CPR / ACLS:
Obstetric Considerations and Current Guidelines

October 23, 2014

Mark Rollins, MD, PhD
UCSF Director Obstetric Anesthesia

Objectives
Discussion of ACLS considerations in pregnancy...

- Frequency of Cardiac Mortality
- ACLS Code Modifications
- Local Anesthetic Toxicity
- Perimortem Delivery
- Checklists & Simulation

No Disclosures

<table>
<thead>
<tr>
<th>Cause</th>
<th>Total</th>
<th>Incidence</th>
<th>95% CI</th>
<th>Anesthesia Related</th>
<th>Incidence</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Maternal death</td>
<td>44</td>
<td>1.102,560</td>
<td>1.778,139, 1.115,192</td>
<td>0</td>
<td>1.124,398</td>
<td>1.35,346, 1.080,218</td>
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<tr>
<td>Myocardial infarction</td>
<td>42</td>
<td>1.153,748</td>
<td>1.14,258, 1.12,283,541</td>
<td>2</td>
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<td>1.35,346, 1.080,218</td>
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<td>Episiotomy</td>
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<td>1.20,274, 1.23,820</td>
<td>4</td>
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<td>Respiratory arrest in labor suite</td>
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<td>1.78,239, 1.17,281</td>
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<td>Aspiration</td>
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<td>0.9</td>
<td>0</td>
<td>0.9</td>
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<td>Failed intubation</td>
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<td>0</td>
<td>0.93</td>
<td>10</td>
<td>0.93</td>
<td>0.9</td>
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<td>Pneumothorax</td>
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<td>1.184,489</td>
<td>1.28,356, 1.184,409</td>
<td>58</td>
<td>1.184,489</td>
<td>1.28,356, 1.184,409</td>
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<tr>
<td>Hypovolemic shock (hemorrhage)</td>
<td>55</td>
<td>1.198,403</td>
<td>1.28,356, 1.184,409</td>
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<td>1.198,403</td>
<td>1.28,356, 1.184,409</td>
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<tr>
<td>Hypothermia</td>
<td>14</td>
<td>1.151,495</td>
<td>1.15,156, 1.15,300</td>
<td>16</td>
<td>1.151,495</td>
<td>1.15,156, 1.15,300</td>
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<tr>
<td>Unrecognized spinal cord injury</td>
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<td>1.151,495</td>
<td>1.15,156, 1.15,300</td>
<td>14</td>
<td>1.151,495</td>
<td>1.15,156, 1.15,300</td>
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<tr>
<td>Total</td>
<td>1571</td>
<td>1.124,398</td>
<td>1.35,346, 1.080,218</td>
<td>858</td>
<td>1.151,495</td>
<td>1.15,156, 1.15,300</td>
</tr>
</tbody>
</table>

Serious Complications Related to Obstetric Anesthesia

The Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology

Robert D'Angelo, M.D., Richard M. Smiley, M.D., Ph.D., Edward T. Riley, M.D., Scott Segal, M.D., M.H.C.M.
Anesthesiology. June 2014

Cardiac Arrest: 1 in 7,151
(CI 1:5,319 - 1:9,615)

Part 12: Cardiac Arrest in Special Situations: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Terry L. Vanden Hoek, Laurie J. Morrison, Michael Shuster, Michael Domino, Elizabeth Sinz, Eric J. Lutasen, Farida M. Jeejeebhoy and Andrea Gabrielli

Part 12.3: Cardiac Arrest Associated With Pregnancy

Scope of the Problem

The Confidential Enquiries into Maternal and Child Health (CEMACH) data set constitutes the largest population-based data set on this target population. The overall maternal mortality rate was calculated at 13.95 deaths per 100,000 maternities. There were 8 cardiac arrests with a frequency calculated at 0.05 per 1000 maternities, or 1:20,000. The frequency of cardiac arrest in pregnancy is on the rise with previous reports estimating the frequency to be 1:30,000 maternities. Despite pregnant women being younger than the traditional cardiac arrest patient, the survival rates are poorer, with one case series reporting a survival rate of 6.9%.[3,4]
Cardiac arrest in pregnancy

