

Prevention and Management of Postpartum Haemorrhage

These guidelines have been reviewed and approved by the Clinical Practice Obstetrics Committee

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Abstract

Objective: the primary objective of these guidelines is to review the clinical aspects of Postpartum Haemorrhage (PPH) and provide guidelines to help clinicians prevent and manage excessive bleeding postpartum.

Options: prevention, appropriate intervention, keys to minimizing its impact.

Outcomes: establish practices to facilitate the identification of women who may be at particularly high risk of PPH and to allow prompt intervention should excessive bleeding occur

Evidence: follows the Quality of Evidence of The Canadian Task Force on the Periodic Health Examination.

Values: developed by experts in the field of obstetrics.

Benefits, harms and costs: the use of uterotonic drugs and other active management techniques have been evaluated based on their convenience, accuracy, availability and safety

Recommendations: the 12 recommendations listed in the guidelines have been graded according to the level of evidence on which they are based

Validation: Medline references were sought using the MeSH heading postpartum haemorrhage. The Cochrane Library was searched for relevant studies. The ALARM course Manual was consulted.

Sponsors: developed and reviewed by the Clinical Practice Obstetrics Committee and approved by the Council of the SOGC.

DEVELOPMENT

In preparation of this paper, Medline references were sought using the MeSH heading postpartum haemorrhage (PPH). All English articles published before September 1999 were obtained and the abstracts of articles in other languages were reviewed. References in the articles were also scrutinized for further useful documents which were also obtained. The Cochrane Library was searched for relevant studies. The ALARM Course Manual was consulted.

The quality of the evidence for each of the recommendations is indicated by a Roman numeral in brackets following the recommendation. The grading system used is that of the Canadian Task Force on the Periodic Health Exam.¹ The guidelines were developed by the Clinical Practice Obstetrics Committee of the Society of Obstetricians and Gynaecologists of Canada.

INTRODUCTION

In spite of marked improvements in management, early PPH remains a significant contributor to maternal morbidity and mortality both in developing countries^{2,3} and in hospitals

equipped with all that modern medicine has to offer.^{4,5,6} This complication is among the most challenging which a clinician will face. Prevention, early recognition and prompt appropriate intervention are the keys to minimizing its impact. Persons providing intrapartum care should routinely take steps to prevent PPH. Practices should be established to facilitate the identification of women who may be at particularly high risk for PPH and to allow prompt intervention should excessive bleeding occur. Appropriate medications and instruments should be readily available and known to all staff. This document will review clinical aspects of PPH and provide guidelines to help clinicians prevent and manage excessive bleeding postpartum.

DEFINITION

Haemorrhage that occurs within the first 24 hours postpartum is termed early postpartum haemorrhage while excessive bleeding after this time is referred to as late postpartum haemorrhage. In general, early PPH involves heavier bleeding and greater morbidity. These guidelines will address early PPH.

The exact definition of PPH remains problematic. Pritchard has shown that the mean blood loss with vaginal delivery and caesarean section are 500 and 1000 ml respectively.⁷ Any greater loss could be termed PPH, however, clinical estimation of the amount of blood loss is notoriously inaccurate.⁷⁻¹⁰ Another proposed definition for PPH is a 10% change in haematocrit.¹¹ This is a retrospective approach which may be useful in research protocols to assess risk factors or compare the effectiveness of treatments but is not very helpful to a clinician faced with excessive bleeding. Combs has suggested a clinical definition of "need for blood transfusion".¹¹ This definition is complicated by large variations in practice patterns and attitudes towards transfusion by both patients and physicians. The diagnosis of PPH, therefore, remains a subjective clinical assessment that includes any amount of blood loss that threatens the woman's haemodynamic stability.

Clinicians should be aware that certain women will become

compromised with a relatively small blood loss. This may include women with gestational hypertension with proteinuria, women who are anemic or dehydrated and women of small stature.¹¹ In general, however, the degree of haemodynamic compromise or shock parallels the amount of blood lost. Table One outlines the expected clinical findings noted with increasing volumes of blood lost. Whereas most women experience mild symptoms and maintain their blood pressure at a blood loss of 500 to 1000 ml (10 to 15 percent of circulating volume), losses of 2000 to 3000 ml (35 to 45 percent of circulating volume) will cause marked hypotension, with cardiovascular collapse, air hunger, anuria and severe shock.¹²

EPIDEMIOLOGY

Excessive bleeding affects approximately 5 to 15 percent of women after giving birth.^{7,11,13,14} The etiologies of early PPH are most easily understood as abnormalities of one or more of four basic processes. Bleeding will occur if for some reason the uterus is not able to contract well enough to arrest the bleeding at the placental site. Retained products of conception or blood clots, or genital tract trauma may cause large blood losses postpartum, especially if not promptly identified. Coagulation abnormalities can cause excessive blood loss alone or when combined with one of the other processes. As a memory aid these processes can be thought of as the four T's; *Tone, Tissue, Trauma and Thrombin*.¹⁵

Many factors affect a woman's risk of PPH. Each of these risk factors can be understood as predisposing her to one or more of the four "T" processes. Some of the many risk factors are outlined in Table 2. Although any woman can experience a PPH, the presence of risk factors for one or more of these processes makes it more likely. When a woman presents in labour, this table may be used to identify women who may be at increased risk of excessive bleeding. For women with such risk factors, consideration should be given to extra precautions such as IV access, coagulation studies, crossmatching of blood and anaesthesia backup. Referral to a tertiary centre should be recommended for some high risk patients.

