Clinical Guidelines

Management of Postpartum Hemorrhage: A Comprehensive Review of Current Evidence and International Guideline Recommendations

Eka Rusdianto Gunardi

Abstract

Objective: To provide a comprehensive overview of contemporary evidence-based strategies for the prevention, diagnosis, resuscitation, and multidisciplinary management of postpartum hemorrhage, with emphasis on current international guideline recommendations and emerging therapeutic approaches.

Methods: A narrative review was conducted using data from the 2025 WHO consolidated guidelines, ACOG Practice Bulletin No. 183 and its 2025 Clinical Practice Update, the RCOG Green-top Guideline No. 52, and current UpToDate clinical topic reviews (literature review current through March 2026). Key randomized controlled trials, meta-analyses, and expert consensus statements were also evaluated.

Results: Management of PPH follows a structured and escalating approach. Initial interventions include quantitative assessment of blood loss, uterine massage, administration of oxytocin, and Early Tranexamic Acid (TXA) administration within three hours of hemorrhage onset. When first-line uterotonic therapy fails, second-line agents such as carboprost, methylergonovine, and misoprostol are recommended. Intrauterine hemorrhage-control devices, including balloon tamponade and vacuum-induced hemorrhage-control systems, may serve as bridges to interventional radiologic or surgical management. In cases of refractory hemorrhage, uterine artery embolization, uterine compression sutures (including BLynch, Hayman, and Pereira techniques), and ultimately peripartum hysterectomy may be required. Resuscitative endovascular balloon occlusion of the aorta (REBOA) has emerged as a potential adjunctive therapy for catastrophic hemorrhage. Additionally, fibrinogen monitoring and goal-directed transfusion strategies using viscoelastic testing may improve outcomes during massive transfusion management.

Conclusions: A multidisciplinary, protocol-driven approach to PPH management that integrates early pharmacologic intervention, minimally invasive procedures, and timely surgical escalation is essential for reducing maternal morbidity and mortality. Standardized obstetric hemorrhage bundles, quantitative blood loss measurement, and institutional massive transfusion protocols should be universally implemented to improve maternal outcomes.

Keywords: massive transfusion; postpartum hemorrhage; REBOA; tranexamic acid; uterine atony; uterine compression sutures; uterotonic agents.

INTRODUCTION

Postpartum haemorrhage (PPH) remains one of the leading causes of maternal morbidity and mortality worldwide and continues to represent a major global public health challenge.[1–4] Despite substantial improvements in obstetric care, haemorrhage accounts for approximately one-quarter of all maternal deaths globally, with the greatest burden occurring in low- and middle-income countries.[1,4] Delayed recognition, inadequate access to emergency obstetric care, insufficient blood product availability, and delayed escalation of treatment continue to contribute significantly to preventable maternal mortality.[5,6]

Traditionally, PPH has been defined as blood loss exceeding 500 mL after vaginal delivery or 1000 mL after caesarean delivery. However, contemporary definitions emphasize clinical consequences rather than strict blood volume thresholds alone. The American College of Obstetricians and Gynecologists (ACOG) defines PPH as cumulative blood loss of 1000 mL or greater, or bleeding associated with signs or symptoms of hypovolaemia within 24 hours after birth, regardless of delivery route.[2]

Maternal mortality review committees have repeatedly identified delayed recognition and delayed response to abnormal vital signs as major contributors to preventable deaths from obstetric haemorrhage.[5,6] Consequently, modern PPH management focuses not only on treatment but also on early warning systems, quantitative blood loss assessment, multidisciplinary haemorrhage bundles, and protocolized escalation of care.[1–6]

The shock index, calculated as heart rate divided by systolic blood pressure, has emerged as an important haemodynamic indicator for early identification of clinical deterioration.[7,8] Values above 0.9 are associated with increased morbidity and mortality, while higher values may indicate the need for massive transfusion activation and urgent intervention.[7,8]

The fundamental principles of PPH management are to recognize excessive bleeding early, identify the underlying cause using a systematic framework such as the 4 Ts (Tone, Tissue, Trauma, and Thrombin), and rapidly initiate evidence-based interventions according to the severity of haemorrhage.[1–4] This review summarizes current evidence and international guideline recommendations regarding the prevention, diagnosis, resuscitation, pharmacologic treatment, minimally invasive interventions, surgical management, transfusion strategies, and emerging therapies in PPH.

