Review Article

Challenges of managing obstetric emergences in the intensive care unit

Abstract

Management of obstetric emergencies are a challenge to all clinicians. Not all emergencies need treatment in the Intensive Care Units. Some common conditions like severe preeclampsia, HELLP syndrome, ARDS, status asthmaticus, puerperal cardiomyopathy, amniotic fluid/pulmonary embolism and trauma in pregnancy present a symptom complex that is hard to diagnose and treat.

Adequate resuscitation of the mother is the most effective method for resuscitation of the fetus. In all emergencies, good knowledge of reanimation protocols is an imperative for the successful treatment. It is vital to immediately recognize the emergency situation and ensure appropriate interventions. In spite of the fact that emergency situations in pregnant women are well described and the strategies for their treatment are generally accepted, there is still a very high percentage of mortality in this group of patients. Today, with the development of the obstetric intensive care units, good knowledge of the emergency situations, resuscitation skills and dexterity in the treatment, morbidity and mortality in pregnancy is significantly decreased.

Keywords: obstetric emergencies, intensive care unit, resuscitation, cardiac arrest, eclampsia, trauma, massive pulmonary embolism, amniotic embolism

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Abbreviations: ICU, intensive care unit; CPCR, cardiac pulmonary cerebral resuscitation; SAPS, simplified acute physiology score; APACHE, acute physiology and chronic health evaluation; TISS, therapeutic intervention scoring system; HELLP, hemolysis, elevated liver enzymes and low platelet count; ARI, acute renal insufficiency; PE, pulmonary embolism; VTE, venous thrombo embolism; AE, amniotic embolism

Introduction

Pregnant women who need intensive care are a rare and distinctive group of patients where it is vital to quickly recognize the urgent situation and ensure rapid intervention. Good knowledge of reanimation procedures in these patients is imperative for the successful treatment. In spite of the fact that emergency situations in pregnant women are well described, and the strategies for their treatment are generally accepted, there is still a very high percentage of mortality in this group of patients.

Discussion

Cardiac arrest in pregnancy

Cardiac arrest is uncommon, often unexpected event in pregnancy, and its successful resuscitation is of a particular challenge. It occurs in predominantly young women and very often health workers with little experience have to deal with it. Although this is rare event, emergency centers are obliged to include recommendations for resuscitation of cardiac arrest in pregnancy in their strategies for treatment of emergencies as well as to be adequately equipped.

There are many causes for cardiac arrest, of which not all are associated with pregnancy, especially now when there are many pregnant women who are older and where cardiac arrest may occur as a result of comorbidities. Possible causes of cardiac arrest in pregnant women are: hemorrhage, pulmonary embolism, heart diseases, preeclampsia and eclampsia, amniotic embolism, toxicity of local anesthetic, high regional blocks (total spinal block), failed ventilation or intubation, anaphylaxis, sepsis and intracranial pathology (subarachnoid hemorrhage, cerebral hemorrhage, cerebral venous thrombosis).[1]

Physiological changes that determine the specificity of resuscitation in pregnancy are:

a. Cardiovascular: Aortocaval compression by the gravid uterus, which leads to decreased venous return and an obstructive outflow in the abdominal aorta.

b. The gravid uterus claims 10% of the cardiac output resulting in a significant shunt that further compromises effective cardiac pulmonary cerebral resuscitation (CPCR).

c. Respiratory: Reduced functional residual capacity and increased oxygen demand leads to faster desaturation and greatly impedes adequate oxygenation during CPCR. In addition, these patients are at high risk for a difficult and failed intubation.

d. Gastrointestinal: Increased risk of aspiration which is due to delayed gastric emptying.

All healthcare team members who monitor the pregnancy must be trained in resuscitation and know the latest recommendations. The training is usually performed on manikins where different clinical scenarios for cardiac arrest are resolved by the team. Resuscitation includes ABC procedures + 100% O2 as well as a team approach (anesthesiologist, neonatologist, and gynecologist).[2] For successful resuscitation left lateral position or manually moving the uterus to the left is imperative in order to limit the impact of aortocaval

compression. Several methods can be employed to accomplish this (pillow or mobilization chair), but, the incompatibility of the left lateral tilt with high-quality CPCR has prompted the elimination of the recommendation for using the lateral tilt and the strengthening of the recommendation for lateral uterine displacement.[3] In general, the pregnant woman is recommended to be positioned so that effective compressions can be performed. Furthermore, complying with the recommendations for resuscitation is crucial along with early intubation with cricoid pressure. If intubation cannot be done, then it is necessary to maintain oxygenation by ventilation through a mask or laryngeal mask. Cesarean section is recommended, if adequate circulation after 5 min of cardiac arrest is not achieved. This is not done to save the life of the fetus, but to improve the likelihood of successful resuscitation of the mother by releasing the aortocaval compression. Cesarean section should be performed at the place of cardiac arrest to delay the transfer to the operating theater. To accomplish this, adequate equipment is required. CPCR continues during the surgery. Mother and baby are transported to a well equipped and staffed ICU if resuscitation has been successful. If resuscitation is not successful, the healthcare team should decide to terminate the CPCR.

