Air Embolism 2
Anaphylaxis 3
Bradycardia 4
Cardiac Arrest 5-7
Difficult Airway 8
Fire: Airway / OR 9-10
Hyperkalemia 11
Hypertension 12
Hypotension 13
Hypoxia 14-15
Local Anesthetic Toxicity 16
Loss of Evoked Potentials 17
Malignant Hyperthermia 18
Myocardial Ischemia 19
Tachycardia 20
Transfusion & Reactions 21-22
Trauma 23-24

Call for help!

Code Team ___________
PICU ___________
Fire ___________
Overhead STAT ___________

Revised April 18, 2014
Objective: Restore normal SpO2, hemodynamic stability, and stop source of air entry.

- Call for help. Notify surgeon.
- Increase oxygen to 100%.
- Stop nitrous oxide and volatile agents.
- Find air entry point, stop source, and limit further entry.
  - Flood wound with irrigation
  - Check for open venous lines or air in tubing
  - Turn off all pressurized gas sources (laparoscope, endoscope)
  - 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
  - Left-side down once source controlled

- Consider
  - Vasopressors (epinephrine, norepinephrine)
  - Chest compressions: 100/min; to force air through lock, even if not in cardiac arrest

- Call for transesophageal echocardiography (if available and/or diagnosis unclear).
Anaphylaxis

Rash, bronchospasm, hypotension

- Call for help.
- Increase oxygen to 100%
- Remove suspected trigger(s).
  - If latex is suspected, thoroughly wash area.
- Ensure adequate ventilation/oxygenation.
- Obtain IV access.
- If hypotensive, turn off anesthetic agents.
- Rapidly infuse NS or LR (10-30 ml/kg IV) to restore intravascular volume
- Epinephrine (1-10 mcg/kg IV as needed) to restore BP and ↓ mediator release
  - Epinephrine infusion (0.02-0.2 mcg/kg/min) may be required to maintain BP.
- Adjuvants
  - Beta-agonists (albuterol 4-10 puffs as needed) for bronchoconstriction
  - Methylprednisolone (2 mg/kg IV, MAX 100 mg) to ↓ mediator release
  - Diphenhydramine (1 mg/kg IV, MAX 50 mg) to ↓ histamine-mediated effects
  - Famotidine (0.25 mg/kg IV) or ranitidine (1 mg/kg IV) to ↓ effects of histamine
- If anaphylactic reaction requires laboratory confirmation, send mast cell tryptase level within 2 hours of event.

Common causative agents:
Neuromuscular blockers, latex, chlorhexidine, IV colloids, antibiotics
Bradycardia: Unstable

- Call for help and transcutaneous pacer.
- Hypoxia is common cause of bradycardia.
  - Ensure pt is not hypoxic. Give 100% oxygen.
  - Go to ‘Hypoxia’ card if hypoxia persists.
- Stop surgical stimulation. If laparoscopy, desufflate.
- Consider
  - Epinephrine 2-10 mcg/kg IV
  - Chest compression if ↓ pulses
  - Atropine (0.01 - 0.02 mg/kg IV) if vagal etiology
- Assess for drug-induced causes
  - Beta-blocker overdose: Glucagon 0.05 mg/kg IV, then 0.07 mg/kg/h IV infusion
  - Calcium channel blocker overdose: Calcium chloride 10-20 mg/kg IV or calcium gluconate 50 mg/kg, then glucagon if calcium ineffective.
- If PEA develops, start chest compressions. Go to ‘Cardiac Arrest : Asystole, PEA’

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 present.**

Age < 30 days: HR < 100
Age > 30 days < 1yr: HR < 80
Age > 1yr: HR < 60
Cardiac Arrest: Asystole, PEA

- Call for help.
- Designate team leader, assign roles.

- Give 100% oxygen. Turn off all anesthetic gases and infusions. Place pt on backboard.
- Obtain defibrillator

- **Start chest compressions (100 chest compressions/min + 8 breaths/min)**
  - Maintain good hand position.
  - Maximize ETCO₂ > 10 mm Hg with force/depth of compressions.
  - Allow full recoil between compressions.
  - Switch with another provider every 2 minutes, if possible.
  - Use sudden increase in ETCO₂ for ROSC – do not stop compressions for pulse check.

- **Epinephrine** 10 mcg/kg IV q 3-5 min
- Check pulse & rhythm (q 2 min during compressor switch).

