

OBSTETRIC EMERGENCIES SERIES

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May 2026

FAILURE TO PREPARE IS PREPARING TO FAIL

Despite efforts to send high-risk women to tertiary centers for delivery,
OB emergencies happen to both "healthy" and "high-risk" women.
They can happen to ANY pregnant woman, anywhere.

- OB airways are well-established to be higher risk of:
  - ✓ **swelling, difficult airway, aspiration, failed airway, and fatal hypoxemia**.

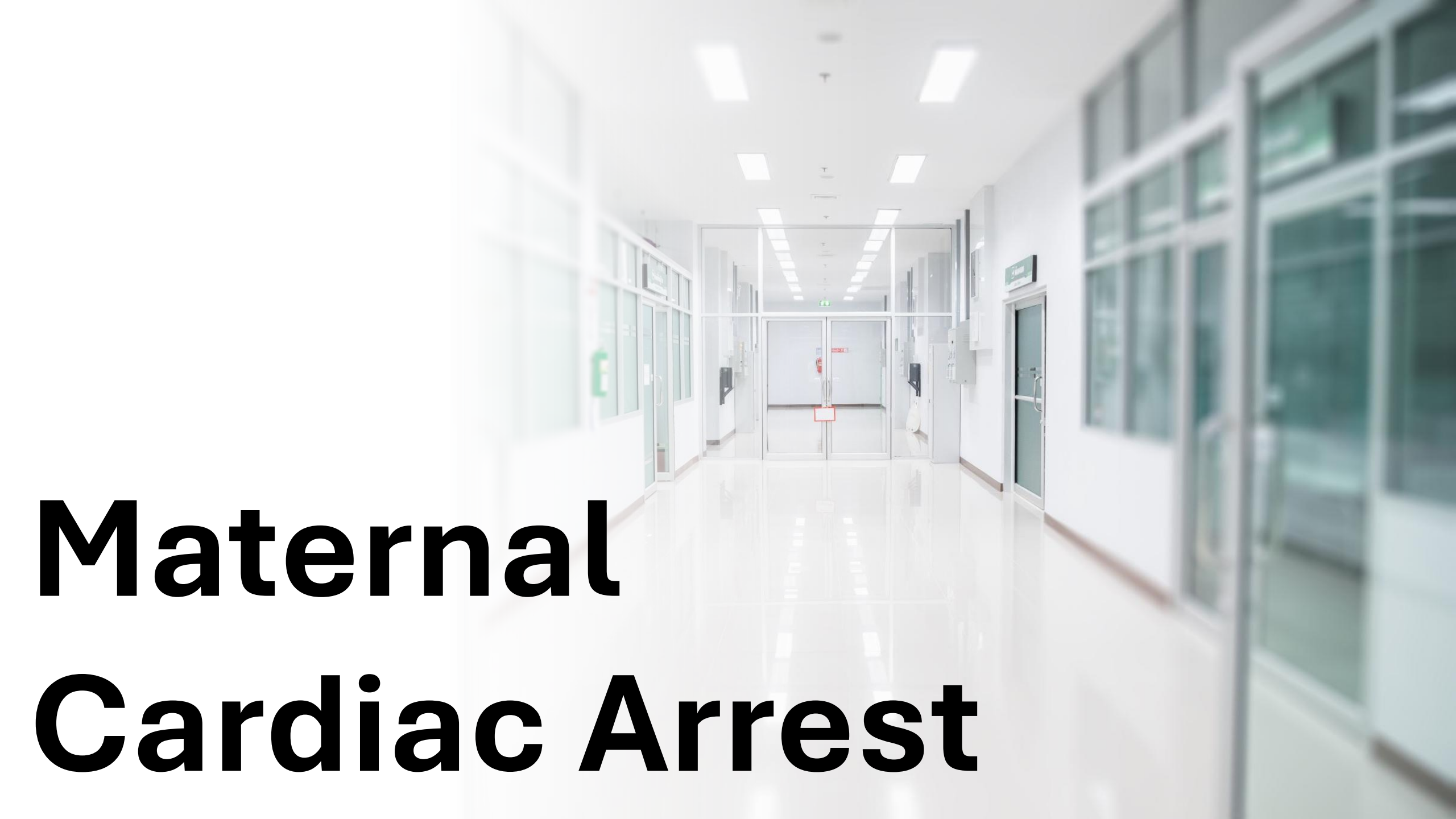
- Emergent airway management is possible in ANY pregnant woman
  - ➢ Critical to consider airway management in **every single woman you care for.**

- Positioning airway appropriately prior to start of c/s by ramping w/ blankets
  - ➢ Can significantly improve success of ventilation and airway management
  - ➢ Failure to do so can significantly increase airway challenges.

OB pts do not tolerate apnea, and do not afford time for inefficient airway management.

✓ Reviewing **OB difficult airway management**, intubation techniques, etc
✓ Knowing exactly **where to find, and how to use** the difficult airway equipment you have available
  - ✓ Can be the difference between life and death when an emergency unfolds.
  - ✓ Includes knowing how to delegate and direct non-anesthesia providers to help you.
    - ✓ Can they find your equipment? Can you explain what you need? Are emergency meds labeled? Etc

We must assume we may have to intubate every single patient, and plan accordingly.



Maternal Cardiac Arrest

IMPENDING DOOM



Listen: Impending Doom Debut Brand New Song From 'Death Will Reign' —...

Visit >





Kayleigh

- 29, G2P0, former D1 soccer player
- Routine term OB visit found HTN→ IOL

- At 10 cm, ready to push, she told husband & RN

"I don't feel well"

- RN reassured her feeling "sick" *can be* normal in transition phase, and re-checked vitals

As soon as NIBP cycle was about to finish, Kayleigh SCREAMED

"SOMETHING'S WRONG WITH MY HEART!"

And immediately arrested.

- Code blue → OR → RCD < 6 minutes of arrest.
- DIC → 143 units of products
- ECMO & Impella "ECpella" for severe refractory cardiogenic shock & LV failure.
- 2 weeks later devices removed, full recovery
- Baby Cal required resuscitation and CPAP, 24hr NICU stay, full recovery







Chelsea





Photos taken seconds before she threw a massive PE and arrested.

"I remember my husband saying, 'you did it, I love you.'

Then I gave my daughter a kiss

and it all went black."

- G2P1 uncomplicated prior and current pregnancy, scheduled rC/S
- Code Blue
- Uterine Atony → OB-GYN held aortic compression to control bleeding.
- 4 rounds CPR, ventilator, and prepped for ECMO
- PE diagnosed → Anticoagulation and thrombectomy
- Full recovery

PERIOPERATIVE MEDICINE: CLINICAL SCIENCE

Cardiac Arrest during Hospitalization for Delivery in the United States, 1998–2011

Mhyre, Jill M. M.D.; Tsen, Lawrence C. M.D.; Einav, Sharon M.D.; Kuklina, Elena V. M.D., Ph.D.; Leffert, Lisa R. M.D.; Bateman, Brian T. M.D., M.Sc.