Definitions and Classification

Table 1. Classification of postpartum hemorrhage by international guidelines

Organization	Definition / Classification	Key Thresholds
WHO (2025)	Emphasizes objective quantitative blood loss measurement and clinical recognition of excessive bleeding.	Early first-response treatment bundle including uterotonics, TXA, fluids, and uterine massage.
ACOG (2017/2025)	Cumulative blood loss ≥1000 mL or bleeding with signs of hypovolemia within 24 hours, regardless of delivery route.	Standardized obstetric hemorrhage bundles and escalation protocols.
RCOG (GTG No. 52)	Minor PPH: 500–1000 mL; Major PPH: >1000 mL.	Uses the 4 Ts framework for etiologic assessment.
POGI (Indonesian Society of Obstetrics and Gynecology)	>500 mL after vaginal birth or >1000 mL after cesarean birth.	Active management of third stage of labour and structured escalation pathways.

Initial Assessment and Resuscitation

Vital Signs and Shock Index

Assessment includes evaluation of blood pressure, heart rate, respiratory rate, peripheral oxygen saturation, and urine output. The shock index (SI = HR/SBP) is a valuable haemodynamic indicator for early identification of haemodynamic instability in patients with postpartum haemorrhage.[7,8] In one study, an SI below 0.9 was considered reassuring, whereas an SI of 1.7 or greater required urgent intervention.7 The delta-SI (peak SI minus baseline SI) may be superior to heart rate or blood pressure alone for predicting the need for advanced intervention.[8] An SI of 1.143 or greater has been proposed as an appropriate threshold for early escalation, whereas an SI of 1.412 or greater may indicate severe haemodynamic compromise.[8]

Quantitative Blood Loss Assessment

The WHO strongly recommends objective quantitative assessment of blood loss rather than visual estimation alone.[1] Methods include graduated volumetric collection drapes, calibrated visual aids, and gravimetric measurement through weighing blood-soaked materials and subtracting dry weight.[1,4] Quantitative blood loss assessment facilitates earlier recognition of haemorrhage and more rapid intervention and is endorsed by WHO, ACOG, and RCOG guidelines.[1–4]

Fluid Resuscitation and Hemodynamic Support

Initial resuscitation follows trauma-based principles emphasizing rapid restoration of organ perfusion while avoiding excessive crystalloid administration.[2,4,22] Isotonic crystalloids are administered to maintain systolic blood pressure above 90 mmHg and urine output above 30 mL/hour.[2,4] Emerging evidence suggests that restrictive fluid strategies may be preferable to liberal crystalloid resuscitation because excessive crystalloid administration may worsen dilutional coagulopathy, tissue oedema, and hypothermia. Continuous monitoring of haematocrit, coagulation parameters, core temperature, and electrolyte balance, particularly calcium and potassium, is essential during large-volume resuscitation.

Table 2. Clinical Correlation of Blood Loss Volume with Signs and Symptoms.

Blood Loss (mL)	SBP (mmHg)	Signs and Symptoms
500–1000	≥90	Palpitations, lightheadedness, mild tachycardia
1000–1500	80–90	Weakness, sweating, tachycardia (100–120 bpm), tachypnea
1500–2000	70–80	Restlessness, confusion, pallor, oliguria, tachycardia (120–140 bpm)
2000–3000	50–70	Lethargy, air hunger, anuria, collapse, tachycardia (>140 bpm)

Pharmacological Management

First-Line Uterotonic: Oxytocin

Oxytocin remains the universal first-line uterotonic agent for prevention and treatment of postpartum haemorrhage.[1–4] Recommended regimens include 10 IU IM/IV for prophylaxis and 10–40 IU diluted in intravenous crystalloid solution for treatment of uterine atony.[1–4] Rapid intravenous administration of high-dose oxytocin may cause severe hypotension, tachycardia, myocardial ischaemia, and cardiovascular collapse; therefore, careful controlled infusion is recommended.[2,4]

Tranexamic Acid

Tranexamic acid (TXA) should be administered as early as possible after diagnosis of postpartum haemorrhage at a dose of 1 g IV infused over 10–20 minutes.[1,9] The WOMAN trial involving more than 20,000 women across 21 countries demonstrated that TXA significantly reduced death due to bleeding, particularly when administered within 3 hours after birth.[9] A subsequent individual patient-level meta-analysis demonstrated that treatment benefit declines progressively with delayed administration, with approximately 10% reduction in survival benefit for every 15-minute delay.10 Consequently, WHO recommends against initiation of TXA more than 3 hours after birth.1 Importantly, TXA administration was not associated with increased thromboembolic complications.[9,10]

