An urgent call to the labour ward

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Key points

Emergencies on the labour ward may have obstetric, anaesthetic, or general medical causes.

Obstetric patients, as a result of robust cardiovascular and respiratory physiology, may initially compensate well for pathophysiological processes such as haemorrhage and sepsis.

The response to any urgent call to labour ward must adopt an 'ABC' approach with early recognition of problems specific to the parturient.

There is good evidence that mandatory skills and drills training can improve outcome in emergency situations.

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Obstetric anaesthetists' primary role in the maternity unit is the provision of anaesthesia and analgesia to women in labour and who require Caesarean delivery. In addition, they are essential members of the multidisciplinary team who will assist with the management of the various types of emergency that can arise in the maternity unit.

Emergencies in the maternity unit may arise as a result of obstetric, anaesthetic, or general medical problems and there is no widely recognized classification or definition for these situations. Emergency problems in obstetric patients pose a unique set of challenges: these situations are generally rare, so even experienced clinicians may only have limited experience; obstetric units are frequently geographically remote, so clinicians may be working in unfamiliar surroundings and lastly obstetric patients are generally fit and healthy, so, faced with a physiological insult, will initially compensate, before deteriorating precipitously, prompting an urgent call for help.

The emergencies that may lead to an urgent call to labour ward are summarized in Figure 1.

Maternal collapse is the generic term that may be used to describe the endpoint of a variety of clinical problems. It is defined as 'an acute event involving the cardiorespiratory systems and/or brain resulting in a reduced or absent conscious level (and potentially death), at any stage in pregnancy and up to 6 weeks post-delivery'.[1] Maternal collapse may arise as a result of pregnancy-related conditions, pre-existing disease, or co-incidentally during pregnancy. As with all patients, the aide memoire four Hs and four Ts (Hypoxia, Hypovolaemia, Hypothermia, Hypo- or hyper-kalaemia/-magnesaemia/-calcaemia, Thromboembolism, Toxins, Tamponade, Tensionpneumothorax) can be used to classify common causes of collapse in pregnancy, with the addition of eclampsia and intracranial haemorrhage (Fig. 2).

Maternal cardiac arrest

Maternal cardiac arrest is rare, occurring in between one in 20 000 and one in 30 000 pregnancies[2] and clinicians may never witness a case of maternal cardiac arrest over the course of their careers. Confidential Enquiry reports consistently cite poor resuscitation skills as contributory factors to both maternal morbidity and mortality, and deficiencies in the knowledge of maternal resuscitation have been repeatedly demonstrated among care givers.[2]

Standard Advanced Life Support applies in the pregnant patient with two modifications:

(i) The patient should be resuscitated with a left lateral tilt of at least 15° (but <30°) to minimize aorto-caval compression, which reduces the efficacy of chest compressions during resuscitation.[2]

(ii) Perimortem Caesarean section should begin within 4 min of arrest and be accomplished by 5 min. The primary reason for perimortem Caesarean is to maximize the chance of maternal survival by relieving aorto-caval compression, improving venous return, and promoting transfusion of blood from the placental bed. However, once arrest occurs, fetal survival is also optimized by rapid delivery; the best chance of survival for fetuses occurs when delivery occurs within 5 min of maternal arrest.

Preparing the equipment for a perimortem Caesarean delivery may take a few minutes; therefore, Caesarean delivery should be considered as soon as a pregnant woman arrests. In order to minimize time to delivery, obstetricians and neonatologists must form part of the arrest team for any woman who is 20 or more weeks pregnant. In addition, equipment required to perform a perimortem Caesarean section should be kept readily available as standard in any area that routinely cares for pregnant patients.

As with all cases of cardiac arrest, consideration should be given to reversible causes while resuscitation continues, using the four Hs and four Ts (Fig. 2). Hypovolaemia may be the result of haemorrhage, which may be concealed. Relative hypovolaemia can also occur secondary

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to vasodilatation, for example, due to sepsis, the leading indirect cause of maternal death in the most recent maternal death enquiry. Cardiac disease, including myocardial infarction, arrhythmias, and cardiomyopathy, was the most common indirect cause of death and should also be considered as a cause of maternal cardiac arrest. With an ageing and increasingly obese obstetric population, cardiac disease in pregnancy is likely to become more prevalent. Other important causes that may be particularly relevant in the obstetric population include pulmonary or amniotic fluid embolism.