Author Information

Anesthesiology 120(4):p 810-818, April 2014. | *DOI:* 10.1097/ALN.0000000000000159

- Retrospective analysis using data from the U.S. government's Nationwide Inpatient Sample (largest all-payer inpatient health care database in the US)
- 56,900,512 hospitalizations for delivery had 4,843 cardiac arrests, rate: **1 in 11,749** (~1 per day in US)
- Overall, 59% of women with cardiac arrest survived to hospital discharge

- Maternal arrests most frequently associated with:
  - **Hemorrhage**
  - **Heart failure**
  - **AFE**
  - **Sepsis**

- **Maternal medical conditions** most strongly associated with arrest included:
  - Pulmonary HTN
  - Malignancy
  - CV disease, (i.e., CAD, Cardiomyopathy, CHD, valvular disease, CHTN)
  - Liver disease
  - SLE

- **Obstetric conditions** most strongly associated with cardiac arrest included:
  - Stillbirth
  - Cesarean delivery*
  - Severe PreE/eclampsia
  - Placenta previa

1. Mhyre et al. *Anesthesiology*. 2014

Table 2

Distribution of Maternal Cardiac Arrests (n = 4,843), the Nationwide Inpatient Sample 1998–2011

	Potential Proximate Etiology of Maternal Cardiac Arrest, N (%)	Cause-specific Cardiac Arrest Frequency per 1,000 Women with Each Condition	Survival to Hospital Discharge,* N (%)
Postpartum hemorrhage	1,349 (27.9)	0.8	739 (55.1)
Antepartum hemorrhage	813 (16.8)	0.9	433 (53.2)
Heart failure	645 (13.3)	15.6	458 (71.1)
Amniotic fluid embolism	645 (13.3)	252.7	337 (52.5)
Sepsis	544 (11.2)	2.1	256 (46.9)
Anesthesia complication	379 (7.8)	29.5	310 (81.9)
Aspiration pneumonitis	346 (7.1)	20.3	287 (82.9)
Venous thrombo embolism	346 (7.1)	43.9	144 (41.5)
Eclampsia	296 (6.1)	6.2	226 (76.5)
Puerperal cerebrovascular disorder	212 (4.4)	13.6	85 (40.0)
Trauma	125 (2.6)	3.9	29 (23.3)
Pulmonary edema	118 (2.4)	11.2	83 (70.9)
Acute myocardial infarction	150 (3.1)	89.8	85 (56.3)
Magnesium toxicity	66 (1.4)	5.2	57 (85.9)
Status asthmaticus†	54 (1.1)	12.6	29 (53.7)
Anaphylaxis†	15 (0.3)	10.8	15 (100)
Aortic dissection/rupture†	14 (0.3)	31.0	0

1. Mhyre et al. *Anesthesiology*. 2014

Maternal Cardiac Arrest: **First Steps**

CALL FOR HELP:

- Anesthesia personnel, OBGYN(s), surgical, & RN staff to prep for RCD.
- NICU staff for potential RCD
- Early MTP, ECMO/CPB consideration if appropriate

Begin CPR immediately:

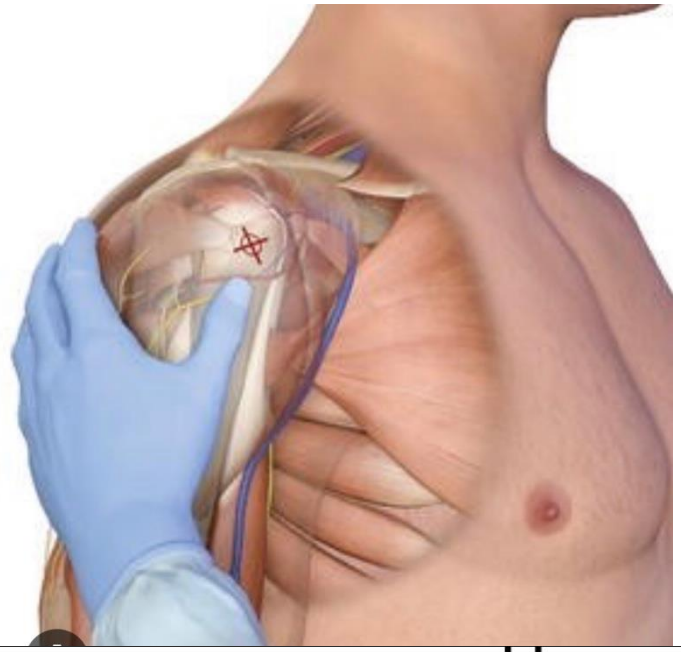
- MANUAL LUD
- ACLS: same drugs, doses, & defibrillation. ***"What's good for mom is good for baby"***
- Backboard for CPR ASAP
- Airway securement
- IV access above diaphragm, or IO proximal humerus

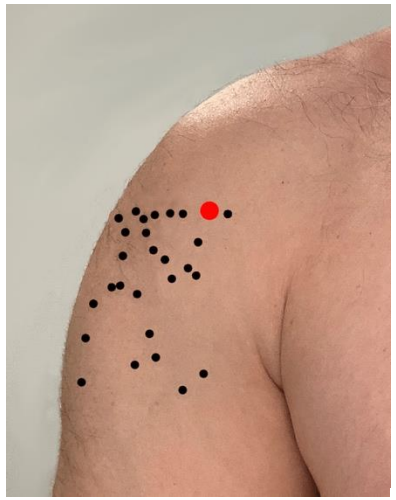
RCS start < 4 min after onset of arrest, delivery by 5 min.

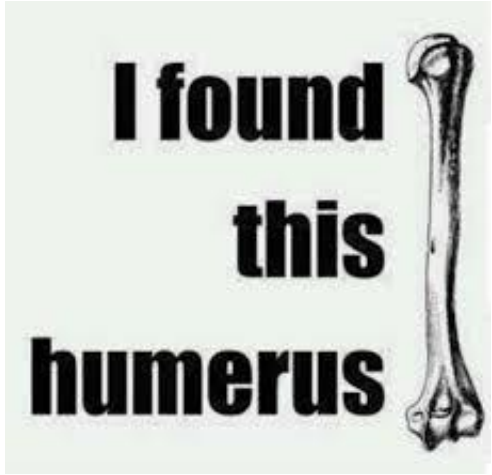
- Transverse or vertical incision, or operative delivery
- LUD maintained throughout RCD
- Abdomen packed until ROSC

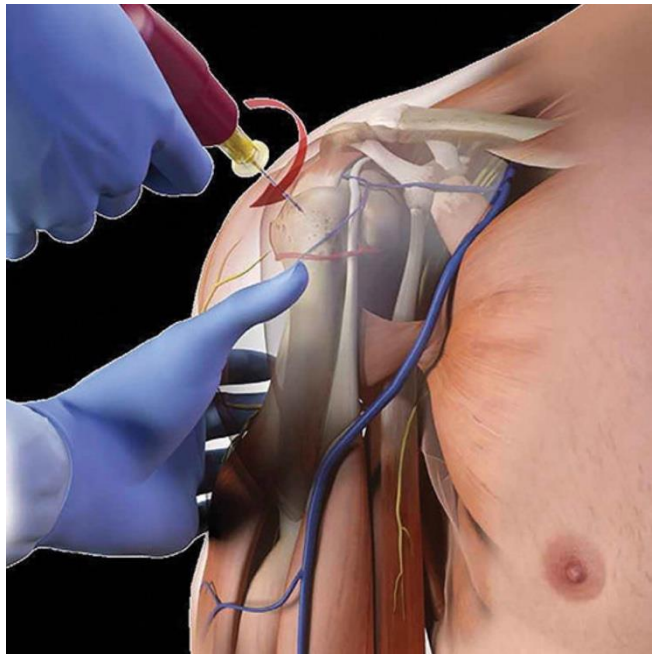
5. Lipman S, Cohen S, Einav S, et al. *Anesthesia & Analgesia*. 2014

