Strategies to manage major obstetric haemorrhage

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Purpose of review

Haemorrhage remains a cause of significant maternal morbidity and mortality. This review summarizes the prevention, management and treatment of obstetric haemorrhage and highlights recent advances and developments.

Recent findings

Postpartum haemorrhage is the most common cause of major obstetric haemorrhage and is usually due to uterine atony. Pharmacological treatment has not altered much in recent years with oxytocin and ergometrine remaining first-line options. Although controversy surrounds its advantages over other uterotonics, the use of misoprostol has been increasing, especially in resource-poor countries. Placenta accreta is becoming more common, a sequelae to the rising caesarean section rate. Interventional radiology may reduce blood loss in these cases. Uterine compression sutures, intrauterine tamponade balloons and cell salvage have all made their debut in the last decade.

Summary

Accurate diagnosis and appropriate management of obstetric haemorrhage can reduce maternal morbidity and mortality. This review outlines the current evidence.

Keywords

cell salvage, factor VIIa, interventional radiology, obstetric haemorrhage, placenta accreta, uterine compression sutures

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Introduction

Every minute of every day a woman dies from complications in pregnancy or childbirth [1]. The global maternal mortality ratio of 402 deaths per 100 000 live births [2] obscures the fact that 99% of these deaths occur in the developing world [3]. The maternal mortality ratio of sub-Saharan Africa is more than a hundred times that of the UK. Haemorrhage accounts for approximately 30% of cases [4] and is the leading cause of maternal death worldwide [5–7]. Although such fatalities are rare in the UK, the recent Confidential Enquiries into Maternal and Child Health (CEMACH) highlighted 17 deaths directly caused by haemorrhage [8••].

Haemorrhage also makes a substantial contribution to maternal morbidity. The Scottish Confidential Audit of Severe Maternal Morbidity reports that over 75% of 'near misses' were attributable to haemorrhage, a rate equivalent to five per 1000 deliveries [9]. It is of note, and concern, that this rate is increasing [10]. The Mothers Mortality and Severe Morbidity study concurred that haemorrhage was the most common cause of severe maternal morbidity [11]. Further, Zeeman's [12] study of obstetric critical care provision identifies haemorrhage as one of the most frequent reasons for admission to intensive care.

Definition

The definition of obstetric haemorrhage varies widely in the literature. Blood loss of more than 500 ml for vaginal delivery and more than 1000 ml for caesarean section are considered abnormal. Additional resources should be mobilized if blood loss exceeds 1500 ml. A practical definition of major obstetric haemorrhage includes

(1) an estimated blood loss of 2500 ml or more,
(2) transfusion of five or more units of blood or
(3) treatment for coagulopathy [9].

It should be borne in mind that maternal blood loss is notoriously difficult to estimate and is often underestimated.

Causes

Antepartum haemorrhage due to placental abruption or placenta praevia can be differentiated by the history and presentation. Ultrasound may aid diagnosis. Uterine atony, retained products and genital tract trauma all cause postpartum haemorrhage (PPH) and account for over half of all cases of major haemorrhage. It is estimated that up to 5% of all births are complicated by PPH greater than

1000 ml [13••]. Data gathered by the UK Obstetric Surveillance System (multidisciplinary group concerned with detailing the epidemiology of uncommon disorders of pregnancy, http://www.npeu.ox.ac.uk/UKOSS/) on peripartum hysterectomy reports that uterine atony was present in over half of the cases. Uterine rupture remains a cause of haemorrhage and regrettably maternal death [8••]. Rupture may present with precipitate labour, fetal bradycardia or abdominal pain with maternal shock. It may occur spontaneously or at the site of previous uterine trauma, for example, caesarean section/retained placenta.

There is an inexorably rising rate of caesarean section. This is not a risk-free procedure and can be associated with serious morbidity [14] specifically caused by abnormal placentation. CEMACH suggests that if a woman has had a previous caesarean section, then the placental site should be localized to exclude placenta praevia and further investigation carried out to exclude placenta accreta. Transvaginal ultrasound is the imaging modality of choice, with sensitivity of 87.5% and specificity of 98.8% [15]. If inconclusive, MRI may be useful. A previous caesarean section increases the risk of peripartum hysterectomy in the subsequent pregnancy six-fold (http://www.npeu.ox.ac.uk/UKOSS/).

