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EMERGENCIES IN OBSTETRICS' ANESTHESIA

Karadjova D[1]

[1]University Clinic for Gynecology and Obsterics, Department of anesthesia, reanimation and intensive care, Clinical Center, Skopje, Macedonia

In obstetric anesthesia emergencies, the anesthesiologist and obstetrician-gynecologist must focus their attention on the well-being of both the mother and the unborn child. To maintain the well-being of the child, the mother's vital functions must be stable at all times.
There are several emergency conditions, but in this presentation, we will focus first on postpartum hemorrhage and hypertensive disorders in pregnancy, as the most common causes of maternal mortality, and further on cardiopulmonary arrest and cardiopulmonary resuscitation of a pregnant woman as the most urgent condition.

Postpartum hemorrhage

Postpartum hemorrhage (PPH) is an obstetric emergency and is one of the top five causes of maternal mortality in both developed and developing countries, although maternal mortality is significantly lower in developed countries (1). It is estimated that PPH is responsible for approximately 100,000 deaths annually. In general, PPH occurs in 1-3% of deliveries, with a tendency of constant increase.
Timely recognition, availability of appropriate resources and appropriate response are key factors to prevent death.
The World Health Organization defines PPH as blood loss ≥500mL within 24 hours of birth, while severe PPH is defined as blood loss ≥1000mL within the same time frame. However, the classic definition of PPH is the most often used for diagnosis: estimated blood loss is ≥500mL after vaginal birth or ≥1000mL after cesarean delivery.
Primary or early PPH refers to PPH that occurs within the first 24 hours after delivery, and secondary or late PPH refers to bleeding that occurs 24 hours to 12 weeks after delivery.
Many risk factors for PPH have been reported and the same are often interdependent. The greatest risk factors associated with the highest chances of PPH are abnormal placentation, placental abruption, hypertensive disorders in pregnancy, intrauterine fetal death, lacerations, instrumental termination of birth, large newborns.
Whenever possible, patients with risk factors for PPH should be identified. Preparation for PPH is an early detection of PPH, and availability of all resourcesat all times. Coordination and multidisciplinary cooperation are essential.
After delivery, vaginal or cesarean, all patients with persistent excessive bleeding should be immediately evaluated by the obstetrician who led the delivery. Assessment primarily involves quantifying blood loss using graduated volumetric containers and weighing scales or using visual aids.
On time recognition of PPH followed by prompt determination of the cause and initiation of appropriate treatment is critical to prevent death, as nearly 90% of deaths due to PPH occur

within four hours of delivery. That's why it's important to recognize the warning signs and intervene early. In order to recognize alarm signs, monitoring of vital signs, determination of shock index, examination of coagulation status, fibrinogen and thrombo-elastography (TEG), should be performedwhere available.
Insight into the medications the patient is receiving, should always be maintained, as some medications may have unexpected hemodynamic side effects and simulate a false scenario (for e.g.,beta blockers, antihistamines).
In the prevention of PPH, active management of the third birth period plays the biggest role. It usually consists of drug prophylaxis just before or after birth along with controlled traction of the umbilical cord. The most important prophylactic intervention is slow intravenous administration or a short infusion of 3 - 5 I.U. oxytocin (Syntocinon) after the delivery of the child.
Treatment of PPH is based on a combination of factors, but the key to managing postpartum hemorrhage is to recognize excessive bleeding before it becomes life-threatening, identify the cause, and initiate appropriate interventions. Initial interventions include:

- Calling for help because the treatment of PPH requires a multidisciplinary approach;
- Monitoring vital signs and quantifying blood loss;
- Moving unstable patients to the operating room.
- Establishing adequate intravenous (IV) access - with two lines, with high volume for administration of fluids, blood and drugs;
- Resuscitation with controlled amounts of crystalloids while the preparation for obtaining blood and blood products continues. Regardless of the cause of PPH, initial circulatory support with crystalloids is required in all patients. Early recourse to blood and blood product replacement is recommended when bleeding is severe in order to rapidly replace lost platelets and coagulation factors and minimize the risk of dilutional coagulopathy, electrolyte imbalance, and hypothermia;
- Provision of adequate analgesia;
- Inspection of the lower genital tract and uterus to determine the cause of bleeding and start of surgical treatment of the cause of bleeding;
- Administration of 1g of tranexamic acid in the first 3 hours from the start of PPH. Tranexamic acid is an antifibrinolytic and is useful in the early stages of major postpartum and traumatic bleeding when increased fibrinolytic activity and depletion of fibrinogen are common. Delay in treatment, even if short, reduces the benefit of tranexamic acid administration (2).