Proximal Humerus IO

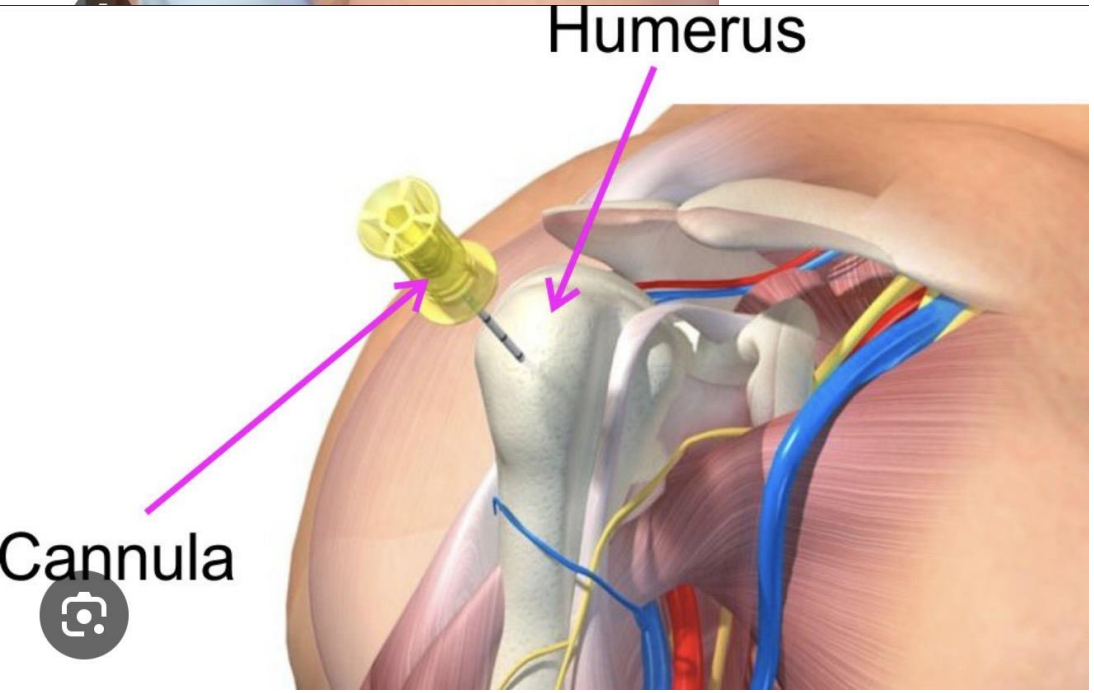


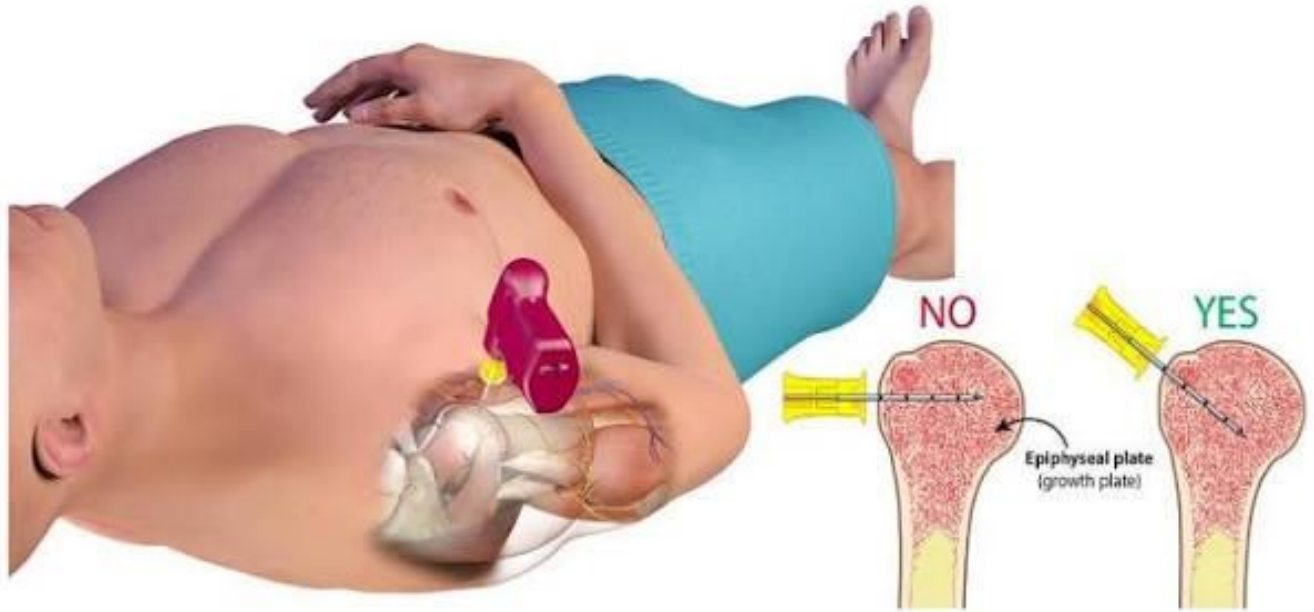




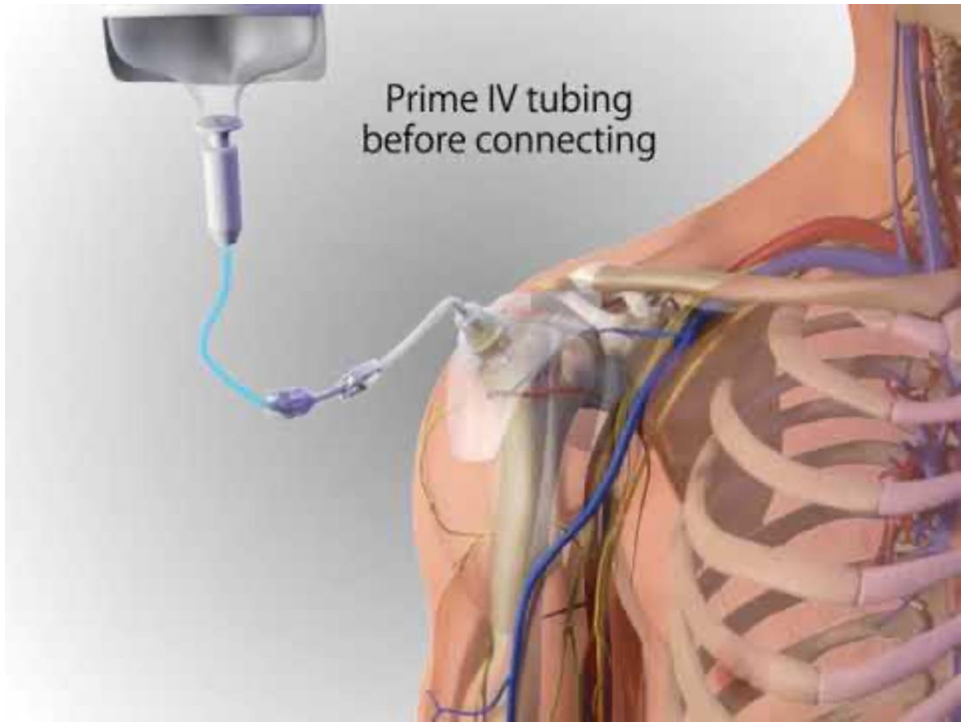


Humerus: Insert needle set at a 45° angle to the anterior plane and posteromedial





