

Maternal Collapse in Pregnancy and the Puerperium

Key Points

- Maternal collapse is a rare but life-threatening event, with a wide-ranging aetiology. The outcome primarily for the mother, but also for the fetus, depends on prompt and effective resuscitation.
- An obstetric modified early warning score chart along with clinical judgment should be used for all women undergoing observation to allow for early recognition of the woman who is becoming critically ill.
- Consider 4 'H's and 4 'T's for the cause of the maternal cardiac arrest; in the pregnant woman, add eclampsia and intracranial haemorrhage.
- Maternal collapse resuscitation should follow the Resuscitation Council (UK) 2021 guidelines (Appendix 1) using the standard ABCDE approach, with some modifications for maternal physiology, in particular relief of aortocaval compression.
- If maternal cardiac arrest occurs in the community setting, 999 call should be made, basic life support should be administered, and rapid transfer arranged.
- Senior staff with appropriate experience should be involved at an early stage.
- Perimortem Caesarean Section (PMCS) should be seen as a resuscitative procedure to be performed primarily in the interests of maternal survival.

Version: 2.0

Date Issued: 21 January 2025

Review Date: December 2027

Key words: Maternal collapse, anaphylaxis, amniotic fluid embolism, toxicity

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Abbreviations

AFE	Amniotic Fluid Embolism
CPR	CardioPulmonary Resuscitation
MEOWS	Modified Early Obstetric Warning System

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1. Introduction

Maternal collapse is defined as an acute event involving the cardiorespiratory systems and/or central nervous system resulting in a reduced or absent conscious level (and potentially cardiac arrest and death), at any stage in pregnancy and up to 6 weeks after birth¹.

The incidence of cardiac arrest in pregnancy is much rarer than maternal collapse at around 1: 36,000 maternities, with a case fatality rate of 42%. Causes of maternal cardiac arrest vary including hypovolaemia, thromboembolic disease, amniotic fluid embolism and cardiac causes with a significant mortality rate if occurring in the community. 25% of collapses were attributed to obstetric anaesthesia, all of whom were successfully resuscitated².

An **obstetric modified early warning score** chart along with clinical judgment should be used to allow early recognition of the woman who is becoming critically ill¹. For full guideline, see [Recognising Deterioration in Pregnant or Recently Delivered Women and Use of Modified Obstetric Warning System \(MEOWS\)](#).

It is essential that the clinical team are skilled in initial effective resuscitation techniques and are able to investigate and diagnose the cause of the collapse to allow appropriate, directed ongoing management^{3,4}.

Early involvement of senior experienced staff, including obstetricians, anaesthetists, haematologists and intensivists, is essential to optimise outcome.

2. Causes of Maternal Collapse

2.1 General

Maternal collapse can result from many causes which may or may not be pregnancy related. A systematic approach to assessment facilitates identification of the cause of collapse. If the cause is reversible, the survival rates are greater and those for which specific treatment exists must be rapidly considered⁵.

A systematic ABCDE approach should enable the clinical team to identify the most common causes of cardiac arrest. Consider 4 'H's and 4 'T's and, in the pregnant woman, add eclampsia and intracranial haemorrhage.

Reversible cause	Cause in pregnancy
4 H's	
Hypovolaemia	Bleeding (obstetric/other; may be concealed) or relative hypovolaemia due to dense spinal block, septic or neurogenic shock and anaphylaxis
Hypoxia	Pregnant women can become hypoxic more quickly. Cardiac events – peripartum cardiomyopathy, myocardial infarction, aortic dissection, large vessel aneurysms
Hypo/hyperkalaemia	No more likely; severe hyperemesis
Hypo/hypernatraemia	May be caused by oxytocin use Iatrogenic administration of fluids in labour/ women's desire to "drink plenty of fluid" in labour
Hypothermia	No more likely

Reversible cause	Cause in pregnancy
4 T's	
Thromboembolism	Amniotic fluid embolism, pulmonary embolus, air embolus, Myocardial infarction
Toxicity	Local anaesthetic, magnesium, other
Tension pneumothorax	Following trauma/suicide attempts
Tamponade	Following trauma/suicide attempts
Eclampsia and pre-eclampsia	
Intracranial Haemorrhage	

Resuscitation Council (UK) 2021.

