Operating Room
Crisis Checklists
Management of Adult Emergencies
October 2023 version

>> Do not remove book from this room <<
### Air Embolism - Venous

*Decreased end-tidal CO\textsubscript{2}, decreased oxygen saturation, hypotension*

#### START

1. **Call for help**
   - **Ask:** "Who will be the crisis manager?"
   - Crisis manager designates checklist reader

2. **Turn FiO\textsubscript{2} to 100%**
   - Turn off nitrous oxide

3. **Stop source of gas entry**
   - Fill wound with irrigation and/or apply bone wax to bone edges
   - Lower surgical site below level of heart if possible
   - Search for entry point (including open venous lines)
   - Desufflate if concern for CO\textsubscript{2} embolism

4. **Support hemodynamics**
   - Escalate vasopressor support as needed
   - Turn down anesthetic agents

5. **Consider…**
   - Positioning patient with left side down, if feasible
     - Continue monitoring during positioning
   - Removing PEEP in patients with PFO at risk for paradoxical embolism
   - Avoid spontaneous ventilation; paralyze as needed
   - Use ETCO\textsubscript{2} to monitor progression and resolution of embolism or for assessment of cardiac output
   - If diagnosis is unclear, call for TEE
   - If ongoing hemodynamic instability, call for ECMO or cardiopulmonary bypass

6. **Continuing care**
   - Consider hyperbaric oxygen treatment within 6 hours for evidence of paradoxical embolism

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<table>
<thead>
<tr>
<th><strong>DIFFERENTIAL diagnosis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amniotic Fluid Embolism</td>
</tr>
<tr>
<td>Cement Embolism</td>
</tr>
<tr>
<td>Venous Thromboembolism / Pulmonary Embolism</td>
</tr>
<tr>
<td>Non-embolic causes of hypotension (CHKLST 10)</td>
</tr>
<tr>
<td>Non-embolic causes of hypoxia (CHKLST 11)</td>
</tr>
</tbody>
</table>

**Critical CHANGES**

*If PEA develops, go to CHKLST 04*
02 Anaphylaxis

Hypotension, bronchospasm, high peak-airway pressures, decreased breath sounds, tachycardia, urticaria

**START**

1. **Call for help**
   - Ask: “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Give EPINEPHrine bolus**
   - Repeat bolus with increasing dose as needed
   - Consider EPINEPHrine infusion

3. **Establish/secure airway**
   - Turn FiO₂ to 100% or start supplemental oxygen

4. **Remove potential causative agents**

5. **Give fluid bolus**

6. **Consider**…
   - Minimize volatile anesthetics if patient remains unstable
   - Consider albuterol as adjunctive therapy for bronchospasm unresponsive to EPINEPHrine
   - Vasopressin bolus and/or infusion for patients with hypotension unresponsive to EPINEPHrine
   - Terminate procedure
   - Once hemodynamically stable:
     - Supplemental treatment with diphenhydramine and corticosteroids
     - Tryptase level: Check within first hour, repeat at 4 and 18-24 hours

**DRUG DOSES & treatments**

- **EPINEPHrine**
  - BOLUS: 10 - 50 MCG IV
  - INFUSION: 0.01 - 0.1 MCG/kg/min
  - If no IV access, 0.3 mg IM

- **Vasopressin**
  - BOLUS: 1-2 units IV
  - INFUSION: 0.03 units/min

- **Albuterol**
  - 2-3 puffs MDI
  - 2.5 mg via nebulizer

**Supplemental treatment**

- **diphenhydramine**
  - 25 - 50 mg IV

- **Corticosteroids**
  - Hydrocortisone 100 mg IV
  - Methylprednisolone 1 mg/kg IV

**Common CAUSATIVE AGENTS**

- Neuromuscular blocking agents
- Antibiotics
- Latex products
- IV contrast and dyes
- Sugammadex
- Allogenic blood components, go to CHKLST 17
- Chlorhexidine

**Critical CHANGES**

If **cardiac arrest** develops:
- Asystole/PEA, go to CHKLST 04
- VF/VT, go to CHKLST 05

If **airway obstruction** develops, go to CHKLST 07
Bradycardia - Unstable

HR < 50 bpm with hypotension, acutely altered mental status, shock, ischemic chest discomfort, or acute heart failure

START

1. Call for help and a code cart
   - Ask: “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. Turn FiO₂ to 100%
   - Verify oxygenation/ventilation adequate
   - Consider securing airway

3. Administer atropine

4. Stop surgical stimulation (if laparoscopy, desufflate)

5. If atropine ineffective:
   - Consider EPINEPHrine or DOPamine
     — or —
   - Start transcutaneous pacing (see box)

6. Consider…
   - Assessing and treating underlying etiology (see differential diagnosis box)
   - If hemodynamically unstable, minimizing volatile anesthetics
   - Calling cardiology consult

7. If bradycardia progresses to asystole or PEA arrest
   - go to CHKLST 04

DRUG DOSES & treatments

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>0.5-1 mg IV, may repeat up to 3 mg total</td>
</tr>
<tr>
<td>EPINEPHrine BOLUS</td>
<td>10 - 100 MCG IV, repeat as needed</td>
</tr>
<tr>
<td></td>
<td>(1 mg in 100 mL = 10 MCG/mL)</td>
</tr>
<tr>
<td></td>
<td>INFUSION: 0.01 - 0.1 MCG/kg/min</td>
</tr>
<tr>
<td>DOPamine</td>
<td>2 - 20 MCG/kg/min IV infusion</td>
</tr>
</tbody>
</table>