Emergencies in pregnant women who require intensive care

Obstetric ICU are a relatively new phenomenon, most of them established in the late 80s and early 90s. At first, the two main criteria for admission of pregnant women to the ICU were hypertensive disorders in pregnancy and major bleeding. Those needing mechanical ventilation and high risk pregnant women with neurological, hemodynamic or respiratory compromise following eclampsia, hemorrhagic shock, pulmonary edema or sepsis expanded indications for admission of these patients to the ICU.[4,5] Pregnant women with polytrauma are a particular challenge treatment in pregnancy. Ideally, these ICUs are supposed to have all the necessary facilities for the intensive care such as mechanical ventilation, dialysis and plasmapheresis and invasive multiparameter monitoring. Also, for assessment of critical conditions and for predicting morbidity and mortality in these patients general scoring systems, Simplified Acute Physiology Score (SAPS) II, Acute Physiology and Chronic Health Evaluation (APACHE) II and APACHE III are used.[6] Most pregnant women are admitted to the ICU for relatively short duration and APACHE II scores are low. A very important and more specific score for critically ill patients is the Therapeutic Intervention Scoring System (TISS) which also suggests the level of intervention required in these patients.[7]

There are several diseases in obstetric population which require intensive treatment, such as: severe preeclampsia, hemolysis, elevated liver enzymes and low platelet count (HELLP) syndrome and asthma. Pregnant women with trauma are a particular challenge for intensivists. Another rare but catastrophic complication is amniotic embolism, and it requires special tests to arrive at a diagnosis. Ectopic pregnancy, abortion, bleeding in pregnancy (placenta previa, placental abruption) and precipitate delivery are emergencies which require prompt recognition.[8] The proper and immediate treatment of these conditions significantly reduces the need for admission of pregnant women to the ICU.

Severe preeclampsia: There are two different opinions for adequate management of severe preeclampsia; the first one promotes early delivery that will prevent severe complications like eclampsia and acute renal failure. The second option for those with severe preeclampsia is aggressive management of the mother to reduce

morbidity and mortality in children associated with premature birth. Early delivery increases the likelihood of necrotizing enterocolitis and hyaline membrane disease, but there is no clear evidence which of the two protocols is better. Evidence exists that in some women with stable preeclampsia at 24-27 weeks of gestation and intensive treatment in ICU may continue the gestation for 12 days with improved perinatal outcome.[9,10] Acute renal insufficiency (ARI) is still the most common condition requiring admission to the ICU, but only a small number of women need long-term dialysis or renal replacement therapy. Most of the patients with severe ARI have associated abruption of the placenta or HELP syndrome. More recently it has been proved that the severity of the disease in preeclampsia and HELP syndrome is in correlation with inflammatory cytokines, antithrombin III, and protein C, suggesting that a therapeutic trial with antithrombin III may be beneficial.

HELLP syndrome: The HELLP syndrome occurs in about 0.2–0.8% of pregnancies. It is associated with increased risks of adverse complications for both mother and fetus and its early detection and accurate diagnosis are essential for correct management.[11] The treatment of HELLP syndrome recommends prolongation of gestation to target fetal maturation, by using high doses of corticosteroids (dexamethasone 10 mg every 12 hours), vasodilatation combined with intravenous fluids and antihypertensive drugs with careful monitoring of the fetus and the mother. Fulminant hepatic failure can also occur in pregnancy and invariably needs ICU admission as it carries a very poor prognosis.

Asthma: Asthma is the most common disorder of the respiratory system in pregnancy, affecting up to one in eight women. During pregnancy asthma can improve, worsen or remain unchanged. Poorly controlled asthma may lead to complications for mothers and babies. Maintaining adequate control of asthma during pregnancy, has to be treated with the goal of preventing exacerbations.[12] Although fatal outcome in patients with acute asthmatic attack admitted in ICU is relatively low (with most deaths at home or outside the hospital), one should know that a severe asthmatic attack associated with hypoxemia, dehydration, acidemia and hypokalemia makes pregnant women vulnerable to cardiac dysrhythmias, and cardiorespiratory arrest. Some patients may require mechanical ventilation.