RECOMMENDATION #1

Clinicians should assess each woman's risk for PPH and make appropriate arrangements for her care. (III)

PREVENTION OF PPH

UTEROTONIC DRUGS

Many trials and several overviews have demonstrated that routine oxytocic administration in the third stage of labour

	Degree of Shock			
	Compensation	Mild	Moderate	Severe
Blood loss	500-1000 ml 10-15%	1000-1500 ml 15-25%	1500-2000 ml 25-35%	2000-3000 ml 35-45%
Blood Pressure Change (systolic pressure)	none	slight fall (80-100 mmHg)	marked fall (70-80 mmHg)	profound fall (50-70 mmHg)
Symptoms and Signs	palpitations dizziness tachycardia	weakness sweating tachycardia	restlessness pallor oliguria	collapse air hunger anuria

can reduce the risk of PPH by more than 40%, meaning that 22 women would need to receive prophylactic treatment to prevent one PPH.¹⁶ Similarly, it has been shown that the routine prophylaxis with oxytocics results in a reduced need to use these drugs therapeutically.^{13,16}

In Canada, oxytocin is the current drug of choice for prevention of PPH. The main advantages are its rapid onset of action and the fact that it does not cause elevations of blood pressure or tetanic contractions like ergomet-rine.^{13,17,18}

Administration of oxytocin is most beneficial in prevention of PPH and has not been demonstrated to increase the risk of retained placenta or the duration of the third stage of labour.¹⁸ Management of the third stage of labour should therefore include the administration of oxytocin after the delivery of the anterior shoulder. Effective protocols include 10 units IM, five units by IV push or 10 to 20 units per litre IV drip run at 100 to 150 cc/hr. There is no evidence that any particular protocol, with regard to dose, route or timing of oxytocin admin-

	Etiology Process	Clinical Risk factors
Abnormalities of uterine contraction (<i>Tone</i>)	- over distended uterus	- polyhydramnios - multiple gestation - macrosomia
	- uterine muscle exhaustion	- rapid labour - prolonged labour - high parity
	- intra amniotic infection	- fever - prolonged ROM
	- functional/anatomic distortion of the uterus	- fibroid uterus - placenta previa - uterine anomalies
Retained Products of conception (<i>Tissue</i>)	- retained products - abnormal placenta - retained cotyledon or succinuriate lobe	- incomplete placenta at delivery - previous uterine surgery - high parity - abnormal placenta on U/S
	- retained blood clots	- atonic uterus
Genital Tract Trauma (<i>Trauma</i>)	- lacerations of the cervix, vagina or perineum	- precipitous delivery - operative delivery
	- extensions, lacerations at caesarean section	- malposition - deep engagement
	- uterine rupture	- previous uterine surgery
	- uterine inversion	- high parity - fundal placenta
Abnormalities of Coagulation (<i>Thrombin</i>)	- pre-existing states - hemophilia A - von Willebrand's Disease	- hx of hereditary coagulopathies - hx of liver disease
	- acquired in pregnancy - ITP - thrombocytopenia with pre-eclampsia - DIC - pre-eclampsia - dead fetus in utero - severe infection - abruption - amniotic fluid embolus	- bruising - elevated BP - fetal demise - fever, WBC - antepartum haemorrhage - sudden collapse
	- therapeutic anti-coagulation	- hx of blood clot

istration is superior to any other.¹⁸

Two published randomized controlled trials have looked at the effectiveness of misoprostol for prophylaxis against PPH.^{19,20} Both were promising although neither was a double blind study nor were they large enough to have statistically significant results. Larger studies are currently ongoing. If found effective, the benefits of misoprostol will be its low cost and nonparenteral administration. Also important, especially in the developing world, is that misoprostol can be stored for long periods of time at room temperature.

A new synthetic analogue of oxytocin, carbetocin, is currently being studied to determine its place in the prevention and treatment of PPH. This long-acting drug has a rapid onset of action and a half life of 40 minutes as compared to oxytocin which is 4 to 10 minutes. Two Canadian randomized double blind studies have compared a single intravenous bolus of carbetocin to an infusion of oxytocin for women undergoing caesarean birth. Carbetocin was well tolerated and appeared to be as effective or more effective than oxytocin as judged by the need for additional oxytocic intervention.^{21,22} More study will be needed to confirm these findings and to determine its value in prophylaxis after vaginal delivery.