OVERDOSE treatment

- Beta-blocker
- Glucagon 5 - 10 mg IV push
- Calcium channel blocker
- Calcium chloride 1g IV
  — or —
- Calcium gluconate 3g IV
- Digoxin
  - Digoxin FAB; consult pharmacy for patient-specific dosing

DIFFERENTIAL diagnosis

- Drug effect or overdose
- Hyperkalemia
- Hypertension
- Hypoventilation
- Acidosis

- Tension pneumothorax
- Autopen
- Surgical stimulation
- High spinal
- Myocardial ischemia
- Malignant Hyperthermia

- Local anesthesia systemic toxicity (CHKLST 12)
- Transcutaneous Pacing instructions

1. Place pacing electrodes front and back
2. Connect 3-lead ECG from pacing defibrillator
3. Turn monitor/defibrillator to PACER mode
4. Set PACER RATE (bpm) to 80/minute (adjust based on clinical response once pacing is established)
5. Start at 60 mA of PACER OUTPUT and increase until electrical capture (pacer spikes aligned with QRS complex)
6. Set final milliamperes 10 mA above initial capture level
7. Confirm effective capture
   - Electrically: assess ECG tracing
   - Mechanically: palpate femoral pulse

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Non-shockable pulseless cardiac arrest

1. Call for help and a code cart
   - Ask: “Who will be the crisis manager?”
   - Say: “The top priority is high-quality CPR”
   - Crisis manager assigns roles - see ROLE assignments box

2. Put backboard under patient
   - Turn supine as soon as possible, but do not delay the start of compressions

3. Turn FiO\textsubscript{2} to 100%, turn off volatile anesthetic

4. Start CPR and assessment cycle
   - Perform CPR
     - “Hard and fast” about 100-120 compressions/min to depth ≥ 2 inches
     - Ensure full chest recoil with minimal interruptions
     - 10 breaths/minute, do not over-ventilate
     - Bag-mask ventilation until able to place endotracheal tube
   - Give EPINEPHrine 1mg IV
     - Repeat EPINEPHrine every 3-5 minutes
   - Assess every 2 minutes (limit assessment to < 10 seconds)
   - Change CPR compression provider
   - Check ETCO\textsubscript{2}
     - If: < 10 mmHg, evaluate CPR technique
     - If: Sudden increase to > 40 mmHg, may indicate return of spontaneous circulation
       - Treat reversible causes, consider reading aloud differential diagnoses
   - Check rhythm
     - If: Asystole/PEA continues:
       - Resume CPR and assessment cycle (restart Step 4)
       - Read aloud differential diagnosis (see list in right column)
     - If: VT/VF
       - Resume CPR
       - go to CHKLST 05

5. Consider ECMO if refractory cardiac arrest

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**DRUG DOSES & treatments**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EPINEPHrine</strong></td>
<td>1 mg IV, repeat every 3-5 minutes</td>
</tr>
<tr>
<td><strong>TOXIN</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Local anesthetic</strong></td>
<td>go to CHKLST 12</td>
</tr>
<tr>
<td><strong>Beta-blocker</strong></td>
<td>Glucagon 5 - 10 mg IV push</td>
</tr>
<tr>
<td><strong>Calcium Channel Blocker</strong></td>
<td>Calcium chloride 1g IV — or — Calcium gluconate 3g IV</td>
</tr>
<tr>
<td><strong>HYPERKALEMIA</strong></td>
<td></td>
</tr>
<tr>
<td>Calcium chloride</td>
<td>0.5 - 1 g IV</td>
</tr>
<tr>
<td>Calcium gluconate</td>
<td>1 - 3 g IV</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>50 mEq IV — or — Calcium chloride 0.5 - 1 g IV — or — Calcium gluconate 1 - 3 g IV</td>
</tr>
<tr>
<td><strong>Insulin</strong></td>
<td>5 - 10 units IV — and — Dextrose 50 - 100 mL D50W IV — or — 250 - 500 mL D10W IV</td>
</tr>
<tr>
<td><strong>Hypovolemia</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Hyper- or hypokalemia</strong></td>
<td>(CHKLST 14)</td>
</tr>
<tr>
<td><strong>Tamponade</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Tension pneumothorax</strong></td>
<td>Hypoxia (CHKLST 11)</td>
</tr>
<tr>
<td><strong>Auto-PEEP</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Embolism</strong></td>
<td></td>
</tr>
<tr>
<td><strong>High neuraxial</strong></td>
<td>Surgical stimulation</td>
</tr>
<tr>
<td><strong>Intra-abdominal hypertension</strong></td>
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</tr>
</tbody>
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**ROLE assignments**

- Chest compressions
- Airway
- Vascular access
- Documentation
- Code cart
- Time keeping
- Checklist reader

**DIFFERENTIAL diagnosis**

- Hypovolemia
- Hyper- or hypokalemia
- Tamponade
- Tension pneumothorax
- Auto-PEEP
- Embolism
- High neuraxial
- Intra-abdominal hypertension
- Myocardial ischemia
- Acidosis
- Hypoxia (CHKLST 11)
- Hypoglycemia
- LAST (CHKLST 12)
05  Cardiac Arrest - VF/VT

Shockable pulseless cardiac arrest

START

1. **Call for help and a code cart**
   - Ask: “Who will be the crisis manager?”
   - Say: “Shock patient as soon as the defibrillator arrives”
   - Crisis manager assigns roles (see ROLE assignments box)

2. **Put backboard under patient**
   - Turn supine as soon as possible, but do not delay the start of compressions

