Prevention and Management of Postpartum Haemorrhage

This is the second edition of this guideline, which was published in 2009 under the same title. The 2009 guideline was based on an earlier guideline on the management of postpartum haemorrhage (PPH) developed in 1998 under the auspices of the Scottish Committee of the Royal College of Obstetricians and Gynaecologists (RCOG) and updated in 2002.1

1. Purpose and scope

Primary PPH is the most common form of major obstetric haemorrhage. The traditional definition of primary PPH is the loss of 500 ml or more of blood from the genital tract within 24 hours of the birth of a baby.2 PPH can be minor (500–1000 ml) or major (more than 1000 ml). Major can be further subdivided into moderate (1000–2000 ml) and severe (more than 2000 ml). In women less that 50 kg, a lower level of blood loss may be deemed significant. The recommendations in this guideline apply to women experiencing a primary PPH of 500 ml or more.

Secondary PPH is defined as abnormal or excessive bleeding from the birth canal between 24 hours and 12 weeks postnatally.3 This guideline also includes recommendations specific to the management of secondary PPH.

Women with pre-existing bleeding disorders and women taking therapeutic anticoagulants are at increased risk of PPH; this guideline does not include specific recommendations for the management of such situations or for managing haemorrhage in women who refuse blood transfusion. Guidance on these topics is available from other sources.4,7

This guideline has been developed primarily for clinicians working in consultant-led obstetric units in the UK; recommendations may be less appropriate for other settings where facilities, resources and routine practice differ. There is increasing emphasis on the availability of births at home or in midwife-led units.8 Obstetricians and midwives should develop guidelines for the management of obstetric emergencies that may occur in the community, including postpartum haemorrhage. This is beyond the scope of this guideline.9

This guideline is restricted in scope to the management of PPH; the management of antepartum haemorrhage is the subject of another RCOG Green-top Guideline.10 The prevention and management of PPH related to placenta praevia and placenta praevia accreta is addressed in Green-top Guideline No. 27,11 while Green-top Guideline No. 47 provides guidance on the appropriate use of blood and blood products in obstetric practice.12

2. Introduction and background epidemiology

Obstetric haemorrhage remains one of the major causes of maternal death in both developed and developing countries. The 2009–2012 Confidential Enquiries into Maternal Deaths and Morbidity report13 identified 17 direct deaths due to obstetric haemorrhage in the UK and Ireland; the report places obstetric haemorrhage as the third leading cause of direct maternal deaths. The recommendations from the report focus on basic clinical skills, with prompt recognition of the severity of a haemorrhage and emphasise communication and teamwork in the management of these cases.
A systematic review suggests that there may be regional variation in the prevalence of PPH. Standardisation of the measurement of PPH is recommended so that data from different regions are comparable.

3. Identification and assessment of evidence

This guideline was developed in accordance with standard methodology for producing RCOG Green-top Guidelines. The Cochrane Library (including the Cochrane Database of Systematic Reviews and the Database of Abstracts of Reviews of Effects [DARE]), EMBASE, Trip, MEDLINE and PubMed (electronic databases) were searched for relevant randomised controlled trials, systematic reviews and meta-analyses. The search was restricted to articles published between 2007 and February 2013. [A top-up literature search will be carried out prior to publication.] The databases were searched using the relevant Medical Subject Headings (MeSH) terms, including all subheadings, and this was combined with a keyword search. Search words included ‘postpartum haemorrhage’, ‘factor VII’, ‘Syntocinon’, ‘carbetocin’, ‘carboprost’, ‘oxytocics’, ‘uterotonicics’, ‘B-Lynch suture’, ‘uterine artery embolism’, ‘bilateral internal iliac ligation’, ‘balloon, Rusch’, ‘Sengstaken catheters’, ‘thromboelastography’, ‘thromboelastometry’, ‘fibrinogen concentrate’, ‘point of care testing’ and the search limited to humans and the English language. The National Library for Health and the National Guideline Clearinghouse were also searched for relevant guidelines and reviews. Guidelines and recommendations produced by organisations such as the British Committee for Standards in Haematology Transfusion Taskforce and national bodies were considered. Where possible, recommendations are based on available evidence and the areas where evidence is lacking are annotated as ‘good practice points’.

4. Prediction and prevention of postpartum haemorrhage

4.1 What are the risk factors for developing PPH and how can they be minimised?

4.1.1 Risk factors

Risk factors for PPH may present antenatally or intrapartum; care plans must be modified as and when risk factors arise. [GPP]

Clinicians must be aware of risk factors for PPH and should take these into account when counselling women about place of delivery. [GPP]

Women with known risk factors for PPH should be encouraged to deliver in a hospital with transfusion facilities. [D]

A number of case–control studies have identified antenatal and intrapartum risk factors for PPH (Appendix I), although most cases of PPH have no identifiable risk factors. These risk factors have been summarised in a 2010 review. Despite methodological limitations, these studies provide a guide to levels of risk, which can help clinicians in their discussions with women about setting for delivery (Table 1). The Confidential Enquiry into Maternal Health has recommended that women with known risk factors for PPH should not be delivered in a hospital without a blood bank on site. Evidence level 4

The Society of Obstetricians and Gynaecologists of Canada has published a guideline on the prevention and management of postpartum haemorrhage. This summarises the causes for PPH as related to abnormalities of one or more of four basic processes – ‘the four T’s’: tone, trauma, tissue and thrombin. The most common cause of PPH is uterine atony. Evidence level 4
Table 1. Risk factors for PPH

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Four Ts</th>
<th>Odds ratio (95% CI)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple pregnancy</td>
<td>Tone</td>
<td>3.3 (1.0–10.6)</td>
<td>Combs et al., 1991a, Sosa et al., 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.7 (2.4–9.1)</td>
<td></td>
</tr>
<tr>
<td>Previous PPH</td>
<td>Tone</td>
<td>3.6 (1.2–10.2)</td>
<td>Combs et al., 1991a</td>
</tr>
<tr>
<td>Pre-eclampsia</td>
<td>Thrombin</td>
<td>5.0 (3.0–8.5)</td>
<td>Combs et al., 1991a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.2 (1.3–3.7)</td>
<td>Combs et al., 1991b</td>
</tr>
<tr>
<td>Fetal macrosomia</td>
<td>Tone</td>
<td>2.11 (1.62–2.76)</td>
<td>Bais et al., 2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.4 (1.9–2.9)</td>
<td>Sosa et al., 2009</td>
</tr>
<tr>
<td>Failure to progress in second stage</td>
<td>Tone</td>
<td>3.4 (2.4–4.7)</td>
<td>Sheiner et al., 2005, Combs et al., 1991b</td>
</tr>
<tr>
<td>Prolonged third stage of labour</td>
<td>Tone</td>
<td>7.6 (4.2–13.5)</td>
<td>Combs et al., 1991a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.61 (1.83–3.72)</td>
<td>Bais et al., 2004</td>
</tr>
<tr>
<td>Retained placenta</td>
<td>Tissue</td>
<td>7.83 (3.78–16.22)</td>
<td>Bais et al., 2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.5 (2.1–5.8)</td>
<td>Sheiner et al., 2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.0 (3.5–10.4)</td>
<td>Sosa et al., 2009</td>
</tr>
<tr>
<td>Placenta accreta</td>
<td>Tissue</td>
<td>3.3 (1.7–6.4)</td>
<td>Sheiner et al., 2005</td>
</tr>
<tr>
<td>Episiotomy</td>
<td>Trauma</td>
<td>4.7 (2.6–8.4)</td>
<td>Combs et al., 1991a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.18 (1.68–2.76)</td>
<td>Bais et al., 2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.7 (1.2–2.5)</td>
<td>Sosa et al., 2009</td>
</tr>
<tr>
<td>Perineal laceration</td>
<td>Trauma</td>
<td>1.40 (1.04–1.87)</td>
<td>Bais et al., 2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.4 (2.0–2.8)</td>
<td>Sheiner et al., 2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.7 (1.1–2.5)</td>
<td>Sosa et al., 2009</td>
</tr>
<tr>
<td>General anaesthesia</td>
<td>Tone</td>
<td>2.9 (1.9–4.5)</td>
<td>Combs et al., 1991b</td>
</tr>
</tbody>
</table>

4.1.2 Minimising risk – treating antenatal anaemia

Antenatal anaemia should be investigated and treated appropriately as this may reduce the morbidity associated with PPH. [D]

Guidelines from the National Institute for Health and Care Excellence (NICE) recommend that pregnant women should be offered screening for anaemia. The British Committee for Standards in Haematology has produced guidelines on the investigation and management of anaemia in pregnancy. Haemoglobin (Hb) levels outside the normal UK range for pregnancy (110 g/l at first contact and 105 g/l at 28 weeks) should be investigated and iron supplementation considered if indicated. It is recommended that parenteral iron therapy should be considered antenatally for women with iron deficiency anaemia who do not respond to oral iron. Evidence level 4

