

DOI: 10.5281/zenodo.1106851

UDC: 618.7-005.1

Recommended options in preventing the postpartum hemorrhage

***Capros Hristiana**, MD, PhD, Assistant Professor; **Mihalcean Luminita**, MD, PhD, Associate Professor; **Porfire Liliana**, MD, PhD, Associate Professor; **Surguci Mihail**, MD, PhD, Associate Professor

Department of Obstetrics and Gynecology, Nicolae Testemitsanu State University of Medicine and Pharmacy
Chisinau, the Republic of Moldova

*Corresponding author: caproscristina@yahoo.com. Received July 03, 2017; accepted December 11, 2017

Abstract

Background: Postpartum hemorrhage (PPH) is a major public health problem due to complications that have a direct impact on the most important reproductive health indicators: maternal morbidity and mortality. It is a leading reason for peripartum hysterectomy, admission of pregnant women to intensive care units, and massive blood transfusion. In the most severe cases, hemorrhagic shock may lead to anterior pituitary ischemia, occult myocardial ischemia, dilutional coagulopathy. Post-partum anemia increases the risk of post-partum depression. To decrease the incidence of postpartum hemorrhage the conditions that are known to be associated with PPH and these women should be identified. Careful anamnesis and obstetrical examination should be done to screen for risk factors in pregnancy and labor. To assure minimal blood loss during delivery several measures are proposed in international protocols. The knowledge of prophylaxis measures is useful to reduce maternal mortality and morbidity from PPH.

Conclusions: The knowledge of prophylaxis measures is useful to reduce maternal mortality and morbidity from PPH. Actually, for prophylaxis of postpartum hemorrhage, evidence based medicine recommend correction of anaemia, use of the partograph in labor and the close supervision first two hours after the delivery.

Key words: postpartum hemorrhage, risk factors, active management, labor.

Introduction

Postpartum hemorrhage (PPH) is the leading cause of maternal mortality in all over the world and a major cause of severe acute maternal morbidity even in well resourced settings [1, 2]. It is a leading reason for peripartum hysterectomy, admission of pregnant women to intensive care units, and massive blood transfusion. In the most severe cases, hemorrhagic shock may lead to anterior pituitary ischemia, occult myocardial ischemia, dilutional coagulopathy [3, 5]. Post-partum anemia increases the risk of post-partum depression [4]. The majority of these maternal complications can be avoided through the active management of the third stage of labor, correct diagnosis of postpartum hemorrhage and adequate treatment [5-8].

The uteroplacental circulation starts with the maternal blood flow into the intervillous space through decidual spiral arteries (fig. 1).

During placental separation, these vessels are tied off the implantation site that induces bleeding from placental site. Reduction in uterine volume after the delivery of the neonate is the result of:

- Strong third-stage contractions
- Placental delivery
- Myometrial contraction
- Compression of spiral arteries
- Clotting and obliteration of the lumen of spiral arteries

in the superficial myometrium at the placental implantation site.

This is why fatal postpartum hemorrhage can result from uterine atony. Adhered placental pieces or large blood clots that prevent effective myometrial contraction will also stimulate bleeding.

Definition. On average, women will lose about 500 ml of blood in a vaginal delivery, 1000 ml in cesarian section, and 1500 ml in a cesarean hysterectomy [9, 10, 11]. In 2012 WHO defined Primary Postpartum Haemorrhage as a blood loss of 500 ml or more within 24 hours after birth. In other guidelines and protocols primary PPH is commonly defined as excessive blood loss of 500 ml or more within 24 hours after the delivery of the baby (after the second stage of labor) in a vaginal delivery, and 1000 ml in a cesarean section [9, 10, 14, 18].

