

# Peripartum Haemorrhage, Diagnosis and Therapy. Guideline of the DGGG, OEGGG and SGGG (S2k Level, AWMF Registry No. 015/063, March 2016)

## Peripartale Blutungen, Diagnose und Therapie. Leitlinie der DGGG, OEGGG und SGGG (S2k-Level, AWMF-Registernummer 015/063, März 2016)



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### Key words

peri-/postpartum haemorrhage, abnormally invasive placenta, uterine atony, surgical therapy, medical therapy, embolisation

### Schlüsselwörter

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### ABSTRACT

**Purpose** This is an official interdisciplinary guideline, published and coordinated by the German Society of Gynaecology and Obstetrics (DGGG), the Austrian Society of Gynaecology and Obstetrics (OEGGG) and the Swiss Society of Gynaecology and Obstetrics (SGGG). The guideline was developed for use in German-speaking countries and is backed by the German Society of Anaesthesiology and Intensive Medicine (DGAI), the Society of Thrombosis and Haemostasis Research (GTH) and the German Association of Midwives. The aim is to provide a consensus-based overview of the diagnosis and management of peripartum bleeding obtained from an evaluation of the relevant literature.

**Methods** This S2k guideline was developed from the structured consensus of representative members of the various

professional associations and professions commissioned by the Guideline Commission of the DGGG.

**Recommendations** The guideline encompasses recommendations on definitions, risk stratification, prevention and management.

## ZUSAMMENFASSUNG

**Ziel** Erstellung einer offiziellen interdisziplinären Leitlinie, publiziert und koordiniert von der Deutschen Gesellschaft für Gynäkologie und Geburtshilfe (DGGG), der Österreichischen Gesellschaft für Gynäkologie und Geburtshilfe (OEGGG) und der Schweizerischen Gesellschaft für Gynäkologie und Geburtshilfe (SGGG). Die Leitlinie wurde für den deutschsprachi-

gen Raum entwickelt und wird von der Deutschen Gesellschaft für Anästhesiologie und Intensivmedizin (DGAI), der Gesellschaft für Thrombose- und Hämostaseforschung (GTH) und dem Deutschen Hebammenverband mitgetragen. Das Ziel dieser Leitlinie ist es, durch die Evaluation der relevanten Literatur einen konsensbasierten Überblick über die Diagnostik und das Management der peripartalen Blutung zu geben.

**Methoden** Diese S2k-Leitlinie wurde durch einen strukturierten Konsens von repräsentativen Mitgliedern verschiedener Fachgesellschaften und Professionen im Auftrag der Leitlinienkommission der DGGG entwickelt.

**Empfehlungen** Es werden Empfehlungen zur Definition, Risikostratifizierung, Prävention und Management gegeben.

## I Guideline Information

### Guidelines programme of the DGGG, OEGGG and SGGG

Information on the guidelines programme is available at the end of the guideline.

### Citation format

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### Guideline documents

The complete long version (in German), a PDF slideshow for PowerPoint presentations and a summary of the conflicts of interest of all the authors is available on the AWMF homepage under: <http://www.awmf.org/leitlinien/detail/II/015-063.html>

### Guideline authors

The following professional and scientific societies/working groups/organisations/associations have stated their interest in contributing to the compilation of the guideline text and participating in the consensus conference and nominated representatives to attend the consensus conference (► **Table 1**).

► **Table 1** Authors and representativity of the guideline group: participation of the target user group.

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## Abbreviations

AAGBI	Association of Anaesthetists of Great Britain and Ireland
AFE	amniotic fluid embolism
AMSTL	active management of third stage of labour
aPTT	activated partial thromboplastin time
AT/AT III	antithrombin/antithrombin III
BGA	blood gas analysis
BMI	body mass index
BL	blood loss
BW	body weight
CMACE	Centre for Maternal and Child Enquiries
DDAVP	desmopressin
DIC	disseminated intravascular coagulation
ESA	European Society of Anaesthesiology
FFP	fresh frozen plasma
Hb	haemoglobin
HR	heart rate
Hct	haematocrit
IM	intramuscular
INR	international normalized ratio
IU	international unit
IUFD	intrauterine fetal death
IV	intravenous
MAP	mean arterial pressure
MRI	magnetic resonance imaging
NICE	National Institute for Health and Care Excellence
OAA	Obstetric Anaesthetists Association
OR	odds ratio
PCC	prothrombin complex concentrate
POC	point of care
PPH	postpartum haemorrhage
rFVIIa	recombinant factor VIIa
RBC	red blood cell concentrate
ROTEM	rotational thromboelastometry
RR <sub>sys</sub> /RR <sub>dia</sub>	RR systolic/RR diastolic
s/p	status post
TEG	thromboelastography
US	ultrasound
VET	viscoelastic test
WHO	World Health Organisation

## II Guideline Application

### Purpose and objectives

This aim of this guideline is to create an interdisciplinary (including anaesthesiologists and intensive care physicians, obstetricians, midwives, puerperal care nursing staff) management and treatment algorithm for the management of peripartum haemorrhage (diagnosis, risk selection, therapy).

The guideline was compiled to improve the knowledge of all persons involved in the care of pregnant women and women in childbed who experience or have an increased risk of haemorrhage.

The aim was to improve the care of affected patients and reduce problems in the management of PPH.

### Targeted areas of patient care

- Outpatient care
- Primary/specialised care
- Inpatient care

### Target user groups/target audience

This guideline is aimed at the following groups of people:

- gynaecologists/obstetricians in private practice (non-hospital based)
- hospital-based gynaecologists/obstetricians
- anaesthesiologists and intensive care physicians
- haemostasis specialists and lab clinicians
- interventional radiologists
- midwives
- nursing staff (surgery, anaesthesiology, intensive care unit, obstetrics/postpartum care)

### Adoption of the guideline and period of validity

The validity of this guideline was confirmed in September 2015 by the respective boards/representatives of the participating professional societies/working groups/organisations/associations, by the board of the DGGG and the DGGG Guideline Commission and by the SGGG and the OEGGG, which constitutes approval of the entire contents of the guideline. This guideline is valid from May 1, 2016 through to March 31, 2019. Because of the contents of this guideline, the above-mentioned period of validity is only an estimate. The guideline can be updated earlier if urgently required. Should the guideline continue to reflect the current level of scientific knowledge, then the guideline's period of validity can be extended.

## III Methodology

### Basic principles

The methodology used to compile this guideline is determined by the class assigned to the guideline. The AWMF Guidance Manual (version 1.0) has set out the respective rules and requirements. Guidelines are differentiated into lowest (S1), intermediate (S2) and highest (S3) class. The lowest class consists of a set of recommendations for action compiled by a non-representative group of experts. In 2004 the S2 class was divided into two subclasses: a systematic evidence-based (S2e) subclass and a structural consensus-based subclass (S2k). The highest S3 class combines both approaches.

This guideline is classified as: **S2k**

## Grading of recommendations

The grading of evidence and the grading of recommendations was not envisaged for S2k class guidelines. Individual statements and recommendations are differentiated by syntax, not by symbols (► **Table 2**).

► **Table 2** Grading of recommendations.

Description of grade of recommendation	Syntax
Strong recommendation, highly binding	must/must not
Recommendation, moderately binding	should/should not
Open recommendation, not binding	may/may not

The above classification of **recommendations** reflects the evaluated evidence and the clinical relevance of the studies on which the recommendations are based and various measures/factors which did not appear in the grading of evidence, such as the choice of patient population, intention-to-treat or per-protocol-outcome analyses, medical or ethical behaviour towards patients, country-specific application, etc.

## Statements

Expert statements included in this guideline which are not recommendations for action but simple statements of fact are referred to as **statements**. It is not possible to provide a level of evidence for these statements.

## Achieving consensus and level of consensus

During structured consensus-based decision-making (S2k/S3 level), the authorised representatives present at the respective session vote on draft Statements and Recommendations. Discussions during the session may lead to significant changes in the wording of Statements and Recommendations. At the end of the session, the extent of agreement (level of consensus) is determined based on the number of participants (► **Table 3**).

► **Table 3** Classification of extent of agreement in consensus decision-making.

Symbol	Level of consensus	Extent of agreement in percent
+++	Strong consensus	> 95% of participants agree
++	Consensus	> 75–95% of participants agree
+	Majority agreement	> 50–75% of participants agree
–	No consensus	< 50% of participants agree

## Expert consensus

As the name implies, this refers to consensus decisions taken with regard to specific Recommendations/Statements without a previous systematic search of the literature (S2k) or when evidence is lacking (S2e/S3). The term “Expert Consensus” (EC) used here is synonymous with the terms “Good Clinical Practice” (GCP) and “Clinical Consensus Point” (CCP) used in other guidelines. The level of recommendation is graded as previously described in the Chapter Grading of recommendations but only semantically (“must”/“must not” or “should”/“should not” or “may”/“may not”) and without using symbols.

# IV Guideline

## 1 Introduction

The incidence of postpartum haemorrhage (PPH) is continually increasing [1–5], mostly because of the increase in uterine atony and disorders of placental implantation and increased rates of surgical vaginal delivery and Caesarean sections and the consequent increase in primary blood loss and, in the case of Caesarean section, the increased PPH rates in subsequent pregnancies [2,6–11].

In the western world, life-threatening postpartum haemorrhage occurs in approximately 2 of 1000 births and severe maternal morbidity occurs in around 3 of 1000 births [12–22]. PPH is

► **Table 4** The 4 Ts: causes of PPH [6, 16, 30–32].