4.1.3 Minimising risk – reducing blood loss at delivery
Prophylactic uterotonics should be routinely offered in the management of the third stage of labour in all women as they reduce the risk of PPH. [A]

For women without risk factors for PPH delivering vaginally, oxytocin (10 iu by intramuscular injection) is the agent of choice for prophylaxis in the third stage of labour. A higher dose of oxytocin is not beneficial. [A]

For women delivering by caesarean section, oxytocin (5 iu by slow intravenous injection) should be used to encourage contraction of the uterus and to decrease blood loss. [B]

Ergometrine–oxytocin may be used in the absence of hypertension in women at increased risk of haemorrhage as it reduces the risk of minor PPH (500–1000 ml). [C]

Clinicians should consider the use of intravenous tranexamic acid (0.5–1.0 g) in addition to oxytocin, at caesarean section to reduce blood loss in women at increased risk of PPH. [A]

Uterine massage

A Cochrane review analysed the effectiveness of uterine massage after birth and before or after delivery of the placenta, or both, to prevent PPH. Two randomised controlled trials were included and the review found no significant difference between groups. [ Evidence level 1+]

Management of the third stage of labour

Various Cochrane reviews have addressed prophylaxis in the third stage of labour for women delivering vaginally. [ Evidence level 1++]

McDonald and colleagues’ meta-analysis addressed prophylactic ergometrine–oxytocin versus oxytocin for the third stage of labour. [ Evidence level 1+]
(Syntometrine®, Alliance, Chippenham, Wiltshire, UK), oxytocin 5 iu and oxytocin 10 iu have similar
efficacy in preventing PPH in excess of 1000 ml. Using the definition of PPH of blood loss of at least
500 ml, ergometrine–oxytocin was associated with a small reduction in the risk of PPH
(Syntometrine® versus oxytocin any dose, OR 0.82, 95% CI 0.71–0.95). There were major differences
between ergometrine–oxytocin and oxytocin alone in the adverse effects of nausea and vomiting
and elevation of blood pressure, with ergometrine–oxytocin carrying a five-fold increased risk (OR
4.92, 95% CI 4.03–6.00). Thus, the advantage of a reduction in the risk of minor PPH needs to be
weighed against the adverse effects associated with the use of ergometrine–oxytocin. Evidence level
1++

A more recent randomised controlled trial assessed whether or not a higher dose of oxytocin after
vaginal delivery was more effective than a low-dose regimen in preventing PPH after a vaginal
delivery.\textsuperscript{41} Compared with 10 iu, administering 40 iu or 80 iu of prophylactic oxytocin did not reduce
overall PPH treatment when given in 500 ml over 1 hour for vaginal delivery. Evidence level 1+

\textbf{Prostaglandins}

The use of prostaglandins for the prevention of PPH has been a subject of two Cochrane reviews.\textsuperscript{36,37}
Neither intramuscular prostaglandins (such as carboprost, a 15-methyl prostaglandin F\textsubscript{2α} analogue)
or misoprostol (a prostaglandin E\textsubscript{1} analogue given orally or sublingual) were preferable to
conventional injectable uterotonics (oxytocin and/or ergometrine) for routine prophylaxis.\textsuperscript{36}
Furthermore, another systematic review concluded that oxytocin is superior to misoprostol in the
prevention of PPH.\textsuperscript{42} Evidence level 1++

Appraisal of the evidence from both the Cochrane reviews, together with consideration of standard
practice in the UK, suggests that, for women delivering vaginally, oxytocin 10 iu by intramuscular
injection is the regimen of choice for prophylaxis in the third stage of labour. This strategy has been
endorsed in the NICE intrapartum care guideline.\textsuperscript{8} Evidence level 1+

\textbf{Carbetocin}

A Cochrane review has addressed the use of a longer-acting oxytocin derivative, carbetocin, in the
prevention of PPH.\textsuperscript{43} Carbetocin is licensed in the UK specifically for the indication of prevention of
PPH in the context of caesarean delivery. Use of carbetocin resulted in a statistically significant
reduction in the need for further uterotonics compared with oxytocin for those undergoing a
caesarean but not for vaginal delivery. However, there were no statistically significant differences
between carbetocin and oxytocin in terms of risk of any PPH (blood loss greater than 500 ml) or in
risk of major PPH (blood loss greater than 1000 ml). Evidence level 1++

Guidelines from the Society of Obstetricians and Gynaecologists of Canada recommend that
carbetocin (100 micrograms given as an intravenous bolus over 1 minute) should be used for the
prevention of PPH in elective caesarean deliveries.\textsuperscript{30} Randomised trials have compared different
uterotonics (oxytocin, ergometrine–oxytocin, misoprostol, carbetocin and 15-methyl prostaglandin
F\textsubscript{2α}) for prophylaxis in women delivering by caesarean section.\textsuperscript{44–49} Appraisal of the evidence from
these trials, together with consideration of standard practice in the UK, led the development group
for the NICE caesarean section guideline\textsuperscript{50} to recommend oxytocin 5 iu by slow intravenous injection
for prophylaxis in the context of caesarean delivery. Evidence level 1+

\textbf{Tranexamic acid}
The use of tranexamic acid in the prevention of PPH has been addressed in a Cochrane review. This found that blood loss greater than 400 ml was less common in women who received tranexamic acid after vaginal birth or caesarean section in the dosage of 1 g or 0.5 g intravenously (RR 0.51, 95% CI 0.36–0.72; two studies, 453 women). Mean blood loss was lower in the group of women who received intravenous tranexamic acid postpartum (mean difference −75.17 ml, 95% CI −108.23 to −42.12 ml; two studies, 361 women). A more recent randomised placebo-controlled trial investigating intravenous tranexamic acid in reducing blood loss at caesarean section concluded that tranexamic acid significantly reduced blood loss associated with surgery, the percentage of women with blood loss greater than 1000 ml and the need for additional uterotonic agents. Evidence level 1++

5. How should PPH be managed?

5.1 Identification of the severity of haemorrhage

Clinicians should be aware that the visual estimation of peripartum blood loss is inaccurate and that clinical signs and symptoms should be included in the assessment of PPH. [C]

As visual estimation often underestimates blood loss, more accurate methods may be used, such as blood collection drapes for vaginal deliveries and the weighing of swabs. However, a study comparing visual estimation of blood loss with the use of a collector bag after vaginal delivery concluded that the latter did not significantly reduce the risk of severe PPH. Participating in clinical reconstructions may encourage early diagnosis and prompt treatment of PPH. Written and pictorial guidelines may help staff working in labour wards to estimate blood loss. Evidence level 2+

Clinical signs and symptoms of hypovolaemia should be included in the assessment of PPH. However, clinicians should be aware that the physiological increase in circulating blood volume during pregnancy means that the signs of hypovolaemic shock become less sensitive in pregnancy. In pregnancy, pulse and blood pressure are usually maintained in the normal range until blood loss exceeds 1000 ml; tachycardia, tachypnoea and a slight recordable fall in systolic blood pressure occur with blood loss of 1000–1500 ml. A systolic blood pressure below 80 mmHg, associated with worsening tachycardia, tachypnoea and altered mental state, usually indicates a PPH in excess of 1500 ml. Evidence level 4

The 2009–2012 Confidential Enquiries into Maternal Deaths and Morbidity report highlighted the importance of correlating clinical signs and symptoms expected from different blood loss values to help target decisions on resuscitation and also emphasised the importance of taking the woman’s stature into account. It is of note that the severity of haemorrhage was not recognised in 11 of the 17 (61%) women who died. Evidence level 4

5.2 Communication and multidisciplinary care

5.2.1 Communication with the woman

Communication with the patient and her birthing partner is important and clear information of what is happening should be given from the outset. [GPP]

PPH often occurs unexpectedly and can be very stressful for the woman and her partner or birth attendants; it is crucial that, where feasible, they are kept informed and reassured if appropriate of the clinical development and proposed management.

5.2.2 Who should be informed when the woman presents with PPH?
Relevant staff with an appropriate level of expertise should be alerted of PPH. [GPP]

The midwife in charge and the first-line obstetric and anaesthetic staff should be alerted when women present with minor PPH (blood loss 500–1000 ml) without clinical shock. [GPP]

A multidisciplinary team involving senior members of staff should be summoned to attend to women with major PPH (blood loss of more than 1000 ml) and ongoing bleeding or clinical shock. [GPP]

Early involvement of appropriate senior staff (including the anaesthetic team and laboratory specialists) is fundamental to the management of PPH. In minor PPH, the first-line staff should be alerted and in major PPH, the following members of staff should be called and summoned to attend:

- an experienced midwife (in addition to the midwife in charge)
- the obstetric middle grade
- the anaesthetic middle grade
- the on-call clinical haematologist with experience in major haemorrhage
- porters for delivery of specimens/blood.

Furthermore, the consultant obstetrician and consultant anaesthetist should be alerted and the blood transfusion laboratory should be informed. One member of the team should be assigned the task of recording events, fluids, drugs, blood and components transfused and vital signs.

