

Cardiopulmonary arrest in the pregnant woman

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ABSTRACT

It is not common for a woman to suffer a cardiac arrest during pregnancy, but when it occurs it can be devastating for both mother and fetus. To improve the likelihood of a positive outcome for the mother and the fetus, the midwife should be skilled in cardiopulmonary resuscitation (CPR). This includes early recognition, early basic life support and early defibrillation until appropriately qualified healthcare professionals can start with advanced life support (ALS). Although CPR during pregnancy is based on the standard method used in adults, some modifications need to be made due to the unique needs of the pregnant woman and her fetus depending on the stage of pregnancy and cause of collapse. In this article the basic principles of CPR is reinforced, as applied to the pregnant woman.

Introduction

Immediate initiation of cardiopulmonary resuscitation (CPR) is crucial for survival in cases of cardiac arrest. Fortunately CPR is a rare event in pregnancy, but when it does occur, it is serious and life-threatening.¹ The true incidence of cardiopulmonary arrest during pregnancy is not known, but has been estimated to be about 1 in 30 000 pregnancies.² In America 10% of maternal deaths are related to cardiac arrest.³ Survival from such an event is exceptional.⁴ Rates of survival and complete physiological recovery following in-hospital cardiac arrest are poor in all age groups and fewer than 20% of adult patients will survive to go home.¹ Outcomes for pregnant women are dependent on the underlying cause of the arrest and the speed and effectiveness of resuscitation efforts by an experienced team.^{2,4} CPR is a team effort.³

However, if this unexpected incident occurs the midwife must have the relevant knowledge and skills to recognise and manage the situation appropriately. In the 2002–2004 triennium 17.9% of maternal deaths in South Africa had an avoidable factor related to resuscitation.⁵ This article aims to reinforce the basic principles of CPR in a hospital setting, as applied to the pregnant woman.

The chain of survival

Survival from cardiac arrest depends on a sequence of interventions. To maximise the chance of survival of an individual, certain interventions must not only take place in order of priority, but are also time-sensitive. The American Heart Association (AHA) uses four links in the “Chain of survival” to illustrate the importance of time-sensitive actions for victims.^{6,7} These links comprise (1) **early recognition** and **call for help**; (2) **early basic life support** to slow the rate of deterioration of the brain and heart, thus, buying time to enable defibrillation; (3) **early defibrillation** to restore a perfusing cardiac rhythm and (4) **early advanced life support**, followed by postresuscitation care delivered by healthcare providers.^{6,7}

The midwife plays an important role in the first three links and is responsible to call for early advanced life support, thus, potentially increasing the survival rate of the pregnant woman.⁷

First link: Early recognition and call for help

It is recognised that many cardiac arrests may be preventable. A report of the Confidential Enquiry into Maternal and Child Health (CEMACH) in the United Kingdom suggested that more than half of pregnancy-related deaths were associated with substandard care. In general the staff failed to recognise and act

on common critical illnesses.⁸ The importance of preventing cardiac arrest in the pregnant woman, therefore, cannot be stressed enough.

The major causes of cardiac arrest during pregnancy are:

- **Trauma induced incidents:** Motor vehicle accidents, assault or penetrating injury²
- **Complications of pregnancy:** Amniotic fluid embolism, hypertensive disorders of pregnancy and septic shock^{2,3,9}
- **Haemorrhage:** Abortion, placenta abruption, placenta praevia, uterine atony and disseminated intravascular coagulation^{2,9}
- **Pre-existing heart disease:** Acute pulmonary heart disease and arrhythmia^{2,9}
- **Others:** Drug toxicity/overdose and anaesthesia-related complications such related to epidural and spinal blocks⁹

The midwife should recognise high-risk patients for cardiopulmonary resuscitation. The patients should then be transferred and nursed in high care units, where continuous monitoring is available. In these units, cardiac monitors (ECG and blood pressure) and pulse oximeters should be used where appropriate.

If the pregnant woman deteriorates, she will display common signs that represent the failing of respiratory, cardiovascular and neurological systems. Therefore, the monitoring of respiratory rate, heart rate, blood pressure and level of consciousness is essential, as it may predict cardiopulmonary arrest.¹ Response to abnormal findings needs to be appropriate and speedy interventions should be planned without hesitation to prevent cardiopulmonary arrest.

The key interventions to prevent cardiac arrest of the critically ill pregnant woman, as proposed by the AHA, include:

- ensuring that the patient is placed in the left lateral position
- then giving 100% **Oxygen (Oh)**
- placing her on the cardiac **Monitor (My)**
- inserting an **Intravenous** line to keep the vein open for future use (**I need help**)¹⁰

The mnemonic “**Oh My I need help**” has been used by Dr Walter Kloock, Chairman of the Resuscitation Council of Southern Africa, to assist healthcare workers in prioritising the immediate actions that need to be implemented if a patient is critically ill.

