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Challenges of major obstetric haemorrhage

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Every minute of every day, a woman dies in pregnancy or childbirth. The biggest killer is obstetric haemorrhage, the successful treatment of which is a challenge for both the developed and developing worlds. The presence of an attendant at every birth and access to emergency obstetric care are key to reducing maternal morbidity and mortality in the developing world while resource-rich countries have a rising caesarean section rate with its consequential effect on the incidence of abnormal placentation and its link with peripartum hysterectomy.

Management of obstetric haemorrhage involves early recognition, assessment and resuscitation. Various methods are available to try to stop the bleeding – from pharmacological methods to aid uterine contraction (e.g., oxytocinon, ergometrine and prostaglandins) to surgical methods to stem the bleeding (e.g., balloon tamponade, compression sutures or arterial ligation). Interventional radiology can be used if placenta accreta is suspected. Cell salvage has been introduced into obstetrics relatively recently in an attempt to reduce allogeneic transfusion.

The burden of maternal mortality and morbidity falls most heavily on the poorest countries in the world where concurrent disease (e.g., tuberculosis and HIV), chronic anaemia and malnutrition all take their toll on maternal health. As much as 99% of maternal deaths occur in the developing world and comparisons with the developed world reveal an uncomfortable statistic: the lifetime risk of dying due to childbirth in Sierra Leone is one in eight, in Ireland it is one in 47 600.[1] As the Millennium

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Development Goals (MDG) Report 2009 puts it, "Giving birth safely is largely a privilege of the rich"[2] and the fifth MDG goal, which is to improve maternal health, is the goal towards which least progress has been made. (http://www.who.int/making_pregnancy_safer/events/2009/wha62/en/index.html)

In spite of such international attention, and a multitude of education programmes, there are more than 500 000 maternal deaths every year because of pregnancy or childbirth.[1] In terms of timing, deaths are clustered around labour, delivery and the immediate post-partum period. The biggest killer is haemorrhage, accounting for about one-third of these deaths.[3]

History shows us that change is possible. Less than a hundred years ago, the risk of dying because of pregnancy or childbirth in the UK was 1:290. Today it stands at 1:19 000.[4] This is a result of the successful treatment of puerperal sepsis, the availability of blood transfusion, improved surgical and anaesthetic techniques and universal access to care.[3] While universal access to an integrated health-care system remains perhaps an unrealistic aim, every mother-to-be deserves an attendant with the knowledge, skills and critical judgement to actively manage her labour, supported by appropriate supplies, equipment and emergency obstetric care.[5,6] Some transitional countries, like Thailand and Malaysia, have managed to reduce maternal mortality in recent years by making long-term investment in midwifery training, referral hospitals and access to care. This has resulted in lower fertility rates and general improvements in health.[3]

What is needed to make change possible is addressing the entrenched views on the role of the woman in society, her education and her right to family planning, and what is required is political commitment on a global scale, with adequate financial backing.

DEFINITION

Part of the difficulty of quantifying the impact and prevalence of obstetric haemorrhage stems from the lack of standard nomenclature and the fact that inclusion criteria vary widely from one report to another.

There appears to be some agreement in the UK on terminology. The Healthcare Commission defined 'significant' blood loss as >1000 ml and 'major' blood loss as >2500 ml in its recent review of maternity services in England and Wales.[7] The Scottish Confidential Audit of Severe Maternal Morbidity (SCASMM) considered major haemorrhage to be blood loss >2500 ml, or transfusion of five or more units of blood or treatment for coagulopathy.[8]

It should be noted that blood loss, and in particular maternal blood loss, is notoriously difficult to quantify and tends to be under-estimated, so additional resources should be mobilised if blood loss exceeds 1000 ml.

CAUSES

Placental abruption or placenta praevia/accreta can present as antepartum haemorrhage and are risk factors for post-partum haemorrhage (PPH).

Uterine atony, eversion, retained products of conception and genital tract trauma all cause PPH and account for the majority of cases of major haemorrhage. In the UK, more than 2.5% of all births are complicated by PPH >1000 ml.[7]

Uterine rupture remains an infrequent cause of haemorrhage and maternal death. Rupture may present with precipitate labour, foetal bradycardia or abdominal pain with maternal shock. It can occur spontaneously, or at the site of previous uterine surgery (e.g., caesarean section or retained placenta).