Risk factors. Unfortunately, PPH is a complication that for many women cannot be predicted. There are, however, some conditions that are known to be associated with PPH and these women should be identified. Risk factors for PPH may present antenatally or intrapartum; careful anamnesis and obstetrical examination should be done to screen for risk factors in pregnancy and labor [11, 12]. The following risk factors for PPH are: anemia diagnosed in the begining of pregnancy, past history of severe PPH, anticoagulant drugs in pregnancy, severe pre-eclampsia, HELLP syndrome, ute-

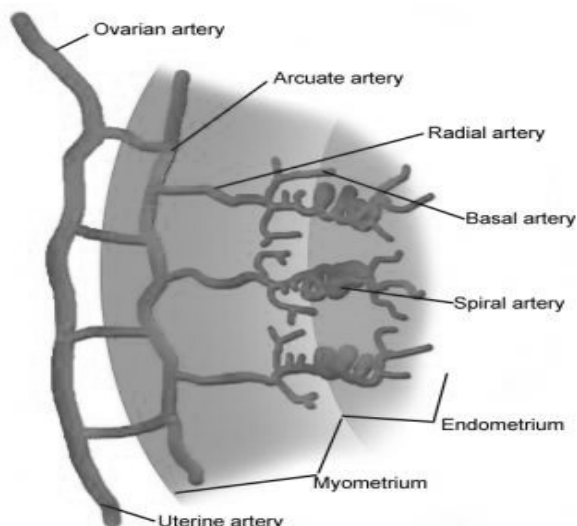


Fig. 1. Schematic presentation of the endometrial vascular system. The primate endometrium is composed of the stratum basalis and stratum functionalis. Uterine arteries branch within the myometrium to yield the arcuate and radial arteries.

rine fibromas, multiple pregnancy, fetal macrosomia, obesity BMI>35, general anaesthesia, failure to progress in the second stage, prolonged third stage of labor, retained placenta, placenta accreta, episiotomy, perineal laceration [13-16]. Clinicians must be aware of risk factors for PPH and should take these into account when counselling women about place and modality of the delivery. Women with significant risk factors for PPH should deliver in a unit with rapid access to blood and blood products. Women with known risk factors for PPH should only be delivered in a hospital with a blood bank on site [17, 18].

Prophylaxis. In order to minimize the risk of PPH we have to reduce blood loss during delivery.

To assure minimal blood loss during delivery several measures are proposed in international protocols:

1. Correction of anaemia.
 - Screening for anaemia at the first antenatal visit and appropriate investigations should be offered to all pregnant women [19, 20]
 - The aim of antenatal care is to ensure a haemoglobin level at 110 gms/dl
 - In order to prevent anemia iron and folate supplementation should be offered to all pregnant women
 - The most common cause of anaemia in pregnancy is iron deficiency [21, 22]
 - Iron should be replaced orally or by iron infusion. Parenteral iron will be given if oral iron is not tolerated or not absorbed or the term is approaching and there is no time for oral supplementation to be effective [23-24]
 - If hemoglobin level is less than 8gms/dl further investigation should be done to diagnose the cause of anemia [25]. Hemoglobin level should be checked in all women at the onset of labor. If less than 10gms/dl, they should be referred to continue labor in the referral hospital where blood is available on site [26, 27].

2. Identification of patients who refuse blood transfusion. Some women refuse the use of blood products for religious pregnant women may refuse blood transfusion because of their religious believes or infection reason. Pregnant women who refuse blood transfusion are at increased risk of severe morbidity, maternal death and perinatal complications [28, 29, 30]. In these patients all the steps should be done to minimize the risk of PPH. Antenatal care and delivery in a level 2 or 3 hospital under specialist supervision and specialist consultation at haematology department [31]:

- Optimization of iron stores with haemetics
- Delivery in the facility with availability of Haemopure (a blood analogue)
- Delivery in the facility with availability of auto transfusion (cell salvage technique)



Fig. 2. Anterior placenta in the third trimester of pregnancy: hyperechoic placenta is surrounded by the hypoechoic myometrium, some calcifications and vascular lacks are seen.