Arrow® EZ-IO® System



https://www.youtube.com/watch?v=3ojdhEgw1zM

Paramedic student demo Humerus IO insertion



https://www.youtube.com/watch?v=lyPgGjqPUMU

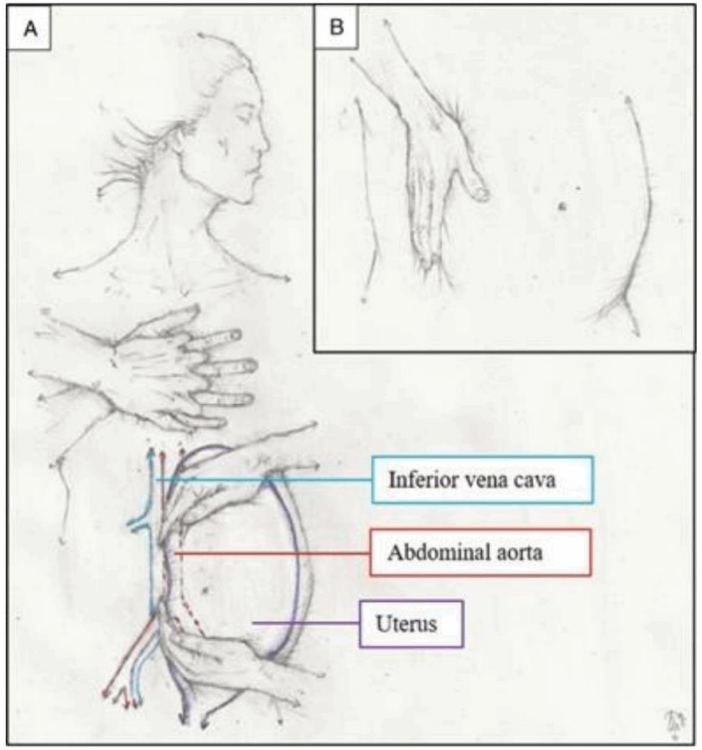
CPR in Pregnancy



- ✓ Place her flat and supine during CPR
- ✓ **Must** use a firm backboard to ensure quality compressions if in bed.
- ✓ **Maintain MANUAL LEFT UTERINE DISPLACEMENT throughout**



- ➢ Do not tilt the backboard or place blankets/roll under right hip
  - ➢ *The 30-degree tilt decreases force & effectiveness of chest compressions and can* ***worsen view for airway management.***



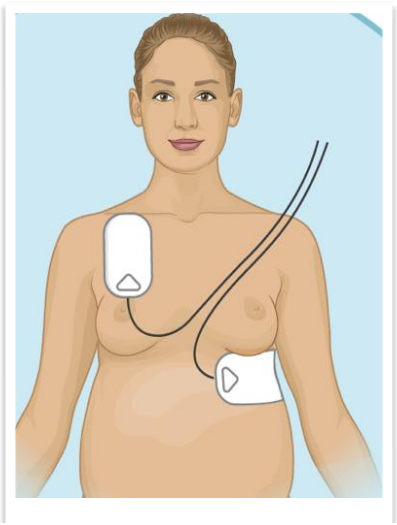
Source: Larson et. al. (2024)



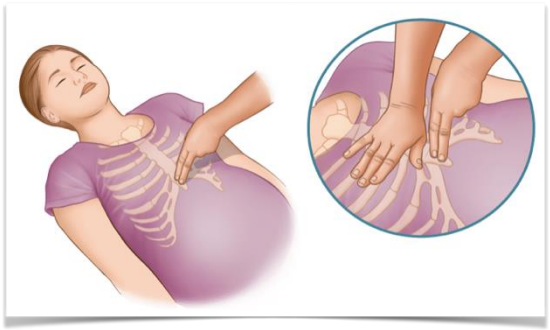
7. Jeejeeybho FM, Zelop CM, Lipman S, et al. *Circulation*. 2015

AED IN PREGNANCY

AED pad placement



Same hand placement - 2 fingers above xyphoid process



- ✓ Defibrillation & cardioversion should pass minimal energy to the fetus
- ✓ **DEFIBRILLATION IS SAFE IN ALL STAGES OF PREGNANCY**
- ✓ Defibrillation unlikely to cause electric arcing to fetal monitors
  - ➢ Fetal monitors should not preclude the use of rapid defibrillation when indicated.
  - ➢ Maternal risk of delaying needed defibrillation outweighs any potential concern about defibrillation with fetal monitors on.
  - ➢ Remove monitors when able.
- ✓ **When indicated, PERFORM DEFIBRILLATION WITHOUT HESITATION OR DELAY.**
- ✓ Place lateral defibrillation pad in correct location under the breast tissue
- ✓ Place extra towels/blankets around patient's torso and upper body to reduce risk of her lying in **pooled amniotic fluid** during defibrillation [8]

5. Lipman S, Cohen S, Einav S, et al. *Anesthesia & Analgesia*. 2014
7. Jeejeeybho et al. Cardiac Arrest in Pregnancy. *Circulation*. 2015
8. Shields AD, Vidosh J, Zelop CM. *American Journal of Obstetrics and Gynecology*. 2026

SOAP

Algorithm for Difficult Airway During CPR

- ✓ **Adequate ventilation ASAP**
- ✓ Alongside effective CPR & defibrillation

- ➢ Apneic pregnant women rapidly develop hypoxia and acidosis due to:
  - ↑ basal metabolic rate
  - ↓ FRC
  - fetal O_2 requirements.



Ventilate 100% O2
- DON'T INTERRUPT CHEST COMPRESSIONS!
- Jaw thrust + chin lift
- Bag mask (2 handed + oral airway if necessary)
- Cycles of 30 chest compressions : 2 breaths
- 2 breaths, each over 1 second

Prepare & Position
- Call for expert airway help and difficult airway cart
- Portable suction + airway equipment
- Endotracheal tube (consider smaller, e.g. 6.0 mm)
- Optimize position
- Don't interrupt chest compressions!

Primary Attempt
- Direct or video-laryngoscopy
- Bougie if available

Secondary Attempt
- Alternative laryngoscopic technique
- Adjust/release cricoid pressure if applied
- Return to mask ventilation if unsuccessful
- Prepare supraglottic airway (+/- gastic port)

Alternative Airway Control
- Insert supraglottic airway (e.g., LMA)
- If ventilation inadequate, return to mask ventilation
- If mask ventilation inadequate → Cricothyrotomy

Airway Controlled
- Confirm ETT placement*
- Secure ETT or SGA
- 10 breaths per minute
- Deliver 500 - 700 mL per breath

5. Lipman S, Cohen S, Einav S, et al. *Anesthesia & Analgesia*. 2014

SPECIAL ARTICLE

CME

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,†

Table 2. Checklist 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	Hypertension* (preeclampsia/eclampsia/HELLP, intracranial bleed)

Search for and Treat Possible Contributing Factors (BEAU-CHOPS)

Bleeding/DIC
Embolism: coronary/pulmonary/amniotic fluid embolism
Anesthetic complications
Uterine atony
Cardiac disease (MI/ischemia/aortic dissection/cardiomyopathy)
Hypertension/preeclampsia/eclampsia
Other: differential diagnosis of standard ACLS guidelines
Placenta abruptio/previa
Sepsis

© 2010 American Heart Association

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

Call for help!	☐ Call "OB Code"
Start CPR	☐ Call neonatal team
	☐ AED/defibrillator
	☐ IMMEDIATE BLS
	☐ Adult code cart
	☐ Adult airway equipment
	☐ Backboard
	☐ Scalpel/Cesarean pack
	☐ Assign timer/documenter
C Circulation	☐ Left uterine displacement (manual)
Chest compressions	☐ Hands mid-sternum
	☐ 100 compressions/min
	☐ PUSH HARD! PUSH FAST!
	☐ Change compressors every 2 min
	☐ Obtain IV access above diaphragm
A Airway	☐ Chin lift/jaw thrust
	☐ 100% O_2 at 10–15 L/min
	☐ Use self-inflating bag mask
	☐ Oral airway or
	☐ Experienced personnel: Intubation with 6–7.0 ETT or
	☐ Supraglottic airway (e.g., LMA)
	☐ Do not interrupt chest compressions!
B Breathing	☐ If not intubated: 30 compressions to 2 breaths
	☐ If intubated: 10 breaths per min (500–700 mL per breath)
	☐ Administer each breath over 1 s
D Defibrillate	☐ Pads front and back
	☐ Use AED or Analyze/defibrillate every 2 min
	☐ Immediately resume CPR for 2 min
	☐ Prepare for delivery
E Extract FETUS	☐ Aim for incision by 4 min
	☐ Aim for fetal delivery by 5 min