INCIDENCE

In the UK, deaths from obstetric haemorrhage are rare (0.8:100,000 births).[9] In the developing world, the risk of death from post-partum haemorrhage alone is 1:1000.[10]

The most recent Confidential Enquiry into Maternal and Child Health (CEMACH)[9] detailed 17 maternal deaths from haemorrhage. Most of these deaths were due to PPH but include three from haemorrhage associated with uterine rupture and genital tract trauma. Worryingly, sub-standard care was a feature in two-thirds of them.

The Scottish Confidential Audit reports that the rate of major haemorrhage in Scotland during 2007 was 4.4:1000 births. Instances of morbidity or 'near miss' are therefore many times more common than death. The most common cause of haemorrhage was uterine atony. The majority of bleeds occurred post-partum (58%) and almost two-thirds (63%) of them involved a caesarean section. Only 23% of cases of severe haemorrhage experienced a normal delivery. It is clear that there is room for improvement: only two-thirds of patients who survived major haemorrhage received 'well managed, appropriate care'. It is, however, encouraging that the rate of major haemorrhage fell for the first time in the audit's 5-year history.[8]

Unfortunately peri-partum hysterectomy, which is usually a surrogate marker for life-threatening haemorrhage, is still required in some cases. The rate of peri-partum hysterectomy, as reported by the UK Obstetric Surveillance System (UKOSS), is 0.41:1000 births.[11] Uterine atony was the cause of bleeding in more than half of these cases. Six in 1000 patients undergoing the procedure will die. One-fifth of patients will require further surgery to control bleeding or repair organ damage, commonly to the bladder or ureters. Risk factors include age >35 years, parity >3, previous manual removal of placenta, previous myomectomy, twins and, notably, previous caesarean section. While one previous caesarean section increases the risk twofold, two or more previous sections increase the risk a staggering 18 times.[12]

MANAGEMENT

Antenatal optimisation of haemoglobin and haematinic status is vital – iron (whether dietary, oral or, if necessary, parenteral), folic acid and vitamin B_{12} all have a role to play.

The active management of labour and the third stage with uterotonics, early cord clamping and controlled cord traction can all reduce the risk of PPH and should be offered to all patients.[6] It is important to be especially vigilant of patients who are at risk of PPH to recognise bleeding or physiological derangement as early as possible. CEMACH highlights the failure to pick up the signs and symptoms of intra-abdominal bleeding, particularly after caesarean section, and recommends the use of maternity early warning scoring systems to address this.[9]

A step-by-step approach to managing haemorrhage is as follows

Assess:

- Take a detailed medical and obstetric history.
- Examine the patient to ascertain whether the source of the bleeding is genital tract trauma, retained placenta or uterine atony. Anaesthesia may be necessary to allow a thorough examination. The patient's bladder should also be emptied.
- The vast majority of patients who have had a vaginal birth will have some degree of genital tract trauma. Bleeding may be profuse if there has been an anterior vaginal tear.[13]

Call for Help:

- Experienced midwifery, obstetric and anaesthetic staff should be in attendance.
- Obstetric and anaesthetic consultants should be informed.
- A 'Major Haemorrhage' call should be made to alert porters, and the blood transfusion service that blood products (e.g., packed red cells, fresh frozen plasma (FFP) and platelets) are urgently needed. This will allow the FFP to be thawed in preparation for use.

Monitor:

- ECG, oxygen saturation, non-invasive blood pressure and hourly urine volume monitoring are mandatory.
- Events should be documented as they happen.
- Invasive arterial monitoring should be considered if repeated venepuncture is required, or if the patient is haemodynamically unstable, or is to be admitted to intensive care.
- A central line may be useful in guiding fluid management in cases where blood loss is most severe. A central line was used in just less than a quarter of reported cases of major haemorrhage in Scotland during 2007.[8]

Resuscitate:

- The key aims are restoration of circulating blood volume and maintenance of tissue perfusion and oxygenation.
- Administer oxygen: 10–15 l min^{-1}.
- If pre-delivery, the patient should be in a left lateral tilt.
- Establish intravenous access: two large-bore cannulae.
- Take blood for a full blood count, clotting screen and a cross-match.
- Administer fluids: crystalloid, colloid (but avoid dextrans) or blood.
- Warm all fluids and the patient herself.
- Administer 10 ml of 10% calcium chloride if necessary: citrate from transfused blood often causes hypocalcaemia.

