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Health Service Executive



INSTITUTE OF OBSTETRICIANS
& GYNAECOLOGISTS
ROYAL COLLEGE OF PHYSICIANS OF IRELAND

CLINICAL PRACTICE GUIDELINE

PREVENTION AND MANAGEMENT OF PRIMARY POSTPARTUM HAEMORRHAGE

Institute of Obstetricians and Gynaecologists
Royal College of Physicians of Ireland and
Directorate of Strategy and Clinical Programmes
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Key Recommendations

1. If a woman with primary PPH is continuing to bleed after an estimated blood loss of 1000 ml (or has clinical signs of shock or tachycardia associated with a smaller estimated loss), this should be described as major PPH and prompt a full protocol of measures to achieve resuscitation and haemostasis.
2. Active management of the third stage of labour compared to expectant or physiological management lowers maternal blood loss and reduces the risk of PPH. Prophylactic oxytocics should be offered routinely in the management of the third stage of labour as they reduce the risk of PPH by about 60%.
3. For women without specific 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.
4. 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.
5. For women delivering by caesarean section, an oxytocin infusion (40 iu in 500ml Normal Saline 0.9% over 4 hours) should be considered in addition to a bolus oxytocin 5iu as it reduces the need for additional uterotonic agents and reduces the risk of Major PPH for inexperienced operators.
6. A bolus dose of oxytocin may be inappropriate in some women, such as those with major cardiovascular disorders, suggesting that a low-dose infusion might be a safer alternative.
7. All women who have had a previous caesarean section must have the placental site determined by ultrasound because of the increased risk of placenta accreta/percreta.
8. Women with placenta accreta/percreta are at very high risk of major PPH. If placenta accreta or percreta is diagnosed antenatally, there should be consultant-led multidisciplinary planning for delivery.
9. Once PPH has been identified, management involves four components, all of which must be undertaken simultaneously: Communication, Resuscitation, Monitoring and Investigation, Arresting the bleeding.
10. Training for all birth attendants in the management of PPH is recommended. Multi-disciplinary Skills and Drills sessions should be scheduled at regular intervals.
11. Major PPH should be notified through a clinical incident reporting or risk management system.

1. Purpose and Scope

The 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 (Mousa and Alfirevic, 2007). PPH can be minor (500–1000 ml) or major (more than 1000 ml). Major can be divided into moderate (1000–2000 ml) or severe (more than 2000 ml). The recommendations in this guideline apply to women experiencing primary PPH of 500 ml or more. Women with pre-existing bleeding disorders such as haemophilia and women taking therapeutic anticoagulants are at increased risk of PPH as are women diagnosed with a morbidly adherent placenta (placenta accreta/percreta); this guideline does not include specific recommendations for the management of such situations, nor for managing haemorrhage in women who refuse blood transfusion. Additional guidance on these topics is available from other sources (Demers et al, 2005; Italian Association of Haemophilia Centres, 2003; Royal College of Surgeons of England, 2002; Association of Anaesthetists of GB and Ireland, 2005).

This guideline has been developed primarily for health professionals working in consultant-led obstetric units in Ireland; recommendations may be less appropriate for other settings where facilities, resources and routine practice differ.

2. Introduction and background

Obstetric haemorrhage remains one of the major causes of maternal death in both developed and developing countries. Major obstetric haemorrhage and the need for peripartum hysterectomy has been the subject of a high profile enquiry in Ireland (www.dohc.ie/publications/lourdes.html). In the UK seventh report of the Confidential Enquiries into Maternal Deaths (2003–2005), haemorrhage was the third highest direct cause of maternal death (6.6 deaths/million maternities) (Confidential Enquiry into Maternal and Child Health, 2006). Even in developed countries, the majority of maternal deaths due to haemorrhage must be considered preventable, with 10 of 17 (58%) cases in the 2003–2005 triennium judged to have received 'major substandard care'. Haemorrhage emerges as the major cause of severe maternal morbidity in almost all 'near miss' audits in both developed and developing countries.

In Scotland, the rate of life-threatening haemorrhage (blood loss 2.5 litres or more or women who received more than 5 units of blood transfusion or women who received treatment for coagulopathy after an acute event) is estimated at 3.7/1000 maternities (Brace et al, 2007). Because of its importance as a leading cause of maternal mortality and morbidity, and because of evidence of sub-standard care in the majority of fatal cases, obstetric haemorrhage must be considered as a priority topic for national guideline development (Scottish Obstetric Guidelines and Audit Project, 1998). Obstetric haemorrhage encompasses both antepartum and post partum bleeding. This guideline is restricted in scope to the management of primary post partum haemorrhage (PPH). Nevertheless, antepartum haemorrhage is often associated with subsequent PPH and the content of this guideline will have relevance for the care of these women.

3. Methodology

This guideline was produced by: Professor Deirdre Murphy (Trinity College Dublin and Coombe Women and Infants University Hospital) and peer reviewed by:

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This guideline is adapted and updated from RCOG guideline No.52 '*Prevention and Management of Postpartum Haemorrhage*' (November 2009). The Cochrane Library (including the Cochrane Database of Systematic Reviews, DARE and EMBASE), TRIP, Medline and PubMed (electronic databases) were searched for relevant randomised controlled trials, systematic reviews and meta-analyses. The original search was restricted to articles published between 2002 and March 2007. The search for this guideline was updated in August 2011.