Management

Active management of the third stage of labour can prevent or reduce PPH and should be offered to all patients [16]. This involves a combination of uterotonics, early cord clamping and controlled cord traction. Furthermore, it is vital to recognize physiological derangement promptly in order to initiate treatment. CEMACH consistently highlights failure to recognize the signs of life-threatening illness, 'too little, too late' being an oft repeated theme, and has recommended the urgent introduction of early warning scoring systems tailored to pregnancy.

The initial assessment of the patient with an obstetric haemorrhage depends on its cause, but in general

(1) take a detailed medical and obstetric history and examine the patient to find the site and cause of the bleeding;
(2) empty the patient's bladder;
(3) ensure that there are no retained products or genital tract lacerations (anaesthesia may be necessary);
(4) estimate blood loss; and
(5) assess the patient's haemodynamic status and initiate appropriate resuscitation.

Get help

(1) Alert front-line staff including experienced midwife, obstetricians, anaesthetists and porters.
(2) Notify obstetric and anaesthetic consultants.
(3) Notify haematology staff to release blood products: packed red cells, fresh frozen plasma and platelets.

Monitor

(1) Monitor ECG, blood pressure and oxygen saturation continuously.
(2) Monitor urine output hourly.
(3) Consider invasive monitoring if the patient is haemodynamically unstable or repeated venepunture is anticipated.

Point-of-care testing devices for haemoglobin estimation (Hemacue) and clotting (thromboelastography) can be useful guides, as are arterial blood gases.

Resuscitate

The aim of resuscitation is to restore circulating blood volume and maintain tissue perfusion:

(1) high-flow oxygen;
(2) head down tilt and left lateral tilt if not yet delivered;
(3) intravenous access (2×14 G cannula) and take blood for full blood count, clotting and cross-match;
(4) fluids: crystalloid, colloid (avoiding dextrans) and, if necessary, blood;
(5) O Rhesus negative should be immediately available – type-specific will take 10 min and a full cross-match 45 min;
(6) give clotting products empirically to avoid dilutional coagulopathy; and
(7) accept haemoglobin of 8 g/dl.

As hypothermia impairs coagulation, fluids should be warmed and the patient kept warm with active warming devices or warmed blankets. Correct acidosis and hypocalcaemia as appropriate.

Stop the bleeding

There are two approaches for controlling haemorrhage: the use of drugs and surgery.

Pharmacological

Oxytocin is the drug of choice for the prevention and treatment of atonic PPH [17]. Five to 10 units are given slowly by intravenous bolus usually followed by an infusion of 10 units per hour. The ensuing vasodilation may cause hypotension in cardiac or haemodynamically unstable patients.

Ergometrine (0.5 mg intravenously or intramuscularly) is as effective as oxytocin but has more side effects. It invariably causes nausea, vomiting and elevates blood

pressure, and so is contraindicated in hypertensive disorders.

Two prostaglandins are worthy of mention. Hemabate (250 μg intramuscularly or intramyometrially) is a potent smooth muscle constrictor and contracts the uterus well. It can, however, cause significant bronchospasm, which may be life threatening as reported by Harber *et al.* [18]. The use of misoprostol (PGE_2) appears to be increasing and has recently been the subject of many reviews. Unlike oxytocin and ergometrine, misoprostol can be administered orally, sublingually or rectally. It is also reportedly stable at high ambient temperatures, which is important in the tropics. In sub-Saharan Africa, 60% of women still give birth without a skilled attendant [6]. Derman *et al.* [19] illustrates the benefits of a uterotonic that can be self-administered or administered by a non-skilled attendant. A number of recent Cochrane reviews [13••,20] and the FIGO/ICM joint statement on the prevention and treatment of PPH [4] suggest that, although the evidence does not justify replacing oxytocin and ergometrine with misoprostol for the treatment of primary PPH, oral or sublingual prostaglandin may be useful in cases in which injectable uterotonics are not available or practical. The World Health Organization takes a different view, concluding that oral misoprostol is more expensive, has more side effects, and, crucially, is less effective than oxytocin. It proposes making oxytocin available in the form of disposable syringes and using the experience of the cold chain management system of the immunization programme [21•].