There is interest in the developing world in the use of non-pneumatic, anti-shock garments (NASGs) in PPH, as a temporising measure while definitive treatment is sought.[14] The technique involves applying 20–40 mmHg of circumferential counter pressure to the legs and lower abdomen to shunt blood from the lower body to vital core organs. Pilot studies have reported decreased bleeding, reduced morbidity and improved survival rates. Randomised controlled trials using NASG are now being carried out in Zimbabwe and Zambia.

Transfusion strategy

The British Committee for Standards in Haematology's guidelines for the management of massive blood loss emphasise the need for prompt action and good communication among the various specialities and laboratory services if bleeding is to be stopped and circulating blood volume restored.[15] The guidelines suggest the following transfusion thresholds:

- Hb <8 g dl^{-1},
- Platelets $<75 \times 10^6$ ml^{-1} if still bleeding,
- PT/APTT ratio of >1.5 and
- Fibrinogen <1.0 g l^{-1}.

Near-patient tests such as haemoglobin assessment with the Haemacue® and thrombo-elastography are vital in cases of massive, rapid haemorrhage because there are unavoidable delays in obtaining the results of full blood counts and clotting screens from the laboratory.[16]

Component therapy is the mainstay of transfusion practice in the UK. The current practice is to give a higher ratio of packed red cells to clotting products, with FFP given empirically once the patient's blood loss reaches her circulating blood volume. There is, however, an argument for giving more clotting products earlier, mimicking the whole blood strategy used by the armed forces. It has been suggested that increasing the ratio of clotting products to packed red cells, to a ratio of 1:2 or even 1:1, might be one method of preventing coagulopathy.[17,18] The risk of disseminated intravascular coagulopathy can be reduced by avoiding the precipitant factors such as shock, hypothermia and acidosis.

Stopping the bleeding

Pharmacological options

Oxytocin is the pharmacological agent of choice.[19] Five units should be given as a slow intravenous bolus. Care must be taken with haemodynamically unstable or cardiac patients as oxytocin can cause vasodilatation, and with it, hypotension. For a sustained effect, an infusion can be run, typically 40 units over 4 h.

Carbetocin is a long-acting oxytocin analogue with a similar safety profile to syntocinon. It has a rapid onset, and a single dose of 100 mcg, given either intravenously or intramuscularly, is thought to

be comparable to an oxytocin infusion.[20] The Cochrane Collaboration states that the limited evidence available suggests that there is little difference in the effectiveness between carbetocin and oxytocin[21] and a recent trial in Malaysia suggested that carbetocin may be more effective than syntometrine in vaginal delivery.[22] The results of a similar trial in Singapore are awaited. The Royal College of Obstetricians and Gynaecologists (RCOG), however, does not recommend the use of carbetocin because of a lack of data and its expense.[23] (http://clinicaltrials.gov/ct2/show/NCT00499005)Ergometrine is as effective as oxytocin but it produces more side effects, for example, nausea and vomiting and, unlike oxytocin, it is contraindicated in hypertensive patients. A dose of 500 mcg is given either intravenously or intramuscularly. The CEMACH[9] and SCASMM[8] reports both raised concerns that ergometrine is often overlooked as an option to stop the bleeding.

Carboprost, an F2α prostaglandin, is given in 250 mcg doses intramuscularly, which can be repeated every 15 min up to a maximum of eight doses. It can cause hypertension, significant bronchospasm and pulmonary shunting with hypoxia.[24] It should not be given intravenously.

Misoprostol, a synthetic prostaglandin E1 analogue is well absorbed when given orally, sublingually or rectally. The correct dose is unknown: 600 mcg orally is the most commonly used dose in clinical trials. There are some dose-related side effects, mainly shivering and pyrexia. Although it is less effective than oxytocin, its use in the developing world is a subject of debate. The attraction for use in the developing world is that it does not require refrigeration in temperatures of 30 °C or more, unlike conventional uterotonics.[19] In resource-rich countries, misoprostol may have a role in the home-birth setting or even in hospital while awaiting senior input during a major haemorrhage.

Surgical options

A review of the management of PPH found no statistical difference among the outcomes of the various available surgical methods.[25] UKOSS is currently gathering data to address this.[26]

The first line in treating uterine atony is to 'rub up' the uterus followed by bimanual compression.

