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SUPPLEMENT ARTICLE

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FIGO recommendations on the management of postpartum hemorrhage 2022

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Conflicts of Interest
GT reports a research grant from the South African Medical Research Council to fund Sinapi Biomedical to develop the Ellavi UBT and conduct associated research. EB reports part ownership of BioIncept. EC was a member of the Guideline Development Group for the RCOG's PPH Greentop Guideline (2016), and the FIGO Guideline on Placenta Acreta Spectrum (2018). SM reports that Regents, University of California receives a royalty fee from LifeWrap-NASG for the use of the trademark name ("LifeWrap") for a Non-pneumatic Anti-Shock Garment (NASG). TB reports PPH research funded by the Gates Foundation; PPH Implementation efforts funded by RzHC; PPH Implementation efforts funded by UK AID; PPH Implementation efforts funded by Grand Challenges Canada; PPH efforts and research funded by USAID; PPH efforts by Norway Government. Other authors report no conflicts of interest.

*Members of the FIGO Safe Motherhood and Newborn Health Committee, 2018–2021, are listed at the end of the document.

Disclaimer

These FIGO recommendations are not intended to be a sole source of guidance or prescriptive protocol in managing PPH. They are designed to assist stakeholders by providing an evidence-based framework for decision-making in a PPH setting. The clinical judgment of the doctor or other practitioner, in the context of the clinical presentation of the patient and the available resources for diagnosis and treatment, should always inform the choice of clinical procedure and treatment plan.

Keywords: FIGO recommendations, management, postpartum hemorrhage, PPH, PPH prevention, PPH treatment

PURPOSE AND SCOPE

The purpose of this document is to update key concepts in the management of postpartum hemorrhage (PPH) and give clear and precise tools to health personnel in low- and middle-income countries (LMICs) to perform evidence-based treatments, with the aim of reducing related maternal morbidity and mortality.

TARGET AUDIENCE

Gynecologists, obstetricians, midwives, nurses, general practitioners, and other health personnel in charge of the care of pregnant women with PPH.

METHODS

The recommendations were developed as a synthesis and update of evidence from the literature. They are based on the FIGO Safe Motherhood and Newborn Health Committee (SMNH) guidelines that were published in 2012[1] and include research and consensus guidelines. For the present document, a bibliographic review was performed, and studies from LMICs and across regions were identified using the search engines PubMed, Medline, Embase, Science Direct, and Google Scholar. According to the GRADE (Grading of Recommendations Assessment, Development and Evaluation) approach, this update does not generate a universal level of evidence. However, each section and the generated conclusions and recommendations use the degrees of evidence that were identified in the bibliographic review.

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Contents

1 | EXECUTIVE SUMMARY

FIGO (International Federation of Gynecology and Obstetrics) is actively contributing to the global effort to reduce maternal death and disability around the world. Its mission statement reflects a commitment to promoting health, human rights, and well-being of all women, especially those at the most significant risk of death and disability associated with childbearing. FIGO provides evidence-based interventions that can reduce the incidence of maternal morbidity and mortality when applied with informed consent.

Postpartum hemorrhage (PPH) continues to be the leading cause of maternal morbidity and mortality in most countries around the world. Despite multiple collaborative efforts at all levels, there is still a lack of implementation or adherence to the recommendations for management of PPH when faced with this obstetric emergency. In part, this delay in implementation lies in the lack of information from current evidence and a lack of unification of the multiple guidelines for diagnosis and strategies to control bleeding. To provide clear and practical tools to approach this obstetric emergency, especially for low- and middle-income countries (LMICs), the FIGO Safe Motherhood and Newborn Health Committee (SMNH), supported by a group of experts worldwide, developed this updated review. It aims to provide multiple alternatives for the diagnosis and management of PPH tailored to the resources available at the institutional, local, or regional level. This document reflects the best available evidence, drawn from scientific literature and expert opinion, on the prevention and treatment of PPH in low-resource settings. FIGO believes that the greatest impediment in the adoption of a given strategy is the absence of an effective implementation tool.

2 | FIGO RECOMMENDATIONS FOR THE PREVENTION AND TREATMENT OF POSTPARTUM HEMORRHAGE

Health workers at all levels of care (particularly in LMICs) need to have access to appropriate medications[1] and training in PPH prevention and management procedures. All attempts should be made to reduce PPH using cost-effective, resource-appropriate interventions. At first, all should be done to avoid PPH and reduce the need for expensive, lifesaving surgical interventions. The routine use of active management of the third stage of labor by all attendants, regardless of where they practice, should be recommended.[2] All birth attendants must know how to provide safe care (physiologic management) to prevent PPH in the absence of uterotonic drugs.[3]

2.1 | FIGO recommendations for prevention of postpartum hemorrhage

1. The use of uterotonics for prevention of PPH during the third stage of labor is recommended for all births.[4,5] Oxytocin (10 IU intravenously/intramuscularly [IV/IM]) is recommended for the prevention of PPH for vaginal delivery and cesarean section.[4,5] In settings where oxytocin is used, attention should be paid to the oxytocin cold chain.[6]
2. In settings where oxytocin is unavailable or its quality cannot be guaranteed, the use of other injectable uterotonics (if appropriate ergometrine/methylergometrine 200 μg IM/IV; hypertensive disorders can be safely excluded prior to its use) or oral misoprostol (400–600 μg orally) or carbetocin 100 μg IM/IV is recommended for the prevention of PPH.[4,5]
3. The combinations of ergometrine plus oxytocin or misoprostol plus oxytocin may be more effective uterotonic drug strategies for the prevention of PPH ≥500 ml compared with the current standard, oxytocin. This comes at the expense of a higher risk of adverse effects (vomiting and hypertension with ergometrine and fever with misoprostol).[7]
4. In settings where skilled birth attendants are not present to administer injectable uterotonics and oxytocin is unavailable, the administration of misoprostol (400–600 μg orally) by community healthcare workers and lay health workers is recommended for the prevention of PPH.[4,5]
5. In settings where skilled birth attendants are unavailable, controlled cord traction (CCT) is not recommended.[4]
6. Sustained uterine massage is not recommended as an intervention to prevent PPH in women who have received prophylactic oxytocin.[8]
7. Postpartum abdominal uterine tonus assessment for early identification of uterine atony is recommended for all women.[4]
8. Oxytocin (IV or IM) and CCT is the recommended method for removal of the placenta for the prevention of PPH in cesarean delivery.[4]

2.2 | FIGO recommendations for treatment of postpartum hemorrhage

1. Intravenous oxytocin alone is the recommended first-line uterotonic drug for the treatment of PPH.[3,4]
2. If intravenous oxytocin is unavailable, or if the bleeding does not respond to oxytocin, the use of intramuscular ergometrine, oxytocin–ergometrine fixed dose, or a prostaglandin drug (including sublingual misoprostol, 800 μg) is recommended.[3,4,9,10]
3. There is no evidence about the safety and efficacy of an additional 800-μg dose of misoprostol for treatment of PPH when given to women who have already received 600 μg of prophylactic misoprostol orally.
4. The use of isotonic crystalloids is recommended in preference to the use of colloids for the initial intravenous fluid resuscitation of women with PPH.[4,11]
5. Early use of intravenous tranexamic acid as soon as PPH is diagnosed but within 3 h of birth in addition to standard care is recommended for women with clinically diagnosed PPH following vaginal birth or cesarean delivery.[12–14]
6. Administration of 1 g (100 mg/ml) tranexamic acid intravenously at 1 ml/min (i.e. administered over 10 min), with a second dose of 1 g intravenously if bleeding continues after 30 min, or if bleeding restarts within 24 h of completing the first dose. Reducing maternal deaths due to bleeding through scaling up of tranexamic acid for PPH treatment could have a positive impact on health equity and improve outcomes among disadvantaged women, especially in LMICs.[15]
7. Uterine massage is recommended for the treatment of PPH.[3,4]
8. The use of bimanual uterine compression or external aortic compression for the treatment of PPH due to uterine atony after vaginal birth is recommended as a temporizing measure until appropriate care is available.[3,4]
9. If women do not respond to treatment using uterotonics, or if uterotonics are unavailable, the use of uterine balloon tamponade is recommended as an effective nonsurgical technique that can potentially improve survival in women with PPH due to uterine atony after ruling out retained products of conception or uterine rupture as a contributing factor.[3,4,16]
10. Use of the nonpneumatic antishock garment is recommended as a temporizing measure until appropriate care is available.[3,4]
11. The use of uterine packing is not recommended for the treatment of PPH due to uterine atony after vaginal birth.[3,4]
12. Uterine artery embolization can be another conservative management measure for PPH if technical conditions and skilled human resources are available for its use.[17]
13. If bleeding does not stop despite treatment using uterotonics and other available conservative interventions (e.g. uterine massage, balloon tamponade), the use of surgical interventions is recommended.[3,4] Surgical interventions include the use of compression suture techniques,[18] uterine and hypogastric artery ligation, and hysterectomy.

14. The priority is to stop the bleeding before the patient develops coagulation problems and organ damage from under-perfusion. Conservative approaches should be tried first, rapidly moving to more invasive procedures if these do not work.

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3 | BACKGROUND

3.1 | Introduction

Postpartum hemorrhage (PPH) is an obstetric emergency complicating 1%–10% of all deliveries.[1] It continues to be the leading obstetric cause of maternal death.[1] In 2015, it was reported to be responsible for more than 80 000 maternal deaths worldwide.[1] Its distribution varies across regions, with the highest prevalence of 5.1%–25.7% reported in Africa, followed by North America at 4.3%–13% and Asia at 1.9%–8%.[2] The incidence of PPH has also been on the rise,[2–5] increasing from 5.1%–6.2% in Canada between 2003 and 2010,[3] and from 2.9%–3.2% in the USA between 2010 and 2014.[4]

3.2 | Past FIGO recommendations for PPH

FIGO has made several recommendations in the past 20 years for the management and treatment of PPH (Table 1). This document will update the recommendations and discuss new approaches.

3.3 | Definition of postpartum hemorrhage

The lack of consistency in the definition of PPH has been a major limitation to the ability to compare prevalence in different studies (Table 2). Classically, it was defined as quantified bleeding of more than 500 ml for vaginal deliveries and more than 1000 ml for cesarean deliveries, occurring within the first 24 h of delivery.[1] However, this definition did not focus on clinical signs and symptoms of hemorrhage, and thus prevented early detection in many cases. Therefore, in 2017, the American College of Obstetricians and Gynecologists (ACOG) changed the definition to blood loss of more than or equal to 1000 ml, or blood loss that was accompanied by signs or symptoms of hypovolemia occurring within 24 h after birth, regardless of the mode of delivery.[6] In contrast, the Royal College of Obstetricians and Gynaecologists (RCOG) defines PPH according to the volume of blood lost: minor (between 500 and 1000 ml) and major (>1000 ml).[7] However, the volume of estimated blood loss remains unreliable in many cases, and therefore much attention should be directed to the general clinical status of the patient instead.[8] Several tools for assessment of blood loss have been used as accurate estimation will directly influence the diagnosis and management of PPH. Many groups cite visual estimation as part of blood loss assessment, but as it has high potential to underestimate hemorrhage, use of additional tools for more objective estimation, such as gravimetric measurement, direct blood collection techniques, and evaluation of clinical parameters, have been proposed.[9–17] Recently, some guidelines have incorporated the shock index[9,11,14,17] and obstetric early warning systems into their recommendations to evaluate bleeding.[11,14,17]

3.4 | Etiologies/risk factors

While there exist several identifiable risk factors for PPH, most cases occur unexpectedly.[6,18] An easy way to remember the most common etiologies is to remember the four T's[19]:

TABLE 1 FIGO recommendations on the management of postpartum hemorrhage

FIGO recommendation	Year	References
Management of the third stage of labor to prevent postpartum hemorrhage	2003	International Confederation of Midwives; International Federation of Gynaecologists and Obstetricians. Joint statement: management of the third stage of labour to prevent post-partum haemorrhage. J Midwifery Womens Health. 2004 Jan-Feb;49(1):76–7.
Postpartum hemorrhage today: ICM/FIGO initiative 2004–2006	2006	Lalonde A, Daviss BA, Acosta A, Herschderfer K. *Int J Gynecol Obstet*. 2006;94:243–253.
Prevention and treatment of post-partum haemorrhage: new advances for low resource settings	2006	Joint Statement: ICM and FIGO https://www.who.int/pmnch/events/2006/figo2006statementeng.pdf
Prevention and treatment of postpartum hemorrhage in low-resource settings	2012	Lalonde A; International Federation of Gynecology and Obstetrics. *Int J Gynecol Obstet*. 2012;117:108–118.
Prevention of postpartum hemorrhage with misoprostol	2012	International Federation of Gynecology and Obstetrics. *Int J Gynecol Obstet*. 2012;119:213–214.
Treatment of postpartum hemorrhage with misoprostol	2012	International Federation of Gynecology and Obstetrics. *Int J Gynecol Obstet*. 2012;119:215–216.
Non-pneumatic anti-shock garment to stabilize women with hypovolemic shock secondary to obstetric hemorrhage	2015	FIGO Safe Motherhood and Newborn Health Committee; International Federation of Gynecology and Obstetrics. *Int J Gynecol Obstet*. 2015;128:194–195.
FIGO's updated recommendations for misoprostol used alone in gynecology and obstetrics	2017	Morris JL, Winikoff B, Dabash R, et al. *Int J Gynecol Obstet*. 2017;138:363–366.
Affordable and low-maintenance obstetric devices	2019	Ayres-de-Campos D, Stones W, Theron G; FIGO Safe Motherhood and Newborn Health Committee. *Int J Gynecol Obstet*. 2019;146:25–28.

TABLE 2 Summary of postpartum hemorrhage definitions from high-quality guidelines around the world

Guideline	Definition
American College of Obstetricians and Gynecologists (2017) Dutch Society of Obstetrics and Gynecology (2012)	>1000 ml regardless of route of delivery Any blood loss that causes hemodynamic instability
Federation of Obstetric and Gynaecological Societies of India (2015) French College of Gynaecologists and Obstetricians/French Society of Anesthesiology and Intensive Care (2016) The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (2017) World Health Organization (2012)	>500 ml regardless of route of delivery Severe PPH >1000 ml
International Federation of Gynecology and Obstetrics (2012) Society of Obstetricians and Gynaecologists of Canada (2018)	Vaginal delivery >500 ml, cesarean delivery >1000 ml Any blood loss that has the potential to produce hemodynamic instability
Royal College of Obstetricians and Gynaecologists (2016)	>500 ml regardless of the route of delivery PPH mild: 500–1000 ml, moderate: 1000–2000 ml, severe: >2000 ml
German Society of Gynecology and Obstetrics/Austrian Society of Obstetrics and Gynecology/Swiss Society of Gynaecology and Obstetrics (2018)	Vaginal delivery ≥500 ml or cesarean delivery ≥1000 ml

1. Tone: uterine atony (accounts for 70% of PPH cases).[20]
2. Trauma: genital tract trauma.
3. Tissue: retained products of conception.
4. Thrombin: coagulopathy.

Uterine atony can be anticipated after prolonged labor particularly with the use of oxytocin, in pregnancies complicated with chorioamnionitis, high parity, general anesthesia, and other factors that lead to uterine overdistension such as multiple fetal gestation, polyhydramnios, and fetal macrosomia.[6,20] Trauma accounts for 15%–20% of cases,[21] and is mostly attributed to perineal or cervical lacerations, perineal hematomas, episiotomies, or uterine rupture.[6,20] These occur in the setting of precipitous uncontrolled deliveries or operative vaginal deliveries.[6] Retained products of conception can increase the risk of PPH by 3.5 times.[22] Risk factors include succenturiate placenta and previous instrumentation.[6] Coagulation problems can be divided into inherited, such as von Willebrand diseases, hemophilia, and idiopathic thrombocytopenic purpura, and acquired, such as the use of anticoagulant therapy[20] and the occurrence of disseminated intravascular coagulopathy after placental abruption, pre-eclampsia with severe features, intrauterine fetal demise, sepsis, or amniotic fluid embolism.[6,20,23] Other etiologies include uterine inversion and abnormal placentation.

