Postpartum haemorrhage and haematological management

Ana Pinas Carrillo
Edwin Chandraharan

Abstract
Postpartum haemorrhage (PPH) is one of the leading causes of maternal morbidity and mortality around the world. In the UK, the Centre for Maternal and Child Enquiries (CMACE) confirmed a reduction in maternal deaths due to postpartum haemorrhage during the last Triennium (2006–2008). However, substandard care continues to contribute to more than half of maternal deaths due to postpartum haemorrhage.

Primary PPH is defined by the Royal College of Obstetricians and Gynaecologists (RCOG) Green Top Guideline on Postpartum Haemorrhage as a blood loss of 500 ml or more within 24 hours of the birth. It is further classified into minor (500–1000 ml) or major (>1000 ml) with a further sub classification into moderate (1000–2000 ml) or severe (>2000 ml). Secondary PPH is defined as excessive bleeding between 24 hours and 12 weeks postnatally. A timely, multidisciplinary and systematic approach to restore the volume and clotting system whilst arresting bleeding is essential to improve maternal morbidity and mortality.

Although in some cases, massive obstetric haemorrhage can be anticipated and prevented, such as morbidly adherent placenta, it often occurs unexpectedly in women considered at ‘low risk’. Hence, all clinicians involved in the care of women during pregnancy and delivery should have the knowledge and skills to promptly recognize symptoms, signs and complications of PPH and immediately activate the appropriate protocol which could save lives.

Keywords cell saver; coagulopathy; HAEMOSTASIS; peri-partum hysterectomy; Shock Index; Triple P Procedure; uterine atony

Introduction
Postpartum haemorrhage (PPH) is one of the leading causes of maternal morbidity and mortality around the world. According to the WHO, it accounts for about one third of all pregnancy-related deaths in Africa and Asia. In the UK, it remains the third leading cause of maternal death (6.6 deaths/million maternities). The progressively increase in cesarean section rates, increasing complexity of patients with increasing rates of obesity, comorbidities and increasing maternal age are likely to contribute to an increase in the rate of PPH.

The definition of primary PPH according to the Royal College of Obstetricians and Gynaecologists (RCOG) Green Top Guideline on PPH states a blood loss of 500 ml or more within 24 hours of the birth. It is further classified into minor (500–1000 ml) or major (>1000 ml) with a further sub classification into moderate (1000–2000 ml) or severe (>2000 ml). Secondary PPH is defined as excessive bleeding between 24 hours and 12 weeks postnatally.

However, clinicians should appreciate that even a smaller blood loss (i.e. <1000 ml) may result in haemodynamic instability in a patient who is anaemic prior to delivery. Similarly, a woman with a low body mass index (BMI) may not be able to withstand even a moderate blood loss (1000–2000 ml) in view of her smaller circulating blood volume. Hence, it is more clinically prudent to consider massive PPH as a loss of >30% of blood volume or any blood loss that results in haemodynamic instability.

It is well recognized that visual estimation of blood loss by clinicians is notoriously inaccurate. It is important to also assess the rate of bleeding and associated haemodynamic response of the woman, so as to institute appropriate management. It is also useful to determine other parameters such as the Shock Index, which is defined as the pulse rate divided by systolic blood pressure (Pulse rate/SBP).

According to the Scottish Confidential Audit into Severe Maternal Morbidity, the incidence of massive obstetric haemorrhage (2500 ml) or women who received more than 5 litres of blood is estimated at 3.7/1000 maternities. Emergency caesarean sections were associated with an approximately three fold increase in postpartum haemorrhage as compared to elective caesarean section or spontaneous vaginal births.

Various risk matrices have been proposed to predict the occurrence of massive PPH. However, up to 40% of cases of PPH occur in women that are initially classified as ‘low risk’. This highlights the need for clinicians to be vigilant and anticipate, recognize and promptly institute timely and appropriate management to reduce morbidity and to avoid mortality due to massive postpartum haemorrhage. The role of multi-disciplinary simulation training, labour ward fire drills and development of local protocols for systematic, multi-disciplinary management of massive obstetric haemorrhage (e.g. ‘Code Blue’) cannot be overemphasized.