Tone (uterine atony)	<b>Uterine distension</b> (multiparity, polyhydramnios, fetal macrosomia) Tocolytics Precipitate labour or prolonged labour (Prolonged) oxytocin augmentation Chorioamnionitis Uterine fibroids
Tissue (placenta)	Retained placenta <b>Abnormally invasive placenta</b> (morbidly adherent placenta, placenta accreta/increta/percreta) Placental remnants
Trauma	Vulvovaginal injury Cervical tear Episiotomy/perineal tear Uterine rupture Uterine inversion
Thrombin (coagulopathy)	<b>Pregnancy-induced:</b> Thrombocytopenia (HELLP syndrome, disseminated intravascular coagulation [DIC]) (e.g. in pre-eclampsia, intrauterine fetal death [IUFD], placental abruption, amniotic fluid embolism) <b>Other:</b> von Willebrand disease, plasmatic coagulopathies, thrombopathy, coagulation factor deficiencies (loss, consumption, dilution)

the cause of approximately 30% of all maternal deaths in the Third World and 13% of maternal deaths in industrialised countries [21].

The majority of maternal deaths from PPH could be avoided; major substandard care was present in 60–80% of all cases [1, 20, 21, 23–25]. What is especially alarming is that a visual estimation of blood loss during delivery results in the extent of bleeding being underestimated by 30–50% [26–29].

In Britain and America, the causes of PPH have been summarized as the “4 Ts”. (Combinations of these causes are the rule.) (► **Table 4**).

The main risk management problems in the management of PPH are [1, 24, 33, 34]:

- Delayed diagnosis and/or therapy due to underestimation of the actual amount of blood lost
- Delayed provision of blood or coagulation products
- Lack of or failure to follow simple instructions
- Lack of adequate training or advanced training
- Poor communication within the interdisciplinary team
- Deficits in the organisational structure
- Delay in initiating treatment standards

## 2 Definitions

Consensus-based Recommendation 2.E1	
Expert consensus	Level of consensus +++
The following definition of PPH is proposed (for German-speaking areas):	
<ul style="list-style-type: none"> <li>▪ Blood loss of <math>\geq 500</math> ml following vaginal delivery</li> <li>▪ Blood loss of <math>\geq 1000</math> ml following Caesarean section</li> </ul>	

## 3 Risk Stratification and Prevention

A complete and detailed patient history, ultrasound examination during antenatal appointments, assessment of the patient's risk of bleeding, presentation to the maternity hospital, and preparations for increased blood loss could reduce patients' risk of PPH [35].

Consensus-based Recommendation 3.E2	
Expert consensus	Level of consensus +++
Location and structure of the placenta must be documented during ultrasound examination in the 2nd trimester. If necessary, patients with low-lying placenta should undergo an additional ultrasound scan to screen for vasa praevia and the findings should be documented [36].	

Consensus-based Recommendation 3.E3	
Expert consensus	Level of consensus +++
An implantation disorder should be considered in women with a high-risk history (previous operations) or findings (placenta praevia) which indicate high risk.	

### 3.1 Risk stratification and risk factors which facilitate peripartum/postpartum haemorrhage (► **Table 5**)

► **Table 5** Risk factors for PPH [16, 23, 37–39].

	Odds ratio or range	
	> 500 ml	> 1000 ml
Blood loss		
Sociodemographic risk factors		
▪ obesity (BMI > 35)	1.6	
▪ maternal age ( $\geq 30$ years)	1.3–1.4	1.5
Obstetric risk factors		
▪ placenta praevia	4–13.1	15.9
▪ premature placental separation	2.9–12.6	2.6
▪ retained placenta	4.1–7.8	11.7–16.0
▪ prolonged expulsion of the placenta	7.6	
▪ pre-eclampsia	5.0	
▪ grand multiparity	2.3–4.5	2.6
▪ s/p PPH	3.0–3.6	
▪ fetal macrosomia	1.9–2.4	
▪ HELLP syndrome	1.9	
▪ Polyhydramnios	1.9	
▪ (prolonged) oxytocin augmentation	1.8	
▪ labour induction	1.3–2	2.1–2.4
▪ protracted labour	1.1–2	
Surgical risk factors		
▪ emergency Caesarean section	3.6	
▪ elective Caesarean section	2.5	
▪ operative vaginal delivery	1.8–1.9	
▪ episiotomy	1.7–2.21	2.07
▪ perineal tear	1.7	2.5
Other risk factors		
▪ antepartum haemorrhage	3.8	
▪ von Willebrand disease	3.3	
▪ anaemia (< 9 g/dl)	2.2	
▪ fever during delivery	2	

Other risk factors include precipitous birth, high maternal parity, fibroids and uterine malformations [39].

**Caution:** The majority of patients who develop PPH do not have identifiable risk factors [39].

### 3.2 Sonographic risk stratification (placental disorders)

Consensus-based Recommendation 3.E4	
Expert consensus	Level of consensus +++
Patients with suspected abnormally invasive placenta must present early to a suitable maternity hospital where they must be treated by a multidisciplinary team (“by the best team at an optimal point in time”) [20, 40].	

The diagnostic value of MRI has not yet been convincingly demonstrated in these cases [41, 42], but MRI examination could provide additional information when findings are ambiguous [42, 43].

### 3.3 Prevention

#### 3.3.1 Active management of third stage of labour

##### 3.3.1.1 Active management after vaginal delivery

Consensus-based Recommendation 3.E5	
Expert consensus	Level of consensus +++
After the infant has been born and commenced breathing, oxytocin (Syntocinon® 3–5 IU slow IV infusion) must be administered for PPH prevention [44].	

Consensus-based Recommendation 3.E6	
Expert consensus	Level of consensus ++
Immediate clamping of the umbilical cord at birth and controlled cord traction have no impact on reducing postpartum haemorrhage and should not be carried out.	

##### 3.3.1.2 Prevention of PPH during Caesarean section

Consensus-based Recommendation 3.E7	
Expert consensus	Level of consensus +++
PPH prophylaxis must be administered as in vaginal delivery.	

Prophylaxis can consist of administering either oxytocin (Syntocinon® 3–5 IU by short infusion [or slow IV infusion]) or carbetocin (Pabal® 100 µg) by short infusion or slow IV infusion.

#### 3.3.2 If risk factors are present

Consensus-based Recommendation 3.E8	
Expert consensus	Level of consensus +++
If risk factors are present, the following measures must be taken:	
<ul style="list-style-type: none"> <li>▪ Adequate venous access for every woman in labour, adequate intravenous access in case of complications of bleeding</li> <li>▪ Uterotonics must be available (oxytocin, e.g. Syntocinon®), prostaglandins (e.g. sulprostone: Nalador®), misoprostol (Cytotec®, off-label use)</li> <li>▪ Check logistics:               <ul style="list-style-type: none"> <li>– Check availability of emergency laboratory tests (complete blood count, blood gas analysis [BGA], aPTT, prothrombin time [PT] or INR, antithrombin [AT], fibrinogen, possibly thromboelastography or thromboelastometry [ROTEM])</li> <li>– Obstetrician and anaesthesiologist must be on site, experienced obstetrician and experienced anaesthesiologist on call</li> <li>– Check availability of blood products: cross-matching, ordering of packed red blood cells, fresh frozen plasma and platelets</li> <li>– Check availability of haemostatic agents (tranexamic acid [Cyclokapron®], fibrinogen [Haemocomplettan®], factor XIII [Fibrogammin®], recombinant activated factor VIIa [rFVIIa, NovoSeven®, off-label use]).</li> </ul> </li> </ul>	

## 4 Management of PPH

Consensus-based Statement 4.S1	
Expert consensus	Strength of consensus +++
Alongside general interventions (such as stabilising the patient's haemodynamic status), causal treatment of PPH includes medical therapy and/or surgical procedures that must be performed quickly, in a coordinated and often simultaneous manner [45–47].	

### 4.1 Procedures

- Measure blood loss! (Caution: blood loss in bandages, etc.)
- Rapid diagnosis of the cause of bleeding (4 T's):
  - Estimation of uterine tone
  - Check whether placenta is complete (ultrasound, manual or instrumental examination)
  - Exclude vulvovaginal trauma by speculum examination
  - Administer uterotonics (in case of atony) and tranexamic acid to treat critical blood loss
  - Uterine compression
- Call in anaesthesiologist (multidisciplinary team) at an early stage
- Drug therapy and/or surgical procedures, depending on the cause of bleeding
- Control vital signs, consider timely invasive monitoring
- Initial volume substitution to maintain normovolaemia: crystalloids, in exceptional cases (e.g. acute haemorrhage and haemodynamic instability) colloidal solutions [48]
- Cross-matching of blood, emergency laboratory tests (incl. full blood count, coagulation)
- Order packed red blood cells and fresh frozen plasma, provide blood products if required (delivery room, operating theatre)
- Coagulation factors, especially fibrinogen
- Other haemostatic agents (e.g. desmopressin), factor XIII or rFVIIa if necessary
- Intensive monitoring of patient during hospital stay, consider invasive monitoring
- Timely surgical intervention when conservative measures fail (see below for appropriate procedures)

#### Measuring blood loss

One of the cardinal problems which occur not only when defining but primarily when diagnosing and treating PPH is that the extent of postpartum blood loss is rarely measured and is **known to be underestimated by 30–50% if assessment is done on a purely visual basis** [35, 49].

Consensus-based Recommendation 4.E9	
Expert consensus	Level of consensus +++
Collecting all blood-soaked pads, bedding, linens and significant coagulum is strongly recommended.	

## 5 General (Emergency) Measures and Diagnosis to Determine Causes of PPH

### 5.1 Atony

- **Diagnosis:** increased fundal height; soft slack uterus; usually intermittent heavy bleeding.
- Void the bladder!
- Mechanical procedures: uterine massage (endogenous prostaglandin formation), bimanual uterine compression (e.g. Hamilton's manoeuvre)
- Exclude vulvovaginal trauma (by speculum examination and abdominal US if necessary)
- Exclude retained placenta (examine the placenta to ensure it is complete, sonography)

Consensus-based Recommendation 5.E10	
Expert consensus	Level of consensus +++
<b>Therapy:</b> After vaginal delivery <ul style="list-style-type: none"> <li>▪ uterotonics, tranexamic acid if required</li> <li>▪ careful curettage in the delivery room or operating theatre if retained placenta is suspected</li> <li>▪ uterine tamponade if required</li> <li>▪ other surgical procedures</li> <li>▪ consider embolisation</li> </ul> After caesarean section <ul style="list-style-type: none"> <li>▪ uterotonics, tranexamic acid if required</li> <li>▪ surgical procedures</li> </ul>	

### 5.2 Implantation disorders

The management of abnormally invasive placenta depends on the time of diagnosis and type of delivery.