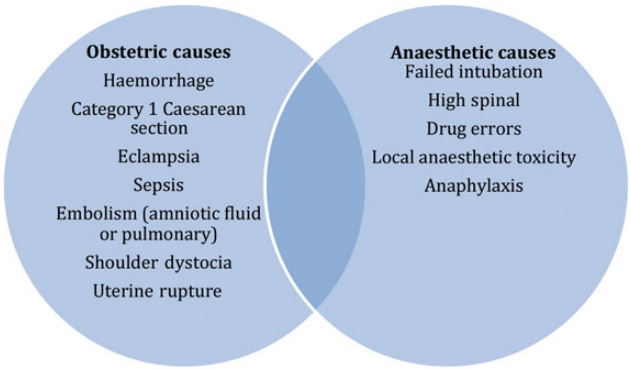

Fig 1 Causes for an urgent call to labour ward.

Eclampsia

Pre-eclampsia is defined as new hypertension [diastolic arterial pressure (DAP) $\geq$90 mm Hg or systolic arterial pressure (SAP) $\geq$140 mm Hg] presenting after 20 weeks of pregnancy with significant proteinuria.[3]

Eclampsia is a convulsive disorder associated with pre-eclampsia. Eclamptic seizures are typically short and self-terminating. In addition to basic resuscitation, the aims of treating eclampsia are to rapidly control arterial pressure and terminate seizures. The majority of deaths in women with severe pre-eclampsia/eclampsia are secondary to intracranial haemorrhage and eclampsia.

Control of arterial pressure

In patients with severe hypertension, arterial pressure should be controlled to SAP of $<$150 mm Hg and DAP between 80 and 100 mm Hg, using one of the following agents:

- labetalol (i.v. or orally),
- hydralazine (i.v.),
- nifedipine (orally).

Before administration of hydralazine, consideration should be given to administering a fluid challenge of 500 ml of colloid, in order to