Rule of 30 (Table 1) and Shock Index (SI) are useful tools that could be used by clinicians in an emergency to understand the amount of blood loss and the degree of haemodynamic compromise. Shock Index refers to pulse rate divided by systolic blood pressure (PR/SBP) and its normal value is 0.5–0.7. As a woman bleeds, the heart rate increases in order to compensate for the blood loss, much before any changes in systolic blood pressure are observed. Hence, the Shock Index (SI) increases. In severe haemorrhage, SI increases to 0.9–1.1 and it has been reported that a Shock Index of >0.9 was associated with a need for intensive therapy on admission. Recently, an ‘Obstetric Shock Index’ (OSI) in a pregnant population has been described and based on the Pilot Study, the authors concluded that if the Obstetric Shock Index is >1 (i.e. Pulse Rate > SBP), then there is a significant increase in the rate of blood transfusion. Therefore, OSI may serve as a useful adjunct to reduce errors due to visual estimation of blood loss.
‘Rule of 30’ for massive obstetric haemorrhage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure</td>
<td>Falls by 30 mmHg</td>
</tr>
<tr>
<td>Pulse</td>
<td>Increases by 30 beats/minute</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Falls by 30% (approx 3 g/dl)</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>Falls by 30%</td>
</tr>
<tr>
<td>Estimated blood loss</td>
<td>30% of normal (70 ml/kg in adults) (100 ml/kg during pregnancy)</td>
</tr>
</tbody>
</table>

Table 1

Haematological management involves recognition of the amount and rapidity of blood loss and replacing the circulating blood volume and restoring ‘coagulability’ of blood. Massive postpartum haemorrhage resulting in a ‘washout phenomenon’ and depletion of coagulation factors is likely once 80% of the blood volume has been lost. This equates to approximately a blood loss of 4.5 litres in an ‘average size’ woman. However, coagulopathy may set in earlier, especially if there is rapid bleeding or if there was an existing predisposing factor such as pre-eclampsia or in a woman with a low body mass index.

Case report

Background and delivery

A 36 year old multigravida was admitted in spontaneous onset of labour at 39 weeks and 3 days of gestation. She did not have any obstetric or medical risk factors. On admission she was found to be 4 cm dilated. Three hours later she had spontaneous rupture of membranes (SROM) and had an epidural sited for pain relief at this stage. She made good progress and 5 hours after admission she was fully dilated. However, she had a prolonged second stage of labour and was actively pushing for 90 minutes. On abdominal examination, head was not palpable and the fetal size was average and on vaginal examination, cervix was fully dilated and the vertex was at –1 station and was in a left occipito-anterior position (LOA). There was no significant caput or moulding. Decision for instrumental delivery (ventouse) was made for failure to progress during second stage of labour. An uncomplicated ventouse delivery was carried out and the patient delivered a 3.9 kg baby, with normal Apgar Scores and umbilical cord blood gases.

Immediate postpartum period and initial management

In view of the profuse bleeding after delivery of the placenta, uterine massage and uterotonics agents (5 units of syntocinon and syntometrine) were administered. Due to continued bleeding, uterine massage and 40 IU Syntocinon infusion (125 ml/hour) were commenced. Resuscitation with intravenous fluids was commenced after insertion of two large bore (14 G) intravenous cannulae and blood was sent for urgent full blood count (FBC), serum electrolytes and clotting screen. Subsequently, a first dose of 250 mcg of Haemabate (Prostaglandin) was administered intramuscularly.

Despite these measures, the patient lost 2.2 litre within approximately 4 minutes and there was continued bleeding despite initial uterotonic agents. At this point, our Major Obstetric Haemorrhage Protocol ‘Code Blue’ was activated.

Careful examination to exclude the “4T’s” (Tone, Tissue, Thrombin and Trauma) was initiated; genital tract was systematically examined and no evidence of genital tract trauma was noted. Following vaginal examination, an ultrasound scan was performed to exclude retained products of conception. In view of continued bleeding and a component of uterine atony identified, decision was made to place a uterine tamponade balloon (Bakri Balloon) with 450 ml of sterile water under ultrasound guidance until vaginal bleeding stopped.

Subsequent management

Total estimated blood volume (EBL) was 2.9 litre and her Obstetric Shock Index (OSI) was 1.2. Haemoglobin level dropped from 11.2 g/dl prior to delivery to 6.9 g/dl and therefore, the patient received a total of 3 units of blood and 2 units of platelets and blood products.