Surgical

There is little in the literature to guide practice when pharmacological treatment fails. The review by Doumouchtsis *et al.* [22••] of the conservative management of PPH found no statistical difference between the various methods (Table 1), and the Cochrane Collaboration [13••] failed to identify any relevant randomized control trials. The UK Obstetric Surveillance System is currently gathering data on therapies and prophylaxis for the treatment of peripartum haemorrhage to quantify use, assess outcome and develop future guidelines.

Table 1 Success rates of surgical and radiological measures in the management of postpartum haemorrhage, no statistical significance between the four groups ($P = 0.06$)

Method	Success rate (%)	95% Confidence interval
B-Lynch/compression sutures	91.7	84.9–95.5
Arterial embolization	90.7	85.7–94.0
Arterial ligation/pelvic devascularization	84.6	81.2–87.5
Uterine balloon tamponade	84.0	77.5–88.8

Reproduced with permission from [22••].

Bimanual compression: This obstetric manoeuvre compresses the uterus between one hand in the vagina and another on the anterior abdominal wall, thus reducing the bleeding.

Uterine balloon tamponade: In the case of intractable PPH, Doumouchtsis *et al.* [22••] proposes balloon tamponade as the most straightforward, rapid and least invasive surgical option. A balloon, such as a Rusch urological balloon (Fig. 1), is inserted through the cervix into the uterine cavity and inflated to create a tamponade. The balloon is gradually deflated as the bleeding subsides. Both insertion and removal of the balloon is relatively painless and does not require anaesthesia.

Uterine compression sutures: These are useful for patients with uterine atony who respond to bimanual compression. B-Lynch *et al.* [23] first described the compression suture in 1997 (Fig. 2) and others have since developed the technique using vertical [24], transverse [25] or multiple square sutures [26] to appose the anterior and posterior walls of the uterus. Successful subsequent pregnancies have been reported, although evidence of fundal grooves from the sutures has been noted [27•]. Uterine necrosis, intrauterine fibrous bands, abdominal adhesions and pyometria are other noted complications [28].

The following alternative techniques are challenging and involve a level of surgical skill that may not be immediately available in the delivery suite. CEMACH [8••] recommends that assistance should be sought from colleagues who have greater experience of gynaecological surgery if appropriate.