RECOMMENDATION #2

Routine prophylactic oxytocin after delivery of the shoulder reduces the risk of PPH. (I)

OTHER ACTIVE MANAGEMENT TECHNIQUES

Disagreement still exists on the relative importance of the various other components of third stage active management, aside from the prophylactic administration of oxytocics. This includes the timing of cord clamping and the method of delivery of the placenta. Although early cord clamping appears to shorten the third stage, there is no evidence that this practice decreases the risk of PPH.¹⁸ Controlled cord traction and use of uterine massage have not been studied independently. Virtually all studies have randomized women to "active management" including oxytocin and cord traction with or without early cord clamping or to "expectant management" without even oxytocin. These trials invariably found active management to reduce the rate of PPH but this effect may be entirely due to the oxytocin.^{23,24,25}

Until such time as studies reveal which parts of these protocols are not required, active management of the third stage of labour should include the use of prophylactic oxytocin and prompt clamping of the umbilical cord. The fundus should then be palpated to ensure uterine contraction while gentle cord traction is applied balanced by upward pressure just above the symphysis pubis. The placenta will deliver spontaneously or may be found at the cervix with gentle digital exam and then lifted from the vagina. If neither occurs readily, IV oxytocin (20 U/L at 100 to 125 cc/hr) may be instituted.¹⁵

With delivery of the placenta, the clinician should ensure continued uterine contraction by fundal palpation and massage as necessary. The placenta should be inspected for completeness and the lower genital tract carefully explored for lacerations. In the cases of an operative delivery, the cervix and upper vagina should also be visualized.¹⁵

RECOMMENDATION #3

Third stage care should also include early cord clamping, controlled cord traction with uterine palpation and inspection of both the placenta and the lower genital tract. (III)

MANAGEMENT OF ESTABLISHED PPH

Early recognition of PPH is a very important factor in management. Clinicians should routinely observe women after delivery for signs of excessive bleeding. They should ensure that nursing practices are in place to allow early detection of atony or haemorrhage. A previously established plan of action for the management of PPH is of great value when the preventative measures above have failed. It is critical that these practices be familiar to all staff in the maternity care facility and that precautions have been taken to ensure the availability of appropriate equipment, drugs and personnel in case of PPH. A stepwise approach to assessing and treating an established PPH is outlined below and diagramed in Figure 1.

INITIAL ASSESSMENT AND TREATMENT

When confronted with excessive ongoing bleeding, the clinician should immediately attempt to determine the cause of the haemorrhage while at the same time instituting resuscitative measures and appropriate investigations (see Step 1 on Figure 1). To identify the etiology, a thorough exploration of the uterus and inspection of the lower genital tract should be performed. Simultaneously, attention should be directed to the "ABC's" with the establishment of a large bore intravenous access, administration of oxygen by mask and monitoring of vital signs including the blood pressure, pulse, respirations and urine output. Crystalloid solutions should be administered through the intravenous site. Consideration may be given to urinary catheter insertion and the use of an oxygen saturation monitor. Blood should be drawn for CBC, coagulation screen and ABO type screen and crossmatch. It may be helpful for the clinician to retain a red topped tube of blood for observation. Failure to form a clot in seven to ten minutes indicates an impairment of the woman's clotting system.

RECOMMENDATION #4

Initial treatment of PPH includes early recognition followed by prompt attention to the resuscitation and a simultaneous search for the cause of the bleeding. Baseline laboratory

tests should be ordered. (III) Fig. (1)

DIRECTED TREATMENT

During the exploration of the genital tract it should be possible to identify the source of the haemorrhage and to begin directed treatment (see Step 2 on Figure 1). Again specific causes will fall into one of the Four "T" categories of Tone, Tissue, Trauma and Thrombin as described above. Uterine atony is the most common problem identified and can be treated immediately by uterine massage and/or compression in addition to the administration of oxytocic medications as detailed below (see also Table 2). If retained blood clots or products of conception are identified, they should be carefully removed, including complete manual removal of the placenta if necessary. After the