Second-Line Uterotonics

Second-line uterotonic agents include carboprost, methylergonovine, and misoprostol.[1–4] Carboprost (15-methyl prostaglandin F2α) is administered intramuscularly at a dose of 0.25 mg every 15–90 minutes up to a maximum cumulative dose of 2 mg; however, it is contraindicated in patients with asthma.[2,4] Methylergonovine 0.2 mg IM may be repeated every 2–4 hours but should be avoided in women with hypertension, coronary artery disease, or Raynaud syndrome.[2] Misoprostol, typically administered sublingually at doses of 400–800 mcg, is particularly useful in low-resource settings where injectable uterotonics may not be available.[1]

Table 3. Uterotonic medications for management of postpartum hemorrhage

Agent	Dose / Route	Contraindications	Key Notes
Oxytocin (first-line)	10–40 IU in 500–1000 mL NS IV; or 5–10 IU IM	Rapid IV bolus (hypotension risk)	Max 40 IU/hour suggested
Tranexamic acid	1 g IV over 10–20 min; repeat at 30 min if needed	Known thromboembolic event in pregnancy; active intravascular clotting	Administer within 3 hours of birth onset; adjunctive agent
Carboprost (15-methyl-PGF2α)	0.25 mg IM every 15–90 min (max 2 mg / 8 doses)	Asthma	~75% respond to single dose; may inject into myometrium
Methylergonovine	0.2 mg IM; repeat every 2–4 hours	Hypertension, coronary/ cerebral artery disease, Raynaud syndrome	Never administer IV; move on quickly if first dose ineffective
Misoprostol (PGE1)	400–800 mcg SL (single dose); WHO suggests 800 mcg SL	None absolute; monitor for hyperthermia	Most useful where injectable uterotonics unavailable; fever risk dose-dependent

Transfusion and Coagulopathy Management

Fibrinogen: The Canary in the Coal Mine

Fibrinogen is the first coagulation factor to decrease to critically low levels during severe postpartum haemorrhage.[11] Normal fibrinogen concentrations during late pregnancy range from approximately 350–650 mg/dL.[11] A fibrinogen level below 200 mg/dL strongly predicts progression to severe haemorrhage and massive transfusion requirements.[9,10] Fibrin-based clot formation measured using viscoelastic and coagulation assays has also emerged as an early biomarker for progression of severe postpartum haemorrhage.[11] Early fibrinogen replacement guided by laboratory or viscoelastic testing may reduce progression of coagulopathy and improve outcomes.[11]

Surgical Management

Uterine Compression Sutures

The B-Lynch compression suture is the most widely used uterine-sparing surgical technique for severe uterine atony refractory to medical management.[12] The technique compresses the uterus mechanically while preserving fertility and has demonstrated high success rates in avoiding hysterectomy.[12] The Hayman modification avoids hysterotomy and is particularly useful following vaginal delivery.[13] The Pereira technique combines transverse and longitudinal subserosal sutures without entering the uterine cavity.[14] Reported complications such as uterine necrosis, synechiae, and pyometra are rare.[12–14]

Vascular Ligation

Bilateral uterine artery ligation (O'Leary stitch) is considered an effective and technically simpler alternative to internal iliac artery ligation for controlling persistent pelvic haemorrhage.[15] When uterine artery ligation alone is insufficient, ligation of the utero-ovarian arcade vessels may also be necessary.[15] Available evidence suggests that future menstrual function and fertility are generally preserved following these procedures.[16]

Minimally Invasive Interventions

Intrauterine Hemorrhage-Control Devices

When pharmacologic interventions are ineffective or only partially effective, intrauterine hemorrhage-control devices are deployed expeditiously. Three main approaches exist: balloon tamponade, intrauterine vacuum-induced devices, and gauze packing. The ACOG 2025 Clinical Practice Update refines guidance on these nonsurgical devices as crucial steps before escalation to laparotomy or hysterectomy. Continued blood loss despite device placement indicates failure and should prompt surgical or embolization intervention.