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4 | POSTPARTUM HEMORRHAGE BUNDLE CARE

Multimodal strategies have been implemented in high-income countries to control pathologies with high mortality rates such as PPH. These initiatives that involve multiple intervention points and actors have been called "bundles" or intervention packages, which consist of the implementation of a group of interventions as well as multidisciplinary programs that standardize and comprehensively address the management of pathologies.[1–6] Bundles represent a selection of existing guidelines and recommendations in a form that aids systematic implementation and a consistency of practice.

The California Maternal Quality Care Collaborative (CMQCC) Working Group on obstetrical hemorrhage developed the Improving the Health Care Response to Obstetric Bleeding Toolkit in 2010 to help obstetric providers, clinical staff, hospitals, and healthcare organizations develop methods within their facility for timely recognition and an organized and rapid response to bleeding. In March 2015, version 2.0 was updated with the latest evidence-based changes.[6]

In 2015, work groups of the National Partnership for Maternal Safety — within the Council on Patient Safety in Women's Health Care that represents all major women's healthcare professional organizations in the USA — developed an obstetric hemorrhage safety bundle. The goal of the partnership was the adoption of the safety bundle by every birthing facility. This consensus bundle is organized into four action domains: readiness; recognition and prevention; response; and reporting and systems learning. There are 13 key elements within these four action domains (Table 3).

In 2017, the World Health Organization (WHO) carried out a technical consultation among international maternal health experts to evaluate the development of care bundles for PPH. A total of 730

TABLE 3 Obstetric hemorrhage safety bundle action domains from the National Partnership for Maternal Safety, Council on Patient Safety in Women's Health[a]

Domain	Key elements
Readiness (Every Unit)	1. Hemorrhage cart with supplies, checklist, and instruction cards for uterine balloon tamponade and compression sutures. 2. Immediate access to hemorrhage medications (kit or equivalent). 3. A response team to call when help is needed (blood bank, advanced gynecologic surgery, other support and tertiary services). 4. Massive and emergency-release transfusion protocols (type-O negative or uncross-matched). 5. Unit education on protocols, unit-based drills (with post drill debriefs).
Recognition and Prevention (Every Patient)	1. Assessment of hemorrhage risk (prenatal, on admission, and at other appropriate times). 2. Measurement of cumulative blood loss (formal and as quantitative as possible). 3. Active management of the third stage of labor (department- wide protocol).
Response (Every Hemorrhage)	1. Uni-standard, stage-based obstetric hemorrhage emergency management plan with checklists. 2. Support program for patients, families, and staff for all significant hemorrhages.
Reporting and Systems Learning (Every Unit)	1. Establish a culture of huddles for high-risk patients and post-event debriefs to identify successes and opportunities. 2. Multidisciplinary review of serious hemorrhages for systems issues. 3. Outcomes monitoring and process metrics in perinatal quality improvement committee.

[a]Reproduced from Council on Patient Safety in Women's Health Care.[7] © 2015 American College of Obstetricians and Gynecologists. Reproduced with kind permission.

TABLE 4 Final care bundles for postpartum hemorrhage[a]

PPH care bundle	Components
First response PPH bundle	Uterotonic drugs Isotonic crystalloids Tranexamic acid Uterine massage Notes: Initial fluid resuscitation is performed together with intravenous (IV) administration of uterotonics. If IV uterotonics are not available, fluid resuscitation should be started in parallel with sublingual misoprostol or other parenteral uterotonics. If PPH is in the context of placental retention, the placenta should be extracted, and a single dose of antibiotics should be administered. If lacerations are encountered, they should be repaired.
Response to refractory PPH bundle	Compressive measures (aortic compression or bimanual uterine compression) Intrauterine balloon tamponade Non-pneumatic antishock garment Notes: A continuing dose of uterotonics (e.g. oxytocin diluted in isotonic crystalloids) and a second dose of tranexamic acid should be administered during the application of this bundle.

[a]Reproduced from Althabe et al.[8]

articles were reviewed and 430 were used for the construction of the theoretical framework of the process. The consultation led to a definition of two care bundles, which are summarized in Table 4.

The first response PPH bundle must be implemented at both the primary healthcare and hospital levels. The discussion about the response to refractory PPH bundle raised some controversy. For the first response PPH bundle, the next phase is the development of an implementation strategy, culminating in a model for use at the facility level in LMICs. For the response to refractory PPH bundle, it is a priority to solve pending controversies, including the operational definition of refractory PPH, and to better understand the effectiveness of various uterine balloon tamponade (UBT) devices.

BOX 1 FIGO recommends incorporation of the PPH bundle approach in the management of PPH.

FIGO considers that the bundle care approach can improve patient outcomes when adherence to all components is high. Every health system needs to adopt a bundle and there are many available for use. Place the bundle in every maternity hospital and train to all elements of bundle, from arrival on obstetrics service to transfer to higher level of care.

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5 | SHOCK INDEX EVIDENCE IN POSTPARTUM HEMORRHAGE EVALUATION AND MANAGEMENT

Shock refers to a reduction in tissue perfusion, which is insufficient to meet the metabolic requirements of tissues and organs. Insufficient blood flow may be clinically identified as the development of one or more of the following: lactic acidosis, altered mental status, oliguria, and tachycardia. Vital signs monitoring is key to hemodynamic assessment and prompt intervention.[1] In healthy pregnant and postpartum women, cardiologic physiologic compensatory mechanisms prevent changes in vital signs until a large volume of blood has been lost (usually >1000 ml). Hence, changes in clinical and vital signs that result from hemorrhage appear late in the process and may not lead to early identification of PPH. This in turn makes it difficult to establish cutoff points to trigger clinical interventions. Moreover, because traditional vital signs change late and are less reliable as triggers for clinical actions, other indicators could help to characterize maternal hypovolemia caused by bleeding.[2] Although the use of conventional individual vital signs (pulse and systolic blood pressure) may lack accuracy in the assessment of hypotension, a simple combination of both may transform routine clinical parameters into a more accurate indicator of hypovolemia, such as the shock index (SI). SI is defined as the ratio of heart rate to systolic blood pressure.[3,4] The SI may improve the predictive capability of individual clinical signs, which aids early identification of women at risk of hypovolemia as the result of obstetric causes.[5] Moreover, the SI has been proposed as a reliable indicator of adverse maternal outcomes,[6] and its values have been set to indicate clinical management.[7] However, the association between shock parameters and advanced treatment modalities in severe PPH has yet to be reported.

5.1 | Assessment of circulating blood volume in postpartum hemorrhage

The essential cornerstone of management of PPH involves prompt diagnosis and rapid replacement of lost blood volume, as well as the oxygen-carrying capacity of blood, accompanied by immediate medical and surgical measures to address the underlying cause(s), and hence prevent more loss. To assess the patient's condition, SI has been introduced as a simple and clinically effective vital sign.

The SI has been shown to have an inverse linear relationship with left ventricular stroke work in acute circulatory failure. Therefore, a concurrent reduction of left ventricular stroke work (induced by hemorrhage, trauma, or sepsis) was associated with an elevation of the SI and a deterioration in left ventricular mechanical performance. Poor left ventricular function or persistent abnormal elevation of the SI after aggressive therapy and hemodynamic stabilization was associated with increased mortality in critically ill, traumatized patients.[8] In obstetric and nonobstetric circumstances, the absence of a significant drop in blood pressure in patients with PPH may mask the actual hypovolemic status due to physiological compensatory mechanisms.[9] For that reason, the SI was the only promising marker that indicated the severity of blood loss.[2,5]

The SI, together with the rule of 30, are important tools that may aid clinicians in an emergency to determine the amount of blood loss and the degree of hemodynamic instability. Before the fall in systolic blood pressure, heart rate rises to compensate for the blood loss, and thus the SI increases. The rule of 30 is an approximated blood loss of 30% of normal (70 ml/kg in adults, 100 ml/kg throughout pregnancy), defined by a fall of 30% in hematocrit, a fall of 30% in hemoglobin (approximately 3 g/dl), a fall of 30 mm Hg in systolic blood pressure, and a rise in pulse rate by 30 beats per minute.[10] It has been shown that an SI ≥0.9 is associated with increased mortality and an SI>1 increases the likelihood of blood transfusion.[11,12] To date, standard obstetric SI has been defined as 0.7–0.9 compared with 0.5–0.7 for the nonpregnant population, taking into account that the hemodynamic changes of pregnancy may delay the recognition of hypovolemia.[5] If intravascular volume depletion is suspected, a rapid clinical assessment is required because the patient's clinical condition can deteriorate, leading to the development of hemorrhagic shock rapidly. Proper medical record-taking skills may highlight symptoms associated with shock such as pain and overt blood loss, as well as general malaise, anxiety, and dyspnea. Notably, in settings where few PPH treatment options exist, and in cases of home deliveries, diagnosis and treatment or referral must occur even earlier than in hospital settings to improve outcomes. For that reason, SI may be a valuable threshold in LMICs, where mortality is highest and is often related to delays in complication recognition, transportation, and level of care at the facility.[2] A threshold of SI ≥0.9 should be tested to alert community healthcare providers of the need for urgent transfer.[13]

BOX 2 FIGO recommends use of the shock index in the diagnosis and management of PPH.

FIGO considers that the shock index can be a marker of the severity of PPH and can alert teams to hemodynamic instability when its value is greater than 0.9.

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6 | REVIEW OF GUIDELINES AROUND THE WORLD

Guidelines are defined as systematically developed statements that assist practitioners to take decisions about appropriate health care in specific clinical circumstances.[1] Over the past decades, many national and international PPH guidelines have been developed and become part of obstetric clinical practice around the world. PPH guidelines usually address similar topics (e.g. diagnosis, prevention, and treatment of PPH) but may differ in their recommendations.[2–4] These differences are because most of the recommendations are based on observational studies, clinical judgment, and expert opinion. There are few randomized controlled trials available to produce strong recommendations for the management of PPH due to the emergency of the condition that hinders this type of study. In the absence of randomized trials, guidelines gather the best available evidence. In addition, population characteristics, cultural aspects, resources availability, as well as frequency and timing of updates may influence the guidelines' contents and justify some disparities.[1–4]

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6.1 | Guidelines that address the prevention of postpartum hemorrhage

Active management of third stage of labor is frequently discussed in guidelines.[1–7] There is consensus that all women should receive uterotonics after delivery as it has proven to reduce PPH rates. Oxytocin has been cited as the drug of choice by most guidelines, but its dosages and route of administration vary largely, especially when considering mode of delivery.[1–5,7–10] In 2012, FIGO established recommendations for the prevention of PPH[11] and in 2018 WHO updated its recommendation for pharmacological PPH prevention and reinforced the use of oxytocin (10 IU intramuscularly or intravenously) as the drug of choice.[12] WHO also recommends the use of carbetocin (if cost-effective), ergot alkaloids (alone or combined if there are no contraindications), or oral misoprostol in settings where oxytocin is not available or its quality cannot be guaranteed. Misoprostol is also recommended when the use of other injectable uterotonics is not possible due to unavailability or contraindication to use such as hypertension in the context of ergometrine.[12,13] The Society of Obstetricians and Gynaecologists of Canada (SOGC) has updated its publication and reinforced the use of carbetocin as a first-line uterotonic for prevention at cesarean delivery or vaginal delivery with one risk factor.[6] The German/Austrian/Swiss guideline mentions that prophylaxis during cesarean delivery can consist of administering either oxytocin or carbetocin.[5] Other prophylactic strategies have been proposed in guidelines, but many had no great consensus or no clear benefits.[1–7] Table 5 summarizes various PPH prevention strategies described by different societies worldwide.

BOX 3 FIGO recommends use of oxytocin (10 IM/IV) for prevention of PPH for all births as a first-line uterotonic agent.

- If oxytocin is not available or its quality is in doubt, other options include carbetocin, misoprostol, or ergot alkaloids.
- Controlled cord traction is recommended for vaginal births in settings where skilled birth attendants are available.
- Early cord clamping (<1 min after birth) is not recommended unless the neonate needs immediate resuscitation.
- Postpartum assessment of uterine tonus is recommended for all women.

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TABLE 5 Summary of postpartum hemorrhage prevention strategies from high-quality guidelines around the world

Guideline/year of publication	Active management of third stage of labor	Pharmacological prevention						Other considerations
		1st line uterotonic	Oxytocin	Alkaloid ergot	Misoprostol	Carbetocin	TXA	
FIGO 2012	Recommended: Administration of uterotonics after delivery	Oxytocin	10 IU/ml IM or 5 IU slow IV push within the first minute after delivery	Ergometrine or methylergometrine 0.2 mg IM, if oxytocin is not available or cannot be safety used	600 μg orally within the first minute after delivery, if oxytocin is not available or cannot be safety used	Not mentioned	Not mentioned	Controlled cord traction (only when a skilled attendant is present at delivery), uterine massage after delivery
FOGSI 2015	Recommended: Uterotonic agent at the time of birth, late cord clamp and controlled cord traction	Oxytocin	Mentioned 10–40 IU; IV or IM or umbilical cord vein, IMM or intramyometrial	If oxytocin is not available: Ergometrine 0.25 mg IM or IMM	400–600 μg (oral, per rectum, per vagina or rectal route) can be used if injectable uterotonics are not available	Not mentioned	Not mentioned	Nipple stimulation or early breast feeding
RCOG 2016	Recommended: Routine administration of uterotonics after delivery	Oxytocin	Vaginal birth: 10 IU IM Cesarean: 5 IU IV, slowly	Ergometrine–oxytocin may be used in the absence of hypertension. Does not mention dosages	Mentioned, without dosage recommendations	Mentioned, without dosage recommendations	Consider TXA: 0.5–1.0 g IV, plus oxytocin, at cesarean in women at increased risk	Prefer deferred cord clamping (RCOG 2015) Uterine massage is of no benefit for prevention
CNGOF/SFAR 2016	Recommended: Administration of uterotonics after delivery	Oxytocin	5 or 10 IU IM or IV slow At cesarean: Routine maintenance can be performed as long as it does not exceed 10 IU/h	Not mentioned	Not mentioned	Mentioned (in the absence of a no inferiority trial, oxytocin remains the reference for preventing PPH after cesarean deliveries)	TXA must not be used routinely for PPH prevention	Routine cord drainage, controlled cord traction, uterine massage, routine voiding after delivery, early or late cord clamping, breastfeeding and any particular position are not recommended for PPH prevention
ACOG 2017	Recommended: Routine administration of uterotonics after delivery	Oxytocin	Mentioned 10 IU IV or IM	Mentioned in association with oxytocin, but did not discuss dosages and their sole use		Not mentioned	Data is insufficient to recommend it	Nipple stimulation or breastfeeding has no effect on prevention. Prefer delayed cord clamping (ACOG 2017–2)
RANZCOG 2017	Recommended: Uterotonics and assisted placenta delivery	Oxytocin	Recommended, but do not mention dosages	Not mentioned	Used when oxytocin is not available. Does not discuss dosages	Not mentioned	Not mentioned	Identify risk factors. Determine placental location by antenatal ultrasound
WHO 2018*	Recommended:	Oxytocin	10 IU IM or IV for all births	In settings where oxytocin is unavailable, or its quality is not guaranteed: ergots alone or associated; or misoprostol; or carbetocin can be used			Not mentioned	Injectable prostaglandins are not recommended

TABLE 5 (Continued)