2.2 Haemorrhage

Major obstetric haemorrhage was responsible for 17 maternal deaths between 2019-2021 with an estimated incidence of 8 in 1000 maternities⁶. Cause of major obstetric haemorrhage include postpartum haemorrhage, major antepartum haemorrhage from placenta praevia, placental abruption, uterine rupture and ectopic pregnancy. Concealed haemorrhage should not be forgotten including following Caesarian section and ruptured ectopic pregnancy. Blood loss is often difficult to estimate and fit healthy women can tolerate significant loss prior to showing signs of decompensation¹. For full guidance, refer to the [Antepartum haemorrhage](#) guideline. In the case of maternal collapse secondary to antepartum haemorrhage, the fetus and placenta should be delivered promptly to allow control of the haemorrhage.

In the case of massive placental abruption, Caesarean section may occasionally be indicated even if the fetus is dead to allow rapid control of the haemorrhage.

Intravenous tranexamic acid significantly reduces mortality due to postpartum haemorrhage.

Point of Care ROTEM Machine should be used along with the other laboratory tests that are requested in the whole blood at the time of PPH. Its viscoelasticity technology would detect coagulation status (Platelets, Fibrinogen and Coagulation factors) and provide an overview of patient's whole blood sample in 10 minutes.

2.3 Thromboembolism

Thromboembolism is the leading cause of direct maternal death during or up to 6 weeks after the end of the pregnancy leading to the deaths of 33 women in the MBRRACE report 2019-2021. For full guidance, refer to [Thromboprophylaxis and the treatment of venous thromboembolism in pregnancy and the puerperium](#).

2.4 Cardiac disease

Cardiac disease remains the commonest cause of indirect maternal death and the commonest cause of maternal death overall when excluding maternal deaths from Covid-19. Between 2019 and 2021, there were 33 women that died from cardiac causes in the UK during pregnancy or within 42 days of delivery⁶.

The majority of deaths secondary to cardiac causes occur in women with no previous history. The main cardiac causes of maternal death are ischaemia and sudden arrhythmic cardiac death with a structurally normal heart. Aortic root dissection, although usually associated with an inherited aortopathy can present in otherwise healthy women, and signs and symptoms, such as central chest or interscapular pain, a wide pulse pressure (mainly secondary to systolic hypertension) and a new cardiac murmur, must prompt appropriate imaging and, if required, referral to a cardiologist. The incidence of congenital and rheumatic heart disease in pregnancy is increasing, secondary to increased survival rates and with improved management of congenital heart disease. In addition, women with mechanical prosthetic heart valves are at particularly increased risk of complications in pregnancy. Other cardiac causes include cardiomyopathy; dissection of the coronary artery; acute left ventricular failure; infective endocarditis; and pulmonary oedema.

After successful resuscitation, cardiac cases should be managed by an expert cardiology team.

2.5 Sepsis

Sepsis is a significant cause of maternal morbidity and mortality. Bacteraemia which can be present in the absence of pyrexia or a raised white cell count, can progress rapidly to severe sepsis and septic shock leading to collapse¹.

Septic shock should be managed in accordance with the Surviving Sepsis Campaign guidelines.

For full guidance refer to the [Management of sepsis in pregnancy and puerperium](#) guideline.

2.6 Amniotic fluid Embolism

UK Incidence of Amniotic Fluid Embolism (AFE) reported in the 2019-2021 MBRRACE report was 0.39 per 100,000 maternities. AFE presents as a collapse during labour or birth, or within (usually) 30 minutes of birth in the form of hypotension, respiratory distress and acute hypoxia. Seizures and cardiac arrest may also occur¹. This is followed by acute coagulopathy in those women who survive the initial event. AFE incidence is increased in women who have multiple pregnancy, polyhydramnios, placenta praevia, placental abruption and induction of labour⁷. If AFE is suspected or proved, the UK National Registry for AFE should be contacted.