#### Approach for antenatal diagnosis

If an advanced implantation disorder (placenta increta, percreta) is diagnosed in the antenatal period, delivery must always be by Caesarean section.

- Extensive findings: Caesarean section with hysterectomy; alternatively, consider expectant management (e.g. delayed delivery of placenta)
- Focal findings: partial resection of the uterine wall
- If necessary carry out interventional radiology with prophylactic occlusion of the internal iliac arteries [50, 51]

#### Approach for intrapartum diagnosis

- Vaginal delivery:
  - If the placenta fails to separate and bleeding is present: carry out manual separation of the placenta followed by curettage with intraoperative ultrasound monitoring, if required [52]
  - If severe bleeding from the placental bed persists: carry out surgical therapy, alternatively embolisation of the uterine arteries
- Caesarean section:
  - Do not manipulate the placenta or attempt to separate it manually
  - Perform Caesarean section with hysterectomy or alternatively consider expectant management (e.g. delayed delivery of placenta)

Consensus-based Recommendation 5.E11	
Expert consensus	Level of consensus ++
<b>Therapy:</b> After vaginal delivery <ul style="list-style-type: none"> <li>▪ uterotonics, tranexamic acid if required</li> <li>▪ if necessary, manual separation of the placenta followed by curettage</li> <li>▪ if necessary, uterine tamponade as a bridging procedure</li> <li>▪ laparotomy and other surgical measures</li> <li>▪ possibly embolisation</li> </ul> After Caesarean section <ul style="list-style-type: none"> <li>▪ uterotonics, tranexamic acid if required</li> <li>▪ surgical measures</li> <li>▪ consider embolisation</li> </ul>	

### 5.3 Uterine inversion

Consensus-based Recommendation 5.E12	
Expert consensus	Level of consensus ++
<b>Therapy:</b> The goal is the reposition of the uterus and treatment of the symptoms of haemorrhagic shock. The following procedures must be carried out immediately after making the diagnosis in the order stated below: <ul style="list-style-type: none"> <li>▪ Stop administration of any uterotonic drug</li> <li>▪ Call in experienced obstetrician and anaesthesiologist               <ul style="list-style-type: none"> <li>– Ensure adequate intravenous access, volume substitution</li> <li>– Make no attempt to remove the placenta (higher blood loss); the placenta must, where possible (placenta accreta), only be removed after repositioning [53, 54]</li> <li>– Attempt to reposition the fundus (Johnson's manoeuvre)</li> </ul> </li> <li>▪ If attempts at repositioning are unsuccessful, administer uterine relaxants (e.g. nitroglycerin 50 µg IV, betamimetics) and repeat the attempt to reposition the uterus with Johnson's manoeuvre</li> <li>▪ If repositioning attempts continue to be unsuccessful → perform laparotomy and Huntington's procedure, simultaneously with Johnson's manoeuvre if necessary; if attempts are still unsuccessful, perform the Haultain procedure</li> <li>▪ Administer uterotonics (e.g. oxytocin) after successful repositioning</li> <li>▪ Provide antibiotic protection (e.g. cephalosporin or clindamycin)</li> </ul>	

## 6 Medication and Surgical Measures to Treat PPH

### 6.1 Uterotonics

#### 6.1.1 Oxytocin (Syntocinon®) IV (IM if necessary)

Consensus-based Recommendation 6.E13	
Expert consensus	Level of consensus +++
A maximum of 6 IU undiluted oxytocin can be administered slowly and intravenously: <ul style="list-style-type: none"> <li>▪ 3–5 IU (1 vial) in 10 ml NaCl 0.9% as a single (slow intravenous!) bolus</li> <li>▪ If necessary, this can be followed by 10–40 IU oxytocin in 500–1000 ml saline as a continuous infusion (dose depends on the clinical situation, particularly the impact on uterine tone) [16, 55].</li> </ul>	

The onset of action after IV administration (half-life of 4–10 min) is less than one minute or 3–5 minutes following intramuscular administration (maximum 10 IU).

### 6.1.2 Carbetocin (Pabal®)

The use of carbetocin to treat PPH is currently not yet been sufficiently investigated. The use of carbetocin to treat PPH has been reported in individual cases.

### 6.1.3 Methylergometrine (Methergin®)

Consensus-based Recommendation 6.E14	
Expert consensus	Level of consensus +++
Given the range of serious side effects and the fact that better alternatives are available, the utmost caution is advised when administering methylergometrine to manage postpartum haemorrhage.	

Consensus-based Recommendation 6.E15	
Expert consensus	Level of consensus ++
Methylergometrine should not be administered as an intravenous bolus.	

### 6.1.4 Prostaglandins

Consensus-based Recommendation 6.E16	
Expert consensus	Level of consensus +++
If first-line uterotonics are not effective and patients do not respond to first-line uterotonics, prostaglandins must be administered immediately [56].	

Consensus-based Recommendation 6.E17	
Expert consensus	Level of consensus +++
Oxytocin receptor agonists and prostaglandins must not be administered simultaneously.	

Consensus-based Statement 6.S2	
Expert consensus	Level of consensus ++
<p><b>Note:</b></p> <p>Postpartum uterine atony and uterine haemorrhage are life-threatening pathologies and an urgent indication for the administration of prostaglandin derivatives if no other alternatives are available or oxytocin is not effective, until patients can receive obstetric/gynaecological treatment. In this situation the side effects and contraindications must be carefully considered (benefits and drawbacks weighed up). Close haemodynamic monitoring is necessary when prostaglandin derivatives are administered.</p>	

#### 6.1.4.1 Sulprostone (Nalador®)

##### Dosage:

- 1 vial = 500 µg in 500 ml solution administered via an infusion pump
- Initial dose: 100 ml/h, up to a maximum of 500 ml/h if required
- Maintenance dose: 100 ml/h
- Maximum dose 1000 µg/10 hours (2 vials)
- Maximum daily dose 1500 µg (3 vials)

#### 6.1.4.2 Misoprostol (Cytotec®)

**Dosage:** 800–1000 µg misoprostol administered rectally or 600 µg administered orally [57–60].

A Cochrane meta-analysis showed that oxytocin infusion was more effective as a first-line therapy than the administration of misoprostol and additionally had fewer side effects. When used after prophylactic uterotonics, misoprostol and oxytocin were equally effective [61].

Consensus-based Statement 6.S3	
Expert consensus	Level of consensus +++
<p><b>Note:</b></p> <p>Because of its delayed onset of action and the availability of better and approved alternatives, misoprostol is not suitable to treat persistent PPH. The use of misoprostol to treat moderately persistent PPH after the administration of oxytocin may be considered (off-label use!). However, the current data is still insufficient to make a final recommendation.</p>	

Consensus-based Statement 6.S4	
Expert consensus	Level of consensus +++
<p><b>Note:</b></p> <p>Postpartum uterine atony and uterine haemorrhage are life-threatening pathologies and the administration of misoprostol is urgently indicated if no other alternatives are available, until patients can receive obstetric/gynaecological treatment. In this context the side effects and contraindications must be carefully considered (benefits and drawbacks weighed up). Close haemodynamic monitoring is essential when misoprostol is administered.</p>	

#### 6.1.4.3 Intrauterine application of prostaglandins

Consensus-based Statement 6.S5	
Expert consensus	Level of consensus +++
The intramyometrial application of sulprostone (e.g. to the uterine fundus in cases with caesarean section) is contra-indicated [56].	

## 7 Uterine Tamponade

The objective of uterine cavity tamponade is twofold: to treat PPH (i.e., to achieve definitive haemostasis) and as a “bridging” measure (i.e., to achieve temporary haemostasis and haemodynamic stabilisation and allow other measures [surgical or interventional radiology] to be put in place) [62–64]. In addition to other second-line treatment strategies, uterine tamponade can significantly reduce the rate of emergency hysterectomies [65, 66].

In addition to tamponade strips, there are a number of different balloon tamponade systems available for uterine tamponade; their efficacy has been described in various publications and their use has the advantage of allowing the early detection of persistent bleeding [64, 67–73].



**Consensus-based Recommendation 7.E18**

Expert consensus	Level of consensus ++
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- Parallel administration of uterotonics
- Vaginal examination/ultrasound (to exclude trauma, retained placenta, clot evacuation)
- Bladder catheter
- Use a liquid (0.9% saline, body temperature if possible) to fill the balloon tamponade – NOT air
- Additional vaginal tamponade
- Intensive monitoring, antibiotic prophylaxis
- Can be left in utero for up to 24 hours

There has been a recent report on the use of a special gauze (Celox®) coated with a haemostatic agent (chitosan), originally developed for emergency treatment and military combat medicine, to successfully manage PPH [74].

**Consensus-based Recommendation 7.E19**

Expert consensus	Level of consensus ++
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Uterine tamponade – in whatever form – does not preclude other necessary therapeutic options, such as compression sutures [64, 75]; the use of compression sutures is strongly recommended, particularly to treat atony [75–78].

## 8 Surgical Measures (Compression, Devascularisation, Hysterectomy) and Embolisation

### 8.1 Bridging procedures

**Consensus-based Recommendation 8.E20**

Expert consensus	Level of consensus ++
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In the event of the lethal triad consisting of persistent haemorrhage, haemorrhagic shock and coagulopathy, the following three-stage approach is recommended [62]:

- Early surgical haemostasis carried out by the attending surgical obstetrician using a Pfannenstiel incision or median laparotomy, eventration of the uterus with cranial traction and uterine compression, and atraumatic clamping of the uterine arteries to minimise perfusion. Placement of uterine compression sutures and application of a uterine tamponade.
- Parallel correction of hypovolaemia, temperature, disturbed acid-base balance and coagulopathy by the anaesthesiologist; if possible, surgery should then be paused until stabilisation.
- Definitive (surgical) treatment of the now haemodynamically stable patient by a surgeon with the appropriate surgical expertise. If the necessary infrastructure is available, option to perform interventional radiological embolisation of afferent uterine arteries [79, 80]. The benefit of this approach is that it can preserve fertility, as has been described for large case series [81–84].

