ PEEP)
 - Temperature: ensure normothermia
 - Check for "unintended" drugs given (e.g. neuromuscular blocker)
 - Decrease depth of anesthetic
- Discuss feasibility of a useful wake-up test:
 - Patient is appropriate candidate if capable of following verbal commands
- Consider high-dose steroid if no improvement:
 - Methylprednisolone 30 mg/kg IV over one hour, then 5.4 mg/kg/hour IV for 23 hours

Malignant Hyperthermia

↑ Temp ↑ HR ↑ CO₂
acidosis

MH hotline 1-800-644-9737

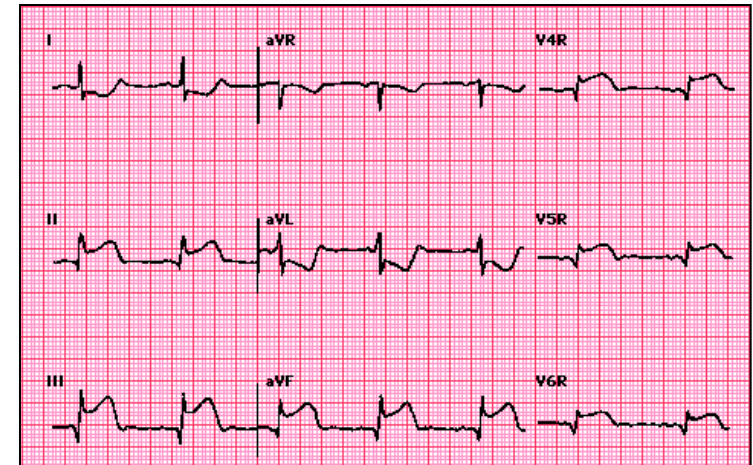
- Obtain Malignant Hyperthermia (MH) Kit
- Stop procedure, if possible
- Stop volatile anesthetic. Transition to non-triggering anesthetic
- Attach charcoal filter. Turn O₂ flow to 10 L/min
- Hyperventilate patient to reduce EtCO₂: 2-4 times patient's minute ventilation
- Give dantrolene or Ryanodex 2.5 mg/kg IV every 5 min until symptoms resolve
 - Dantrium/Revonto: Assign dedicated person to mix these formulations of dantrolene (20 mg/vial) with 60 mL non-bacteriostatic sterile water
 - Ryanodex: 250 mg is mixed with 5 mL non-bacteriostatic sterile water
- Give sodium bicarbonate 1-2 mEq/kg IV for suspected metabolic acidosis; maintain pH > 7.2
- Cool patient if temperature > 39° C
 - Apply ice externally to axilla, groin and around head
 - Infuse cold saline intravenously
 - NG lavage with cold water
 - Stop cooling when temperature < 38° C
- Hyperkalemia treatment:
 - Calcium gluconate 30 mg/kg IV or calcium chloride 10 mg/kg IV;
 - Sodium bicarbonate 1-2 mEq/kg IV;
 - Regular insulin 0.1 units/kg IV (MAX 10 units) and dextrose 0.5 gm/kg
- VT or afib treatment: Do NOT use calcium channel blocker; give amiodarone 5 mg/kg
- Send labs: ABG or VBG, electrolytes, serum CK, serum/urine myoglobin, coagulation
- Place Foley catheter to monitor urine output. Call ICU to arrange disposition
- If cardiac arrest occurs, begin CPR and consider ECMO

Treatment:

- Improve O₂ Supply:
 - Give 100% O₂
 - Correct anemia
 - Correct hypotension
- Decrease O₂ Demand:
 - Reduce heart rate
 - Correct hypertension
 - Restore sinus rhythm
- Drug therapy:
 - Nitroglycerin 0.5-5 MICROgrams/kg/min
 - Consider heparin infusion 10 Units/kg bolus, then 10 Units/kg/hour

Potential Causes:

- Severe hypoxemia
- Systemic arterial hypo- or hypertension
- Marked tachycardia
- Severe anemia
- Coronary air embolus
- Cardiogenic shock
- Local anesthetic toxicity



Recognition

- ST depression >0.5 mm in any lead
- ST elevation >1 mm (2mm in precordial leads)
- Flattened or inverted T waves
- Arrhythmia: VF, VT, ventricular ectopy, heart block

Diagnostic studies

- 12-lead ECG:
 - II, III, aVF for inferior (RCA)
 - V5 for lateral ischemia (LCx)
 - V2, V3 anterior ischemia (LAD)
- Compare to previous ECGs
- Request Ped Cardiology consult and echocardiogram

Pulmonary Hypertensive Crisis

Mean PAP > Mean SAP

22

Manifestation

- Acute ↓ O₂ sat, ↓ BP, ↓ EtCO₂, ↑ CVP
- ↓ Airway pressures from RV failure after abrupt pulmonary vasoconstriction
- RV diastolic hypertension → reduced LV filling and ↓ cardiac output
- Bradycardia → Hypotension → Cardiac arrest