Uterine balloon tamponade has proved very popular with success rates of over 80%[8] and is now a first-line approach in the management of PPH.[27] Various varieties of balloon, including Rusch and Bakri, are widely used. The balloon is inserted and inflated to exert pressure on the interior of the uterus. Insertion is easy and does not require anaesthesia. Once inserted, the patient must be monitored continually, broad-spectrum antibiotics given and an oxytocin infusion administered. The balloon can be deflated gradually and withdrawn without the need for anaesthesia. The Bakri has an advantage over the Rusch in that bleeding above the balloon can be detected.[28]

If the uterus responds to bimanual compression, compression sutures, which exert external tamponade by apposing the anterior and posterior walls of the uterus, are an option. Success rates of over 90% have been reported.[27] There are a variety of sutures in use: B-Lynch was the original,[29] and Hayman's horizontal brace suture[30] and Cho's multiple square technique have been described.[31] Adverse events include pyometria[32] (as drainage of the uterine cavity is restricted), uterine necrosis,[33] intrauterine bands and abdominal adhesion. There have been reports of subsequent, successful pregnancies following uterine sutures.[34]

More advanced surgical techniques, such as arterial ligation, can be very challenging and require considerable skill. Early involvement of senior obstetricians and gynaecologists is therefore important. Arterial ligation can be used to decrease pulse pressure and overall blood flow, but it carries the risk of damage to neighbouring veins, arteries and the ureters. The uterine artery should be ligated, or if this is not possible, the anterior division of the internal iliac artery.[35] Inadvertent ligation of the external iliac artery can lead to ischaemia of the legs and buttocks. In cases of uterine rupture, the uterine artery may be torn close to the origin of the internal iliac artery and needs to be ligated, making subsequent interventional radiology more difficult.

If the patient is extremely haemodynamically unstable, clamping the aorta temporarily may allow time for adequate fluid resuscitation to occur and for senior surgical assistance to be sought.

While hysterectomy remains a measure of last resort, it should be considered sooner rather than later, as it is preferable to uncontrolled haemorrhage or coagulopathy. A subtotal hysterectomy is simpler and quicker to perform in the circumstances.

Adjuncts

Cell salvage

Donor blood is a limited and expensive resource. Further, it is cold and acidic with high levels of potassium and low levels of 2,3 diphosphoglyceric acid, which results in impairment of oxygen transport for up to 24 h post-transfusion. Infection, immunosuppression, allergic sequelae and acute lung injury are all well-documented hazards of transfusion.[36] For these reasons, the use of cell salvaged blood could be useful in massive obstetric haemorrhage, although it must be remembered that salvaged blood has no coagulation factors.

Concerns about amniotic fluid embolism (AFE) in cell salvage have not been realised. AFE is an anaphylactoid reaction rather than an embolic event. It would nevertheless appear prudent to avoid contaminating cell-salvaged blood with amniotic fluid, so current practice is to discard the suction contents used pre-delivery once the placenta and amniotic fluid have been removed. However, recent work has demonstrated that the cell salvage process, combined with the Pall leucodepletion filter, can be effective in significantly reducing amniotic fluid contaminants, allowing the same suction device to be used throughout the whole procedure.[37]

The other concern about the use of cell salvage is rhesus immunisation. This may occur if foetal red cells are aspirated and re-transfused into the maternal circulation. The risk has been estimated to be similar to that present in a normal vaginal delivery. Rhesus immunisation can be prevented with prompt Kleihauer testing and anti-D treatment.[38]

Although the use of cell-salvaged blood has been endorsed by CEMACH,[4] the National Institute of Clinical Excellence,[39] the Obstetric Anaesthetists' Association (OAA) and the Association of Anaesthetists of Great Britain and Ireland,[40] a recent survey of consultant-led maternity units in Scotland indicated that it is used regularly in only two of the 18 consultant obstetric units surveyed.[41] A similar OAA survey in 2006 cited a lack of equipment, insufficient cases to ensure familiarity, issues with ongoing training, maintenance of equipment and technical difficulties as reasons for not using the technique.[42] When cell salvage was introduced at Queen Charlotte's Hospital in London, it was targeted at high-risk patients but it appeared that none of these patients benefited from its use.[43]