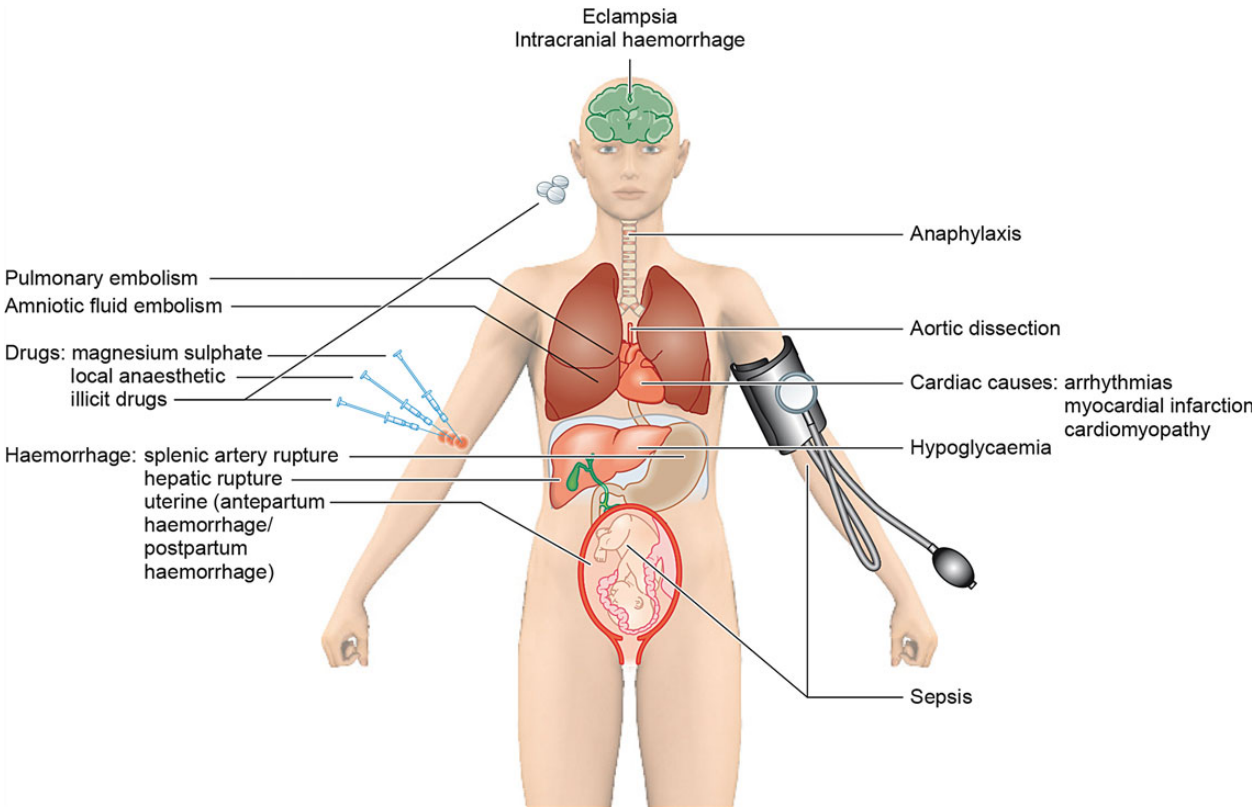

Fig 2 Common causes of collapse in pregnancy. Reproduced from Royal College of Obstetricians and Gynaecologists. Maternal collapse in pregnancy and the puerperium. *Green-top Guideline No. 56*. London: RCOG, 2011, with the permission of the Royal College of Obstetricians and Gynaecologists.

prevent a catastrophic decrease in arterial pressure upon vasodilatation. Women should be closely monitored, ideally on a maternity high dependency unit, to ensure an adequate response to treatment and that there are no adverse effects on the fetus.

Prevention and treatment of seizures

In the most recent confidential enquiry, five women died as a result of eclamptic seizures. All patients who suffer eclamptic seizures should be treated with magnesium sulphate. A loading dose of 4 g should be administered i.v. over 5 min. This should be followed by an infusion of 1 g h^{-1}, which should be continued for 24 h. Recurrent seizures should be treated with a further bolus dose of 2–4 g over 5 min. In contrast to seizures of other aetiology, diazepam, phenytoin, and other anticonvulsants, should not be used in eclampsia. Treatment should occur in a high-dependency or critical care setting. At high plasma levels (5–6.5 mmol $litre^{-1}$), magnesium can result in paralysis of respiratory muscles and respiratory arrest. Should this occur, the airway should be maintained, and 10 ml of 10% calcium chloride should be given i.v. Many maternity units have dedicated trolleys or 'eclampsia boxes', containing magnesium sulphate, antihypertensive drugs, emergency airway equipment, and calcium chloride, to facilitate the acute management of eclampsia.

Treatment with magnesium sulphate should also be considered in all obstetric patients with severe pre-eclampsia.[3] This includes:

- severe hypertension (DAP $\geq$110 mm Hg or SAP $\geq$160 mm Hg),
- mild or moderate hypertension associated with:
  - severe headache,
  - visual disturbances,
  - papilloedema,
  - liver tenderness,
  - clonus,
  - HELLP (Haemolysis, Elevated Liver enzymes, Low Platelets) syndrome,
  - platelets count decreasing to below 100×10^9 $litre^{-1}$,
  - abnormal liver enzymes.

High 'spinals'

The term 'high spinal' is used to describe a subarachnoid block that has extended above the higher thoracic dermatomes. However, inadvertently high block can also arise as a complication of epidural analgesia/anaesthesia. Despite the extensive use of central neuraxial block, on delivery suite, the occurrence of high or total central neuraxial block is uncommon. It may occur as a result of unrecognized, inadvertent intrathecal placement of an epidural catheter or due to unintentional upward spread after an intrathecal, or occasionally epidural, injection of local anaesthetic. Patients may be particularly susceptible to a high block if spinal anaesthesia follows failed epidural top-up. Although undoubtedly distressing, there have been no reported deaths secondary to high spinal in the last 20 yr. Delayed maternal resuscitation has, however, resulted in hypoxic–ischaemic encephalopathy of the baby.

Table 1 Clinical features of a high spinal

Cardiac	Respiratory	Neurological	Other
Hypotension	Low oxygen saturations	High sensory block	Nausea and vomiting
Bradycardia	Apnoea	Paralysis or weakness of upper limbs	
Cardiac arrest	Difficulty coughing or speaking	Loss of consciousness	
		Cranial nerve block	

Time to onset of a high spinal is variable, and the spectrum of clinical manifestations is wide (Table 1). They can include:

- Hypotension and bradycardia secondary to sympathetic block of vasoconstriction and cardiac accelerator fibres. This can be compounded by aorto-caval compression.
- Respiratory arrest after loss of motor supply to the intercostal muscles and the diaphragm.
- Loss of consciousness secondary to lack of blood flow and block of the reticular activating system.

