Operating Room Crisis Checklists

Management of Adult Emergencies

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>> Do not remove book from this room <<

ARIADNE LABS

Brigham and Women's Hospital
Founding Member, Mass General Brigham

HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH

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SUSPECTED EVENT *(alphabetical)*	INDEX
Air Embolism - Venous	01
Anaphylaxis	02
Bradycardia - Unstable	03
Cardiac Arrest - Asystole/PEA	04
Cardiac Arrest - VF/VT	05
Delayed Emergence	06
Failed Airway	07
Fire	08
Hemorrhage	09
Hypotension	10
Hypoxia	11
Local Anesthetic Systemic Toxicity (LAST)	12
Malignant Hyperthermia	13
Myocardial Ischemia	14
OB Hemorrhage	15
Tachycardia - Unstable	16
Transfusion Reaction	17

01 Air Embolism - Venous

Decreased end-tidal CO_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_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_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 $ETCO_2$ 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

DIFFERENTIAL diagnosis

Amniotic Fluid Embolism
Cement Embolism
Venous Thromboembolism / Pulmonary Embolism
Non-embolic causes of hypotension (CHKLST 10)
Non-embolic causes of hypoxia (CHKLST 11)

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 FiO_2 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 (1 mg in 100 mL = 10 MCG/mL) INFUSION: 0.01- 0.1 MCG/kg/min If no IV access, 0.3 mg IM
Vasopressin	BOLUS: 1 -2 units IV (1 mL of 20 units/mL in 19 mL = 1 unit/mL) 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

03 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 FiO_2 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

Atropine	0.5-1 mg IV, may repeat up to 3 mg total
EPINEPHrine	BOLUS: 10 - 100 MCG IV, repeat as needed (1 mg in 100 mL = 10 MCG/mL) INFUSION: 0.01 - 0.1 MCG/kg/min
— or —	
DOPamine	2 -20 MCG/kg/min IV infusion

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
Tension pneumothorax	Hypothermia
Auto-PEEP	Hypovolemia
Surgical stimulation	Local anesthesia systemic toxicity (CHKLST 12)
High spinal	Malignant Hyperthermia (CHKLST 13)
Acidosis	Myocardial ischemia (CHKLST 14)

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

04 Cardiac Arrest - Asystole/PEA

Non-shockable pulseless cardiac arrest

START

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_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 $ETCO_2$
       - 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**

DRUG DOSES & treatments

EPINEPHrine	1 mg IV, repeat every 3-5 minutes
TOXIN treatment	
Local anesthetic	*go to* CHKLST 12
Beta-blocker	**Glucagon** 5 - 10 mg IV push
Calcium Channel Blocker	**Calcium chloride** 1g IV
	— or —
	Calcium gluconate 3g IV
HYPERKALEMIA treatment	
Calcium chloride	0.5 - 1 g IV
— or —	
Calcium gluconate	1 - 3 g IV
Sodium bicarbonate (if pH < 7.2)	50 mEq IV
Insulin (Regular)	5 - 10 units IV
– and –	
Dextrose	50 - 100 mL D50W IV
	— or —
	250 - 500 mL D10W IV

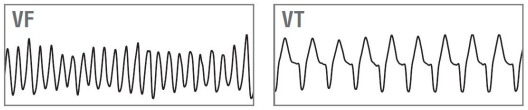
ROLE assignments

- 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)
- Surgical stimulation

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 FiO_2 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 $ETCO_2$
       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**

DRUG DOSES & treatments

EPINEPHrine 1 mg IV, repeat every 3 - 5 minutes

ANTIARRHYTHMICS

Amiodarone 1st dose: 300 mg IV
2nd dose: 150 mg IV

Lidocaine 1st dose: 1 - 1.5 mg/kg
2nd dose: 0.5 - 0.75 mg/kg

Magnesium 2 - 4 g IV for ***Torsades de Pointes***

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

Naloxone	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
Flumazenil	0.2 mg IV Repeat dose q 1 minute Max dose 1 mg
	AVOID in chronic benzodiazepine use or seizure history
Sugammadex	2 - 4 mg/kg IV

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

Failed Airway

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

START

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 SpO_2**
   - 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 SpO_2?
     - Capnographic evidence of adequate ventilation?

Switch if status changes

Ventilation **NOT ADEQUATE**

- Consider/attempt supraglottic airway
  - Optimize patient position
- If unsuccessful, attempt alternative intubation approaches as you **prepare** for emergency invasive airway
  - Limit to **"3+1"**
- If you remain unable to intubate and unable to ventilate, **implement** emergency invasive airway

Ventilation **ADEQUATE**

- Attempt alternative intubation techniques
  - Limit to **"3+1"**
- Consider doing procedure with a supraglottic or mask airway
- Optimize ventilation/intubating conditions
- Consider invasive airway
- Consider awakening patient
- If awakening patient, consider:
  - Awake intubation
  - Complete procedure under local or regional
  - Cancel the procedure