3. **Turn FiO₂ to 100%; turn off volatile anesthetics**

4. **Start CPR - defibrillation - assessment cycle**
   - Perform high-quality CPR
     - “Hard and fast” about 100 - 120 compressions/min to depth ≥ 2 inches
     - Ensure full chest recoil with minimal interruptions
     - 10 breaths/minute; do not over-ventilate
       - Bag-mask ventilation until able to place endotracheal tube
   - Defibrillate
     - Shock at highest setting
     - Resume CPR immediately after shock
   - Give EPINEPhrine
     - Repeat EPINEPhrine every 3-5 minutes
   - Give antiarrhythmics for refractory VF/VT after 2 shocks
   - Assess every 2 minutes
     - Change CPR compression provider
     - Check ETCO₂
       - If: < 10 mm Hg, evaluate CPR technique
       - If: Sudden increase to > 40 mm Hg, may indicate return of spontaneous circulation
     - Treat reversible causes, consider reading aloud differential diagnoses
     - Check rhythm; if rhythm organized, check pulse
       - If: VF/VT continues: Resume CPR cycles (restart Step 4)
       - If: Asystole/PEA: go to CHKLST 04

5. **Consider ECMO**

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**DRUG DOSES & treatments**

<table>
<thead>
<tr>
<th>DRUG</th>
<th>DOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EPINEPhrine</strong></td>
<td>1 mg IV, repeat every 3 - 5 minutes</td>
</tr>
</tbody>
</table>

**ANTIARRHYTHMICS**

<table>
<thead>
<tr>
<th>DRUG</th>
<th>1st dose</th>
<th>2nd dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amiodarone</td>
<td>300 mg IV</td>
<td>150 mg IV</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>1st dose: 1 - 1.5 mg/kg</td>
<td>2nd dose: 0.5 - 0.75 mg/kg</td>
</tr>
<tr>
<td>Magnesium</td>
<td>2 - 4 g IV for Torsades de Pointes</td>
<td></td>
</tr>
</tbody>
</table>

**DEFIBRILLATOR instructions**

1. Place electrodes on chest
2. Turn defibrillator ON, set to DEFIB mode, and increase ENERGY LEVEL. **Biphasic:** Follow manufacturer recommendation. (If unknown, use highest setting.)
   - **Monophasic:** 360J
3. Deliver shock: press CHARGE, then press SHOCK

**ROLE assignments**

- Chest compressions
- Airway
- Vascular access
- Documentation
- Code cart
- Time keeping
- Checklist reader

**DIFFERENTIAL diagnosis**

- Hypovolemia
- Hyper- or hypokalemia
- Tamponade
- Tension pneumothorax
- Auto-PEEP
- Embolism
- High neuraxial
- Intra-abdominal hypertension
- Myocardial ischemia
- (CHKLST 14)
- Acidosis
- Hypoxia (CHKLST 11)
- Hypoglycemia
- LAST (CHKLST 12)
Delayed Emergence

Prolonged unresponsiveness following general anesthesia or abnormal neurologic exam following general anesthesia

START

1. Call for help
   ▶ Ask: “Who will be the crisis manager?”
   ▶ Crisis manager designates checklist reader

2. Ensure all anesthetic medications have been stopped

3. Check for and correct hypoxemia, hypercarbia, hypothermia, or hypotension
   ▶ Consider signs of increased intracranial pressure (widened pulse pressure, bradycardia, irregular respirations)

4. Check for and treat residual drug effects
   ▶ Neuromuscular blockade (check TOF)
   ▶ Opiates and hypnotics

5. Send labs
   ▶ Arterial blood gas, electrolytes, glucose

6. Correct electrolyte abnormalities

7. Perform neurologic examination
   ▶ If unresponsive: pupil changes, gag reflex, level of arousal
   ▶ If responsive: stroke assessment
     ■ Facial droop - show teeth in smile
     ■ Pronator drift - eyes closed, extend arms with palms up for 10 seconds
     ■ Speech assessment - say “you can’t teach old dogs new tricks”
     ■ Assess for severe sudden headache
   ▶ Consider STAT head CT and neurology consult for abnormal exam

DRUG DOSES & treatments

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose and Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naloxone</td>
<td>40 MCG IV (0.4 mg to total 10 mL = 40 MCG/mL) Repeat q 2 minutes. If no response to 400 MCG, consider non-opiate causes</td>
</tr>
<tr>
<td>Flumazenil</td>
<td>0.2 mg IV Repeat dose q 1 minute Max dose 1 mg AVOID in chronic benzodiazepine use or seizure history</td>
</tr>
<tr>
<td>Sugammadex</td>
<td>2 - 4 mg/kg IV</td>
</tr>
</tbody>
</table>

DIFFERENTIAL diagnosis

- High spinal
- Serotonin syndrome
- Myxedema coma or thyroid storm
- Concomitant head injury
- Hepatic or uremic encephalopathy
- Neurosurgical complications
  - Hemorrhage
  - Vascular occlusion
  - Elevated ICP
- Postictal state following intraoperative seizure
- Medication error
- Local Anesthetic Systemic Toxicity (CHKLST 12)
- Central anticholinergic syndrome
1. **Call for help and a code cart**
   - Ask: “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Get difficult airway cart**

3. **Monitor elapsed TIME, intubation ATTEMPTS, and SpO₂**
   - Limit attempts to 3 by initial provider plus 1 attempt by other airway expert (“3+1”)

4. **Bag-mask ventilate with 100% Oxygen**
   - Is ventilation adequate?
     - Maintaining adequate SpO₂?
     - Capnographic evidence of adequate ventilation?