In minor cases, the patient may only exhibit moderate hypotension, but at its most extreme, a high spinal can result in a hypoxia, hypotensive, unconscious parturient with marked fetal distress, or cardiac arrest.

After resuscitation, management of a high spinal is essentially supportive, until the block recedes to a sufficient level. High-flow oxygen should be administered. If the patient is apnoeic or shows signs of respiratory distress, intubation and ventilation are likely to be required. The loss of respiratory effort and paralysis do not necessarily correlate with the loss of consciousness, and reassurance should be provided while supporting ventilation and preparing for intubation. Care should be taken to ensure the parturient is not aware during intubation by, for example, administering an appropriate anaesthetic agent and anaesthesia should be maintained while the patient remains intubated. Cardiovascular support consists of administration of i.v. fluids, the use of vasopressors, or ephedrine and atropine. The patient should be positioned with a left lateral tilt, to avoid aorto-caval compression. Fetal monitoring must be continued throughout the resuscitation period, and Caesarean delivery may be necessary. Anaesthesia and ventilation should be continued until the block has receded to the extent that the patient is able to safely maintain their airway and breathe spontaneously.[4]

Haemorrhage

Haemorrhage is the most common cause of maternal collapse.[1] Major obstetric haemorrhage (MOH) has an incidence of ~3.7/1000 maternities. The main causes are post-partum haemorrhage (the four Ts—Table 2), antepartum haemorrhage from placental pathologies (placenta praevia, placenta accreta, placental abruption), uterine rupture, and ectopic pregnancy. Although the cause of haemorrhage

is usually obvious, occult bleeding may occur, especially after Caesarean section and ectopic pregnancy. Other rare causes of occult bleeding include hepatic rupture and splenic artery rupture. In general, obstetric patients are young and healthy, with a large physiological reserve. Significant blood loss can occur before patients show signs of decompensation.

All maternity hospitals have a 'MOH' protocol which should be activated immediately in the event of major blood loss. In addition to notifying appropriate members of the multidisciplinary team to assist with management of the MOH, a haematologist and the haematology laboratory are also notified to ensure that blood products are rapidly cross-matched. Finally, a dedicated porter should be available to collect blood products from the laboratory when they become available.

Initial management should include inserting two large-bore i.v. cannulae, administering high-flow oxygen, and obtaining blood samples for full blood count, coagulation profile, and group and screen. Rapid i.v. fluid resuscitation with crystalloid or colloid should be commenced. Patient warming using forced-air warming blankets, and a fluid warmer, should be initiated as soon as practicable. A member of the team should be appointed to liaise directly with the laboratory, who will be able to give an indication of time needed to supply either group specific or fully cross-matched blood. In the event of life-threatening haemorrhage, O negative blood will be available on the delivery suite. Point-of-care tests, such as HemoCue®, venous blood gas, and thromboelastography (TEG) (if available) can help to determine blood products required, while awaiting formal lab results. While resuscitation continues, attempts should be made to identify and treat the underlying cause of haemorrhage. This may require transfer to the operating theatre.

In the last decade, there has been a change in transfusion strategy, such that red cells and clotting products are given in a reduced ratio. This approach has been adopted from haemorrhage related to trauma, and lacks a firm evidence base in obstetrics. Coagulation factors should however be administered earlier rather than later during resuscitation. There is currently a great deal of research investigating the role of fibrinogen in obstetric haemorrhage. Recent evidence suggests that low fibrinogen may act as an indicator for severity of post-partum haemorrhage.[5] Results from the WOMAN (WOrlwide Maternal ANtifibrinolytic) Trial, investigating the effects of early tranexamic acid on mortality and morbidity from post-partum haemorrhage, are also keenly awaited.

Uterine atony is a common cause of post-partum haemorrhage. It can be treated pharmacologically or surgically. Pharmacological management includes administration of oxytocin, ergometrine, carboprost, or misoprostol (Table 3). Surgical treatments include a B-lynch (brace) suture, Rusch balloon insertion, surgical ligation of the external iliac arteries, or hysterectomy. Intervention radiology can also be used to identify and occlude a specific bleeding point. However, patients may be too unstable to allow transfer to the radiology department.

