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Review Article

Role of intensive care in management of post-partum hemorrhage (PPH)

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ABSTRACT

The management of obstetric emergencies is a challenge and in most hospital setting the management in intensive care is ill-defined. A multidisciplinary approach to the management of obstetric emergency helps to give favorable outcome. In low resource setting, maternal care can be challenging as it faces lack of infrastructure facilities, specialist trained in intensive care, availability of drugs and equipment. Though early intervention is the need of hour there are delays in seeking healthcare due to lack of awareness, financial constraints, culture and beliefs. This article describes the approach to management of PPH in intensive care, defining clear transition from labor care to intensive care should occur.

1. Introduction

Pregnancy results in a physiological compromise which may pose a threat when presented with a pathology like eclampsia, pulmonary edema, and trauma. The physiological changes include, an increase in cardiac output by 30-40%, decreased systemic vascular resistance, and compression of the gravid uterus on the aorta leading to a decrease in cardiac return. The already compromised hemodynamic change poses a threat in any obstetric emergency.[1–3] The common cause of obstetric emergencies leading to maternal mortality is Postpartum hemorrhage, hypertensive disorders, and pregnancy-related infections. Keeping in mind these entities need to build ICU care guidelines will help in effective management of these emergencies.[4] Obstetric hemorrhage accounts for 25-30% of total presentation in emergency.[5] A report by the National Health Mission of India observed that PPH-related mortality was 38% in the year (2001-2003). India recorded a maternal mortality rate of 130 deaths per 100000 live births in 2015 when the global rate was 216 per 100000. The incidence of intensive care unit (ICU) admission of an obstetric patient in developed countries is 2-4/1000 deliveries, whereas in developing nations it is as high as 2-13.5/1000 deliveries. There is an acute need of providing obstetric critical care from primary health care through tertiary health care.[6] The lack of specialized healthcare and the absence of dedicated obstetric intensive care facilities in most public hospitals has been overlooked in the ever-developing intensive care scenario. There is a lack of universal policy on providing specialist care to an impending obstetric emergency.[7] Maternal age more than 35 years, puerperal sepsis, loss of antenatal care, existing comorbidities and altered mentation were major contributions to mortality in the ICU. These can be considered as predictors of poor prognosis during antenatal screening.[8] Multidisciplinary team care may improve clinical outcomes in these patients. However, lack of multidisciplinary team or difficulty in

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accessibility can have impact on the maternal mortality.[9] In the expectant need to reduce the maternal mortality rate to 70 per 100000, there is an acute need for organizing an obstetric intensive care facility dedicated to managing protocol-driven intensive care. Obstetric critical care is different in developing nations from that in the developed world. Developing nations are already resource strained and planning of specialist care may be difficult.[10,11] A study reported that in India the frequently reported obstetric emergencies were hemorrhage and hypertensive crises, hence concentrating obstetric care around these can help reduce maternal mortality.[12]

2. Indication of Admission to ICU

The presentation of obstetric hemorrhage as in PPH, is like that of hemorrhagic shock. The initial assessment of the obstetric emergency patient is the same as the other critically ill patient. MEOWS score charting has been reported to better prognosticate severity and outcomes in obstetric patients. MEOWS score should be carried out at 8-12 hour intervals depending on the clinical presentation of the patient.(Table 1) A score of >3-4 should be an indication to consider the shift to an intensive care facility.

Table 1: Clinical evaluation of impending distress by -A modified early obstetric warning system (MEOWS)[13]

Physiological parameters	Yellow alert	Red alert
Respiration rate	21–30	< 10 or > 30
Oxygen saturation	-	< 95
Temperature	35–36	< 35 or > 38
Systolic blood pressure	150–160 or 90–100	< 90 or > 160
Diastolic blood pressure	90–100	> 100
Heart rate	100–120 or 40–50	> 120 or < 40
Pain score	2–3	
Neurological response	Voice	Unresponsive, pain

Note: Respiration rate (breaths per minute); oxygen saturation (%); temperature (°C); systolic blood pressure (mm Hg); heart rate (beats per minute); level of consciousness is based on the Alert Voice Pain Unresponsive (AVPU) scale which assesses four possible outcomes to measure and record a patient's level of consciousness; pain scores (0 = no pain, 1 = slight pain on movement, 2 = intermittent pain at rest/moderate pain on movement). A single red score or two yellow scores triggers an evaluation.

3. Role of ICU

The triage of a patient of PPH in labor care to higher levels of care has been defined by the guidelines set by NHS which are applicable to any patient under ward care developing complications.

Levels of care

Level 0 – patients can be kept in the inpatient ward for observation.