She was monitored in the obstetric high dependency unit (HDU) for 24 hours and the uterine tamponade balloon was deflated and removed in 12 hours. She made a very good recovery and her haemoglobin on day 2 was 8.7 g/dl. However, she was asymptomatic and therefore, did not require any further blood transfusion.

Case discussion

This case illustrates the importance of a rapid response to massive obstetric haemorrhage and appropriate management of PPH, instituting a multi-disciplinary care plan to ensure optimum outcome. Even in ‘low risk’ pregnancies and deliveries, doctors and midwives need to be alert to ensure an appropriate response in an obstetric emergency.

The use of algorithms aids systematic management of postpartum haemorrhage in a logical and sequential manner. One such algorithm is HAEMOSTASIS (Table 2). It has been reported that the use of this algorithm ‘HAEMOSTASIS’ is associated with excellent outcomes and a low Peripartum Hysterectomy rate.

A multi-disciplinary approach with the input of senior staff (consultant obstetricians, consultant anaesthetists, haematologist and senior midwives) is essential to achieve optimum outcome.

Communication

Effective and clear communication between the members of the team is of most importance. This includes timely activating ‘Code

Management algorithm of PPH ‘HAEMOSTASIS’

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Ask for Help and hands on uterus (uterine massage)</td>
</tr>
<tr>
<td>A</td>
<td>Assess and resuscitate</td>
</tr>
<tr>
<td>E</td>
<td>Establish aetiology, ensure availability of blood and ecbolics</td>
</tr>
<tr>
<td>M</td>
<td>Massage uterus</td>
</tr>
<tr>
<td>O</td>
<td>Oxytocin infusion/prostaglandins — IV/IM/per rectal</td>
</tr>
<tr>
<td>S</td>
<td>Shift to theatre-aortic pressure or anti — shock garment/bimanual compression as appropriate</td>
</tr>
<tr>
<td>T</td>
<td>Tamponade balloon/uterine packing — after exclusion of tissue and trauma</td>
</tr>
<tr>
<td>A</td>
<td>Apply compression sutures — B — Lynch/modified</td>
</tr>
<tr>
<td>S</td>
<td>Systematic pelvic devascularisation-uterine/ovarian/quadruple/internal iliac</td>
</tr>
<tr>
<td>I</td>
<td>Interventional radiology and, if appropriate uterine artery embolization</td>
</tr>
<tr>
<td>S</td>
<td>Subtotal/total abdominal hysterectomy</td>
</tr>
</tbody>
</table>

Table 2
Blue’ to ensure availability of appropriate blood products. At the same time, it alerts all the team members quickly and ensures that senior clinicians are involved early in the management. Identifying a leader and establishing roles are also of great importance to effectively manage a PPH.

Maternal resuscitation during PPH

The principles of maternal resuscitation are to restore intravascular volume and then maximize oxygen carrying capacity and coagulability of blood. Airway, Breathing and Circulation (ABC) should be promptly assessed and maintained. High flow oxygen (10–15 litres/minute) should be administered via a face mask. Circulation is assessed by examining the pulse rate, blood pressure, Obstetric Shock Index (OSI) and capillary filling time. Two large bore (14 G) cannulae should be inserted and blood should be sent for FBC, urgent cross match of at least 4 units, coagulation screen and urea and electrolytes.

Maternal signs of haemorrhagic shock include tachycardia, tachypnoea, falling oxygen saturation, confusion or unresponsiveness and biochemical evidence of metabolic acidosis. Signs of ‘peripheral shut down’ include cold extremities and oliguria. Clinicians should be aware that ‘young, fit and healthy’ pregnant women are able to compensate for significant blood loss prior to developing hypotension.

Managing the bleeding

Determining cause of bleeding requires a systematic approach which can be summarized as the ‘4T’s’ approach: tone, tissue, trauma and thrombin. The uterus should be examined to assess contraction and retraction (tone) followed by ensuring the complete emptiness’ of the uterine cavity (tissue). A thorough examination of uterus, cervix, vaginal walls and external genitalia should be performed to identify genital tract tears, lacerations or haematomas as other sources of bleeding (trauma). Finally, previous history of clotting disorders and current clotting screening will help us identify other causes of bleeding (thrombin), including the ‘washout phenomenon’.