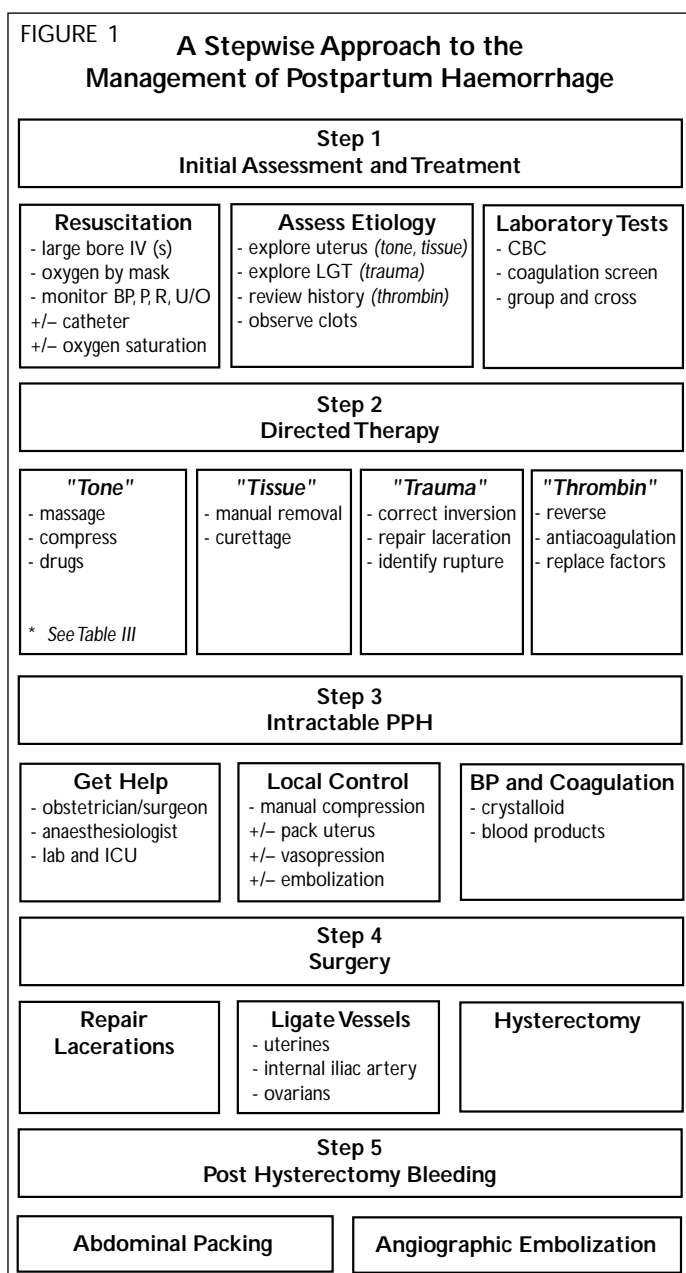
uterus is empty, massage, compression and medications should be used to combat atony. Initial exploration may also reveal trauma including uterine inversion or rupture and lacerations of the cervix or lower genital tract. If uterine inversion is identified, prompt replacement should be undertaken prior to administration of further oxytocic drugs. Lacerations must be carefully visualized and repaired. If uterine rupture has occurred, arrangements for laparotomy should be initiated (see Step 3). If a coagulation abnormality is known or suspected, direct pressure at the bleeding site should be employed to minimize losses until specific therapy has taken effect.

Several drugs are available to treat uterine atony. They should be employed in a methodical fashion, while maintaining uterine massage and compression. The currently available products include oxytocin, methylergonovine maleate and carboprost.

Oxytocin is a synthetic hormone identical to that produced in the posterior lobe of the pituitary. This medication causes contraction of the uterus with its effect increasing with the gestation as oxytocin receptors develop. In small doses oxytocin increases the tone and frequency of contractions but in larger doses can cause tetany. It can be given IV or IM. For a patient with active bleeding, a continuous infusion of saline or Ringer's lactate with 20 units of oxytocin per liter should be infused.²⁶ If circulatory collapse has occurred, 10 units may be given intramyometrially (IMM). Very few side effects are noted with oxytocin aside from occasional nausea and vomiting. Water intoxication is a theoretical risk rarely encountered. There are no contraindications to the use of this drug for PPH prevention or treatment.

Methylergonovine maleate is an ergot alkaloid which produces tetanic contractions of the uterus within five minutes of intramuscular injection. It is given IM in doses of 0.25 mg, which may be repeated up to every 5 minutes to a maximum dose of 1.25 mg.^{15,27} It may also be given directly into the uterine muscle if necessary or as an IV bolus of 0.125 mg. This drug is known to cause peripheral vasospasm and can exacerbate hypertension. It also may cause nausea and vomiting. It should not be used when the patient has hypertension.

Carboprost is a synthetic 15 methyl analogue of prostaglandin F₂alpha. It is given IM or IMM in doses of 0.25 mg, which may be repeated every 15 minutes to a maximum dose of 2 mg. It is an extremely effective agent for increasing uterine tone but may produce prostaglandin side effects including nausea, vomiting, diarrhea, headache, hypertension and bronchospasm due to smooth muscle contraction. Carboprost also acts on the central nervous system thermoregulatory centre, sometimes causing flushing, diaphoresis and restlessness due to increased basal temperatures. It has been shown to cause oxygen desaturation due to increased pulmonary shunting.²⁸ Carboprost should not be used in patients with major cardiovascular, pulmonary, renal or hepatic dysfunction.^{29,30} In spite of these potential risks, serious side effects are rare and most are self limiting. Several case series reported in the literature show that the



use of carboprost is extremely effective for persistent bleeding due to uterine atony, often obviating the need for surgical management. The success rate for controlling bleeding was between 84 and 96 percent in these reports.³¹⁻³³ Because atony is the most frequent cause of PPH, clinicians should consider the use of this highly effective drug early in the management of haemorrhage, especially in the face of massive bleeding.³⁴