- Incidence: 1:20,000 patients
- Mostly: stick to ACLS algorithms
- IV above diaphragm
- Difficult airway
- Left uterine displacement
- Cesarean section

Obstetric Interventions for Patient With an Obviously Gravid Uterus

- Perform manual left uterine displacement (LUD)—displace uterus to the patient’s left to relieve aortic caval compression
- Remove both internal and external fetal monitors if present

Obstetric and neonatal teams should immediately prepare for possible emergency cesarean section

- If no ROSC by 4 minutes of resuscitative efforts, consider performing immediate emergency cesarean section
- Aim for delivery within 5 minutes of onset of resuscitative efforts

"An obviously gravid uterus is a uterus that is deemed clinically to be sufficiently large to cause aortic caval compression"

Key Objectives

- Appropriate Team
- Relieve Aorto-Caval Compression
- Focus on Chest Compressions
- Do Not Delay Defibrillation
- Prepare for Emergent Delivery
- Checklists and Simulation

The Society for Obstetric Anesthesia and Perinatology Consensus Statement on the Management of Cardiac Arrest in Pregnancy

Steven Lipman, MD,† Sheila Cohen, MB, ChB, FRCA,*, Sharon Einav, MD,† Fanda Jepsebghi, MD, FRCPC, RACC,† Jill M. Myhre, MD,§ Lauren J. Morrison, MD, MS, FRCPC,¶ Vern Katz, MD,¶ Lawrence C. Tien, MD,¶ Kay Daniels, MD,¶ Louis P. Halamek, MD, RAPR‡ Maya S. Suresh, MD,‡ Julie Arefeh, RN, MSN,‡‡ Dodi Gauthier, MD, RNC-OB, C-EM,‡‡ Jose C. A. Carvalho, MD, PhD, FANZCA, FRCPC,‡‡ Maurice Druzin, MB, BCH,** and Brendan Carvalho, MBChB, FRCA* Anesth & Analg, June 2014

- How Does This Consensus Statement Differ From Existing Guidelines?

Call for Help “Code OB”
Call for Help
“Hey, Who’s resuscitating the baby?”

Cardiology, Anesthesia, Obstetricians & Nurses:
The phenylephrine is causing the decels… Can you use that pressor?
Should we stop the nitro drip? Why are you tilting her to the left?
Are you sure you want a stent placed? The loss of variability is just the fentanyl…
You won’t be able to place an epidural for delivery… I thought Versed was a teratogen…
Isn’t supplemental oxygen bad for the baby? Where did all this fluid come from?

Aortocaval compression
- The gravid uterus compresses the IVC and aorta when supine
- Hypovolemic shock

Left uterine tilt/displacement

Vanden Hoek. Circulation; 122:S829. 2010
Cardiac arrest in pregnancy: CABDE

- **C**: Circulation
  - Left uterine displacement
  - Compressions
    - 2 or 3 cm Higher on Sternum
    - 5-cm depth (Hard)
    - 100/min (Fast)
  - Rotate Compressors q 2 min
  - Minimize Interruptions
  - Capnography (> 10 mmHg)
  - IV above the diaphragm

- **A**: Airway
- **B**: Breathing

Airway and Breathing

- An example of a “simplified algorithm”
- Call for Help
- Don’t get fixated on ETT placement
Airway and Breathing

- 10 breaths per min.
- 500-700 ml/breath
- EtCO₂ confirmation

Cardiac arrest in pregnancy: CABDE

- D: Defibrillate:
- Performed on shockable rhythms ASAP
- No change in energy during pregnancy
- AED?
- Goal of < 3 min from collapse
- Removal of monitors

Cardiac arrest in pregnancy: CABDE

- D: Drugs:
  - All ACLS drugs OK
  - Oxytocin?
  - Lipid Emulsion with Local Anesthetic Toxicity

Local Anesthetic CNS Toxicity

- Perioral Numbness or Tingling
- Metallic Taste
- Tinnitus
- Diplopia
- Lightheadedness
- Confusion & Drowsiness
- Restlessness
- Sense of Impending Doom
- Muscular Twitching
- Tonic-Clonic Seizures
- Unconsciousness
- Respiratory Arrest
Local Cardiovascular Toxicity