Clinicians and blood transfusion staff should liaise at a local level to agree:
- a standard form of words (such as ‘we need compatible blood now’ or ‘group-specific blood’) to be used in cases of major obstetric haemorrhage
- a timescale in which to deliver various blood components.

The use of the term ‘controlled major obstetric haemorrhage’ or ‘ongoing major obstetric haemorrhage’ may be used to define the urgency for the need of the team.

Senior staff must be receptive to concerns expressed by juniors and by midwives. The RCOG recommends that the consultant obstetrician should attend in person when there is a PPH of more than 1500 ml where the haemorrhage is continuing.65 Evidence level 4

5.3 Resuscitation

5.3.1 Measures for minor PPH

Measures for minor PPH (blood loss 500–1000 ml) without clinical shock:

- intravenous access (14-gauge cannula x 1)
- urgent venepuncture (20 ml) for:
  - group and screen
  - full blood count
  - coagulation screen including fibrinogen
- pulse, respiratory rate and blood pressure recording every 15 minutes
- commence warmed crystalloid infusion

5.3.2 Measures for major PPH
Full protocol for major PPH (blood loss greater than 1000 ml) and continuing to bleed or clinical shock:

- **A and B** – assess airway and breathing
  
  A high concentration of oxygen (10–15 litres/minute) via a facemask should be administered, regardless of maternal oxygen concentration. If the airway is compromised owing to impaired conscious level, anaesthetic assistance should be sought urgently. Usually level of consciousness and airway control improve rapidly once the circulating volume is restored.

- **C** – evaluate circulation
  
  Establish two 14-gauge intravenous lines; a 20 ml blood sample should be taken and sent for diagnostic tests, including full blood count, coagulation screen, urea and electrolytes and cross-match (4 units). The urgency and measures undertaken to resuscitate and arrest haemorrhage need to be tailored to the degree of shock.

  - Position the patient flat
  - Keep the woman warm using appropriate available measures
  - Transfuse blood as soon as possible
  - Until blood is available, infuse up to 3.5 litres of warmed clear fluids (up to 2 litres of warmed Hartmann’s solution and/or 1.5 litres of colloid) as rapidly as required
  - The best equipment available should be used to achieve rapid warmed infusion of fluids
  - Special blood filters should not be used, as they slow infusions

**Table 2.** Fluid therapy and blood product transfusion (please refer to sections 5.3.3, 5.3.4 and 5.3.5)

<table>
<thead>
<tr>
<th>Fluid therapy</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crystalloid</strong></td>
<td>Up to 2 litres Hartmann’s solution</td>
</tr>
<tr>
<td><strong>Colloid</strong></td>
<td>Up to 1.5 litres colloid until blood arrives</td>
</tr>
<tr>
<td><strong>Blood</strong></td>
<td>Cross-matched</td>
</tr>
<tr>
<td></td>
<td>If immediate transfusion needed, give emergency group O Rh (RhD)-negative K (Kell)-negative red cell units</td>
</tr>
<tr>
<td></td>
<td>Switch to group specific red cells as soon as feasible</td>
</tr>
</tbody>
</table>

**Fresh frozen plasma (FFP)**

Administration of FFP should be guided by haemostatic testing and whether haemorrhage is continuing:

- If prothrombin time (PT) or activated prothrombin time (APTT) ratios are prolonged, administer 12–15 ml/kg of FFP
- If haemorrhage continues after 4 units of red blood cells (RBC) and haemostatic tests are unavailable, administer 4 units of FFP

**Platelets concentrates**

If platelet count < 75 x 10⁹/l

**Cryoprecipitate**

If fibrinogen < 2 g/l

The cornerstones of resuscitation during PPH are restoration of both blood volume and oxygen-carrying capacity. Volume replacement must be undertaken on the basis that blood loss is often underestimated.⁵⁹,⁶² Compatible blood (supplied in the form of red cell concentrate) to replace red cell loss should be transfused as soon as available, if necessary. The clinical picture should be the main determinant of the need for blood transfusion and time should not be unnecessarily spent awaiting laboratory results.⁶¹,⁶⁴ Obstetricians should draw on the expertise of their colleagues in anaesthesia, haematology and transfusion medicine in determining the most appropriate combination of intravenous clear fluids, blood and blood products for continuing resuscitation.
Guidance from the British Committee for Standards in Haematology summarises the main therapeutic goals of the management of massive blood loss as maintaining:

- Hb greater than 80 g/l
- platelet count greater than 50 x 10^9/l
- PT ratio less than 1.5 x mean normal
- APTT ratio less than 1.5 x mean normal
- fibrinogen greater than 2 g/l.

5.3.3 Fluid replacement

A dilutional coagulopathy occurs when large volumes of crystalloid, colloid or red cells are used with insufficient transfusion of FFP and platelets. Traditionally, a total volume of 3.5 litres of clear fluids (up to 2 litres of warmed Hartmann’s solution as rapidly as possible, followed by up to a further 1.5 litres of warmed colloid if blood still not available) comprises the maximum that should be infused while awaiting compatible packed red cells. While there is controversy as to the most appropriate fluids for volume resuscitation, the nature of fluid infused is of less importance than rapid administration and warming of the infusion. The woman needs to be kept warm using appropriate measures to prevent hypothermia which in turn could exacerbate acidosis.

5.3.4 Blood transfusion

There are no firm criteria for initiating red cell transfusion. The decision to provide blood transfusion should be based on both clinical and haematological assessment. [GPP]

The use of blood and blood products in obstetric practice is addressed in RCOG Green-top Guideline No. 47. There are no firm criteria for initiating red cell transfusion and the decision to provide blood transfusion should be based on both clinical and haematological assessment. While blood transfusion is almost always required when the Hb is less than 60 g/l and rarely required when the Hb is more than 100 g/l, patients with acute haemorrhage can have normal Hb and clinical evaluation in this situation is therefore extremely important. Between 2009 and 2012, there were at least three maternal deaths where an acute point of care Hb measurement result is thought to have falsely reassured staff. Furthermore, the Serious Hazards of Transfusion (SHOT) reporting scheme has highlighted the risk of errors in using near patient testing of Hb measurements to guide transfusion. While single Hb/haematocrit estimations may be misleading and can lead to delays in initiating red cell transfusion, serial measurements may be helpful to monitor ongoing progress. Guidelines from the European Society of Anaesthesiology recommend that repeated measurements of serum lactate and base deficit, together with haematocrit/Hb, are measured during haemorrhage and resuscitation to assess tissue perfusion and oxygenation; however, it has not yet been shown whether the outcome of severe bleeding can be improved if volume resuscitation is guided by serum lactate concentration and base deficit.

Selection of red cell units for transfusion

Major obstetric haemorrhage protocols must include the provision of emergency blood with immediate issue of group O, RhD-negative and K-negative units, with a switch to group-specific blood as soon as feasible. [D]

If clinically significant red cell antibodies are present, close liaison with the transfusion laboratory is essential to avoid delay in transfusion in life-threatening haemorrhage. [D]
All delivery units, especially small units without a blood bank on site, should maintain a supply of O RhD-negative blood. [GPP]

Intraoperative cell salvage should be considered for emergency use in PPH associated with both caesarean section and vaginal delivery. [D]

Pregnant women (and women of childbearing age) who are RhD negative must only receive RhD-negative blood to avoid the risk of D alloimmunisation. Previous blood transfusion is an important cause for alloimmunisation with antibodies other than anti-D, in particular anti-K, which can cause severe haemolytic disease of the fetus and newborn (HDFN). Accordingly, unless a woman is known to be K positive, only K-negative blood should be used for transfusion in women of childbearing age. The aim of antibody screening is to determine the presence of red cell antibodies of likely clinical significance. In addition to the risk of HDFN, these red cell antibodies may have implications for the selection of blood for transfusion in the mother, with the risk of haemolytic transfusion reactions, and the laboratory should select red cell units negative for the relevant antigen for cross-matching. Close liaison with the transfusion laboratory is essential, with input if needed from the clinical haematology team and specialist advice from the national blood service. Evidence level 4

Cross-matching versus electronic issue of blood

The principles of blood grouping, antibody testing and selection of blood in pregnancy are addressed in the RCOG Green-top Guideline on blood transfusion in obstetrics. The majority of laboratories in the UK now use automated testing for blood grouping and antibody testing with advanced information technology systems for documentation and reporting of results. The hospital transfusion laboratory can readily provide red cells that are ABO and RhD compatible using electronic issue with no cross-matching needed, provided that the patient does not have any antibodies and there are robust automated systems in place for antibody testing and identification of the patient. In this setting, since blood can be readily issued, there is no need to reserve units for individual cases. Where electronic issue is not available, a locally agreed maximum surgical blood ordering schedule should be used to decide how many red cell units should be reserved and available for particular cases, based on the obstetric diagnosis. In unforeseen haemorrhage group O, RhD-negative and K-negative units must be immediately available for emergency use, with a switch to group-specific blood as soon as feasible. Evidence level 4