5. Lipman S, Cohen S, Einav S, et al. *Anesthesia & Analgesia*. 2014

Hemodynamic Improvement With Left Uterine Displacement

Rossi *et al. Journal of Cardiovascular Magnetic Resonance* 2011, **13**:31
http://www.jcmr-online.com/content/13/1/31

Journal of Cardiovascular Magnetic Resonance

RESEARCH Open Access

Quantitative cardiovascular magnetic resonance in pregnant women: cross-sectional analysis of physiological parameters throughout pregnancy and the impact of the supine position

Alexia Rossi[1,2], Jerome Cornette[3], Mark R Johnson[4], Yusuf Karamermer[1,2], Tirza Springeling[1,2], Petra Opic[1], Adriaan Moelker[2], Gabriel P Krestin[2], Eric Steegers[3], Jolien Roos-Hesselink[1] and Robert-Jan M van Geuns[1,2*]

2011 MRI study comparing maternal hemodynamics in left lateral vs supine position.
Recruited healthy non-pregnant controls, and healthy parturients at 20 and 32 weeks EGA without CV disease.

At **20 wks**: left lateral percentage increases: ($p < 0.05$)

- EF: 8%
- SV: 27%
- RVEDV: 25%
- RVSV: 31%

At **32 wks**, left lateral percentage increases: ($p < 0.05$)

- EF: 11%
- LVEDV: 21%
- SV: 35%
- CO: 24%
- LA volume : 45%

6. Rossi et al. *J Cardiovasc Magn Reson*. 2011. doi: 10.1186/1532-429X-13-31.

Fig. 2
Percentage differences of hemodynamic parameters of LEFT side of the heart.

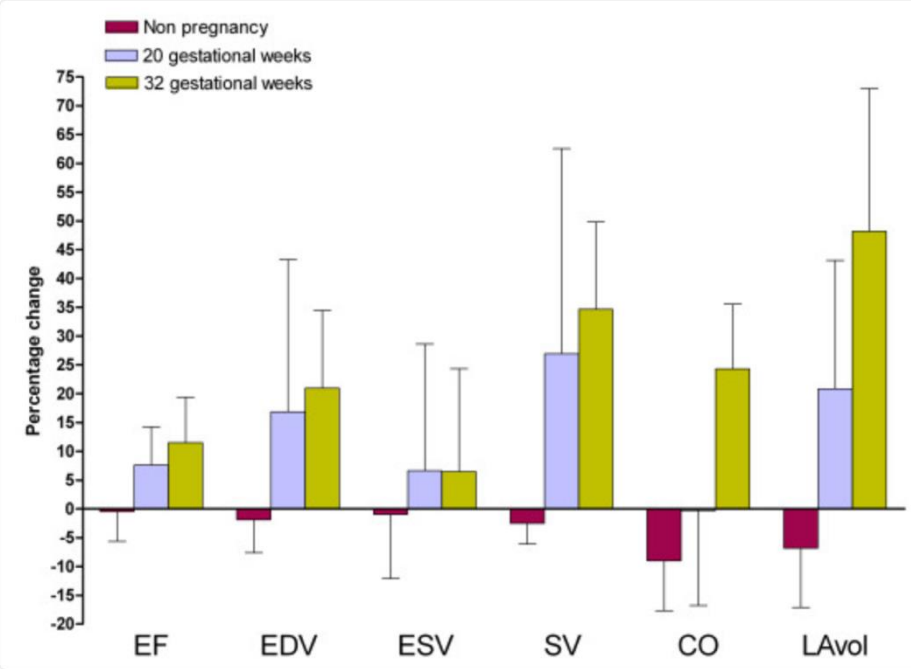
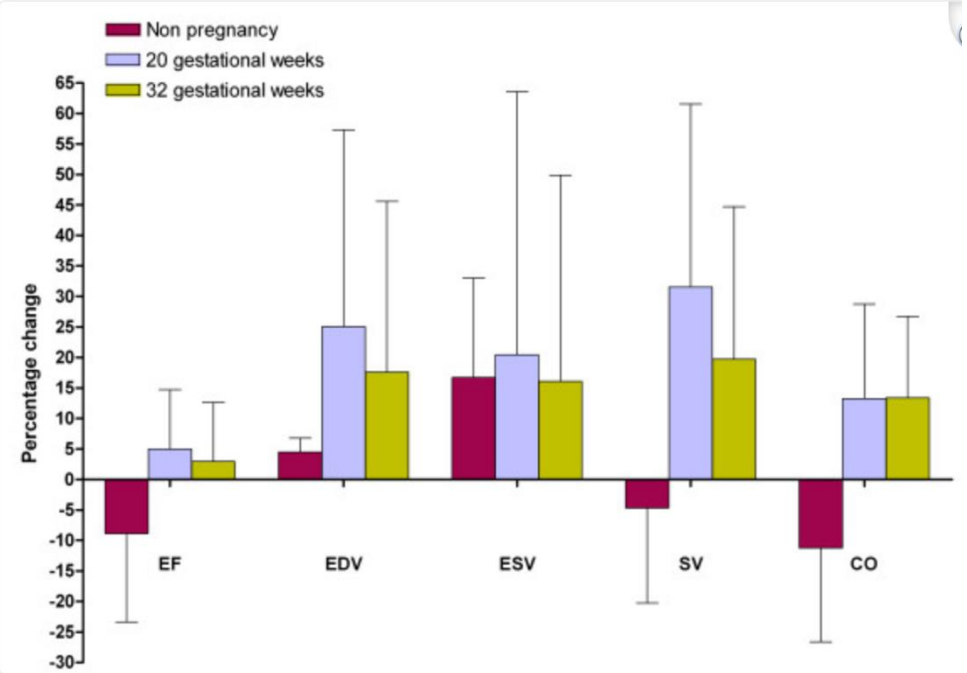


Fig. 3
Percentage differences of hemodynamic parameters of RIGHT side of the heart.





6. Rossi et al. *J Cardiovasc Magn Reson*. 2011. doi: 10.1186/1532-429X-13-31.

Resuscitative Cesarean Delivery

aka “Perimortem Cesarean Delivery”
or “Resuscitative Hysterotomy”

Emergent cesarean delivery performed when a pregnant woman with a palpable uterine fundus above the umbilicus arrests without achieving ROSC within 4 minutes.



“The 4-minute Rule”

If a pregnant woman’s heart stops beating, physicians should **begin** cesarean delivery **within 4 minutes** and aim to have the **fetus delivered within 5 minutes** of cardiac arrest.