- Early use of uterotonic agents, oxytocin 5 iu by slow intravenous injection for prophylaxis in the context of caesarean delivery and for women delivering vaginally, oxytocin 10 iu by intramuscular injection is the regimen of choice for prophylaxis in the third stage of labour. Intramuscular oxytocin should be administered with the birth of the anterior shoulder, or immediately after the birth of the baby and before the cord is clamped and cut.
 - Early application of surgical procedures to stop the hemorrhage [32-36].
3. Determination of placental localization via ultrasound (fig. 2).
- Recognition, preparation and management of women with placenta praevia decrease the risk of catastrophic haemorrhage.
 - Patients with suspected morbidly adherent placentation should be detected before delivery in order to organize the delivery in the specialized units [37, 38].
4. Use of oxytocin and prostoglandins. Induction of labor should be done with precautions and with strict indications because using excessive dose of prostaglandins and oxytocin can lead to uterine rupture. Induction with prostaglandins in the presence of uterine activity can provoke uterine. Inappropriate use of oxytocin if fetopelvic disproportion or malpresentation are suspected can lead to uterine rupture [39, 40, 41].
5. No to the "Active management of the third stage of labour". The administration of a prophylactic uterotonic after the delivery of a baby and the controlled cord traction are recommended. The agent of choice for prophylaxis in the third stage of labour is oxytocin 10 iu by intramuscular injection [42, 43, 44]. In comparison with the active management, the expectant management involves waiting for signs of placenta separation and spontaneous delivery. Compared with expectant management, the active management of the third stage of labour is associated with a substantial reduction of PPH [45,46]. Active management of the third stage includes routine early clamping of the umbilical cord. A systematic review showed that delaying clamping for at least 2 minutes is beneficial to the newborn and that the benefits extend into infancy [47, 48]. That is why active management of the third stage of labour can no longer be recommended [49].
6. Routine episiotomy. Episiotomy means incision of the perineum in order to enlarge the vaginal orifice during the second stage of labor. It can laterally be done midline or medio-lateral. There are routine episiotomy that is done for every birth and restrictive episiotomy- only under indications. Restrictive episiotomy results in less severe perineal trauma. Restrictive episiotomy results in less posterior perineal trauma, less suturing and fewer PPH rates [50, 51, 52].
7. Use of partogram in labour. The partograph is a graphic record of the progress of labour and relevant details of the mother and fetus. Use of partogram helps to assure

appropriate care and monitoring of women in labour because it is an early warning system to detect labour that was not progressing normally [53, 54]. The partograph has been shown to be effective in:

- Prevention of prolonged labor with the associated PPH due to the uterine atony,
- Prevention of prolonged labor with the associated PPH due to the chorioamnionitis,
- Prevention of prolonged obstructed labor- the uterine rupture and associated catastrophic haemorrhage,
- Prevention of scar dehiscence and uterine rupture in case of women having labour after one caesarean section [54, 55, 56].

8. Close monitoring during first 2 hours after birth. Following delivery all women will be observed in the delivery room for 2 hours. The observation include her general physical condition, as shown by her colour, respiration and her own report of how she feels, the vaginal blood loss, blood pressure, heart rate. Early detection of PPH before blood loss has become severe and will result in earlier initiation of resuscitation and definitive treatment to arrest haemorrhage, thus reducing the morbidity from the PPH [58, 59, 60].

Diagnosis. The diagnosis of PPH is established by observing the amount of bleeding and the patient's clinical status. Physiological increase in circulating blood volume during pregnancy means that the signs of hypovolemic shock become less sensitive [61, 62].

Tachycardia, tachypnoea and a slight recordable fall in systolic blood pressure occur with blood loss of 1000–1500 ml. A systolic blood pressure below 80 mmHg, associated with worsening tachycardia, tachypnoea and altered mental state, usually indicates a PPH in excess of 1500 ml [63, 64, 65].

Blood loss estimation. We have taken into consideration that estimation of blood loss is notoriously inaccurate, especially with excessive bleeding. Also, physiological changes of pregnancy may mask the severity of blood loss. Clinical signs and symptoms should be included in the assessment of PPH. Estimation of blood loss should begin immediately after the infant's birth and prior to delivery of the placenta. Urinary catheter should be placed as soon as possible. All blood-soaked materials and clots should be taken into consideration to determine cumulative volume. 1 gram weight = 1 milliliter blood loss volume [67, 69, 70].

Methods of measuring blood loss were divided into five categories:

- ✓ Visual estimation,
- ✓ Direct measurement,
- ✓ Gravimetric,
- ✓ Photometry,
- ✓ Miscellaneous methods.

For this purpose a basin in front of the external genitalia, a douche pan, underbuttocks drapes with a graduated pouch for measurement, weigh sponges and suction contents placed on a scale can be used.