Cytomegalovirus (CMV) status

In elective transfusion in the antenatal period, CMV-seronegative products should be used to avoid transmission of CMV to the fetus, although the UK policy of universal leucocyte depletion substantially reduces the risk of CMV transmission. In an emergency, such as PPH, standard leucocyte-depleted components should be given to avoid delay and CMV-negative blood or platelets are not needed for transfusion during delivery or in the postpartum period. Evidence level 4
Intraoperative cell salvage

Intraoperative cell salvage (the process whereby blood shed during an operation is collected, filtered and washed to produce autologous red blood cells for transfusion to the patient) is commonly being used in cardiac, orthopaedic and vascular surgery with a relative reduction of blood transfusion of 38% and an absolute risk reduction of 21%, with cell salvage not appearing to impact adversely on clinical outcomes. Several bodies have endorsed cell salvage in obstetric practice, including NICE, the Centre for Maternal and Child Enquiries (CMACE) and the Association of Anaesthetists of Great Britain and Ireland. It has been proposed that cell salvage should be considered for emergency use in PPH associated with both caesarean section and vaginal delivery. Although large prospective trials of cell salvage with autotransfusion in obstetrics are lacking, to date, no single serious complication leading to poor maternal outcome has been directly attributed to its use. Evidence level 4

5.3.5 Blood components

There are limited data to inform best clinical practice on the management of haemostatic impairment during PPH, but the principle of management is to treat haemostatic abnormalities during bleeding but not to correct abnormalities in non-bleeding women. It is not known whether haemostasis should be corrected to normality for pregnant or nonpregnant women.

Methods to assess haemostatic impairment during PPH include clinical observation, laboratory-based tests (PT, APTT, Clauss fibrinogen and platelet count) and point of care testing. Studies in patients following surgery show that laboratory or point of care testing leads to appropriate use of blood components and both may be used simultaneously. Coagulopathies may evolve rapidly and repeated testing (such as every 30 minutes) during continued bleeding and observation of trends are more useful than single measurements. Evidence level 3

Routine coagulation tests are widely available and have well-regulated quality control. They include PT, APTT, Clauss fibrinogen and a platelet count. However, turnaround times are often too slow to be clinically useful in acute and rapidly evolving bleeds and inevitably reflect the past haemostatic status of the women. Clauss fibrinogen should always be measured as part of the routine coagulation screen because it falls early and may be reduced to a clinically significant level despite a normal PT/APTT. Platelet number should be measured as part of the full blood count. Evidence level 3

Point of care testing using viscoelastometry such as thromboelastography (TEG®, Haemonetics, Braintree, Massachusetts, USA) and rotational thromboelastometry (ROTEM®, Tem, Munich, Germany), combined with an agreed treatment algorithm, has been associated with decreased blood loss and blood product use, both outside and within the obstetric setting. The main advantage is that results are known sooner than for laboratory tests. Point of care testing using TEG® and ROTEM® has been recommended by the Obstetric Anaesthetists’ Association/Association of Anaesthetists of Great Britain and Ireland, although NICE has concluded that there is insufficient evidence to recommend the routine adoption of viscoelastometric point of care testing in the management of PPH. If used, a quality control protocol should be agreed with the haematology laboratory. Evidence level 4

Transfusion of fresh frozen plasma
If no haemostatic results are available and bleeding is continuing, then, after 6 units of RBC (or if it is anticipated after 4 units of RBC that further units will be required), FFP should be infused at a dose of 12–15 ml/kg until haemostatic test results are known. [D]

Early FFP should be considered in conditions with a suspected coagulopathy such as placental abruption or amniotic fluid embolism or where detection of PPH has been delayed. [GPP]

Clinicians should be aware that these blood component must be ordered as soon as a need for them is anticipated, as there will always be a short delay in supply because of the need for thawing. [GPP]

In the rare cases of massive bleeding where women have been given 8 units of RBCs and FFP and they continue to bleed and still no coagulation results or platelet counts are available then 2 pools of cryoprecipitate and 1 pool of platelets should be infused. [D]

Formulaic protocols such as 1:1 or 6:4 RBC:FFP, based on data derived from traumatic bleeding, have been advocated for the management of major haemorrhage, although there is no evidence that this improves outcomes in PPH. The drawbacks of early FFP are that the majority of women with PPH will have normal coagulation at the time of administration and that it is associated with an increased risk of transfusion-associated circulatory overload (TACO) and transfusion-related acute lung injury (TRALI). FFP results in relatively small increments in fibrinogen level and to increase the level rapidly cryoprecipitate or fibrinogen concentrate are required. [D]

If results of haemostatic tests are not available and haemorrhage is continuing then, after 6 units of RBC have been transfused, (or if it is anticipated after 4 units of RBC that further units will be required), FFP should be infused at a dose of 12–15 ml/kg and 6:4 RBC:FFP transfusion maintained until tests of haemostasis are available. Such empirical use of FFP is in line with published guidance. FFP transfusion earlier than this could be considered for placental abruption or amniotic fluid embolism because these situations are associated with early coagulopathy or if diagnosis of PPH has been delayed. [D]

In the rare cases of massive bleeding where women have been given 8 units of RBCs and FFP and they continue to bleed and still no coagulation results or platelet counts are available then 2 pools of cryoprecipitate and 1 pool of platelets should be infused. [D]

Fibrinogen

A plasma fibrinogen level of greater than 2 g/l should be maintained during ongoing PPH. [C]
Cryoprecipitate should be used for fibrinogen replacement. [D]

Observational studies show that a fibrinogen level of 1–1.5 g/l is likely to be too low for adequate haemostasis during ongoing PPH. Fibrinogen below 3 g/l and especially below 2 g/l is associated with progression of bleeding, increased RBC and blood component requirement and the need for invasive procedures. A double-blind randomised controlled trial has shown that pre-emptive infusion of 2 g fibrinogen concentrate in women with 500–1000 ml PPH has no benefit; however, the fibrinogen level at the time of randomisation was greater than 4 g/l in most women. Evidence level 2+

The appropriate fibrinogen intervention trigger or target level is unknown. A pragmatic view based on available evidence is that, during continuing PPH, cryoprecipitate or fibrinogen concentrate should be used to maintain a fibrinogen level of at least 2 g/l, even if PT/APTT are normal. Fibrinogen loss can be replaced by cryoprecipitate or fibrinogen concentrate, although fibrinogen concentrate is not licensed for acquired hypofibrinogenaemia in the UK. Similar clinical outcomes have been reported for cryoprecipitate and fibrinogen concentrate but this is based on limited data. Two pools of cryoprecipitate (one pool is taken from five donors) would be expected to increase the fibrinogen level by about 1 g/l increasing the fibrinogen level by 1 g/l requires about 60 mg/kg fibrinogen concentrate. Observational studies report improved clinical haemostasis, and possible reduced use of FFP and post transfusion associated events such as TACO associated with increased fibrinogen levels but randomised controlled trials are required. Evidence level 3

Transfusion of platelets

During PPH, platelets should be transfused when the platelet count is less than 75 x 10⁹/l based on laboratory monitoring. [D]

There is general consensus that platelets should be transfused at a trigger of 75 x 10⁹/l to maintain a level greater than 50 x 10⁹/l during ongoing PPH. Evidence level 4

5.3.6 Is there a role for antifibrinolytic drugs?

Consideration should be given to the use of tranexamic acid in the management of PPH. [B]

A large randomised controlled trial found that early administration of tranexamic acid in the management of trauma in nonpregnant patients, resulted in a significant reduction in death from haemorrhage. The dose employed in this study was 1 g intravenously over 10 minutes followed by an infusion of 1 g over 8 hours. One randomised controlled trial assessed the role of high-dose tranexamic acid in PPH. Women with PPH greater than 800 ml following vaginal delivery were randomly assigned to receive tranexamic acid (loading dose 4 g over 1 hour, then infusion of 1 g/hour over 6 hours) or not; the study concluded that high-dose tranexamic acid can reduce blood loss and fall in Hb, and the need for blood transfusion. The study was not powered to address safety issues and specifically the risk of the treatment causing deep vein thrombosis. Evidence level 1+

A Cochrane review on treatments for PPH found that trials testing the effectiveness of tranexamic acid were too small to draw meaningful conclusions. A large trial is currently in progress aiming to determine the effect of early administration of tranexamic acid on mortality, hysterectomy and other morbidities in women with PPH. The dose of tranexamic acid employed in this trial is 1 g by intravenous injection; a second dose may be given after 30 minutes. Evidence level 1+
5.3.7 Is there a role for recombinant factor VIIa (rFVIIa) therapy?