<table>
<thead>
<tr>
<th>No Pulse and Not Shockable: Resume CPR and checklist.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Read out H&amp;Ts</strong></td>
</tr>
<tr>
<td>Hypovolemia</td>
</tr>
<tr>
<td>Hypoxemia</td>
</tr>
<tr>
<td>Hydrogen ion (acidosis)</td>
</tr>
<tr>
<td>Hyperkalemia</td>
</tr>
<tr>
<td>Hypoglycemia</td>
</tr>
<tr>
<td>Hypothermia</td>
</tr>
<tr>
<td>Tension Pneumothorax</td>
</tr>
<tr>
<td>Tamponade (Cardiac)</td>
</tr>
<tr>
<td>Thrombosis</td>
</tr>
<tr>
<td>Toxin (anesthetic, β-blocker)</td>
</tr>
<tr>
<td>Trauma (bleeding outside surgical area)</td>
</tr>
</tbody>
</table>

- Call for ECMO (if available) if no ROSC after 6 min of CPR.
- Notify parents/guardian that cardiac arrest occurred.
Cardiac Arrest: VF/VT

- Call for help and defibrillator.
- Designate team leader / assign roles.
- Give 100% oxygen. Turn off all anesthetic gases. Place pt on backboard.

- Start chest compressions (100 chest compressions/min + 8 breaths/min).
  - Maintain good hand position
  - Maximize ETCO₂ > 10 mm Hg with force/depth of compressions
  - Allow full recoil between compressions – lift hands off chest

- Shock 2-4 joules/kg
- Resume chest compressions x 2 min.
- Epinephrine 10 mcg/kg IV
- Check pulse & rhythm (q2 min during compressor switch)

If shockable rhythm continues:
- Shock 4 joules/kg.
- Resume chest compressions x 2 min.
- Epinephrine 10 mcg/kg IV
- Check pulse & rhythm (q 2 min during compressor switch).
- Shock 4-10 joules/kg, continue chest compressions, and epinephrine 10 mcg/kg every 3-5 min.
- Amiodarone 5 mg/kg bolus; may repeat x 2
- Call for ECMO (if available) after 6 min of CPR
- Notify parents/guardian that cardiac arrest occurred.

Shockable, pulseless cardiac arrest
Call for help.

Children/Adolescents

No midline incision:
Compress with heel of hand on spine and second hand on top

Midline incision:
Compress with heel of each hand under scapula

Infants

Compress with encircling technique:
• Thumbs midline if no incision
• Thumbs lateral if incision


Difficult Airway: After Induction

Unable to intubate or ventilate; oxygen saturation < 90%

- Call for help.
- Increase oxygen to 100%.
- Get airway cart.
- Bag-mask ventilation
- Notify surgeon – may need to stop or cancel surgery. May awaken if surgery not started.
- If unable to mask ventilate, 2-hand if needed:
  - Add oral airway
  - Add nasal airway
  - Add LMA
- Regain spontaneous ventilation, if able; reverse neuromuscular blocker
- Alternative approaches for intubation:
  - Different blade
  - Different operator
  - Re-position head
  - Blind oral
  - Blind nasal
  - Video-laryngoscope
  - Intubating LMA
  - Fiberoptic scope
  - Light wand
  - Elastic bougie
  - Intubating stylet
  - Retrograde intubation

- If still unable to ventilate:
  - Consider possibility of invasive airway in early stage.
  - Emergency non-invasive airway (rigid bronchoscopy)
  - Emergency invasive/surgical airway
Fire: Airway

- Call for help.

- **Disconnect** breathing circuit and **Stop** all gas flow (O₂, N₂O)
- Pour saline into ETT, if available.
- **Remove** ETT.
- Remove sponges and other flammable materials from 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, and remove residual material.
- Impound all equipment and supplies for later inspection.

Picture from ECRI: www.ecri.org
OR Fire (non-airway)

- Call for help.
- Protect patient, contain fire.

- If drapes on fire, remove drapes from patient.

- Activate fire alarm.

- Stop medical gases.
- Declare team leader and define roles.

- Make one attempt to extinguish fire.
  - Use fire extinguisher or saline soaked gauze.

- If fire not extinguished on 1st attempt:
  - 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

Causes:
- Excessive intake: massive or "old" blood transfusion, cardioplegia, "K+ runs"
- Shift of K+ from tissues to plasma: crush injury, burns, succinylcholine, malignant hyperthermia, acidosis
- Inadequate excretion: renal failure

Manifestations:
Tall peaked T wave, heart block, sine wave, v fib or asystole

Management:
☑ CALL FOR HELP!