Trauma: The most common etiology of trauma in pregnant women is traffic accidents, falls and burns. Head and neck injuries and hemorrhagic shock are usually encountered. Pregnancy must be suspected in all young women with trauma. Trauma in pregnancy presents a unique range of challenges for the healthcare team. Adequate resuscitation of the mother is the most effective method for resuscitation of the fetus, and it requires knowledge of the anatomical and physiological changes that occur during pregnancy. Initial examination in pregnant trauma patients is not different from that in any other patient. But it is important to stress that changes in pregnancy can mask the normal physiological responses to trauma and they always have to be taken into account (Table 1).

The secondary examination in pregnant women usually includes examination from head to toe, and a detailed examination of the abdomen and pelvis. The examination of uterine activity by palpating the uterus to note the height of the fundus and tone at rest, as well as contractions in their frequency, intensity and duration are of particular importance. The mode of contractions can indicate several conditions that can have negative impact on fetal outcome if urgent interventions are not undertaken.

Table 1 Effects of physiological changes in pregnant trauma patients

Airway	- Risk of aspiration caused by relaxation of the gastric sphincter, abdominal compression and reduced gastric motility
	- Difficult intubation because of increased vascularity of the upper airway
Breathing	- Normal condition of compensated metabolic alkalosis in pregnancy masks the signs of metabolic acidosis (shock) until the situation deteriorates
	- Reduced oxygen reserves and increased metabolic demands predispose the patient to hypoxia
Circulation	- In order to increase the circulating volume by 40%, signs of shock may not be evident until loss of 1500 ml blood.
	- Pregnant women (who are normally hot and red), may never develop coldness and skin typical for shock.
	- Physiological anemia in pregnancy complicates the interpretation of Hb and Ht results.
	- Normal hypotension and tachycardia in pregnancy complicates the interpretation of vital signs.
	- After 20 weeks of gestation, the combined weight of the fetus, uterus, placenta and amniotic fluid will compress the vena cava and will reduce the blood pressure if the patient is in supine position.
	- In hypovolemia, the body considers uterus as a non-vital organ and hypoperfusion occurs in the fetus very early.
	- As a result of increased circulating volume congestive heart failure might appear in pregnancy.
	- Most coagulation factors are elevated in pregnancy, exposing the patient at risk of clotting or bleeding.
	- Due to the large circulatory volume and hormonal changes, pregnant woman does not concentrate urine effectively and will have increased diuresis during hypovolemia.
	- Bloodstream in the uterus predisposes pregnant women to major bleeding if the uterus or uterine blood vessels are injured.

Trauma to uterus affects both the mother and the fetus. Because the fetus depends on the mother regarding its oxygen needs, uninterrupted supply of oxygenated blood must be provided throughout the whole pregnancy. Infrequently, trauma associated with uterine rupture can be life-threatening with high maternal mortality up to 10% and fetal mortality up to 100%.[13] Placental abruption may be a result of smaller or larger injuries. Placental abruption is the most common cause of fetal death after trauma. However, prolonged hypotensive shock and direct blunt trauma to gravid uterus (without placental abruption) can be additional factors for fetal death. Therefore, treatment of hypotension has to begin at the site of the injury in women of reproductive age, whether pregnant or not.

Vena caval compression by the uterus reduces venous return to the heart and can reduce cardiac output and impair response to the treatment of shock. If spinal injury is excluded, the pregnant woman should be transported in propped up left lateral position. Although radiation is of risk to the fetus, diagnostic x-ray examination is often unavoidable. CT of the abdomen and pelvis exposes the fetus to 5-10 r, doses that are not likely to cause harm. If the condition of the mother is stable, there is a need for further examination of the condition of the fetus and the severity of the injury to the uterus. Fetus that shows no signs of distress should be monitored by ultrasound and, since premature birth is always possible, it is necessary to monitor the contractions. If premature labor occurs, then it is necessary to start tocolytic therapy. But if the fetus shows signs of distress despite satisfactory resuscitation of the mother, emergency Cesarean section must be performed.

Abdominal trauma and gravid uterus: Abdominal trauma in pregnant women can be blunt or penetrating as a result of a car accident, a fall or injury. In resuscitation, A, B, C and D priorities remain unchanged. Due to its size, the uterus is more vulnerable, both in blunt and penetrant trauma.

a. At 12 weeks of gestation, the fundus of the uterus is at the height of the symphysis

b. At 20 weeks of gestation the fundus is at the level of the umbilicus

c. At 36 weeks of gestation the fundus is at level of xyphoides.