Guideline/year of publication	Active management of third stage of labor	Pharmacological prevention						Other considerations
		1st line uterotonic	Oxytocin	Alkaloid ergot	Misoprostol	Carbetocin	TXA	
*(Supersedes previous 2012 WHO guideline recommendations of uterotonics for the prevention of PHH)	WHO guideline (2012): Uterotonics, late cord clamp and controlled cord traction if skilled attendant		Regardless of route of delivery	Ergometrine or M-Ergometrine: 0.2 mg IM or IV or Combination: oxytocin 5 IU+Ergometrine 0.5 mg IM (after hypertension is excluded prior to its use)	Misoprostol 400 µg or 600 µg, orally. If injectable uterotonics are not feasible	Carbetocin: 100 µg IM or IV. Where its cost is comparable to other effective uterotonics		Recommended for the prevention of PPH. (Carboprost or sulprostone)
SOGC 2018	Recommended: Uterotonics, late cord clamp and controlled cord traction	Vaginal low risk: Oxytocin Cesarean: Carbetocin	Vaginal: 10 IU IM or oxytocin, 20–40 IU in 1000 ml, 150 ml per hour.	Ergonovine, 0.2 mg IM When oxytocin is not available	600–800 µg (oral, sublingual, or rectal route) When oxytocin is not available	Carbetocin, 100 µg given as an IV bolus over 1 min	Not mentioned	Suggest considering carbetocin for high-risk women delivering vaginally
DGGG/OEGGG/SSGO 2018	Recommended: Oxytocin after birth	Vaginal: Oxytocin Cesarean: Oxytocin or carbetocin	3–5 IU slow IV	Not mentioned	Not mentioned	100 µg by short infusion or slow IV infusion	Not mentioned	Immediate cord clamping and controlled cord traction have no impact on reducing PPH and should not be carried out
FLASOG 2018	Recommended	Oxytocin	10 IU IM or IV	Not mentioned	600 ug oral when oxytocin is not available	Not Mentioned	Not mentioned	Controlled cord traction, (only when a skilled attendant is present at delivery), uterine massage after delivery

Abbreviations: TXA, tranexamic acid; FIGO, International Federation of Gynecology and Obstetrics; IU, international unit; IM, intramuscular; IV, intravenous; FOGSI, Federation of Obstetric and Gynaecological Societies of India; IMM, intramammary; RCOG, Royal College of Obstetricians and Gynaecologists; CNGOF/SFAR, College of Gynaecologists and Obstetricians/French Society of Anesthesiology and Intensive Care; ACOG, American College of Obstetricians and Gynecologists; RANZCOG, Royal Australian and New Zealand College of Obstetricians and Gynaecologists; WHO, World Health Organization; SOGC, Society of Obstetricians and Gynaecologists of Canada; DGGG/OEGGG/SSGO, German Society of Gynecology and Obstetrics/Austrian Society of Obstetrics and Gynecology/Swiss Society of Gynaecology and Obstetrics, FLASOG, Federación Latinoamericana de Sociedades de Obstetricia y Ginecología.

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6.2 | Guidelines that address the treatment of postpartum hemorrhage

PPH guidelines frequently recommend a multidisciplinary approach for reaching effective early control of bleeding. Treatment should be directed to the specific cause of PPH (uterine atony, genital trauma, retained placenta, and/or coagulopathy) and therapeutic steps should move from the less invasive method to the more complex and radical approach. A set of initial measures also seems to be consensual in most guidelines and consist of maintenance of two large IV lines, supplementation of oxygen, strict monitoring of women, crystalloids infusion, and measures to avoid hypothermia and evaluate the PPH cause.[1–9]

If atony is the etiology, most guidelines suggest performing temporary mechanical measures, such as uterine massage or uterine bimanual compression, with concurrent pharmacological treatment.[1–10] Uterotonics are considered the first-line treatment for uterine atony. Intravenous oxytocin is usually the preferred drug and route of administration, but its dosage varies widely. When oxytocin fails to control PPH, guidelines recommend the use of an additional drug, such as ergot alkaloids, injectable prostaglandins, or misoprostol.[1–4,6–8,10] SOGC mentions carbetocin as a uterotonic available for treatment,[5] and the German/Austrian/Swiss guidelines highlight that the use of carbetocin to treat PPH is currently not sufficiently investigated[4] (Table 6).

Since publication of the World Maternal Antifibrolytic (WOMAN) trial,[11] tranexamic acid (TXA), an antifibrinolytic drug, has been incorporated into PPH guidelines around the world.[4,6–10,12,13] WHO has updated this topic and recommends the use of TXA, as soon as possible, within the first 3 h from birth, at a dose of 1 g intravenously, regardless of the route of birth.[12,13] However, some guidelines do not cite it[5] or do not add it in a definitive manner because their last update occurred before the WOMAN trial results.[1,2] Another drug that has been discussed in many guidelines is recombinant activated factor VII for massive PPH; however, there is no consensus about its use.[1–6]

When pharmacological treatment fails in controlling hemorrhage, guidelines usually recommend some mechanical, radiological, and more conservative surgical approaches before performing hysterectomy. The available guidelines are summarized in Table 6. The most cited ones are uterine balloon tamponade (UBT), uterine compressive sutures (UCS), pelvic vascular ligation (PVL), and embolization.[1–7,10] Uterine packing with gauze is also mentioned in some guidelines, but its use is controversial.[3,5] ACOG mentions the use of a gauze soaked with thrombin.[6]

German/Austrian/Swiss guidelines cite the use of intrauterine packing with a gauze coated with a hemostatic agent.[4] Due to the lack of evidence, guidelines do not necessarily recommend these conservative approaches in a well-defined, step-wise progression, and their utilization depends mainly on the availability of resources, professional familiarity with technique, and clinical circumstances.[10]

UBT is typically indicated as the treatment of choice when uterine atony is refractory to uterotonics after vaginal delivery as it is less invasive than the other procedures.[1–3,6–9] This should be considered after ruling out retained products of conception, ruptured uterus, or vaginal or cervical laceration as a contributing factor. If UBT fails to control bleeding in these cases, invasive treatments by arterial embolization or, most commonly, by surgical approaches are recommended (Table 7). UCS and/or PVL are recommended to avoid hysterectomy when laparotomy is performed. The most mentioned UCS techniques in guidelines are B-Lynch, Hayman, and/or Cho sutures, while the most cited PVL techniques are bilateral uterine and/or utero-ovarian vessel ligations and, less frequently, hypogastric ligature.[1–10] PVL and UCS can also be used together.

Embolization is also cited as a conservative therapeutic strategy; however, it is most often indicated in places where specialized equipment and professionals are available in a timely manner.[1–5,7,10] Therefore, these conditions may limit its use in acute bleedings.

If bleeding is severe, especially in low-resource settings, some guidelines recommend the use of temporizing measures such as aortic compression and, more recently, the nonpneumatic antishock garment (NASG), to reduce blood loss until appropriate care is available or while awaiting transfer to a higher-level facility.[3,7,14,15] NASG has been recommended by WHO and FIGO for postpartum women with severe hemorrhage showing signs of shock or hemodynamic instability at all levels of care, especially at the primary healthcare level or if transport to a higher facility is necessary.[3,14,15]

Regarding hysterectomy, it is usually recommended when other procedures have failed to control massive bleeding or when they were not indicated. Guidelines highlight that hysterectomy should be performed "sooner rather than later," before the patient develops coagulopathy.[1–7,9,10] Recently, damage control surgery (intra-abdominal or pelvic packing) has been mentioned in some PPH guidelines as an approach for critically ill patients with persistent bleeding after hysterectomy.[4,7]

Finally, many guidelines also address statements for the management of genital tract trauma (especially uterine inversion and uterine rupture), coagulopathy disorders, and retained placenta in obstetric patients. Because of the high maternal morbidity and mortality related to the placenta accreta spectrum and its relation to the high rates of cesarean deliveries in many countries around the world,

TABLE 6 Summary of pharmacological treatment from high-quality guidelines around the world

Guideline/ year of publication	Pharmacological treatment						
	1st line uterotonic	Oxytocin	Ergot alkaloids	Misoprostol	Injectable prostaglandin	TXA	Carbetocin
FIGO 2012	Oxytocin	10 IU IM *or* 20–40 IU in 1 L of normal saline at 60 drops per minute Continue oxytocin infusion (20 IU in 1 L of IV fluid at 40 drops per minute) until hemorrhage stops	Ergometrine or methylergometrine (used if oxytocin is not available or if bleeding continues despite having used oxytocin): 0.2 mg IM or can be given slowly IV, repeated every 2–4 h (maximum of 5 doses)	If oxytocin is not available or administration is not feasible): Single dose of 800 μg sublingually (4×200 μg tablets)	Carboprost (should be offered as the third line of treatment): 0.25 mg IM Q15 min (maximum 2 mg)	Not mentioned	Carbetocin recommended as a second-line treatment: 100 μg IM or IV over 1 min
WHO 2012	Oxytocin	Does not specify	Ergometrine or oxytocin-ergometrine if IV oxytocin fails or if it is not available. Dosages not specified	800 μg sublingual if IV oxytocin fails or if it is not available	Does not specify	Use in all cases of PPH, regardless of the cause. Used as soon as possible. Dose: 1 g IV, over 10 min, within 3 h of birth, with a second dose of 1 g IV if bleeding continues after 30 min or restart within 24 h of completing the first dose	
FOGSI 2015	Oxytocin	10–40 IU in 1 L of normal saline	Methylergonovine 0.2 mg IM	800–1000 μg rectally; 200 μg orally plus 400 μg sublingually; *or* 200 μg orally plus 400 μg rectally	250 μg IM every 15–90 min, as needed, up to a total dose of 2 mg	Not mentioned	Not mentioned
RCOG 2016	Oxytocin (preferred initially)	Oxytocin 5 IU, by slow IV injection (may have repeat dose); oxytocin infusion (40 IU in 500 ml isotonic crystalloids at 125 ml/h) unless fluid restriction is necessary	Ergometrine 0.5 mg, slow IV or IM (contraindicated in women with hypertension)	800 μg sublingual	Carboprost 0.25 mg IM, repeated at intervals of not less than 15 min to a maximum of 8 doses (use with caution in women with asthma)	Consider TXA 1 g IV	

(Continues)

TABLE 6 (Continued)

Guideline/ year of publication	Pharmacological treatment						
	1st line uterotonic	Oxytocin	Ergot alkaloids	Misoprostol	Injectable prostaglandin	TXA	Carbetocin
ACOG 2017	Healthcare provider's discretion	10–40 IU per 500–1000 ml as continuous infusion (IV) or 10 IU IM	Methylergonovine 0.2 mg IM, every 2–4 h. Contraindicated in hypertension	600–100 μg, oral, sublingual, or rectal	Carboprost 0.25 mg IM, every 15–90 min, 8 doses maximum (can be used as intramyometrial). Contraindicated in asthma	Should be considered when initial medical therapy fails. Earlier use is likely to be superior to delayed treatment	
CNGOF/SFAR 2016	Oxytocin	5–10 IU slow IV or IM followed by 5–10 IU/h, IV, for 2 h. Cumulative dose must not exceed 40 IU (IM route is only an option for vaginal birth)	Not mentioned	It is not recommended as a second-line treatment	Sulprostone within 30 min, if oxytocin fails	1 g, renewable once if ineffective the first time, limited to cases of sulprostone-resistant PPH	
RANZCOG 2017	Does not clearly specify	5 IU by slow IV injection and 40 IU in an IV infusion over 4 h	Ergometrine 0.25 mg by slow IV or IM, repeated if necessary, every 5 min up to a maximum of 1 mg; in the absence of contraindications	Up to 1000 μg rectally	Carboprost 0.25 mg IM, repeat as required at intervals of not less than 15 min up to 8 doses (maximum 2 mg); or intramyometrial injection of 0.5 mg, under the responsibility of the administering clinician Contraindicated if significant history of asthma	Dose: 1 g IV, with a clinical diagnosis of PPH. The dose is repeated after 30 min if bleeding was persistent	
SOGC 2018	Does not clearly specify	10 IU IM (consider ability of the medication to reach a uterus with poor tissue perfusion); 5 IU IV push; 20–40 IU in 250 ml of normal saline, infused IV at 500–1000 ml/h	Ergometrine 0.25 mg IM or IV, can be repeated every 2 h	400–800 μg; onset of effects is faster with oral or sublingual than rectally 800–1000 μg; effects are longer lasting with rectal than with oral	Carboprost 0.25 mg IM or intramyometrially; can be repeated every 15 min, to a maximum of 2 mg (8 doses) Asthma is a relative contraindication Carbetocin: 100 μg IM or IV over 1 min	Not mentioned	Carbetocin recommended

TABLE 6 (Continued)

Guideline/ year of publication	Pharmacological treatment						
	1st line uterotonic	Oxytocin	Ergot alkaloids	Misoprostol	Injectable prostaglandin	TXA	Carbetocin
German/ Austrian/ Swiss 2018	Oxytocin	3−−5 IU in 10 ml of NaCl 0.9% slow IV bolus. If necessary, it is followed by 10–40 IU oxytocin in 500-1000mL saline as a continuous infusion Maximum of 6 IU undiluted oxytocin can be administered IV, slowly. Oxytocin IM only if necessary	Not recommended routinely. If used, caution with adverse effects. Methylergometrine should not be used as IV bolus. Does not mention dosages	If first-line uterotonics are not effective: 800–1000 μg rectally or 600 μg orally After administration of oxytocin may be considered	If first-line uterotonics are ineffective. Option: sulprostone 500 μg in 500 ml IV (pump). Initial dose: 100–500 ml/h. Maintenance: 100 ml/h. Maximum 1000 μg/10 h or 1500 μg daily. Intramyometrial application is contraindicated	Early use if required. 1–2 g (15–30 mg/kg), to be repeated as needed	Carbetocin not recommended
FLASOG 2018	Oxytocin	40 IU in 500 ml crystalloids at 60 ml per hour. Dose from 80–160 thousand units per minute	Methylergonovine 0.2 mg IM, repeat if necessary, after 20 min and then every 4 h up to a maximum of 5 doses	800 ug sublingual or rectal single dose	Not mentioned	1 g IV, the same dose can be repeated after 30 min if bleeding persists	Not mentioned

Abbreviations: TXA, tranexamic acid; FIGO, International Federation of Gynecology and Obstetrics; IU, international unit; IM, intramuscular; IV, intravenous; WHO, World Health Organization; FOGSI, Federation of Obstetric and Gynaecological Societies of India; RCOG, Royal College of Obstetricians and Gynaecologists; ACOG, American College of Obstetricians and Gynecologists; CNGOF/SFAR, College of Gynaecologists and Obstetricians/French Society of Anesthesiology and Intensive Care; RANZCOG, Royal Australian and New Zealand College of Obstetricians and Gynaecologists; SOGC, Society of Obstetricians and Gynaecologists of Canada; DGGG/OEGGG/SSGO, German Society of Gynecology and Obstetrics/Austrian Society of Obstetrics and Gynecology/Swiss Society of Gynaecology and Obstetrics, FLASOG, Federación Latinoamericana de Sociedades de Obstetricia y Ginecología.