The management of AFE is supportive rather than specific, as there is no proven effective therapy.

Point of Care ROTEM Machine should be used along with the other laboratory tests that are requested in the whole blood at the time of the event. Its viscoelasticity technology would detect coagulation status (Platelets, Fibrinogen and Coagulation factors) and provide an overview of patient's whole blood sample in 10 minutes.

Coagulopathy needs early, aggressive treatment, including the use of fresh frozen plasma.

Recombinant factor VII should only be used if coagulopathy cannot be corrected by massive blood component replacement as it has been associated with poorer outcome in women with AFE.

2.7 Drug toxicity and overdose

Drug toxicity and overdose should be considered in all cases of collapse. Substance misuse should be remembered as a potential cause of collapse, especially outside of hospital.

Therapeutic drug toxicity is possible with commonly used drugs in obstetric practice such as magnesium sulphate in the presence of renal impairment and local anaesthetic agents. The antidote to cardiac dysrhythmias, respiratory depression or resistant hypotension caused by magnesium toxicity is 6.8mmol of 10% calcium gluconate (30ml if weight >50kg) or 10% 6.8mmol 10% calcium chloride (10ml if weight > 50kg) given by slow intravenous injection over 5-10minutes. For full information, please refer to [Toxbase®](#).

Signs and symptoms of Local Anaesthetic Toxicity	
Mild	Severe
Tingling, numbness of the tongue or around the mouth	Sudden loss of consciousness
Metallic taste	Tonic-clonic convulsions
Mild visual disturbances	Cardiovascular collapse
Light headedness	Sinus bradycardia
	Conduction blocks
	Asystole and ventricular tachyarrhythmias

If local anaesthetic toxicity is suspected, stop injecting immediately.

Lipid rescue should be used in cases of collapse secondary to local anaesthetic toxicity.

Intralipid 20% is available on the Resuscitation trolley.

Manage arrhythmias as usual, recognising that they may be very refractory to treatment.

All cases of lipid rescue should be reported to NHS Improvement and the Lipid Rescue site.

Refer to the guideline for [Management of severe local anaesthetic toxicity](#) (Royal College of Anaesthetists).

2.8 Eclampsia

Fitting (Seizures) after 20 weeks gestation may be attributed to eclampsia, notably where there is no known history of epilepsy. However, epilepsy should always be considered in cases of maternal collapse associated with seizure activity.

For full guidance refer to the [Hypertensive disorders in pregnancy](#) guideline.

2.9 Intracranial haemorrhage

Intracranial haemorrhage is a potential complication of uncontrolled, particularly systolic hypertension, but can also result from ruptured aneurysms and arteriovenous malformations. The initial presentation may be maternal collapse, but often severe headache precedes this. Neuroradiologists and neurosurgeons should be involved in the care of pregnant women with intracranial haemorrhage at the earliest opportunity.

2.10 Anaphylaxis

Anaphylaxis is a severe, life threatening systemic hypersensitivity reaction, resulting in respiratory, cutaneous and circulatory changes, and collapse. There is significant intravascular volume redistribution, which can lead to decreased cardiac output. Acute ventricular failure and myocardial ischaemia may occur.

Airway obstruction secondary to angioedema, bronchospasm and mucous plugging of smaller airways all contributing to significant hypoxia and difficulties with ventilation¹.

In cases of anaphylaxis, all potential causative agents should be removed, and the ABCDE approach to assessment and resuscitation followed.

If a cardiac arrest secondary to an anaphylactic reaction occurs in the community, the woman should have basic life support, including IM adrenaline if available, and be transferred to a hospital setting as quickly as possible, unless a suitably trained healthcare professional is present with appropriate equipment and drugs in which case definitive resuscitation and treatment should be commenced.

The treatment for anaphylaxis is 1:1000 (1mg/ml) adrenaline injection: Give 500 micrograms (0.5 ml) intramuscularly. This dose is for intramuscular use only.

3.0 Physiological and anatomical changes in pregnancy that affect resuscitation.

It is essential that anyone involved in the resuscitation of pregnant women is aware of the physiological differences.