☑ Stop K+ containing fluids (LR/RBCs) → Switch to NS/washed RBCs
☑ If hemodynamically unstable: initiate CPR/PALS
☑ Hyperventilate with 100% Oxygen and give
  • Calcium chloride 20 mg/kg or calcium gluconate 60 mg/kg IV
  • Albuterol by nebulizer
  • Insulin IV/SC 0.1 Unit/kg
  • Dextrose IV 0.25 -1 gram/kg
  • Sodium Bicarbonate IV 1-2 mEq/kg
  • Furosemide IV 0.1 mg/kg
  • Terbutaline 10 mcg/kg load then 0.1-10 mcg/kg/min
☑ Dialysis if refractory to treatment
☑ Activate ECMO (if available) if cardiac arrest > 6 min

Hypertension

- Consider likely cause. Rule out medication error, light anesthesia, measurement error (e.g. transducer level) and other patient-specific factors.
- Ensure that correct BP cuff size is used with a cuff bladder width approximately 40% of limb circumference.
- 99th %tile for BP is based on patient age and height.

### Acute Hypertension

BP > 99 %tile for age + 5 mmHg

<table>
<thead>
<tr>
<th>Action</th>
<th>Drug (IV Dosing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct smooth muscle relaxation</td>
<td></td>
</tr>
<tr>
<td><strong>Sodium nitroprusside</strong> 0.5-10 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Hydralazine</strong> 0.1-0.2 mg/kg (adult dose 5-10 mg)</td>
<td></td>
</tr>
<tr>
<td>β-Adrenergic blockade</td>
<td></td>
</tr>
<tr>
<td><strong>Esmolol</strong> 100-500 mcg/kg over 5 min then 50-200 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Labetalol</strong> (also α effect) 0.2-1 mg/kg q10 min or 0.4-3 mg/kg/h (adult dose)</td>
<td></td>
</tr>
<tr>
<td><strong>Propranolol</strong> 10-100 mcg/kg slow push (adult dose 1-5 mg)</td>
<td></td>
</tr>
<tr>
<td>α₂-Agonist</td>
<td></td>
</tr>
<tr>
<td><strong>Clonidine</strong> 0.5-2 µg/kg</td>
<td></td>
</tr>
<tr>
<td>Calcium channel blockade</td>
<td></td>
</tr>
<tr>
<td><strong>Nicardipine</strong> 0.5-5 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Clevidipine</strong> 0.5-3.5 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td>D-1 agonist</td>
<td></td>
</tr>
<tr>
<td><strong>Fenoldopam</strong> 0.3-0.5 mcg/kg/min (max. 2.5 mcg/kg/min)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>99th %tile systolic range (5th – 95th %tile height)</th>
<th>99th %tile diastolic range (5th – 95th %tile height)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>105-114</td>
<td>61-66</td>
</tr>
<tr>
<td>2</td>
<td>109-117</td>
<td>66-71</td>
</tr>
<tr>
<td>3</td>
<td>111-120</td>
<td>71-75</td>
</tr>
<tr>
<td>4</td>
<td>113-122</td>
<td>74-79</td>
</tr>
<tr>
<td>5</td>
<td>115-123</td>
<td>77-82</td>
</tr>
<tr>
<td>6</td>
<td>116-125</td>
<td>80-84</td>
</tr>
<tr>
<td>7</td>
<td>117-126</td>
<td>82-86</td>
</tr>
<tr>
<td>8</td>
<td>119-127</td>
<td>83-88</td>
</tr>
<tr>
<td>9</td>
<td>120-129</td>
<td>84-89</td>
</tr>
<tr>
<td>10</td>
<td>122-130</td>
<td>85-90</td>
</tr>
<tr>
<td>11</td>
<td>124-132</td>
<td>86-90</td>
</tr>
<tr>
<td>12</td>
<td>126-135</td>
<td>86-91</td>
</tr>
</tbody>
</table>
## Hypotension