### 8.2 Uterine compression sutures

The aim of these sutures is to compress the uterus, reduce the placental adhesion area and tamponade the bleeding site. This approach is indicated for uterine bleeding after vaginal delivery or following Caesarean section. At present it is not possible to say anything about the optimal efficacy of specific types of sutures. All of the employed methods had high success rates in terms of preventing hysterectomy which would otherwise have been necessary. The choice of the appropriate suture method depends on the indication (atony, bleeding from the placental bed, diffuse bleeding) [85].

**Consensus-based Recommendation 8.E21**

Expert consensus	Level of consensus +++
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Suitable suture materials (large needles, long suture threads) must be kept in readiness in the operating theatre.

### 8.3 Vascular ligatures

In addition to simple ligature of the uterine artery [86] stepwise uterine devascularisation can also be used for haemostasis. The technique consists of 5 consecutive steps to ligate the ascending and descending branches of the uterine arteries and the ovarian arterial collaterals [87, 88].

**Consensus-based Recommendation 8.E22**

Expert consensus	Level of consensus +++
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Ligature of the internal iliac artery must only be carried out as a last resort and only by a surgeon with extensive experience of pelvic surgery.

### 8.4 Postpartum hysterectomy

**Consensus-based Recommendation 8.E23**

Expert consensus	Level of consensus +++
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Conservative measures to preserve the uterus are only useful if the patient is haemodynamically stable and does not have life-threatening bleeding [89, 90]. The decision that hysterectomy is indicated must not be delayed or left too late.

**Consensus-based Recommendation 8.E24**

Expert consensus	Level of consensus +++
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Supracervical hysterectomy is the procedure of choice for atony, as the operating time is significantly shorter and the operation does not lead to unintended vaginal shortening. Total hysterectomy should be considered for placental implantation disorders of the lower uterine segment; visualisation of the ureters during this procedure is recommended.

**Relative contraindications for uterus-preserving measures are:**

- Extensive abnormally invasive placenta (placenta increta/percreta) where the placental implantation bed is open, bleeding from the placental implantation bed is resistant to treatment or the implantation bed covers large areas of the uterine wall.
- Non-reconstructable uterine injury
- Septic uterus

Consensus-based Recommendation 8.E25	
Expert consensus	Level of consensus ++
During the bridging time to definitive treatment, (bimanual) compression of the aorta for up to 20 minutes may be carried out to avoid unnecessary blood loss [91, 92]. If it is clear that the haemorrhage cannot be controlled by hysterectomy or is continuing even though hysterectomy has been carried out, the lesser pelvis and abdomen should be packed with sufficient moistened abdominal cloths.	

**8.5 Arterial catheter embolisation**

Consensus-based Recommendation 8.E26	
Expert consensus	Level of consensus +++
Every obstetric department should ascertain whether arterial catheter embolisation can be performed in their facility and the time it takes for this method to be available and then create the organisational structure which will determine at what point the patient should be transferred to the interventional radiology department. The precondition for transfer is that the patient is haemodynamically stable and does not have massive bleeding.	

Consensus-based Recommendation 8.E27	
Expert consensus	Level of consensus ++
If catheter embolisation is available on site, the radiologist should be notified early (e.g. when an attempt at haemostasis using uterine compression sutures is unsuccessful). Because of the range of side effects, medical and surgical treatment options should be largely exhausted. The time of transfer to the radiology department is also determined by how important it is to preserve the uterus.	

Consensus-based Recommendation 8.E28	
Expert consensus	Level of consensus +++
Before the patient is transferred, intra-abdominal packing should be considered as a bridging procedure if the patient has just undergone a hysterectomy procedure to prevent a critical loss of blood during transportation and contain the bleeding during the sometimes protracted intervention.	

Consensus-based Recommendation 8.E29	
Expert consensus	Level of consensus ++
If the intervention can be planned ahead (e.g., placenta increta/percreta), endovascular catheters can already be placed preoperatively into the internal iliac artery on both sides.	

Catheter embolisation may be used as a last resort to treat persistent diffuse bleeding in the lesser pelvis after postpartum hysterectomy [93].

**9 Haemostasis and Coagulation Management – Intensive Medical Procedures**

**9.1 Background**

Understanding and recognising the most probable pathophysiology of the bleeding is important, as this will offer pointers for different therapeutic approaches. The problem associated with haemostatic management is the difficulty in differentiating between increased bleeding caused by a major injury and protracted bleeding where the composition of blood has changed (i.e., the normal capacity of the system to compensate for smaller injuries has been reversed; this equates to an impairment of the coagulation system = coagulopathy). It is therefore necessary to distinguish between:

- trauma-induced coagulopathy with shock and massive tissue trauma
- initial “traumatic” haemorrhage caused by tissue trauma, and
- initial coagulopathic bleeding.

Impaired coagulation (= coagulopathy) is often an early pathology of PPH which can occur before dilutional coagulopathy occurs [39, 94].

Consensus-based Recommendation 9.E30	
Expert consensus	Level of consensus +++
The length of time needed to obtain diagnostic findings means that it is not possible to await the results of diagnostic procedures which differentiate between different coagulopathies (e.g. congenital vs. acquired) before making treatment decisions. As a rule (if the patient’s medical history does not indicate any congenital coagulopathy), it should be assumed that patients with peripartum or postpartum haemorrhage have an acquired coagulopathy, unless a surgical cause of haemorrhage can be clearly identified.	

It is also important to take account of the fact that, because of the associated dilution effect and the use of coagulation factors, every primary mechanical bleeding treated with volume replacement and fresh frozen plasma (FFP) will become coagulopathic if volume substitution and FFP administration is continued over a lengthy period [95 – 97].

Consensus-based Statement 9.S6	
Expert consensus	Level of consensus +++
It is therefore essential that all hospitals with obstetric departments develop a treatment algorithm for peri-/postpartum haemorrhage which is adapted to the specific conditions in the respective hospital [46, 98 – 101]. The aim must be to identify haemorrhaging patients early on and describe the appropriate interdisciplinary surgical, interventional and haemostatic treatment to manage the bleeding. This algorithm should define the approach for the treatment process based on the clinical situation and take account of all available treatment options (pharmacological therapies, interventional procedures, surgical interventions).	

## 9.2 Options to treat peri-/postpartum coagulopathic haemorrhage

### Consensus-based Statement 9.S7

Expert consensus	Level of consensus +++
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During active bleeding, any iatrogenic aggravation of the tendency to bleed (e.g. by administering artificial colloids for volume replacement which has a strong dilution-related coagulopathic effect, or attempt to achieve high-normal blood pressure) should be avoided, where possible.

### Consensus-based Statement 9.S8

Expert consensus	Level of consensus ++
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Blood component therapy is currently the standard therapy for haemostasis, either using labile (cellular components, FFP) or stable (lyophilised factor concentrates) blood products, and should be administered early to prevent dilutional coagulopathy occurring in addition to the already existing loss of blood.

Based on the current state of knowledge, **fibrinogen** plays a key role. In patients with a history of peri-/postpartum haemorrhage and patients with peripartum bleeding, plasma fibrinogen concentrations should be determined (irrespective of treatment), as concentrations <2 g/l could help identify those patients at increased risk of severe PPH [39, 46].

### Consensus-based Recommendation 9.E31

Expert consensus	Level of consensus ++
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In any case, potentially increased fibrinolytic activity should be treated by the administration of **tranexamic acid** (an antifibrinolytic) before the substitution of fibrinogen (factor concentrate or FFP) is considered [39].

### Consensus-based Statement 9.S9

Expert consensus	Level of consensus +++
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The beneficial effects (lower loss of blood, reduced blood transfusion, increased Hb, lower number of invasive procedures) of administering tranexamic acid to treat PPH have since been shown in randomised, controlled studies of around 2000 patients [102–110].

In 2013 the ESA issued a strong recommendation based on moderate evidence for the administration of tranexamic acid to treat obstetric bleeding to reduce blood loss, bleeding duration and the number of transfusions [46].

There are no reliable data on the use of **DDAVP** (Minirin®) in obstetrics which would permit an evidence-based recommendation [111], although there have been repeated reports of observational studies with positive outcomes [112]. According to the ESA, DDAVP may be useful to treat platelet function disorders resulting from acquired von Willebrand syndrome (from drugs, acidosis, hypothermia) [46].

### Consensus-based Recommendation 9.E32

Expert consensus	Level of consensus +++
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Although the data is controversial and prospective randomised studies are lacking, one or two attempts at treatment with rFVIIa at a dose of 90 µg/kg BW can be undertaken as a last resort in carefully selected cases if

1. the patient has previously received adequate and appropriate treatment with other blood products,
2. the other methods used for haemostasis were not sufficiently effective, and
3. the patient still wants to have other children before undergoing a hysterectomy [39, 113–116].

Because of the risk of thromboembolism, recombinant FVIIa (NovoSeven®) should only be given as a last resort [117]. Plasmatic factor concentrations and platelet numbers should be optimised before rFVIIa is administered [46].

### Consensus-based Statement 9.S10

Expert consensus	Level of consensus ++
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In summary, the conclusions to be drawn from the currently available data on haemostatic management recommend

- an escalating concept (i.e., a successive step-by-step range of treatment options) adapted to the respective conditions in each hospital [46, 99, 100],
- early administration of tranexamic acid, preferably immediately after making the diagnosis,
- stabilisation of physiological preconditions for coagulation (i.e. pH, temperature, calcium level) [46, 95],
- if bleeding persists, viscoelastic test or conventional diagnostic tests to diagnose the cause of bleeding,
- if bleeding persists and substitution is required (if need be, in parallel to other mechanical forms of treatment), early replacement of coagulation factors with factor concentrates and/or FFP (fibrinogen should be considered if dilutional coagulopathy is present, otherwise PCC and F XIII may be used),
- if necessary (i.e. when other approaches are not effective), optimisation of platelet numbers (target > 100,000/µl for patients with active bleeding requiring transfusion) [46].