If bleeding continues:

- Transfusion of erythrocytes (Er) and fresh frozen plasma (FFP) according the recommendations for the Er: SSP ratio vary. Usually, 1 SSP per 1 or 2 units of Er, or 4 SSP per 6 units Er is recommended. At times when massive transfusion is required, the recommended Er: SSP: Tr ratio is 1:1:1 (3,4);
- Correction of fibrinogen. The normal level of fibrinogen in pregnancy is almost twice as high as in nonpregnant patients and falls to a critical low level earlier than other coagulation factors during PPH and is a more sensitive indicator of ongoing major blood

loss. Although SSP contains small amounts of fibrinogen, cryoprecipitate and fibrinogen concentrate are preferred for the treatment of hypofibrinogenemia;

- Prothrombin complex concentrate - (PCC) can be used as an alternative to SSP. Perceived advantages are reduced risk of volume overload, no need for thawing or blood typing, and reduced risk of transfusion-related acute lung injury (TRALI) and allergic reactions;
- Maintain oxygenation with oxygen >95% by giving O_2 (10-15l/min). The anesthesiologist should assess the patient's airway and breathing and intubate if indicated. A high flow mask and correct flow rate is important as a low oxygen flow rate can result in CO_2 retention and worsen the condition;
- Avoidance of hypothermia and acidosis, which increase the risk of clinically significant bleeding. Blood products should be properly warmed, and patient’s warming devices should be used.

In patients with blood loss >1500mL and ongoing excessive bleeding refractory to medical and minimally invasive interventions, it is important to move quickly to more aggressive treatment, including laparotomy, hysterectomy, which should not be delayed if bleeding cannot be promptly controlled. Massive bleeding requires additional preparations: placement of two large-bore IV catheters for volume administration, placement of a central venous catheter for administration of vasopressors, coordination of the planned massive transfusion with the blood bank, and consideration of the use of the intraoperative blood cell salvage device.
Ensuring adequate anesthesia is also an important factor in the treatment of patients with PPH. Neuraxial anesthesia is usually the preferred technique for cesarean section and most procedures performed for postpartum hemorrhage. It may be appropriate for patients who are hemodynamically stable and without evidence of coagulopathy. Neuraxial anesthesia causes sympathectomy and vasodilation and may cause severe hypotension or hemodynamic collapse in patients with clinically significant hypovolemia and may be contraindicated in patients who develop dilutional or consumptive coagulopathy.
But if PPH is serious or likely to become serious, general anesthesia is preferred. Advantages of general anesthesia for patients with severe PPH include the following: secure airway, muscle relaxation, easier vascular access, unconscious patient. Induction of general anesthesia should not be delayed once the need for it is determined, as ongoing IV fluid resuscitation can cause airway edema and difficulty with endotracheal intubation. Induction of anesthesia can cause cardiovascular collapse in severely hypovolemic patients, so continuous IV volume resuscitation and administration of vasopressors should be maintained if necessary. Etomidate (20mg IV) or ketamine (0.5 to 1mg/kg IV) is recommended instead of propofol for induction to minimize the risk of hypotension. Airway edema and difficult airway should be expected.
Key things in the management of PPH include recognizing excessive bleeding before it becomes life-threatening, identifying the cause and appropriate intervention.

Hypertensive disorders in pregnancy
Hypertensive disorders in pregnancy belong to obstetric emergencies and are one of the main causes of maternal mortality.