Figure 1 Rusch balloon

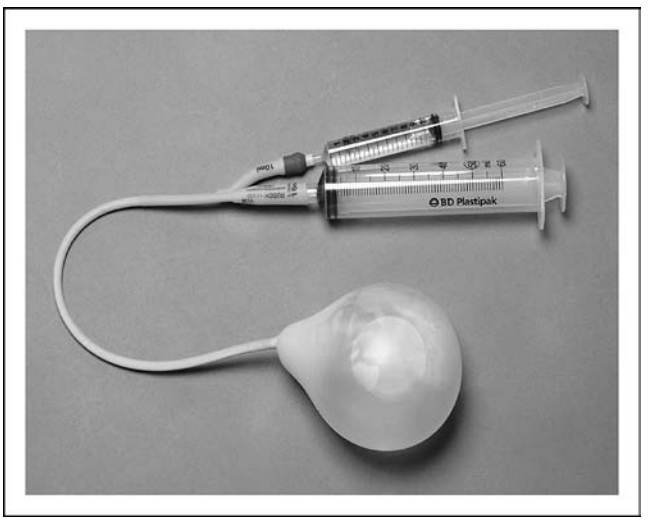
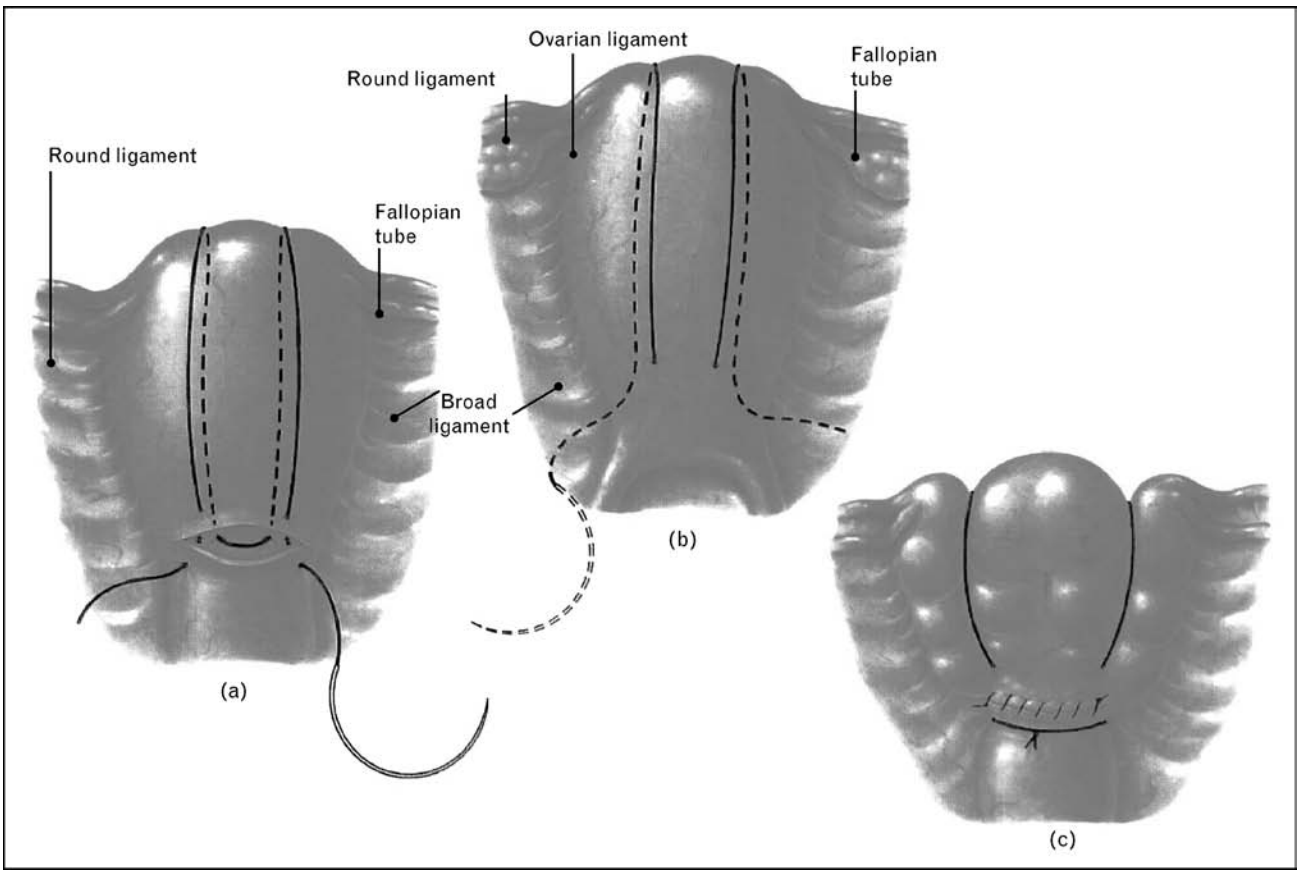


Figure 2 B-Lynch suture



(a) Anterior view. (b) Posterior view. (c) Anterior view. Reproduced with permission from [23].

Arterial ligation: A technically demanding procedure, given the many important structures nearby, for example ureter, iliac vein. Although ligation of the internal iliac arteries can reduce pelvic blood flow and pulse pressure, it may be ineffective if there are extensive collaterals. Joshi *et al.* [29••] presents a series on internal iliac arterial ligation and concludes that, in the right hands, it can be useful in cases of uterine atony. It may also facilitate hysterectomy in cases of uterine trauma. Temporary clamping of the abdominal aorta may allow for restoration of the circulation and stabilization of the clinical situation.

Peripartum hysterectomy: The incidence of peripartum hysterectomy in the UK is four per 10 000 deliveries (http://www.npeu.ox.ac.uk/UKOSS/). The decision, however difficult, should be made sooner rather than later and prior to the development of coagulopathy.