Level 1 – patients with deteriorating conditions and needing a higher level of observation or those recently relocated from higher levels of care. Can be managed in a High Dependency Unit(HDU). Here patients can be monitored clinically. From here, a step up for ICU care or a step down to inpatient ward can be done.

Level 2 – patients requiring invasive monitoring/intervention that includes support for a single failing organ system (excluding advanced respiratory support), need admission to the intensive care unit.

Level 3 – patients requiring advanced respiratory support (mechanical ventilation) alone or basic respiratory support along with support of at least one additional organ. This level of care can also be done in ICU.

Level 4 – patients requiring highly advanced supports such as extracorporeal membrane oxygenation (ECMO) and intra-aortic balloon pump. This level of care is available in very few facilities across the country.

4. Indications for Intensive Care Management

The obstetrically modified quick sequential organ failure assessment (omqSOFA) is easy to implement as it requires clinical data to assess the clinical deterioration even when laboratory reports are awaited.(Table 2).

Table 2:

S. No.	Clinical parameter	Score
1.	Systolic blood pressure<-90mmHg (100mmHg in non-pregnant female)	1
2.	Respiratory rate>-25/minute (>=22/minute in non-pregnant female)	1
3.	Altered level of consciousness (Glasgow Coma Scale< 15 in non-pregnant female)	1

A omqSOFA score >2 is suggestive of clinical deterioration and a need for intensive care management.

Protocol-based management of PPH should include-

1. Call for help.
2. Draw blood samples for cross match and necessary investigations. (list of investigations given below).
3. Collect information on vital signs, urine output, drugs, and fluid administered.
4. Operating theatre stand-by to be kept ready.

4.1. Airway

The assessment of the airway is very important as pregnant women tolerate hypoxemia poorly. The possibility of difficult airway intubation is higher in pregnant women. Assess airway and ventilation requirements. If falling oxygen saturation (PaO2<65mmHg), start oxygen at 10-15

liter per minute with a face mask. The need for endotracheal intubation can be decided based on worsening respiratory distress. A stand by intubation cart should be kept ready. Monitor oxygen level by pulse oximeter and arterial blood gas (ABG) analysis.

4.2. Breathing

For effective gas exchange use of oxygen by face mask, high flow nasal method or non-invasive ventilation can be used. ABG value PaO2 <65 mmHg, PaCO2 > 45 mmHg and PaO2/FiO2 ratio <150 suggest increasing respiratory distress and should prompt endotracheal intubation or tracheostomy followed by partial or full ventilation support. Refractory hypoxemia and continued respiratory distress along with adult respiratory distress syndrome (ARDS), indicate the need for Extracorporeal membrane oxygenation.

5. Circulation

The crux of management is to avoid tissue hypoperfusion along with the need to maintain utero-placental perfusion. PPH manifests as hemorrhagic shock and loss of circulating blood volume can be detrimental to tissue perfusion. Secure an IV line using 14 Guage canula, followed immediately by collecting blood samples for investigation. [14]

Following investigations can be routinely done to assess and monitor patient in PPH:-

1. Hemogram
2. Blood for cross matching
3. Serum glucose
4. Kidney and liver function tests
5. Urine microscopy
6. Coagulation profile
7. Arterial blood gas analysis
8. D dimer and fibrinogen
9. Imaging studies for the cause of PPH, presence of pulmonary edema, or pulmonary embolism.

6. Fluid Resuscitation

Passive leg raise can return almost 200 ml of blood from the lower extremities and is a bedside maneuver. A crystalloid challenge can help improve fall in circulating blood volume. The choice of fluid for resuscitation are crystalloids either Normal saline or Ringer lactate. Colloids are no longer favored due to their adverse effects in shock. A liter of blood loss requires replacement with 4-5 liter of crystalloid. This should be achieved if kidney function is normal. Hourly Urine output of more than 25-30 ml is a good indicator of normal kidney function. If kidney function is compromised despite adequate replacement of circulating blood volume then inotrope infusion can be initiated. A bedside ultrasound examination for inferior vena cava patency and distensibility index is an approximate indication of adequate resuscitation after which the inotrope infusion can be started.