The most common 4 hypertensive disorders that occur in pregnant patients are: preeclampsia, eclampsia, HELLP syndrome, gestational hypertension, chronic hypertension, and preeclampsia superimposed on chronic hypertension.
In this presentation, we will focus on the treatment of preeclampsia with severe features, eclampsia and HELLP syndrome, because these disorders usually require urgent treatment.
The definitive treatment of preeclampsia, eclampsia and HELLP syndrome, is delivery to prevent maternal or fetal complications from disease progression. In certain premature pregnancies with preeclampsia, expectant management is preferred, but if the risks associated with expectant management are greater than any potential benefits, immediate delivery is recommended (5).
Treatment of these patients includes:

- Administration of magnesium sulfate for seizure prophylaxis, as well as for neuroprotection of the newborn in case of premature delivery (6);
- Frequent monitoring of blood pressure, given the risk of severe hypertension;
- Careful recording of fluid intake and urine output, considering the risk of pulmonary edema (7);
- Laboratory analyses, including complete blood count, electrolytes, degradation products, liver enzymes, coagulation factors. Laboratory tests are repeated every 6 to 12 hours, while the patient is in the intensive care unit;
- Acute treatment of severe hypertension. Labetolol and hydralazine are drugs of choice in the treatment of severe hypertension (8);
- Magnesium sulfate ($MgSO_4$) – For patients with eclampsia, treatment with intravenous magnesium sulfate is recommended. A 6-gram initial dose over 15 to 20 minutes, followed by a 2-gram/hour continuous intravenous infusion, is commonly used as a maintenance dose. Maintenance doses may be increased or decreased, and deep tendon reflexes, respiratory rate, and urine output should always be monitored.

Anesthesiology Approach to Hypertensive Disorders in Pregnancy
Anesthesiologists should generally evaluate patients with preeclampsia early in the labor period. Evaluation should focus on airway, hemodynamic status and coagulation abnormalities. Particular attention is paid to airway assessment due to airway edema associated with preeclampsia and eclampsia.
For anesthesia, neuraxial techniques are always recommended and preferred if not contraindicated. Thrombocytopenia and other coagulopathies in association with preeclampsia/eclampsia/HELLP may preclude neuraxial anesthetic techniques due to the risk of spinal epidural hematoma. Apart from the number of platelets, the dynamics of the number of platelets over time is also very important. In the absence of other coagulopathies, an epidural catheter is safe to place in patients with a platelet count >75,000/microL, it is not safe if the platelet count is ≤50,000/microL, and individualized decisions are needed for patients with a platelet count between 50,000 and 75,000/microl (9). In terms of analgesia for painless delivery, placement of an epidural catheter early in labor is preferable, especially for patients with declining platelet counts. Continuous epidural analgesia attenuates the hypertensive response to labor pain, reduces circulating catecholamines, and provides a means of rapid conversion to surgical neuraxial anesthesia and avoidance of general anesthesia. Prophylactic, titrated administration of a low-dose infusion of phenylephrine is recommended to prevent hypotension induced by neuraxial anesthesia in these patients, while ephedrine is alternatively recommended in patients with bradycardia.

Caution is needed with fluids in patients with preeclampsia/eclampsia/HELLP and limitation of intravenous fluids to avoid pulmonary edema. Recommendations are 80-100mL/hr IV, also restrictive fluid volumes during initiation of neuraxial analgesia or anesthesia.
Neuraxial techniques are preferred for caesarean section anesthesia whenever possible. The most important advantage of neuraxial anesthesia is that it avoids severe hypertension, which can be life-threatening. On the other hand, it also avoids the need for endotracheal intubation, which can be particularly difficult in these edematous patients, and avoids the need for the administration of neuromuscular blocking agents. Induction of general anesthesia for these patients should always include steps to minimize or eliminate the hypertensive response to intubation.
The anesthesiologist's choice of a particular neuraxial technique is based on many factors, including the urgency and expected duration of labor. The obstetrician and the anesthetist should discuss these factors before starting anesthesia.