The databases were searched using the relevant MeSH terms, including all subheadings, and this was combined with a keyword search. Search words included 'postpartum haemorrhage', 'factor VII', 'Syntocinon', 'carbetocin', 'carboprost', 'oxytocics', 'uterotonics', 'B-lynch suture', 'uterine artery embolism', 'bilateral ligation', 'balloon, Rusch, Sengstaken catheters' and the search limited to humans and English language. The National Library for Health and the National Guidelines Clearing House were also searched for relevant guidelines and reviews. Where possible, recommendations are based on available evidence and the areas where evidence is lacking are annotated as 'good practice points'.

4. Clinical Guidelines

4.1 Definition of postpartum haemorrhage

How should postpartum haemorrhage care be applied?

Primary PPH involving an estimated blood loss of 500–1000 ml (and in the absence of clinical signs of shock) should be described as MINOR PPH and prompt basic measures (close monitoring, intravenous access, full blood count, group and screen, insert urinary catheter) to facilitate resuscitation should it become necessary.

If a woman with primary PPH is continuing to bleed after an estimated blood loss of 1000 ml (or has clinical signs of shock or tachycardia associated with a smaller estimated loss), this should be described as MAJOR PPH and prompt a full protocol of measures to achieve resuscitation and haemostasis.

The traditional World Health Organization definition of primary PPH encompasses all blood losses over 500 ml (World Health Organisation, 1990). Most mothers in Ireland can readily cope with a blood loss of this order and an estimated loss of more than 1000 ml has been suggested as an appropriate cut-off point for major PPH which should prompt the initiation of a protocol of emergency measures (Drife,

1997). A low antenatal haemoglobin (less than 11 g/dl) should be investigated and treated appropriately to optimise haemoglobin before delivery.

This guideline adopts a pragmatic approach, whereby an estimated blood loss of 500–1000 ml (in the absence of clinical signs of shock) prompts basic measures of monitoring and 'readiness for resuscitation', whereas an estimated loss of more than 1000 ml (or a smaller loss associated with clinical signs of shock, tachycardia, hypotension, tachypnoea, oliguria or delayed peripheral capillary filling) prompts a full protocol of measures to resuscitate, monitor and arrest the bleeding.

Allowing for the physiological increase in pregnancy, total blood volume at term is approximately 100 ml/kg (an average 70 kg woman-total blood volume of 7000 ml) a blood loss of more than 40% of total blood volume (approx 2800 ml) is generally regarded as 'life-threatening' (Jansen et al, 2005). It seems appropriate that PPH protocols should be instituted at an estimated blood loss well below this figure, as the aim of management is to prevent haemorrhage escalating to the point where it is life-threatening. As visual blood loss estimation often underestimates blood loss, (Glover, 2003; Toledo et al, 2007) more accurate methods may be used, such as blood collection drapes for vaginal deliveries and weighing swabs (Patel et al, 2006).

4.2 Prediction and prevention of primary postpartum haemorrhage

What are the risks of PPH and how can they be minimised?

Most cases of PPH have no identifiable risk factors therefore vigilance and early recognition of haemorrhage is required in all settings.

Health professionals must be aware of specific antenatal and intrapartum risk factors for PPH and should take these into account when counselling women about place of delivery and type of care. Care plans must be modified when risk factors are identified.

Active management of the third stage of labour compared to expectant or physiological management lowers maternal blood loss and reduces the risk of PPH.

Prophylactic oxytocics should be offered routinely in the management of the third stage of labour as they reduce the risk of PPH by about 60%.

For women without specific 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.

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.

For women delivering by caesarean section, an oxytocin infusion (40 iu in 500ml Normal Saline 0.9% over 4 hours) should be considered in addition to a bolus

oxytocin 5 iu as it reduces the need for additional uterotonic agents and reduces the risk of Major PPH for inexperienced operators.

A bolus dose of oxytocin may be inappropriate in some women, such as those with major cardiovascular disorders, suggesting that a low-dose infusion might be a safer alternative.

All women who have had a previous caesarean section must have the placental site determined by ultrasound. Where facilities exist, magnetic resonance imaging (MRI) may be a useful tool to assist in determining whether the placenta is accreta or percreta.

Women with placenta accreta/percreta are at very high risk of major PPH. If placenta accreta or percreta is diagnosed antenatally, there should be consultant-led multidisciplinary planning for delivery.

Investigators from the USA, the UK, and Zimbabwe analysed data from case-control studies to quantify the level of risk associated with various antenatal and intrapartum factors (Coombs et al, 1991; Stones et al, 1993; Al-Zirqi et al, 2008; Tsu, 1993). Information on risk factors for PPH is summarised in Table 1 along with an approach adapted from a guideline on prevention and management of postpartum haemorrhage from the Society of Obstetricians and Gynaecologists of Canada (Leduc, 2009).