Blood transfusion can be initiated in a 1:1:1 ratio of platelets, fresh frozen plasma, and whole blood. Postpartum hemorrhage (PPH) is defined as estimated blood loss more than 500 mL in a vaginal delivery or greater than 1000 mL in a caesarean delivery. American College of Obstetrics and Gynaecology redefined this in 2017, as a cumulative blood loss greater than 1000 mL with signs and symptoms of hypovolemia within 24 hours of the delivery, regardless of the route of delivery. The need for transfusion is higher with a conservative approach and hence early active management in the third stage of labor, can bring down the need for blood transfusion. [14]

7. Choice of Emergency Drugs in Pregnant Women

7.1. Vasopressors

Ephedrine can be used as a vasopressor for short-term episodes of hypotension. It has a good safety record and minimal effect on placental perfusion. However, it can cause fetal tachycardia and acidosis, especially in compromised fetuses. Phenylephrine can be used as an infusion if a longer vasopressor effect is needed as it's safe for the fetus. Both Dopamine and dobutamine can be used as inotropes and are known to decrease uterine blood flow, however, dobutamine is a better choice as it decreases mean arterial pressure and increases pulse rate. Vasopressin is not advised as it causes uterine contractions. Both epinephrine and norepinephrine can cause severe utero-placental vasoconstriction and are best avoided especially in hypoxic situations. However, they can be used as short-term agents in an emergency. [15,16]

8. Muscle Relaxants

Succinylcholine has a better safety profile in rapid sequence anaesthesia in pregnant women**.** Non-depolarising agents such as Rocuronium, vecuronium, Pancuronium, etc are also a good choice of safe agents however doses should be adjusted as there could be the possibility of prolonged neuromuscular blockade. Opioids, barbiturates, and benzodiazepines are safe in pregnancy, even though they easily cross the placenta and also enter the breast milk. Their use can be justified in a risk versus benefit situation and especially considered if the newborn has withdrawal effects. Fentanyl is the drug of choice as its oral absorption is low. Dexmedetomidine is also a safer drug in pregnancy. [17]

If whole blood is not available then packed red blood cell (PRBC) can be given. Treating clinicians must be aware of the availability, timing, and access to transfusion components of their blood bank to gain ease of access in an emergency.

In the event of unavailability of desired blood group an uncrossmatched O-type Rh-negative PRBCs can be used for

catastrophic bleeding. The un-cross matched ABO- and Rh-compatible blood is usually available because a blood group and antibody screen have already been performed. Cross matched blood should be made available within half an hour of the event. To restore lost circulating blood volume care should be taken to aim for rapid transfusion of 2-4 units of PRBC. The use of an integrated filter and blood warmer in the infusion set will help to prevent clotting especially when transfusion rates are higher than 100ml/minute. PRBC are viscous and to prevent blood clotting add 100 ml of normal saline to each unit of PRBC. Avoid Ringer lactate as it may prompt clotting due to calcium in the solution.[18]

Regular hemostasis screen includes platelet count, bleeding time, partial thromboplastin time, prothrombin time, and fibrinogen. Thromboelastography (TEG) is a promising diagnostic modality that offers several advantages compared to the other tests that have been mentioned above. It gives a quantitative estimation of the conversion of whole blood to clot. TEG was developed and first described by Dr. Hellmut Hartert.[19]

TEG may not be available in many of the low-resource ICUs. Clinical evidence of mucosal bleeding, oozing from the mucosal surface, puncture sites, or wounds is an indication of a need for transfusion of additional blood components. Fresh frozen plasma in the dose of 4 units can be transfused to maintain a platelet count at or below $50x10^9$/L. Platelets should be given in packs of 5-6 units. Each unit of platelet increases the counts by $10x10^9$ /L. If bleeding continues then 10-12 units can be given initially. If there is a need for urgent surgical intervention then the platelet count should be at or above $80\text{-}100x10^9$/L. For RH Negative mothers Rho GAM[anti D immunoglobulin] is recommended.[20] A deranged coagulation profile at the onset of PPH should prompt the consideration of underlying causes like HELLP, abruptio placentae, amniotic fluid embolus, fatty liver of pregnancy, Septicemia, intrauterine fetal demise, or preexisting disorder.

A suspicion of disseminated intravascular coagulation (DIC) should be kept in mind if the D dimer is high and fibrinogen levels are low. The treatment is the same as that of dilutional coagulopathy which is the restoration of circulating blood volume and transfusion of blood components as mentioned above. In markedly low fibrinogen levels cryoprecipitate can be used. It contains concentrated fibrinogen and clotting factors 8,13 and von Willebrand factor. A dose of 6-12 units can be given before the surgical intervention, in patients with deranged coagulation. Heparin and antifibrinolytic therapy is not recommended in DIC of obstetric origin.