Check for responsiveness

To assess for responsiveness, tap the pregnant woman firmly on

the shoulder and ask her in a loud voice: "Are you all right?" Check for signs of life, which include movement, response to stimulation and regular breathing.¹¹

If responsive, address the possible underlying cause. Turn the woman on her left side and use the "Oh My I need help" mnemonic.

If unresponsive, continue with 'Call for help'.

Call for help

If the woman is unresponsive, immediately call for help or raise the alarm. Calling for help includes calling additional healthcare workers to assist with CPR, as well as delegating a person to collect the emergency equipment such as the bag-valve-mask ("Ambu bag") and the automated external defibrillator (AED), if available, or the manual defibrillator.⁷ The resuscitation team or treating doctor should be contacted. Then continue with 'Open airway'.

Second link: Early basic life support

The "ABCs" are used to guide the steps of CPR. Guidelines, summarised in Figure 1 are provided to guide the midwife through the chronological steps.

Open airway

Place the woman in a supine position. Beyond 20 weeks gestation the uterus should be displaced by 15–30 degree lateral tilt or by using manual displacement of the uterus.¹² Open the airway by using the head tilt-chin lift manoeuvre.⁷ Place your hand on the woman's forehead and gently tilt her head back. Place your fingertips under the point of the woman's chin and then lift the chin to open the airway.¹³ This manoeuvre opens the airway by displacing the tongue into the posterior pharynx.¹³ Suctioning should be used to remove vomit if present in the mouth.⁴

Breathing

While keeping the airway open, look, listen and feel for normal breathing, for no more than 10 seconds.⁷ Look for chest movement, listen at the woman's mouth for breath sounds and feel for air movement against your cheek.^{7,13} In the first few minutes following cardiac arrest, the pregnant woman may be breathing very slowly, or even taking infrequent, noisy gasps. Do not confuse this with normal breathing. If you are in doubt whether the breathing is normal or not, act as if it is abnormal.

If the midwife detects normal breathing, place the pregnant woman in the recovery position. The position should be stable, near to a true lateral position with the head supported and with no pressure on the chest which may cause impaired breathing.¹⁴ Continue to reassess the pregnant woman by checking for breathing regularly.

If the midwife does not detect normal breathing within 10 seconds, give two rescue breaths, using bag-valve-mask ventilation. Each breath should be given over one second, with enough volume to produce a visible chest rise.⁷ If the rescue breaths do not make the chest rise, check her mouth and remove any visible obstruction. Then, recheck that there is adequate head tilt-chin lift and re-attempt the rescue breath. Do not attempt more than two breaths each time before continuing to chest compressions as described under 'Circulation'.

The midwife should avoid excessive ventilation by giving the recommended breaths per minute and limiting the volume given to only achieve the necessary chest rise. The delivery of more than 12 breaths per minute during CPR increases the thoracic pressure, which in turn decreases the venous return and then leads to a diminished cardiac output. This in turn decreases the coronary and cerebral perfusion. In addition, if the breath is too large or too forceful it may cause gastric inflation, regurgitation and aspiration (Mendelson's syndrome). Thus, it is critically important that the midwife maintains a ventilation rate of 10 breaths per minute and avoids excessive ventilation.⁷

Bag-valve-mask ventilation is a challenging skill that requires considerable practice to achieve an adequate level of competency.⁷ If oxygen is not available, remove the reservoir bag before initiating the two rescue breaths. If oxygen is available, the reservoir bag should be attached to the oxygen supply before delivering the rescue breaths to ensure that a high percentage of oxygen (100%) is delivered to the mother. The reservoir bag must be fully inflated. Adjust the oxygen flow rate to ensure that the reservoir bag is kept two thirds inflated during inspiration (i.e. 10–15 L/min).

Use a two-hand technique during bag-valve-mask ventilation to maximise the seal with the pregnant woman's face. Resuscitation is most effective when at least two people are involved.⁷

Pregnant women are at great risk for airway related complications. Hormonal changes cause a delay in gastric emptying and relax the gastro-oesophageal sphincter. This enhances the chances for regurgitation, which in turn can cause airway obstruction and/or aspiration.^{7,9-10,15} Use cricoid pressure during bag-valve-mask ventilation if a third person is available, who is not responsible for either compressions or ventilations.^{7,10,12,15} Cricoid pressure is applied to the pregnant woman's cricoid cartilage and pushes the trachea to the posterior, compressing the oesophagus against the cervical vertebrae. This can prevent gastric inflation and reduces the risk of regurgitation and aspiration.⁷

Once 2 effective breaths have been provided, continue with 'Circulation'.