Aortocaval compression significantly reduces cardiac output from 20 weeks of gestation onwards and the efficacy of chest compressions during resuscitation.

Changes in lung function, diaphragmatic splinting and increased oxygen consumption make pregnant women become hypoxic more readily and make ventilation more difficult.

Difficult intubation is more likely in pregnancy. Weight gain in pregnancy, large breasts inhibiting the working space and laryngeal oedema can all contribute to making intubation more difficult.

Pregnant women are also at an increased risk of aspiration.

4.0 Management of the collapsed woman

Maternal collapse resuscitation should follow the Resuscitation Council (UK) 2021 guidelines using the standard ABCDE approach, with some modifications for maternal physiology, in particular relief of aortocaval compression.

4.1 In the event of maternal collapse

- Ensure safe to approach
- Stimulate and assess response
- **If she responds**
 - Call for help **2222 Obstetric Emergency call**,
 - Place in **left lateral position if tilted in theatres** or, if outside this environment, **manually and gently displace the uterus** by placing a hand below the uterus on the maternal right and pushing the uterus slightly upwards and to the **to the left** to relieve aortocaval compression.
 - Give high-flow oxygen to achieve Sat O₂ of at least 94%
 - Commence MEOWS chart if not already in use and escalate as appropriate
 - Assess fetal wellbeing.
 - Check blood glucose level
 - Insert 16G IV cannula
 - Take bloods for:
 - full blood count
 - group and save or crossmatch 4 units dependent on perceived cause of collapse
 - urea and electrolytes
 - clotting studies
 - Arterial blood gas/venous blood gas including lactate
 - Blood cultures should be obtained by separate venous stab as per trust guidelines.

All sample should be processed as URGENT by Pathology.

Ongoing treatment will depend on the cause of the collapse.

- **If No response**
 - Call **2222** for **Maternal Cardiac Arrest**
 - Ensure manual uterine displacement in women above 20 weeks gestation or where the uterus is palpable at or above the level of the umbilicus.

4.2 Airway

- Open airway
 - Check for obstruction
 - Head tilt, chin lift
- Assess for breathing for up to 10 seconds
 - Look for chest movement, listen for breath sounds, feel for air
- **Breathing normally**
 - Turn into recovery position
 - Check help is on the way
 - Assess breathing, pulse, blood pressure, fetal heart rate regularly using a MEOWS chart.
- **Not breathing , start CardioPulmonary Resuscitation (CPR) as per Resuscitation Council (UK) 2021 guidelines**

The airway should be managed as soon as possible by an experienced anaesthetist.

- Persons not directly involved with the resuscitation should ensure that:
 - The security doors are open to allow emergency access to the area.
 - The cardiac arrest trolley is taken to the room.
 - The consultant obstetrician and consultant obstetric anaesthetist should be summoned at the time of the cardiopulmonary arrest call.
 - Someone is available to act as a 'runner'.
 - Appoint a scribe.
 - The woman's records are available.
- Supplemental oxygen with a gas flow 10-15 lt per minute should be administered as soon as possible.
Bag and mask ventilation should be undertaken until intubation
- When the defibrillator arrives, apply self-adhesive defibrillation pads to the woman and analyse the rhythm. These should be applied whilst chest compressions are ongoing.

4.3 Circulation

- **Assess cardiac rhythm**

Shockable Rhythm	Non-Shockable
VF / pulseless VT	Asystole and PEA
Defibrillation with 200 j/300 j/360j biphasic 360 j monophasic	
CPR 30:2 for 2 minutes	Immediate CPR 30:2

- **During CPR**

- Establish IO/ IV access – ideally two wide bore cannulae should be inserted as soon as possible. If peripheral venous access is not possible early consideration of intraosseous access (IO), central venous access or venous cutdown should be considered.
- Give adrenaline as per Advanced Life support algorithm.
- **Correct reversible causes – 4 H's, 4T's**