In the case of mild haemophilia A and type 1 von Willebrand's, there is well established evidence that the use of desmopressin, before surgery or for treating severe haemorrhage, normalizes bleeding time and factor VIII levels and is clinically efficacious.³⁵ Although the evidence is less clear, desmopressin has been used successfully to prevent or stop bleeding in patients with congenital defects of platelet function, with hemostatic abnormalities associated with chronic liver disease, and with those induced by therapeutic use of antiplatelet and anticoagulant agents.³⁵

RECOMMENDATION #5

The second step in the management of PPH involves attention to the specific cause, proceed with massage, compression and medications for atony, evacuation of the uterus for retained blood clots or products of conception, physical repair of any trauma and reversal of coagulation defects. (III)

INTRACTABLE PPH

INITIAL APPROACH

Only a small proportion of women will fail to respond to these initial management steps. Bleeding which has not resolved at this point may soon become life threatening and require surgical intervention. Consequently, Step 3 on Figure 1 outlines organizational steps to be taken when uterotonic agents and local measures have failed. First ensure that all appropriate services including Blood Bank and ICU are notified in addition to summoning the help of another experienced physician, obstetrician or surgeon and an anaesthesiologist. While such arrangements are being made, local control should be attempted with manual compression. Consideration should be given to packing of the uterus. Vasopressin may be used at caesarean for the control of placental site bleeding. Continued administration of large quantities of crystalloid and blood products intravenously may be required to maintain blood pressure, urine output and coagulation.

In some centres angiographic embolization is available and may be considered at this point. However, the clinician must carefully consider whether the woman's haemodynamic and coagulation status can be maintained for the time required to organize and complete this procedure. This procedure is discussed in more detail later under post hysterectomy bleeding.

Uterine packing was first described in the 1800s and was practised by many obstetricians and supported by most major

obstetrical textbooks.^{36,37} It fell out of favour in the 1950s because it was felt that it was not "physiologic" and that it may mask trauma and ongoing bleeding and cause infection. There is very little evidence in the literature to support or refute these fears. Several small retrospective reviews in the literature indicate it may be useful in certain PPH situations.³⁸ The technique involves packing the uterine cavity completely and uniformly with mesh gauze. The patient is given antibiotics and the pack is left in place for 24 hours while fluid and blood component replacement is completed. Uterine packing may be particularly useful when surgical treatment is unavailable at the current site or when the woman is too unstable to undergo surgery at that time.

Vasopressin causes acute vasospasm, decreasing blood flow near the injection site allowing coagulation to occur. Lurie describes six cases of injection of dilute vasopressin for intractable bleeding due to placenta accreta, where bleeding ceased without need for further surgery.^{39,40} Twenty units (one ml) of vasopressin is diluted with 100 ml normal saline giving a 0.2 units/ml solution, which is infiltrated one ml at a time sub-endometrially at the bleeding site. It is very important that the solution is correctly diluted and that the needle not be in a blood vessel because high doses or intravascular injection of vasopressin can cause acute arterial hypertension, bradycardia, or death.⁴¹ Local vasopressin infiltration into the placental site may be indicated in cases of intractable bleeding during caesarean section.

RECOMMENDATION #6

For the small proportion of women not responding to the initial management steps, a multi-disciplinary team should be assembled including a second obstetrician or surgeon, anesthesiologist, and the associated staff from the operating room, blood bank and intensive care unit. If invasive radiology services are available consideration may be given to angiographic embolization. While such arrangements are being made, blood loss should be minimized by compression, packing and/or vasopressin. Fluid and blood component therapy must be continued to maintain haemodynamic and coagulation status. (III)

SURGICAL APPROACHES

Intractable postpartum haemorrhage remains one of the major causes of direct maternal death. However, since it is quite rare, published research consists primarily of descriptive case reports and retrospective and occasional prospective reviews of relatively small numbers of cases treated by specific techniques, with discussion of successes, failures and complications. This fact and the resultant limitations in our knowledge are not likely to change.

Surgical management plans for intractable PPH might include laparotomy with ligation of the uterine vessels or internal iliac arteries, or even hysterectomy (see Step 4 on Figure 1).

Clearly there are geographic variations in acceptance and usage of various techniques, which illustrates that more than one technique may be equally effective in given circumstances, with success depending largely on the teaching and familiarity of an operator with specific procedures. What can be concluded from this is that there is often no one correct way to manage a particular case of intractable PPH. Management needs to be tailored to the particular situation at hand, the experience of the obstetrician, and the facilities and personnel available. What is most important is that treatment be prompt and that ongoing monitoring and replacement of blood and clotting factors be continued throughout. All available expertise should be used.