In spite of more than 400 case reports of the use of cell salvage, all without incident, and the fact that the disposable kit for a single case costs less than one unit of blood, there is still a marked reluctance to use cell salvage on obstetrics.[44,45] A recent review stated that there is "limited evidence to support or refute its use at caesarean section" and called for a "multicentre randomised controlled trial to address the equipoise."[46]

Interventional radiology

The Royal College of Obstetrics and Gynaecology recommends the use of interventional radiology in elective cases of placenta praevia and placenta accreta, as well as in emergency cases.[47] The Healthcare Commission suggests that it has the "potential to save the lives of patients who have catastrophic postnatal bleeding."[48] Success rates are over 90%,[27] and in the most recent confidential enquiry, all of the patients who underwent radiological embolisation survived.[8]

In elective cases, the procedure begins by inserting sheaths into the femoral arteries, and a balloon into each of the internal iliac arteries prior to delivery. This can be done under local anaesthesia to reduce exposure of the foetus to general anaesthesia. Once in place, caesarean section proceeds as normal. The balloons are inflated immediately after delivery. If there is no major bleeding, they are deflated in turn, but can be re-inflated immediately should bleeding recur, allowing a hysterectomy to be performed if necessary. The surgical field will not be bloodless (because of the collateral blood supply of the uterus), but it will be much drier than in cases where no balloons are used.[49] After surgery, the femoral sheaths should be left in place until haemostasis is assured, so if bleeding recurs embolisation can be carried out through the sheaths. Embolisation should be performed as selectively as possible to minimise complications such as thrombus, ischaemia, necrosis and post-embolisation pyrexia. The occlusion of the distal uterine bed is temporary and the vessels will recanalise within weeks. Patients have had successful pregnancies after undergoing this procedure.

In cases where the patient is actively bleeding, it should be noted that the emergency placement of the sheaths and balloons can be extremely challenging.

Methotrexate

Methotrexate can be used for the conservative treatment of placenta accreta where there is no bleeding from the placental site and the patient is haemodynamically stable.[50, 51] It is given intramuscularly every week, with outpatient monitoring of beta Human Chorionic Gonadotrophin (bHCG) and ultrasound to check placental volume and function. In cases where subsequent surgery has been necessary, concerns about the reliability of bHCG as a marker of placental function, and that ultrasound findings do not always coincide with actual physical appearance at laparotomy, mean that the value of methotrexate remains unclear.[52–54]

Haemostatic agents

Tranexamic acid

Tranexamic acid is the most effective of the available anti-fibrinolytics,[55] which as a class "provide worthwhile reductions in blood loss and need for allogeneic red cell transfusion."[56] Its use should be considered in cases where blood loss is major and ongoing. The recommended dose is 1 g by slow intravenous bolus with a further 1 g after 4 h.

Tranexamic acid has also been given prior to elective caesarean section. Blood loss was found to be significantly reduced at 2 h post-partum, and haemoglobin was higher at 24 h with no apparent complications or side effects.[57] A phase 3 clinical trial is about to commence looking at its use in PPH.(http://clinicaltrials.gov/ct2/show/NCT00872469)

Recombinant factor VIIa

Recombinant Factor VIIa is extremely expensive and licensed for the prophylaxis and treatment of haemorrhage caused by haematological disorders, but it is not licensed for use in obstetrics. Despite this, its use in obstetrics appears to be growing seemingly as a result of anecdotal reports and editorial opinion about its efficacy rather than the results of randomised controlled trials.[58,59]

While there is general agreement that, before administering the drug, it is vital to minimise the other causes of coagulopathy (e.g., acidosis, hypothermia and hypocalcaemia) and ensure that the patient has adequate clotting products, platelets and fibrinogen on board, there is no consensus on timing or dose:

- Ahonen recommends administering a single dose of 90–120 mcg kg^{-1} once blood loss reaches 1.5 times the patient's circulating blood volume and highlights the need for adequate clotting factors, fibrinogen and platelets.[60]
- In Australia and New Zealand, the median dose administered is 90 mcg kg^{-1} (rounded to the nearest vial). Temperature, acidosis, calcium and platelets and fibrinogen are optimised. If there is no response to the first dose after 20 min, a second dose may be administered.[61] (http://www.med.monash.edu.au/epidemiology/traumaepi/haemostasis.html)
- A retrospective case-matched analysis in Dublin found that there was no statistical difference in outcome between patients who received factor VIIa and patients who did not. However, Factor VIIa still continues to be used there: a dose of 4.8 mg is administered followed by an infusion of 90–100 mcg kg^{-1} h^{-1} until the bleeding stops. Care is taken to ensure that the patient is not acidotic and that blood, FFP, cryoprecipitate and platelets have been given within the 30 min prior to the administration of the drug, with appropriate resuscitation and surgical management throughout. [62]
- A French trial due to be completed in December 2009 is looking at the use of Factor VIIa in PPH, which persists despite all other medical and surgical treatments. (http://clinicaltrials.gov/ct2/show/NCT00370877)

Fibrinogen concentrate

Fibrinogen is the substrate required for clot formation. Studies have shown that the aggressive and early replacement of fibrinogen can improve clot strength and survival. Cryoprecipitate is the

traditional method used to increase fibrinogen levels. However, a pasteurised fibrinogen concentrate has recently been developed. Use of the fibrinogen concentrate in bleeding patients resulted in significant reductions in red blood cell, FFP and platelet requirements along with a significant reduction in blood loss.[63] Its use has also been reported in a case of placental abruption with hypofibrinogenaemia.[64]

Topical haemostatic agents

Topical haemostatic agents are used in other surgical specialities such as neurosurgery, urology and gynaecology. While they are no replacement for meticulous surgical haemostasis, the highly viscous gel (composed of gelatine matrix and thrombin) has been used in cases of PPH to promote local tissue coagulation in areas of persistent ooze.[65]

PLACENTA ACCRETA

Placenta accreta is one of the major obstetric challenges facing the developed world. Its incidence is increasing as the proportion of deliveries by caesarean section grows. Over one-third of patients who require a caesarean hysterectomy have an adherent placenta.[12] The initiating factor for abnormal placentation is myometrial tissue damage, which may arise spontaneously (e.g., in the presence of a fibroid) or as a result of previous uterine trauma (e.g., previous caesarean section or manual removal of retained placenta). If abnormal placentation does occur, it will be present from early pregnancy and significant bleeding may occur if the pregnancy is terminated.[66]

Antenatal recognition is vital. CEMACH[9] recommends that the placental site must be determined if the patient has had a previous caesarean section. If there is a placenta praevia, further specialist imaging is required to identify a potential accreta (specialist ultrasound with colour Doppler has a sensitivity of 0.77 and a specificity of 0.96 compared to magnetic resonance imaging (MRI), which has a sensitivity of 0.88 and specificity of 1.0).[67]

Care should be consultant-led with multidisciplinary planning. The patient must be informed that a caesarean section in these circumstances may involve invasive monitoring and carries the risk of major haemorrhage, which may necessitate blood transfusion, admission to intensive care and possible hysterectomy.[68]

Delivery by elective section should take place with appropriate facilities for cell salvage and interventional radiology to hand. A majority of accretae will invade anteriorly and the bladder may be involved. A more fundal incision may avoid the placenta. Attempts to remove the adherent placenta can result in catastrophic haemorrhage. If the patient is haemodynamically stable, the placenta can be left *in situ*, and the administration of methotrexate considered.[50] The placenta often separates spontaneously. If this happens, local dissection and repair may be possible, but the blood loss may be so severe that a hysterectomy is the only option.

Although the RCOG[47,68] and Healthcare Commission[48] recommend the use of interventional radiology, Bodner[69] and similarly Shrivastava,[70] found that the use of interventional radiology made no statistical difference to the estimated blood loss, volume of replaced blood products, fluid replacement needs, operating time or postoperative recovery time of patients undergoing caesarean hysterectomy.