Cardiopulmonary resuscitation in pregnancy
Cardiopulmonary arrest (CPA) in pregnancy is a rare, life-threatening condition that affects two patients: the mother and the fetus. The treatment of these patients requires a rapid multidisciplinary approach. Basic and advanced life support algorithms should be implemented to manage these patients, but the physiological and anatomical changes of pregnancy require certain modifications to these protocols. Randomized trials on the treatment of pregnant women with cardiopulmonary arrest are lacking, and therefore, recommendations for these modifications are based on expert opinion and data from small case series and small cohort studies involving patients with cardiopulmonary arrest during cesarean delivery.
The prevalence of cardiopulmonary arrest in pregnancy ranges from 1 in 20,000 to 1 in 50,000 pregnant patients.
Etiological CPA in pregnant women can be the result of conditions characteristic of pregnancy, but also conditions unrelated to pregnancy. The most common causes of CPA are pulmonary embolism, hemorrhage, sepsis, peripartum cardiomyopathy, preeclampsia/eclampsia, complications related to anesthesia (difficult or impossible intubation, high spinal block, toxicity of local anesthetics), amniotic fluid embolism, myocardial infarction, preexisting heart disease, trauma.
Cardiopulmonary resuscitation (CPR) includes the following maneuvers and interventions performed simultaneously:

- Activation of the team for resuscitation of a pregnant woman and team approach (anesthesiologist, obstetrician, neonatologist, cardiologist);
- Manual displacement of the uterus laterally and to the left if the uterus is at or above the umbilicus to minimize aortocaval compression, optimize venous return, and ensure adequate stroke volume during CPR. Manual displacement of the uterus allows the patient's upper torso to remain supine, which allows for more effective chest compressions, improves airway, intravenous access, and improves defibrillation access;
- Starting with chest compressions (100-120 compressions per minute) with the same hand position as in non-pregnant women (10);
- Early intubation is recommended to secure an airway, but always consider a difficult airway and have additional devices for difficult intubation ready. Pregnant women are at increased risk of rapid development of hypoxemia due to reduced functional residual capacity and increased oxygen consumption, as well as increased intrapulmonary

shunting. Smaller volume ventilation with 100% O_2 (approximately 350 to 500mL) is recommended in large pregnancies with a uterus above the umbilicus;

- Do not delay defibrillation and administration of drugs;
- Adrenaline 1mg every 3-5 minutes in patients with asystole, antiarrhythmics, discontinuation of $MgSO_4$, lipid emulsion in the treatment of toxicity from local anesthetics;
- Intravenous access above the diaphragm;
- Use end-tidal CO_2 monitoring to see the return of spontaneous circulation.;
- To assess the gestational age of the fetus;
- Fetal monitoring during resuscitation is not recommended;
- When four minutes have passed since the mother's cardiac arrest began, someone should alert the entire team. If there is no return of spontaneous circulation with the usual resuscitation measures and the uterine fundus is at or above the umbilicus, perimortem caesarean section should be initiated at four minutes and full delivery of the infant within five minutes after CPA. If there are conditions for instrumental termination of birth in this time interval, it is also recommended. These measures are labeled as "four minutes rule" and "five minutes rule" (11). Delivery should take place at the CPR site. In pregnant women, delivery early in the resuscitation process is a key intervention to improve CPR success rates. Cardiac output peaks immediately after delivery as the laboring uterus contracts and blood from the myometrial veins is auto-transfused into the systemic circulation and the vena cava rises, resulting in greater venous return to the heart and increased cardiac output. Although it may seem inappropriate to operate on a hemodynamically unstable patient, cesarean delivery can be lifesaving for both mother and fetus in this condition. But practically, the few available studies show that the "five minutes rule" is difficult to achieve. However, even if labor does not occur within four to five minutes, a perimortem caesarean section can still be helpful. The minimum gestational age for perimortem caesarean section is recommended ≥20 weeks of gestation and the uterus at or above the umbilicus;
- After 15 minutes of unsuccessful resuscitation, direct cardiac massage is initiated if adequate resources and personnel are available;
- The reanimation is continued until all resources are exhausted and then the whole team decides to stop the CPR;
- Factors causing or contributing to cardiac arrest should be treated at the same time (e.g., bleeding, electrolyte abnormalities, tamponade, hypothermia, hypovolemia, hypoxia, hypermagnesemia, myocardial infarction, poisoning, embolism, anaphylaxis, tension pneumothorax, complications of anesthesia, aortic dissection).