A recent Cochrane review addressing prophylaxis in the third stage of labour for women delivering vaginally included five trials involving 6,477 women (Begley et al, 2010). It found that active management (which included the use of a uterotonic, early clamping of the umbilical cord and controlled traction for the delivery of the placenta) was associated with a reduced risk of severe primary haemorrhage (> 1000 ml) (relative risk 0.34, 95% confidence interval 0.14 to 0.87) and of maternal Hb < 9g/dl following birth (RR 0.50, 95% CI 0.30 to 0.83). However, active management was associated with an increased incidence of nausea, vomiting and raised blood pressure; side effects usually related to use of ergometrine containing uterotonic agents (e.g. syntometrine).

A further Cochrane review specifically addressed prophylactic ergometrine-oxytocin (syntometrine) versus oxytocin for the third stage of labour; six trials were included (McDonald, 2004). The review indicated that syntometrine, oxytocin 5 iu and oxytocin 10 iu, have similar efficacy in prevention of PPH in excess of 1000 ml (syntometrine versus any dose oxytocin: odds ratio 0.78, 95% confidence interval 0.58–1.03; syntometrine versus oxytocin 5 iu: odds ratio 0.14, 95% confidence interval 0.00–6.85; syntometrine versus oxytocin 10 iu: odds ratio 0.78, 95% confidence interval 0.59–1.04).

Syntometrine carried a five-fold increased risk of the unpleasant side effects of nausea, vomiting and elevation of blood pressure (odds ratio 4.92, 95% confidence interval 4.03–6.00). The oxytocic regimens used in individual trials comprised a mixture of intravenous and intramuscular administration. Appraisal of the evidence from these reviews, together with consideration of standard practice in Ireland and the recommendations of the British National Formulary (BNF), 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.

A further review considered prostaglandins for the prevention of postpartum haemorrhage (Gulmezoglu et al, 2007). It included 32 trials and concluded that conventional injectable uterotonics were preferable to prostaglandins for routine prophylaxis and that research on prostaglandins in the context of obstetric haemorrhage should focus on treatment, rather than prevention. Misoprostol (600 micrograms orally) is not as effective when compared with oxytocin (10 iu intravenously) in preventing PPH; it also carries increased adverse effects, which are dose related (Alfirevic et al, 2007).

Four randomised trials have compared alternative uterotonics for prophylaxis in women delivering by caesarean section (Dennehy et al, 1998; Munn et al, 2001; Lokugamage, 2001; Chou and MacKenzie, 1994).

Appraisal of the evidence from these trials, together with consideration of standard practice in the UK, led the development group for the National Institute for Health and Clinical Excellence *Caesarean Section* guideline to recommend oxytocin 5 iu by slow intravenous injection for prophylaxis in the context of caesarean delivery (National Collaborating Centre for Women's and Children's Health, 2004). A large multi-centre trial of 2069 women delivered by elective caesarean section in Ireland found that an oxytocin infusion (40iu in 500ml Hartmanns over 4 hours) in addition to an oxytocin bolus (5iu slowly iv) had no effect on overall rates of Major PPH compared with oxytocin bolus and placebo infusion, but that the need for an additional uterotonic agent was reduced (Sheehan et al, 2011).

Major PPH was reduced following use of oxytocin bolus and oxytocin infusion at caesarean section by inexperienced obstetricians compared to senior obstetricians. Side effects were not increased by use of an oxytocin infusion after an initial bolus.

A longer-acting oxytocin derivative, carbetocin, is licensed in the UK and Ireland specifically for the prevention of PPH in the context of caesarean delivery. Randomised trials suggest that a single dose (100 micrograms) of carbetocin is at least as effective as oxytocin by infusion or oxytocin bolus (Boucher et al, 1998; Dansereau et al, 1999; Attilakos et al, 2010).

Several small trials have also compared carbetocin with Syntometrine and with oxytocin by infusion in the context of vaginal delivery (Leung et al, 2006; Boucher et al, 2004). Again, carbetocin appeared to be at least as effective as the more conventional regimen. Carbetocin is not currently recommended for routine use because of the limited data and its higher price.

Abnormally adherent placenta (placenta accreta and the more severe forms: increta or percreta) is associated with catastrophic haemorrhage and carries a high mortality. The incidence appears to be increasing and has been linked to the increase in caesarean section, particularly repeat caesarean section (You and Zahn, 2006). The management of abnormally adherent placenta requires specialist multi-disciplinary care and is the subject of a separate related guideline.

4.3 Management of primary PPH?

How should primary PPH be managed?

Once PPH has been identified, management involves four components, all of which must be undertaken **SIMULTANEOUSLY**: Communication, Resuscitation, Monitoring and Investigation, Arresting the bleeding.

Health professionals should be aware that minor PPH can easily progress to major PPH and is sometimes unrecognised.

Where primary PPH occurs in a woman delivering outside a consultant-led maternity unit, the role of the professionals on site is to institute 'first aid' measures while arranging transport to a consultant-led maternity unit by the most expeditious means.

4.4 Communication

Who should be informed when the woman presents with postpartum haemorrhage?