### DRUG DOSES & treatments

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<th>Dose</th>
<th>Note</th>
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<tbody>
<tr>
<td>Sugammadex</td>
<td>8 - 16 mg/kg IV</td>
<td></td>
</tr>
<tr>
<td>Naloxone</td>
<td>0.4 mg IV</td>
<td></td>
</tr>
<tr>
<td>Flumazenil</td>
<td>0.2 mg IV</td>
<td>May repeat up to 1 mg</td>
</tr>
</tbody>
</table>

*AVOID in chronic benzodiazepine use or seizure history*

### Alternative INTUBATION TECHNIQUES

- Video laryngoscope
- Intubation via supraglottic device
- Different blades
- Intubating stylet
- Gum elastic bougie
- Flexible bronchoscope
- Lightwand
- Retrograde intubation
- Blind oral or nasal intubation

### Failed Airway

2 unsuccessful intubation attempts by an airway expert in a patient under general anesthesia

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08 Fire

Evidence of fire (smoke, odor, flash) on patient or drapes, or in patient’s airway, or in OR equipment

START

1. Call for help
   ▶ Ask: “Who will be the crisis manager?”
   ▶ Crisis manager designates checklist reader
2. Halt surgery, if possible

If AIRWAY FIRE

3. Attempt to extinguish fire
   ▶ Shut off medical gases
   ▶ Remove endotracheal tube
   ▶ Remove flammable material from airway
   ▶ Pour saline in airway
4. After fire extinguished
   ▶ Re-establish ventilation using self-inflating bag with room air
     ■ If unable to re-establish ventilation, go to CHKLST 07
     ■ Avoid N₂O and minimize FiO₂
   ▶ Confirm no secondary fire
   ■ Check surgical field, drapes, and towels
   ▶ Assess airway for injury or foreign body
   ■ Assess ETT integrity (fragments may be left in airway)
   ▶ Consider bronchoscopy
5. Assess patient status and devise ongoing management plan
6. Save involved materials/devices for review

If NON-AIRWAY patient fire

3. Obtain a fire extinguisher
4. Attempt to extinguish fire
   FIRST ATTEMPT
   ▶ Discontinue N₂O and minimize FiO₂
   ▶ Remove drapes / all flammable materials from patient
   ▶ If patient or drapes are on fire: extinguish burning materials with saline or saline-soaked gauze
   If Fire PERSISTS
   ▶ Use fire extinguisher (Class A and BC are safe in wounds)
   ▶ Activate fire alarm
5. After fire extinguished
   ▶ Assess patient for injury at site of fire, and for inhalational injury if not intubated
   ▶ Confirm no secondary fire
   ■ Check surgical field, drapes, and towels
6. Devise ongoing patient management plan
7. Save involved materials / devices for review

If OR EQUIPMENT fire

3. Obtain a fire extinguisher
4. Attempt to extinguish fire
   ▶ Use CO₂ (Class BC) fire extinguisher (avoid liquids)
   If Fire PERSISTS
   ▶ Evacuate patient
   ▶ Close OR door
   ▶ Turn OFF gas supply to room
   ▶ Activate fire alarm
5. After fire extinguished or patient evacuated
   ▶ Assess patient for injury at site of fire, and for inhalational injury if not intubated
   ▶ Confirm no secondary fire
   ■ Check surgical field, drapes, and towels
6. Devise ongoing patient management plan
7. Save involved materials / devices for review

FIRE extinguisher use
P - pull the pin
A - aim at the base of the fire
S - squeeze the handle
S - sweep side to side

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1. **Call for help**
   - **Ask:** “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Open IV fluids until blood products available**

3. **Obtain large bore IV access, rapid infuser**
   - Obtain arterial access

4. **Turn FiO₂ to 100% and reduce volatile anesthetics**

5. **Call blood bank**
   - Activate massive transfusion protocol
   - Consider whole blood
   - Consider uncrossmatched Type O RBC and Type AB plasma
   - Assign 1 person as primary contact for blood bank

6. **Begin transfusion in 1 PRBC : 1 FFP : 1 Platelet**
   - Calcium repletion for massive transfusion

7. **Consider TXA administration**

8. **Warm patient and fluids**

9. **Discuss management plan** with surgical, anesthesiology, and nursing teams
   - Call for additional surgery consultation as indicated
   - Consider damage control surgery (pack, close, resuscitate)
   - Consider resuscitative endovascular balloon occlusion of the aorta (REBOA) for hemorrhage below the diaphragm
   - Consider ECMO or cardiac bypass to facilitate surgical repair

10. **Send labs**
    - CBC, PT / PTT / INR, fibrinogen, lactate, arterial blood gas, potassium, and ionized calcium
    - Viscoelastography

11. **Consider re-dosing antibiotics** if EBL > 1500 mL

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**DRUG DOSES & treatments**

**ANTIFIBRINOLYTIC treatment**
- **Tranexamic Acid (TXA)**
  - **BOLUS:** 1 g IV
  - Over 10 min
  - **INFUSION:** 1 g/ 500 mL
  - Over 8 hours

**HYPOCALCEMIA treatment**
- **Calcium Gluconate**
  - 1 g per 3 units product
- **Calcium Chloride**
  - 1 g per 5 units product
  - *Adjust to measured ionized calcium*

**HYPERKALEMIA treatment**

- **Insulin (Regular)**
  - 5 - 10 units IV
  - *and—*
  - **Dextrose**
    - 50 - 100 mL D50W IV
    - 250 - 500 mL D10W IV
  - **Sodium bicarbonate**
    - 50 mEq IV (if pH < 7.2)
Hypotension

Unexplained drop in blood pressure refractory to initial treatment

START

1. Call for help
   ▶ Ask: “Who will be the crisis manager?”
   ▶ Crisis manager designates checklist reader

2. Check...
   ▶ Measurement artifact
   ▶ ETCo₂ - adequacy of perfusion
   ▶ Heart rate
     ■ If BRADYCARDIA, go to CHKLST 03
     ■ If TACHYCARDIA, go to CHKLST 16
   ▶ Rhythm
     ■ If PEA, go to CHKLST 04
     ■ If VF / VT, go to CHKLST 05