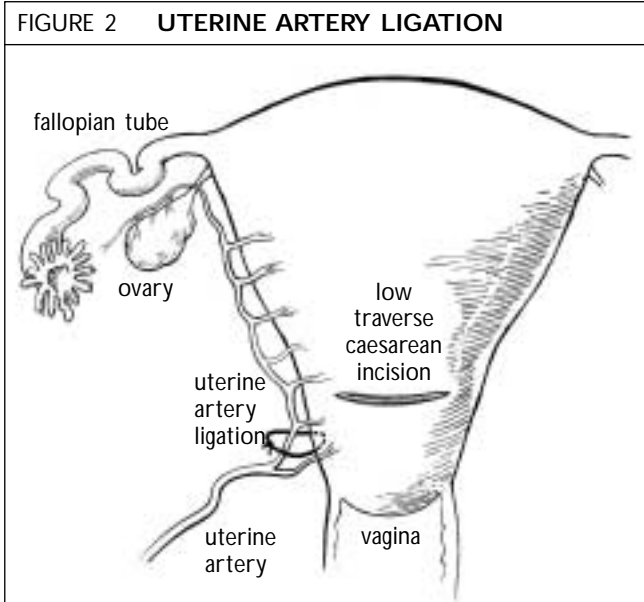
RECOMMENDATION #7

The approach to intractable PPH will be individualized depending on the clinical situation and the skills and technology available. Continued monitoring and fluid and blood component replacement and use of all available expertise are essential. (III)

UTERINE VESSEL LIGATION

Waters⁴² first described this procedure in 1952 and others have subsequently reported success rates of 80-90 percent.⁴³⁻⁴⁹ The largest experience in the literature is O'Leary's report of 30 years experience with 265 patients, with 96 percent success rate.⁵⁰ Another large study reports 100 percent effectiveness in 103 patients with intractable PPH using a stepwise approach to uterine devascularization, which begins with unilateral uterine vessel ligation and may include subsequent ovarian vessel ligation.⁵¹ No serious complications were noted and subsequent pregnancies have been documented.

While Waters originally described dissecting out the artery from the vein, the authors of the above large studies did not find this to be necessary and instead described a technique of mass ligation of both artery and vein in a relatively simple manner which can be rapidly performed. In this technique, the uterine artery is ligated at the level where it runs along the uterine border beside the upper part of the lower uterine segment. If a caesarean section has been performed, the ligation is done 2-3 cm below the level of the uterine incision. To do this, it may be necessary to advance the bladder. A large atraumatic needle with appropriate absorbable suture material is employed. The uterine artery and vein are ligated by passing the needle 2-3 cm medial to the vessels, including almost the full thickness of the myometrium, and then bringing it through broad ligament in the avascular area lateral to the vessels. In order to produce a mass ligation, avoid damaging uterine vessels and help obliterate intramyometrial ascending arterial branches, it is important to include 2-3 cm of myometrium in the suture (see Figure 2).⁵² A second stitch can be placed if the above step is ineffectual and for cases with continued lower uterine segment haemor-



rhage.⁵¹ With the bladder well mobilized a second lower bilateral uterine vessel ligation was performed 3-5 cm below the upper ligatures. This ligature would obliterate most of the branches of the uterine artery to the lower uterine segment and a branch that extends to the cervix.⁵¹ If there is continued bleeding, unilateral or bilateral ovarian vessel ligation may be performed.

In most cases of intractable PPH, uterine vessel ligation should be among the first surgical steps attempted, as it is simple to perform and can be done quickly. Advantages over internal iliac ligation include easier dissection, lower complication rates, more distal occlusion of arterial supply with less potential for rebleeding because of collaterals, and high reported rates of success in controlling haemorrhaging.

RECOMMENDATION #8

Uterine vessel ligation may be effective in controlling PPH. (II-3)

INTERNAL ILIAC ARTERY LIGATION (IIAL)

Ligation of the internal iliac arteries is a procedure originally described in the 1800s for management of bleeding from pelvic tumours, and applied more recently in obstetrical haemorrhage. Experiments in the 1960s by Burchell ascertained that the effect of ligation of the internal iliacs was to convert the affected pelvic circulation to a venous system, thereby allowing clotting to develop and persist.⁵³ The published literature on IIAL consists mostly of numerous case reports.⁵⁴ A few papers⁵⁵⁻⁵⁸ present the results of a series of 13 to 18 obstetrical patients who had the procedure performed over a period of several years. The success rates in these studies ranged from 42 to 100 percent. With such small numbers in the studies, it is difficult to make

conclusions about its effectiveness.

The technique involves identifying the bifurcation of the common iliac artery, where the ureter crosses it. To do this, a 5-8 cm incision is made in the peritoneum lateral and parallel to the line of the ureters. With the peritoneum open the ureter is then retracted medially, and the artery is ligated 2.5 cm distal to the bifurcation of internal and external iliacs. A right-angled clamp is passed gently behind the artery and appropriate non absorbable suture material is fed around the artery and two free ligatures tied 1.5 to 2 cm apart. The vessel is not divided. Care must be taken to avoid trauma to the internal iliac veins. External iliac artery and femoral pulse must be identified before and after tying the ligatures.