Basic measures for MINOR PPH (blood loss 500–1000 ml, no clinical shock):

- Alert the midwife-in-charge
- Alert first-line obstetric and anaesthetic staff trained in PPH care

Full protocol for MAJOR PPH (blood loss more than 1000 ml and continuing to bleed OR clinical shock):

- Call experienced midwife (in addition to midwife in charge)
- Call obstetric middle grade and alert consultant
- Call anaesthetic middle grade and alert consultant
- Alert consultant clinical haematologist on call
- Alert blood transfusion laboratory
- Call porters for delivery of specimens/blood
- Alert one member of the team to record events, fluids, drugs, vitals

Early involvement of appropriate senior staff including laboratory specialists is fundamental to the management of PPH. Clinicians and blood transfusion staff should liaise at a local level to agree i) 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 and ii) a timescale in which to produce various products.

It is vital that trainee obstetricians and anaesthetists do not perceive the calling of senior colleagues as involving 'loss of face'. Senior staff must be receptive to concerns expressed by juniors and by midwives. In contemporary Irish maternity services, intrapartum care within consultant units should be consultant-based, rather than simply consultant-led. In the face of major PPH with continuing bleeding, a consultant obstetrician should be alerted and should normally attend to provide hands-on patient care. If a midwife perceives a need for a consultant obstetrician's presence, they should feel able to call a consultant colleague themselves if on-site obstetric junior staff appear reluctant to do so.

Communication with the patient and her birthing partner is important and clear information of what is happening should be given, as this is a very frightening event.

4.5 Resuscitation

How should the patient be resuscitated?

Basic measures for MINOR PPH (blood loss 500–1000 ml, no clinical shock):

- Intravenous access (14-gauge cannula x 1)
- Commence crystalloid infusion
- Insert urinary catheter

Full protocol for MAJOR PPH (blood loss > 1000 ml and continuing to bleed OR clinical shock):

- Assess airway
- Assess breathing
- Assess circulation
- Oxygen by mask at 10–15 litres/minute
- Intravenous access (large gauge cannula x 2)
- Position 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 fluid solution, crystalloid (2 litres) and/or colloid (1–2 litres), rapidly as required
- The best equipment available should be used to achieve RAPID WARMED infusion of fluids
- Special blood filters should NOT be used for non-blood products, as they slow infusions
- Recombinant factor VIIa therapy should be based on clinical evaluation and on the results of coagulation
- Apply clinical judgement in each situation

Fluid therapy and blood product transfusion:

Crystalloid Up to 2 litres Hartmann's solution (or similar)

Colloid Up to 1–2 litres colloid until blood arrives

Blood Cross-matched

If cross-matched blood is unavailable, give when available group-specific blood or give 'O RhD negative' blood, whichever is available sooner.

Solvent Detergent (SD) plasma 4 units for every 6 units of red cells or prothrombin time/activated partial thromboplastin time > 1.5 x normal (12–15ml/kg or total 1litres)

Platelets If platelet count < 50 x 10⁹ Give one adult therapeutic dose

Fibrinogen concentrate Give 4g if fibrinogen < 1.5g/l

A primary survey of a collapsed or severely bleeding woman should follow a structured approach of simple 'ABC', with resuscitation taking place as problems are identified; that is, a process of simultaneous evaluation and resuscitation. The

urgency and measures undertaken to resuscitate and arrest haemorrhage need to be tailored to the degree of shock.

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.

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 grossly underestimated (Glover, 2003; Toledo et al, 2007; Patel et al, 2006). Compatible blood (supplied in the form of red cell concentrate) is the best fluid to replace major blood loss and should be transfused as soon as available. The clinical picture should be the main determinant for the need of blood transfusion and time should not be wasted waiting for laboratory results (Ho et al, 2005; Hirshberg et al, 2003).

A 2006 guideline from the British Committee for Standards in Haematology summarises the main therapeutic goals of management of massive blood loss is to maintain (Stainsby et al, 2006):

- Haemoglobin > 8g/dl
- Platelet count > 75 x 10⁹/l
- Prothrombin < 1.5 x mean control
- Activated prothrombin times < 1.5 x mean control
- Fibrinogen > 1.0 g/l **

** Note for obstetric settings the goal is to maintain Fibrinogen >1-5-2.0 g/l (Rossaint et al, 2010)

4.5.1 Fluid replacement

By consensus, 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 blood (Schierhout and Roberts, 1998). The choice of fluid to be infused is controversial but of greater importance is rapid administration and warming of the infusion. The woman needs to be kept warm using appropriate measures.

4.5.2 Blood transfusion

If fully cross-matched blood is unavailable by the time that 3.5 litres of clear fluid have been infused, the best available alternative should be given to restore oxygen-carrying capacity. Group O RhD-negative blood may be the safest way to avoid a mismatched transfusion in an acute emergency. However, for most women, the ABO and rhesus groups will have been determined on a current admission sample; if not, testing on a new sample takes 10 minutes; then ABO & D group-compatible, uncross-matched blood can be issued.