Clinical signs of hemorrhage are: cool extremities, decreased urine output, dizziness, marked pallor, hypotension with sitting, anxious state, oliguria / anuria, agitation, confusion, loss of consciousness, unstable blood pressure [71,72,73].

Causes of PPH: The modern approach to the postpartum haemorrhage implies the 4T approach (tab. 1) that means implications of 4 factors in the realisation of haemostasis [74, 75, 76].

These 4 T of obstetric hemorrhage are:

1. Tone (Uterine atony).
2. Trauma (Genital trauma including damage to vulva, vagina, cervix and uterus).
3. Tissue (Retained and invasive placenta).
4. Thrombin (Coagulopathy).

Table 1

“4 T” causes of post-partum hemorrhage

<p>Tissue. Placental causes: Retained placenta Retained clots Placenta previa Placenta accreta/increta/percreta Hydatiform mole</p>	<p>Tone. Uterine atony. Hyperstimulation High parity Obstructed labor Early preterm labor Uterine overdistention Large fetus- estimated fetal weight > 4kg Multiple fetuses Hydramnios Labor induction Anesthesia or analgesia Halogenated agents Conduction analgesia with hypotension Labor abnormalities Rapid labor Prolonged labor Augmented labor Previous uterine atony Chorioamnionitis Sepsis syndrome</p>
<p>Trauma. Injuries to the birth canal Episiotomy and lacerations Forceps or vacuum delivery Cesarean delivery or hysterectomy Uterine rupture Previously scarred uterus Intrauterine manipulation Midforceps rotation Breech extraction Shoulder dystocia</p>	<p>Thrombin. Coagulopathy Congenital coagulopathies Placental abruption Sepsis syndrome Severe preeclampsia Syndrome Acute fatty liver Anticoagulant treatment Amnionic-fluid embolism Prolonged retention of dead fetus Massive transfusions</p>

If the placenta is out, the most common cause is uterine atony, diagnosed by palpation of a poorly contracted uterus. This is first done by knowing if the placenta has been delivered or not. If retained then the management follows along the retained placenta route in the algorithm. Perineal tears will be diagnosed on routine inspection after vaginal deliv-

ry. If there is no response to oxytocin infusion additional oxytocic agents should be given as indicated in the algorithm. First line is represented by ergometrine and misoprostol, but intramyometrial PGF2alpha requires a special indications to administer. However at this stage, in the presence of persisting bleeding, it is very important to exclude another cause such as deep vaginal lacerations, cervical tears and/or retained fragments of placenta or membranes.

Conclusions

The knowledge of prophylaxis measures is useful to reduce maternal mortality and morbidity from PPH. Actually, for prophylaxis of postpartum hemorrhage, evidence based medicine recommend correction of anaemia, use of the partograph in labor and the close supervision first two hours after the delivery.