Management

- Give 100% O₂
- ASAP: Call for inhaled nitric oxide (iNO) 20-40 ppm
- Deepen anesthetic/sedation, administer narcotic, but avoid decreasing SVR.
- Consider using additional pulmonary vasodilators such as inhaled prostacyclin & IV milrinone
- Administer muscle relaxant
- Ventilation:
 - Use lowest PEEP necessary to maintain oxygenation, long expiratory phase
 - Ventilate with low airway pressures, but maintain adequate tidal volume to avoid atelectasis and preserve FRC
 - Hyperventilation to avoid hypercarbia
- Fluid management:
 - Use judicious fluid administration
 - Correct acidosis with sodium bicarbonate
 - Consider Plasmalyte rather than normal saline to reduce acid load
- Maintain coronary perfusion and treat RV ischemia
 - Administer norepinephrine, phenylephrine, vasopressin to maintain perfusion
 - Utilize pulmonary vasodilators as needed
- Maintain NSR and AV synchrony
- Temperature: ensure normothermia
- If cardiac arrest occurs, begin CPR and consider ECMO

Tachycardia

Tachycardia associated with hypotension

- Call for defibrillator and code cart
- Place pt on backboard. Attach defibrillator pads
- Give 100% O₂
- If NO pulse present, start CPR/PALS; go to 'Cardiac Arrest, VF/VT' Card

VT, wide-complex irregular rhythm	SVT, tachyarrhythmia with pulse
<ul style="list-style-type: none"> ▪ Biphasic 2 joules/kg, then 4 joules/kg for additional shock, increasing up 10 joules/kg 	<ul style="list-style-type: none"> ▪ Synchronized cardioversion: 0.5-1 joule/kg, then 2 joules/kg for additional shocks

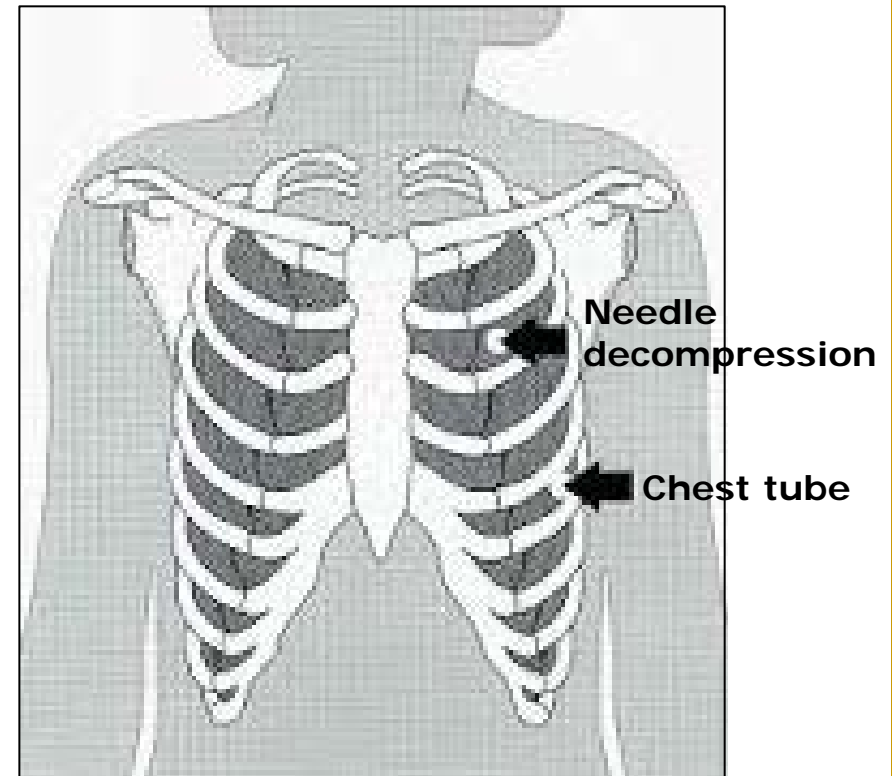
- If pulse present, administer appropriate treatment (see table below)

Treatment		
Narrow complex: p waves present before every QRS	Wide complex	Torsade de Pointes: polymorphic VT with prolonged QT
<ul style="list-style-type: none"> ▪ Vagal maneuvers <ul style="list-style-type: none"> • Ice to face • Valsalva • Carotid massage ▪ Adenosine 0.1- 0.3 mg/kg IV push (1st dose 6 mg MAX; 2nd dose 12 mg MAX) 	<ul style="list-style-type: none"> ▪ Amiodarone 5 mg/kg IV bolus over 20-60 min or ▪ Procainamide 15 mg/kg IV bolus over 30-60 min or ▪ Lidocaine 1 mg/kg IV bolus 	<ul style="list-style-type: none"> ▪ Magnesium sulfate ▪ Isoproterenol ▪ Lidocaine 1 mg/kg IV ▪ Phenytoin ▪ Sodium bicarbonate (for quinidine-related SVT) ▪ Temporary pacing (see 'Bradycardia' card)

