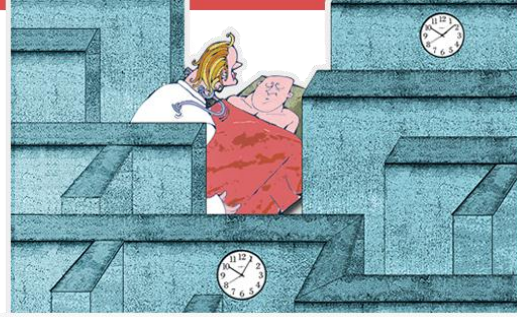




10. ULUSAL  
ACIL TIP KONGRESİ

15 - 18 Mayıs 2014  
Gloria Golf Resort Hotel,  
Belek-Antalya



# Expectant Resuscitation

Prof. Dr. Cuma Yıldırım

yildirimca@hotmail.com



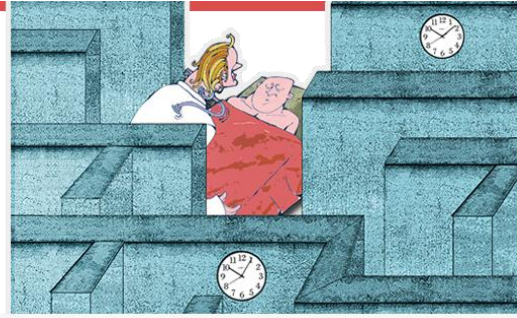


10. ULUSAL

ACIL TIP KONGRESİ

15 - 18 Mayıs 2014

Gloria Golf Resort Hotel,  
Belek-Antalya



# Pregnancy Associated With Cardiac Arrest

Prof. Dr. Cuma Yıldırım

yildirimca@hotmail.com



# REFERENCES

- CIRCULATION AHA 2010, **Cardiac Arrest Associated With Pregnancy**
- Tintinalli's Emergency Medicine, Section 3. Resuscitation, CHAPTER 16. **RESUSCITATION ISSUES IN PREGNANCY**  
**RESUSCITATION ISSUES IN PREGNANCY, 7th Ed.**
- F. Jeejeebhoy, R. Windrim. **Management of cardiac arrest in pregnancy** / Best Practice & Research Clinical Obstetrics and Gynaecology xxx (2014) 4 1–12 <http://dx.doi.org/10.1016/j.bpobgyn.2014.03.006>.
- RICHARD V. LEE, M.D. **Cardiopulmonary Resuscitation of Pregnant Women.** August 1986 The American Journal of Medicine Volume 91 311
- Farida M. Jeejeebhoya, Carolyn M. Zelopb, Rory Windrimc, Jose C.A. Carvalhod, Paul Doriane, Laurie J. Morrisonf,\*  
**Management of cardiac arrest in pregnancy: A systematic review**, Review article, 82 (2011) 801–809,  
[doi:10.1016/j.resuscitation.2011.01.028](https://doi.org/10.1016/j.resuscitation.2011.01.028)
- Stephen Morris, Mark Stacey *ABC of Resuscitation* **Resuscitation in pregnancy**, BMJ VOLUME 327 29 NOVEMBER 2003
- Mallampalli, Antara MD; Guy, Elizabeth MD, **Cardiac arrest in pregnancy and somatic support after brain death**,  
Critical Care Medicine: October 2005 - Volume 33 - Issue 10 - pp S325-S331, [doi:10.1097/01.CCM.0000182788.31961.88](https://doi.org/10.1097/01.CCM.0000182788.31961.88)
- Stephen Bernard a,b,, Michael Buist a, Orlando Monteiro a, Karen Smith b, **Induced hypothermia using large volume, ice-cold intravenous fluid in comatose survivors of out-of-hospital cardiac arrest: a preliminary report**, Resuscitation 56 (2003) 9 /13
- WHITTY, JANICE E. MD, **Maternal Cardiac Arrest in Pregnancy**, Clinical Obstetrics & Gynecology: June 2002 - Volume 45 - Issue 2 - pp 377-392
- [Yildirim C](#)1, [Goksu S](#), [Kocoglu H](#), [Gocmen A](#), [Akdogan M](#), [Gunay N](#). **Perimortem cesarean delivery following severe maternal penetrating injury.** [Yonsei Med J](#). 2004 Jun 30;45(3):561-3.
- Chang J, Elam-Evans LD, Berg CJ, et al: **Pregnancy-related mortality surveillance—United States, 1991–1999.** *MMWR Surveill Summ* 52: 1, 2003.