WOMEN WHO REFUSE BLOOD PRODUCTS

CEMACH highlights the challenges posed when dealing with patients who refuse blood products because of personal or religious beliefs.[4]

A Dutch retrospective case study showed that patients who are Jehovah's witnesses were 3 times more at risk of serious maternal morbidity, and 6 times more at risk of maternal death, than other women. However, the study also made it clear that such patients are 130 times more likely to die from obstetric haemorrhage when specific causes of death were considered.[71]

Some of the antenatal steps to be taken are to:

- discuss the patient's beliefs with her, and address the question of which blood products (if any) are acceptable

- put together a written plan including details of any acceptable products so that there is no ambiguity on admission to the labour ward (Fig. 1)
- optimise haemoglobin and haematinic status
- identify the placental site
- ensure that delivery takes place in a centre that has access to interventional radiology, cell salvage and appropriate surgical expertise
- encourage vaginal delivery, with active management of the third stage, as this is associated with lower blood loss
- inform obstetric and anaesthetic consultants of admission

ANAESTHETIC CHECKLIST FOR

WOMEN WHO MAY REFUSE BLOOD PRODUCTS

Patient label

	WILLING TO HAVE IF REQUIRED	REFUSE UNDER ANY CIRCUMSTANCES
Red cells		
Platelets		
Fresh frozen plasma		
Cryoprecipitate		
Fibrinogen concentrate		
Prothrombin complex concentrate		
Factor VIIa		
Cell saver		
Haemofiltration/dialysis		
Cardiac bypass		
Erythropoietin		

Any other information :

Signature (Patient) _____

Signature (Anaesthetist) _____

Fig. 1. Anaesthetic checklist for women who refuse blood products. Simpson Centre for Reproductive Health, NHS Lothian.

If significant bleeding occurs, the use of all methods to stop bleeding that are available and acceptable to the patient should be considered as early as possible, including hysterectomy (early hysterectomy is advocated in such cases).

DRILLS

Local obstetric haemorrhage protocols must be produced and regularly tested by the use of drills.[72] These drills raise clinical awareness and highlight system failures. MOET[73] (Managing Obstetric Emergencies and Trauma) and ALSO[74] (Advanced Life Support for Obstetricians) courses are helpful.

EDUCATIONAL PROGRAMMES

A variety of educational programmes are available: Integrated Management of Pregnancy and Childbirth (IMPAC)[75] from the World Health Organisation and Advances in Labour And Risk Management (ALARM)[5] from the International Federation of Gynecology and Obstetrics. There is also the HAEMOSTASIS algorithm for the treatment of the atonic uterus.[76]

ANAESTHESIA

The provision of anaesthesia in major haemorrhage is often extremely difficult and the approach is dictated by both the condition of the patient and her baby. In the presence of haemodynamic instability or ensuing coagulopathy, regional anaesthesia is contraindicated and general anaesthesia is mandatory. Senior anaesthetists should be informed and involved in all cases as soon as possible.

For elective placenta praevia cases, there is evidence that regional anaesthesia is safe[77,78] a combined spinal/epidural may be preferable to allow more time for surgery. The patient should be counselled and prepared for general anaesthesia in case it becomes necessary to convert. General anaesthesia should be used from the outset in cases of placenta accreta to allow greater control of the situation. The use of invasive monitoring is indicated in these cases as is cell salvage, warming and rapid infusor devices and near-patient testing as blood loss is often so rapid and high volume that laboratory results are 'out-of-date' by the time they are obtained.

Following surgery, the vast majority of patients can be looked after in a high-dependency facility, ideally within the labour ward. However, some patients may require intensive care, usually for respiratory and haematological support.

In summary, women in both the developing and developed world continue to suffer morbidity and mortality from obstetric haemorrhage. The challenge comes with ensuring that all that could be done to successfully treat them is provided at the frontline. The presence of a birth attendant at every delivery is the single most important factor in reducing maternal morbidity and mortality but this is a low priority in resource-poor countries. The basic principles: prompt recognition, early management with fluid resuscitation, uterotonics to treat atony and surgery with adjuncts when available and appropriate should be achievable no matter where the parturient is geographically.

Better care of the parturient is needed but the power to do so lies not necessarily in the medical world but in the political arena where funds must be drastically re-directed towards health care. Only then can we begin to address the disparity between rich and poor.

Practice points

- Existence of local protocols
- Regular drills to test effectiveness
- Use of thrombo-elastography and Haemacue® to give 'real-time' coagulation status and haemoglobin
- Tranexamic acid should be used more often

Research agenda

- Dose and duration of treatment of methotrexate for conservative treatment of placenta accreta
- The role of carbetocin versus syntocinon in uterine atony
- The use of recombinant Factor VIIa in obstetrics
- The indications and efficacy of cell salvage in obstetrics

Conflict of interest

Dr. Wise has no conflict of interest/affiliation. Dr. Clark is a member of the UK Cell Salvage Action Group.

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