### Consensus-based Recommendation 9.E33

Expert consensus	Level of consensus +++
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After the underlying cause of bleeding has been treated, thromboprophylaxis must be administered within 24 hours [39]. Because of the reduced antithrombin activity (absolute activity may even be less than 0.5 kIU/l) in the majority of women with PPH, an increased risk of thromboembolism is expected **after the bleeding has stopped** [118]. After the administration of individual coagulation factor concentrates or complex preparations (e.g. PCC), antithrombin activity can be determined on the intensive care unit and substituted if necessary [119]. The target value is ≥ 80% or ≥ 0.8 kIU/l [119–121].

### 9.3 Anaesthesia-related aspects of managing PPH

Consensus-based Recommendation 9.E34	
Expert consensus	Level of consensus +++
<ul style="list-style-type: none"> <li>Maintain or achieve haemodynamic stability and normovolaemia: <b>myocardial ischaemia</b> with reduced contractility is often present when Hb values <math>\leq 6</math> g/dl (3.726 mmol/l) with or without haemodynamic abnormality (<math>RR_{sys} &lt; 90</math> mmHg and/or <math>RR_{dia} &lt; 50</math> mmHg and/or <math>HR \geq 115</math>/min) [122, 123].</li> <li><b>Timely call for expert assistance</b> is recommended for uncontrolled blood loss of more than 500 ml following vaginal delivery or more than 1000 ml following Caesarean section and is essential if blood loss is more than 1500 ml [29, 89, 95, 124].</li> <li>For patients receiving <b>regional anaesthesia</b> (spinal anaesthesia, epidural anaesthesia): if blood loss is <math>\geq 1500</math>–2000 ml and there are signs of persistent bleeding: <b>secure the airway and ensure sufficient oxygen supply</b>; if necessary, perform early intubation after consultation with the surgeon [125]. If there is a loss of protective reflexes, endotracheal intubation to secure the airway and ensure sufficient oxygenation must take priority.</li> <li>Place <b>wide-diameter</b> access points (<math>2 \times \geq 16</math> G) followed by arterial blood pressure measurement, if necessary even before intubation. A wide-diameter central access (<math>\geq 9</math> Fr) is recommended [125–128].</li> <li><b>Cell saver</b> blood (official recommendations of CMACE, NICE, OAA/AAGBI, ESA): use of mechanical autotransfusion in patients undergoing elective Caesarean section (e.g. in cases with placenta increta/percreta) can reduce the administration of allogenic blood postoperatively and the duration of hospital stay [129, 130]. In the emergency setting of PPH the following <b>caveats</b> must be taken into consideration: should only be used, after amniotic fluid removal and delivery of the neonate.               <ul style="list-style-type: none"> <li>Cell-saver blood does not contain clotting factors or platelets. Coagulation factors should be substituted to prevent coagulopathy when administering high transfusion volumes [131].</li> <li>Cases of hypotension have been reported following the re-transfusion of cell-saver blood with a leukocyte depletion filter [132].</li> </ul> </li> <li><b>Target values in haemodynamic therapy</b> for “healthy” pregnant women and strong bleeding:               <ul style="list-style-type: none"> <li><b>After cord clamping, hypotensive resuscitation</b> until surgical haemostasis is achieved with <b>restrictive fluid therapy</b> [133, 134].</li> <li>“Normal recapillarisation time” or “palpable radial pulse” are the target values for volume replacement therapy [135, 136]</li> <li><b>Goal:</b> MAP <math>&gt; 65</math> mmHg or lower [137] or <math>RR_{sys} \sim 90</math> mmHg [138].</li> <li><b>Target Hb:</b> indication for blood transfusion until surgical haemostasis: <b>7 g/dl</b> (4.347 mmol/l); after surgical haemostasis and successful treatment of the underlying pathology: <b>7–9 g/dl</b> (4.347–5.589 mmol/l) [23, 134, 138].</li> </ul>               Note: ensure sufficient additional iron supplementation on the ward postoperatively.             </li> <li><b>Pharmacological thromboprophylaxis</b> within 24 hours after the pathology causing the bleeding has been treated [134].</li> </ul>	

Escalating regimen of haemostatic therapeutic options to treat PPH (based on recommendations of the S3-guideline 012/019 “Polytrauma/Schwer- verletztenbehandlung” [Multitrauma/Treatment of Severely Injured Persons], DGAI recommendations on treating severe bleeding and ESA recommendations on treating perioperative haemorrhage) [100, 136].

1.	Stabilise general conditions ( <b>prophylaxis and therapy!</b> )	Core temperature $\geq 34$ °C (preferably normothermia) pH $\geq 7.2$ ionised $Ca^{++}$ concentration $> 0.9$ mmol/l (preferably normocalcaemia)
2.	Prevent potential (hyper-) fibrinolysis ( <b>always PRIOR to the administration of fibrinogen and/or FFPI</b> )	<b>Tranexamic acid (Cyklokapron®)</b> initially 1–2 g (15–30 mg/kg BW), repeat as needed
3.	Substitution of oxygen carriers	RBC administration Haemostatic target in patients with severe bleeding: Hb $\sim 7$ –9 g/dl (4.3–5.5 mmol/l) or Hct $\sim 30\%$
4.	Substitution of clotting factors ( <b>if severe haemorrhage persists</b> ) depending on availability in hospital	FFP $\geq 20$ (preferably 30) ml/kg BW <b>or/and</b> <b>fibrinogen (Haemocomplettan®)</b> (2–)4(–8) g (30–60 mg/kg BW) Target: $\geq 200$ mg/dl or $\geq 2.0$ g/l
	Patients who require (or are anticipated to require) massive transfusion or suffer life-threatening haemorrhagic shock may benefit from high FFP:RBC ratio of $\geq 1:2$ or from combined administration of FFP and factor concentrates.	If required, <b>PCC</b> initially 1000–2500 IU (25 IU/kg BW) <b>if required, 1–2 × FXIII (Fibrogammin® P)E; 1250 IU (15–20 IU/kg BW)</b>
	<b>and (if thrombocytopenia is suspected)</b> increased platelet adhesion to endothelium + release of von Willebrand factor and FVIII from endothelium/liver sinusoids ( $\rightarrow$ agonist for vasopressin type 2 receptor)	<b>DDAVP = desmopressin (Minirin®)</b> 0.3 $\mu$ g/kg BW over a period of 30 minutes (1 vial per 10 kg BW over a period of 30 min)
5.	Platelet substitution for primary haemostasis	<b>Platelet concentrate</b> (target for haemorrhage requiring transfusion: 100 000/ $\mu$ l)
6.	If necessary, thrombin burst with platelet and coagulation activation ( <b>consider general haemostatic conditions!</b> )	In individual cases and when all other treatment options have been unsuccessful <b>rFVIIa (NovoSeven®)</b> if required, initially 90 $\mu$ g/kg BW
	During ongoing bleeding	<b>No antithrombin (ATIII)</b> during haemorrhage, may be considered after administration of PCC and cessation of bleeding <b>No heparin</b> during haemorrhage
CAUTION: Thrombosis prophylaxis is mandatory within 24 hours after cessation of the pathology causing the bleeding!		

## 9.4 Rotational thromboelastometry (ROTEM)/ thromboelastography (TEG)

The mean time until the results of standard laboratory parameters are available in the operating room is at least 45 minutes [139]. Coagulation disturbances can be detected significantly faster with the viscoelastic test (VET) [139, 140].

Currently, two procedures are used for point-of-care (POC) diagnostics offering prompt, bedside recognition of clotting disorders based on VET: rotational thromboelastometry (ROTEM, Tem International GmbH, Munich, Germany) and thromboelastography (TEG, Haemonetics, Braintree, MA, USA) [141].

At present there are no class 1 recommendations on the use of these procedures [46].

## 10 Transportation

### Consensus-based Recommendation 10.E35

Expert consensus	Level of consensus +++
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As transporting a haemodynamically instable patient is a serious risk, any transportation of such patients as part of the management of PPH must be carefully weighed up, quite apart from the organisational conditions at the facility caring for the patient (or transportation should only be considered after haemodynamic stabilisation). It is important that the facility transferring the patient and the facility accepting the patient agree about timing and staff coverage during transportation of the patient in the run-up to the patient transfer and record what the two facilities have agreed upon in writing [142].

## 11 Monitoring after PPH

### Consensus-based Recommendation 11.E36

Expert consensus	Level of consensus +++
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Following PPH, individually adapted active monitoring must be carried out for at least 24 hours.

## 12 Documentation

### Consensus-based Recommendation 12.E37

Expert consensus	Level of consensus +++
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Every event defined as an emergency must be carefully documented. It is recommended to use the special forms developed for the respective organisational unit for documentation.

## 13 Debriefing

### Consensus-based Recommendation 13.E38

Expert consensus	Level of consensus +++
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Interdisciplinary team debriefing is recommended.

## 14 Training

### Consensus-based Recommendation 14.E39

Expert consensus	Level of consensus +++
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Simulations of haemorrhagic situations must be carried out by an interdisciplinary team at regular intervals; studies have shown that this leads to an improvement in the management of peri-/postpartum haemorrhage [35, 143].

## Conflict of Interest

Almost all of the authors give talks on the topic of PPH at conferences and company-sponsored meetings.