3. Inspect surgical field for bleeding
   ▶ If BLEEDING, go to CHKLST 09

4. Run IV fluids wide open

5. Give vasopressors and titrate to response
   ▶ MILD hypotension:
     ■ Give ePHEDrine or phenylephrine
   ▶ SIGNIFICANT / REFRACTORY hypotension:
     ■ Administer norepinephrine; consider escalating to add vasopressin or EPINEPHrine

6. Turn FiO₂ to 100% and minimize volatile anesthetics

7. Consider...
   ● Trendelenburg position
   ● Additional IV access
   ● Arterial line
   ● Point of care ultrasound or echocardiography for diagnosis
   ● Mechanical circulatory support

DIFFERENTIAL diagnosis

Volume / Vasoplegia (Vasodilation)
● Occult bleeding
● Anaphylaxis, go to CHKLST 02
● Drug overdose or error
● Sepsis
● Hypoxia, go to CHKLST 11
● Hypocalcemia
● Adrenal insufficiency
● Reperfusion

Obstructed Blood Flow
● Mechanical or surgical manipulation
● Insufflation during laparoscopy
● Vascular compression
● Tamponade
● Increased PEEP
● Pneumothorax

Cardiac Function
● Myocardial ischemia, go to CHKLST 14
● Heart failure
● Emboli (pulmonary, fat, amniotic, CO₂, air), go to CHKLST 01
● Bone cementing
● Malignant hyperthermia, go to CHKLST 13

DRUG DOSES & treatments

ePHEDrine 5 - 25 mg IV
   — or —
   50 mg IM x 1

Phenylephrine BOLUS: 50 - 200 MCG IV
   (1mL of 10 mg/mL in 100 mL = 100 MCG/mL)
   INFUSION: 0.5 - 1 MCG/kg/min

Norepinephrine BOLUS: 5 - 20 MCG IV
   (4mL of 1mg/mL in 250 ml = 16 MCG/mL)
   INFUSION: 0.05 - 0.5 MCG/kg/min

Vasopressin BOLUS: 1 - 2 units IV
   (1 mL of 20 units/mL in 19 mL = 1 unit/mL)
   INFUSION: 0.01 - 0.04 units/min

EPINEPHrine BOLUS: 4 - 10 MCG IV
   (1 mg in 100 mL = 10 MCG/mL)
   INFUSION: 0.01 - 0.1 MCG/kg/min

REFRACTORY VASOPLEGIA treatment

Methylene Blue 1 - 2 mg/kg in 100mL NS over 20 - 60 minutes
   Consider pharmacy consultation

Hydrocortisone 100 mg IV

HYPOCALCEMIA treatment

Calcium Gluconate 1 - 3 g IV
   — or —

Calcium Chloride 0.5 - 1 g IV
Hypoxia
Unexplained oxygen desaturation

11

1. **Call for help**
   - **Ask:** “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Turn FiO₂ to 100%** at high gas flows
   - Confirm inspired FiO₂ = 100% on gas analyzer
   - Confirm presence of end-tidal CO₂

3. **Hand-ventilate** to assess compliance

4. **Listen** to breath sounds

5. **Check…**
   - Blood pressure, pulse, airway pressures
   - Capnogram waveform
   - Endotracheal tube/supraglottic device position
   - Pulse oximeter placement and limb perfusion
   - Circuit integrity: disconnection, kinks, holes

6. **Consider initial stabilization actions**
   - Suction secretions
   - Remove circuit and use self-inflating bag
   - Alveolar recruitment maneuver and PEEP titration
   - Bronchodilator therapy
   - Deepen anesthetic and paralysis
   - Optimize positioning and insufflation pressure

7. **Consider causes - see DIFFERENTIAL Diagnosis**

8. **If hypoxia persists, consider ECMO**

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**DRUG DOSES & treatments**

- **Albuterol**: 3 MDI puffs per ETT
  - 2.5 mg via nebulizer
- **EPINEPHrine**: 10 - 20 MCG IV, repeat PRN
  - (1 mg in 100 mL = 10 MCG/mL)

**Additional DIAGNOSTIC TESTS**

- Fiberoptic bronchoscopy
- Chest x-ray
- Electrocardiogram
- Transesophageal Echocardiogram
- Arterial or venous blood gas
- Lung ultrasound

**DIFFERENTIAL diagnosis**

**Airway / Breathing**
- Right mainstem intubation
- Aspiration
- Atelectasis
- Bronchospasm
- Anaphylaxis (CHKLST 02)
- Hypoventilation
- Laryngospasm
- Obesity / positioning
- Pneumothorax
- Pulmonary edema
- Auto-PEEP

**Circulation**
- Embolism (CHKLST 01)
- Heart disease
- Tamponade
- Septic shock
- Severe hypotension (CHKLST 10)

**Artifacts**
- Dyes (e.g. methylene blue)
- Hemoglobinopathies (e.g. methemoglobinemia)
Neurologic or Cardiovascular Signs/Symptoms following use of local anesthetic

1. Call for help
   ▶ Ask: “Who will be the crisis manager?”
   ▶ Crisis manager designates checklist reader

2. Get LAST rescue kit or lipid emulsion and consider early call for ECMO

3. STOP local anesthetic infusion, if running

4. START administering lipid emulsion
   ▶ Do not delay airway protection or hemodynamic management while waiting for lipid emulsion

5. If seizing:
   ▶ Ensure adequate airway patency and ventilation
   ▶ Administer benzodiazepine
   ▶ If only propofol is available, administer low dose, e.g. 20 mg increments