The occurrence of transfusion-associated lung injury (TRALI) and transfusion-associated circulatory overload (TACO) are serious complications besides other complications of blood transfusion. A bedside ultrasound study for the presence of B lines can effectively detect pulmonary edema.[21]

The role of Recombinant activated factor VIIa (RFVIIa) in massive hemorrhage situations is growing. Its use is as a 'universal hemostasis ' and is explored in severe haemorrhage.[22] This experience has extended to severe postpartum hemorrhage and results have been encouraging[23] Recombinant factor VIIa, the recommended initial dose is 90 μg/kg, and a second dose can be given 20–60 minutes after the first dose if there is no response. RFVIIa has been used if conventional medical management fails and also when varying degrees of surgical management are unsuccessful, up to and including hysterectomy. Therapy is very expensive and its use in less severe cases may be potentially harmful. A study reported thrombosis as an adverse effect following its use in cardiac surgery however its occurrence in obstetric practice is rare.[24]

9. Role of Tranexamic Acid

Tranexamic acid (TXA) is a synthetic derivative of the amino acid lysine that acts by blocking plasminogen-binding sites and inhibiting the proteolytic function of plasmin, thereby preventing fibrin degradation. TXA has effectively been demonstrated to have reduced the need for blood product transfusions and mortality. Its off-label clinical applications are used in trauma and surgery, gastrointestinal bleeding, and more recently, PPH. The dose of TXA is administered as 1 gram in 10ml of normal saline at 1ml/minute dose over 10 minutes and a second dose of 1 gram IV if bleeding continues within 24 hours. It should be given slowly, as bolus injections can cause a risk of hypotension.[25–27]

10. Sepsis and Septic Shock

Maternal sepsis accounts for 11% of deaths globally and is the third leading cause of death.[28] However, prevention, diagnosis, source control, and treatment are key components of maternal sepsis management.[29] Septic shock causes organ dysfunction which can be estimated by obstetric Sequential organ failure assessment (SOFA) score. Biomarkers of sepsis are Procalcitonin, lactate, and C reactive protein. Treatment includes broad spectrum antibiotics, especially for *Escherichia coli* and group B streptococcus which are common bacterial pathogens in obstetric cases.[30] Treatment should be guided by clinical assessment and the source of infection. Early prophylactic antibiotics and later on changing to specific culture sensitivity based antibiotics can treat sepsis.

11. Early Nutrition Therapy

Muscle wasting is common in ICU and may lead to hospital infection and long hospital stay As with the non-pregnant critically ill patient, the need for early nutrition therapy plays an important role in giving favorable outcome

in obstetric emergency patient. If enteral nutrition is contraindicated patients can be started on total parenteral nutrition.[31]

12. Pharmaconutrient Therapy

In critically ill patients, specialized nutrients such as macro or micronutrients helps in immunomodulation. Critical illness alters immune response and there is a logical basis for providing the replacement of deficient nutrients.[32] Iron deficiency anemia is common in Indian women and anemia plays an important role in prognosticating outcomes in many disease conditions.[33] Initiation of early iron therapy can help avoid complication during the course of pregnancy.

Clinical signs of response to resuscitation are as follows-
Improved level of consciousness
Capillary refilling time
Normal mean arterial blood pressure (65-70 mm Hg)
Improved oxygen saturation (88-97%)
Urine output 25-30ml/hour
Improved coagulation profile
Improved Acid Base gas analysis.

In the event of deterioration of the clinical parameters and continued hemorrhage causing hypovolemic shock, central venous access either by jugular or sub clavian approach can be done. Large amounts of crystalloid Fluid and Inotrope infusions can be started. It also helps in ease of access to circulation and blood work. An arterial line may be required in cases of hemodynamic instability and for invasive blood pressure monitoring in severe shock. A bedside noninvasive 2 D ECHO can estimate cardiac output, contractility of the heart and helps to estimate right or left ventricle dysfunction.

13. Role of Nursing Care

MEOWS score charting can be done by nurses in the inpatient ward itself. Monitoring vital signs, Urine output, drugs and fluids administered, and keeping a record of blood loss will help in the prompt recovery of circulating blood volume. Nurses can alert the treating clinician when there is deterioration in clinical condition of the patient and prompt shift to an intensive care facility can be beneficial as “time is life”. Nurses play a pivotal role in alerting and triaging obstetric emergencies and saving two lives ;that of the mother and the fetus.[34] Education and skill training of the nurses will not only help build confidence but competence too in managing the obstetric emergency.

14. Conclusion

The need for a dedicated Obstetric intensive care facility can give favourable outcomes in obstetric emergencies, especially in PPH, and help reduce maternal mortality. A multidisciplinary team trained in intensive care can help in early and prompt treatment of the obstetric emergency. Health system failure translating to poor quality health care, lack of dedicated facilities, and insufficient and inadequately trained health care workers, can lead to maternal deaths. There is a need to make key policy decisions and outreach programs to allow patients to have easy access to specialized healthcare especially those at risk of obstetric emergencies.

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16. Conflict of Interest

None.

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