Uterine Artery Embolization

Selective uterine artery embolization performed by an interventional radiologist is appropriate for haemodynamically stable patients with persistent haemorrhage despite conservative management.[17] Embolization using temporary occlusive materials such as Gelfoam achieves haemorrhage control in approximately 90–97% of cases.[17] Disseminated intravascular coagulation is associated with an increased risk of embolization failure.[17] Menstrual and reproductive function generally recover after embolization, with minimal long-term reproductive impairment.[16]

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Peripartum Hysterectomy

Hysterectomy is the definitive treatment for uncontrolled uterine bleeding. Early resort to hysterectomy may be the least morbid approach in patients with placenta accreta spectrum or large uterine rupture. In contrast, atony can usually be controlled by uterotonic medications and fertility-preserving procedures. Approximately one-third of postpartum patients in shock will need hysterectomy to control hemorrhage. Surgery should not be delayed in patients with severe coagulopathy requiring prompt hemorrhage control.

Damage Control Surgery

Patients with persistent severe hemorrhage after hysterectomy can enter a lethal triad of hypothermia, coagulopathy, and metabolic acidosis. The damage control approach involves pelvic packing, temporary skin closure, active warming, and aggressive blood product resuscitation. The patient remains in the operating room until hemodynamically stable. Packing is typically removed at approximately 48 hours; removal before 24 hours risks re-bleeding, while leaving it beyond 72 hours increases infection risk.

Emerging Techniques: REBOA

Resuscitative endovascular balloon occlusion of the aorta (REBOA) is increasingly used to control catastrophic obstetric hemorrhage. The balloon catheter is placed in the aorta via the femoral artery and positioned below the renal arteries. Complete aortic occlusion at the distal thoracic aorta should be limited to 15 minutes; more distal occlusion is limited to 30–60 minutes. Technical improvements include partial balloon inflation (allowing continued reduced-pressure flow), ultrasound-guided placement without fluoroscopy, smaller catheter size (4F vs 7F), and prophylactic placement in high-risk patients. REBOA has shown promising results in placenta accreta spectrum management.

Emerging Techniques: REBOA

Resuscitative endovascular balloon occlusion of the aorta (REBOA) has emerged as a promising adjunctive therapy for catastrophic obstetric haemorrhage.[18] The balloon catheter is inserted via the femoral artery and positioned within the aorta to temporarily reduce distal blood flow and pelvic haemorrhage.[18] Complete occlusion times should be minimized to reduce distal ischaemic complications.[18] Prophylactic REBOA placement in patients with placenta accreta spectrum disorders has demonstrated promising reductions in blood loss and transfusion requirements.[19] Recent technical developments include smaller catheter systems, partial REBOA techniques, and ultrasound-guided insertion.[20] More recent evidence evaluating 4-French catheter systems has suggested improved procedural safety and feasibility in obstetric haemorrhage management.[25]

Transfusion and Coagulopathy Management

Massive Transfusion Principles

Blood product replacement takes priority over crystalloid infusion in massive hemorrhage. Before laboratory results are available, 2 units of RBCs are transfused if hemodynamics do not improve after 2–3 liters of saline. A reasonable empiric approach is 4 units RBCs followed by 4 units FFP, maintaining a 1:1 ratio until goal-directed therapy is possible. One platelet apheresis pack is transfused for each 4–6 units of RBCs.

Massive Transfusion Principles

In severe haemorrhage, blood product replacement takes priority over excessive crystalloid infusion.[21] Massive transfusion protocols generally emphasize balanced transfusion strategies using packed red blood cells, fresh frozen plasma, and platelets in approximately 1:1 ratios until laboratory-guided therapy becomes available.[21] Maintenance of normothermia, correction of hypocalcaemia, and serial monitoring of coagulation parameters are essential components of haemostatic resuscitation.[21]

Table 4. Minimum transfusion targets during active PPH

Parameter	Target
Hemoglobin	>7.5 g/dL
Platelet count	>50,000/mm³
Fibrinogen	>200 mg/dL (target >300 mg/dL with active bleeding)
Prothrombin time	<1.5× control value
aPTT	<1.5× control value
Ionized calcium	>1.0 mmol/L (replace empirically per 4 units RBC)

Viscoelastic Testing

Thromboelastography (TEG) and rotational thromboelastometry (ROTEM) provide rapid bedside assessment of global haemostasis and enable goal-directed transfusion therapy.[22] Viscoelastic-guided fibrinogen replacement strategies have been associated with reduced blood loss, decreased transfusion requirements, and reduced use of fresh frozen plasma in severe postpartum haemorrhage.[22] Early cryoprecipitate replacement and targeted coagulation management may further improve haemostatic control in severe PPH.[23] Recombinant activated factor VII has also been investigated as rescue therapy in refractory haemorrhage requiring escalation beyond conventional transfusion strategies.[24]