- Tachycardia
- Hypertension
- Myocardial Depression
- Decreased Cardiac Output
- Peripheral Vasodilation
- Hypotension
- Conduction Block
- Sinus Bradycardia
- Ventricular Arrhythmias
- Asystole
- Collapse

Who’s at Increased Risk

- Advanced Age
- Severe Cardiac Dysfunction
- Conduction Abnormalities
- Liver Disease
- Low Plasma Protein
- Acidosis

Checklist for Treatment of Local Anesthetic Systemic Toxicity

The Pharmacologic Treatment of Local Anesthetic Systemic Toxicity (LAST) is Different from Other Cardiac Arrest Scenarios

- Get Help
- Initial Focus
  - Airway management: ventilate with 100% oxygen
  - Seizures suppression: benzodiazepines are preferred; AVOID propofol
    in patients having signs of cardiovascular instability
  - Alert the nearest facility having cardiopulmonary bypass capability

Checklist for Treatment of Local Anesthetic Systemic Toxicity

- Management of Cardiac Arrhythmias
  - Basic and Advanced Cardiac Life Support (ACLS) will require adjustment of medications and perhaps prolonged effort
  - AVOID vasopressin, calcium channel blockers, beta blockers, or local anesthetic
  - REDUCE individual epinephrine doses to <1 mcg/kg

Checklist for Treatment of Local Anesthetic Systemic Toxicity

- Lipid Emulsion (20%) Therapy (values in parenthesis are for 70kg patient)
  - Bolus 1.5 mL/kg (lean body mass) intravenously over 1 minute (~100mL)
  - Continuous infusion 0.25 mL/kg/min (~18 mL/min; adjust by roller clamp)
  - Repeat bolus once or twice for persistent cardiovascular collapse
  - Double the infusion rate to 0.5 mL/kg/min if blood pressure remains low
  - Continue infusion for at least 10 minutes after attaining circulatory stability
  - Recommended upper limit: Approximately 10 mL/kg lipid emulsion over the first 30 minutes
- Post LAST events at www.lipidregistry.org and report use of lipid to www.lipidregistry.org

Evidence of Efficacy

Brief Report

Availability of Lipid Emulsion in United States Obstetric Units
Paloma Toledo, MD, MPH,* Heather C. Nixon, MD,† Jill M. Mhyre, MD,‡ Cynthia A. Wong, MD,§ and Guy Weinberg, MD

- 88% of responding units have lipid emulsion immediately available.
- The remainder have it available elsewhere in the hospital.

Case Reports

Successful Use of a 20% Lipid Emulsion to Resuscitate a Patient after a Presumed Bupivacaine-related Cardiac Arrest
Meg A. Rosenberg, M.D.,* Mark Abel, M.D.,† Gregory W. Fisher, M.D.,‡ Chad J. Riesarchik, M.D.,‡ James B. Slivka, M.D.§

The infusion of a lipid emulsion has been shown to increase the survival rates of both rats and dogs that have been resuscitated after an overdose of bupivacaine. We report the first successful use of a 20% lipid infusion to resuscitate a patient from a prolonged cardiac arrest that immediately followed the placement of an intercostal block with bupivacaine and meperidine.

Case Report

The patient was a 49-year-old 74 kg, 170 cm male who presented for ambulatory repair of a torn rotator cuff in the right shoulder. The

Editorial

Lipid Resuscitation: Listening to Our Patients and Learning from Our Models
Guy Weinberg, MD,* and Lisa Warren, MD‡

"we believe randomized trials are no longer ethically defensible in studying lipid infusion for local anesthetic toxicity and are probably not feasible"
**Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials**

Gordon C S Smith, Jill P Pell

*BMJ. December 2003*

**What is already known about this topic**
- Parachute use is widely used to prevent death and major injury after gravitational challenge.
- Parachute use is associated with adverse effects due to failure of the intervention and iatrogenic injury.
- Studies of free fall do not show 100% mortality.