4.4 Perimortem Caesarean Section (PMCS)

- PMCS should be seen as a resuscitative procedure to be performed primarily in the interests of maternal survival.
- Senior staff should be involved at an early stage.
- **In women over 20 weeks of gestation, if there is no response to correctly performed CPR within 4 minutes of maternal collapse or if resuscitation is continued beyond this, then PMCS should be undertaken to assist maternal resuscitation. Ideally, this should be achieved within 5 minutes of the collapse.**
- A scalpel and umbilical cord clamps should be available on the resuscitation trolley in all areas where maternal collapse may occur, including accident and emergency department.
- Perimortem caesarean section should be performed where the resuscitation is taking place.
- The operator should use the incision which will facilitate the most rapid access. This may be a midline vertical incision or a suprapubic transverse incision.

- Where the outcome is not successful, the case should be discussed with the coroner to determine whether a post-mortem is required before any medical devices such as lines and endotracheal tubes are removed, as per the Royal College of Pathologists recommendations.

5.0 What are the outcomes for the mother and the baby?

Outcomes for mothers and babies depend on the cause of collapse, gestational age and access to emergency care, with survival rates being poorer if the collapse occurs out of hospital. In maternal cardiac arrest, maternal survival rates of over 50% have been reported.

6.0 Post resuscitation care

- Ongoing management depends on the underlying cause of the collapse
- It is essential the woman and baby is transferred to an appropriate environment such as high dependency or critical care area.
- Accurate documentation is essential in all cases of maternal collapse and a critical incident form should be submitted whether or not resuscitation is successful.
- All cases of maternal death must be reported to MBRRACE-UK
- All maternity staff should have annual formal multidisciplinary training in generic life support and the management of maternal collapse.
- Life support training improves resuscitation skills.
- Small group multidisciplinary interactive practical training is recommended to improve the management of maternal collapse.
- **Debriefing is recommended for the woman, the family and the staff involved in the event.**

7.0 References

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Appendix - Obstetric Cardiac Arrest (Resuscitation Council UK 2021)

Obstetric Cardiac Arrest

Resuscitation
Council UK

Alterations in maternal physiology and exacerbations of pregnancy related pathologies must be considered. Priorities include calling the appropriate team members, relieving aortocaval compression, effective cardiopulmonary resuscitation (CPR), consideration of causes and performing a timely emergency hysterotomy (perimortem caesarean section) when ≥ 20 weeks.

START

- 1 Confirm cardiac arrest and call for help. Declare 'Obstetric cardiac arrest'
 - Team for mother and team for neonate if > 20 weeks
- 2 Lie flat, apply manual uterine displacement to the left
 - Or left lateral tilt (from head to toe at an angle of $15-30^\circ$ on a firm surface)
- 3 Commence CPR and request cardiac arrest trolley
 - Standard CPR ratios and hand position apply
 - Evaluate potential causes (Box A)
- 4 Identify team leader, allocate roles including scribe
 - Note time
- 5 Apply defibrillation pads and check cardiac rhythm (defibrillation is safe in pregnancy and no changes to standard shock energies are required)
 - If VF / pulseless VT → defibrillation and first adrenaline and amiodarone after 3rd shock
 - If PEA / asystole → resume CPR and give first adrenaline immediately
 - Check rhythm and pulse every 2 minutes
 - Repeat adrenaline every 3-5 minutes
- 6 Maintain airway and ventilation
 - Give 100% oxygen using bag-valve-mask device
 - Insert supraglottic airway with drain port – or – tracheal tube if trained to do so (intubation may be difficult, and airway pressures may be higher)
 - Apply waveform capnography monitoring to airway
 - If expired CO_2 is absent, presume oesophageal intubation until absolutely excluded
- 7 Circulation
 - I.V. access above the diaphragm, if fails or impossible use upper limb intraosseous (IO)
 - See Box B for reminders about drugs
 - Consider extracorporeal CPR (ECPR) if available
- 8 Emergency hysterotomy (perimortem caesarean section)
 - Perform if ≥ 20 weeks gestation, to improve maternal outcome
 - Perform immediately if maternal fatal injuries or prolonged pre-hospital arrest
 - Perform by 5 minutes if no return of spontaneous circulation
- 9 Post resuscitation from haemorrhage - activate Massive Haemorrhage Protocol
 - Consider uterotonic drugs, fibrinogen and tranexamic acid
 - Uterine tamponade / sutures, aortic compression, hysterectomy