All delivery units, especially small units without a blood bank on site, should maintain a supply of O RhD-negative blood, as this might offer the only means of restoring oxygen-carrying capacity within an acceptable timescale. The minimum number of units of O RhD-negative to be maintained on site should be agreed within local protocols and should reflect the likely period of delay in the arrival of further supplies should a dire emergency arise. Small delivery units remote from the nearest blood bank will require a larger minimum supply than those within a short distance of a blood bank. In addition, the Confidential Enquiry into Maternal and Child Health recommends that women with known risk factors for PPH should not be delivered in a hospital without a blood bank on site (Confidential Enquiry into Maternal and Child Health, 2006).

Bedside testing of haemoglobin can be used with caution to give an indication of urgency and therefore of the type of blood to be transfused. However, the use of adequate quality control for testing devices, together with the training of theatre staff and the use of standard operating procedures and compliance with the hospital guidelines should be maintained. The Serious Hazards of Transfusion (SHOT) reporting scheme has highlighted the risk of errors in using near-patient testing of haemoglobin measurements to guide transfusion (www.shotuk.org).

Intra-operative 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 being used in cardiac, orthopaedic and vascular surgery with relative reduction of blood transfusion by 39% and absolute risk reduction by 23%, with cell salvage not appearing to impact adversely on clinical outcomes (Carless et al, 2006; Allam, et al, 2008). Although large prospective trials of cell salvage with auto-transfusion in obstetrics are lacking, to date, no single serious complication leading to poor maternal outcome has been directly attributed to its use. Current evidence, albeit limited, supports the use of cell salvage in obstetrics, which is likely to become increasingly commonplace, but more data are required concerning its clinical use and safety (National Institute of Clinical Excellence, 2005).

4.5.3 Additional blood components

When the blood loss reaches about 4.5 litres (80% of blood volume) and large volumes of replacement fluids have been given there will be clotting factor defects and blood components should be given. While acknowledging the general principle that results of coagulation studies and the advice of a haematologist should be used to guide transfusion of coagulation factors, up to 4 pools of SD plasma and 4 G of fibrinogen may be given empirically in the face of relentless bleeding, while awaiting the results of coagulation studies (Walker et al, 1994). Such empirical use of SD plasma and fibrinogen is in line with recommendations from the British Committee for Standards in Haematology (www.transfusionguidelines.org.uk). Clinicians should be aware that these blood products 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.

4.5.4 Recombinant factor VIIa therapy

Recombinant activated factor VII (rFVIIa) was developed for the treatment of haemophilia. Over the past decade, it has also been used to control bleeding in other circumstances. A 2007 review identified case reports of 65 women treated with rFVIIa for PPH (Franchini et al, 2007).

Although the case reports suggested that rFVIIa reduced bleeding, 30 of the 65 women underwent peripartum hysterectomy. In the face of life-threatening PPH, and in consultation with a haematologist, rFVIIa may be used as an adjuvant to standard pharmacological and surgical treatments. A suggested dose is 90 micrograms/kg, which may be repeated in the absence of clinical response within 15–30 minutes (Sobieszczyk and Breborowicz, 2004). Although there is no clear evidence of thrombosis with the use of rFVIIa in obstetric practice, there have been case reports of thrombosis with the use in cardiac surgery (Birchall et al, 2008; Haynes et al, 2007; Franchini et al, 2008). Women with PPH are particularly susceptible to severe hypofibrinogenaemia; rFVIIa will not work if there is no fibrinogen and effectiveness may also be suboptimal with severe thrombocytopenia (less than $20 \times 10^9/l$). Therefore, fibrinogen should be above 1g/l and platelets greater than $50 \times 10^9/l$ before rFVIIa is given. It is also important to maintain pH >7.1 and prothombin time $<1.5 \times$ ULN to try and ensure optimal effectiveness of Rfviiia. If there is a suboptimal clinical response to rFVIIa, these should be checked and acted on (with fibrinogen concentrate or platelet transfusion as appropriate) before a second dose is given.

4.5.5 Antifibrinolytic drugs

Although evidence is conflicting, there is a consensus view that fibrinolytic inhibitors (such as tranexamic acid) seldom, if ever, have a place in the management of obstetric haemorrhage (Stainsby et al, 2006; Walker, et al, 2004). The results of the World Maternal Antifibrinolytic trial (WOMAN) are awaited (www.thewomantrial.lshtm.ac.uk).

4.6 Monitoring and Investigation

What investigations should be performed and how should the woman be monitored?

Basic measures for MINOR PPH (blood loss 500–1000 ml, no clinical shock):

- Consider venepuncture (20 ml) for:
 - Group and screen
 - Full blood count
 - Coagulation screen including fibrinogen
 - Pulse and blood pressure recording every 15 minutes

Full Protocol for MAJOR PPH (blood loss greater than 1000 ml and continuing to bleed OR clinical shock):

- Consider 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)
- Transfer to a high dependency unit on delivery suite once the bleeding is controlled or an intensive therapy unit if appropriate
- Recording of parameters on a flow chart such as a high dependency chart or the modified obstetric early warning system charts
- Documentation of fluid balance, blood, blood products and procedures

Fluid replacement and the use of blood and blood products should be strictly monitored and the amount given should be dictated by the lead clinician (consultant anaesthetist or consultant obstetrician) aided by the results of full blood count and clotting screen under the guidance of a haematologist and/or consultant in transfusion medicine. Continuous physiological monitoring is necessary and the recording of parameters over time on a flowchart that will give the reader good visual cues on the clinical progress of the patient. The need to continually re-evaluate the woman's physiological condition, even when bleeding appears to have stopped, is essential to recognise continuing bleeding. Record keeping on an intensive-care unit style chart would help in monitoring the clinical situation.