In surveys, healthcare rescuers were reluctant to perform mouth-to-mouth ventilations on unknown victims of cardiac arrest.⁷ If the bag-valve-mask has not arrived and you are unwilling to perform direct mouth-to-mouth ventilation, but need to initiate CPR on a pregnant woman (who is in respiratory and cardiac arrest), open the airway and continue with chest compressions only. Start with bag-valve-mask ventilation as soon as the equipment becomes available.

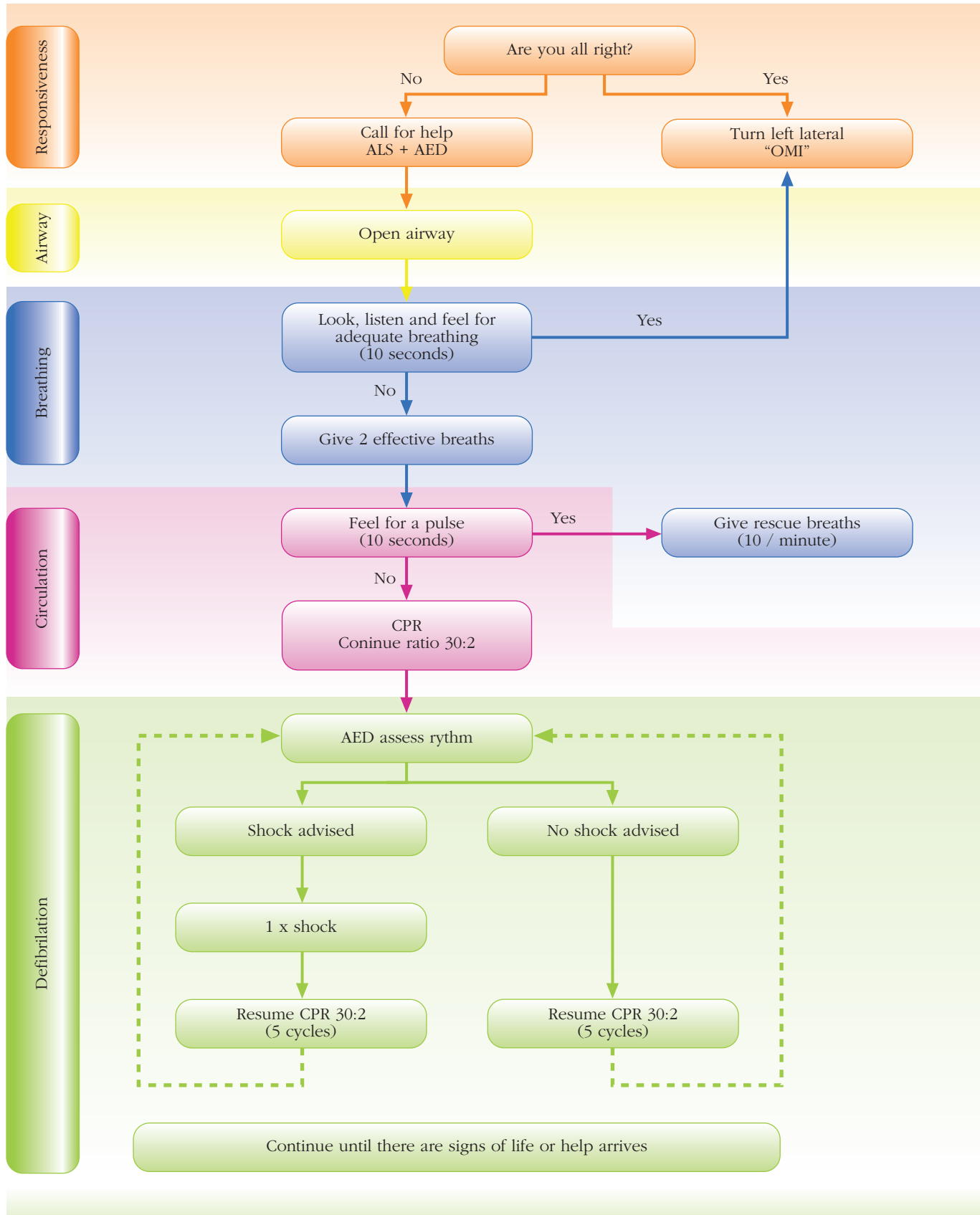
Circulation

Healthcare providers may have difficulty in determining whether a carotid pulse is present or absent.⁷ Therefore, the midwife should not take longer than 10 seconds to check for a pulse. If a pulse is not definitely felt, continue with chest compressions.¹⁴

If the pulse is present and the pregnant woman is in respiratory arrest (i.e. lack of breathing but a palpable pulse), rescue breaths without chest compressions should be delivered at a rate of about 10 breaths per minute (i.e. one breath every six seconds).^{7,16} Recheck the pulse every two minutes, but spend no more than 10 seconds in doing so.^{7,14}