Tension Pneumothorax

↑ HR, ↓ SpO₂ ↓ BP , tracheal deviation, mediastinal shift

- Stop N₂O; increase O₂ to 100%
- Secure airway with endotracheal tube
- Reduce positive ventilation pressure
- Administer vasopressors for circulatory collapse
- Perform immediate needle decompression, then chest tube placement
- Needle decompression:
 - 2nd rib space superior to 3rd rib, mid-clavicular line
 - ◆ 14-16g angiocath for teens/adults
 - ◆ 18-20g angiocath for infants/children
- Chest tube insertion
 - 5-6th intercostal space, mid-axillary line
- If no improvement in hemodynamics after a rush of air, consider:
 - Needle decompression of contralateral side
 - Presence of pneumopericardium



Downloaded from:
http://www.uwhealth.org/images/ewebeditpro/uploadimages/5384_Figure_1.jpg

Transfusion: Massive Hemorrhage

Replacement > half total blood volume (TBV) per hour or TBV < 24 hours

- Notify Blood Bank immediately if massive transfusion needed
 - Begin institutional massive transfusion protocol, if available
 - Consider RBC : FFP : Platelets = 2:1:1 or 1:1:1, if no protocol available
 - Use un-crossmatched O negative blood until crossmatched blood available
 - Consider intraoperative blood salvage (e.g., Cell Saver)
 - Give cryoprecipitate to maintain fibrinogen > 100
- Obtain additional vascular access if needed
- Send labs q 30 min
 - CBC, platelets, PT/PTT/INR, fibrinogen
 - ABG, Na, K, Ca, lactate
- Warm the room
- Blood product administration:
 - Use 140 micron filter for all products
 - Use a blood warmer for RBC and FFP transfusion (NOT for platelets)
 - Rapid transfusion pumps may be used when increased flow is needed
- Monitor for hypothermia, hypocalcemia, electrolyte, blood gas, and acid-base disturbances
- Consider rFactor VIIa for refractory hemorrhage if above measures are corrected
- Terminate the massive transfusion protocol once bleeding is under control

Maintain:

- HCT > 21% or Hgb > 7
- Platelet Count > 50,000 (>100K for brain injury)
- INR < 1.5 (< 1.3 brain injury)
- Fibrinogen > 100

Transfusion Reactions

Reactions may occur with any type of product.
Important to determine type of reaction.

For All Reactions:

- Stop transfusion
- Disconnect donor product and IV tubing
- Infuse normal saline through clean tubing
- Examine blood product ID; determine correct pt
- Send product to Blood Bank

Hemolytic	Non-Hemolytic	Anaphylactic
<p><u>Signs:</u> Hemoglobinemia, hemoglobinuria, DIC, ↓ BP, ↑ HR, bronchospasm</p> <ul style="list-style-type: none"> ▪ Furosemide 0.1 mg/kg ▪ Mannitol 0.5 g/kg (2 mL/kg of 25% mannitol) ▪ Dopamine 2-4 MICROgrams/kg/min ▪ Maintain urine output at least 1-2 mL/kg/hour ▪ Prepare for cardiovascular instability ▪ Send blood and urine sample to laboratory 	<p><u>Signs:</u> ↓ BP, bronchospasm, pulmonary edema, fever, rash</p> <ul style="list-style-type: none"> ▪ Treat fever ▪ Treat pulmonary edema ▪ Observe for signs of hemolysis 	<p><u>Signs:</u> Erythema, urticaria, angioedema, bronchospasm, tachycardia, shock</p> <ul style="list-style-type: none"> ▪ Support airway and circulation as necessary. ▪ Epinephrine 10 MICROgrams/kg IV ▪ Diphenhydramine 1 mg/kg IV ▪ Hydrocortisone 2-5 mg/kg ▪ Maintain intravascular volume

Set-up prior to patient arrival to OR:

- Assemble team and assign roles
- Estimate weight and prepare emergency drugs
- Gather equipment:
 - airway supplies
 - invasive monitors
 - fluid warmer
 - rapid infusion device
 - code cart with programmed defibrillator
- Type and cross blood products. If severe trauma, inform blood bank that massive transfusion protocol may be needed

On patient arrival to OR:

- Maintain c-spine precautions for transport
- Secure/confirm airway (aspiration risk, unstable c-spine)
- Ensure adequate ventilation (maintain PIP < 20 cm H₂O)
- Obtain/confirm large-bore IV access (central or intraosseous if peripheral unsuccessful)
- Assess circulation
- Hypovolemia = persistent tachycardia, delayed cap refill, decreased pulse pressure
 - Bolus 20 mL/kg LR or NS (repeat x 2) and/or 10 mL/kg RBCs or 20 ml/kg whole blood
- Place invasive monitors
- Temperature: ensure normothermia
- Rapidly treat associated conditions (acidosis, electrolyte disturbances)
- Continuously assess for secondary injury (ongoing blood loss)