The presence of a central line not only provides a means of accurate central venous pressure (CVP) 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 (Walker et al, 1994) and others advocating caution (Franchini et al, 2007). CVP 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 (Confidential Enquiry into Maternal and Child Health, 2006).

It is also important that, once the bleeding is arrested and any coagulopathy is corrected, thrombo-prophylaxis is administered, as there is a high risk of thrombosis. Alternatively, pneumatic compression devices can be used, if thrombo-prophylaxis is contraindicated in cases of thrombocytopenia.

4.7 Anaesthetic management

What is the safest form of anaesthesia for management of MAJOR PPH?

If cardiovascular stability has been achieved, the patient remains stable, further bleeding is unlikely and there is no evidence of coagulation failure, one may consider the use of an existing functioning epidural catheter. When there is ongoing bleeding and cardiovascular stability is compromised, general anaesthesia is more appropriate. A rapid sequence induction with pre-

oxygenation, cricoids pressure, endotracheal intubation should be used to reduce the risk of aspiration in the immediately post-partum patient.

All emergency equipment (including difficult intubation, invasive monitoring, anaesthetic medications and inotropes) should be checked and readily available. Active warming devices including fluid warmers, hot air convection blankets or warming mats should be employed at the start of anaesthesia (if not already in place) to minimise heat loss and reduce the risk of hypothermia contributing to the development of coagulopathy.

Cardiostable induction agents with minimal peripheral vasodilating effects should be considered. Ventilation with high inspired oxygen concentrations may be necessary to optimise oxygenation until the bleeding is under control.

4.8 Arresting the bleeding

What approach should be taken to arrest the bleeding?

The most common cause of primary PPH is uterine atony. However, clinical examination and haematological assessment must be undertaken to exclude other or additional causes such as:

- Retained products (placenta, membranes, clots)
- Vaginal/cervical lacerations or haematoma
- Ruptured uterus
- Broad ligament haematoma
- Extragenital bleeding (for example, subcapsular liver rupture)
- Uterine inversion
- Abnormalities of coagulation

When uterine atony is perceived to be a cause of the bleeding, the following mechanical and pharmacological measures should be instituted, in turn, until the bleeding stops:

- Bimanual uterine compression (rubbing up the fundus) to stimulate contractions
- Ensure bladder is empty (Foley catheter, leave in place)
- Syntocinon 5 units by slow intravenous injection (may repeat dose)
- Ergometrine 0.5 mg by slow intravenous or intramuscular injection (contraindicated in women with hypertension)
- Syntocinon infusion (40 units in 500 ml Normal Saline 0.9% at 125 ml/hour) unless fluid restriction is necessary
- 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)
- Direct intramyometrial injection of carboprost 0.5 mg (contraindicated in women with asthma), unlicensed use at discretion of clinician
- Misoprostol 600 micrograms orally or sublingual

If pharmacological measures fail to control the haemorrhage, the following interventional / surgical measures should be instituted until the bleeding stops:

- Balloon tamponade
- Haemostatic brace suturing (such as B-Lynch approach)
- Bilateral ligation of uterine arteries
- Bilateral ligation of internal iliac (hypogastric) arteries

- Selective arterial embolisation
- Hysterectomy

Clinicians should resort to hysterectomy SOONER RATHER THAN LATER (especially in cases of placenta accreta or uterine rupture).

A second consultant clinician should be consulted in the decision for hysterectomy.

A 2006 Cochrane review addressing the treatment of primary postpartum haemorrhage identified only three randomised controlled trials (Mousa and Alfirevic, 2007). All three studies related to the role of misoprostol in the treatment of PPH; no trials dealing with surgical techniques, radiological interventions or other haemostatic drugs were identified. Thus, recommendations on treatment strategies are based largely on observational data and consensus.

4.8.1 What mechanical and pharmacological strategies can be used?

The simple mechanical and physiological measures of 'rubbing up the fundus', bimanual uterine compression and emptying the bladder to stimulate uterine contraction, represent time-honoured first-line management of PPH. Professional consensus supports their continued use.

Despite decades of empirical use in clinical practice, there are no trials comparing oxytocin and ergometrine as first-line agents for the treatment (rather than prevention) of PPH. It seems appropriate to use both agents, although oxytocin is to be preferred initially especially in women with prior hypertension or pre-eclampsia. The British National Formulary recommends a dose of '5–10 units by slow intravenous injection'; however, the 1997–1999 report of the UK CEMD highlighted the risk of profound hypotension, which may be associated with oxytocin injection (Confidential Enquiry into Maternal Deaths, 2001; Buttino and Garite, 1986). Thus the guideline recommends that 'when given as an intravenous bolus, the drug should be given slowly in a dose of not more than 5 units'.