Table 1. Antihypertensive agents used for immediate control of blood pressure in pregnancy.

Medicine	Initial dose	Maintenance dose
Labetolol	20mg IV gradually over 2 min.	In 10 minutes: 40 mg IV over 2 min.

	Continuous IV infusion 1-2 mg/min as start or after starting dose 20mg IV	In 20 min: 80 mg IV over 2 min. In 30 min: 80 mg IV over 2 min. In 40 min: 80 mg IV over 2 min. The maximum cumulative dose is 300 mg. If the target BP is not achieved, switch to another agent class.
Hydralazine	5 mg IV gradually over 1-2 minutes	In 20 min: 5 or 10 mg IV over 2 min. In 40 min: 5 to 10 mg IV over 2 min. Cumulative maximum dose is 20-30 mg. If the target BP is not achieved, switch to another agent class.
Nicardipine	Initial dose is 5mg/hour IV by continuous infusion with gradual titration to a maximum of 15mg/hour	Adjust the dose within this range to achieve the target BP.
Nifedipine (fast release)	10mg orally It may be associated with a sudden drop in BP and with abnormalities of the CTG record	In 20 min: 10 or 20mg orally. In 40 min: 10 or 20mg orally. If the target BP is not achieved, switch to another agent class.

IV-intravenous, BP-blood pressure, CTG – cardiotocographic.

References:

1. Say L, Chou D, Gemmill A, TunçalpÖ, Moller AB, Daniels J et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health. 2014;2(6):e323. Epub 2014 May 5.
2. WOMAN Trial Collaborators. Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial.Lancet. 2017;389(10084):2105.
3. Allard S, Green L, Hunt BJ. How we manage the haematological aspects of major obstetric haemorrhage. Br J Haematol. 2014 Jan;164(2):177-88.
4. Committee on Practice Bulletins-Obstetrics. Practice Bulletin No. 183: Postpartum Hemorrhage. Obstet Gynecol. 2017;130(4):e168.
5. Magee LA, Yong PJ, Espinosa V, CôtéAM, Chen I, von Dadelszen P. Expectant management of severe preeclampsia remote from term: a structured systematic review. Hypertens Pregnancy. 2009;28(3):312.
6. Okusanya BO, Oladapo OT, Long Q, Lumbiganon P, Carroli G, Qureshi Z et al. Clinical pharmacokinetic properties of magnesium sulphate in women with pre-eclampsia and eclampsia. BJOG. 2016 Feb;123(3):356-66. Epub 2015 Nov 24.
7. Pretorius T, van Rensburg G, Dyer RA, Biccard BM. The influence of fluid management on outcomes in preeclampsia: a systematic review and meta-analysis. Int J ObstetAnesth. 2018;34:85.
8. Gestational Hypertension and Preeclampsia: ACOG Practice Bulletin, Number 222. Obstet Gynecol. 2020;135(6):e237.

9. The Society for Obstetric Anesthesia and Perinatology Interdisciplinary Consensus Statement on Bauer ME, Arendt K, Beilin Y, Gernsheimer T, Perez Botero J, James AH, et al. Neuraxial Procedures in Obstetric Patients With Thrombocytopenia. AnesthAnalg. 2021;132(6):1531.
10. Jeejeebhoy FM, Zelop CM, Lipman S, Carvalho B, Joglar J, Mhyre JM, et al. Cardiac Arrest in Pregnancy: A Scientific Statement From the American Heart Association. Circulation. 2015;132(18):1747.
11. Rose CH, Faksh A, Traynor KD, Cabrera D, Arendt KW, Brost BC. Challenging the 4- to 5-minute rule: from perimortem cesarean to resuscitative hysterotomy. Am J Obstet Gynecol. 2015 Nov;213(5):653-653.e1.