DRUG DOSES & treatments

Sugammadex	8 - 16 mg/kg IV
Naloxone	0.4 mg IV
Flumazenil	0.2 mg IV May repeat up to 1 mg

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

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

FIRE EXTINGUISHER use

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

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 N_2O and minimize FiO_2
   - ▶ 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 N_2O and minimize FiO_2
   - ▶ 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 CO_2 (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

Hemorrhage

Acute massive bleeding

START

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 FiO_2 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

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
— or —	
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 — or — 250 - 500 mL D10W IV
Sodium bicarbonate (if pH < 7.2)	50 mEq IV

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
   - ▶ $ETCO_2$ - 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 FiO_2 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, CO_2, 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

START

1. **Call for help**
   - **Ask:** "*Who will be the crisis manager?*"
   - Crisis manager designates checklist reader
2. **Turn FiO_2 to 100%** at high gas flows
   - Confirm inspired FiO_2 = 100% on gas analyzer
   - Confirm presence of end-tidal CO_2
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**

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)

Local Anesthetic Systemic Toxicity (LAST)

Neurologic or Cardiovascular Signs/Symptoms following use of local anesthetic

START

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%

Weight ≥ 70 kg	Weight < 70 kg
BOLUS: 100mL IV over 2-3 min	1.5 mL/kg IV over 2-3 min
INFUSION: 250mL IV over 15-20 min	0.25 mL/kg/min IV

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

Dantrolene	2.5 mg/kg, repeat up to 10 mg/kg until symptoms subside Rarely, may require up to 30 mg/kg
Ryanodex	Reconstitute 250 mg vials with 5 mL sterile water (shake until orange) 2.5 mg/kg = 0.05 mL/kg 70kg patient dose = 3.5 mL (~ 1 vial)
— or —	
Dantrium *or* **Revonto**	Reconstitute 20 mg vials with 60 mL sterile water 2.5 mg/kg = 7.5 mL/kg 70kg patient dose = 525 mL (~9 vials)
Bicarbonate	50 mEq IV
Furosemide	40 mg IV

HYPERKALEMIA treatment

Calcium gluconate	1- 3 g IV
— or —	
Calcium chloride	0.5 - 1 g IV
Insulin (Regular)	5 - 10 units regular IV
— and —	
Dextrose	50 - 100 mL D50W IV — or — 250 - 500 mL D10W IV

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

Cardiorespiratory
- Hypoventilation
- Sepsis

Endocrine
- Thyrotoxicosis
- Pheochromocytoma

Iatrogenic
- Exogenous CO_2 source (e.g. laparoscopy)
- Overwarming
- Neuroleptic Malignant Syndrome

Neurologic
- Meningitis
- Intracranial bleed
- Hypoxic encephalopathy
- Traumatic brain injury

Toxicology
- Radiologic contrast neurotoxicity
- Anticholinergic syndrome
- Cocaine, amphetamine, salicylate toxicity
- Alcohol withdrawal

14 Myocardial Ischemia

Chest Pain, Shortness of Breath, ST Elevation or Depression, Ventricular Arrhythmias

START

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 % FiO_2
     - 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**

DRUG DOSES & treatments

Nitroglycerin	0.5 - 5 MCG/kg/min
Aspirin	325 mg PO/PR x1 dose
Heparin	4000 - 5000 units IV push
Norepinephrine	BOLUS: 5 - 20 MCG IV (4mL of 1mg/mL in 250 ml = 16 MCG/mL) INFUSION: 0.05 - 0.5 MCG/kg/min
EPINEPHrine	BOLUS: 4 - 10 MCG IV (1 mg in 100 mL = 10 MCG/mL) INFUSION: 0.01 - 0.1 MCG/kg/min
Esmolol	50 - 300 MCG/kg/min
Metoprolol	5 - 20 mg IV

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

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 FiO_2 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
Caution 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

Adenosine	6 mg rapid IV push If persistent, 12 mg rapid IV push *Caution in severe asthma*
Amiodarone	150 mg IV over 10 minutes May repeat x1

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

CONDITION	ENERGY LEVEL
Narrow complex, regular	50 J - 100 J
Narrow complex, irregular	120 J - 200 J biphasic; 200 J monophasic
Wide complex, regular	100 J
Wide complex, irregular	Treat as VF, *go to* CHKLST 05

Critical CHANGES

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

17 Transfusion Reaction

Hemolytic Reaction: *Cardiac instability, bronchospasm, bleeding, dark urine;* ***Non-hemolytic Reaction****: fever, rash, pulmonary edema;*
Anaphylactic Reaction*: hypotension, urticaria, bronchospasm*

START

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**
   - FiO_2 100%
   - 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

DRUG DOSES & treatments

EPINEPHrine	BOLUS: 10 -20 MCG IV (1 mg in 100 mL = 10 MCG/mL) INFUSION: 0.01 - 0.1 MCG/kg/min
Furosemide	40 mg IV
Albuterol	2-3 puffs MDI via ETT 2.5 mg via nebulizer

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)