Box A: POTENTIAL CAUSES 4H's and 4T's (specific to obstetrics)

Hypoxia	Respiratory – Pulmonary embolus (PE), Failed intubation, aspiration Heart failure Anaphylaxis Eclampsia / PET – pulmonary oedema, seizure
Hypovolaemia	Haemorrhage – obstetric (remember concealed), abnormal placentation, uterine rupture, atony, splenic artery/hepatic rupture, aneurysm rupture Cardiac – arrhythmia, myocardial infarction (MI) Distributive – sepsis, high regional block, anaphylaxis
Hypo/hyperkalaemia	Also consider blood sugar, sodium, calcium and magnesium levels
Hypothermia	
Tamponade	Aortic dissection, peripartum cardiomyopathy, trauma
Thrombosis	Amniotic fluid embolus, PE, MI, air embolism
Toxins	Local anaesthetic, magnesium, illicit drugs
Tension pneumothorax	Entonox in pre-existing pneumothorax, trauma

Box B: IV DRUGS FOR USE DURING CARDIAC ARREST

Fluids	500 mL IV crystalloid bolus
Adrenaline	1 mg IV every 3-5 minutes in non-shockable or after 3 rd shock
Amiodarone	300 mg IV after 3 rd shock
Atropine	0.5-1 mg IV up to 3 mg if vagal tone likely cause
Calcium chloride	10% 10 mL IV for Mg overdose, low calcium or hyperkalaemia
Magnesium	2 g IV for polymorphic VT / hypomagnesaemia, 4 g IV for eclampsia
Thrombolysis/PCI	For suspected massive pulmonary embolus / MI
Tranexamic acid	1 g if haemorrhage
Intralipid	1.5 mL kg^{-1} IV bolus and 15 mL $\text{kg}^{-1} \text{hr}^{-1}$ IV infusion

Obstetric Anaesthetists' Association
Promoting the highest standards of anaesthetic practice in the care of mother and fetusGUIDELINES
2021

Version 1.1

Full version control record

Version:	2.0
Guidelines Leads:	Miss Petya Doncheva, Consultant Obstetrician and Gynaecologist, WPH Miss Sukhera Furness, Consultant Obstetrician and Gynaecologist, FPH
Lead Director/ Chief of Service:	Miss Anne Deans, Chief of Service for Obstetrics and Gynaecology
Library check completed:	13 September 2024
Professional midwifery advocates:	Maria Thomsen, Angeliki Karava-Sood
Ratified at:	Cross Site Obstetric Clinical Governance meeting, 16 December 2024
Date Issued:	21 January 2025
Review Date:	December 2027
Pharmaceutical dosing advice and formulary compliance checked by:	Rashmi Selli, Principal Pharmacist for Surgery, January 2025
Key words:	Maternal collapse, anaphylaxis, amniotic fluid embolism, toxicity

This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt, contact a senior colleague or expert. Caution is advised when using guidelines after the review date.

This guideline is for use in Frimley Health Trust hospitals only. Any use outside this location will not be supported by the Trust and will be at the risk of the individual using it.

Version History

Version	Date	Guideline Lead(s)	Status	Comment
1.0	February 2022	P. Doncheva, N. Rashid	Final	First cross site version, approved by OCGC, Feb 22
2.0	December 2024	P Doncheva, S Furness	Final	Approved at Cross Site Obstetric Clinical Governance meeting, 16 December 2024

Related Documents

Document Type	Document Title
Guideline	Thromboprophylaxis and the treatment of venous thromboembolism in pregnancy and the puerperium
Guideline	Hypertensive Disorders in Pregnancy
Guideline	Antepartum Haemorrhage (APH)
Guideline	Recognising Deterioration in Pregnant or Recently Delivered Women and Use of Modified Obstetric Warning System (MEOWS)
Guideline	Management of sepsis in pregnancy and puerperium