TABLE 7 Summary of postpartum hemorrhage mechanical, surgical, and radiological treatment from high-quality guidelines around the world

Guideline/ year of publication	Mechanical, radiological, and surgical treatments						
	Tamponade technique	Compressive uterine sutures	Vessel ligation	Embolization	Hysterectomy	NASG	Other techniques
FIGO 2012	Bimanual compression of the uterus (external or internal). IBT recommended	B-Lynch or Cho sutures should be tried first if bleeding does not stop despite treatment with uterotonics or other conservative interventions	Uterine, utero-ovarian, and hypogastric vessel ligation may be tried after compression suture	Recommended	In case life-threatening bleeding continues even after ligation	Recommended as a temporizing measure	Aortic compression
WHO 2012	Bimanual uterine compression: temporizing measure for atony at vaginal delivery. IBT: if uterotonics fail or are not available; Uterine packing is not recommended	Compression sutures may be attempted as a first conservative surgical approach for atony	Uterine, utero-ovarian, and hypogastric vessel ligation may be tried after compression suture	Recommended as a treatment for PPH due to uterine atony	When life-threatening bleeding continues even after ligation, subtotal or total	Recommended as a temporizing measure	Uterine massage. External aortic compression as a temporizing measure
RCOG 2016	IBT: recommended as first-line "surgical" intervention	B-Lynch, Hayman	Stepwise uterine devascularization; Bilateral internal iliac ligation	Recommended, even after hysterectomy	Sooner rather than later (to discuss with a second experienced clinician if feasible) Technique: subtotal is preferred	Not mentioned	Compression of the aorta Rub up the uterine fundus
FOGSI 2015	Bimanual compression–hand in vagina elevating uterus stretches uterine artery	B-Lynch, Hayman, Cho suture	Stepwise devascularization: unilateral or bilateral; low uterine vessel ligation or bilateral ovarian vessel ligation	Recommended when the routine medical and conservative methods of bleeding control have been tried and not found effective	Last option, it reflects the failure of all other methods at stopping PPH	Mentioned: Research was ongoing to evaluate the potential benefits and harms of this intervention	Compression of aorta against vertebrae useful emergency measure for 10 min
ACOG 2017	Bimanual uterine compression. IBT: when uterotonics and bimanual uterine massage fail. If balloon system is not available, pack with gauze	Secondary treatment for atony unresponsive to medical management. Cited: B-Lynch, Cho, and Hayman; can be associated with vessel ligations	When less invasive approaches fail; bilateral uterine artery (most common), utero-ovarian vessels, and/or internal iliac artery (less frequently used)	Recommended in stable patient, with persistent slow bleeding and when less invasive therapy has failed	When conservative therapies have failed as a definitive treatment	Not mentioned	Uterine massage
CNGOF/SFAR 2016	IBT: can be performed if sulprostone fails and before contemplating either surgery or interventional radiology	In cases of PPH resistant to pharmacological treatment; can be associated with vessel ligations; no technique for conservative surgery is favored over another	Ligation (bilateral ligation of the uterine arteries (BLUA) or bilateral ligation of the internal iliac arteries (BLIIA). No technique for conservative surgery is favored over another	Recommended	Massive PPH; if previous surgical procedure fails; total or subtotal	Not mentioned	Uterine massage

TABLE 7 (Continued)

Guideline/ year of publication	Mechanical, radiological, and surgical treatments						
	Tamponade technique	Compressive uterine sutures	Vessel ligation	Embolization	Hysterectomy	NASG	Other techniques
RANZCOG 2017	Bimanual compression; IBT: recommended	B-Lynch	Bilateral ligation of uterine arteries; bilateral ligation of internal iliac arteries by an experience operator	Recommended; it needs equipment and expertise; should not preclude other approaches	Sooner rather than later	Not mentioned	Uterine massage
	Procedures should not necessarily be a stepwise progression and both order and utilization will depend on the services/clinical experience and the individual clinical circumstances						
SOGC 2018	Bimanual uterine compression: until further measures are taken, or assistance arrives. IBT: when medical therapy fails for uterine atony; consider uterine packing	B-Lynch, vertical compression, and Cho	Uterine and hypogastric artery ligation if bleeding continues (after compression sutures in atony)	Option when there is active PPH, in a stable woman, and before surgical intervention (it requires expertise and equipment)	Failure of previous interventions; subtotal or total	Not mentioned	Uterine massage; external aortic compression
German/ Austrian/ Swiss 2018	Bimanual uterine compression UBT: does not preclude other necessary therapeutic options. Fill with liquid at body temperature, not air) Uterine packing with chitosan-covered gauze (special gauze with hemostatic agent)	Strongly recommended, particularly to treat atony. Choice of appropriate suture depends on indication (atony, bleeding from placental bed, diffuse bleeding)	In addition to simple ligature of uterine artery, stepwise uterine devascularization can be performed. Ligature or internal iliac artery must only be carried out as a last resort and only by experienced surgeon	Recommended; radiologist should be notified early (e.g. when compression suture is unsuccessful)	Must not be delayed or left too late. Total hysterectomy: should be considered for placental disorder. Supracervical: the procedure of choice for atony	Not mentioned	Uterine massage Bimanual compression of aorta Pelvis-abdominal packing: if bleeding persists after hysterectomy
FLASOG 2018	Bimanual uterine compression. IBT: when uterotonics and bimanual uterine massage fail.	B-Lynch, Hayman, Cho suture	Stepwise uterine devascularization; Bilateral internal iliac ligation. Recommended according to the competencies of the medical staff	Recommended primarily for vaginal trauma when available	In case life-threatening bleeding and when conservative therapies have failed as a definitive treatment	Recommended as a temporizing measure and as part of the treatment	Compression of the aorta

Abbreviation: NASG, nonpneumatic antishock garment; IBT, uterine balloon tamponade; FIGO, International Federation of Gynecology and Obstetrics; WHO, World Health Organization; RCOG, Royal College of Obstetricians and Gynaecologists; FOGSI, Federation of Obstetric and Gynaecological Societies of India; ACOG, American College of Obstetricians and Gynecologists; CNGOF/SFAR: College of Gynaecologists and Obstetricians/French Society of Anesthesiology and Intensive Care; RANZCOG, Royal Australian and New Zealand College of Obstetricians and Gynaecologists; SOGC, Society of Obstetricians and Gynaecologists of Canada; FLASOG, Federación Latinoamericana de Sociedades de Obstetricia y Ginecología.

FIGO and other medical societies have specific guidelines for the placenta accreta spectrum.[16–19]

BOX 4 FIGO recommends the preparedness of obstetric care teams for the management of PPH according to the updated guidelines established locally, regionally, or globally.

- These guidelines should include medical and nonmedical treatment options according to the degree of development of each country or region.
- Local, regional, and national medical and nonmedical options for prevention and treatment of PPH need to consider the resources available locally.
- National societies are encouraged to lobby to establish a PPH bundle approach and ensure availability of medical supplies and surgical equipment.

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7 | MEDICAL PREVENTION AND TREATMENT

7.1 | Carbetocin versus oxytocin use in PPH: recent evidence

Oxytocin has been traditionally used as the first-line uterotonic for the prevention of PPH. Since 1992, carbetocin has been extensively tested in the management of PPH.[1,2] Beyond its uterotonic effects, carbetocin may also promote blood coagulation.[3]

7.1.1 | Clinical evidence for PPH prevention: oxytocin versus carbetocin (vaginal delivery)

The Heat-Stable Carbetocin versus Oxytocin to Prevent Hemorrhage after Vaginal Birth (CHAMPION) study provided new evidence comparing oxytocin and carbetocin.[4] It studied 29 645 women with cervical dilation <6 cm having a singleton pregnancy and planned for vaginal delivery. Patients were randomized to receive intramuscular injection of 100 μg heat-stable carbetocin (Paban) or 10 IU oxytocin in 10 different countries. The data showed that for PPH prevention, heat-stable carbetocin was not inferior to oxytocin administration for blood loss of at least 500 ml (RR 1.01; 95% CI, 0.95–1.06) or the use of additional uterotonic agents. Noninferiority was not shown for the outcome of blood loss of at least 1000 ml (RR 1.04; 95% CI, 0.87–1.25). In this study, when the two drugs were compared, the following results were obtained: in women with >500 ml blood loss, additional uterotonic agents were required in almost 15% of cases in both arms. When blood loss exceeded 1000 ml, the requirement for additional uterotonics was only 1.5% in both arms.[3] Therefore, access to drugs is key since oxytocin has problems with drug purity in low-resource settings. The safety profile appeared to be similar for both drugs.

More recently, a network meta-analysis including 140 randomized trials with data from 88 947 women was developed to identify the most effective uterotonic drug(s) to prevent PPH and generate a ranking according to their effectiveness and adverse effect profile.[5] The data showed that compared with oxytocin, the combination of ergometrine plus oxytocin had a risk ratio of 0.69 (95% CI, 0.57–0.83), and was more effective; however, with only moderate quality evidence and with higher risk of adverse effects such as vomiting and hypertension. For carbetocin, the risk ratio was 0.72 (95% CI, 0.52–1.00), and although it was significant, there was very low-quality evidence. Finally, for misoprostol plus oxytocin the risk ratio was 0.73 (95% CI, 0.60–0.90), with moderate quality evidence and higher risk of fever.[5] In a low-risk setting there may be advantages to using well-tested and readily available drugs. When the carbetocin effect was compared with the use of rectal misoprostol for preventing PPH in low-risk patient populations in a randomized controlled trial among 150 pregnant women, the data showed the superiority of carbetocin for efficacy.[6] This was evidenced in all indices tested; beyond blood loss, patients had a shorter third stage of labor and reduced need for additional uterotonic drugs. Additionally, adverse effects such as diarrhea, shivering, and fever were more pronounced with misoprostol administration.[6] In a randomized controlled trial of patients with severe pre-eclampsia, carbetocin was shown to be a good alternative to oxytocin, requiring a lower volume per dose.[7]

7.1.2 | Clinical evidence for PPH prevention: oxytocin versus carbetocin (cesarean delivery)

Cesarean delivery is a surgical procedure requiring high skill, operating time, anesthesia, intravenous fluids, and different drugs. The addition of carbetocin, therefore, is expected to be of benefit and the need for a single drug administration reduces the need for an intensive management team, which is generally required following a cesarean delivery. A Cochrane review including 11 studies showed that despite a statistically significant reduction in the need for further uterotonics in the carbetocin group compared with oxytocin in women undergoing a cesarean delivery, no statistically significant differences in terms of the risk of PPH were noted.[8] In 2018 a meta-analysis to analyze the effectiveness of carbetocin compared with oxytocin for the prevention of PPH in cesarean deliveries (seven studies involving 2012 patients) demonstrated a significant reduction in the rates of PPH (RR 0.79; 95% CI, 0.66–0.94, $P = 0.009$), use of additional uterotonics (RR 0.57; 95% CI, 0.49–0.65, $P < 0.001$), and transfusion (RR 0.31; 95% CI, 0.15–0.64, $P = 0.002$) when carbetocin was used instead of oxytocin. However, despite the potential benefits, the disparity between the cost of carbetocin and oxytocin suggests that a locoregional cost-effectiveness analysis should be performed before making the decision to adopt carbetocin for routine prophylaxis.[9]

In 2020, sequential trial analysis of five randomized controlled trials of studies with data on women (a total of 1214) undergoing nonelective cesarean deliveries, where carbetocin was compared with oxytocin, was performed.[10] The need for additional uterotonics was reduced with carbetocin compared with oxytocin (OR 0.30; 95% CI, 0.11–0.86; I^2, 90.60%). Trial sequential analysis (TSA) confirmed that the information size needed to show a significant reduction in the need for additional uterotonics had been exceeded. No significant differences were shown with respect to any of the secondary outcomes, but there was significant heterogeneity between the studies. The authors concluded that further trials utilizing consistent core outcomes are needed to determine an effect on PPH.[10]

On the other hand, a single center study was carried out to evaluate the cost-effectiveness of carbetocin compared with oxytocin when used for prophylaxis against PPH. With approximately 3000 cesarean deliveries per year, the study showed that the use of carbetocin could prevent 108 episodes of PPH, 104 episodes

of transfusion, and 455 patients would require fewer uterotonics. Their cost-saving per PPH case was USD$ 278.70.[11] Another study where 1500 cesarean deliveries (both elective and emergency) were analyzed over 12 months, carbetocin use, as opposed to oxytocin use, reduced 30 (88 vs 58) PPH events (>500 ml blood loss) and saved £27 518. Carbetocin had a 91.5% better outcome and was 69.4% cheaper.[12] When compared with the need for additional uterotonics in the carbetocin group, none required additional medication versus 71.5% in the oxytocin group ($P < 0.01$). In another prospective cohort study, carbetocin used for 400 patients undergoing cesarean delivery led to reduced PPH and the use of other oxytocic agents, saving £68.93 per patient.[13] In 2019, a systematic review of the cost-effectiveness of uterotonic agents for the prevention of PPH was published with 15 studies across all income categories that compared misoprostol versus no uterotonic (five studies) or versus oxytocin (one study), carbetocin versus oxytocin (eight studies), and one study comparing numerous uterotonics.[14] The evidence on the cost-effectiveness of various uterotonic agents was not generalizable to different contexts. In the absence of reliable evidence, the choice of uterotonic will likely be highly influenced by uterotonic price and contextual factors. In the context of cesarean delivery, carbetocin was more cost favorable than oxytocin. The authors concluded the quality of the evidence provided by these studies has a lack of sensitivity analyzes and incomplete description of the methods of outcome and costs measurements in most studies. In addition, some studies from middle-income countries favoring carbetocin were funded by the manufacturer. They interpreted findings from these studies and those of the conference abstracts with limited data cautiously, owing to the potential risk of bias and imprecision. Therefore, it can be easily inferred that the relative cost-effectiveness of carbetocin is still inconclusive.

Beyond its primary efficacy, which is reduced blood loss, a drug's safety profile must also be considered before wide-scale utilization. The adverse effects of carbetocin and oxytocin were examined in a small, randomized study.[15] The data showed that carbetocin had a lower rate of nausea. In contrast with other clinical indices, including the need to stabilize systolic blood pressure and heart rate, no other differences were noted.[15] Since anesthesiologists administer carbetocin for cesarean delivery, the requirement for increased dose beyond the standard 100 ug in some instances was raised.[16] The longer half-life of carbetocin prevents additional dosing in case of a persistent bleed and does not permit additional oxytocin administration. The increase in carbetocin dose from 100 μg to 140 μg injection increases cardiovascular complications.[17] Thus, in cases of pre-eclampsia, close attention is warranted for preserving patient safety before high dose carbetocin is administered. Also, in those cases, oxytocin doses must be increased to control bleeding beyond the standard treatment, mainly if the drug was used during labor, which may also increase complications rate. A case report showed that carbetocin administration for a patient with asthma led to nearly fatal bronchospasm and cardiac arrest requiring resuscitation, which was successful.[18] Therefore, this drug should be used with caution in patients with asthma or those with advanced pulmonary pathology. This and other studies show inconsistency in adverse events data and indicate that the utility of carbetocin should be further assessed in additional pregnancy pathologies to establish the population in which the risk–benefit profile is favorable.

BOX 5 FIGO reaffirms its recommendation regarding oxytocin as the first choice for prevention of PPH in vaginal and cesarean deliveries.

In settings where oxytocin is unavailable (or its quality cannot be guaranteed), the use of other uterotonics (carbetocin, ergometrine/methylergometrine, or misoprostol) is recommended.

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8 | TRANEXAMIC ACID

Tranexamic acid (TXA) is a synthetic analogue of the amino acid lysine that inhibits fibrinolysis by reducing the binding of plasminogen and tissue plasminogen activator (tPA) to fibrin.[1] Labeled indications of this medication are cyclic heavy menstrual bleeding, and oral procedures in patients with hemophilia. An antifibrinolytic drug is useful because hyperfibrinolysis and fibrinogen depletion are common in the early stages of major postpartum bleeding, and although existing medical and surgical interventions can be used to treat postpartum bleeding, TXA offers an alternative way to support hemostasis.