**Systolic BP < 5%tile for age.**
**For pt > 1yr, 5th %tile = 70mmHg + (2 x age in yrs)**

### Causes of Hypotension

<table>
<thead>
<tr>
<th>↓Preload</th>
<th>↓Contractility</th>
<th>↓Afterload</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hypovolemia</td>
<td>• Negative inotropic drugs (anesthetic agents)</td>
<td>• Drug-induced vasodilation</td>
</tr>
<tr>
<td>• Vasodilation</td>
<td>• Arrhythmias</td>
<td>• Sepsis</td>
</tr>
<tr>
<td>• Impaired venous return</td>
<td>• Hypoxemia</td>
<td>• Anaphylaxis</td>
</tr>
<tr>
<td>• Tamponade</td>
<td>• Heart failure (ischemia)</td>
<td>• Endocrine crisis</td>
</tr>
<tr>
<td>• Pulmonary embolism</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Treatment of Hypotension

- Inform surgeon and OR nurse
- Ensure oxygenation/ventilation
- Turn off anesthetic agents
- Verify patient is truly hypotensive, check cuff size and position
- Expand circulating blood volume (administer fluids rapidly)
- Trendelenberg position
- Place or replace IV; consider interosseous needle
- Start inotrope infusion (dopamine, epinephrine, milrinone) as needed
- Review ECG for rhythm disturbances or ischemia
- Send ABG, Hb, electrolytes
- Start vasopressor infusion: phenylephrine, norepinephrine
- Follow “Anaphylaxis” Card if appropriate.
- Administer steroids for endocrine crisis
<table>
<thead>
<tr>
<th>Hypoxia: All Patients</th>
<th>Hypoxia: Intubated Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Give 100% oxygen</strong></td>
<td><strong>Dislodged:</strong> Check ETT position</td>
</tr>
<tr>
<td>Check:</td>
<td>▪ Mainstem</td>
</tr>
<tr>
<td>□ Oxygen flow</td>
<td>▪ Not in trachea</td>
</tr>
<tr>
<td>□ Airway patency</td>
<td><strong>Obstructed:</strong> Suction ETT</td>
</tr>
<tr>
<td>□ Breathing circuit connected and patent</td>
<td>▪ Kinked</td>
</tr>
<tr>
<td>□ Ventilation rate and depth adequate</td>
<td>▪ Mucus plug</td>
</tr>
<tr>
<td>□ Listen to breath sounds:</td>
<td><strong>Pneumothorax:</strong> Listen to breath sounds</td>
</tr>
<tr>
<td>▪ Wheezing</td>
<td>▪ Decompress with needle</td>
</tr>
<tr>
<td>▪ Crackles</td>
<td><strong>Equipment</strong></td>
</tr>
<tr>
<td>▪ Diminished or absent</td>
<td>Check from patient to wall:</td>
</tr>
<tr>
<td>□ Is pulse oximeter working correctly?</td>
<td>▪ Oxygen flow</td>
</tr>
<tr>
<td>□ Presence of cardiac shunt</td>
<td>▪ Valves</td>
</tr>
<tr>
<td>□ Possibility of embolus</td>
<td>▪ CO₂ canister</td>
</tr>
<tr>
<td></td>
<td>▪ Inspect for disconnections and obstructions</td>
</tr>
</tbody>
</table>
### Hypoxia: Loss of ETCO2

<table>
<thead>
<tr>
<th>Respiratory</th>
<th>Cardiac Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Give 100% oxygen</strong></td>
<td><strong>Embolus: air, blood, fat</strong></td>
</tr>
<tr>
<td><strong>Check:</strong></td>
<td><strong>Actions:</strong> See Air Embolism card</td>
</tr>
<tr>
<td>- Airway patency</td>
<td>- Inform surgeon</td>
</tr>
<tr>
<td>- Breathing circuit connections</td>
<td></td>
</tr>
<tr>
<td>- Kinked endotracheal tube</td>
<td>- Flood surgical field with saline</td>
</tr>
<tr>
<td>- Breath sounds and chest excursion</td>
<td></td>
</tr>
<tr>
<td>- Bilateral sounds and chest movement</td>
<td>- Lower surgical site below heart</td>
</tr>
<tr>
<td>- Quality of breath sounds</td>
<td></td>
</tr>
<tr>
<td>- Presence of <strong>wheezing</strong> or crackles</td>
<td><strong>Low cardiac output or cardiac arrest</strong></td>
</tr>
<tr>
<td>- Gas analyzer connections; power on?</td>
<td><strong>Actions:</strong></td>
</tr>
<tr>
<td>- Ventilation rate (excessive?)</td>
<td>- Follow PALS algorithm if cardiac arrest</td>
</tr>
</tbody>
</table>

- Give 100% oxygen
- Support ventilation
- Support blood pressure with IV saline (10-20 mL/kg bolus)
- Turn off anesthetic agents
Local Anesthetic Toxicity

- Call for help.
- Stop local anesthetic.
- Request Intralipid kit.