6. If hemodynamically unstable, give low-dose EPINEPHrine
   ▶ Doses of EPINEPHrine are LOWER than ACLS recommendations
   ▶ AVOID: beta blockers, calcium channel blockers, local anesthetics, and vasopressin
   ▶ Ensure adequate airway patency and ventilation

7. If cardiovascular collapse is unresponsive to EPINEPHrine and lipid emulsion, initiate ECMO or cardiac bypass

8. Continue lipid emulsion for at least 15 minutes after achieving hemodynamic stability

### DRUG DOSES & treatments

**Lipid Emulsion 20%**

<table>
<thead>
<tr>
<th>Weight ≥ 70 kg</th>
<th>Weight &lt; 70 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOLUS: 100mL IV over 2-3 min</td>
<td>1.5 mL/kg IV over 2-3 min</td>
</tr>
<tr>
<td>INFUSION: 250mL IV over 15-20 min</td>
<td>0.25 mL/kg/min IV</td>
</tr>
</tbody>
</table>

Repeat bolus and double infusion if patient remains unstable

Max lipid dose 12 mL/kg for initial dosing

- **Midazolam** 0.05 mg/kg, max 2 mg per dose, repeat as needed
- or —
- **LORazepam** 0.1 mg/kg, max 4 mg per dose, repeat as needed

**EPINEPHrine**

10 - 20 MCG IV bolus, increase as needed to max 1 MCG/kg

(1 mg in 100 mL = 10 MCG/mL)

### SIGNS and SYMPTOMS

**Timing:** onset from 60 seconds to 60 minutes following injection of local anesthetic

**Neurologic Symptoms:** neurologic excitement (agitation, metallic taste, auditory changes) -> seizures (generalized or focal) and neurologic depression

**Cardiac Symptoms:** HTN, tachycardia, arrhythmia -> bradycardia, conduction block, asystole

### Critical CHANGES

- If **PEA** develops, go to CHKLST 04 (note EPINEPHrine dose modifications in LAST)
- If **VF/VT** develops, go to CHKLST 05 (note EPINEPHrine dose modifications in LAST)
**Malignant Hyperthermia**

In presence of trigger agent: unexpected, unexplained increase in end-tidal CO$_2$, unexplained tachycardia / tachypnea, masseter muscle spasm after succinylcholine. Hyperthermia is a late sign.

### START

1. **Call for help and a code cart**
   - **Ask:** “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Get Malignant Hyperthermia Kit**

3. **Call MH Hotline 1.800.644.9737**

4. **Assign dedicated person to start mixing dantrolene**

5. **Open IV fluids and consider furosemide**
   - Goal urine output 1 - 2 mL/kg/hr

6. **Turn off volatile anesthetics and transition to non-triggering anesthetics**
   - **DO NOT** delay treatment to change circuit or CO$_2$ absorber
   - Insert charcoal filters on inspiratory and expiratory limbs, if available

7. **Turn FiO$_2$ to 100%**

8. **Hyperventilate patient at flows of 10 L / min or more**

9. **Terminate procedure, if possible**

10. **Give dantrolene**

11. **Give sodium bicarbonate** for suspected metabolic acidosis (maintain pH > 7.2)

12. **Treat hyperkalemia**, if suspected

13. **Treat dysrhythmias**, if present
   - Standard antiarrhythmics are acceptable
   - **DO NOT** use calcium channel blockers

14. **Send labs**
   - Arterial blood gas
   - Electrolytes
   - Serum creatinine kinase (CK)
   - Serum / urine myoglobin
   - Coagulation profile

15. **Initiate supportive care**
   - Cool patient if >39°C:
     - Lavage open body cavities
     - Gastric lavage with cold water
     - Apply ice externally
     - Infuse cold saline IV
     - STOP cooling if < 38°C
   - Place Foley catheter, monitor urine output
   - Plan for ICU monitoring for 24 hrs

### DRUG DOSES & treatments

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dantrolene</strong></td>
<td>2.5 mg/kg, repeat up to 10 mg/kg until symptoms subside</td>
</tr>
<tr>
<td><strong>Ryanodex</strong></td>
<td>Reconstitute 250 mg vials with 5 mL sterile water (shake until orange)</td>
</tr>
<tr>
<td></td>
<td>2.5 mg/kg = 0.05 mL/kg</td>
</tr>
<tr>
<td></td>
<td>70kg patient dose = 3.5 mL (~ 1 vial)</td>
</tr>
<tr>
<td><strong>Dantrium</strong> or <strong>Revento</strong></td>
<td>Reconstitute 20 mg vials with 60 mL sterile water</td>
</tr>
<tr>
<td></td>
<td>2.5 mg/kg = 7.5 mL/kg</td>
</tr>
<tr>
<td></td>
<td>70kg patient dose = 525 mL (~9 vials)</td>
</tr>
<tr>
<td><strong>Bicarbonate</strong></td>
<td>50 mEq IV</td>
</tr>
<tr>
<td><strong>Furosemide</strong></td>
<td>40 mg IV</td>
</tr>
</tbody>
</table>

### HYPERKALEMIA treatment

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calcium gluconate</strong></td>
<td>1 - 3 g IV</td>
</tr>
<tr>
<td><strong>Calcium chloride</strong></td>
<td>0.5 - 1 g IV</td>
</tr>
<tr>
<td><strong>Insulin (Regular)</strong></td>
<td>5 - 10 units regular IV</td>
</tr>
<tr>
<td></td>
<td><strong>and</strong></td>
</tr>
<tr>
<td><strong>Dextrose</strong></td>
<td>50 - 100 mL D50W IV</td>
</tr>
<tr>
<td></td>
<td><strong>or</strong></td>
</tr>
<tr>
<td></td>
<td>250 - 500 mL D10W IV</td>
</tr>
</tbody>
</table>