8.1 | Administration of TXA

1. **Administration of TXA is recommended as soon as the diagnosis of PPH is made if the diagnosis is made within 3 h of delivery**. When more than 3 h has elapsed since delivery, there is no clear evidence of benefit from TXA administration. TXA for PPH treatment is given 1 g IV over 10 min within 3 h of vaginal or cesarean delivery. One gram (10 ml of a 100 mg/ml solution) is infused over 10–20 min because infusion >1 ml/min can cause hypotension. If bleeding continues after 30 min or stops and restarts within 24 h after the first dose, a second dose of 1 g may be given. The antifibrinolytic effect lasts up to 7–8 h in the serum. The concentration in breast milk is approximately one hundredth of the serum peak concentration, so it is unlikely to have antifibrinolytic effects in the infant.[2,3] The WOMAN trial found that administration of TXA within 3 h of delivery to women with established PPH decreases maternal mortality secondary to bleeding and reduces the need for laparotomy to control hemorrhage.[2]
2. **TXA, as a management strategy, in addition to uterotonics reduced the risk of PPH in randomized trials**. Its use is effective in high-risk clinical settings (e.g. delivery of patients who refuse blood products, patients with a significant risk for PPH such as placenta accreta or placenta previa or previous PPH). Usually, 1 g TXA intravenously is recommended within 10 min after vaginal delivery in addition to oxytocin, cord traction, and uterine massage.[4,5] A Cochrane review of antifibrinolytic agents used for the treatment for PPH identified three eligible trials, two of which compared intravenous TXA with placebo or standard care (the WOMAN trial and a French trial).[4,6] A meta-analysis of 20 172 women from the WOMAN trial and the French trial (152 women with PPH received high-dose TXA, a loading dose of 4 g over 1 h followed by an infusion of 1 g over 6 h) showed that TXA reduces the risk of death due to bleeding (RR 0.81; 95% CI, 0.65–1.00), with early treatment being more effective. WHO updated its recommendation on the early use of TXA for the treatment of PPH (within 3 h of birth) with intravenous TXA using the same dosing regimen as in the WOMAN trial: a fixed dose of 1 g in 10 ml (100 mg/ml) intravenously at a rate of 1 ml/min. A second 1 g intravenous dose should be administered if bleeding continues after 30 min or restarts within 24 h of the first dose.
3. **TXA should be given to all women with clinically estimated blood loss of more than 500 ml after vaginal birth or 1000 ml after cesarean delivery, or any blood loss that is sufficient to compromise hemodynamic stability, regardless of the cause of hemorrhage**. TXA forms a reversible complex that displaces plasminogen from fibrin resulting in inhibition of fibrinolysis and inhibition of the proteolytic activity of plasmin. TXA is recommended for PPH management. It is given concomitantly with other drugs and procedures for control of bleeding. An antifibrinolytic drug is useful because hyperfibrinolysis and fibrinogen depletion are common in the early stages of major postpartum bleeding. Delay in treatment, even if short, reduces the benefit of TXA administration. The WOMAN trial found that TXA reduced death due to bleeding in women with PPH by 20%–30% and was not associated with an increase in adverse effects. It also reduced the incidence of laparotomy to control bleeding by 36% but did not reduce hysterectomy rates. However, the decision to perform hysterectomy was sometimes made at the same time as randomization, so some hysterectomies were performed before or concurrently with administration of TXA.[2,3]

8.2 | TXA as a prophylactic measure

Although the WOMAN trial presents evidence for the use of TXA to treat established PPH, there is limited evidence for its role in prevention of PPH. Reviews and meta-analyses of multiple trials have shown that prophylactic use of TXA may decrease both postpartum bleeding and the need for blood transfusions.[7,8] However, larger adequately powered, multicenter randomized controlled trials are needed before the prophylactic use of TXA can be recommended for the prevention of PPH. In 2021, a multicenter, double-blind, randomized controlled trial was conducted with 4551 women undergoing cesarean delivery before or during labor at 34 or more gestational weeks who received an intravenously administered prophylactic uterotonic agent and either TXA (1 g) or placebo. Among women who underwent cesarean delivery and received prophylactic uterotonic agents, TXA treatment resulted in a significantly lower incidence of calculated estimated blood loss greater than 1000 ml or red-cell transfusion by day 2 compared with placebo, but it did not result in a lower incidence of hemorrhage-related secondary clinical outcomes.[9] Several systematic reviews related to the treatment of PPH exist. Mousa et al.[10] conducted a review that sought to include studies examining the effectiveness of all types of treatments for PPH. However, their review primarily included studies involving treatment with misoprostol, and little evidence regarding TXA. They concluded that more research was needed regarding the effectiveness of TXA for treatment of PPH.[10] Additionally, the existing systematic reviews that examined TXA for prophylaxis against PPH (where

all laboring patients receive TXA) did not address the potential effects of administering TXA only to mothers with PPH.[11] FIGO does not recommend the use of TXA prophylactically, given the limited evidence in that regard.

8.3 | Adverse reactions to TXA

1. Greater than 10%: headache (oral: 50%), abdominal pain (oral: 20%), back pain (oral: 21%), musculoskeletal pain (oral: 11%), nasal signs and symptoms (oral: 25%; including sinus symptoms).
2. 1%–10%: fatigue (oral: 5%), anemia (oral: 6%), arthralgia (oral: 7%), muscle cramps (oral: ≤7%), muscle spasm (oral: ≤7%).
3. Less than 1%: allergic dermatitis, allergic skin reaction, anaphylactic shock, anaphylactoid reaction, anaphylaxis, cerebral thrombosis, chromatopsia, conjunctivitis (ligneous), deep vein thrombosis, diarrhea, dizziness, hypersensitivity reaction, hypotension (with rapid intravenous injection), nausea, pulmonary embolism, renal cortical necrosis, retinal artery occlusion, retinal vein occlusion, seizure, ureteral obstruction, visual disturbance, vomiting.

8.4 | Contraindications

Hypersensitivity to TXA or any component of the formulation.

8.5 | Implementation of treatment with TXA

1. TXA should always be readily available in obstetric care facilities. It is cost-effective, heat stable, and widely available with a long shelf life. An economic evaluation that used data from the WOMAN trial to assess the cost-effectiveness of early TXA for usual care of women with PPH in Nigeria and Pakistan concluded that it is likely to be highly cost-effective.[4]
2. TXA should be used in addition to all usual treatments for the management of PPH including medical (uterotonics), nonsurgical, and surgical interventions.[2,3]
3. It has a wide therapeutic index, and a further intravenous injection could be given when this becomes possible. Alternative routes of administration should be a research priority, as recommended by WHO.[12]
4. Owing to improvements in emergency obstetric care, including use of TXA as a first-line therapy, more women will survive PPH than ever before. Furthermore, the incidence of PPH is increasing,[1] and consequently the number of women who will experience its physical and psychological consequences will also increase. More research is needed on how to reduce the risk factors for PPH.

BOX 6 FIGO recommends administration of tranexamic acid as soon as the diagnosis of PPH is made, as long as this is within 3 h postpartum.

One gram of tranexamic acid, intravenously over 10 min is to be given regardless of the cause of PPH. If bleeding continues after 30 min or stops and restarts within 24 h after the first dose, a second dose of 1 g may be given.

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9 | NONSURGICAL CONSERVATIVE MANAGEMENT

9.1 | Nonpneumatic antishock garment (NASG)

The NASG is a low-technology, affordable, first-aid compression device for the management and stabilization of women with hypovolemic shock due to PPH and management of refractory PPH.[1] This device serves as a temporizing measure to recover hemodynamic stability to allow definitive surgical interventions, blood transfusions, or transfer to more specialized healthcare facilities.[2–4]

The NASG is a lightweight, lower body compression device comprising six articulated neoprene and hook-and-loop fastener segments that provide lower body circumferential counterpressure to improve cardiac output and blood pressure.[5]

The estimated circumferential pressure applied by the NASG is around 20–40 mm Hg. Direct abdominal and pelvic compression reduces the total vascular space in the lower body and decreases pelvic perfusion to pelvic compartment organs and smaller pelvic blood vessels, promoting hemorrhage arrest.[6] Additionally, the pressure applied increases cardiac output and the central circulation, allowing an increased distribution of blood flow to vital upper body organs (heart, lung, brains) and contributing to a rapid recovery from shock.[1,7]

Likewise, the direct compression of the descending aorta reduces bleeding from the uterine arteries and the mesenteric bed's vasculature, perhaps decreasing up to 90% of blood flow at the level of the superior mesenteric artery.[1,8]

A further property of the NASG that makes it useful for maternal hemorrhage is the easy access to the vagina and perineum, thereby facilitating genital medical and surgical interventions. Additionally, it is extremely cost-effective even for very low-resource settings, and is reusable as it can be disinfected and washed over 100 times without losing its compressive effects.[3] It is also adjustable for many women of different girths and heights.

9.1.1 | Safety

According to human studies, the NASG is a safe device, with no adverse effects such as abdominal wall lesions or other types of potential injuries secondary to the circumferential pressure applied, independent of the patient's body mass index or the strength used to close each of the segments of the garment.[2] In multiple studies, there were no adverse events associated with NASG use: no increased rates of dyspnea, cardiac, or renal dysfunctions. In fact, in all studies of NASG involving extremely ill women with severe PPH, there were decreased rates of all severe maternal morbidities.[4]

Doppler studies of the distal aorta when the NASG is applied have shown a drop in the flow rate (volume/time) up to 33%. Additionally, when the garment's abdominal and pelvic segments are placed, the resistive index (inversely proportional to flow rate) of the internal iliac arteries increases.[7]

9.1.2 | Effectiveness and advantages

Multiple studies have been carried out to assess the efficacy and effectiveness of the NASG. Observational quasi-experimental studies at referral centers in Egypt, Nigeria, India, Zambia, and Zimbabwe showed a 48% drop in maternal mortality related to hypovolemic shock (secondary to PPH).[2] Overall, the groups that received NASG treatment required fewer transfers to higher complexity facilities as well as abdominal hysterectomies (for definitive therapeutic approach) than women in the control groups, with a relative risk of 0.44 (95% CI, 0.23–0.86).[9]

A randomized controlled trial implemented in Zambia and Zimbabwe demonstrated that early placement of the NASG at primary healthcare centers was associated with a statistically significant decline in shock recovery time (defined as shock index <0.9), with a median time to recovery of 170 min for the NASG group versus 209 min for the control group, with a hazard ratio of 1.2 (95% CI, 1.02–1.52, $P = 0.03$). Although the reduction in mortality and severe maternal morbidities (54%) in this study was not statistically significant (perhaps due to much smaller sample size than was necessary to show statistical significance), it is still significant considering the seriousness of the outcomes.[10]

In 2015, a systematic review of quasi-experimental studies and the trial above compared PPH standard care versus standard care plus NASG. It found that the use of the NASG combined with standard PPH care reduces both maternal mortality (48%), with a relative risk of 0.52 (95% CI, 0.36–0.77) and a 68% reduction in combined adverse outcomes, mortality, and severe morbidities (RR 0.31; 95% CI, 0.17–0.59). Furthermore, safety was demonstrated by the absence of differences in adverse events among groups.[2]

Effectiveness outside of clinical trials has been reported in one large implementation project in Tanzania that was conducted in 280 healthcare facilities in four rural regions, with over 1700 women with PPH, 24.5% ($n = 419$) of whom had severe PPH and hypovolemic shock.[11] Of these women, 70.8% received the NASG, which indicated high utilization and high acceptability. There was also a temporal association of a 67% reduced risk of mortality among women with severe PPH during the project (RR 0.33; 95% CI, 0.16–0.60).

Use of the NASG is recommended for the clinical stabilization and safe transfer to high complexity centers in the clinical scenario of PPH. This device is currently used in over 50 countries worldwide, and it has been recommended in many national and international guidelines such as GLOWM, WHO, FIGO, and others.[12–15] This device should be present in every healthcare facility, as it has proven to be effective and safe, granting significant reductions in PPH-related mortality.[3,15,16] Besides the acceptability demonstrated in the Tanzania study, qualitative research in a few settings has reported high acceptability from women and providers.[11,17–19]

9.1.3 | Indications

Women with PPH presenting with clinical signs or laboratory findings compatible with shock or hemodynamic instability are suitable for treatment with the NASG. It is important to note that the garment serves as a temporizing measure. Thus, once hemodynamic stability is restored, patients should receive definitive medical and surgical treatment. Table 8 provides a reference for the indications for NASG application.[3]

9.1.4 | Instructions for use

The NASG is composed of six articulated segments. The first three segments are bilateral and independent segments for the lower body parts: ankles, calves, and thighs. The other three circumferential segments are placed over the pelvic and abdominal areas. It must first be unfolded entirely and placed under the patient's body. To assure proper application of the garment, placement of the superior edge of segment 6 (the superior segment) over the lower rib should be confirmed. The device can be adjusted to all sizes and heights. For instance, in shorter patients, segment 1 can be folded into segment 2 to keep the first applied segment at the ankle and it can be performed whenever someone who is competent to insert it is available.

TABLE 8 Indications for NASG application[a]

FIGO recommendations on use of the nonpneumatic anti-shock garment for hypovolemic shock secondary to obstetric hemorrhage	
Population	Any pregnant or postpartum woman with severe hemorrhage showing signs of shock/hemodynamic instability, at the primary healthcare level or if transport to higher facility is necessary: EBL 500 ml, SBP <100 mm Hg, pulse >100 bpm; at high-level facilities: EBL >1000 ml, SBP <90 mm Hg, pulse >110 bpm (or per facility protocols)
Recommendation	Rapidly apply NASG starting at the ankles. NASG to remain in place until source of bleeding found, and bleeding decreased to 25–50 ml/h
Scientific evidence	4 pre/post studies, 1 randomized controlled trial, 1 systematic review
Modifications	Depending on capacity of facility and staff, the NASG could either be applied as first-line first aid before any other intervention or could be used to reverse shock when other methods to stop bleeding have failed, or while awaiting definitive therapy (embolization, surgery, blood transfusions)
Grade	B (temporizing measure)

Abbreviations: EBL, estimated blood loss; SBP, systolic blood pressure; NASG, nonpneumatic anti-shock garment.

[a]Source: FIGO Safe Motherhood and Newborn Health Committee [3]. Reproduced with permission from FIGO.

For garment applications, each segment must be stretched and closed as tightly as possible, starting at the ankles with segment 1 and continuing with the remaining segments successively.[5] It is important to try to keep both knees uncovered by the leg segments to preserve joint mobility. The leg segments of the NASG can be placed by one or two people, depending on the availability of healthcare personnel. Appliers can use the pubic symphysis as an anatomical reference point for placing segment 4. Appliers can use the umbilicus as guidance for placing segments 5 and 6. Although all segments should be closed firmly and tightly, the abdominal section must not be closed too tightly in order to maintain adequate respiration. For that reason, it is advised that only one person should close segments 5 and 6. If there is more than one person available, two people can coordinate their actions, with one person presenting the opposite segment to the person who will close both segments together. If the patient shows signs of respiratory distress, abdominal segments (5 and 6) can be loosened, but not completely opened.

If the patient requires surgical intervention the leg sections should remain closed, while the pelvic and abdominal segments can be temporarily opened, just before the skin incision is made, and then closed once the procedure is concluded. In addition, a drop in blood pressure should be expected when the abdominal and pelvic segments are opened, and hence appropriate measures should be taken.

9.1.5 | Monitoring and removal

Patients using the NASG should be closely followed with continuous monitoring of heart rate and blood pressure and optimal fluid resuscitation.[5] This device can be used safely for up to 48 h as a temporizing measure until hemodynamic stability or adequate hemorrhage control is achieved. Nevertheless, there are reports of the NASG used for longer than 72 h. To safely remove the NASG, healthcare professionals must verify the following criteria: blood loss <50 ml/h, heart rate <100 bpm, and systolic blood pressure ≥100 mm Hg (rule of 100's) for at least 2 h.[5] Once the following criteria are corroborated, it is safe to start removing the garment. The intravenous line should remain in situ during the removal. Removal should follow the same steps as application, starting with segment 1 at the ankles and moving slowly up to segment 6. Every time a segment is opened, a 15-min period is allowed to re-evaluate vital signs and check for active bleeding. If vital signs remain stable and there are no signs of active bleeding, it is safe to open the next segment. However, if systolic blood pressure drops ≥20 mm Hg or heart rate increases ≥20 bpm (rule of 20's) or active bleeding is identified, all of the segments must be rapidly closed again. Once removed, the NASG should be placed in a biohazard container and sent to be laundered, dried, and refolded. Videos and presentation slides of correct application, use, removal, and cleaning can be obtained for free at: www.safemotherhood.ucsf.edu. These instructions must be followed strictly, as incorrect removal of the garment could result in hemodynamic instability and recurrence of shock, especially if the abdominal segment is the first segment to be opened.[5] In the absence of hemodynamic instability

signs, the whole garment can be removed in 1 h and 15 min. Routine follow-up laboratories, including hemoglobin and hematocrit are encouraged. Values over 7.5 mg/dl of hemoglobin and a hematocrit >23% are recommended; however, there is neither consensus nor evidence about these values, and further research is needed.