References

1. Khan KS, Wojdyla D, Say L, et al. WHO analysis of causes of maternal death: a systematic review. *Lancet*. 2006;367(9516):1066-74.
2. Penney G, Brace V. Near miss audit in obstetrics. *Curr Opin Obstet Gynecol*. 2007;19:145-50.
3. Royal College of Obstetricians and Gynaecologists (RCOG). Improving patient safety: risk management for maternity and gynaecology . London: RCOG; 2009. 10 p. (Clinical Governance Advice; no. 2).
4. National Collaborating Centre for Women's and Children's Health. Caesarean Section. London: RCOG; 2011.
5. Begley C, Gyte G, Devane D, et al. Active versus expectant management for women in the third stage of labour. *Cochrane Database Syst Rev*. 2015;(3):CD007412. doi: 10.1002/14651858.CD007412.pub4.
6. Al-Zirqi I, Vangen S, Forsen L, et al. Prevalence and risk factors of severe obstetric haemorrhage. *BJOG*. 2008;115(10):1265-72.
7. Royal College of Obstetricians and Gynaecologists (RCOG). Antepartum haemorrhage. London: RCOG; 2011. 23 p. (Green-top guideline; no. 63).
8. Combs CA, Murphy EL, Laros RK Jr. Factors associated with postpartum hemorrhage with vaginal birth. *Obstet Gynecol*. 1991;77(1):69-76.
9. Rath WH. Postpartum hemorrhage – update on problems of definitions and diagnosis. *Acta Obstet Gynecol Scand*. 2011;90(5):421-8.
10. World Health Organization. WHO recommendations for the prevention and treatment of postpartum haemorrhage. Geneva: WHO; 2012. 48 p.
11. Oyelese Y, Ananth CV. Postpartum hemorrhage: epidemiology, risk factors, and causes. *Clin Obstet Gynecol*. 2010;53(1):147-56.
12. Schuurmans N, MacKinnon K, Lane C, et al. Prevention and management of postpartum haemorrhage. *J Soc Obstet Gynaecol Can*. 2000;22(4):271-81.
13. Centers for Disease Control and Prevention [Internet]. Reproductive Health: Pregnancy Mortality Surveillance System; [cited 2017 Oct 29]. Available from: <https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html>
14. World Health Organization. Evaluating the quality of care for severe pregnancy complications: the WHO nearmiss approach for maternal health. Geneva: WHO; 2011. 29 p.
15. Dildy GA 3rd. Postpartum hemorrhage: new management options. *Clin Obstet Gynecol*. 2002 Jun;45(2):330-44.
16. Royal College of Obstetricians and Gynaecologists (RCOG). Placenta praevia, placenta praevia accreta and vasa praevia: diagnosis and management. London: RCOG; 2011. 26 p. (Green-top guideline; no. 27).
17. World Health Organization (WHO). Reducing the global burden: postpartum haemorrhage. *Making Pregnancy Safer*. 2007;4:[8 p].