If there is no definite pulse palpable or the midwife is unsure, start with chest compressions at a ratio of 30 compressions and two ventilations.⁷ Effective chest compressions are essential for providing blood flow to the vital organs during CPR. To maximise the effectiveness of the chest compressions, ensure that the woman beyond 20 weeks gestation is in the supine position with a 15–30 degree lateral tilt or a wedge under her right side (i.e. right thigh and buttock) to avoid pressure on the vena cava inferior.^{7,12} She should be laying on a hard surface, e.g. backboard or floor.¹⁷ Place the heel of your hand just above the centre of the sternum because the gravid uterus elevates the diaphragm.¹² Interlock the fingers of your hands and ensure that the pressure is not applied over the woman's ribs, upper abdomen or end of the sternum. Position yourself vertically above the woman's chest, and with your arms held straight, "push hard and push fast".⁷

Figure 1: ABCs as guideline for CPR in the pregnant woman



Since the emphasis is on effective chest compressions, a rate of 100 or more compressions should be delivered per minute, with a compression depth of one third of the diameter of the chest.^{7,12} Allow the chest to return to its normal position between compressions, as this allows venous return to the heart and, thus, increases the coronary and cerebral perfusion. Minimise interruptions in the chest compressions. Change the rescuers approximately every two minutes to prevent compression fatigue and deterioration in the quality of the chest compressions.⁷

Third link: Early defibrillation

Early defibrillation is an integral part of the chain of survival. For every minute that goes by, the chances for a successful cardioversion decreases by 10%. Patients receiving defibrillation within the first 30 seconds to one minute of cardiac arrest, with ventricular fibrillation as the presenting cardiac rhythm, have an 80–90 % chance of a successful cardioversion.^{7,14} All healthcare workers providing basic life support should be trained to provide defibrillation. Midwives who are not trained in rhythm recognition or manual defibrillation, and where defibrillators are used infrequently, should use an AED as alternative.^{14,18} If no AED or defibrillator is available, the midwife should continue with CPR until advanced life support healthcare practitioners arrive.

Defibrillation shocks do not transfer significant current to the fetus.¹⁰ Fetal or uterine monitors should be removed before delivering the shock.^{10,12}

AED's are medical devices that are able to check a person's heart rhythm and then recognise a rhythm that requires a shock. AED's are extremely accurate and easy to use.⁷

The AHA¹⁸ and Resuscitation Council (UK)¹⁴ suggest that the following steps be followed as soon as the AED arrives:

1. **SWITCH ON** the AED
2. **ATTACH** the AED electrode pads to the pregnant woman's bare chest
3. **STAND CLEAR** of the patient
4. **ANALYSE** the rhythm
5. Deliver a **SHOCK** if indicated

Continuous professional development with regard to ensuring that midwives are and remain competent to use the AED is of utmost importance.

Fourth link: Early advanced life support

It is crucial to continue CPR until advanced life support healthcare practitioners arrive and take over.^{7,18} Advanced life support would include endotracheal intubation and appropriate drug management.

The fetus

Fetal monitoring is only indicated after the mother has been resuscitated and stabilised for cases 26 weeks and more. In cases 15–26 weeks listening to the fetal heart with a doppler or confirmation by sonar may be needed. The fetus is entirely dependent on the mother for oxygen supply.⁹ Unfortunately, external cardiac compressions are not sufficient to provide effective utero-placental perfusion.⁹ The best hope for fetal survival is maternal survival.¹³ The resuscitation team leader should consider the need for an emergency caesarean section/hysterotomy as soon as cardiac arrest is diagnosed in a woman after 20 weeks gestation.¹² This relieves aortocaval obstruction and improves maternal resuscitation.¹² The best survival rate for infants > 24 weeks of gestation, occurs when the delivery takes place within no more than five minutes of cardiac arrest.¹⁰

Conclusion

Cardiac arrest in the pregnant woman may be prevented by early recognition and early interventions. Early interventions include turning the pregnant woman to the left lateral position, giving 100% oxygen, insertion of an intravenous line to keep the vein open for future use.

If cardiac arrest is diagnosed, basic life support should be provided immediately to attempt to increase the survival rate of the pregnant woman. This includes checking for responsiveness, calling for help, ensuring an open airway, initiating and supporting breathing, as well as focusing on the most important aspect, namely maintaining optimal circulation.

Defibrillation, preferably with an AED, should follow as soon as the equipment is available to increase the chances of survival. CPR should continue until skilled advanced life support practitioners arrive to continue with advanced life support skills. Successful CPR will not only improve the mother's chances of survival, but also that of her fetus.

Routine emergency "drills" for maternal emergencies, including CPR and the use of a manual defibrillator or AED, should be emphasised in all maternity units. This will enhance the confidence and skills of the midwife when dealing with cardiopulmonary arrest in the clinical setting, which in turn will increase the survival rate of mother and fetus.

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