Once atomic uterus has been identified, measures should be taken to ensure uterine contraction. Administration of Syntocinon (5 IU intramuscular or 40 IU diluted in 500 ml saline intravenous infusion), syntometrine (combination of syntocinon and ergometrine) or ergometrine should be commenced.

Prostaglandins such as Haemabate (250 mcg intramuscular) can be administered every 15 minutes for a maximum of eight doses. Rectal misoprostol (600–1000 mcg) can also be used. This option is especially valuable in low resource settings.

Tranexamic acid (1–4 g first dose followed by 1 g 8-hourly) can be considered if other drugs have failed. Although results from multi-centre randomized trails are still awaited, the WHO Guideline on PPH recommends its use if bleeding still continues despite administration of oxytocin and prostaglandins or if PPH is due to trauma.

Blood and blood products

In the presence of massive obstetric haemorrhage (MOH) or in patients haemodynamically a blood transfusion is necessary to replace volume and oxygen carrying capacity. In addition, to compensate for the ‘Washout Phenomenon’, other blood products (clotting factors, fibrinogen and platelets) should be administered.

Guidelines from the British Committee for Standards in Haematology summarize the main therapeutic aims of management of massive blood loss, which are to maintain the following levels:

- Haemoglobin >8 g/dl
- Platelet count >75 × 10⁹/litres
- Prothrombin time <1.5 × mean control
- Activated Prothrombin Time <1.5 × mean control
- Fibrinogen >1.0 g/litres

Blood

Concentrated red cells are the first line therapy in MOH, each unit is estimated to increase the haemoglobin by 1 g/dl and the haematocrit by 3%. It is appropriate to replace fluids with crystalloid and colloid up to 3.5 litres whilst cross-matched blood is available. The decision to commence transfusion of blood should be a clinical decision and it is not necessary to wait for the results of FBC. Obstetric Shock Index (OSI) >1 may be helpful in making a decision to commence blood transfusion.

Management of coagulopathy

It is essential to have effective communication with the haematologist who will advise on the use of other blood products.

A prothrombin time (PT) and Activated Partial Thromboplastin Time (APTT) ratios of >1.5 are associated with an increased risk of a clinical coagulopathy. In the presence of ongoing bleeding this requires correction with FFP. Disseminated Intravascular coagulation (DIC) is characterized by widespread intravascular activation of the coagulation system leading to vascular deposition of fibrin and resultant consumption of clotting factors. It is associated with certain obstetric complications including amniotic fluid embolization, placental abruption and severe choioamnionitis. It can also be triggered by massive blood loss or secondary to a washout phenomenon.

Blood products

Fresh frozen plasma (FFP) is derived from whole blood and contains clotting factors. It is stored at −30° to prevent the clotting factors from decaying and needs to be defrosted thoroughly prior to administration. Cryoprecipitate contains more fibrinogen than FFP and is useful in correcting hypofibrinogenaemia.

Platelet infusions are also derived from whole blood and can be stored for up to 5 days at room temperature. Each pool should produce an increment of 50 × 10⁹/litres.

Other coagulation factors

Recombinant factor VIIa (rFVIIa) is the activated form of factor VII made in hamster kidney cells. It is licensed for use in patients with haemophilia. However, it is not licensed for use in massive PPH as there are no randomized controlled trials on its use in PPH. A review of 65 case studies on the use of rFVIIa in massive haemorrhage was suggestive of its effectiveness in PPH. However, the review highlighted the lack of good data and hence, individualized evaluation of risks of rFVIIa (thrombo-embolic complications, myocardial infarction and ischaemic stroke) against its benefits must be considered. Efficacy may be affected by haemodilution and rFVIIa requires adequate fibrinogen level and platelets to exert its action. According to the RCOG guidelines on PPH, a dose of 90 mg/kg should be administered and this may be repeated in the absence of a clinical response in 15–30
Cell salvage
According to the RCOG guidelines, intraoperative cell salvage (IOCS) should be made available for mothers who refuse blood or blood products or in those cases were MOH can be anticipated (abnormal placentation).

However, the National Institute of Health and Care Excellence (NICE) has called for evidence from RCTs to support its routine use, although it recommends IOCS for MOH in an emergency.