18. Xiong X, Buekens P, Alexander S, et al. Anemia during pregnancy and birth outcome: a meta-analysis. *Am J Perinatol.* 2000;17(3):137-46.
19. Pavord S, Myers B, Robinson S, et al.; British Committee for Standards in Haematology. UK guidelines on the management of iron deficiency in pregnancy. *Br J Haematol.* 2012;156(5):588-600.
20. National Institute for Health and Care Excellence. Intrapartum care: care of healthy women and their babies during childbirth. Manchester: NICE; 2014. 839 p. (NICE clinical guideline; no. 190).
21. Cantwell R, Clutton-Brock T, Cooper G, et al. Saving Mothers' Lives: reviewing maternal deaths to make motherhood safer: 2006–2008. The eighth report on confidential enquiries into maternal deaths in the United Kingdom. *BJOG.* 2011;118(Suppl 1):1-203.
22. Novikova N, Hofmeyr GJ, Cluver C. Tranexamic acid for preventing postpartum haemorrhage. *Cochrane Database Syst Rev.* 2015;(6):CD007872.
23. Hofmeyr GJ, Abdel-Aleem H, Abdel-Aleem MA. Uterine massage for preventing postpartum haemorrhage. *Cochrane Database Syst Rev.* 2013;(7):CD006431.
24. McDonald SJ, Abbott JM, Higgins SP. Prophylactic ergometrine-oxytocin versus oxytocin for the third stage of labour. *Cochrane Database Syst Rev.* 2004;(1):CD000201.
25. Tuncalp O, Hofmeyr GJ, Gulmezoglu AM. Prostaglandins for preventing postpartum haemorrhage. *Cochrane Database Syst Rev.* 2012;(8):CD000494.
26. World Health Organization. WHO guidelines for the management of postpartum haemorrhage and retained placenta [Internet]. Geneva: WHO; 2009; [cited 2017 March 3]. 62 p. Available from: http://whqlibdoc.who.int/publications/2009/9789241598514_eng.pdf
27. World Health Organization. Knowledge to action (KTA) framework and the G.R.E.A.T project. Geneva: WHO; 2010; [cited Sep 15]. Available from: http://www.who.int/reproductivehealth/topics/best_practices/greatproject_KTAframework/en/index.html
28. Van Wolfswinkel ME, Zwart JJ, Schutte JM, et al. Maternal mortality and serious maternal morbidity in Jehovah's witnesses in The Netherlands. *BJOG.* 2009 Jul;116(8):1103-8.
29. World Health Organization. Guidelines on basic newborn resuscitation. Geneva: WHO; 2012; [cited 2017 March 3]. Available from: http://apps.who.int/iris/bitstream/am/10665/75157/1/9789241503693_eng.pdf
30. World Health Organization. The WHO Reproductive Health Library. Geneva; 2012.
31. Royal College of Obstetricians and Gynaecologists. Blood transfusion in obstetrics. London: RCOG; 2015. 23 p. (Green-top Guideline; no. 47).
32. World Health Organization. Introducing WHO's sexual and reproductive health guidelines and tools into national programmes: principles and process of adaptation and implementation. Geneva: WHO; 2007. 33 p.
33. Mousa HA, Alfirevic Z. Treatment for primary postpartum haemorrhage. *Cochrane Database Syst Rev.* 2007;(1):CD003249.
34. Currie J, et al. Management of women who decline blood and blood products in pregnancy. *The Obstetrician and Gynaecologist.* 2010;12:13-20.
35. Fotopoulou C, Dudenhausen JW. Uterine compression sutures for preserving fertility in severe postpartum haemorrhage: an overview 13 years after the first description. *J Obstet Gynaecol.* 2010;30:339-49.
36. 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.e1-4.
37. World Health Organization. WHO multicountry survey on maternal and newborn health 2010-2012. Geneva: WHO; 2012.
38. World Health Organization. Managing complication in pregnancy and childbirth: a guide for midwives and doctors. Geneva: WHO; 2000. 390 p.
39. Campbell OM, Graham WJ; Lancet Maternal Survival Series Steering Group. Strategies for reducing maternal mortality: getting on with what works. *Lancet.* 2006;368(9543):1284-99.
40. Baskett TF. Complications of the third stage of labour. In: *Essential Management of Obstetrical Emergencies.* 3rd ed. Bristol (England): Clinical Press; 1999. p. 196-201.
41. Sheiner E, Sarid L, Levy A, Seidman DS, Hallak M. Obstetric risk factors and outcome of pregnancies complicated with early postpartum hemorrhage: a population-based study. *J Matern Fetal Neonatal Med.* 2005 Sep;18(3):149-54.
42. Pattinson RC, Say L, Makin JD, et al. Critical incident audit and feedback to improve perinatal and maternal mortality and morbidity. *Cochrane Database Syst Rev.* 2005;(4):CD002961.
43. Royal College of Obstetricians and Gynaecologists. Clamping of the umbilical cord and placental transfusion. London: RCOG; 2015. 9 p. (Scientific Impact Paper; no. 14).
44. Begley CM, Gyte GM, Devane D, et al. Active versus expectant management for women in the third stage of labour. *Cochrane Database Syst Rev.* 2011;(11):CD007412.
45. Cotter A, Ness A, Tolosa J. Prophylactic oxytocin in the third stage of labour. *Cochrane Database Syst Rev.* 2001 (4):CD001808.
46. Orji E, et al. A randomized comparative study of prophylactic oxytocin versus ergometrine in the third stage of labour. *Int J Gynaecol Obstet.* 2008;101(2):129-32.
47. Su LL, Chong YS, Samuel M. Oxytocin agonists for preventing postpartum haemorrhage. *Cochrane Database Syst Rev.* 2007;(3):CD005457.
48. Gülmezoglu AM, et al. Prostaglandins for preventing postpartum haemorrhage. *Cochrane Database Syst Rev.* 2007;(3):CD000494.
49. Poeschmann RP, Doesburg WH, Eskes TK. A randomized comparison of oxytocin, sulprostone and placebo in the management of the third stage of labour. *B J Obstet Gynaecol.* 1991;98(6):528-30.
50. Al-Zirqi I, Vangen S, Forsen L, et al. Effects of onset of labor and mode of delivery on severe postpartum hemorrhage. *Am J Obstet Gynecol.* 2009;201:273.e1-9.
51. 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.
52. Holm C, Langhoff-Roos J, Petersen KB, et al. Severe postpartum haemorrhage and mode of delivery: a retrospective cohort study. *BJOG.* 2012;119:596-604.
53. 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;158:183-8.
54. World Health Organization. WHO Handbook for guideline development. Geneva: WHO; 2012. 63 p.
55. 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.
56. Royal College of Obstetricians and Gynaecologists. Placenta praevia: diagnosis and management. London (England): RCOG Press; 2001. (Green-top guideline; no 27).
57. Cameron CA, Robberts CI, Bell J, et al. Getting an evidence-based post-partum haemorrhage protocol into practice. *Aus N Z J Obstet Gynecol.* 2007;47:169-75.
58. FIGO-ICM Joint statement management of the third stage of labour to prevent post-partum hemorrhage, 2003.
59. Lalonde A; FIGO Safe Motherhood and Newborn Health (SMNH) Committee. Prevention and treatment of postpartum hemorrhage in low-resource settings - FIGO guidelines. *Int J Gynecol Obstet.* 2012;117(2):108-18.
60. AbouZahr C. Global burden of maternal death and disability. *Br Med Bull.* 2003;67:1-11.
61. International Confederation of Midwives (ICM), International Federation of Gynaecology and Obstetrics (FIGO). Joint statement: Management of the third stage of labour to prevent post-partum haemorrhage. New York: FIGO, ICM; 2003.
62. Royal College of Obstetricians and Gynaecologists. Prevention and management of postpartum haemorrhage. London: RCOG; 2009. (Green-top guideline; no 52).