Stepwise Management Algorithm

The following table summarizes the recommended stepwise escalation approach to PPH management, integrating WHO, ACOG, RCOG and POGI recommendations:

Table 5. Stepwise escalation algorithm for PPH management

Stage	Blood Loss / Status	Interventions
Stage 1	500–1000 mL (vaginal) or >1000 mL (cesarean)	IV access (16–18G); fundal massage; oxygen administration; isotonic crystalloid resuscitation; increase oxytocin (max 40 IU); identify etiology (4 Ts); consider balloon tamponade; vitals every 5 min; QBL every 15 min
Stage 2	1000–1500 mL, ongoing bleeding	Second large-bore IV; prepare OR; stat labs (CBC, PT/PTT/INR, fibrinogen); type and crossmatch; transfuse RBCs per clinical signs; add second-line uterotonics (methylergometrine, carboprost, misoprostol)
Stage 3	>1500 mL, continued bleeding	Activate OB emergency; move to OR; TXA 1 g IV; initiate massive transfusion protocol; labs every 30 min; TEG/ROTEM if available; warm all fluids; consider embolization, compression sutures, or hysterectomy
Stage 4	Refractory to above; hemodynamic collapse	Aortic compression (manual or REBOA); laparotomy with uterine-sparing procedures or hysterectomy; damage control surgery with pelvic packing if needed; ICU transfer

Comparative Guideline Recommendations

Table 6. Comparison of key recommendations across WHO (2025), ACOG (2017/2025), RCOG (GTG No. 52), POGI (CPG 2016)

Domain	WHO	ACOG	RCOG	POGI
Prevention	Oxytocin 10 IU IM/IV for all births; carbetocin or misoprostol if oxytocin unavailable	Active management of third stage; standardized hemorrhage care bundles	Active management of third stage for all births	Active management of third stage for all deliveries; oxytocin IM preferred after vaginal birth; identify antepartum/intrapartum risk factors and optimize maternal Hb before delivery
Blood loss assessment	Quantitative measurement (strongly recommended)	Quantitative measurement (recommended)	Quantitative measurement encouraged; visual aids	Continuous assessment of blood loss, uterine tone, and hemodynamic status; close postpartum monitoring every 15–30 minutes in high-risk patients
TXA	1 g IV as part of first-response bundle; not after 3 hours	Recommended early in PPH management	1 g IV; administer early	1 g IV in the first 10 minutes: Tranexamic acid may be used as adjunctive therapy for PPH management

Surgical escalation	Bundles emphasizing simultaneous interventions	Sequential escalation; 2025 update emphasizes vacuum/balloon devices before laparotomy	Balloon tamponade → brace sutures → arterial ligation → hysterectomy	Uterine tamponade balloon → B-Lynch/compression sutures → uterine/internal iliac artery ligation → hysterectomy
Resuscitation	First-response treatment bundle (fluids + uterotonics + TXA + massage)	Massive transfusion protocol; hemorrhage carts	Balanced crystalloids initially; O-negative blood if group-specific delayed; keep patient warm	**RIMOT approach:** - Resuscitation IV access with two large-bore lines (14–16G), rapid isotonic crystalloid infusion, blood sampling for Hb/ coagulation/crossmatch, early blood product replacement (PRC, FFP, platelets, cryoprecipitate if indicated) Monitor blood pressure, pulse, urine output Oxygen administration Team approach (multidisciplinary management)

CONCLUSIONS

Postpartum hemorrhage remains a leading preventable cause of maternal mortality worldwide. Current WHO, ACOG, RCOG, and POGI guidelines emphasize similar key management principles, including early recognition, quantitative blood loss assessment, prompt uterotonic and tranexamic acid administration, stepwise escalation of interventions, and goal-directed transfusion strategies.[1-4,21-24] A multidisciplinary, protocol-driven approach supported by standardized haemorrhage bundles, institutional preparedness, and coordinated emergency response systems is essential to improve maternal outcomes and reduce preventable deaths from obstetric haemorrhage.[20,26-28]

Future Directions

Emerging developments in PPH management include the expanding role of REBOA, refinement of intrauterine haemorrhage-control devices, ROTEM/TEG-guided transfusion algorithms, and point-of-care fibrinogen testing to facilitate more rapid clinical decision-making.[18,19,22-25] Future research should focus on optimal fluid resuscitation strategies, comparative effectiveness of haemorrhage-control devices, whole blood transfusion in obstetric haemorrhage, and validation of obstetric-specific massive transfusion protocols.[21-25]

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