The routine use of rFVIIa is not recommended in the management of major PPH unless as part of a clinical trial. [GPP]

rFVIIa (NovoSeven®, Novo Nordisk, Bagsværd, Denmark) is an expensive product that is licensed in the UK for the treatment of bleeding episodes in patients with specific inherited bleeding disorders. Outwith its licence, it has been used primarily in the management of uncontrolled haemorrhage in the trauma setting although its use has been reported in the management of obstetric haemorrhage.\(^{115}\) It reduces blood loss through enhancement of tissue factor-dependent coagulation. Its effectiveness is markedly diminished by hypothermia and acidosis and so effective resuscitation towards normal physiology is a prerequisite of its use. \(^{116}\) \(^{117}\) \(^{118}\) Evidence level 3

There are only poor quality data from anecdotal reports or patient registries to support its use. \(^{116}\) Systematic reviews of case series and observational studies have examined the use of rFVIIa in PPH. \(^{117}\) \(^{118}\) In a review of the literature regarding the use of rFVIIa in the treatment of PPH, Ahonen\(^{115}\) concluded that rFVIIa should not be used to compensate for inadequate blood transfusion therapy; administration of blood and blood products as well as management of uterine atony are essential in the treatment of PPH before considering administration of rFVIIa. There was a recent open-label randomised controlled trial in women with severe PPH unresponsive to uterotonics which showed a reduction in the need for second-line therapies but one in 20 patients had a nonfatal venous thromboembolic event. \(^{119}\)

A study investigating the safety of rFVIIa when employed on an off-label basis to treat life-threatening haemorrhage found a significant increase in the risk of arterial but not venous thromboembolic events when compared with placebo (5.5% versus 3.2%). \(^{120}\) Evidence level 1+

The use of rFVIIa may be considered as a treatment for life-threatening PPH, but should not delay or be considered a substitute for a life-saving procedure such as embolisation or surgery, or transfer to a referral centre.

5.4 Monitoring and investigation in major PPH: what investigations should be performed and how should the woman be monitored?

Full protocol for monitoring and investigation in \textit{major} PPH (blood loss greater than 1000 ml) and ongoing haemorrhage or clinical shock:

- immediate venepuncture (20 ml) for:
  - cross-match (4 units minimum)
  - full blood count
  - coagulation screen including fibrinogen
  - renal and liver function for baseline
- monitor temperature every 15 minutes
- continuous pulse, blood pressure recording and respiratory rate (using oximeter, electrocardiogram and automated blood pressure recording)
- Foley catheter to monitor urine output
- two peripheral cannulae, 14-gauge
- consider arterial line monitoring (once appropriately experienced staff available for insertion)
- consider transfer to intensive therapy unit once the bleeding is controlled or monitoring at high dependency unit on delivery suite, if appropriate
- recording of parameters on a modified early obstetric warning score (MEOWS) chart
- acting and escalating early on when abnormal scores from a MEOWS chart are observed
• documentation of fluid balance, blood, blood products and procedures.

Record keeping on intensive care unit-style charts will help in monitoring the clinical situation. Continuous physiological monitoring is necessary and the recording of parameters over time on a flow chart that will give the reader good visual cues on the clinical progress of the patient (Appendix II). The need to continually re-evaluate the woman’s physiological condition, even when bleeding appears to have stopped, is essential to recognise continuing bleeding.

The presence of a central line not only provides a means of accurate central venous pressure monitoring but also a route for rapid fluid replacement. Nevertheless, the threshold for instituting invasive monitoring has been controversial, with some authorities advising early recourse to central venous pressure monitoring and others advocating caution. The 2000–2002 report of the UK Confidential Enquiries into Maternal Deaths (CEMD) included the recommendation: ‘Central venous and direct arterial pressure monitoring should be used when the cardiovascular system is compromised by haemorrhage or disease’. Central venous pressure monitoring requires early involvement of a senior skilled anaesthetist, who will usually take responsibility for this aspect of management. The use of ultrasound is more likely to make the procedure safer as this procedure carries significant morbidity and mortality. Once bleeding is under control, transfer to an intensive care or high dependency unit on delivery suite should be considered, depending on the severity of the blood loss (see section 5.6.3). Evidence level 4

It is also important that once the bleeding is arrested and any coagulopathy is corrected, chemical thromboprophylaxis is administered, as there is a high risk of thrombosis. Alternatively, antiembolism stockings, foot impulse devices or intermittent pneumatic compression devices can be used if chemical thromboprophylaxis is contraindicated, for example, in cases of thrombocytopenia. Evidence level 4

5.5 What is the role of the anaesthetist in the management of PPH?

The management of PPH requires a multidisciplinary approach: the anaesthetist plays a crucial role in maintaining haemodynamic stability and, if necessary, in determining and administering the most appropriate method of anaesthesia. [D]

Anaesthetists play an important role in the multidisciplinary team involved in the management of patients with PPH. A senior anaesthetist should be consulted early to help assess, initiate and continue prompt resuscitation of these patients, using their expertise in fluid and transfusion therapy as well as their experience in managing critically ill patients. Evidence level 4

If the patient needs to go to theatre for a surgical intervention, an experienced anaesthetist should promptly assess the patient, in order to decide on the most suitable mode of anaesthesia, depending on the patient’s haemodynamic status. Neuraxial anaesthesia has become the anaesthetic technique of choice in the obstetric population and this has resulted in a reduction in maternal mortality. Evidence level 4

While general anaesthesia in obstetric patients is associated with increased morbidity and mortality when compared with regional anaesthesia due to the physiological changes that occur in pregnancy, it may be preferable in patients who are haemodynamically unstable or who have a coagulopathy. Evidence level 4
The patient may need high dependency or intensive care in the postoperative period. An obstetric early-warning score system would help in the early identification of continuous bleeding, especially in cases which are not apparent, as recommended by CMACE (Appendix III).\textsuperscript{125} \textit{Evidence level 4}

5.6 \textit{What methods should be employed to arrest the bleeding?}

Clinicians should be prepared to use a combination of pharmacological, mechanical and surgical methods to arrest a PPH. These methods will be directed towards the causative factor. [D]

Careful clinical examination is required to determine the cause of PPH (see Table 1 and Appendix I for the causes of PPH). A 2014 Cochrane review addressing the treatment of primary PPH found no trials evaluating surgical techniques or radiological interventions for women with primary PPH that was unresponsive to pharmacological methods.\textsuperscript{2} Thus, recommendations on treatment strategies are based on observational data and consensus only. \textit{Evidence level 4}

5.6.1 \textit{What pharmacological and mechanical strategies can be used?}

When uterine atony is perceived to be a cause of the bleeding, then a sequence of mechanical and pharmacological measures should be instituted in turn until the bleeding stops. [GPP]

The most common cause of primary PPH is uterine atony.\textsuperscript{27} The initial management of PPH should therefore involve measures to stimulate myometrial contractions. The following mechanical and pharmacological measures should be instituted/administered in turn:

- bimanual uterine compression (‘rubbing up the fundus’) to stimulate contractions
- ensuring that the bladder is empty (Foley catheter, leave in place)
- oxytocin 5 iu by slow intravenous injection (may have repeat dose)
- ergometrine 0.5 mg by slow intravenous or intramuscular injection (contraindicated in women with hypertension)
- oxytocin infusion (40 iu in 500 ml Hartmann’s solution at 125 ml/hour) unless fluid restriction is necessary
- misoprostol 1000 micrograms rectally
- carboprost 0.25 mg by intramuscular injection repeated at intervals of not less than 15 minutes to a maximum of 8 doses (contraindicated in women with asthma).

The simple mechanical and physiological measures of bimanual uterine compression and emptying the bladder to stimulate uterine contraction represent first-line management of PPH. No published studies were identified to provide an evidence base for these interventions; nevertheless, professional consensus supports their continued use.\textsuperscript{128} \textit{Evidence level 4}

Despite decades of empirical use in clinical practice, there are no trials comparing ergometrine with oxytocin as first-line agents for the treatment of PPH. It seems appropriate to use both agents, although oxytocin is to be preferred initially, especially in women with hypertension or pre-eclampsia. Previous guidance advocated an initial dose of 10 iu of oxytocin by slow intravenous injection for treatment (rather than prophylaxis) of PPH.\textsuperscript{1} The British National Formulary recommends a dose of 5 iu ‘by slow intravenous injection (dose may be repeated)’;\textsuperscript{129} however, the 1997–1999 report of the UK CEMD highlighted the risk of profound hypotension, which may be associated with oxytocin injection.\textsuperscript{117,130} This guideline has adopted the CEMD recommendation that ‘When given as an intravenous bolus the drug should be given slowly in a dose of not more than 5 iu’. This dosage is in line with guidance from other authorities.\textsuperscript{30,129} \textit{Evidence level 4}
There are no trials comparing the prostaglandin carboprost (15-methyl prostaglandin F\(_2\)) with other uterotonic agents. Two case series from the USA\(^{131,132}\) comprising 26 and 237 cases respectively, have reported on the use of carboprost in the successful management of PPH, without resort to surgical interventions in 85% and 95% of cases. Two of the four failures in the smaller series were associated with placenta accreta. If bleeding occurs at the time of caesarean section, intramyometrial injection of carboprost may be used (although not licensed). If a laparotomy is undertaken following failure of pharmacological management, intramyometrial carboprost injection should be the first-line measure once the uterus is exposed. It is also possible to inject intramyometrial carboprost through the abdominal wall in the absence of laparotomy. The recommended dose is 250 micrograms intramuscular. This may be repeated every 15 minutes to a total dose of 2 mg (total eight doses). \textit{Evidence level 3}