63. World Health Organization. The selection and use of essential medicines: Report of the WHO Expert Committee, 2011. Geneva: World Health Organization; 2011. 268 p.
64. Siassakos D, Crofts JF, Winter C, et al. The active components of effective training in obstetric emergencies. *BJOG*. 2009;116:1028-32.
65. United Nations. UN Commission on life-saving commodities for women and children. Commissioners' Report: Sep 2012. New York: United Nations; 2012.
66. Karanja J, Muganyizi P, Rwamushaija E, Hodoglugil N, Holm E. Regional Experts' Summit Group. Confronting maternal mortality due to postpartum hemorrhage and unsafe abortion: a call for commitment. *Afr J Reprod Health*. 2013;17(2):18-22.
67. Lalonde A; International Federation of Gynecology and Obstetrics. Prevention and treatment of postpartum hemorrhage in low-resource settings. *Int J Gynaecol Obstet*. 2012;117(2):108-18.
68. Ejembi CL, Norick P, Starrs A, et al. New global guidance supports community and lay health workers in postpartum hemorrhage prevention. *Int J Gynaecol Obstet*. 2013;122(3):187-90.
69. Blake S, Cody A, Kaur A, et al. Maternal Health Task Force. Global Health Vision. UN Commission on life saving commodities for women and children: country case studies. New York: United Nations; 2012.
70. World Health Organization (WHO). Optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting. Geneva: WHO; 2012. 98 p.
71. Marino P. The ICU Book. 3rd ed. Philadelphia: Lippincot Williams & Wilkins; 2007. Section 5, Disorders of circulatory flow, Haemorrhage and hypovolaemia. p. 211-33.
72. Geller SE, Adams MG, Kelly PJ, Kodkany BS, Derman RJ. Postpartum hemorrhage in resource-poor settings. *Int J Gynecol Obstet*. 2006;92:202-11.
73. Seligman B, Liu X. Economic assessment of interventions for reducing postpartum hemorrhage in developing countries. Bethesda (MD): Abt Associates Inc; 2006. 73 p.
74. Sentilhes L, Vayssière C, Deneux-Tharaux C, et al. Postpartum hemorrhage: guidelines for clinical practice from the French College of Gynaecologists and Obstetricians (CNGOF): in collaboration with the French Society of Anesthesiology and Intensive Care (SFAR). *Eur J Obstet Gynecol Reprod Biol*. 2016 Mar;198:12-21.
75. Society of Obstetrics and Gynecology of Canada. Advances in Labour and Risk Management (ALARM) Course Manual. 15th ed. Ottawa: SOGC; 2008. Postpartum hemorrhage.
76. Floyd RC, Morrison JC. Postpartum hemorrhage. In: Plauche WC, Morrison JC, O'Sullivan MJ, editors. *Surgical Obstetrics*. Philadelphia (Pa): Saunders; 1992. p. 373-82.