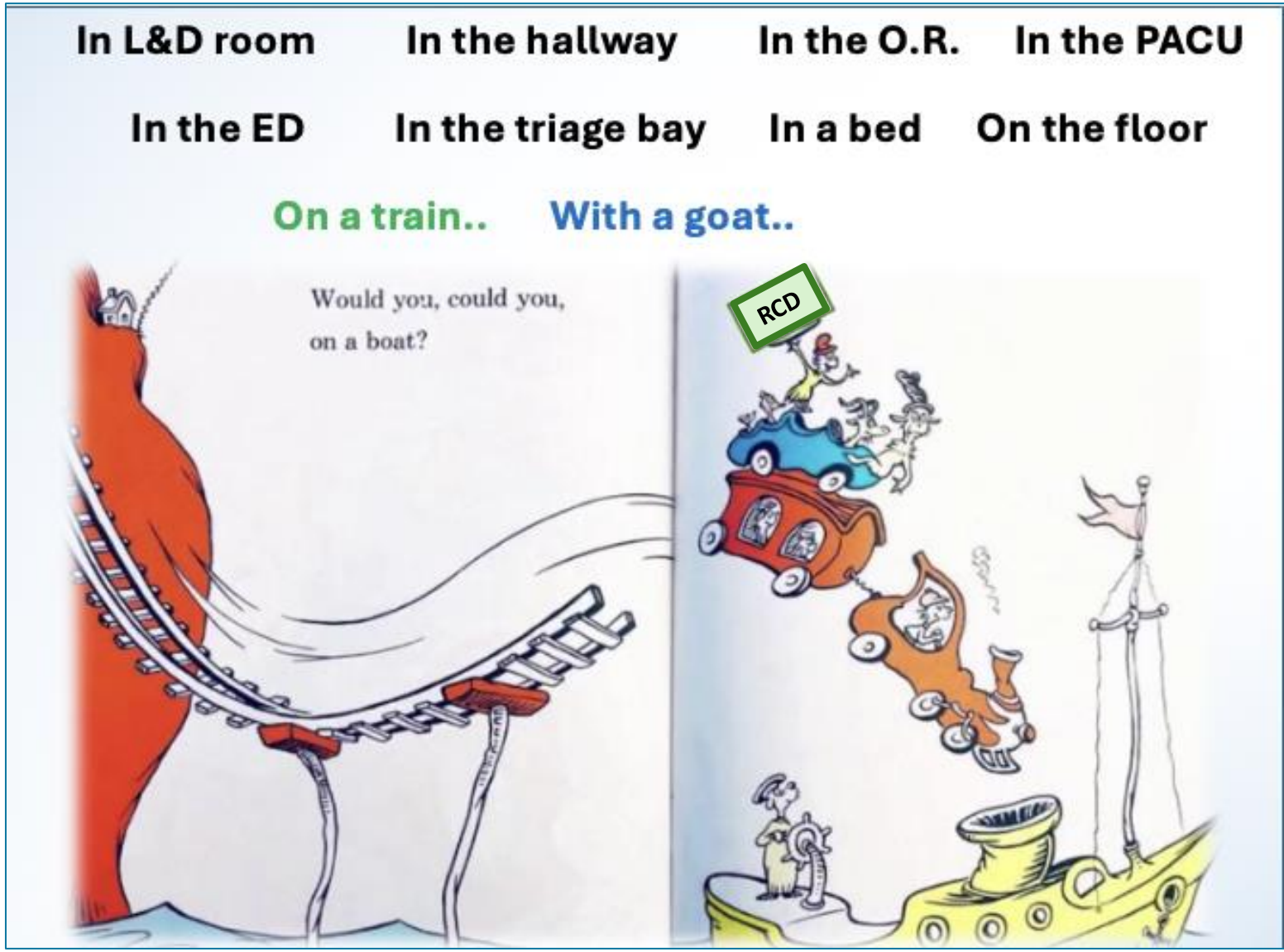
This improves likelihood of both **maternal and fetal** survival without brain damage

RCD occurs at site of arrest - **DO NOT MOVE HER**

✓ ***DO use*** **backboard or firm surface for CPR**

- OR transport shown to provide **no benefit**, as time spent transporting causes significant delays and interruptions to CPR that can **worsen outcomes** for both mother and fetus.[3,4,8]

- Once ROSC achieved, can → OR for controlled conditions
  - may require hysterectomy for hemorrhage control, etc.[8]



Resuscitative Cesarean Delivery

RCS primarily for maternal survival, not fetal benefit.

- < 5mins from arrest to delivery does show improved fetal outcomes.[2]
- Delivery improves maternal venous return, provides uterine autotransfusion, improves FRC and ventilation.[8]
- NICU team for delivery

RCS usually > 20 wks

- Prior to this, fetus likely too small to severely impair maternal circulation, and viability unlikely - **Manual LUD may suffice, and is always still applied.**
- However if palpable fundus above umbilicus and > 4 min without ROSC, RCD indicated.[8]

Transverse or vertical incision

- Abdomen can be packed until ROSC.[8]
- If Vaginal Delivery *imminent*, decision to try operative VD vs RCD at discretion of OBGYN[5]

EARLY ECMO/CPB consideration if ROSC not rapidly achieved.

- DIC considerations and bleeding control prior to cannulation

Simply stated..



If uterus is palpable at or above the umbilicus

+

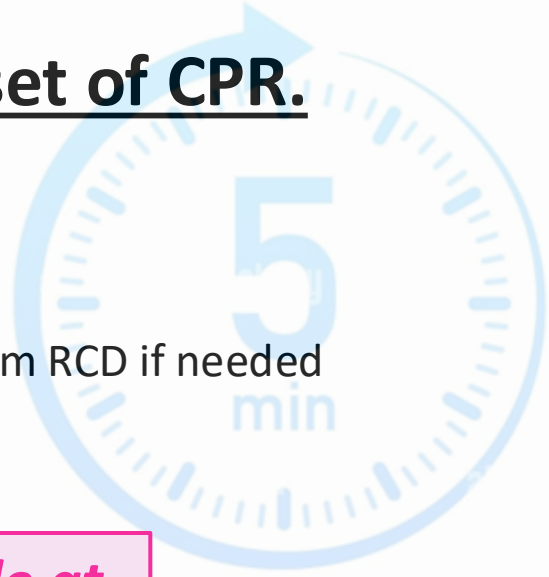
There is no return of spontaneous circulation after 4 minutes

=

Resuscitative Cesarean Delivery

8. Shields AD, Vidosh J, Zelop CM. *American Journal of Obstetrics and Gynecology*. 2026

RCD goal < 5 min means from onset of ARREST, NOT from onset of CPR.



5 min mark is ***NOT A MANDATE TO WAIT***

- Eg: *If she is found down with unknown time of arrest* → team should immediately perform RCD if needed

"We [must] reinforce the concept that ***if the uterus is palpable at or above the umbilicus,***
preparations for delivery should be made simultaneous with initiation of maternal [CPR];
if maternal condition is <u>not rapidly reversible</u>,
hysterotomy with delivery should be performed regardless of fetal viability or elapsed time since arrest."[10]

8. Shields AD, Vidosh J, Zelop CM. *American Journal of Obstetrics and Gynecology*. 2026
10. Rose et at. *American Journal of Obstetrics and Gynecology*. 2015

- **<u>Delivery goal</u>** <u>is uterine evacuation within 1 minute of incision</u>

  - ✓ Crash carts in L&D units should be equipped with:
    - ✓ #10 blade scalpel
    - ✓ Betadine splash prep
    - ✓ Clamps for cutting the umbilical cord
    - ✓ Sponges
    - ✓ Absorbable suture
    - ✓ Additional clamps and/or retractors if feasible.
  - ✓ **Neonatal resuscitation cart** should accompany the adult cart.