### DIFFERENTIAL diagnosis (consider when using high doses of dantrolene without resolution of symptoms)

<table>
<thead>
<tr>
<th>Category</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiorespiratory</td>
<td>Hypoventilation, Sepsis</td>
</tr>
<tr>
<td>Iatrogenic</td>
<td>Exogenous CO$_2$ source (e.g. laparoscopy), Overwarming, Neuroleptic Malignant Syndrome</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Thyrotoxicosis, Pheochromocytoma</td>
</tr>
<tr>
<td>Neurologic</td>
<td>Meningitis, Intracranial bleed, Hypoxic encephalopathy, Traumatic brain injury</td>
</tr>
<tr>
<td>Toxicology</td>
<td>Radiologic contrast neurotoxicity, Anticholinergic syndrome, Cocaine, amphetamine, salicylate toxicity, Alcohol withdrawal</td>
</tr>
</tbody>
</table>
1. **Call for help**
   - **Ask:** “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Increase oxygen delivery and decrease oxygen demand**
   - **Increase supply:**
     - 100% FiO₂
     - Correct anemia (goal hgb 7 - 9 g/dL)
     - Correct hypotension (see CHKLST 10)
   - **Decrease demand:**
     - Correct tachycardia - caution in RCA ischemia (II, III, aVF)
     - Correct hypertension
     - Restore sinus rhythm (see CHKLST 16)

3. **Obtain 12-lead EKG and send troponin levels**

4. **Consult cardiology**
   - Consideration of anticoagulation and/or antiplatelet therapy
   - Consideration of thrombolysis or cardiac catheterization

5. **Discuss clinical condition with surgical team**
   - Safe to abort surgery?
   - Safe to consider anticoagulation and/or antiplatelet therapy?

6. **Consider hemodynamic monitoring**
   - If ongoing hemodynamic instability, arterial line
   - If persistent vasopressor requirement, central line
   - If evidence of cardiogenic shock, non-invasive cardiac output monitor or PA catheter

7. **Consider TEE or TTE if ongoing hemodynamic instability**

8. **Consider ICU disposition**

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### DRUG DOSES & treatments

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitroglycerin</td>
<td>0.5 - 5 MCG/kg/min</td>
</tr>
<tr>
<td>Aspirin</td>
<td>325 mg PO/PR x1 dose</td>
</tr>
<tr>
<td>Heparin</td>
<td>4000 - 5000 units IV push</td>
</tr>
<tr>
<td>Norepinephrine</td>
<td>BOLUS: 5 - 20 MCG IV&lt;br&gt;INFUSION: 0.05 - 0.5 MCG/kg/min</td>
</tr>
<tr>
<td>EPINEPHrine</td>
<td>BOLUS: 4 - 10 MCG IV&lt;br&gt;INFUSION: 0.01 - 0.1 MCG/kg/min</td>
</tr>
<tr>
<td>Esmolol</td>
<td>50 - 300 MCG/kg/min</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>5 - 20 mg IV</td>
</tr>
</tbody>
</table>

### DIFFERENTIAL diagnosis

- Coronary artery disease with acute thrombus
- Coronary artery disease with demand ischemia
- Coronary artery embolism
- Local Anesthetic Systemic Toxicity (CHKLST 12)
- Severe hypoxia (CHKLST 11)

### Critical CHANGES

- **If PEA develops,** go to CHKLST 04
- **If VF/VT develops,** go to CHKLST 05
15 OB Hemorrhage

Cumulative Blood Loss (intrapartum and postpartum) > 1000mL in vaginal or cesarean delivery or blood loss associated with signs or symptoms of hypovolemia within 24 hours after delivery

START

1. Call for help
   ▶ Ask: “Who will be the crisis manager?”
   ▶ Crisis manager designates checklist reader
   ▶ Crisis manager designates a person to monitor estimated blood loss

2. Announce vital signs and cumulative blood loss every 10 minutes

3. Open IV fluids and establish adequate IV access
   ▶ Warm patient and fluids
   ▶ Insert bladder catheter
   ▶ Consider arterial access

4. Turn FiO₂ to 100% or start supplemental oxygen
   ▶ Minimize volatile anesthetics

5. Prepare for transfusion
   ▶ Assign 1 person as primary contact with Blood Bank
   ▶ Activate massive transfusion protocol
   ▶ Request rapid transfuser device

6. Send STAT labs
   ▶ CBC, BMP, Type and Screen, fibrinogen, PT, aPTT, lactate
   ▶ Viscoelastography

7. Give uterotonic agents and tranexamic acid

8. Begin transfusion
   ▶ Transfuse with products in ratio of 4 PRBCS : 4 FFP : 1 Platelet
   ▶ Target fibrinogen > 200 mg/dL
     ■ 10 units cryoprecipitate, expected rise 100 mg/dL
     ■ Fibrinogen concentrate 4g, expected rise 100 mg/dL

9. Surgical team: perform exam and uterine massage
   ▶ Consider the differential diagnosis (see box)
   ▶ Consider D+C, laceration repair, uterine tamponade
   ▶ If bleeding unresponsive, consider uterine artery ligation or hysterectomy, or Interventional Radiology for embolization

DRUG DOSES & treatments

Oxytocin (Pitocin)
3 units IV BOLUS or 5-10 units IM BOLUS
   — followed by —
10 - 40 units in 500 - 1000 mL IV INFUSION
   Calcium in hypotension