- The overall maternal mortality rate was calculated at 13.95 deaths per 100 000 maternities.
- During attempted resuscitation of a pregnant woman, providers have 2 potential patients: [the mother and the fetus](#).
- The best hope of fetal survival is maternal survival.
- For the critically ill pregnant patient, rescuers must provide appropriate resuscitation based on consideration of the physiological changes caused by pregnancy.

# Pregnancy-Related Causes of Maternal Cardiopulmonary Arrest

- Obstetric complications
  - Hemorrhage (17.2%)
    - Uterine atony
    - Placental abruption
    - Placenta previa, accreta, increta, or percreta
    - Disseminated intravascular coagulopathy
  - Severe pregnancy-induced hypertension (15.7%)
  - Amniotic fluid embolism
  - Idiopathic peripartum cardiomyopathy (8.3%)
  - Iatrogenic events
  - Failed intubation
  - Pulmonary aspiration
  - Intravascular local anesthetic overdose (1.6%)
  - Drug error, overdose, or allergy
  - Hypermagnesemia
- Pulmonary embolism (19.6%)
  - Thrombus
  - Air
  - Fat
- Stroke (5%)
- Trauma
  - Homicide
  - Suicide
  - Motor vehicle accident
- Infection or sepsis (12.6%)
- Other (19.2%) (cardiovascular, pulmonary, and neurologic comorbidities)

The leading causes of maternal death are  
pulmonary embolism, hemorrhage,  
pregnancy-induced hypertension, and  
infection

# GENERAL PRINCIPLES

- Resuscitation of a pregnant patient can become a chaotic event.
- Multiple specialists may be involved, including pediatricians, neonatologists, anesthesiologists, obstetricians, and, possibly, others.
- The team leader for such resuscitations may be decided by hospital policy. If such a policy does not exist, then typically the emergency physician should direct the resuscitation.

# Modifications

- ***Patient Positioning***
  - Patient position has emerged as an important strategy to improve the quality of CPR and resultant compression force and output.



- During pregnancy, the gravid uterus compresses the aorta and inferior vena cava.
- Compression of the inferior vena cava impedes venous return and results in reduced stroke volume and cardiac output, an important factor to consider during resuscitation.

- Aortocaval compression can also be relieved by manual left uterine displacement.

- When manual left uterine displacement is used, the woman can remain supine, which allows for high-quality chest compression and easier access for defibrillation and airway management.



If this technique is unsuccessful, and an appropriate wedge is readily available, then providers may consider placing the patient in a left-lateral tilt of  $27^{\circ}$  to  $30^{\circ}$ , using a firm wedge to support the pelvis and thorax



# BLS, and ACLS Modifications

There **should be no delay** in delivering usual treatments during the management of cardiac arrest in pregnancy.

# ***Airway***

- Airway management is more difficult during pregnancy and placing the patient in a tilt may increase the difficulty.
- In addition, altered airway anatomy increases the risks of aspiration and rapid desaturation.
- Therefore, optimal use of bag-mask ventilation and suctioning, while preparing for advanced airway placement is critical.

Bag-mask ventilation with 100% oxygen  
before intubation is especially important in  
pregnancy



# ***Breathing***

- Pregnant patients can develop hypoxemia rapidly because of decreased functional residual capacity and increased oxygen demand.
- Ventilation volumes may need to be reduced because the mother's diaphragm is elevated.
- Providers should be prepared to support oxygenation and ventilation and monitor oxygen saturation closely.

# ***Circulation***

- Chest compressions should be performed slightly higher on the sternum than normally recommended to adjust for the elevation of the diaphragm and abdominal contents caused by the gravid uterus.



# ***Circulation***

- *Changes in Pharmacokinetics*
  - Current recommended drug dosages for use in resuscitation of adults should also be used in resuscitation of the pregnant patient.

## Medications Used during CPR—Considerations in Pregnancy

Drug	Indications	Considerations in Pregnancy
Epinephrine	Potentially beneficial in all forms of cardiac arrest.	Category C. Has been shown to be teratogenic in animals in large doses; may induce uteroplacental vasoconstriction
Lidocaine	Ventricular ectopy, tachycardia, and fibrillation	Category C. Use during pregnancy is not well studied; crosses the placenta but in therapeutic doses has no teratogenic effect on the fetus; may cause fetal bradycardia.
Bretylium	Ventricular fibrillation and tachycardia unresponsive to other therapy	Category C. No longer recommended as a first-line drug for resuscitation because of potential risk of reduced uterine blood flow and fetal hypoxia (bradycardia); appropriate when benefits outweigh risks.
Atropine	Symptomatic bradycardia, asystole	Category B. Crosses placenta but results in no fetal abnormalities; can cause fetal tachycardia.
Sodium bicarbonate	Cardiac arrest unresponsive to other measures; documented preexisting metabolic acidosis	Category C. Studies to define risk of hypertonic sodium bicarbonate therapy in pregnancy have not been done
Dopamine	Hemodynamically significant hypotension in the absence of hypovolemia	Category C. No teratogenic effects have been observed in laboratory animals, but sufficient studies in humans are lacking; use only when clearly indicated.