9.1.6 | Adverse effects

Currently, no adverse effects have been documented with correct implementation of the NASG[4]; no increase in shock-related organ dysfunction adverse effects have been noted.[9]

9.1.7 | Contraindications

Currently, there are no absolute medical contraindications for NASG use.[3] Cardiac and pulmonary comorbidities such as heart failure, severe mitral stenosis, and pulmonary hypertension are considered relative contraindications in nonobstetric patients. Although in severe hemorrhage, benefits are thought to outweigh any potential harm.[5]

BOX 7 FIGO recommends that all healthcare facilities have the NASG as an effective nonsurgical device that can be used as a temporary measure to recover hemodynamic stability for the management and transfer of a patient to a high level of care.

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9.2 | Uterine balloon tamponade

Despite active management of the third stage of labor, 2%–7% of women experience postpartum blood loss of more than 500 ml.[1] Uterine balloon tamponade (UBT) is both a diagnostic and therapeutic tool. If bleeding does not stop after its insertion, then it is better to review the etiology of PPH. Placement of a UBT device should be considered early when emergency measures for management of PPH are initiated. It should be performed by competent healthcare providers who are trained in its insertion to avoid complications that can arise from misplacement. Perineal, vaginal, and cervical tears and ruptured uterus must be excluded, and the placenta carefully assessed for completeness to rule out retained fragments of the placenta. First-line emergency interventions for atonic PPH include uterine massage, initiation of large intravenous

access, emptying the uterus and bladder, and administration of oxytocin and TXA (first response bundle). If the uterus fails to contract, ergometrine or misoprostol should be administered, bimanual uterine or aortic compression should be initiated, a UBT placed, and the NASG applied (response to refractory PPH bundle).[2] These two sets of approaches have recently been defined as the "PPH bundle".[3]

Observational studies have reported UBT success rates between 83% and 95% overall with nearly 100% survival among women with uncontrolled hemorrhage when a UBT device was placed before the onset of advanced shock.[4–6] The integration of UBT into PPH clinical pathways in high-income countries has been shown to avert hysterectomy and significantly reduce the need for PPH-related invasive procedures such as artery ligation, uterine compression sutures, and arterial embolization.[7–10]

A 2020 systematic review and meta-analysis showed an overall pooled success rate of 85.9% (95% CI, 83.9–87.9%) for the treatment of PPH, with higher pooled success rates corresponding to PPH due to uterine atony and placenta previa, and lower pooled success rates for PPH due to placenta accreta spectrum (PAS) and retained products of conception.[11] A safety trial in Kenya and Sierra Leone on a uniquely designed condom uterine tamponade device (ESM-UBT) demonstrated no increased risk of infections or perineal injuries, and success rates of condom UBT devices appear to be comparable to those of Bakri balloons.[12] Available UBT devices and specific considerations are described below.

9.2.1 | Available UBT devices

Uterine balloon devices can be divided into two groups:

1. Fixed volume devices: condom uterine balloons (ESM-UBT kit, CG balloon), Bakri balloon, Rusch balloon, and Ebb system.[12–16]
2. Free flow devices: the glove balloon, Ellavi UBT, and Zukovski balloon.[17–19] The glove and Ellavi balloons allow intrauterine pressure control according to systolic blood pressure. The Zukovski balloon uses 50 cm (3.8 cmHg) pressure for inflating the balloon.

9.2.2 | Tamponade effect

The mechanism of action of UBT devices is likely multifactorial. Two proposed mechanisms include device stimulation of receptors, which in turn stimulates uterine contraction, as well as the direct application of hydrostatic pressure against the bleeding sinuses. It has been proposed that if uterine wall pressure exerted by a UBT equals the systolic arterial pressure of the bleeding sinuses, a tamponade effect is created.[14] However, Georgiou[20] measured intraluminal pressures in Bakri balloons in two cases where UBTs had been placed and discovered that tamponade occurred at UBT device pressures lower than systolic blood pressures. Further research is needed to better understand the precise biomechanical relationship between a UBT device and a bleeding uterus.

9.2.3 | Free flow tamponade device

Blood is supplied to the uterus via maternal arterial blood that passes through the myometrium through low resistance sinuses.[21] Following delivery of the placenta, the muscle fibers of the myometrium contract and retract, closing off the sinuses and limiting blood loss. While the immediate aim in PPH due to atonic uterus is to arrest blood loss, the ultimate goal is to employ best practice interventions to facilitate contraction of the myometrium. The surgical glove balloon, the Ellavi UBT, and the Zukovsky balloon are free flow systems that allow water to be expelled from the balloon to theoretically better allow for the natural physiological process of contraction and retraction of the myometrium once the uterus has recovered.[17–19] However, almost all commercially available UBT devices are low-pressure, high-volume systems that allow for easy UBT expulsion when the uterus regains its tone and begins to contract.

9.2.4 | Drainage port

The need for a drainage port with a UBT device is questionable.[13,14,16] Drainage ports are only a few millimeters in diameter and therefore are easily obstructed by clotted blood. Furthermore, since the source of bleeding in atonic uterus is from the site of placental implantation, which encompasses only about 20% of the uterine cavity, a drainage port is less likely to be in proximity to the bleeding site.

9.2.5 | Correct placement

Multiple techniques have been described on the best approach to place a UBT device. The approach should in part be determined by the device being used (e.g. stiffness of the introducing end and number of balloons). To ensure that the balloon could engage within the area that is actively bleeding, all UBTs should be inserted through the cervix and positioned to sit in the upper uterine segment. One approach includes placing the hand into the uterus and ensuring that the fingertips reach the thick anterior and posterior layers of the upper segment. The UBT is then fed into the upper segment of the uterus with the free hand. When withdrawing the uterine hand, the tubing is held with the free hand. While the balloon is filled, two fingers are held in the vagina below the cervix to prevent inadvertent balloon expulsion.

9.2.6 | Assessment of effect

Multiple studies have shown that women with uncontrolled PPH from an atonic uterus will almost universally survive if a UBT device is placed in a timely fashion. If UBTs are placed before patients progress to advanced shock, success rates approach 100%.[6] However, studies such as by Dumont et al.[22] and Natarajan et al.[23] have shown that improvised UBTs, delays in recognition of PPH, and lack of

action on actual UBT placement may be barriers to improved outcomes. While different UBT systems may fill to their desired states at different rates, it is even more important to recognize that improvised and untested UBTs are less often used. Moreover, whenever they are, their use is often delayed, they are more difficult to place, fall out more easily, and are associated with overall lower success rates.[12–14,17,19] Therefore, immediate recognition of PPH and emergency action with a quality UBT device is imperative to save lives.

9.2.7 | Transfer

Many studies report high rates of hemorrhage control after UBT insertion thus rendering transfers unnecessary. Most often, incorrect diagnosis and misplacement are the cause of UBT failure. If bleeding recurs or the patient continues to be unstable after UBT insertion, then consideration of transfer to higher levels of care should be made. Transfer can occur with both fixed-volume balloons and closed-off free-flow balloons, but all UBTs must be carefully secured to prevent accidental displacement. A transfer plan should be in place in all obstetric settings, regardless of whether it will be needed or not. This is an absolute necessity in PPH bundles.

9.2.8 | UBT after cesarean delivery

Use of UBTs for hemorrhage control after cesarean delivery is a commonly performed technique worldwide, but there is scant supporting literature. There are a few reports on successful outcomes with use of UBT in placenta previa. It appears that UBT has higher success rates in women with PPH after vaginal delivery than after cesarean delivery.[11,18,24–26]

9.2.9 | Combining UBT with compression sutures

Placing a UBT after application of uterine compression sutures requires control of the amount of pressure exerted in the uterus to prevent uterine necrosis. Although uterine necrosis is possible following the insertion of compression sutures alone, the risk understandably would increase with pressure exerted from inside the uterus when UBT is used additionally. Cases with uterine necrosis following insertion of compression sutures have been reported with and without UBT.[27,28] The surgical glove balloon and the Ellavi UBT are UBT devices that allow the intrauterine pressure to be controlled by adjusting the height of the intravenous fluid bag or supply bag above the patient.[17,18] With systolic blood pressure of 100 mm Hg and the supply bag or intravenous infusion fluid 1.3 m above the patient, the pressure exerted by the balloon will be 100 mm Hg. The specific gravity of mercury is 13 times more than water. The device used for the balloon must be large enough to be inflated with fluid without requiring any expansion pressure. This is achieved by using a surgical glove and the Ellavi UBT.[17,18]

9.2.10 | Other uses of UBT

While the use of UBT for uncontrolled PPH is fairly well established, published case reports and senior leaders in obstetrics and gynecology have described successful use of UBTs in other circumstances, such as in molar pregnancy-associated hemorrhage, placenta accreta, retained placenta, and in cases of intentional vaginal and cervical placement to temporize uncontrolled bleeding from lacerations.[29]

WHO recently published recommendations regarding use of UBT in the context of PPH due to uterine atony after vaginal birth in women who do not respond to standard first-line treatment.[30] According to WHO, among the prerequisites for use of UBT, evidence supports the need for access to surgical intervention and blood products, as well as the availability of health personnel skilled in its use. They recognize that conditions may not be operationalized across all clinical settings and that observational studies suggest a substantial reduction in the risk of maternal morbidity and mortality following uterine balloon tamponade, and that further research is needed in low-resource settings.

BOX 8 FIGO recommends uterine balloon tamponade in the context of refractory PPH.

Uterine balloon tamponade has proven to be an effective nonsurgical technique so that when employed rapidly by a properly trained person, as the only prerequisite for its use, it can potentially improve survival in women with PPH.

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9.3 | Uterine artery embolization

Since the first report of the successful use of uterine artery embolization (UAE) for the treatment of PPH in 1979, success rates have been frequently reported at 90%. However, unlike the medical and surgical treatments for PPH, no randomized controlled trials regarding its effectiveness have been conducted. The decision to perform uterine artery embolization in patients with persistent uterine bleeding should be made in consultation with an interventional radiologist. Although embolization may be considered as the technique of choice for managing PPH by some authors, certain practical issues must be considered.[1]

Uterine artery embolization has been shown to be effective in the treatment of various causes of PPH including placenta accreta: Both UAE and uterine artery ligation have reported success rates of greater than 90% with low complication rates. If both techniques are available, embolization is the preferred first choice as it obviates laparotomy. Ligation can be attempted subsequently if embolization is unsuccessful. In contrast, after an unsuccessful uterine artery ligation, embolization may be extremely difficult or even impossible, leaving hysterectomy as the only remaining option. Some cases may require hysterectomy because of failure of embolization. UAE has shown to be effective in controlling secondary bleeding and the placenta was found to gradually decrease in size in all patients. UAE plays an important role in managing these patients because it is effective at reducing uteroplacental blood flow to further induce thrombosis of the intervillous space and to achieve necrosis of the retained placental tissue.[2–7] Selective UAE is effective in the control of PPH, thus avoiding hysterectomy.

Availability of resources to perform the procedure: A radiologist trained in embolization techniques is a prerequisite, as is the appropriate equipment for vascular intervention. Digital road-mapping may be required, and the possible complexity means that this procedure can only be performed in a fully equipped X-ray department.[8] The interventional radiologist inserts sheaths into both femoral arteries to deploy a deflated occlusion balloon into each of the internal iliac arteries.[9] The sheaths are removed, and the deflated balloons remain in place until after delivery. After the patient has undergone a cesarean delivery, the interventional radiologist will inflate the balloons if needed based on the amount of bleeding. If inflating the

balloons is postponed, the balloons may remain in place for up to a few days until the patient's providers are certain she will not begin to bleed again; the balloons can then be removed.[9]

UAE has become recognized as a relatively safe technique when preserving the patient's fertility is a priority[10–12]**:** Catheterization of the uterine arteries with temporary occlusion by endovascular balloon is considered a valid option in the management of patients at high risk of bleeding, in particular those with a pre-existing diagnosis of placenta accreta in patients requesting to preserve their uterus. Ojala et al.[13] and Badawy[14] described a series of cases in patients who underwent embolization of the uterine arteries. Catheterization averted hysterectomy in close to 80% of cases.

9.3.1 | Complications

Some studies have documented resumption of menses and even pregnancies after the procedure.[15] Complications of pelvic embolization for PPH occur at a rate of 8.7%. The most common complication is low-grade fever. Less common complications are pelvic infection, groin hematoma, iliac artery perforation, transient buttock ischemia, transient foot ischemia, and bladder gangrene. Lee et al.[16] listed dissection of the uterine arteries, hematoma at the puncture site, paresthesia, and lower limb edema as complications.

Currently, most PPH cases requiring hysterectomy are related to placenta previa.[17] . These patients are commonly diagnosed before delivery and are usually delivered by elective cesarean delivery. This planning may allow increased use of invasive radiological services in the management of such cases by inserting the intra-arterial balloons before going to surgery.

9.3.2 | Implementation of treatment

1. A radiologist trained in embolization techniques is a prerequisite, as is the appropriate equipment for vascular intervention. Digital road-mapping may be required, and the possible complexity means that this procedure can only be performed in a fully equipped X-ray department.[8]
2. The obstetrics staff and interventional radiologist select the appropriate operative procedure (UAE or cesarean hysterectomy) based on the patient's clinical condition and a refractory response to conservative medical management.[8]
3. UAE is preferred for patients who have a stable systolic and diastolic blood pressure or heart rate.

BOX 9 FIGO recommends uterine artery embolization for refractory bleeding uncontrolled by medical and nonsurgical treatment modalities with the availability of trained personnel and necessary equipment for using this technology.

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10 | SURGICAL TREATMENT

10.1 | Uterine compression sutures for PPH

When a decision is made for surgical intervention, adequate operative theatre should be set up with adequate anesthesia, surgical and nursing staff, and blood should be available for transfusion. Upon laparotomy, bleeding at the surgical site should be minimized by adequate packing to minimize time lost for suturing while active bleeding is ongoing. In all cases the uterus should be fully exteriorized, if possible. Blood loss should be minimized while fully extending the uterus, causing vasoconstriction and a tourniquet placed around the low segment until surgical compression sutures are successfully applied.[1] This enables the surgical team to use the following described methods by applying the uterine compression sutures with a high degree of safety. In addition, injections of vasopressin at a dose of 4 U in 20 ml of saline in the placental bed after removal of the placenta may lead to reduced blood loss as well.[2] Placement of endouterine square hemostatic sutures may also be used to control bleeding from the placental bed.[3]

Hemostatic suturing technique as a second-line strategy for control of uterine bleeding due to uterine atony is an effortless, fast, and conservative surgical procedure. It can be performed satisfactorily after a cesarean delivery or after a vaginal delivery.[4] Complications related to its application have been identified but there are no reports of deaths related to compression sutures. Complications can include uterine synechia or ischemia, uterine necrosis,[5] intrauterine infection,[6] and strangulation of the intestinal loop and abdominal omentum when nonabsorbable stitches are used,[7] but nonabsorbable sutures can be used if other types of sutures are not available.