- Secure airway and ventilation
- Give 100% oxygen.
- Confirm or establish adequate IV access.
- Confirm and monitor continuous ECG, BP, and SaO2.

Seizure treatment: **midazolam** 0.05-0.1 mg/kg IV or **propofol** 1-2 mg/kg IV. Treat resultant hypoventilation.
- Treat hypotension with small doses of **epinephrine** 1 mcg/kg.
- Monitor and correct acidosis, hypercarbia and hyperkalemia.
- Avoid vasopressin, calcium channel blockers and beta blockers.
- If cardiac instability occurs:
  - Start CPR
  - Start Intralipid therapy (see inset box)
    - Continue chest compressions (lipid must circulate)

Consider alerting nearest cardiopulmonary bypass center and ICU if no ROSC.

**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 until hemodynamic stability is restored.
- Maximum total Intralipid 20% dose: 10 mL/kg over first 30 min
Loss of Evoked Potentials

- Notify surgeon.
- Turn off inhalation agent/N₂O and switch to propofol/ketamine infusion.
- Turn off or reverse neuromuscular blockers
- Increase perfusion pressure (MAP > 70 mmHg) using ephedrine (0.2 – 0.3 mg/kg IV) and/or phenylephrine (1-10 mcg/kg IV).
- Check Hb; transfuse RBC (10-15 mL/kg IV) if anemic.
- Ensure normocarbia: ↑ I/E ratio, ↓ PEEP
- Ensure normothermia.
- Consider wake-up test.
- Consider high-dose steroid for spinal cord injury:
  - Methylprednisolone 30 mg/kg IV over 15 min, then 5.4 mg/kg/h IV infusion.
Call for help.

- Get Malignant Hyperthermia (MH) Kit.
- Stop procedure if possible
- Stop volatile anesthetic. Transition to non-triggering anesthetic
- Request chilled IV saline.
- Hyperventilate pt to reduce CO$_2$: 2-4 times patient’s minute ventilation
- Dantrolene 2.5 mg/kg IV every 5 min until symptoms resolve.
- Assign dedicated person to mix dantrolene (20 mg/vial) with 60 mL sterile water.
- Bicarbonate 1-2 meq/kg IV for suspected metabolic acidosis; maintain pH > 7.2.
- Cool patient if temperature > 38.5° C.
  - NG lavage with cold water.
  - Apply ice externally.
  - Infuse cold saline intravenously.
  - Stop cooling if temperature < 38° C.

Hyperkalemia treatment: (See ‘Hyperkalemia’ card)
  - Ca gluconate 30 mg/kg IV or Ca chloride 10 mg/kg IV;
  - Sodium bicarbonate 1-2 mEq/kg IV;
  - Regular insulin 10 Units IV with 1-2 amps D50 (0.1 units insulin/kg and 1 mL/kg D50)

Dysrhythmia treatment: Standard anti-arrhythmics; do NOT use calcium channel blocker

- Send labs: ABG or VBG, electrolytes, serum CK, serum/urine myoglobin, coagulation
- Place Foley catheter to monitor urine output.
- Call ICU to arrange disposition.
Myocardial Ischemia

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

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

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
- Ped Cardiology consult; echocardiography

Treatment
- Improve O₂ Supply
  - 100% oxygen
  - Correct anemia
  - Correct hypotension
- Decrease O₂ Demand
  - Reduce heart rate
  - Correct hypertension
  - Restore sinus rhythm
- Drug therapy
  - Nitroglycerin 0.5-5 mcg/kg/min
  - Consider heparin infusion
    - 10 units/kg bolus, then 10 units/kg/hr
Tachycardia

**Diagnosis:**
- **ST:** narrow complex, p waves present before every QRS
- **SVT:** narrow complex, no p waves or p waves not associated with QRS
- **VT:** wide complex, polymorphic or monomorphic

**Treatment:**
*If no pulse present, start CPR, go to ‘Cardiac Arrest, VF/VT’ Card*

If pulse present:

**Narrow Complex**
- Vagal maneuvers: Ice to face; Valsalva; carotid massage
- **Adenosine** 0.1-0.3 mg/kg iv push
  (Max 1st dose 6mg/max 2nd dose 12mg)

**Wide Complex**
- Synchronized cardioversion at 0.5 -1.0 joules/kg (see table)
- **Amiodarone** 5 mg/kg IV bolus over 20-60 minutes, or
- **Procainamide** 15 mg/kg IV bolus over 30-60 minutes, or
- **Lidocaine** 1 mg/kg IV bolus

**VT, Wide-complex irregular rhythm**

<table>
<thead>
<tr>
<th>VT, Wide-complex irregular rhythm</th>
<th>SVT, tachyarrythmias with pulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biphasic 2 J/kg, then 4 J/kg for additional shocks</td>
<td>Synchronized cardioversion 0.5-1 J/kg, then 2 J/kg for additional shocks</td>
</tr>
</tbody>
</table>

**Read out H&Ts**

| Hypovolemia | Tension pneumothax |
| Hypoxemia | Tamponade |
| Hydrogen ion (acidosis) | Thrombosis |
| Hyperkalemia | Toxin |
| Hypoglycemia | Trauma |
| Hypothermia | |
Transfusion: Massive Hemorrhage

- **Call for help.**

- Notify **Blood Bank** immediately of massive transfusion need.
  - **RBC : FFP : Platelets = 1:1:1**
  - Use un-cross matched O negative blood until cross-matched blood available
  - Give cryoprecipitate to maintain fibrinogen > 100

- Obtain additional vascular access if needed.

- Send labs q 30 min
  - Type & Cross
  - 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 transfuser pumps may be used when increased flow is needed.

- Monitoring 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 HB > 7
- Platelet Count > 50,000 (>100k brain injury)
- INR < 1.5 (< 1.3 brain injury)
- Fibrinogen > 100
For All Reactions

- Call for help.
- 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.
- Document per Institutional Policy

**Hemolytic** - Hgbemia, Hgburia, DIC, ↓BP, ↑HR, bronchospasm

- Furosemide 0.1 mg/kg
- Mannitol 0.5 grams/kg (2 mL/kg of 25% mannitol)
- Dopamine (2-4 mcg/kg/min)
- Maintain urine output at least 1-2 mL/kg/h.
- Prepare for cardiovascular instability.
- Send blood and urine sample to laboratory.

**Non-Hemolytic** - ↓BP, bronchospasm, pulmonary edema, fever, rash

- Stop Transfusion
- Send blood to blood bank
- Treat fever
- Observe for signs of hemolysis

**Anaphylactic** - Erythema, urticaria, angioedema, bronchospasm, tachycardia, shock

- Stop transfusion
- Support airway and circulation as necessary.
- Epinephrine 10 mcg/kg IV
- Diphenhydramine 1 mg/kg IV
- Hydrocortisone 2-5 mg/kg
- Maintain intravascular volume.
Prior to pt 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.

On pt arrival to OR:
- Maintain c-spine precautions for transport.
- Secure/confirm airway (aspiration risk, unstable c-spine).
- Ensure adequate ventilation (maintain PIP <20 cmH₂O).
- Obtain/confirm large-bore IV access (central or interosseus if peripheral unsuccessful).
- Assess circulation
- Persistent tachycardia, delayed cap refill, decreased pulse pressure = hypovolemia.
  - Bolus 20 mL/kg LR or NS (repeat x2) and/or 10 mL/kg RBCs or 20 mL/kg whole blood
- Place invasive monitors.
- Maintain normothermia.
- Rapidly treat associated conditions (acidosis, electrolyte disturbances).
- Continuously assess for secondary injury (ongoing blood loss)
Secure airway if GCS < 9, respiratory distress, hemodynamic instability, or elevated ICP.

- Maintain PaCO$_2$ 30-35 mmHg and PaO$_2$ >60mmHg.

- Maintain cerebral perfusion pressure.
  - (MAP – ICP) > 40 mmHg and systolic BP >5$^{\text{th}}$ percentile for age (see ‘Hypotension’ card)
  - Use CVP in place of ICP if no ICP monitor available.

- Treat elevated ICP with:
  - Hyperventilation
  - Propofol or etomidate
  - Mannitol (1g/kg)
  - Hypertonic saline (3% via central venous catheter; 4mL/kg)

- Maintain normoglycemia.
  - Avoid glucose-containing solutions if hyperglycemic.