## References

- [1] Dupont C, Touzet S, Colin C et al. Incidence and management of postpartum haemorrhage following the dissemination of guidelines in a network of 16 maternity units in France. *Int J Obstet Anesth* 2009; 18: 320–327
- [2] Knight M, Callaghan WM, Berg C et al. Trends in postpartum hemorrhage in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group. *BMC Pregnancy Childbirth* 2009; 9: 55
- [3] Bateman BT, Berman MF, Riley LE et al. The epidemiology of postpartum hemorrhage in a large, nationwide sample of deliveries. *Anesth Analg* 2010; 110: 1368–1373
- [4] Callaghan WM, Kuklina EV, Berg CJ. Trends in postpartum hemorrhage: United States, 1994–2006. *Am J Obstet Gynecol* 2010; 202: 353.e1–353.e6
- [5] Kramer MS, Berg C, Abenheim H et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. *Am J Obstet Gynecol* 2013; 209: 449.e1–449.e7
- [6] Joseph KS, Rouleau J, Kramer MS et al. Investigation of an increase in postpartum haemorrhage in Canada. *BJOG* 2007; 114: 751–759
- [7] Samangaya R, Pennington R, Vause S. Factors relating to a rising incidence of major postpartum haemorrhage. *BJOG* 2010; 117: 370; author reply 370–371
- [8] Kramer MS, Dahhou M, Vallerand D et al. Risk factors for postpartum hemorrhage: can we explain the recent temporal increase? *J Obstet Gynaecol Can* 2011; 33: 810–819
- [9] Buchanan SL, Patterson JA, Roberts CL et al. Trends and morbidity associated with oxytocin use in labour in nulliparas at term. *Aust N Z J Obstet Gynaecol* 2012; 52: 173–178
- [10] Liu S, Joseph KS, Hutcheon JA et al. Gestational age-specific severe maternal morbidity associated with labor induction. *Am J Obstet Gynecol* 2013; 209: 209.e1–209.e8
- [11] Mehrabadi A, Hutcheon JA, Lee L et al. Epidemiological investigation of a temporal increase in atonic postpartum haemorrhage: a population-based retrospective cohort study. *BJOG* 2013; 120: 853–862
- [12] Mousa HA, Walkinshaw S. Major postpartum haemorrhage. *Curr Opin Obstet Gynecol* 2001; 13: 595–603
- [13] Waterstone M, Bewley S, Wolfe C. Incidence and predictors of severe obstetric morbidity: case-control study. *BMJ* 2001; 322: 1089–1093; discussion 1093–1084
- [14] AbouZahr C. Global burden of maternal death and disability. *Br Med Bull* 2003; 67: 1–11

- [15] Hogberg U. The World Health Report 2005: "make every mother and child count" – including Africans. *Scand J Public Health* 2005; 33: 409–411
- [16] American College of Obstetricians and Gynecologists. ACOG Practice Bulletin: Clinical Management Guidelines for Obstetrician-Gynecologists Number 76, October 2006: postpartum hemorrhage. *Obstet Gynecol* 2006; 108: 1039–1047
- [17] Khan KS, Wojdyla D, Say L et al. WHO analysis of causes of maternal death: a systematic review. *Lancet* 2006; 367: 1066–1074
- [18] Roberts CL, Ford JB, Algert CS et al. Trends in adverse maternal outcomes during childbirth: a population-based study of severe maternal morbidity. *BMC Pregnancy Childbirth* 2009; 9: 7
- [19] Ronsmans C, Graham WJ; Lancet Maternal Survival Series steering group. Maternal mortality: who, when, where, and why. *Lancet* 2006; 368: 1189–1200
- [20] Cantwell R, Clutton-Brock T, Cooper G et al. Saving mothers' lives: reviewing maternal deaths to make motherhood safer: 2006–2008. The eighth report of the confidential enquiries into maternal deaths in the United Kingdom. *BJOG* 2011; 118 (Suppl. 1): 1–203
- [21] Haeri S, Dildy GA 3rd. Maternal mortality from hemorrhage. *Semin Perinatol* 2012; 36: 48–55
- [22] Grobman WA, Bailit JL, Rice MM et al. Frequency of and factors associated with severe maternal morbidity. *Obstet Gynecol* 2014; 123: 804–810
- [23] Arulkuman S, Mavrides E, Penney GC. RCOG Green-top Guideline No. 52: Prevention and management of postpartum haemorrhage. 2011. Online: <https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg52/>; last access: 04.04.2018
- [24] Farquhar C, Sadler L, Masson V et al. Beyond the numbers: classifying contributory factors and potentially avoidable maternal deaths in New Zealand, 2006–2009. *Am J Obstet Gynecol* 2011; 205: 331.e1–331.e8
- [25] Saucedo M, Deneux-Tharaux C, Bouvier-Colle MH; French National Experts Committee on Maternal Mortality. Ten years of confidential inquiries into maternal deaths in France, 1998–2007. *Obstet Gynecol* 2013; 122: 752–760
- [26] Duthie SJ, Ven D, Yung GL et al. Discrepancy between laboratory determination and visual estimation of blood loss during normal delivery. *Eur J Obstet Gynecol Reprod Biol* 1991; 38: 119–124
- [27] Descargues G, Pitette P, Gravier A et al. [Missed diagnosis of postpartum hemorrhage]. *J Gynecol Obstet Biol Reprod (Paris)* 2001; 30: 590–600
- [28] Bose P, Regan F, Paterson-Brown S. Improving the accuracy of estimated blood loss at obstetric haemorrhage using clinical reconstructions. *BJOG* 2006; 113: 919–924
- [29] Rath W, Schneider M. Definitionen und Diagnostik postpartaler Blutungen (PPH): Unterschätzte Probleme! [Definitions and Diagnosis of Postpartum Haemorrhage (PPH): Underestimated Problems!]. *Geburtsh Frauenheilk* 2010; 70: 36–40
- [30] Alexander J, Thomas P, Sanghera J. Treatments for secondary postpartum haemorrhage. *Cochrane Database Syst Rev* 2002; (1): CD002867
- [31] Rizvi F, Mackey R, Barrett T et al. Successful reduction of massive postpartum haemorrhage by use of guidelines and staff education. *BJOG* 2004; 111: 495–498
- [32] Obstetrical hemorrhage. In: Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY, eds. *Williams Obstetrics*. 23rd ed. New York: McGraw-Hill; 2010: 757–803
- [33] Upadhyay K, Scholefield H. Risk management and medicolegal issues related to postpartum haemorrhage. *Best Pract Res Clin Obstet Gynaecol* 2008; 22: 1149–1169
- [34] Driessen M, Bouvier-Colle MH, Dupont C et al. Postpartum hemorrhage resulting from uterine atony after vaginal delivery: factors associated with severity. *Obstet Gynecol* 2011; 117: 21–31
- [35] Main EK, Goffman D, Scavone BM et al. National partnership for maternal safety: consensus bundle on obstetric hemorrhage. *Obstet Gynecol* 2015; 126: 155–162
- [36] Merz E, Eichhorn KH, von Kaisenberg C et al.; Arbeitsgruppe der DEGUM-Stufe III. [Updated quality requirements regarding secondary differentiated ultrasound examination in prenatal diagnostics (= DEGUM level II) in the period from 18 + 0 to 21 + 6 weeks of gestation]. *Ultraschall Med* 2012; 33: 593–596
- [37] Al-Zirqi I, Vangen S, Forsen L et al. Prevalence and risk factors of severe obstetric haemorrhage. *BJOG* 2008; 115: 1265–1272
- [38] Sosa CG, Althabe F, Belizan JM et al. Risk factors for postpartum hemorrhage in vaginal deliveries in a Latin-American population. *Obstet Gynecol* 2009; 113: 1313–1319
- [39] Abdul-Kadir R, McLintock C, Ducloy AS et al. Evaluation and management of postpartum hemorrhage: consensus from an international expert panel. *Transfusion* 2014; 54: 1756–1768
- [40] Rajan PV, Wing DA. Postpartum hemorrhage: evidence-based medical interventions for prevention and treatment. *Clin Obstet Gynecol* 2010; 53: 165–181
- [41] Comstock CH. Antenatal diagnosis of placenta accreta: a review. *Ultrasound Obstet Gynecol* 2005; 26: 89–96
- [42] Comstock CH, Bronsteen RA. The antenatal diagnosis of placenta accreta. *BJOG* 2014; 121: 171–181; discussion 181–172
- [43] Chalubinski KM, Pils S, Klein K et al. Prenatal sonography can predict degree of placental invasion. *Ultrasound Obstet Gynecol* 2013; 42: 518–524
- [44] Kluckow M, Hooper SB. Using physiology to guide time to cord clamping. *Semin Fetal Neonatal Med* 2015; 20: 225–231
- [45] Rath W, Bohlmann MK. Postpartale Hämorrhagie – Prävention und Therapie. *Gynäkologe* 2011; 44: 538–548
- [46] Kozek-Langenecker SA, Afshari A, Albaladejo P et al. Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol* 2013; 30: 270–382
- [47] von Heymann C, Kaufner L, Korber M. [Perioperative management and therapy of bleeding complications]. *Anesthesiol Intensivmed Notfallmed Schmerzther* 2014; 49: 196–204; quiz 205
- [48] Montufar-Rueda C, Rodriguez L, Jarquin JD et al. Severe postpartum hemorrhage from uterine atony: a multicentric study. *J Pregnancy* 2013; 2013: 525914
- [49] Rath W. [Postpartum Haemorrhage (PPH): "too little is done too late!"]. *Z Geburtshilfe Neonatol* 2011; 215: 177–181
- [50] Teixidor Vinas M, Chandraran E, Moneta MV et al. The role of interventional radiology in reducing haemorrhage and hysterectomy following caesarean section for morbidly adherent placenta. *Clin Radiol* 2014; 69: e345–e351
- [51] Teixidor Vinas M, Belli AM, Arulkumaran S et al. Prevention of postpartum hemorrhage and hysterectomy in patients with morbidly adherent placenta: a cohort study comparing outcomes before and after introduction of the Triple-P procedure. *Ultrasound Obstet Gynecol* 2015; 46: 350–355
- [52] Fuchs I, Dudenhausen JW, Sehoul J et al. Placenta pathology: disorders of placental location, placental implantation and cord insertion. *Ultraschall Med* 2008; 29: 4–17; quiz 18–23
- [53] You WB, Zahn CM. Postpartum hemorrhage: abnormally adherent placenta, uterine inversion, and puerperal hematomas. *Clin Obstet Gynecol* 2006; 49: 184–197
- [54] Witteveen T, van Stralen G, Zwart J et al. Puerperal uterine inversion in the Netherlands: a nationwide cohort study. *Acta Obstet Gynecol Scand* 2013; 92: 334–337
- [55] Kenyon S, Tokumasu H, Dowswell T et al. High-dose versus low-dose oxytocin for augmentation of delayed labour. *Cochrane Database Syst Rev* 2013; (7): CD007201