Table 2 The four Ts —causes of post-partum haemorrhage

Tone	Uterine atony
Tissues	Retained products
Trauma	Genital tract tears
Thrombin	Coagulation abnormalities

Sepsis

The UK maternal mortality rate from sepsis has almost tripled in the last 25 yr, and in the most recent Confidential Enquiry into Maternal Deaths in the UK, sepsis overtook haemorrhage and thromboembolic disease to become the leading direct cause of maternal death.[6] Normal physiological changes of pregnancy may mask the clinical signs of sepsis, and the young, generally well, obstetric population compensate well before collapsing.[7] Causes of sepsis can be divided into obstetric causes and other causes (Table 4).

Clinical features

The onset of sepsis may vary from being insidious and non-specific to being overwhelming and rapidly fatal. It is characterized by reduced systemic vascular resistance due to vasodilatation, tachycardia, and tachypnoea, and the development of a metabolic lactic acidosis. Although pyrexia is common, normo- or hypothermia does not preclude the diagnosis. A raised white cell count is commonly associated with sepsis; however, pregnancy also leads to an increase in white cell count, particularly during labour. A low or rapidly decreasing white cell count is a sinister feature.

Management

Management of the septic pregnant patient follows the same principles as that of any septic patient: resuscitation, identification and treatment of the source, management of complications such as

Table 3 Pharmacological management of uterine atony

Drug	Dose	Side-effects	Contraindications
Oxytocin	5 unit slow i.v. bolus, and infusion of 40 units in 500 ml over 4 h	Hypotension and reflex tachycardia; antidiuretic effect; prolongation of the QT interval	
Ergometrine	250–500 μg i.m. (or very slow i.v.)	Hypertension; nausea and vomiting; headache	Pre-eclampsia; hypertension; cardiac disease
Carboprost	250 μg i.m. every 15 min (max. 2 g)	Diarrhoea; vomiting; bronchospasm; flushing; hypertension	Asthma
Misoprostol	1000 μg p.r. or p.o.	Nausea and vomiting; diarrhoea	

Table 4 Causes of sepsis in obstetrics

Obstetric causes		Non-obstetric causes
Genital tract causes	Non-genital tract causes	
Wound infection, after vaginal tear, episiotomy, Caesarean section	Lower urinary tract infection	Malaria
Septic abortion	Pyelonephritis	Tuberculosis
Endometritis	Breast infection—mastitis or abscess	Pneumonia
Chorioamnionitis	Septic pelvic thrombophlebitis	Human immunodeficiency virus

hypotension, and application of organ protective strategies. The RCOG advocates the use of the following care bundle developed by the Surviving Sepsis Campaign for the treatment of sepsis in the obstetric patient. It should be carried out immediately where possible or within 6 h.

(i) Measure serum lactate levels.
(ii) Obtain blood/swab cultures before administration of antibiotics.
(iii) Administer broad-spectrum antibiotics.
(iv) In the event of hypotension and/or lactate >4 mmol litre^{-1}:
  (a) deliver an initial minimum of 20 ml kg^{-1} or crystalloid or colloid;
  (b) use a vasopressor (e.g. norepinephrine), an inotrope (e.g. dobutamine), or both to maintain mean arterial pressure >65 mm Hg once adequate volume replacement has been achieved.
(v) In the event of ongoing hypotension and/or lactate >4 mmol litre^{-1}:
  (a) achieve a central venous pressure of ≥ 8 mm Hg with further fluid resuscitation;
  (b) achieve a central venous oxygen saturation of $\geq 75\%$ or mixed venous oxygen saturation of $\geq 65\%$.

Early haemodynamic resuscitation and hence restoration of adequate oxygen supply to peripheral tissues is a key goal of therapy. Fluid balance can be difficult to manage in the obstetric patient. Care should be taken with i.v. fluid resuscitation, as fluid overload and pulmonary oedema may have contributed to several deaths in the most recent CMACE report.[6]

Initially, antibiotics should be administered i.v. and at high dosage. Urgent microbiological advice should be sought, and broad-spectrum antibiotics should be given as first-line therapy. The source of sepsis should be identified as a priority. Swinging pyrexia should arouse suspicion of an abscess or collection, and further imaging, and/or return to theatre for evacuation of products, wound exploration, or laparotomy may be necessary.