8. Shields AD, Vidosh J, Zelop CM. *American Journal of Obstetrics and Gynecology*. 2026
10. Rose et at. *American Journal of Obstetrics and Gynecology*. 2015

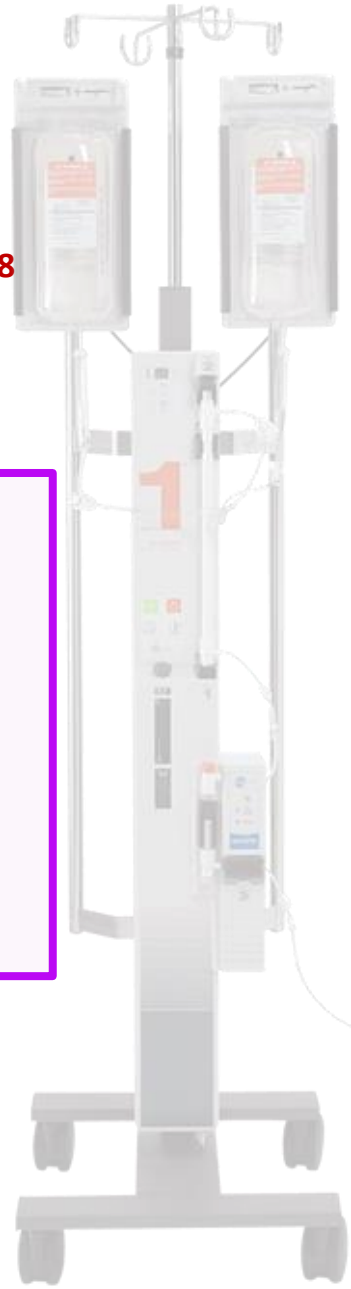
Resuscitative Cesarean Delivery

- Most likely etiologies of arrest: **cardiac, hemorrhage & AFE.**
  - ✓ Suspect AFE with any sudden arrest, particularly when accompanied by **bleeding** [5,8]

- Anticipate considerable hemorrhage after RCD:

Critical interventions in massive obstetric hemorrhage:

- ✓ Avoid large IV Pitocin bolus – SVR drop may cause her to re-arrest[9]
- ✓ Multiple sites of large-bore vascular access
- ✓ MTP with warming rapid infuser
- ✓ **Mechanical uterine compression**:
  - B-lynch, manual external or internal subhepatic aortic compression, etc [5,8]
- ✓ Timely inclusion of gyn-onc and vascular and/or trauma surgeons, REBOA.



- IR for pelvic vessel embolization
- Hysterectomy
- ECMO - requires careful consideration in coagulopathy

5. Lipman et al. *Anesthesia & Analgesia*. 2014
8. Shields AD, Vidosh J, Zelop CM. *American Journal of Obstetrics and Gynecology*. 2026
9. Archer et al. *International Journal of Obstetric Anesthesia*. 2008

Post-ROSC Considerations

- After ROSC in an **UNDELIVERED** woman, **maintain LUD** to optimize both uterine blood flow and maternal venous return and minimize the risk of recurrent arrest

- After ROSC in a **DELIVERED** woman, uterine distension or obese abdomen may continue to impair venous return, maintain LUD or abdominal displacement

- Consider ECMO or CPB if needed.

- **Therapeutic hypothermia** strongly considered for maternal benefit after cardiac arrest
  - Similar indications in pregnant & postpartum women as general population
  - Fetal effects of maternal hypothermia in this circumstance largely unknown
    - Fetal bradycardia reported during maternal hypothermia, so continuous fetal monitoring used to guide obstetric management
      - **Caution in setting of maternal hemorrhage and coagulopathy**
        - **Hypothermia may impair hemostasis and worsen bleeding**

5. Lipman S, Cohen S, Einav S, et al. *Anesthesia & Analgesia*. 2014

Where did the 4-5-minute guideline come from?



1986 landmark paper: *Perimortem Cesarean Delivery*

Table 2. Postmortem Cesarean Deliveries With Surviving Infants With Reports of Time From Death of the Mother Until Delivery (From 1900–1985)

Cases	No. patients	Percent
0–5 min	42 (normal infants)	70
6–10 min	7 (normal infants)	13
	1 (mild neurologic sequelae)	
Subtotal	8	
11–15 min	6 (normal infants)	12
	1 (severe neurologic sequelae)	
Subtotal	7	
16–20 min	1 (severe neurologic sequelae)	1.7
21 + min	2 (severe neurologic sequelae)	
	1 (normal infant)	3.3
Subtotal	3	
Total	61	100

Published in *Obstetrics & Gynecology*
OB-GYN Authors:
Vern L. Katz
Deborah J. Dotters
William Droegemueller



Established "The 4-minute Rule":

- ✓ Irreversible maternal brain damage begins at **4** - 6 min anoxic time.
  - ✓ Gravid uterus impairs effectiveness of CPR → remove circulatory obstruction (fetus)
- ✓ Discussed case studies on maternal arrests where ROSC was immediately achieved after emergent cesarean.
- ✓ Discussed existing literature on fetal survival - most surviving neonatal deliveries without brain damage/ neurological injury reported were under 5 min, and rarely survived arrests > 10 min.
- ✓ Rhesus monkey experiment data found fetal brain damage occurred in < 6 min of maternal anoxia.

Vern L. Katz MD - 20 years later: 2005

TRANSACTIONS FROM THE 71ST ANNUAL MEETING OF THE PACIFIC COAST OBSTETRICAL AND GYNECOLOGICAL SOCIETY · Volume 192, Issue 6, P1916-1920, June 2005

Perimortem cesarean delivery: Were our assumptions correct?

Vern Katz, MD [a] · Keith Balderston, MD [a] · Melissa DeFreest, MD [b]

Findings:

- 1986-2004: 38 documented RCDs
  - 34 infants survived
    - 11 delivered < 5 min, 4 in 6 -10 min, 2 in 11 - 15 min, and 7 > 15 min.
  - Of 20 RCDs with potentially resuscitatable causes, 13 mothers resuscitated and D/Ced from hospital in good condition.
  - In 12 of 18 reports documenting hemodynamic status
    - RCD preceded return of maternal pulse & BP, often in a dramatic fashion.
      - Other cases noted improvement in maternal status
- **Importantly, *in no case was there deterioration of the maternal condition with the RCD*.**

Conclusion:

- Published reports from 20 years *support* … RCD < 4 minutes of maternal arrest improves maternal & neonatal outcomes.



BJOG An International Journal of Obstetrics and Gynaecology
Royal College of Obstetricians & Gynaecologists

General Obstetrics

The CAPS Study: incidence, management and outcomes of cardiac arrest in pregnancy in the UK: a prospective, descriptive study

VA Beckett, M Knight, P Sharpe

First published: 24 February 2017 | https://doi.org/10.1111/1471-0528.14521 | VIEW METRICS



- The **C**ardiac **A**rrest in **P**regnancy **S**tudy (CAPS) provided the strongest evidence to date that timely resuscitative cesarean delivery improves maternal survival.

- Reviewed all maternal arrests in the UK from 2011-2014 (n=66)
  - ✓ 58% maternal survival rate with timely resuscitation, including RCD.

- Resuscitation delay associated with maternal death:
  - **Median time from maternal arrest to fetal delivery**:
    - **<u>3 min in survivors</u>** and **<u>12 min in those who died.</u>**
  - Survival improved with IMMEDIATE CPR and delivery in < 5min

A maternal arrest with RCD in under 5 minutes ?

Expectation



Reality



ORIGINAL RESEARCH

Labor Room Setting Compared With the Operating Room for Simulated Perimortem Cesarean Delivery

A Randomized Controlled Trial

Lipman, Steve MD; Daniels, Kay MD; Cohen, Sheila E. MBChB, FRCA; Carvalho, Brendan MBBCh, FRCA



2011 RCT of maternal arrest simulations under ideal conditions:

- *Only **14%*** of teams randomized to **transport** to OR for RCD made incision in < 5 min.
  - ***Transport ↑ CPR interruptions, ↓ quality of chest compressions, and delayed delivery.***
- *Only **57%*** of teams randomized to perform **RCD at site of arrest** made incision in < 5 min.
  - AHA and others propose < 5 min delivery from of the onset of arrest without ROSC
    - ➢ But it still has been shown to be quite difficult, even in ideal conditions.

4. Lipman et al. *ObstetGynecol*. 2011

RESUSCITATION
EUROPEAN RESUSCITATION COUNCIL
REVIEW ARTICLE · Volume 83, Issue 10, P1191-1200, October 2012 Download Full Issue

Maternal cardiac arrest and perimortem caesarean delivery: Evidence or expert-based?