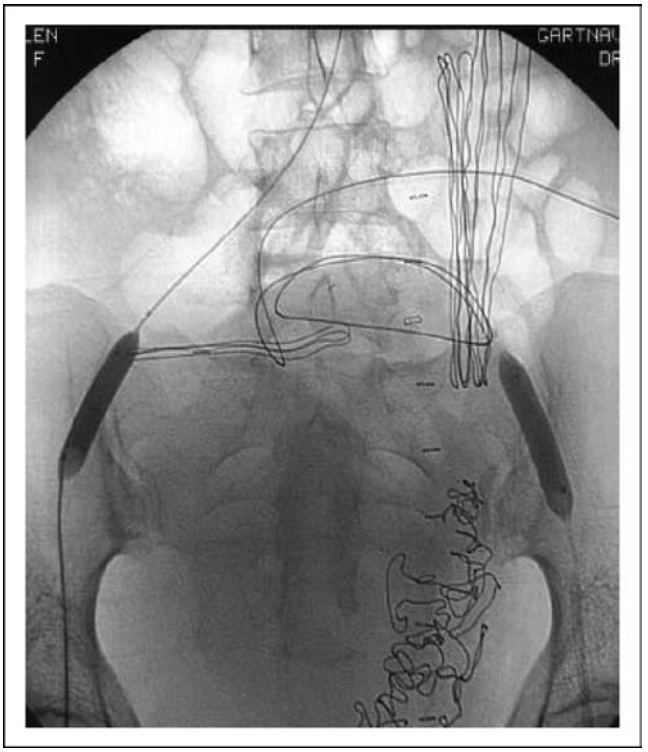
Adjuncts

There are some new techniques that are currently controversial and not universally accepted. These include the use of interventional radiology and methotrexate in placenta accreta, cell salvage as a means of reducing donor blood transfusion, tranexamic acid and factor VIIa to aid coagulation.

Interventional radiology: If a placenta accreta is suspected, delivery should be by elective caesarean section on a site with interventional radiology as well as cell salvage and a blood bank. Interventional radiology involves internal iliac arterial balloon occlusion and/or selective arterial embolization of the uterine arteries. The Royal College of Obstetricians and Gynaecologists recommend its use both in elective placenta praevia/accreta cases [15] and in emergency situations [30••] where there is localized bleeding and conventional means have failed. The Healthcare Commission (http://www.healthcarecommission.org.uk/_db/_documents/Northwick_tagged.pdf) also recognizes its 'potential to save the lives of patients who have catastrophic postnatal bleeding'. Success rates are around 90% [31].

In elective cases, femoral artery sheaths are inserted and the internal iliac artery balloons positioned appropriately and inflated if necessary following delivery (Fig. 3). In

Figure 3 Internal iliac artery balloons



emergencies, arterial balloon occlusion is often a temporary measure to abate bleeding and allow transfer to the interventional radiology department for definitive embolization. Nevertheless, this can be a challenge in an unstable, actively bleeding patient and a C-arm image intensifier of suitable quality should be available within the delivery suite.

At the end of interventional radiology cases, the femoral sheaths should be left *in situ* for a few hours as a precaution so that if bleeding recurs, embolization can be easily facilitated. To minimize the complications (thrombus, ischaemia and necrosis) [22••], embolization should be performed as selectively as possible. The occlusion of the distal uterine artery bed is, however, temporary and it will recanalize. Successful pregnancies have been reported after internal iliac embolization. Postembolization pyrexia is a relatively common occurrence for which antibiotics are often prescribed [31].

Methotrexate: Attempts to manually remove an adherent placenta can result in catastrophic haemorrhage. To minimize this, conservative management has been advocated. In a review of the literature, Timmermans *et al.* [32••] argue that leaving an adherent placenta *in situ* may be appropriate in patients who have minimal blood loss, are haemodynamically stable and desire future fertility. Such an approach has been used in conjunction with surgery for placenta percreta involving the bladder [33]. Although occasionally used, the benefit of adjuvant methotrexate is uncertain.

Cell salvage: Allogeneic blood is cold, acidic, has high levels of potassium and low levels of 2,3-diphosphoglycerate (DPG) resulting in poor oxygen transport. Donor blood carries risks of infection and allergic sequelae in the form of incompatibility, acute lung injury and immunosuppression. There is also a national shortage of donor blood and increasing production cost.