Two systematic reviews\(^2,133\) including a recent Cochrane review, focused on misoprostol to treat PPH and examined the optimal route and dosage and its efficacy. Compared with 40 iu oxytocin infusion, 800 micrograms sublingual misoprostol was associated with a significant increase in the number of women who had blood loss of at least 1000 ml (RR 2.65, 95\% CI 1.04–6.75) and who required blood transfusion (RR 1.47, 95\% CI 1.02–2.14). The review authors concluded that oxytocin infusion should be recommended as first-line treatment for primary PPH. When used following prophylactic uterotonics, misoprostol and oxytocin infusion work similarly. \textit{Evidence level 1+}

\subsection*{5.6.2 What surgical treatments can be employed to arrest the bleeding?}

If pharmacological measures fail to control the haemorrhage, surgical interventions should be initiated sooner rather than later. [D]

Intrauterine balloon tamponade is an appropriate first-line ‘surgical’ intervention for most women where uterine atony is the only or main cause of haemorrhage. [C]

Conservative surgical interventions may be attempted as second line, depending on clinical circumstances and available expertise. [C]

It is recommended that a laminated diagram of the brace technique be kept in theatre. [GPP]

Resort to hysterectomy sooner rather than later (especially in cases of placenta accreta or uterine rupture). [C]

Ideally and when feasible, a second experienced clinician should be involved in the decision for hysterectomy. [GPP]

The use of pharmacological agents other than those listed should not delay recourse to surgery. Once the decision is made to embark on surgical haemostasis, the most appropriate choice of procedure will depend, in part, on the experience and expertise of available staff.

Compression of the aorta may be a temporary but effective measure to allow time for resuscitation to catch up with the volume replacement and the appropriate surgical support to arrive. The judgement of senior clinicians, taking into account the individual woman’s future reproductive aspirations, is required in deciding the appropriate sequence of interventions.

The management of placenta praevia accreta is associated with significant morbidity and guidance is available in RCOG Green-top Guideline No. 27.\(^{11}\)
5.6.2.1 Uterine balloon tamponade

Tamponade using various types of hydrostatic balloon catheter has superseded uterine packing for control of atonic PPH.\textsuperscript{134} Case series have used a Foley catheter,\textsuperscript{135} Bakri balloon,\textsuperscript{136} Sengstaken–Blakemore oesophageal catheter\textsuperscript{137,138} and a condom catheter.\textsuperscript{139} The urological Rusch balloon has been described as preferable by virtue of larger capacity, ease of use and low cost.\textsuperscript{140} A detailed protocol for uterine tamponade using the Rusch balloon is available.\textsuperscript{140} The 2014 Scottish Confidential Audit of Severe Maternal Morbidity report identified 339 women who had an estimated blood loss of 2500 ml or higher; in 82 cases balloon tamponade was employed, successfully avoiding hysterectomy in 75 (91%) women.\textsuperscript{141} This success rate is of the same order as that reported in other case series. \textit{Evidence level 3}

Some of the reports of balloon tamponade\textsuperscript{139,142} describe the intervention as the ‘tamponade test’. A ‘positive test’ (control of PPH following inflation of the balloon) indicates that laparotomy is not required, whereas a ‘negative test’ (continued PPH following inflation of the balloon) is an indication to proceed to laparotomy. The concept of balloon tamponade as a ‘test’ serves to affirm its place as first-line ‘surgical’ management. There is no clear evidence on how long the balloon tamponade should be left in place. In most cases, 4–6 hours of tamponade should be adequate to achieve haemostasis and ideally it should be removed during daytime hours, in the presence of appropriate senior staff, in case further intervention should be necessary.\textsuperscript{137,138} \textit{Evidence level 4}

A systematic review concluded that uterine balloon tamponade is an effective treatment for PPH in resource-poor settings.\textsuperscript{143} \textit{Evidence level 2++}

5.6.2.2 Haemostatic suturing

Several case series have been published describing success with haemostatic brace sutures. The best known version, described by B-Lynch in 1997, requires hysterotomy for its insertion and is particularly suitable when the uterus has already been opened at caesarean section.\textsuperscript{144} A review published in 2005 summarised nine case series of B-Lynch suturing (a total of 32 cases), reporting success in all but one case.\textsuperscript{145} \textit{Evidence level 3}

In 2002, Hayman et al. described a modified compression suture which does not require hysterotomy\textsuperscript{146} and success in 10/11 women managed with this suture has been reported.\textsuperscript{147} Other authors have described variants on these techniques.\textsuperscript{148,149} Double vertical compression sutures have proved effective in treating PPH due to atony and placenta praevia. This may have a dual action of reducing uterine blood flow and compressing the bleeding surface.\textsuperscript{150} \textit{Evidence level 3}

A prospective population-based study of 211 women treated with a uterine compression suture to control PPH concluded that the overall failure rate of sutures leading to hysterectomy was 25%.\textsuperscript{151} There was no difference in failure rate between B-Lynch, modified B-Lynch and other suture techniques. Risk factors for a hysterectomy included increasing age and vaginal delivery. In addition, a prolonged delay of 2–6 hours between delivery and uterine compression suture was independently associated with a four-fold increased risk of hysterectomy. This emphasises the need for careful postpartum evaluation of blood loss to avoid prolonged delay in haemorrhage recognition. \textit{Evidence level 3}

The 2014 Scottish Confidential Audit of Severe Maternal Morbidity report identified 21 cases where haemostatic brace suturing was used for the management of PPH (greater than or equal to 2500 ml); hysterectomy was averted in 16 (76%) women.\textsuperscript{141} Again, this success rate is of the same order as that reported in other case series. \textit{Evidence level 3}
These observational data suggest that haemostatic suture techniques are effective in controlling severe PPH and in reducing the need for hysterectomy. In the absence of comparative data to demonstrate that any one variant is superior to another, obstetricians are encouraged to familiarise themselves with one technique, under the supervision of an experienced colleague. It is recommended that a laminated diagram of the brace technique be kept in theatre.

A systematic review has concluded that compression sutures are associated with a low complication rate. A higher risk of uterine ischaemia appeared to be caused when the procedure was combined with vessel ligation. No negative impact on fertility has been reported. Evidence level 3

5.6.2.3 Internal iliac artery ligation

When internal iliac artery ligation is being considered, a senior gynaecologist or vascular surgeon should be informed and involved. A case series described 84 women with PPH from various causes who underwent internal iliac artery ligation as the first-line surgical intervention. Hysterectomy was subsequently required in 33 women (39%). Evidence level 3

A follow-up study of 45 women suggested that internal iliac artery ligation does not impair subsequent fertility and pregnancy outcomes. Evidence level 3

5.6.2.4 Selective arterial occlusion or embolisation by interventional radiology

A large retrospective study has evaluated arterial embolisation in 251 patients after PPH. It was successful in arresting the bleeding in 86.5% (217/251). The analysis suggested that caesarean section delivery, disseminated intravascular coagulation and transfusion of more than 10 units of packed red cells were related to failed embolisation. Evidence level 3

The logistics of performing arterial occlusion or embolisation where the equipment or an interventional radiologist may not be available may mean that uterine balloon tamponade is a more appropriate first-line treatment.

Follow-up studies of 17 and 25 women who underwent arterial embolisation for treatment of PPH suggest that the intervention does not impair subsequent menstruation, fertility and obstetric outcome. Selective arterial occlusion may also be effective after failed internal iliac artery ligation. Evidence level 3

5.6.2.5 Hysterectomy

The decision for hysterectomy should be made by an experienced consultant clinician and the decision preferably discussed with a second experienced clinician when feasible. Early recourse to hysterectomy is recommended, especially where bleeding is associated with placenta accreta or uterine rupture. Hysterectomy should not be delayed until the woman is in extremis or while less definitive procedures with which the surgeon has little experience are attempted. The procedure should be carried out by a surgeon who is experienced in carrying out hysterectomies. Subtotal hysterectomy is the operation of choice in many instances of PPH requiring hysterectomy, unless there is trauma to the cervix or a morbidly adherent placenta in the lower segment. Evidence level 4

Sequential reports of the Scottish Confidential Audit of Severe Maternal Morbidity from 2003 until 2012 have shown a statistically significant fall in the proportion of women with PPH (greater than
or equal to 2500 ml) requiring a hysterectomy to control the bleeding and an increase in the use of
conservative surgical techniques. *Evidence level 3*

### 5.6.3 Intensive and high dependency unit and post-PPH care

The 2006–2008 CMACE report identified that three deaths were due to lack of optimal care
following PPH and in particular a lack of routine observation in the postpartum period. Sequential
reports have recommended the use of MEOWS charts to alert caregivers to abnormal trends in
haemodynamic measurements. *Evidence level 4*