Methylergonovine maleate (Methergine)
0.2 mg IM q 2 - 4 hours
   DO NOT administer IV
   Caution in hypertension, cardiac disease

Carboprost tromethamine (Hemabate)
250 MCG q 15 - 90 min IM x8 max
   DO NOT administer IV
   Caution in asthma, HTN

miSOPROStol (Cytotec)
800 - 1000 MCG PR/buccal/SL x1 dose

Tranexamic Acid (TXA)
1000mg IV over 10 min, repeat x1 after 30 min

Calcium Chloride
1 g per 5 units product
   — or —
Calcium Gluconate
1 g per 3 units product

DIFFERENTIAL diagnosis

- Tone (uterine atony)
- Trauma (lacerations or uterine rupture)
- Tissue (retained placenta)
- Thrombin (clotting factor deficiency)
**Tachycardia - Unstable**

*Persistent tachycardia with hypotension, ischemic chest pain, altered mental status, or shock*

### START

1. **Call for help and a code cart**
   - Ask: “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Turn FiO₂ to 100% and turn down volatile anesthetic**

3. **Analyze rhythm**
   - If wide complex, irregular: treat as VF, go to CHKLST 05
   - If narrow complex, regular: consider adenosine while awaiting cardioversion

4. **Prepare for immediate synchronized cardioversion**
   - Sedate conscious patients unless deteriorating rapidly

5. **Cardiovert per instructions in gray box**
   - If cardioversion needed and unable to synchronize, use high-energy unsynchronized shocks (biphasic - select highest setting, monophasic - 360 J)

6. **If resistant to electrical conversion, consider amiodarone**

7. **Consider cardiology consultation**

### DRUG DOSES & treatments

<table>
<thead>
<tr>
<th>DRUG</th>
<th>DOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adenosine</strong></td>
<td>6 mg rapid IV push</td>
</tr>
<tr>
<td></td>
<td>If persistent, 12 mg rapid IV push</td>
</tr>
<tr>
<td></td>
<td><em>Caution in severe asthma</em></td>
</tr>
<tr>
<td><strong>Amiodarone</strong></td>
<td>150 mg IV over 10 minutes</td>
</tr>
<tr>
<td></td>
<td>May repeat x1</td>
</tr>
</tbody>
</table>

### SYNCHRONIZED CARDIOVERSION instructions

1. Turn monitor/defibrillator ON, set to defibrillator mode
2. Place electrodes on chest
3. Engage synchronization mode
4. Adjust EKG if necessary until SYNC markers seen with each R-wave
5. Select energy level
6. Press charge button
7. Press and hold shock button
8. Check monitor, if tachycardia persists, increase energy level
9. Engage synchronization mode after delivery of each shock

### ENERGY Level

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>ENERGY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow complex, regular</td>
<td>50 J - 100 J</td>
</tr>
<tr>
<td>Narrow complex, irregular</td>
<td>120 J - 200 J biphasic; 200 J monophasic</td>
</tr>
<tr>
<td>Wide complex, regular</td>
<td>100 J</td>
</tr>
<tr>
<td>Wide complex, irregular</td>
<td>Treat as VF, go to CHKLST 05</td>
</tr>
</tbody>
</table>

### Critical CHANGES

If **cardiac arrest** develops:
- Asystole/PEA, go to CHKLST 04
- VF/VT, go to CHKLST 05
Hemolytic Reaction: Cardiac instability, bronchospasm, bleeding, dark urine; Non-hemolytic Reaction: fever, rash, pulmonary edema; Anaphylactic Reaction: hypotension, urticaria, bronchospasm

1. **Call for help**
   - Ask: “Who will be the crisis manager?”
   - Crisis manager designates checklist reader

2. **Disconnect any blood products infusing**
   - Check blood product labels for correct patient name and ABO compatibility
   - Send the blood product(s) back to the blood bank for evaluation

3. **Support hemodynamics with EPINEPHrine**
   - Repeat bolus with increasing dose as needed
   - Consider EPINEPHrine infusion

4. **Manage bronchospasm**
   - FiO₂ 100%
   - Albuterol or EPINEPHrine

5. **Maintain urine output if hemolysis noted**
   - Volume load 20 mL / kg crystalloid. *Caution if signs of volume overload.*
   - Consider furosemide or mannitol to goal UOP 1-2 mL / kg / hr

6. **Monitor labs**
   - Arterial or venous blood gas, electrolytes
   - PT, aPTT, fibrinogen, viscoelastography
   - Direct antiglobulin (Coomb’s) test, haptoglobin, LDH, free hemoglobin, tryptase

7. **Consider invasive lines**
   - Arterial line for ongoing hemodynamic instability
   - Central venous catheter for vasopressors

8. **Further treatment**
   - Consider hematology consult and ICU disposition

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**DRUG DOSES & treatments**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Bolus Dose</th>
<th>Infusion Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPINEPHrine</td>
<td>10 - 20 MCG IV</td>
<td>0.01 - 0.1 MCG/kg/min</td>
</tr>
<tr>
<td>(1 mg in 100 mL = 10 MCG/mL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furosemide</td>
<td>40 mg IV</td>
<td></td>
</tr>
<tr>
<td>Albuterol</td>
<td>2-3 puffs MDI via ETT</td>
<td>2.5 mg via nebulizer</td>
</tr>
</tbody>
</table>

**DIFFERENTIAL diagnosis**

- Anaphylaxis from other causes (CHKLST 02)
- Hypotension (CHKLST 10)
- Transfusion Related Acute Lung Injury (TRALI)
- Transfusion-Associated Circulatory Overload (TACO)
- Septic Shock
- Other hemolytic anemias (idiopathic, HUS, HELLP)