The fetus is well protected by a thick wall of the uterus and the large amount of amniotic fluid. Blunt trauma may result in uterine irritability and premature labor, as well as in a partial or complete rupture of the uterus and partial or complete placental separation (up to 48 hours after trauma). In pelvic fracture potential blood loss should be considered. A vaginal examination for possible bleeding or cervical dilation is obligatory. Resuscitation of the mother may save the baby, but sometimes it is necessary to sacrifice the fetus to save the mother.

Pregnant woman with head injury: In reproductive-age patients with trauma there are many conflicting opinions regarding anesthetic management, particularly management of the airway. These are:

i. Uncertain intracranial pressure (ICP probably elevated);

ii. Uncertain cervical spine (probably broken);

iii. Uncertain airway (possibly difficult);

iv. Uncertain volume status (possibly reduced);

v. Uncertain level of consciousness (probably comatose or sopor);

vi. Uncertain stomach (almost always full);

vii. Uncertain oxygenation (possibly reduced); and finally

viii. Obstetric uncertain status (probable pregnancy).

If there is any uncertainty about the integrity of the cervical spine, direct laryngoscopy should be avoided and if possible (time constraints or availability of equipment) fiberoptic (awake) intubation of the trachea is recommended. If a direct intubation is considered a necessity, stabilization of the neck and head "in line" with the help of an assistant to prevent extension and rotation of the cervical spine is indicated. If awake fiberoptic intubation is chosen, it is essential to titrate sedative and analgesic medications carefully to maintain verbal communication. It is desirable to apply a local anesthetic by spray/nebulization for better patient cooperation and offset respiratory depression and aspiration with excessive sedation. Midazolam and propofol are safer choices as the fetus: mother relationship for midazolam is 0.76 after 15-20 minutes of administration. Unlike other benzodiazepines the ratio rapidly falls down. No adverse effects on the fetus are found.

Succinylcholine-induced elevation of ICP was once under consideration, but today's problem analysis shows that the clinical significance of this increase has been overemphasized. If there is a need for urgent establishment of airway in pregnant women with head injury, succinylcholine is as an adequate and safe drug. All intravenous anesthetics (excluding ketamine) cause certain degree of vasodilatation and hence reduced cerebral blood flow. All inhalation agents cause cerebral vasodilatation; however, their administration is associated with acceptable ICP values. There is no ideal way for the anesthetic management of pregnant women with head injury. Procedures A, B and C in maternal resuscitation have high priority and their application prior to ICP increase, can rescue both, the mother and the fetus.[14]

Burns in pregnant women: The incidence of pregnant women with burns admitted in ICU is 6.8-7.8% of all patients. Maternal and fetal outcome is related to the area of burnt surface, the presence or absence of complications from burns and gestational age of the fetus. In pregnant women with burns over 25-50% of the whole body, mortality reaches up to 63% for the mother and the fetus.[15] In term woman who has extensive burns, immediate delivery is recommended. The procedure of management is the same as in any other victim in terms of A, B, C. Precautions are necessary since the inhalation burns severely compromise the upper airway and the possibility of damaging the lower airway should also be taken into consideration. Tracheal intubation is indicated in the first 8 hours prior to onset of edema. Priority care is given to the mother, and then the attention is directed to the fetus. In fact, the management of these patients should follow the principles of advanced life support in trauma.

Massive pulmonary embolism: Pulmonary embolism (PE) is still the leading cause of maternal mortality.[16] Inability to recognize the risk factors is considered as a substandard level of care. Pregnant women are at a high risk of venous thromboembolism (VTE) due to physiological changes during pregnancy that produces a hypercoagulable state. Additional risk factors include advanced maternal age, family history, increased weight, operative delivery, preeclampsia, immobilization or travel. The challenge for resuscitation after massive PE is huge, but the focus should be on prevention and adequate treatment when VTE is identified. Acute symptoms that suggest thromboembolism in women with known risk are urgent and anticoagulation may be indicated before a clear diagnosis is established. Dyspnea, syncope, anxiety, chest pain, hemoptysis, and collapse can occur. Dizziness, distended neck veins with accentuated second heart sound and symptoms associated with VTE should always be taken into consideration for the diagnosis of PE. Investigations include: ECG (often normal. Sinus tachycardia, right axis deviation, right bundle branch block and rarely seen modus -S1 Q3 T3); X-ray (often normal: wedge form of heart attack can be seen, pleural effusion, it is useful to exclude other causes and symptoms); arterial blood gas analysis (hypoxemia and hypocapnia); ventilation perfusion scan (if the woman is stable for transfer); pulmonary CT angiography (if the woman is stable for transfer); and transthoracic echocardiography: a useful, but not sensitive method (may help in confirming the PE by identifying the right ventricular dysfunction and may exclude PE, for example aortic dissection, pericardial tamponade or myocardial infarction).