A prospective audit of the management of major PPH (defined in the audit as blood loss of 2500 ml
or more, transfused 5 or more units of packed red cells or received treatment for coagulopathy)
found that the majority of women received high dependency care on the labour ward, while only
21% were admitted to intensive care. The authors concluded that care for these women may be
better provided by obstetricians and anaesthetists on labour ward, a view that others have
shared. *Evidence level 3*

### 6. How should secondary PPH be managed?

In women presenting with secondary PPH, an assessment of vaginal microbiology should be
performed (high vaginal and endocervical swabs) and appropriate use of antimicrobial therapy
should be initiated when endometritis is suspected. [D]

A pelvic ultrasound may help to exclude the presence of retained products of conception,
although the diagnosis of retained products is unreliable. [C]

Surgical evacuation of retained placental tissue should be undertaken or supervised by an
experienced clinician. [D]

The causes of secondary PPH are numerous and include endometritis, retained products of
conception and subinvolution of the placental implantation site. The management of women
presenting with secondary PPH should include an assessment of their haemodynamic status, an
assessment of the blood loss and an evaluation of the woman’s concerns (for example, is her
bleeding becoming inconvenient because it has persisted longer than she had expected?). *Evidence
level 4*

Investigations should include bacteriological testing for endometritis (high vaginal swab), although a
low yield of positive vaginal swab results has been reported in patients with secondary PPH. In
contrast, Pather et al. found a high incidence of abnormal vaginal microbiology (52%) and
endometritis in their case series, supporting the practice of routine assessment of vaginal
microbiology and appropriate use of antimicrobial therapy in women presenting with secondary
PPH. *Evidence level 3*

A Cochrane review investigated the effect of different antibiotic regimens for the treatment of
postpartum endometritis. This review concluded that a combination of clindamycin and
gentamicin is appropriate and that once uncomplicated endometritis has clinically improved with
intravenous therapy, there is no additional benefit from further oral therapy. The management of
women presenting with secondary PPH and sepsis is addressed in RCOG Green-top Guideline No.
64b. *Evidence level 1–*
Pelvic ultrasound scans are commonly performed on women presenting with secondary PPH to identify any retained products of conception (RPOC). Case series have reported a wide range of sensitivities and specificities of ultrasound in the detection of RPOC (44–94% and 16–92% respectively). These series suggest that the presence of an echogenic mass and a thickened ‘endometrium’ is strongly associated with RPOC. In a prospective observational study of 79 women with secondary PPH, Mulic-Lutvica and Axelsson concluded that an echogenic mass in the uterine cavity and an anteroposterior diameter of the cavity above the 90th centile (approximately 25 mm on days 1–7 postpartum) was associated with RPOC. It has been proposed that colour flow Doppler imaging should be included in the evaluation of the postpartum uterus although there is no strong evidence to support its use; it may facilitate the diagnosis of pseudoaneurysms and arteriovenous malformations which are rare but recognised causes of secondary PPH. Evidence level 3

Surgical evacuation of the uterus for RPOC is not without morbidity and can result in uterine perforation (1.5%) and Asherman’s syndrome. It is therefore recommended that surgical evacuation of retained placental tissue should be undertaken or supervised by an experienced clinician. Evidence level 3

A 2002 Cochrane review (updated in January 2008) addressed treatments for secondary PPH. No trials were identified which met the review group’s inclusion criteria and no recommendations were made regarding effective treatments. Uterotonics such as misoprostol and ergometrine have been recommended in the management of secondary PPH, although evidence to support their use is limited. Transcatheter arterial embolisation and balloon tamponade have been employed in cases of secondary PPH with ongoing bleeding. Evidence level 3

7. Risk management

7.1 Training and preparation: what measures can be taken to ensure optimal management of PPH?

Every maternity unit should have a multidisciplinary protocol for the management of PPH. [GPP]

All staff involved in maternity care should receive training in the management of obstetric emergencies, including the management of PPH. [B]

Training for PPH should be multiprofessional and include team rehearsals. [B]

All cases of PPH involving a blood loss of greater than 1500 ml should be the subject of a formal clinical incident review. [D]

To ensure optimal management of PPH, every unit should have a multidisciplinary protocol with which staff should be familiar (see section 5). Updates on the management of obstetric emergencies (including the management of PPH) are a proactive approach to risk management. Skills drills should ensure that all members of staff, including those working in the transfusion laboratory, are aware of their role in the management of PPH. A systematic review of the effectiveness of multidisciplinary simulation training in obstetric emergencies (including PPH) showed that teamwork training in a simulation setting resulted in improvement of knowledge, practical skills, communication and team performance. Training in a simulation centre did not further improve outcome compared with training at a local unit. Evidence level 2++

The RCOG recommends that all cases of PPH with an estimated blood loss of more than 1500 ml should be the subject of a formal clinical incident review. Evidence level 4
7.2 Documentation

Accurate documentation of a delivery with PPH is essential. [GPP]

Accurate documentation is important for further clinical management, continuity of care and team work. In addition, inadequate documentation can contribute to the likelihood of there being medico-legal consequences.\textsuperscript{181} It may be helpful to use a structured pro forma to aid accurate record keeping. PPH should be notified through a clinical incident reporting or risk management system. \textit{Evidence level 4}

It is important to record:
- the staff in attendance and the time they arrived
- the sequence of events
- the administration of different pharmacological agents, their timing and sequence
- the time of surgical intervention, where relevant
- the condition of the mother throughout the different steps
- the timing of the fluid and blood products given

7.3 Debriefing

An opportunity to discuss the events surrounding the obstetric haemorrhage should be offered to the woman (possibly with her companions in labour) at a mutually convenient time. [GPP]

After obstetric emergencies, women can be psychologically affected by postnatal depression or fear of further childbirth. Major PPH can be traumatic to women and their families and has been associated with the subsequent development of post-traumatic stress disorder.\textsuperscript{182} Women who have experienced a major PPH should be offered an opportunity to discuss the events surrounding her delivery. This should include arrangements for appropriate investigations as necessary, such as testing for coagulopathies if there are other indicators and screening for the rare complication of panhypopituitarism (Sheehan syndrome) secondary to hypotension.\textsuperscript{183} \textit{Evidence level 4}

8. Recommendations for future research

- Randomised controlled trials are required to identify the best drug combinations, route and dose of uterotonics for the treatment of primary PPH.
- The role of viscoelastometric point of care tests using TEG\textsuperscript{®} and ROTEM\textsuperscript{®} in the management of PPH requires evaluation.
- Studies are required to determine the optimal ratio of packed red cells to FFP in the management of obstetric haemorrhage.
- Studies are required to determine the role of fibrinogen concentrate in the management of PPH.
- The role of prothrombin complex concentrate in the management of PPH requires evaluation.
- Randomised controlled trials are required to investigate the role of uterotonic agents (misoprostol and ergometrine) in the management of secondary PPH.

9. Auditable topics

- The proportion of women who are screened for antenatal anaemia (100%).
- The proportion of women who are offered active management of the third stage of labour (100%).
• The proportion of women undergoing an assessment of risk factors for PPH when she presents in labour (100%).
• Appropriate documentation of management, especially with the timing of events for women who had PPH (100%).
• Notification to the risk management team of women with PPH involving a blood loss greater than 1500 ml (100%).
• Proportion of the multidisciplinary team who have undergone skills drills training in PPH (100%).

10. Useful links and support groups

• Royal College of Obstetricians and Gynaecologists. Heavy bleeding after birth (postpartum haemorrhage). Information for you. London: RCOG; 2013 [new version to be developed for this guideline].
• Patient. Postpartum Haemorrhage [www.patient.co.uk/showdoc/40000261].
• Netdoctor.co.uk. I suffered with postpartum haemorrhage [www.netdoctor.co.uk/ate/womenshealth/207160.html].

References


102. Green L, Knight M, Seeney F, Hopkinson C, Collins PW, Collins RE, et al. The haematological features and transfusion management of women who required massive transfusion for major obstetric haemorrhage in the UK: a population based descriptive study,


148. Hwu YM, Chen CP, Chen HS, Su TH. Parallel vertical compression sutures: a technique to control bleeding from placenta praevia or accreta during caesarean section. BJOG 2005;112:1420–3.