## Medications Used during CPR—Considerations in Pregnancy

Drug	Indications	Considerations in Pregnancy
Dobutamine	Short-term inotropic support of patients with depressed myocardial contractility	Category C. Not found to be teratogenic in animal studies, but its effects in pregnant humans are unknown use only if clearly indicated.
Amiodarone	Ventricular fibrillation, tachycardia, and supraventricular tachycardia	Category D. Should not be used in pregnancy; serious fetal adverse effects have been observed.
Adenosine	Supraventricular tachycardia	Class C. Multiple case reports have described the safe use of adenosine to treat maternal and fetal supraventricular tachycardia.
Magnesium sulfate	Acute myocardial infarction and torsades de pointes	Class B. This drug is commonly used in pregnancy for toxemia and tocolysis with no reports of congenital defects; neonatal neurologic depression may occur with respiratory depression, muscle weakness, and loss of reflexes
Ephedrine	Hypotension unresponsive to fluids	Class C. Multiple reports of use during anesthesia-related hypotension in pregnancy. Maintains uterine blood flow. May cause dose-dependent increase in fetal acidosis, tachycardia, and abnormal variability in fetal heart rate (indicative of fetal stress), or an increase in metabolic activity.
Vasopressin	Cardiac arrest	Class C. There are no controlled data in human pregnancy. Vasopressin is only recommended for use during pregnancy when benefit outweighs risk.

# ***Defibrillation***

Use of an AED on a pregnant victim has not been studied but is reasonable.

# ***Defibrillation***

- Defibrillation should be performed at the recommended ACLS defibrillation doses.
- The greatest predictor of risk for adverse fetal outcome is if the current travels through the uterus, because amniotic fluid most likely transmits current in a manner similar to that transmitted via other body fluids, which could increase the risk of fetal death or burns.

# ***Defibrillation***

Although there is a small risk of inducing fetal arrhythmias, cardioversion and defibrillation on the external chest are considered safe at all stages of pregnancy.

# COMPLICATIONS FROM CPR

- Maternal problems secondary to CPR and ACLS include
  - Liver lacerations,
  - Uterine rupture,
  - Hemothorax, and hemopericardium.
- Fetal complications include
  - Cardiac dysrhythmias from maternal defibrillation and ACLS drugs,
  - Central nervous system toxicity from ACLS drugs,
  - And altered uteroplacental blood flow from maternal hypoxia, acidosis, and vasoconstriction.

# Treatment of Reversible Causes

- The same reversible causes of cardiac arrest that occur in non-pregnant women can occur during pregnancy.
- Providers should be familiar with pregnancy-specific diseases and procedural complications and during resuscitation attempts should try to identify common and reversible causes of cardiac arrest in pregnancy.



# ***Cardiac Disease***

- The most common causes of maternal death from cardiac disease are myocardial infarction, followed by aortic dissection.
- Illnesses related to congenital heart disease and pulmonary hypertension are the third most common cause of maternal cardiac deaths.

# Cardiac Ischemia

- Treatment of pregnant women with acute cardiac ischemia is the same as that of nonpregnant patients, **with the exception of thrombolytic therapy.**
  - **Pregnancy is a relative contraindication for fibrinolytic therapy.**
  - Patients with suspected myocardial infarction should be evaluated for emergent percutaneous interventional therapy or medical management.

# ***Preeclampsia/Eclampsia***

- Preeclampsia/eclampsia may develop after the 20th week of gestation and can produce severe hypertension and ultimately diffuse organ-system failure.
- If untreated, maternal and fetal morbidity and mortality may result.

# ***Magnesium Sulfate Toxicity***

- Patients with magnesium toxicity present with
  - **Cardiac effects** ranging from ECG interval changes (prolonged PR, QRS and QT intervals) at magnesium levels of 2.5–5 mmol/L to AV nodal conduction block, bradycardia, hypotension and cardiac arrest at levels of 6–10 mmol/L.
  - **Neurological effects** ranging from loss of tendon reflexes, sedation, severe muscular weakness, and respiratory depression are seen at levels of 4–5 mmol/L.
  - Other signs of magnesium toxicity include
    - **Gastrointestinal symptoms** (nausea and vomiting),
    - **Skin changes** (flushing),
    - **And electrolyte/ fluid abnormalities** (hypophosphatemia, hyperosmolar dehydration).