Massive pulmonary embolism is characterized by hypotension and cardiogenic shock. Strategic options for the treatment of massive pulmonary embolism are extremely important for a possible reduction in the incidence of mortality which is remarkably high. They include: ABC procedures if there is a collapse and its treatment is the same as for cardiac arrest in pregnancy; high dose i.v. unfractionated heparin and continuous infusion in case of massive PE, for e.g. 40,000 U/24 hr. The goal is to continue APTT for 1.5-2 sec. It is also advised to use a low molecular weight heparin, for e.g. Enoxaparin of 1 mg/kg twice daily. Additional therapeutic options are systemic thrombolysis, open surgical embolectomy and percutaneous thrombectomy with catheter.

Amniotic embolism: Amniotic embolism (AE) is a rare, unpredictable, nonpreventable and progressive complication reserved for pregnancy. Today the mortality rate is very high despite attempts to apply quick and aggressive treatment protocols, and the implication for existence of a high index of suspicion. It occurs once in 20,000 births. This condition is the most common cause of peripartal maternal death and is responsible for over 10% of all deaths among mothers. The total mortality ranges from 60-80%. More than 50% of patients die in the first hour and two-thirds in the next 5 hours. In survivors, the incidence of severe and permanent neurological damage is alarmingly high.[17]

The exact etiology and pathophysiology of AE is unknown, but may be related to the entry of the amniotic fluid and fetal debris in the circulation of the mother. Although this complication occurs during pregnancy it may also occur in the immediate postpartum period or until 48 hours after delivery. Classically, AE appears in older pregnant women in advanced pregnancy, who suddenly collapse. AE may also occur after the end of pregnancy, after amniocentesis, placental abruption and trauma during a cesarean section and 30 min after delivery. Symptoms of AE begin with sudden onset of dyspnea and hypotension (abnormal behavior, convulsions, respiratory distress and cyanosis) that can occur before the cardiovascular collapse. DIC and hemorrhage can develop quickly. Hypertonic contractions and fetal distress may also occur. Amniotic fluid and fetal amniocytes enter the circulation of the mother and trigger a two-phase phenomenon. Phase 1 is indicated by hypoxia resulting from pulmonary arterial vasospasm and pulmonary hypertension, which eventually leads to the right and then left heart failure and acute respiratory distress syndrome. Women who survive these events may enter Phase 2 (hemorrhagic phase) characterized by massive hemorrhage, uterine atony and disseminated intravascular coagulopathy (DIC).

There is no diagnostic scheme to confirm the presence of AE; diagnosis is usually confirmed at autopsy by the presence of fetal squames and fibers of hair in the pulmonary vasculature of the mother. More recently a sensitive noninvasive method for diagnosis of AE through peripheral maternal blood is applied. The presence of a glycoprotein antigen in the serum of the mother, which is found in the amniotic fluid and meconium, confirms the development of AE.

Patients with AE have a very poor prognosis. Thus, a rapid diagnosis is essential and resuscitation that must begin as soon as possible by an experienced team consisting of anesthesiologist, gynecologist and transfusionist. The treatment is non-specific, supportive, but it must be quick and it includes: oxygen support, correction of cardiovascular collapse with fluids and vasopressors, blood transfusion and clotting factors; advanced life support if cardiac arrest occurs (according to the principles of resuscitation in pregnancy); and treatment of coagulopathy with platelets, fresh frozen plasma and cryoprecipitate. Intensive monitoring together of mother with fetal monitoring in order to improve the outcome in the newborn is important, but resuscitation should not be delayed. In a woman who has not yet given birth, but has experienced a cardiac arrest, an emergency cesarean section postmortem should be considered. However, if the pregnant woman is hemodynamically unstable, but that does not have a cardiac arrest, this decision becomes much more complex and often depends on the status of the fetus.

Amniotic embolism is a life-threatening complication, but it can be potentially reversible. However, the fact remains that this syndrome can neither be predicted nor prevented.[18]

Conclusion

Today, with the development of the obstetric intensive care units, good knowledge of the emergency situations, resuscitation skills and dexterity in the treatment, morbidity and mortality in pregnancy is significantly decreased.

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Conflicts of interest

The authors declare there is no conflict of interests.

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