Sharon Einav [a] · Nechama Kaufman [a,b] · Hen Y. Sela [c]



2012 review of 91 published cases of maternal cardiac arrests:

- 54% of mothers survived to hospital discharge.
- RCD performed in 87% of viable pregnancies. (76 total RCD)
- ***Only 7%* of women were delivered in < 5 min**. (4 out of 76)
  - Despite 66% of arrests occurring in highly monitored areas of the hospital, and **89% of them were witnessed**
- RCD determined to have **maternal benefit in 32% of the cases** and to have **caused no harm in any others.**
- In-hospital arrest and RCD < *10 minutes of arrest* associated with better maternal outcomes.

3. Einav S, Kaufman N, Sela HY. *Resuscitation* 2012

SPECIAL ARTICLE

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

Identified Areas for Improvement

- **Key calls often missed** at the start of simulated maternal cardiac arrest:
  - Call for NICU
  - Call for equipment necessary for emergency delivery (i.e., scalpel).
    - ➢ *Recommendation*: emergency call system (w/ backup) where all providers in the maternal/neonatal resuscitation teams are activated immediately & simultaneously
      - ➢ Example **"Code OB"** as a suggested approach
- **Key designated roles:**
  - ✓ Timer/documenter
  - ✓ Airway assistant
  - ✓ 2nd person to rotate for chest compressions
  - ✓ Staff person dedicated to performing manual LUD
- **Key interventions most often neglected:**
  - ✓ Timely defibrillation
  - ✓ Timely backboard insertion*
  - ✓ Continuous LUD, maintained after ROSC if needed.



5. Lipman et al. *Anesthesia & Analgesia*. 2014



MATERNAL ARREST

FIRST RESPONDER

- Activate CODE BLUE
- Document TIME OF ONSET of arrest
- Place patient SUPINE
- **Start chest compressions** (place hands slightly higher on sternum.)

SUBSEQUENT RESPONDER(S)

- **DO NOT DELAY DEFIBRILLATION**
  - Remove all internal & external fetal monitors
- ***MANUAL* Left Uterine Displacement** maintained
- Follow ACLS protocols – early consideration of VA ECMO if ROSC not achieved
- Ventilate with 100% O_2, **secure airway – minimize interruption to chest compressions.** – BVM/LMA/ if ETT not possible.
  - *no induction meds or paralytics* if unconscious– just intubate. Anticipate swollen OB airway.

PREPARE FOR RECUSCITATIVE C/S: goal < 4min FROM ONSET OF ARREST, AT SITE OF ARREST.

  - IVs ABOVE diaphragm only, Humeral I.O. if necessary.
  - Continue CPR until ROSC. May need ECMO.
  - If $MgSO_4$- toxicity suspected: TX: Ca gluconate (30mL 10%) or Ca Chloride (10mL 10%)
  - NICU team for fetal delivery

POSSIBLE CAUSES

BLEEDING/DIC: Atony, Vaginal/Cervical Lac, Retroperitoneal or Intra-abdominal bleeding, Coag disorder, HELLP/capsule rupture, AFE, Abruption, AFLP

- ✓ **Run hemorrhage checklist**
- ✓ MTP: early cryo, may need factor/fibrinogen concentrates
- ✓ Consider ECMO if severe pulmonary edema & unable to ventilate, or heart failure $^2/_2$ AFE

EMBOLISM: Coronary clot v SCAD, PE, AFE, VAE

- ✓ **PE:** consider STAT CTA
- ✓ **VAE:** flood field with NS, 100% O_2, position pt L lateral, TEE, aspirate air from R heart catheter, inotropes, CPR may break up VAE
- ✓ **MI/SCAD:** consider STAT PCI → cath lab
- ✓ **AFE:** RV failure → LV failure. Tx: **inotropes, minimize fluids, maintain MAP, pulmonary vasodilators → early alert VA ECMO team**
  - Airway securement, vent settings to ↓PVR: ↓ETCO2, ↑FIO2, ↓PEEP & airway pressures.
  - Doses in **mcg/kg/min:** Dobutamine: 2-10, Dopamine: 2-10, Epi: 0.02-0.1, NE: 0.05-3.3, Milrinone: 0.125-0.375, vaso < 0.08 **U/min.**
  - Avoid phenylephrine in RV failure to **avoid ↑ PVR** . Avoid milrinone *bolus* to **avoid ↓ SVR.**
  - DIC → MTP. **Early cryo, fibrinogen replacement***
  - Pulmonary vasodilators: inhaled Nitric Oxide (5-40 ppm) or inhaled prostacyclin: Epoprostenol 10-50 ng/kg/min
  - Consider AOK: 1mg Atropine, 8mg Ondansetron, 30mg Ketorolac – if no s/s DIC

ANESTHETICS: **L.A.S.T** → "*intralipid*" or "*fat emulsion*" in pyxis & continue CPR until either ROSC, or initiation of cardiac bypass until LA cleared.

- ✓ **L.A.S.T ACLS: REDUCE EPI DOSE: < 1mcg / kg ~ 50-100 mcg at a time****
- ✓ **100mL 20% intralipid bolus (or 1.5 mL/kg/min), then gtt 0.25mL/kg/min, can repeat bolus 2x, max total 10-12mL/kg in 1st 30min.**
- ✓ Secure airway if LOC. Normocapnia: Hyperventilation worsens CNS toxicity. Hypoventilation worsens cardiac toxicity.
- ✓ Seizure control: BENZOS, not propofol*
- ✓ Avoid Vasopressin, CCB, BB

HIGH SPINAL → supportive: maintain BP and secure airway → stat c/s

- ✓ Epi: 10-100mcg doses to effect, +/- CPR to circulate meds, ventilator support until LA wears off.
  - **Bezold-Jarisch Reflex** (2/2 neuraxial): triad of hypotension, severe bradycardia, & hypopnea/apnea → LOC, arrest→ stat c/s
  - → **Atropine** to abolish reflex, **Ephedrine, Epi** 10-100mcg to effect, IV fluids, +/- CPR to circulate meds

ANAPHYLAXIS: Supportive: maintain airway & hemodynamic support

- ✓ Epi 50-100mcg IV to effect for hemodynamic support (0.5-1mg IM), vasopressin, methylene blue for refractory vasoplegia
- ✓ Hydrocortisone 100-200mg IV, Albuterol, Diphenhydramine (H_1), Famotidine (H_2)

CARDIAC DX: MI/Ischemic heart dx/Cardiomyopathy/Aortic dissection (e.g. Marfan's)

- ✓ MI/SCAD: ACLS, Cath lab → PCI
- ✓ Cardiomyopathy: Inotropes: Dobutamine, NE, Milrinone, Epi, TTE/TEE. Consider VA ECMO.
- ✓ Dissection: MTP → cardiac OR

HTN: PreE/Eclampsia

- ✓ Seizure control: AIRWAY protection, suction, MAG = DEFINITIVE TX: IV or IM to prevent next seizure, re-dose mag +/- benzos if refractory.
- ✓ $MgSO_4$- Toxicity? NO DTRs?→ Tx: Ca Gluconate 30mL 10%, or CaCl 10mL 10%. *If DTRs present → seek other cause of cardioresp collapse.
- ✓ AIRWAY – expect ++ airway swelling.
- ✓ **SBP < 160mmHg** to avoid maternal stroke.

SEPSIS: IAI, Urologic, IUFD, Pneumonia, etc.. [E-coli, Staph, Strep A*]

- ✓ Supportive care & assess for: DIC, ARDS vs Pulm Edema, TTE/TEE to assess CV fxn

OTHER: Hs & Ts: **Hypovolemia, Hypo/Hyper K+, Hypoxia, Hypo/hyperthermia, Tension pneumo, Tamponade, Thrombosis, Toxins (Narcan?)**

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