**What this study adds**
- No randomised controlled trials of parachute use have been undertaken.
- The basis for parachute use is purely observational, and its apparent efficacy could potentially be explained by a “healthy cohort” effect.
- Individuals who insist that all interventions need to be validated by a randomised controlled trial need to come down to earth with a bump.

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**Perimortem cesarean section**

No perfusing rhythm after 4 minutes?

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**Cardiac arrest in pregnancy: CABDE**

- **E:** Extract (the fetus)
  - Incision at 4 minutes
  - Delivery by 5 minutes post-arrest

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**Perimortem cesarean section**

<table>
<thead>
<tr>
<th>Table II</th>
<th>Reported cases of perimortem cesarean deliveries with cause of maternal cardiac arrest, 1985-2004</th>
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<tbody>
<tr>
<td>Cause of maternal cardiac arrest</td>
<td>Cases</td>
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<tr>
<td>Trauma</td>
<td>8</td>
</tr>
<tr>
<td>Cardiac</td>
<td>8</td>
</tr>
<tr>
<td>Embolism (AFE, air)</td>
<td>7</td>
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<tr>
<td>Magnesium overdose</td>
<td>5</td>
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<tr>
<td>Sepsis</td>
<td>3</td>
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<tr>
<td>Anesthesia</td>
<td>2</td>
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<td>Eclampsia</td>
<td>1</td>
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<tr>
<td>Spontaneous uterine rupture</td>
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<td>Intracranial hemorrhage</td>
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<td>TOTAL</td>
<td>38</td>
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</table>

Perimortem cesarean section

**Table III** Effect of perimortem cesarean section on maternal circulation, reported cases 1985-2004 \(^{9-18,22,23,27-29,33,35}\)

<table>
<thead>
<tr>
<th>Time from maternal cardiac arrest until delivery (min)</th>
<th>Return of spontaneous circulation and or improvement in hemodynamic status</th>
<th>No change</th>
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<tbody>
<tr>
<td>0-5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>6-10</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>11-15</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>&gt; 15</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Not reported</td>
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<td>1</td>
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<tr>
<td>Total</td>
<td>12</td>
<td>8</td>
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**Perimortem cesarean section**

**Table I** Perimortem cesarean deliveries with surviving infants with reports of time from maternal cardiac arrest to delivery of the infant, 1985-2004 \(^{9-18,22,23,27,29,33,35}\)

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>Gestational age (wk)</th>
<th>Number of infants</th>
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<tr>
<td>0-9</td>
<td>25-42</td>
<td>8 (normal infant)</td>
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<tr>
<td>Subtotal</td>
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<td>8</td>
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<td>6-10</td>
<td>28-37</td>
<td>1 (normal infant)</td>
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<tr>
<td>Subtotal</td>
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<td>1</td>
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<tr>
<td>11-15</td>
<td>38-39</td>
<td>1 (normal infant)</td>
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<tr>
<td>Subtotal</td>
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<td>1</td>
</tr>
<tr>
<td>&gt; 15</td>
<td>30-38</td>
<td>6 (normal infants)</td>
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<tr>
<td>Subtotal</td>
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<td>6</td>
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<tr>
<td>Total</td>
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<td>20</td>
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**Resuscitation**

Review article
Maternal cardiac arrest and perimortem caesarean delivery: Evidence or expert-based? \(^{9,18,22,23,27-29,33,35}\)
Sharon Einau, Nechama Kaufman, Hen Y. Sela

- 84% of cases had C/D: 32% Benefited
- Only 7% had delivery within 5 minutes
- In No Cases DId Maternal Status Deteriorate with C/D

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**Perimortem cesarean section**

- Location?
- Operative Vaginal Delivery?
Deficits in the provision of cardiopulmonary resuscitation during simulated obstetric crises

Steven S. Lipman, MD; Kay J. Dzenitis, MD; Brandon Gervais, MBChB, FRCA; Julie Aranibar, RN, MSN; Kimberly Hanney, MD; Andrea Puck, RN, MSN; Sheila F. Cohen, MBChB, FRCA; Mauricio Draus, MD