- [56] Langer B, Boudier E, Haberstick R et al.; Collège National des Gynécologues et Obstétriciens Français; Agence Nationale d'Accréditation et d'Evaluation en Santé. [Obstetrical management in the event of persistent or worsening postpartum hemorrhage despite initial measures]. *J Gynecol Obstet Biol Reprod (Paris)* 2004; 33 (8 Suppl.): 4S73-4S79
- [57] Surbek DV, Fehr PM, Hosli I et al. Oral misoprostol for third stage of labor: a randomized placebo-controlled trial. *Obstet Gynecol* 1999; 94: 255–258
- [58] Hofmeyr GJ, Walraven G, Gulmezoglu AM et al. Misoprostol to treat postpartum haemorrhage: a systematic review. *BJOG* 2005; 112: 547–553
- [59] Langenbach C. Misoprostol in preventing postpartum hemorrhage: a meta-analysis. *Int J Gynaecol Obstet* 2006; 92: 10–18
- [60] Lapaire O, Schneider MC, Stotz M et al. Oral misoprostol vs. intravenous oxytocin in reducing blood loss after emergency cesarean delivery. *Int J Gynaecol Obstet* 2006; 95: 2–7
- [61] Mousa HA, Blum J, Abou El Senoun G et al. Treatment for primary postpartum haemorrhage. *Cochrane Database Syst Rev* 2014; (2): CD003249
- [62] Schlembach D, Moertl MG, Girard T et al. Management der postpartalen Blutung. *Der D-A-CH-Algorithmus. Frauenarzt* 2013; 54: 1072–1080
- [63] Kaufner L, Schuster M, Vogt M et al. [Case report: recurrent postpartum haemorrhage after emergency caesarean section – clipping, embolization and haemostaseological therapy]. *Anesthesiol Intensivmed Notfallmed Schmerzther* 2012; 47: 308–314
- [64] Gronvall M, Tikkanen M, Tallberg E et al. Use of Bakri balloon tamponade in the treatment of postpartum hemorrhage: a series of 50 cases from a tertiary teaching hospital. *Acta Obstet Gynecol Scand* 2013; 92: 433–438
- [65] Chan LL, Lo TK, Lau WL et al. Use of second-line therapies for management of massive primary postpartum hemorrhage. *Int J Gynaecol Obstet* 2013; 122: 238–243
- [66] Ibrahim M, Ziegler C, Klam SL et al. Incidence, indications, and predictors of adverse outcomes of postpartum hysterectomies: 20-year experience in a tertiary care centre. *J Obstet Gynaecol Can* 2014; 36: 14–20
- [67] Dabelea V, Schultze PM, McDuffie RS jr. Intrauterine balloon tamponade in the management of postpartum hemorrhage. *Am J Perinatol* 2007; 24: 359–364
- [68] Patacchiola F, D'Alfonso A, Di Fonso A et al. Intrauterine balloon tamponade as management of postpartum haemorrhage and prevention of haemorrhage related to low-lying placenta. *Clin Exp Obstet Gynecol* 2012; 39: 498–499
- [69] Aibar L, Aguilar MT, Puertas A et al. Bakri balloon for the management of postpartum hemorrhage. *Acta Obstet Gynecol Scand* 2013; 92: 465–467
- [70] Florian A, Carles G, Dallah F et al. [Value of the Linton-Nachlas balloon for the management of post-partum hemorrhage: a series of 25 cases]. *J Gynecol Obstet Biol Reprod (Paris)* 2013; 42: 493–498
- [71] Nelson BD, Stoklosa H, Ahn R et al. Use of uterine balloon tamponade for control of postpartum hemorrhage by community-based health providers in South Sudan. *Int J Gynaecol Obstet* 2013; 122: 27–32
- [72] Tindell K, Garfinkel R, Abu-Haydar E et al. Uterine balloon tamponade for the treatment of postpartum haemorrhage in resource-poor settings: a systematic review. *BJOG* 2013; 120: 5–14
- [73] Morel O, Perdiolle-Galet E, Mezan de Malartic C et al. [Management of severe or persistent postpartum hemorrhage after vaginal delivery.]. *J Gynecol Obstet Biol Reprod (Paris)* 2014; 43: 1019–1029
- [74] Schmid BC, Rezniczek GA, Rolf N et al. Uterine packing with chitosan-covered gauze for control of postpartum hemorrhage. *Am J Obstet Gynecol* 2013; 209: 225.e1–225.e5
- [75] Diemert A, Ortmeyer G, Hollwitz B et al. The combination of intrauterine balloon tamponade and the B-Lynch procedure for the treatment of severe postpartum hemorrhage. *Am J Obstet Gynecol* 2012; 206: 65.e1–65.e4
- [76] Nelson WL, O'Brien JM. The uterine sandwich for persistent uterine atony: combining the B-Lynch compression suture and an intrauterine Bakri balloon. *Am J Obstet Gynecol* 2007; 196: e9–e10
- [77] Merrick K, Jibodu OA, Rajesh U. The difficult PPH: experience of combined use of B-Lynch brace suture and intrauterine Bakri balloon in York hospital, UK. *J Obstet Gynaecol* 2013; 33: 314–315
- [78] Cekmez Y, Ozkaya E, Ocal FD et al. Experience with different techniques for the management of postpartum hemorrhage due to uterine atony: compression sutures, artery ligation and Bakri balloon. *Ir J Med Sci* 2015; 184: 399–402
- [79] Deux JF, Bazot M, Le Blanche AF et al. Is selective embolization of uterine arteries a safe alternative to hysterectomy in patients with postpartum hemorrhage? *AJR Am J Roentgenol* 2001; 177: 145–149
- [80] Rath W, Hackethal A, Bohlmann MK. Second-line treatment of postpartum haemorrhage (PPH). *Arch Gynecol Obstet* 2012; 286: 549–561
- [81] Sentilhes L, Gromez A, Razzouk K et al. B-Lynch suture for massive persistent postpartum hemorrhage following stepwise uterine devascularization. *Acta Obstet Gynecol Scand* 2008; 87: 1020–1026
- [82] Sentilhes L, Trichot C, Resch B et al. Fertility and pregnancy outcomes following uterine devascularization for severe postpartum haemorrhage. *Hum Reprod* 2008; 23: 1087–1092
- [83] Gaia G, Chabrot P, Cassagnes L et al. Menses recovery and fertility after artery embolization for PPH: a single-center retrospective observational study. *Eur Radiol* 2009; 19: 481–487
- [84] Sentilhes L, Gromez A, Trichot C et al. Fertility after B-Lynch suture and stepwise uterine devascularization. *Fertil Steril* 2009; 91: 934.e5–934.e9
- [85] Hollatz-Galuscki E, Michaelis S, Rauber S et al. Uteruskompressionsnähte – Welche Nahttechnik ist wann indiziert? *Geburtsh Frauenheilk* 2013; 73: P70
- [86] O'Leary JA. Uterine artery ligation in the control of postcesarean hemorrhage. *J Reprod Med* 1995; 40: 189–193
- [87] AbdRabbo SA. Stepwise uterine devascularization: a novel technique for management of uncontrolled postpartum hemorrhage with preservation of the uterus. *Am J Obstet Gynecol* 1994; 171: 694–700
- [88] Morel O, Malartic C, Muhlstein J et al. Pelvic arterial ligations for severe post-partum hemorrhage. Indications and techniques. *J Visc Surg* 2011; 148: e95–e102
- [89] Ahonen J, Stefanovic V, Lassila R. Management of post-partum haemorrhage. *Acta Anaesthesiol Scand* 2010; 54: 1164–1178
- [90] Rossi AC, Lee RH, Chmait RH. Emergency postpartum hysterectomy for uncontrolled postpartum bleeding: a systematic review. *Obstet Gynecol* 2010; 115: 637–644
- [91] Riley DP, Burgess RW. External abdominal aortic compression: a study of a resuscitation manoeuvre for postpartum haemorrhage. *Anaesth Intensive Care* 1994; 22: 571–575
- [92] Keogh J, Tsokos N. Aortic compression in massive postpartum haemorrhage—an old but lifesaving technique. *Aust N Z J Obstet Gynaecol* 1997; 37: 237–238
- [93] Bloom AI, Verstandig A, Gielchinsky Y et al. Arterial embolisation for persistent primary postpartum haemorrhage: before or after hysterectomy? *BJOG* 2004; 111: 880–884
- [94] McLintock C, James AH. Obstetric hemorrhage. *J Thromb Haemost* 2011; 9: 1441–1451
- [95] Lier H, Rath W. Aktuelle interdisziplinäre Handlungsempfehlungen bei schweren peri-(post-)partalen Blutungen (PPH). [Current Interdisciplinary Recommendations for the Management of Severe Postpartum Hemorrhage (PPH)]. *Geburtsh Frauenheilk* 2011; 71: 577–588