Internal iliac artery ligation offers a proximal intervention which should have a significant impact on uterine blood flow; however, it carries some risk of injury to the iliac veins which could exacerbate the bleeding problems. This procedure should be attempted by surgeons comfortable operating within the retroperitoneal space. In deciding to perform internal iliac artery ligation, the clinician must consider also whether the patient's condition will allow time for her to undergo this conservative procedure at the expense of a delay in definitive treatment.

RECOMMENDATION #9

Internal iliac artery ligation has been reported for use in PPH, however its effectiveness is not yet proven. This procedure requires more extensive surgical skills and the situation may deteriorate if the iliac veins are injured. (II-3)

EMERGENCY PERIPARTUM HYSTERECTOMY

Emergency hysterectomy is the most common treatment modality when massive postpartum haemorrhage requires surgical intervention. The incidence of emergency peripartum hysterectomy reported in the literature varies from 7 to 13 per 10,000 births,⁵⁹⁻⁶¹ and is much higher after caesarean section than vaginal delivery.

In a retrospective review of 123 cases of emergency peripartum hysterectomy from 1985-1990 in Los Angeles County,⁵⁹ the most common indication for the procedure was placenta accreta or percreta (49.6%). This was a change from a similar review from the same centre for 1978 to 1982, when uterine atony was the most frequent cause. The authors postulated that this change was likely caused by newer or more effective prostaglandins for use with uterine atony, and an increase in the number of labouring patients with prior caesarean delivery. The association of placenta previa and prior caesarean section with placenta accreta and risk of hysterectomy is well documented in the literature.^{59,60,62-64} Other frequently cited indications for emergency hysterectomy are rupture of the uterus, severe extension of caesarean section on incision, broad ligament haematoma after forceps, lacerated

cervix/vagina after forceps or ventouse, and chorioamnionitis.⁶⁰

The technique and avoidance of pitfalls is well described in detail in a comprehensive review of the subject by Plauché.⁶⁴ Because this procedure is done with ongoing active bleeding, it is fastest to "clamp, cut and drop" the pedicles to below the level of the uterine arteries, and then tie them off.⁶⁴ To avoid damage to the ureter, the uterine arteries should be clamped high on the uterus and then successive smaller pedicles taken, each inside the other down through the cardinal and uterosacral ligaments. Because the cervix may be difficult to palpate, it is best to open the vagina (if necessary with the aid of a double-gloved finger in the vagina) and then circumscribe the cervix. It is often advised to leave the vagina at least partially open, with or without a drain, after securing the vaginal angles with figure of eight sutures and oversewing the edges of the vagina.

Subtotal hysterectomy has been advocated to reduce operative time and blood loss. It is hard to find data which will support this as subtotal hysterectomy is often performed in the worst cases which already have larger blood losses and longer operating times.⁶⁵ Leaving the cervix in place would appear to be a reasonable option if the bleeding is controlled. This might occur with bleeding secondary to uterine atony. If the bleeding site is in the lower uterine segment or cervix, as occurs with placenta previa or with abnormal placentation, bleeding will not be controlled as it is supplied by the cervical branches of the uterine arteries.

The advantages of emergency hysterectomy in the situation of massive haemorrhage are the ability to remove the source of bleeding and the familiarity of the obstetrician with the procedure of hysterectomy, which, albeit more technically difficult in this situation, is still a familiar operation to any obstetrician/gynaecologist. The disadvantage of hysterectomy may include the loss of uterus in a woman who wishes to continue childbearing. Hysterectomy is associated with more blood loss and longer operative time but this may reflect the fact that hysterectomy is reserved for the worst cases of PPH.⁶¹

RECOMMENDATION #10

Peripartum hysterectomy can be life saving in PPH. A clamp, cut and drop technique should be used to gain control of bleeding as rapidly as possible. (II-3)

POST HYSTERECTOMY BLEEDING

Unfortunately hysterectomy does not guarantee control of blood loss in severe PPH. Bleeding may persist from the pelvic surfaces due to decreased coagulation combined with the trauma from prolonged manipulation. These small sites may be difficult or impossible to isolate and coagulate or suture. Bleeding vessels may retract deep into the pelvic retroperitoneal space

Drug	Dose	Side Effects	Contraindications
Oxytocin	10 units IM/IMM 5 units IV bolus 10 to 20 units/litre	Usually none painful contractions nausea, vomiting, (water intoxication)	hypersensitivity to drug
Methylergonovine maleate	0.25mg IM/0.125mg IV repeat every 5 mins as needed maximum 5 doses	peripheral vasospasm hypertension nausea, vomiting	hypertension hypersensitivity to drug
Carboprost (15-methyl PGF₂ alpha)	0.25 IM/IMM repeat every 15 mins as needed maximum 8 doses	flushing, diarrhea, nausea, vomiting bronchospasm, flushing, restlessness, oxygen desaturation	active cardiac, pulmonary, renal, or hepatic disease hypersensitivity to drug
Vasopressin	20 units diluted in 100 ml normal saline = (0.2 units/ml) inject 1 ml at bleeding site avoid intravascular injection	acute hypertension, bronchospasm nausea, vomiting, abdominal cramps angina, headache, vertigo death with intravascular injection	coronary artery disease hypersensitivity to drug

and be difficult or impossible to isolate surgically.