While most births are uncomplicated, obstetricians are often faced with PPH at the time of vaginal or cesarean delivery.[8,9] If initial management with fundal massage, manual uterine compression, or uterotonics (oxytocin, misoprostol, methergine, or carboprost tromethamine) does not adequately reduce bleeding, placement of compression sutures can be done to slow bleeding and stabilize the patient, avoid hysterectomy, and ultimately reduce maternal morbidity or death. The three most used compression suture techniques for PPH are B-Lynch,[10] Hayman,[11] and Pereira.[12] Other compression sutures are cited in the literature, such as Cho, Ouahba, Hackethal, and Massuba.[8] If a Bakri balloon is available, the obstetrician can combine any of these three compression sutures with the placement of the balloon to tamponade bleeding. In some instances, expedient placement of an O'Leary stitch for temporary devascularization of the uterine arteries can decrease bleeding and allow additional time for placement of the compression sutures. As with the conduct of cesarean delivery, specific practical issues have to be considered. First, the obstetrician should be well versed in sterile pelvic vascular operative techniques, as placement of sutures will occur at the time of cesarean delivery or with laparotomy following vaginal delivery and PPH. Second, since time is critical to reducing maternal blood loss, an operative team with the technical skills for additional anesthesia, administration of blood products, and surgical assistance is crucial to the success of surgical management. Three commonly used compression sutures are described below and existing data are summarized on the effectiveness of each compression technique.

10.1.1 | Commonly used compression sutures for managing PPH

The B-Lynch suture was first introduced in 1997 by Christopher Lynch to address hemorrhage with open hysterotomy at the time of cesarean delivery.[10] A suture is placed on the right side of the hysterotomy, entering at the base of the incision and exiting at the top.[13] The suture is then carried across the top of the right fundus and a posterior stitch is placed, with the entrance of the suture at the same level of the anterior suture and exiting on the left posterior side of the uterus at the level of the uterine incision. Suture is then looped over the left fundus, and another stitch is placed at the top of the left side of the uterine incision and exiting at the base of the incision. The suture is then tugged tightly, compressing the body of the uterus with placement of a surgeon's knot. Following placement of the B-Lynch suture, the transverse hysterotomy is closed in the usual fashion. In the original description of B-Lynch, a chromic suture was used. Subsequent case studies have reported successful use of a monocryl suture.

Additional options for compression sutures include the Hayman and Pereira. In 2002, the Hayman suture was designed to be a technically easier alternative to the B-Lynch suture that could be placed expediently and not require hysterotomy. The steps for placing a Hayman suture include two to four longitudinal (on the left and right side of the uterus) sutures that pass directly from the anterior uterine wall and through the posterior uterine wall and are tied using a surgeon's knot at the fundus. A transverse cervicoisthmic suture traversing the anterior and posterior uterine walls can be placed to address bleeding from the lower uterine segment.

The Pereira compression technique includes five sutures, combining two longitudinal sutures with three transverse sutures. The advantage of the Pereira sutures is that placement occurs in the submucosal region and avoids the endometrial cavity. However, attention is needed for correct placement of the transverse sutures to prevent damage to the uterine vessels and ureters.

Based on the available literature, the success rate of compression sutures in achieving hemostasis is 76%–100%.[14] To date, no randomized controlled trials or controlled studies have compared the efficacy of the different compression sutures. In the three original studies for B-Lynch, Hayman, and Pereira, success rates were reported as 100% (5/5 for B-Lynch, 3/3 for Hayman, and 7/7 for Pereira). In a systematic review,[14] the overall success rate of compression sutures was reported as 91.7%. Given the broad use of compression sutures and the impact on maternal morbidity and mortality, it is unlikely that a randomized controlled trial to compare the efficacy of different compression techniques will be conducted. However, an observational study comparing the effectiveness of

different compression sutures on estimated blood loss and measures of maternal morbidity is an obvious next step to move the literature forward.

BOX 10 FIGO recommends compression sutures as one of the options to control PPH when medical and nonsurgical treatment modalities fail.

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10.2 | Uterine artery ligation

Uterine artery ligation has been described for the control of PPH since 1960; it is considered a simple, fast-performing technique[1] and one of the most popular fertility-preserving surgical techniques.[2] It is an effective management strategy for bleeding control with success rates of 42% and 88% described.[3–6]

The recent evidence on the effectiveness of uterine artery ligation to control bleeding in PPH is centered on case reports, mainly associated with other techniques and with the use of tranexamic acid.[7–11] The success rates for the procedure are higher depending on the time of the intervention from the beginning of the bleeding, the presence of coagulopathy, and the expertise of the surgeons.[12,13] The latest Cochrane systematic review of mechanical and surgical interventions for treating primary PPH found no controlled clinical trials evaluating its effectiveness for uterine artery ligation.[14]

BOX 11 FIGO recommends uterine artery ligation as one of the options to rapidly control PPH when medical, nonsurgical approaches, and compression sutures fail.

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10.3 | Bilateral internal iliac artery ligation

Internal iliac artery ligation was first performed by Kelly in 1894,[1] with reported success rates between 40% and 100%.[2,3] It reduces pelvic blood flow by half and pulse pressure by 85%, thereby simulating a venous rather than an arterial circulation, and promoting hemostasis.[1,2] Although this technique provides a rapid and effective way to control hemorrhage, it remains underused because of understandable fear of injury to surrounding structures: internal and external iliac arteries and ureters[2,4] and should only be considered if experienced pelvic surgeons are available. Internal iliac artery ligation may avoid the need for hysterectomy in the context of uterine atony.[2] In addition, in cases of traumatic PPH such as uterine rupture and extensive genital injuries, internal artery ligation clears the operative field and facilitates hysterectomy.[2]

During the procedure, the common iliac artery is identified. After dissection, the ureter is visualized crossing the common iliac artery at its bifurcation. The common iliac artery branches into an internal iliac (hypogastric) artery, coursing medially and inferiorly, and the external iliac artery coursing laterally and superiorly. The arteries are not infrequently adherent to the underlying veins and require appropriate dissection.[5] With right-angled forceps a suture is introduced between the artery and the vein, and a knot is made.[4,5]

Noteworthy is that even after bilateral internal iliac artery ligation, the vascular supply to the pelvis is not completely compromised due to the extensive collateral circulation that exists.[4,5] The revascularization is provided by the deep femoral artery, the anastomosis between the medial femoral circumflex and obturator artery, and that between the lateral femoral circumflex and superior gluteal artery, and the ovarian artery.[4,5] Obstetricians ought to be more familiar with this procedure as it is an effective and rapid way to control PPH.

BOX 12 FIGO recommends internal iliac artery ligation as one of the options to rapidly control PPH for management of PPH when medical, nonsurgical approaches, and compression sutures fail.

FIGO also recommends that all obstetricians familiarize themselves with the internal iliac artery location and with the technique of its ligation.

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10.4 | Hysterectomy

Peripartum hysterectomy is performed in the treatment of PPH when all other conventional methods fail to control the bleeding.[1] The prevalence is higher in low-income regions than in high-income regions (2.8 and 0.7 per 1000 deliveries, respectively).[2] The incidence of this procedure has been on the rise, increasing by 15% in the USA between 1994 and 2007.[3] Similarly, in Turkey, the rate has increased from 0.03% in 2000–2006 to 0.07% in 2007–2013. In most of the studies, this was attributed to the increased rates of cesarean delivery.[1–5]

The most common indications for peripartum hysterectomy are placental pathology such as abnormal placentation, placenta previa, and placental abruption (38%), uterine atony (27%), and uterine rupture (26%).[2] Peripartum hysterectomy is associated with high rates of maternal morbidity and complications due to the need for blood transfusions, coagulation disorders, injury to the urinary tract, the need for re-exploration in case of persistent bleeding, and postoperative fever.[1]

The maternal mortality rate varies according to countries, ranging from 0% in Turkey,[6] the UK,[7] and New Zealand,[8] to 3.2% in Australia,[9] and as high as 11.8% in Nigeria.[10]

BOX 13 FIGO recommends abdominal hysterectomy as treatment for PPH when all other medical, nonsurgical, and surgical treatment modalities have failed to control PPH.

Care must be taken to have adequate blood supplies. Subtotal hysterectomy can shorten the procedure and is important in a hemodynamically unstable patient.

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11 | ASSESSMENT AND RESUSCITATION

11.1 | Damage control resuscitation in PPH

Hemorrhagic shock is the most frequent type of shock in obstetric patients.[1] Blood loss exceeding 40% of total blood volume leads to global hypoxia and metabolic acidosis.[2] These metabolic complications, accompanied by organ hypoperfusion, trigger an irreversible state of coagulopathy, bolstering hemorrhage and inducing multiple organ dysfunction and death.[3] The concept of damage control resuscitation (DCR) was first reported by trauma surgeons and its applicability has spread in traumatic and nontraumatic scenarios in general surgery, orthopedics, and obstetrics.[4] DCR consists of a series of strategies to minimize hemorrhage, prevent the deadly triad (coagulopathy, acidosis, and hypothermia), and maximize tissue oxygenation. This is achieved by a staged surgical approach that minimizes operative time, counteracting life-threatening conditions and deferring the definitive surgical procedures until normal physiology is restored at the intensive care unit (ICU).[5–7]

Efforts in DCR are focused on permissive resuscitation by blood product transfusion, use of massive blood transfusion protocols, limited use of crystalloids, bleeding control (including damage control surgery [DCS] and damage control interventional radiology [DCIR]), and physiological and biochemical stabilization in the ICU.[4–6] DCR is usually reserved for severely injured patients who may not survive the surgical efforts to achieve primary repair in the operating room.[4] It is evident that this approach can be considered only in higher-level care facilities where there is availability of experienced personnel with 24-h laboratory and blood bank services.

The most important aspects of DCS are described below. Hypotensive and hemostatic reanimation are discussed in sections 11.2.1 and 11.2.6, respectively.

11.1.1 | Decision for damage control surgery

Physiological and metabolic markers have been proposed to identify patients that could benefit from DCS.[4] Three parameters have been described in the literature as significant clinical indicators for early implementation of DCR and DCS[8]: acidosis (base deficit >8), blood loss >1500 ml, and hypothermia (temperature <35°C). Other important parameters to consider are systolic blood pressure <70 mm Hg, maternal blood pH <7.1, and persistent bleeding despite several transfusions (defined as 6 units of packed red blood cells by some authors[7] and >10 units by others[4]) (Table 9).

Continuous vital sign monitoring and serial monitoring with blood gas analysis and body temperature are recommended. Operative time and number of blood units transfused are also crucial for DCR decision-making.[4]

TABLE 9 Alternative indications for damage control surgery secondary to postpartum hemorrhage[a]

Indication
Systolic blood pressure <70 mm Hg
Body temperature <34°C
Maternal blood pH <7.1
Venous bleeding not suitable for surgical control
Persistent bleeding despite several transfusions of blood products (>10 units of PRBC)
Massive transfusion: 6 units of Red Blood Cells (during the first 4 h)
Increasing and continuous need for fluids due to active nonarterial bleeding
Hemodynamic instability, requiring persistent vasopressor support or that results in the development of ventricular arrhythmias
Coagulopathy resulting from a combination of hypothermia (temperature <35°C), acidosis (pH <7.3), and loss of coagulation factors
Duration of surgery >90 min

[a]Source: Carvajal et al. [4] and Pacheco et al. [7]. Adapted with permission.

11.1.2 | Bleeding control

After identifying eligible DCS patients, when medical and surgical conservative measures to control bleeding fail, a sequential four-phase approach should be performed.[4]

Initial laparotomy

The primary objective is hemorrhage control, which is achieved by an abdominal hysterectomy. The type of hysterectomy to be performed depends on the preference and expertise of the operator and the clinical condition of the patient; other factors such as age, cause of hemorrhage, hemodynamic stability, and pelvic anatomy must be considered.[9] According to several studies, there are no statistically significant differences between total and subtotal hysterectomy in terms of complications, blood transfusions, and ICU admission.[9–11] Subtotal hysterectomy has been associated with quicker hemorrhage control and shorter operative times, hence is the preferred approach over total hysterectomy.[9,11]

The bleeding site must be identified to pick the most suitable approach. When the bleeding is in the lower uterine segment, cervix, or vaginal fornices, a subtotal hysterectomy may not be the most effective approach for hemorrhage control since the arterial circulation of the cervix has a high blood flow rate and could cause bleeding persistence. In these cases, total hysterectomy is preferred.[9,10]

Operative time is a crucial determinant in patient survival. Prolonged operative time has been linked to adverse outcomes as it can institute an irreversible physiologic insult; thus, the need to keep operative time under 90 min.[4]

As in other surgical specialties, packing is the cornerstone of obstetric DCS.[4,7] Pelvic packing should be performed with at least 7–10 compresses, according to reported experience.[2,12] Aside from pelvic packing, temporary abdominal closure is performed alongside, as a complementary feature of the procedure. The latter can be achieved using a negative pressure system like vacuum pack or partial closure with a Viaflex bag (Bogota Bag) without the need for negative pressure.[2,12] Currently, there is neither consensus nor sufficient evidence regarding the use of prophylactic antibiotics in patients undergoing DCS with abdominal packing.[4] Several surgical guidelines recommend the administration of a single preoperative dose of broad-spectrum antibiotics, which theoretically should provide sufficient coverage for aerobic and anaerobic microorganisms.[4,13,14] Other experts suggest administration of prophylactic broad-spectrum antibiotics every 6–8 h until the abdominal packing is removed. Nevertheless, further studies are necessary to provide evidence-based recommendations in the obstetric population.[7]

Resuscitation – ICU

At this stage, the patient must be transferred to the ICU to address the physiologic derangements of the hemorrhagic patient: coagulation disorders and metabolic abnormalities.[6] Interdisciplinary care involving the obstetrician and critical care specialist is key for these patients as complications could arise at any time.[4] It is crucial to accurately quantify the accumulation of blood in the abdominal cavity. The optimal device to do so, after partial abdominal closure, is the vacuum pack, which allows a more precise quantification of bleeding during the postoperative period. In patients without coagulopathy, the drainage of >400 ml/h of blood through the vacuum pack represents an early indication for laparotomy.[4]

Definitive surgery

After restoring normal physiology, it is considered safe to review the abdominal cavity. Ideally, this should be performed 48–72 h after the initial surgical procedure.[4] Patients may require one or more surgical interventions, depending on the operative findings. In cases where further interventions are warranted, it is recommended to continue with techniques of temporary closure of the abdominal cavity.[15]

Definitive closure of abdominal wall and cavity

The final stage is the definitive closure of the abdominal wall, which is performed after all surgeries have been successfully completed and all additional damage has been repaired.[4]

11.1.3 | Complications

The majority of DCS complications depend on the time of closure of the abdominal fascia. It is important to consider that the number of reinterventions is directly related to a higher percentage of infectious complications, wound dehiscence, and abdominal wall closure problems.[16] The main complications include infection of the surgical wound in 28% of cases, presence of intra-abdominal collections in 20%, and evisceration in 10% of patients.[2] Implementation of prophylactic antibiotic therapy could counteract these complications, as it targets the polybacterial flora present in the female genital tract. An interdisciplinary approach could be required in case of complications derived from injuries secondary to the surgical procedure such as urinomas, perforations, or fistulas, among others.[17]

11.1.4 | Final objectives in resuscitation

DCR should be maintained as long as there are signs of bleeding and coagulopathy. A continuous assessment of the hemodynamic and physiological status of the patient is required. Monitoring several resuscitation parameters is essential until tissue hypoxia reverts. These parameters include pH, base deficit, lactate, hematocrit, and coagulation—ideally evaluated with conventional laboratory tests and point-of-care testing (POCT) of viscoelastic coagulation such as thromboelastography (TEG) and rotational thromboelastometry (ROTEM). In patients with a clinical trend toward improvement, the decision to perform definitive surgery is appropriate.[4]

BOX 14 FIGO recommends that damage control resuscitation (DCR) should be implemented in the management algorithms for major obstetric hemorrhage.

All countries should establish one or more referral hospital(s) and develop expert teams that are familiar with this strategy, the technique, and indications to be able to offer DCR.