Salvaged blood is as good as or better than banked blood in terms of red cell survival, morphology, potassium and 2,3-DPG levels. Although well established in other specialties, its introduction into obstetrics has been resisted because of concerns about rhesus immunization and amniotic fluid embolism [34]. Nevertheless, there are now well over 400 cases of the use of salvaged blood in obstetrics without incident. The National Blood Service has called it the 'most valuable form of autologous transfusion' [35••] and it has also been endorsed by CEMACH [36], NICE [37] and the OAA/AAGBI [38]. Cell salvage is acceptable to most Jehovah's Witnesses.

Amniotic fluid embolism is now thought to be an immunological phenomenon rather than an embolic event and has not been reported in the context of cell salvage. Although it is prudent to avoid unnecessary contamination, unpublished data suggest that even when exposed to amniotic fluid, the Pall leukocyte filter reduces the foetal squame load to zero (J. Faulds, in press).

Rhesus immunization is a real concern as the cell saver cannot distinguish between fetal and maternal red cells. Therefore, any aspirated fetal cells will be retransfused into the maternal circulation. Prompt Kleihauer testing and anti-D treatment, however, make it entirely preventable.

Tranexamic acid: An antifibrinolytic agent, tranexamic acid may be useful in emergencies. A dose of 1 g is given intravenously and can be repeated every 4 h.

Recombinant factor VIIa: This is licensed for the treatment and prophylaxis of haemorrhage in patients with haematological disorders. Although not licensed for use in obstetrics, there are numerous reports of its successful use as summarized by Franchini [39•] and Haynes *et al.* [40•]. They note that practice is far from uniform with regard to dosage and timing. Substantial quantities of coagulation products will still be necessary. Guidance is available from Ahonen *et al.* [41••] who, to date, have published the largest case series of factor VIIa use in obstetrics. Case reports of nonresponders and thromboembolic complications have

also recently been published [42••]. Jehovah's Witnesses will accept its administration.

Anaesthesia

In elective placenta praevia cases, the Royal College of Obstetricians and Gynaecologists states that the choice of anaesthetic is at the discretion of the anaesthetist, but there is increasing evidence to support the safety of regional anaesthesia. If regional anaesthesia is used, consideration should be given to a combined spinal/epidural technique to allow time for surgery. As general anaesthesia may be necessary, the patient should be fully prepared for conversion. For placenta accreta cases, although some centres advocate the use of regional anaesthesia, general anaesthesia may allow for more control.

In emergencies, haemodynamic instability and concerns over coagulopathy make general anaesthesia the technique of choice. Nevertheless, if a working epidural is in place then cautious top-ups may be appropriate. Senior anaesthetists should be informed and involved in all cases.

A high-dependency setting is appropriate for at least half of those with a major obstetric haemorrhage. The majority who do require intensive care do so only for mechanical ventilation and usually for less than 48 h. Traditional intensive care scoring systems such as Acute Physiology, Age, Chronic Health Evaluation (APACHE) and Simplified Acute Physiology Score (SAPS) tend to overestimate maternal mortality [11].

An alternative to blood transfusion in the recovery period is intravenous iron. Ferrous sucrose has an excellent safety profile [43].

Protocols and drills

The use of protocols and regular drills to test their effectiveness are encouraged by the Obstetric Anaesthetists' Association/The Association of Anaesthetists of Great Britain and Ireland [39•] and the Royal College of Anaesthetists [44]. Managing Obstetric Emergency and Trauma (www.alsg.org/) courses and simulation training may also raise awareness.

Summary

Major obstetric haemorrhage is an extremely challenging obstetric emergency associated with significant morbidity and mortality especially in the developing world. Pharmacological treatment of uterine atony has not altered much in recent years apart from the increasing use of misoprostol, although controversy surrounds its advantages over other uterotonics. Placenta accreta is becoming more common, a sequela to the rising caesarean section rate. Interventional radiology may reduce blood loss in these cases. Uterine compression sutures, intrauterine tamponade balloons and cell salvage have been introduced in the last decade.

References and recommended reading

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Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 413).

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