ABDOMINAL PACKING

Intra-abdominal packs have been used for continued bleeding from peritoneal surfaces when hysterectomy has been done, a consumptive coagulopathy exists, and there is continued widespread bleeding. This method is also used in other surgical disciplines for similar indications. In this situation the pelvis is packed firmly with large laparotomy packs, which are then removed 24 hours later after correction of the coagulopathy. A variation on this method involves the use of a transvaginal pressure pack, in which Kerlix gauze is held in place in the pelvis by a sterile plastic bag and brought out through the vagina. Traction on the pack produced pressure against the pelvic floor. The pack can later be removed through the vagina.⁶⁶

UTERINE ARTERY / INTERNAL ILIAC EMBOLIZATION

Angiographic embolization techniques were first described for the management of bleeding with postpartum haemorrhage in 1979.⁶⁷ The authors described a case where emergency hysterectomy and hypogastric artery ligation failed to stop haemorrhage and embolization of a vaginal branch of the left internal pudendal resulted in immediate cessation of bleeding and stabilization of the patient. A recent review by Vedantham *et al.*⁶⁸ cited 49 cases in the literature in which this procedure was successful in controlling postpartum haemorrhage. Disadvantages of this procedure include the time needed to perform a procedure (1-2 hours) and the fact that the necessary facilities and skills may not be available in all centres. Nevertheless, it is a useful technique, particularly in a patient with ongoing bleeding who is stable or when surgical options have been exhausted.

RECOMMENDATION #11

Diffuse post hysterectomy bleeding may be controlled by abdominal packing to allow time for normalization of the woman's haemodynamic and coagulation status. Specific vessels which haemorrhage persistently may be controlled with embolization procedures. (II-3)

SPECIAL CIRCUMSTANCES

PATIENTS WHO REFUSE BLOOD TRANSFUSION

In the *Report on Confidential Enquiries into Maternal Deaths in the United Kingdom 1991-1993*, haemorrhage accounted for 11.6 percent of direct maternal deaths. Of the 15 deaths due to haemorrhage, in 11 cases the care was substandard. Three of these women refused blood transfusions because of their religious beliefs. It is very important that a woman's refusal of blood products is not mistaken as a desire for no intervention or an excuse for suboptimal care. Instead these woman should challenge the clinician to provide her with all other means of maintaining her health. Regardless of the clinician's personal views, he should be prepared to provide such care or transfer the woman's care to someone who can. The Report suggests guidelines for the management of such cases.^{69,70} Although true for all parturients, in women who refuse blood for religious reasons there must be increased vigilance by experienced staff for any bleeding. It is helpful to involve other consultants early and if necessary to refer to a centre which has capability and experience in non-blood management of haemorrhage.

In addition to the management options already discussed, these centres may offer intraoperative blood salvage and auto-transfusion which is acceptable to most Jehovah's Witnesses as

long as the blood remains in a continuous circuit with the body. A cohort study involving the use of this technology during 139 caesarean sections showed no increased risk of complications.⁷¹

The safety of acute normovolemic haemodilution has also been studied in non-randomized fashion.⁷² In 38 women having caesarean section who were identified as having a high risk for PPH on the basis of placenta previa, large fibroids or other abnormalities of placentation, haemodilution was found to be both safe and feasible. It can be acceptable to Jehovah's Witnesses again as long as the blood remains in a continuous circuit with the woman's body.

Other considerations should be to optimize the predelivery haemoglobin with supplemental iron, folate and possibly recombinant human erythropoietin, and to avoid hypertension and excessive fluid administration. Gelatin is the only colloid volume expander that is believed not to interfere with haemostasis. These products should be used in an intensive care setting with appropriate monitoring to avoid pulmonary edema.⁶⁹ Medical Antishock Trousers and hyperbaric oxygen treatment may also be helpful.^{73,74}

RECOMMENDATION #12

Patients who cannot be given blood require careful pre-labour assessment and transfer to the centre most equipped to deal with a PPH should it occur. While respecting the woman's desire for no blood products to be given, the clinician must employ all other treatment options for PPH to the fullest. (II-3)

CONCLUSION

Each year thousands of women die from PPH around the world. The prevention and management of postpartum haemorrhage are therefore very important aspects of maternity care. Clinicians should identify risk factors, take steps to prevent PPH and learn and employ as many of the management techniques described in this paper as possible.

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