Similarly, there are no trials comparing the prostaglandin carboprost with other uterotonic agents. However, two case series from the USA comprising 26 and 237 cases, respectively, report success in controlling haemorrhage, without resorting to surgical means in 85% and 95% of cases (Buttino and Garite, 1986; Oleen and Mariano, 1990). If bleeding occurs at the time of caesarean section, intramyometrial injection of carboprost can be used and, if 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.

Two systematic reviews focused on misoprostol to treat PPH and address optimal route, dosage and efficacy (Mousa and Alfirevic, 2007; Hofmeyr et al, 2005). In view of the scant data available, the more established uterotonic prostaglandin, carboprost, would seem preferable for the treatment of PPH in Irish settings. Where there are contraindications to carboprost (usually asthma), misoprostol (prostaglandin E1) may be an appropriate alternative.

A single dose of misoprostol 600 micrograms by the oral or sub-lingual route is recommended by FIGO for prophylaxis or treatment of PPH (www.figo.org) (Weeks and Faundes, 2007).

4.8.2 What surgical treatments can be employed to arrest the bleeding?

The judgement of senior clinicians, taking into account the individual woman's future reproductive aspirations, is required in deciding the appropriate sequence of interventions. Surgical techniques like 'tamponade and haemostatic suture' may give immediate arrest of haemorrhage and facilitate an early decision regarding the need for hysterectomy. Compression of the aorta may be a temporary but effective measure to allow time for resuscitation to catch up with the volume replacement and for the appropriate surgical support to arrive.

The decision for hysterectomy should be made by an experienced consultant clinician (preferably after discussion with a second experienced consultant clinician, if available) and the procedure should be carried out by a surgeon who is experienced in carrying out hysterectomy. An explanation should be given to the woman and/or her partner and written consent should be documented where possible. Early recourse to hysterectomy is recommended, especially where bleeding is associated with placenta accreta or uterine rupture and should not be delayed until the woman is in extremis. Subtotal hysterectomy is the operation of choice in many instances of PPH requiring hysterectomy, unless there is trauma to the cervix or lower segment; the risk of neoplasia developing in the cervical stump several years later is not relevant in the context of life-threatening haemorrhage.

4.8.3 Balloon tamponade

In recent years, tamponade using various types of hydrostatic balloon catheter has superseded uterine packing for control of atonic PPH. Case series have used a Foley catheter, Bakri balloon, Sengstaken–Blakemore oesophageal catheter and a condom catheter (Ikechebelu et al, 2005; Bakri et al, 2001; Chan et al, 1997; Condous et al, 2003; Akhter et al, 2003). The urological Rusch balloon has been described as preferable by virtue of larger capacity, ease of use and low cost (Keriakos and Mukhopadhyay, 2006). The Scottish Confidential Audit of Severe Maternal Morbidity identified 64 cases where balloon tamponade was used for the management of major PPH; hysterectomy was averted in 50 (78%) women (Brace et al, 2007). Some reports of balloon tamponade describe the intervention as the 'tamponade test' (Akhter et al, 2003; Frenzel et al, 2005). 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.

There is no clear evidence 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 day time hours, in the presence of appropriate senior staff, should further intervention be necessary (Chan et al,

1997; Condous et al, 2003). Before its complete removal, the balloon could be deflated but left in place to ensure that bleeding does not reoccur.

4.8.4 Haemostatic suturing

Over the past decade, case series have been published describing success with haemostatic brace sutures. The version described by B-Lynch in 1997 requires hysterotomy for its insertion and is thus particularly suitable when the uterus has already been opened at caesarean section (www.cblynch.com/HTML/bjog1.html) (B-Lynch et al, 1997). A review published in 2005 of 32 cases of B-Lynch suture reported success in all but one case (Harma et al, 2005). In 2002, Hayman *et al.* described a modified compression suture which does not require hysterotomy and in 2007, Ghezzi *et al.* reported success in 10 of 11 women managed with the Hayman suture (Hayman et al, 2002; Ghezzi et al, 2007). Further variants on these techniques have been described (Hwu et al, 2005; Kafali et al, 2003).

The Scottish Confidential Audit of Severe Maternal Morbidity reported that hysterectomy was averted in 42 of 52 cases (81%) where haemostatic brace suturing was used for the management of major PPH (Brace et al, 2007). These observational data suggest that haemostatic suture techniques are effective in controlling severe PPH and in reducing the need for hysterectomy. Obstetricians are encouraged to familiarise themselves with one technique, under the supervision of an experienced colleague. Experience with these techniques is limited and few complications have been reported to date.

4.8.5 Internal iliac artery ligation

A recent case series described 84 women with PPH from various causes who underwent internal iliac artery ligation as the first-line surgical intervention. Hysterectomy was required in 33 women (39%) (Joshi et al 2007). A lack of comparative studies means that it is impossible to assess which of the various 'surgical' haemostatic techniques is most effective. Nevertheless, the available observational data suggest that balloon tamponade and haemostatic suturing may be more effective than internal iliac artery ligation and they are unquestionably easier to perform. A follow-up study of 45 women suggested that internal iliac artery ligation does not impair subsequent fertility and pregnancy outcomes (Nizard et al, 2003).