# ***Magnesium Sulfate Toxicity***

- Patients with renal failure and metabolic derangements can develop toxicity after relatively lower magnesium doses.
- Iatrogenic overdose is possible in the pregnant woman who receives magnesium sulfate, particularly if the woman becomes oliguric.
- **Empirical calcium administration** may be lifesaving in these cases.

# ***Life-Threatening Pulmonary Embolism***

- Thromboembolic disease is increased in pregnancy.
- When pulmonary embolism is suspected, empiric treatment with heparin should be started immediately, especially if the patient is hypoxic or hemodynamically unstable.
- Once treatment has begun, a CT scan or ventilation-perfusion scan should be obtained to confirm the diagnosis.
- **D-dimer concentrations increase progressively throughout normal pregnancy and an elevated D-dimer level is not a helpful screen for the diagnosis of venous thromboembolic disease during pregnancy.**
- **Traditionally, thrombolytic therapy for pulmonary embolism has been considered relatively contraindicated in pregnant patients.**

# Amniotic Fluid Embolism

- The classic presentation of amniotic fluid embolism is the development of dyspnea and hypotension in association with labor or an abortion.
- Invasive cardiac monitoring and blood products may be required.

# ***Emergency Cesarean Section in Cardiac Arrest***

- Resuscitation team leaders should activate the protocol for an emergency cesarean delivery as soon as cardiac arrest is identified in a pregnant woman with an obviously gravid uterus.
- By the time the physician is ready to deliver the baby, standard ACLS should be underway and immediately reversible causes of cardiac arrest should be ruled out.
- When the gravid uterus is large enough to cause maternal hemodynamic changes due to aortocaval compression, emergency cesarean section should be considered, regardless of fetal viability.



# **PERIMORTEM CESAREAN SECTION**

- **Prognosis for intact survival of the infant is best if delivery occurs within 5 minutes of maternal arrest.**
- The patient should not be moved to an operating suite, as this wastes time. **It is not necessary and only delays a potentially lifesaving procedure to evaluate fetal viability before initiation of the cesarean section**

Yonsei Medical Journal  
Vol. 45, No. 3, pp. 561-563, 2004

## **Perimortem Cesarean Delivery Following Severe Maternal Penetrating Injury**

**Cuma Yıldırım<sup>1</sup>, Sitki Goksu<sup>2</sup>, Hasan Kocoglu<sup>2</sup>, Ahmet Gocmen<sup>3</sup>, Melek Akdoğan<sup>3</sup>, and Nurullah Gunay<sup>1</sup>**

*Departments of <sup>1</sup>Emergency Medicine, <sup>2</sup>Anesthesiology and Reanimation, and <sup>3</sup>Gynecology, Gaziantep University, Faculty of Medicine, Gaziantep, Turkey.*

# **Post–Cardiac Arrest Care**

# Therapeutic hypothermia

- Therapeutic hypothermia may be considered on an individual basis after cardiac arrest in a comatose pregnant patient based on current recommendations for the nonpregnant patient.
- During therapeutic hypothermia of the pregnant patient, it is recommended that the fetus be continuously monitored for bradycardia as a potential complication, and obstetric and neonatal consultation should be sought.

# Therapeutic hypothermia

- Induction of postcardiac arrest hypothermia increases the likelihood of neurologically intact survival and mitigates neurologic damage in select patients after ventricular fibrillation and ventricular tachycardia cardiac arrest.
- Fetal bradycardia may occur, as it is associated with maternal hypothermia related to other conditions such as sepsis, hypermagnesemia, and induced hypothermia for operative procedures.

# AS A RESULT...

- Maternal cardiac arrest is rare but is increasing in frequency.
- Resuscitation of these mothers requires a well-coordinated, multi-team response.

# AS A RESULT...

- If you are First Responder

- Activate maternal cardiac arrest team
- Document time of onset of maternal cardiac arrest
- Place the patient supine
- Start chest compressions as per BLS algorithm: place hands slightly higher on sternum than usual

# AS A RESULT...

- Start IV above the diaphragm
- Assess for hypovolemia and give fluid bolus when required
- Anticipate difficult airway; experienced provider preferred for advanced airway placement
- If patient receiving IV/IO magnesium prearrest, stop magnesium and give IV/IO calcium chloride 10 ml in % 10 solution
- Continue all material resuscitative interventions (CPR, positioning, defibrillation, drugs, and fluids) during and after cesarean section



# AS A RESULT...

- Maternal Interventions (Treat per BLS and ACLS Algorithms)
  - Do not delay defibrillation
  - Give typical ACLS drugs and doses
  - Ventilate with % 100 oxygen
  - Monitor waveform capnography and CPR quality
  - Provide post-cardiac arrest care as appropriate

# Thank you....