Table 1. Checklists of Key Tasks During the First Minutes of In-House Maternal Cardiac Arrest

| Call for help | Start CPR | Call medical team | AGP, O & W | Damped ECG monitor | Adrenaline 1mg I.M. | Adult airway equipment | Baseline | Suction/Resuscitation bag and mask | Gain airway or | Intubation personnel/entubation with | | CPR, 100 beats/min | | 2:5:2 CPR, 100 beats/min | PLURIMED 100% FIO2 | Open airway (e.g., LMA) | Do not interrupt chest compressions | CPR, 100 beats/min | 2:5:2 CPR, 100 beats/min | | | | 2:5:2 CPR, 100 beats/min | 2:5:2 CPR, 100 beats/min | Do not interrupt chest compressions | 2:5:2 CPR, 100 beats/min | 2:5:2 CPR, 100 beats/min | | | 2:5:2 CPR, 100 beats/min | 2:5:2 CPR, 100 beats/min | | 2:5:2 CPR, 100 beats/min | 2:5:2 CPR, 100 beats/min | | 2:5:2 CPR, 100 beats/min | 2:5:2 CPR, 100 beats/min |

Table 2. Checklists of Potential Contributing Factors to Maternal Cardiac Arrest

A. Anesthetic complications (high neuraxial block, loss of airway, aspiration, respiratory depression, hypotension, local anesthetic systemic toxicity)
B. Bleeding* (coagulopathy, uterine atony, placenta accreta, placental abruption, placenta previa, uterine rupture, trauma, surgical, transfusion reaction)
C. Cardiovascular causes (cardiomyopathy, myocardial infarction, aortic dissection, arrhythmias)
D. Drugs (anaphylaxis; illicit; drug error; magnesium, opioid, insulin, or oxytocin overdose)
E. Embolic (pulmonary embolus, amniotic fluid [AFE], air)
F. Fever* (infection, sepsis)
G. General nonobstetric causes of cardiac arrest (H’s and T’s)†
H. Hypertensive* (preeclampsia/eclampsia/HELLP intracranial bleed)

Most likely causes: Cardiac, hemorrhage and AFE. Suspect amniotic fluid embolus (AFE) with any sudden maternal cardiac arrest, particularly when accompanied by bleeding.
COGNITIVE AIDS FOR OB
PERIOPERATIVE CRITICAL EVENTS


CHECKLISTS

ACLS
Asystole/PEA...............................................
1
Bradyardia – Unstable...............................
2
Tachycardia – Unstable...............................
3
Pulseless VF/VT...........................................
4
CRITICAL EVENTS: NON-ACLS
Amniotic Fluid Embolism.......................5
Anaphylaxis.............................................6
Bronchospasm...........................................
7
Difficult airway – Unanticipated................8
Fire..........................................................9
Post-partum Hemorrhage.......................10
Hypotension............................................11
Hypoxia..................................................12
Local Anesthetic Toxicity.......................13
Malignant Hyperthermia.......................14
Myocardial Ischemia...............................15
Tachycardia – Stable SVT.......................16
Total Spinal Anesthesia........................17
Transfusion Reaction.............................18
Venous Air Embolus..............................19

Are you seeking to help clinicians deliver the best possible care during medical emergencies?
Despite best intentions, well-trained clinicians often miss known key steps during critical events.

This FREE perioperative Emergency Manual contains 25 critical events as well as Crisis Resource Management key points. It has been iteratively tested with simulation over many years.

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Table of Contents
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Potential Drills & Simulations

- Severe Fetal Bradycardia
- Eclamptic Seizure
- Shoulder Dystocia
- Massive Hemorrhage
- Failed Intubation
- Anaphylaxis
- Total Spinal
- Magnesium Overdose

Opportunities for New Facilities

- Where are the supplies located? Airway cart? Code cart?
- What are the work flows?
- How long does it take to transfer patient locations?
- How do I call for help? A code? A crash?
- How do I get emergency blood?
- How do I get STAT labs? Point of care testing?

Summary

- Cardiac Arrest in Pregnancy is Rare
- Appropriate Help “Code OB”
- Relieve Aorto-Caval Compression
- Focus on Compression & Defibrillation
- Use Lipid Emulsion with LAST
- Prepare Early for Emergent Delivery
- Checklists and Simulation Beneficial