4.8.6 Selective arterial occlusion or embolisation by interventional radiology

A 2002 review summarised case series totalling 100 women and reporting 97% success with selective arterial embolisation for obstetric haemorrhage (Dildy, 2002). Subsequent case series have reported success in 1 of 1, 4 of 4, 10 of 10 and 26 of 29 women (wee et al, 2004; Bloom et al, 2004; Hong et al, 2004; Yong and Cheung, 2006). The Scottish Confidential Audit of Severe Maternal Morbidity identified 14 cases where arterial embolisation was used for the management of major PPH; hysterectomy was averted in 10 (71%) women (Brace et al, 2007). The

logistics of performing arterial occlusion or embolisation where the equipment or an interventional radiologist may not be available on-site mean that uterine balloon tamponade (which appears to have similar efficacy) is a more appropriate first-line treatment. Nevertheless, pre-operative interventional radiology may be considered in cases of placenta praevia with accreta if intra-arterial balloons can be placed in the radiology department before the woman goes to theatre for caesarean section (see HSE accreta guideline). Follow up studies of 17 and 25 women who had undergone arterial embolisation for control of PPH suggest that the intervention does not impair subsequent menstruation and fertility (Salomon et al, 2003; Descargues et al, 2004).

4.8.7 Intensive and high-dependency unit

Once the bleeding has been controlled and initial resuscitation has been completed, continuous close observations in either a high-dependency unit on the labour ward or an intensive care unit is required. The recording of observations on a flowchart would help in the early identification of continuous bleeding, especially in cases which are not apparent.

5. Risk management

5.1 What measures can be taken to ensure optimal management of PPH?

Training for all birth attendants in the management of postpartum haemorrhage is recommended by the Royal College of Midwives (RCM) and RCOG. Multi-disciplinary Skills and Drills sessions should be scheduled at regular intervals.

A formal follow-up meeting that analyses each case and addresses what could be done better in the future should be triggered for every significant PPH. A structured reporting form is available from the National Perinatal Epidemiology Centre (NPEC).

In the seventh CEMD report, failure of identification and management of intra-abdominal bleeding, uterine atony and placenta percreta were the main reasons for substandard care (Confidential Enquiry into Maternal and Child Health, 2006). Furthermore, a reduction in postgraduate training programmes and reduced hours have led to less practical experience, which may result in failure to recognise even the clear signs and symptoms of intra-abdominal bleeding. The Royal Colleges (RCOG, RCM) have thus recommended annual 'skill drills', including maternal collapse. A multidisciplinary approach to treatment should ensure that everyone knows how to work together to ensure prompt and efficient treatment in such an emergency. A prospective randomised trial in the UK demonstrated that practical, multi-professional training in the management of obstetric emergencies increases midwives' and doctors' knowledge. Furthermore, conducting such training locally or in a simulation centre was no different (Crofts et al, 2007; Maslovitz et al, 2007).

5.2 How can documentation be improved when PPH occurs?

Accurate documentation of a delivery with MAJOR PPH is essential. Use of a structured pro forma to aid accurate record keeping should be considered.

MAJOR PPH should be notified through a clinical incident reporting or risk management system.

It is important to record:

- Staff in attendance and the time they arrived
- Sequence of events
- Time of administration/sequence of pharmacological agents given
- Time of surgical intervention, where relevant
- Condition of the mother throughout the different steps
- Timing of the fluid and blood products given

5.3 Debriefing and follow-up

What measures should be put in place following the acute event?

Major obstetric haemorrhage can be traumatic to the woman, her family and the birth attendants; therefore, debriefing is recommended at the earliest opportunity by a senior member of the team who was involved at the time of events.

Arrangements for proper follow-up and investigations, such as screening for coagulopathies and screening for the rare complication of panhypopituitarism (Sheehan syndrome) secondary to hypotension should be offered if appropriate.

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7. Implementation Strategy

- Distribution of guideline to all members of the Institute and to all maternity units.
- Implementation through HSE Obstetrics and Gynaecology programme local implementation boards.
- Distribution to other interested parties and professional bodies.

8. Key Performance Indicators

1. Monitor all cases with blood loss greater than 1000ml.
2. Appropriate management of women with previous PPH.
3. Documentation of management, especially with the timing of events for women who had PPH.
4. Appropriate management of labour and outcome in women with PPH.
5. Notification to the risk management team for women with PPH.
6. Appropriate training of the obstetric team (midwifery and medical staff).

9. Qualifying Statement

These guidelines have been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. Clinical material offered in this guideline does not replace or remove clinical judgement or the professional care and duty necessary for each pregnant woman. Clinical care carried out in accordance with this guideline should be provided within the context of locally available resources and expertise.

This Guideline does not address all elements of standard practice and assumes that individual clinicians are responsible to:

- Discussing care with women in an environment that is appropriate and which enables respectful confidential discussion.
- Advising women of their choices and ensuring informed consent is obtained.
- Meeting all legislative requirements and maintaining standards of professional conduct.
- Applying standard precautions and additional precautions as necessary, when delivering care.
- Documenting all care in accordance with local and mandatory requirements.