### Appendix I: The causes of PPH

<table>
<thead>
<tr>
<th>The four Ts</th>
<th>Risk factors/notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tone: abnormalities of uterine contraction</strong></td>
<td>Polyhydramnios, multiple gestation, macrosomia</td>
</tr>
<tr>
<td>Overdistension of uterus</td>
<td></td>
</tr>
<tr>
<td>Intra-amniotic infection</td>
<td>Fever, prolonged rupture of membranes</td>
</tr>
<tr>
<td>Functional/anatomic distortion of uterus</td>
<td>Rapid labour, prolonged labour, fibroids, placenta praevia, uterine anomalies</td>
</tr>
<tr>
<td>Uterine-relaxing medications</td>
<td>Terbutaline, halogenated anaesthetics, glyceryl trinitrate</td>
</tr>
<tr>
<td>Bladder distension</td>
<td>May prevent uterine contraction</td>
</tr>
<tr>
<td><strong>Tissue: retained products of conception</strong></td>
<td></td>
</tr>
<tr>
<td>Retained cotyledon or succenturiate lobe</td>
<td></td>
</tr>
<tr>
<td>Retained blood clots</td>
<td></td>
</tr>
<tr>
<td><strong>Trauma: genital tract injury</strong></td>
<td>Precipitous delivery, operative delivery</td>
</tr>
<tr>
<td>Lacerations of the cervix, vagina or perineum</td>
<td>Malposition, deep engagement</td>
</tr>
<tr>
<td>Extensions, lacerations at caesarean section</td>
<td>Previous uterine surgery</td>
</tr>
<tr>
<td>Uterine rupture</td>
<td>High parity with excessive cord traction</td>
</tr>
<tr>
<td>Uterine inversion</td>
<td></td>
</tr>
<tr>
<td><strong>Thrombin: abnormalities of coagulation</strong></td>
<td>History of hereditary coagulopathies or liver disease</td>
</tr>
<tr>
<td>Pre-existing states</td>
<td></td>
</tr>
<tr>
<td>Haemophilia A</td>
<td></td>
</tr>
<tr>
<td>Idiopathic thrombocytopenic purpura</td>
<td></td>
</tr>
<tr>
<td>Von Willebrand’s disease</td>
<td></td>
</tr>
<tr>
<td>History of previous PPH</td>
<td></td>
</tr>
<tr>
<td>Acquired in pregnancy</td>
<td></td>
</tr>
<tr>
<td>Gestational thrombocytopenic</td>
<td></td>
</tr>
<tr>
<td>Preclampsia with thrombocytopenia</td>
<td></td>
</tr>
<tr>
<td>e.g. HELLP</td>
<td></td>
</tr>
<tr>
<td>Disseminated intravascular coagulation</td>
<td></td>
</tr>
<tr>
<td>a) Gestational hypertensive disorder of pregnancy with adverse conditions</td>
<td></td>
</tr>
<tr>
<td>Coagulopathy</td>
<td></td>
</tr>
<tr>
<td>b) dead fetus in utero</td>
<td>Fetal demise</td>
</tr>
<tr>
<td>c) severe infection</td>
<td>Fever, neutrophilia/neutropenia</td>
</tr>
<tr>
<td>d) abruption</td>
<td>Antepartum haemorrhage</td>
</tr>
<tr>
<td>e) amniotic fluid embolus</td>
<td>Sudden collapse</td>
</tr>
<tr>
<td>Therapeutic anticoagulation</td>
<td>History of thromboembolic disease</td>
</tr>
</tbody>
</table>

### Abbreviations
- HELLP: haemolysis, elevated liver enzymes and low platelet count
Appendix II: A flow chart of the different steps for the management of major postpartum haemorrhage

Resuscitation, monitoring, investigation and treatment should occur simultaneously

Major obstetric haemorrhage
Blood loss > 1000 ml
Continuing major obstetric haemorrhage or clinical shock

Call for help
Senior midwife/obstetrician and anaesthetist
Alert haematologist
Alert blood transfusion laboratory
Alert consultant obstetrician on-call

Resuscitation
Airway
Breathing
Circulation
Oxygen mask (15 litres)
Fluid balance (2 litres Hartmann’s, 1.5 litres colloid)
Blood transfusion (O RhD-negative or group-specific blood)
Blood products (FFP, PLT, cryoprecipitate, factor VIIa)
Keep patient warm

Monitoring and investigations
14-gauge cannula x 2
FBC, coagulation, U&Es, LFTs
Cross-match (4 units, FFP, PLT, cryoprecipitate)
ECG, oximeter
Foley catheter
Hb bedside testing
Blood products
Consider central and arterial lines
Commence record chart
Weigh all swabs and estimate blood loss

Medical treatment
Bimanual uterine compression
Empty bladder
Oxytocin 5 iu x 2
Ergometrine 500 micrograms
Oxytocin infusion (40 iu in 500 ml)
Carboprost 250 micrograms IM every 15 minutes up to 8 times
Carboprost (intramyometrial) 0.5 mg
Misoprostol 1000 micrograms rectally

Theatre
Is the uterus contracted?
Examination under anaesthesia
Has any clotting abnormality been corrected?

Intrauterine balloon tamponade
Brace suture
Consider interventional radiology
Surgery
Bilateral uterine artery ligation
Bilateral internal iliac ligation
Hysterectomy (second experienced clinician)
Uterine artery embolisation

High-dependency unit
or intensive care unit

Abbreviations
ECG electrocardiogram; FBC full blood count; FFP fresh frozen plasma; Hb haemoglobin; IM intramuscular;
LFTs liver function tests; PLT platelets; RhD rhesus D; U&Es urea and electrolytes.
Appendix III: Obstetric early warning chart

[To be added before publication]
Appendix IV: Example obstetric haemorrhage chart

[To be added before publication]
Appendix V: Explanation of guidelines and evidence levels

Clinical guidelines are: ‘systematically developed statements which assist clinicians and patients in making decisions about appropriate treatment for specific conditions’. Each guideline is systematically developed using a standardised methodology. Exact details of this process can be found in Clinical Governance Advice No. 1 Development of RCOG Green-top Guidelines (available on the RCOG website at http://www.rcog.org.uk/green-top-development). These recommendations are not intended to dictate an exclusive course of management or treatment. They must be evaluated with reference to individual patient needs, resources and limitations unique to the institution and variations in local populations. It is hoped that this process of local ownership will help to incorporate these guidelines into routine practice. Attention is drawn to areas of clinical uncertainty where further research may be indicated.

The evidence used in this guideline was graded using the scheme below and the recommendations formulated in a similar fashion with a standardised grading scheme.

Classification of evidence levels

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1++</td>
<td>High-quality meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a very low risk of bias</td>
</tr>
<tr>
<td>1+</td>
<td>Well-conducted meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a low risk of bias</td>
</tr>
<tr>
<td>1–</td>
<td>Meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a high risk of bias</td>
</tr>
<tr>
<td>2++</td>
<td>High-quality systematic reviews of case-control or cohort studies or high-quality case-control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal</td>
</tr>
<tr>
<td>2+</td>
<td>Well-conducted case-control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal</td>
</tr>
<tr>
<td>2–</td>
<td>Case-control or cohort studies with a high risk of confounding, bias or chance and a significant risk that the relationship is not causal</td>
</tr>
<tr>
<td>3</td>
<td>Non-analytical studies, e.g. case reports, case series</td>
</tr>
<tr>
<td>4</td>
<td>Expert opinion</td>
</tr>
</tbody>
</table>

Grades of Recommendation

A  At least one meta-analysis, systematic reviews or RCT rated as 1++, and directly applicable to the target population; or a systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population and demonstrating overall consistency of results

B  A body of evidence including studies rated as 2++ directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+

C  A body of evidence including studies rated as 2+ directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2+

D  Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+

Good Practice Points
Recommended best practice based on the clinical experience of the guideline development group

This guideline was produced on behalf of the Guidelines Committee of the Royal College of Obstetricians and Gynaecologists by:

Ms E Mavrides MRCOG, London; Dr S Allard, Consultant Haematologist, NHS Blood and Transplant and Barts Health NHS Trust, London; Dr E Chandraharan MRCOG, London; Professor P Collins, Cardiff; Dr L Green, Consultant Haematologist, NHS Blood and Transplant and Barts Health NHS Trust, London; Professor BJ Hunt, London; Mr SA Riris MRCOG, London; and Dr AJ Thomson MRCOG, Paisley

and peer reviewed by: XXX

The committee lead reviewer was: Dr PS Arunakumari FRCOG, Basildon.

The chairs of the Guidelines Committee were: Dr M Gupta¹ MRCOG, London; Dr P Owen² FRCOG, Glasgow; and Dr AJ Thomson¹ MRCOG, Paisley.

¹co-chairs from June 2014 ²until May 2014.

All RCOG guidance developers are asked to declare any conflicts of interest. A statement summarising any conflicts of interest for this guideline is available from: https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg52/.

The final version is the responsibility of the Guidelines Committee of the RCOG.

The review process will commence in 20XX, unless otherwise indicated.

DISCLAIMER

The Royal College of Obstetricians and Gynaecologists produces guidelines as an educational aid to good clinical practice. They present recognised methods and techniques of clinical practice, based on published evidence, for consideration by obstetricians and gynaecologists and other relevant health professionals. The ultimate judgement regarding a particular clinical procedure or treatment plan must be made by the doctor or other attendant in the light of clinical data presented by the patient and the diagnostic and treatment options available.

This means that RCOG Guidelines are unlike protocols or guidelines issued by employers, as they are not intended to be prescriptive directions defining a single course of management. Departure from the local prescriptive protocols or guidelines should be fully documented in the patient’s case notes at the time the relevant decision is taken.