- [96] Schols SE, Feijge MA, Lance MD et al. Effects of plasma dilution on tissue-factor-induced thrombin generation and thromboelastography: partly compensating role of platelets. *Transfusion* 2008; 48: 2384–2394
- [97] Tanaka KA, Key NS, Levy JH. Blood coagulation: hemostasis and thrombin regulation. *Anesth Analg* 2009; 108: 1433–1446
- [98] Shields LE, Smalarz K, Reffigee L et al. Comprehensive maternal hemorrhage protocols improve patient safety and reduce utilization of blood products. *Am J Obstet Gynecol* 2011; 205: 368.e1–368.e8
- [99] Mellin-Olsen J, Staender S, Whitaker DK et al. The Helsinki declaration on patient safety in anaesthesiology. *Eur J Anaesthesiol* 2010; 27: 592–597
- [100] Grottko O, Frietsch T, Maas M et al. Umgang mit Massivblutungen und assoziierten perioperativen Gerinnungsstörungen. [Dealing with massive bleeding and associated perioperative coagulopathy: recommendations for action of the German Society of Anaesthesiology and Intensive Care Medicine]. *Anaesthesist* 2013; 62: 213–224
- [101] Einerson BD, Miller ES, Grobman WA. Does a postpartum hemorrhage patient safety program result in sustained changes in management and outcomes? *Am J Obstet Gynecol* 2015; 212: 140–4.e1
- [102] Yang H, Zheng S, Shi C. [Clinical study on the efficacy of tranexamic acid in reducing postpartum blood loss: a randomized, comparative, multicenter trial]. *Zhonghua Fu Chan Ke Za Zhi* 2001; 36: 590–592
- [103] Gai MY, Wu LF, Su QF et al. Clinical observation of blood loss reduced by tranexamic acid during and after caesarian section: a multi-center, randomized trial. *Eur J Obstet Gynecol Reprod Biol* 2004; 112: 154–157
- [104] Gohel M, Patel P, Gupta A et al. Efficacy of tranexamic acid in decreasing blood loss during and after cesarean section: a randomized case controlled prospective study. *J Obstet Gynecol India* 2007; 57: 227–230
- [105] Sekhavat L, Tabatabaai A, Dalili M et al. Efficacy of tranexamic acid in reducing blood loss after cesarean section. *J Matern Fetal Neonatal Med* 2009; 22: 72–75
- [106] Ducloy-Bouthors AS, Jude B, Duhamel A et al. High-dose tranexamic acid reduces blood loss in postpartum haemorrhage. *Crit Care* 2011; 15: R117
- [107] Gungorduk K, Yildirim G, Asicioglu O et al. Efficacy of intravenous tranexamic acid in reducing blood loss after elective cesarean section: a prospective, randomized, double-blind, placebo-controlled study. *Am J Perinatol* 2011; 28: 233–240
- [108] Movafegh A, Eslamian L, Dorabadi A. Effect of intravenous tranexamic acid administration on blood loss during and after cesarean delivery. *Int J Gynaecol Obstet* 2011; 115: 224–226
- [109] Senturk MB, Cakmak Y, Yildiz G et al. Tranexamic acid for cesarean section: a double-blind, placebo-controlled, randomized clinical trial. *Arch Gynecol Obstet* 2013; 287: 641–645
- [110] Novikova N, Hofmeyr GJ, Cluver C. Tranexamic acid for preventing postpartum haemorrhage. *Cochrane Database Syst Rev* 2015; (6): CD007872
- [111] Karanth L, Barua A, Kanagasabai S et al. Desmopressin acetate (DDAVP) for preventing and treating acute bleeds during pregnancy in women with congenital bleeding disorders. *Cochrane Database Syst Rev* 2013; (4): CD009824
- [112] Trigg DE, Stergiotou I, Peitsidis P et al. A systematic review: the use of desmopressin for treatment and prophylaxis of bleeding disorders in pregnancy. *Haemophilia* 2012; 18: 25–33
- [113] Ahonen J. The role of recombinant activated factor VII in obstetric hemorrhage. *Curr Opin Anaesthesiol* 2012; 25: 309–314
- [114] Gawron LM, Goldman KN, Kiley J. A gravid development: should the desire to maintain fertility determine treatment for profuse bleeding in pregnancy? *Am J Obstet Gynecol* 2013; 208: 332.e1–332.e2
- [115] Jan JY, Lin SY, Lin CH et al. Recombinant activated factor VII as a promising adjuvant therapy for postpartum hemorrhage in the practice of obstetric anesthesia: experience from a university hospital in Taiwan. *J Obstet Gynaecol Res* 2011; 37: 901–907
- [116] Mercier FJ, Bonnet MP. Use of clotting factors and other prohemostatic drugs for obstetric hemorrhage. *Curr Opin Anaesthesiol* 2010; 23: 310–316
- [117] Lavigne-Lissalde G, Aya AG, Mercier FJ et al. Recombinant human FVIIa for reducing the need for invasive second-line therapies in severe refractory postpartum hemorrhage: a multicenter, randomized, open controlled trial. *J Thromb Haemost* 2015; 13: 520–529
- [118] Kevane B, Donnelly J, D'Alton M et al. Risk factors for pregnancy-associated venous thromboembolism: a review. *J Perinat Med* 2014; 42: 417–425
- [119] Karlsson O, Sporrang T, Hillarp A et al. Prospective longitudinal study of thromboelastography and standard hemostatic laboratory tests in healthy women during normal pregnancy. *Anesth Analg* 2012; 115: 890–898
- [120] Szecsi PB, Jorgensen M, Klajnbard A et al. Haemostatic reference intervals in pregnancy. *Thromb Haemost* 2010; 103: 718–727
- [121] James AH, Konkle BA, Bauer KA. Prevention and treatment of venous thromboembolism in pregnancy in patients with hereditary anti-thrombin deficiency. *Int J Womens Health* 2013; 5: 233–241
- [122] Karpati PC, Rossignol M, Pirot M et al. High incidence of myocardial ischemia during postpartum hemorrhage. *Anesthesiology* 2004; 100: 30–36; discussion 35A
- [123] Heyer L, Mebazaa A, Gayat E et al. Cardiac troponin and skeletal muscle oxygenation in severe post-partum haemorrhage. *Crit Care* 2009; 13 (Suppl. 5): S8
- [124] Rossen J, Okland I, Nilsen OB et al. Is there an increase of postpartum hemorrhage, and is severe hemorrhage associated with more frequent use of obstetric interventions? *Acta Obstet Gynecol Scand* 2010; 89: 1248–1255
- [125] Gallos G, Redai I, Smiley RM. The role of the anesthesiologist in management of obstetric hemorrhage. *Semin Perinatol* 2009; 33: 116–123
- [126] Kuczkowski KM. Anesthesia for the repeat cesarean section in the parturient with abnormal placentation: what does an obstetrician need to know? *Arch Gynecol Obstet* 2006; 273: 319–321
- [127] Fuller AJ, Bucklin BA. Blood product replacement for postpartum hemorrhage. *Clin Obstet Gynecol* 2010; 53: 196–208
- [128] Bonnet MP, Deneux-Tharaux C, Bouvier-Colle MH. Critical care and transfusion management in maternal deaths from postpartum haemorrhage. *Eur J Obstet Gynecol Reprod Biol* 2011; 158: 183–188
- [129] Rainaldi MP, Tazzari PL, Scagliarini G et al. Blood salvage during caesarean section. *Br J Anaesth* 1998; 80: 195–198
- [130] Goucher H, Wong CA, Patel SK et al. Cell salvage in obstetrics. *Anesth Analg* 2015; 121: 465–468
- [131] Catling S, Haynes SL. Coagulopathy during intraoperative cell salvage in a patient with major obstetric haemorrhage. *Br J Anaesth* 2011; 106: 749; author reply 750
- [132] Waldron S. Hypotension associated with leucocyte depletion filters following cell salvage in obstetrics. *Anaesthesia* 2011; 66: 133–134
- [133] Pacheco LD, Saade GR, Gei AF et al. Cutting-edge advances in the medical management of obstetrical hemorrhage. *Am J Obstet Gynecol* 2011; 205: 526–532
- [134] Spahn DR, Bouillon B, Cerny V et al. Management of bleeding and coagulopathy following major trauma: an updated European guideline. *Crit Care* 2013; 17: R76
- [135] Cotton BA, Jerome R, Collier BR et al. Guidelines for prehospital fluid resuscitation in the injured patient. *J Trauma* 2009; 67: 389–402



- [136] Stürmer KM, Neugebauer E, Waydhas C et al. S3-Leitlinie Polytrauma/Schwerverletzten-Behandlung. AWMF 012/019 – S3-Leitlinie. 2011. Online: [https://www.dggg.de/fileadmin/documents/leitlinien/archiviert/federfuehrend/012019\\_Polytrauma\\_und\\_Schwerverletzten-Behandlung/012019\\_2011.pdf](https://www.dggg.de/fileadmin/documents/leitlinien/archiviert/federfuehrend/012019_Polytrauma_und_Schwerverletzten-Behandlung/012019_2011.pdf); last access: 04.04.2018
- [137] Morrison CA, Carrick MM, Norman MA et al. Hypotensive resuscitation strategy reduces transfusion requirements and severe postoperative coagulopathy in trauma patients with hemorrhagic shock: preliminary results of a randomized controlled trial. *J Trauma* 2011; 70: 652–663
- [138] Napolitano LM, Kurek S, Luchette FA et al. Clinical practice guideline: red blood cell transfusion in adult trauma and critical care. *J Trauma* 2009; 67: 1439–1442
- [139] de Lange NM, van Rheeën-Flach LE, Lance MD et al. Peri-partum reference ranges for ROTEM(R) thromboelastometry. *Br J Anaesth* 2014; 112: 852–859
- [140] Karlsson O, Jeppsson A, Hellgren M. Major obstetric haemorrhage: monitoring with thromboelastography, laboratory analyses or both? *Int J Obstet Anesth* 2014; 23: 10–17
- [141] McNamara H, Mallaiah S, Barclay P et al. Coagulopathy and placental abruption: changing management with ROTEM-guided fibrinogen concentrate therapy. *Int J Obstet Anesth* 2015; 24: 174–179
- [142] Wilson AK, Martel MJ, Arsenaault MY et al. Maternal transport policy. *J Obstet Gynaecol Can* 2005; 27: 956–963
- [143] Quinn KH, Mackey A, Cohen J et al. A curriculum to teach and evaluate resident skills in the management of postpartum hemorrhage. *J Perinat Med* 2012; 40: 635–639

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