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11.2 | Resuscitation

Once the shock has occurred in PPH, it is estimated that the mortality of patients will increase dramatically.[1–3] To mitigate metabolic complications, strategies such as hypotensive fluid resuscitation and transfusion protocols have been studied for hemostatic reanimation.

There are two strategies for fluid resuscitation in patients with hemorrhage: the aggressive approach and the hypotensive resuscitation approach. Aggressive resuscitation refers to the traditionally used strategy in which the key principle is restoring the effective circulating blood volume, and rapid normalizing of blood pressure with administration of large amounts of crystalloids.[2,4] Hypotensive resuscitation, also called permissive hypotension, consists of restrictive crystalloid resuscitation during the early stages of a hemorrhagic shock to maintain lower than normal systolic or mean blood pressure, sustaining organ perfusion until control of the bleeding occurs.[2,5]

In contrast, hemostatic reanimation is based on early and aggressive blood product replacement, transfusing red blood cells (PRBC), fresh frozen plasma (FFP), and platelets (PLT) in the same proportion as found in circulating blood to correct coagulopathy.[6–8] Hypotensive resuscitation and hemostatic reanimation are the fundamentals for DCR.[9,10]

11.2.1 | Hypotensive resuscitation

The concept of hypotensive resuscitation is because administering small crystalloid volumes reduces the risk of dilutional coagulopathy and maintaining a lower blood pressure is less likely to disintegrate the pre-formed blood clots. Aggressive resuscitation may worsen coagulopathy and hemorrhage by increasing intravascular hydrostatic pressures, diluting coagulation factors, and inducing more hypothermia, which results in deterioration of the triad of death.[4,10,11] Furthermore, an excessive rise in blood pressure could also result in higher red blood cell loss leading to more hypoxia and acidosis in tissues.[4,11]

11.2.2 | Intravenous fluids

Among the initial strategies for reanimation, the administration of crystalloids in small boluses of 500 ml is recommended.[10] Scientific evidence recommends the use of balanced crystalloid solutions such as Ringer's lactate owing to the risk of hyperchloremic acidosis and the worsening of kidney function with chlorine-rich fluids (saline solution).[7] This is particularly important for LMICs, where saline-based solutions are in abundance. After the administration of each bolus, physicians must assess the clinical status of patients, looking for an improvement in signs and symptoms of shock resulting from blood loss.[10]

11.2.3 | Targeted blood pressure

The difference between aggressive and hypotensive resuscitation lies within targeted blood pressure management.[4] Mean arterial pressure (MAP) represents the perfusion of the majority of organs, therefore providing the target for clinicians to guide fluid administration.[11] Hemorrhagic shock animal models have demonstrated a positive benefit in survival with MAP between 55–60 mm Hg during active bleeding.[10] The European guideline on management of major bleeding and coagulopathy following trauma recommends permissive hypotension with a systolic blood pressure target of 80–90 mm Hg (MAP 50–60 mm Hg) until major bleeding has been controlled (Recommendation Grade 1C).[12]

11.2.4 | Aggressive approach and adverse outcomes

During hemorrhagic shock the endothelial glycocalyx becomes thinner and administration of large amounts of crystalloids exacerbates this state, leading to fluid extravasation that may cause cerebral, cardiac, and pulmonary edema.[7,10,11] Third spacing may also lead to cardiac dysfunction, worsen hemodynamics, and decrease kidney perfusion. Decreased kidney perfusion occurs because of an increase in intra-abdominal pressure, which can additionally result in abdominal compartment syndrome.[7,11]

11.2.5 | Evidence

Several studies in trauma patients have demonstrated that hypotensive resuscitation is correlated with benefits to survival,

with significantly lower PRBC and amounts of fluid required; in addition, there is diminution in the occurrence of multiple organ dysfunction and acute respiratory distress syndrome.[2] Although recent evidence is mostly from trauma studies, a cohort study of women with PPH showed that the group that received lower amounts of fluids had fewer signs of shock with less blood product requirements.[13] In addition, the study showed that increased fluid administration leads to decreased concentrations of fibrinogen, hemoglobin, hematocrit, platelet count associated with prolonged prothrombin time, and partial thromboplastin time.[13] The study also demonstrated that administration of >4 L of fluids is associated with subsequent bleeding and adverse maternal outcomes.[14]

11.2.6 | Hemostatic resuscitation

Resuscitation in hemorrhage was classically focused only on the administration of fluids and PRBC. The use of FFP, PLT, and cryoprecipitate was delayed until coagulopathy was demonstrated in paraclinics.[7] Hemostatic resuscitation limits the use of crystalloids and involves early administration of blood products (not only PRBC), making massive transfusion protocols the cornerstone of resuscitation.[7,10]

11.2.7 | Transfusion ratios

In hemostatic resuscitation, PRBC, FFP, and PLT are applied in a 1:1:1 ratio due to the resemblance with whole blood and because a "high ratio" is related to fewer complications and better patient survival outcomes.[6,7,10,15] If PRBC is not available, then whole blood can be used instead in case of massive hemorrhage.

The strongest evidence for massive transfusions comes from the Prospective, Observational, Multicenter, Major Trauma Transfusion (PROMTT) and Pragmatic, Randomized, Optimal Platelet and Plasma Ratios (PROPPR) trials. The PROMTT study evidenced an improvement in mortality in the first 6 h for patients with high ratios of transfusion (<1:2 vs ≥1:1).[16] Moreover, a secondary analysis from PROMTT revealed that early administration of plasma (first 3 h and within the first 3–6 transfused units) was related to a decrease in mortality at 24 h and 30 days.[17] However, the PROPPR study demonstrated that patients transfused with a 1:1:1 ratio achieved hemostasis and suffered fewer deaths due to exsanguination at 24 h.[18]

11.2.8 | Fibrinogen and cryoprecipitate

In hemorrhages, fibrinogen is the first clotting factor to diminish its concentrations to critical levels, with values of <200 mg/dl considered an indication for component replacement.[7,10] Achieving specific fibrinogen levels is an important target during massive transfusion (at least 150–200 mg/dl in PPH).[7]

Sources for fibrinogen replacement are FFP, cryoprecipitate, and fibrinogen concentrates (which are not widely available). Because fibrinogen concentration in FFP is variable and relatively low, and its administration may dilute the existent fibrinogen, most fibrinogen replacement is done with cryoprecipitate.[12] A unit of cryoprecipitate contains 2 g fibrinogen for each 100 ml; thus, a unit of cryoprecipitate will increase serum fibrinogen by 10 mg/dl.[7] The usual dose of cryoprecipitate is 10 units, which is estimated to raise serum fibrinogen by 100 mg/dl.[7] Subsequent doses must be adjusted conforming to serum fibrinogen levels.

11.2.9 | Massive transfusion protocols

As the underlying physiological imbalance and clinical course in trauma seem similar to severe PPH, massive transfusion protocols with high ratios utilized for trauma may be useful for PPH.[19,20] Recommendations for ratios 1:1–1:2 for transfusions are different from previously proposed protocols with ratios of 6:4:1 or 4:4:1, as in the CMQCC Obstetric Hemorrhage Toolkit and from other obstetrics societies.[21] ACOG recommends administration of blood products in 1:1:1 ratio, mimicking whole blood replacement.[22]

Massive transfusion means requirements of ≥4 PRBC units (some articles considered ≥10 PRBC within 24 h), replacement of total blood volume within 24 h, or replacement of 50% of blood volume within 3 h.[10] The protocol for massive transfusion is specific at each institution, but some schemes have been suggested in the literature.

Once the massive transfusion protocol has been activated, the blood bank will send blood products in rounds to the operating or labor room. Each round has a specific number of PRBC, FFP, PLT, and cryoprecipitate units according to the protocol established in the institution.

Typical rounds consist of 6 units PRBC, 6 units FFP, 6 units PLT or 1 platelet apheresis, and 10 units of cryoprecipitate (Table 10).[7,23,24] Unless inactivated, the blood bank will prepare and send the products for rounds 2–4 successively, and if the patient continues bleeding the protocol will start again from round 1.[7]

TABLE 10 Massive transfusion protocol in obstetrics[a]

	PRBCs	FFP	Platelets	Cryoprecipitate
Round 1	6 U	6 U	6 U	10 U
Round 2	6 U	6 U	6 U	10 U
Round 3	Tranexamic acid 1 g intravenously over 10 min			
Round 4	6 U	6 U	6 U	

[a]Source: Pacheco et al. [7].

It is very important to notify the blood bank as soon as the transfusion requirements decrease to stop the preparation of blood products.[7]

11.2.10 | Adverse outcomes

Although early transfusions are lifesaving and in theory help to achieve hemostasis faster, thereby decreasing the number of blood products administered, the application of multiple units of blood products could be associated with a higher incidence of transfusion-related complications. These complications include hyperkalemia, hypocalcemia, citrate toxicity, transfusion-related immunomodulation, transfusion-related circulatory overload (TACO), transfusion-related kidney injury, transfusion-related acute lung injury (TRALI) (0.1 per 1000 units transfused), transfusion-related febrile nonhemolytic reactions (0.8 per 1000 units transfused), and acute hemolytic transfusion reaction (0.19 per 1000 units transfused).[22,24,25] Transfusion-related infectious diseases are uncommon (less than 1/100 000–1 000 000).[22,25]

BOX 15 FIGO recommends that all obstetricians are familiar with resuscitative measures in the context of PPH including massive transfusion protocols.

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12 | KEY STATEMENTS

1. Care bundles have been associated with improved patient outcomes when adherence is high. The goal of the PPH bundle is to reduce the frequency of severe hemorrhage and improve maternal outcomes. There is still a need for good-quality research to determine whether the bundle approach will ultimately make a difference in saving women's lives from PPH.
2. In recent years, new scientific evidence and the availability of new technologies have driven important reflections about PPH. To guarantee quality of guidelines it is important to update the evidence and base recommendations on the best quality studies available. It is also essential to stimulate production of new research on the key themes of PPH to reduce disparities among guidelines. PPH guidelines have helped improve the care of women around the world and their use should be stimulated in all scenarios.
3. The shock index indicator, defined as the ratio of heart rate to systolic blood pressure, is simple to use. It has better predictive ability than other vital signs because it detects acute changes in the maternal cardiovascular system and appears as an early marker to predict adverse outcomes.
4. Evidence continues to support oxytocin as the first-line drug in the prevention of PPH in all births.
5. Women with PPH should receive a fixed dose of 1 g tranexamic acid in 10 ml (100 mg/ml) intravenously (1 ml/min) as soon as possible after delivery and no more than 3 h after birth. A second dose of 1 g should be given intravenously if bleeding continues after 30 min or restarts within 24 h of the first dose. Tranexamic acid should be given in addition to usual treatments for the management of PPH including medical (uterotonics), nonsurgical, and surgical interventions, regardless of the cause of hemorrhage or the mode of delivery.
6. The nonpneumatic antishock garment (NASG) is an effective nonsurgical device that should be in every healthcare facility. The NASG, when used as a temporizing measure to recover hemodynamic stability in the context of PPH, decreases morbidity, mortality, and hypovolemic shock, and is of special importance in LMICs. While considerable research is still necessary to improve knowledge on implementation issues, professional associations and national and international guidelines should continue to encourage NASG use for refractory PPH management.
7. Uterine balloon tamponade (UBT) is an effective nonsurgical technique that when employed rapidly by a properly trained person with a proven device in the context of quality PPH care (the PPH bundle) improves survival of women with refractory PPH. National and international guidelines should include UBT use in the management of PPH.
8. Interventional radiology may be indicated for the prevention and treatment of PPH either before delivery, in cases of known placental abnormalities and implantation, or after delivery when the patient is hemorrhaging. Prophylactic catheterization of the uterine arteries, with embolization, can be considered an important therapeutic strategy that is safe and effective for reducing maternal and fetal morbidity and mortality by controlling blood loss.
9. Regardless of the compression suture chosen, obstetricians must first quickly recognize the onset of PPH, safely administer uterotonics, and place emergent compression sutures if needed. In the immediate postoperative period, women should be monitored for complications such as hematometra, pyometra, and uterine synechiae. Most important is the ability of the obstetrician to control bleeding using medical and surgical interventions, stabilize the mother, and reduce maternal morbidity.
10. PPH is a serious life-threatening obstetric emergency and early recognition of this condition results in better outcomes. In cases where medical treatment fails to control the bleeding, several surgical options exist. To date, no randomized controlled trials have assessed these techniques, nor compared the superiority of one to another, and all the data are based on case reports and case series. Moreover, the use of these methods largely depends on the facilities provided in each institution and on the care providers' skills and familiarity with the procedures. Hence, an effort should be exercised for better training of all care providers in these life-saving techniques. Future fertility rate following these procedures remains underassessed due to the lack of long-term follow-up for these cases. In the future, more research should target these surgical techniques to shy away from the more morbid procedures, thereby improving maternal and perinatal outcomes.
11. Damage control resuscitation (DCS) is a combination of resuscitation and surgical interventions with the purpose of restoring hemostasis and normal physiology. These techniques have proven to be applicable in obstetrics, with satisfactory results controlling refractory PPH and an overall decreased mortality of critically ill patients, especially in patients in whom conventional treatment can be linked to a high risk of failure. DCS is an available therapeutic approach for the management of severe PPH, thus proper training must be widespread to implement this technique.
12. Basic recommendations for resuscitation in PPH include administration of crystalloids in small boluses of 500 ml, checking clinical signs and looking for its improvement, and use of balanced crystalloid solutions such as Ringer's lactate, which is preferred over chlorine-rich solutions. The target blood pressure in hypotensive resuscitation is 80–90 mm Hg for systolic blood pressure or 50–60 mm Hg for mean blood pressure.
13. In hemostatic reanimation, fewer crystalloids are administered and, instead, transfusional replacement is started earlier with high ratios of transfusion (1:1:1). During massive transfusions, the target for serum fibrinogen is 150–200 mg/dl and the usual dose of cryoprecipitate is 10 units; it is estimated that these will raise the serum fibrinogen by 100 mg/dl. The protocol for massive transfusion is specific at each institution. Physicians should be familiar with their hospitals' protocol and recommendations.

14. Anyone who attends a birth can be taught simple home-based life-saving skills. The evidence-based prevention and management of PPH can be achieved with the use of relatively inexpensive drugs. Women should be monitored closely during the first hour after delivery of the baby and placenta, and accurate blood loss measurement should be implemented. Barriers and gaps can be addressed through providing an enabling environment through supportive policies, designing a formal plan for supplies, task shifting strategies, and use of guidelines and protocols for successful implementation.
15. Simulation training on how to manage PPH is encouraged, and each hospital should have a protocol on the management of PPH. OBGYN societies should lobby to have the essential medications that are needed to prevent and treat PPH readily available in all maternity centers.

13 | IMPLEMENTATION OF THE FIGO RECOMMENDATIONS BY HEALTH SYSTEMS AND NATIONAL SOCIETIES FOR THE MANAGEMENT OF POSTPARTUM HEMORRHAGE

1. FIGO must lobby and work with other international organizations to reduce maternal mortality and morbidity due to PPH.
2. FIGO recommends that all national societies work in collaboration with nurses and midwives to lobby with their respective regional and national organizations to promote and implement these recommendations.
3. All OBGYN societies in conjunction with other healthcare societies must endorse a strategy for effective prevention and treatment of PPH.
4. All national societies must lobby with their local national governments to establish a PPH bundle approach and make the medical supplies and surgical equipment needed for the management of PPH readily available in all regions of their countries.
5. All health systems are obligated to provide respectful care of the woman, the infant, and the associated family. Health systems must provide the appropriate and effective medications, water, oxygen, equipment, training, and transfer mechanisms to save the lives of women and newborns.

MEMBERS OF THE FIGO SAFE MOTHERHOOD AND NEWBORN HEALTH COMMITTEE, 2018–2021

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