Category 1 Caesarean section

Definitions

The classification of the urgency of Caesarean section, recognized by both the Royal College of Anaesthetists and Royal College of Obstetricians and Gynaecologists, is based upon the presence or absence of maternal or fetal compromise. A Category 1 Caesarean section (the most urgent category) is defined as immediate threat to life of either the woman or the fetus.[8] A joint statement by the Royal Colleges recommends that delivery should be carried out with an 'urgency appropriate to the risk of the baby and the safety of the mother'. A decision to delivery interval of 30 min should be used only as an audit tool to allow testing of efficiency of the delivery suite team, and should not be used as a benchmark by which to judge individual cases. There are certain situations where delivery in <30 min will make a real difference to outcome for either the mother or the baby, for example, maternal cardiac arrest or absolute placental failure. These cases account for only a small proportion of Category 1 Caesarean sections. In the remainder of cases, there is partial, but frequently reversible, placental dysfunction, resulting in a pathological cardiac tocography (CTG). However, with fetal heart rate as the only monitoring tool, the two scenarios can be difficult to distinguish.

Minimizing the decision to delivery time; maximizing outcome

Good communication is critical in reducing decision to delivery time. Informing all team members in a timely manner is critical. All hospitals in the UK have a phone number dedicated to summoning help in emergencies. This can be utilized to activate a 'Category 1 Caesarean section' call, which is likely to be faster than calling each team member individually. While the team is mobilizing, simple active measures can be taken to resuscitate the fetus. These include positioning the mother in the recumbent left lateral position, administering maternal oxygen at a high inspired percentage, and rapid infusion of non-glucose-based crystalloids. In addition, oxytocin infusions should be stopped or contractions inhibited, for example, by administering terbutaline 250 μg subcutaneously. These measures alone may result in improvement of the CTG, and downgrading of the Caesarean section from Category 1 to Category 2 (no immediate threat to life of the woman or fetus).

Choice of anaesthetic technique

The anaesthetic technique for a Category 1 Caesarean section should be selected on a patient-by-patient basis, taking into consideration both the comorbidities of the patient and the urgency of the situation. General anaesthesia is considered to be faster than regional anaesthesia, but is associated with increased maternal morbidity and mortality. Because of time constraints, general anaesthesia is used disproportionately for Category 1 Caesarean delivery in UK obstetric units.[9] Kinsella and colleagues[10] have described an approach for

spinal anaesthesia for Category 1 Caesarean section—so-called 'rapid sequence spinal anaesthesia'. Principles of this approach include using a 'no-touch' technique and using sterile gloves only, utilizing other staff members to perform i.v. cannulation, limiting the number of attempts to one, and preparing the patient for general anaesthesia during attempted spinal insertion. The authors reported successful reduction in the decision to delivery interval with this approach; however, concerns exist around minimizing the aseptic technique.

In the obstetric population, failed intubation rates as high as 1 in 300 have been reported. As with all patients, oxygenation and ventilation are the main priorities after failed intubation. Even if these are established, serious consideration should still be given to waking the patient up rather than proceeding with surgery without a protected airway. The Obstetric Anaesthetists' Association and the Difficult Airway Society are currently preparing an algorithm for the management of the unanticipated difficult intubation in the obstetric patient and it is expected that this will be published in 2015.

Drug errors

The Third National Audit Project investigating serious complications of central neuraxial block was reassuring for obstetric anaesthetists with the majority of serious complications occurring in non-obstetric patients. However, one area where obstetrics featured more significantly was drug errors: of 11 cases reported to the audit, six were in obstetric patients. The most common error was the administration of local anaesthetic intended to be given by the epidural route, instead given i.v. Inadvertent administration of bupivacaine via the i.v. route has been associated with maternal death. A postal survey published in 2003 looking at drug errors in obstetrics found that 39% of units had had at least one drug error in the preceding 12 months, including giving the wrong drug (most commonly thiopental instead of antibiotics or vice versa cases), or using the wrong route. Working in the maternity unit may be an unfamiliar environment and simple strategies such as double-checking of drugs, the use of pre-filled labelled syringes, and limiting the range of drugs available should be used to reduce the morbidity or mortality from drug errors. National guidelines are available for the management of local anaesthetic toxicity and every anaesthetist working in the maternity unit must know where the Intralipid® is stored.

Training

There is a wealth of published evidence that regular, multidisciplinary training, using simulated scenarios ('skills and drills'), improves the outcome in many emergency situations, whether leading to a reduction in decision to delivery interval in a Category 1 Caesarean section situation or the earlier administration of antibiotics in a septic patient. All units should implement such training on a regular basis.

Declaration of interest

None declared.

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Please see multiple choice questions 29–32.