Currently, a multi-centre trial of cell salvage in caesarean section (SALVO) is examining the effectiveness of this intervention.

Surgical management
Failure to control the bleeding with medical measures or presence of tissue or trauma requires the patient to be transferred to theatre for surgical management. Appropriate measures should be taken according to the cause of the bleeding. Intrauterine Balloon tamponade has been proven to be an effective measure prior to the insertion of the balloon. An ultrasound guided insertion of the balloon may be performed to ensure the correct position, followed by filling it with 200–600 ml of warm water or saline depending on the size of the uterine cavity. The reported success rates are between 70 and 100%. Once bleeding is arrested, it is reported that 80–85% of patients won’t need a laparotomy. There are no short or long term complications reported and the balloon can be removed after 6–12 hours or earlier if the coagulopathy has been corrected.

If the cause of the bleeding is due to trauma, cervical and vaginal tears and lacerations should be repaired. Tamponade may also be useful in case of multiple vaginal lacerations by adequately placing a balloon or a vaginal pack.

If these attempts fail to arrest the bleeding, it is appropriate to proceed to laparotomy, preferably through a Pfannenstiel incision. If the cause of PPH is uterine atony, compression sutures such as B-Lynch suture or modified sutures may be attempted. Complications of these sutures include uterine necrosis, pyometra and uterine adhesions.

Other surgical techniques include systematic devascularization whether it is by ligation of the uterine, ovarian and or internal iliac arteries. The most simple ligation is uterine artery ligation which is useful if the bleeding is coming from the body of the uterus but not if the source is the lower segment, cervix or vagina. Ligation of the internal iliac arteries is a more complex procedure which requires the presence of a more experienced surgeon. This procedure will also arrest the bleeding coming from the lower segment, the broad ligament or the vagina. Success rates are between 40 and 100%. If a uterine rupture is clinically suspected (Figure 1), then an immediate laparotomy should be carried out whilst ensuring haemodynamic stability of the patient.

Should all of the above fail or it is not appropriate to perform, the options are to proceed with a hysterectomy or if the patient is haemodynamically stable, to consider the use of interventional radiology. The decision to proceed with a hysterectomy should be done by two senior clinicians. Subtotal hysterectomy is the most suitable option unless there is trauma to the cervix or lower segment. It is recommended that an experienced gynaecological surgeon should be present due to the high incidence of complications to include bladder and ureter injuries, ovarian damage and infection. Peripartum Hysterectomy may be associated with long term psychological sequelae, due to loss of femininity and fertility. Therefore, the need for appropriate debriefing cannot be overemphasized.

Massive PPH occurring secondary to abnormal placentation (placenta accrete, percreta and increta) requires a different approach with a pre-operative plan that should involve other clinicians such as interventional radiologists, anaesthetists and haematologists. Although in the past this pathology advocated a peripartum hysterectomy in the majority of cases, surgical innovations for management of morbidly adherent placenta are currently being developed so as to avoid it and the consequently maternal morbidity and mortality. One of these new approaches is the ‘Triple-P’ procedure which involves perioperative placental localization and delivery of the fetus via transverse uterine incision above the upper border of the placenta; pelvic devascularization; and placental non — separation with myometrial excision and reconstruction of the uterine wall. Excellent outcomes with no cases of peripartum hysterectomy was recently reported in the first 16 cases with morbidly adherent placenta that were managed with Triple P Procedure in the United Kingdom.

Conclusion
Massive postpartum haemorrhage is associated with increased maternal morbidity and mortality. In some cases, it is possible to
Anticipated postpartum haemorrhage: ‘8 C’s for consideration

- Care plan (individualized) with consent
- Competent clinicians
- Cell saver
- Catheterization of pelvic blood vessels
- Cross-matched blood in theatre
- Coagulation cascade — ensure availability of blood products
- Control measures for haemorrhage — pharmacological, special sutures, tamponade balloons
- Care after birth (ITU)

Table 3

A checklist for anticipated massive obstetric haemorrhage has been proposed (Table 3).

**FURTHER READING**


Knight M, on behalf of UKOSS. Peripartum hysterectomy in the UK: management and outcomes of the associated haemorrhage. *BJOG* 2007 Nov; **114**: 1380–7.


**USEFUL WEBSITES**


UKOSS — www.npeu.ox.ac.uk.