



CURRENT MODULES AND METHODS OF OBSTETRIC CRITICAL CARE TO REDUCE MATERNAL MORTALITY

Clinical Research

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KEYWORDS

Every parturient deserves special care during pregnancy and immediately post partum as she gives birth to future mankind. Any unfortunate incident leading to a higher mortality in this subset of patient population leaves a big question mark on the functioning of health administrators and society as a whole.

Maternal mortality represents broader gender and social inequities across and within countries.^{1,3} Reduction of maternal mortality is a global public health priority. There is a need for studies to explore and understand the use of ICUs for obstetric complications, especially in low- and middle-income countries where health resources are scarce and the costs of ICUs are high.⁴ With increasing healthcare expenditures, it is necessary to show evidence of effectiveness to drive investment.⁵

The present rate of ICU utilization of 0.5% for the whole population of women giving birth was in accordance with the range suggested in the literature of studies in obstetric intensive care (0.5–6 per 1000 deliveries).⁶ The availability of beds and the availability of an ICU in general were not able to be differentiated; admission to an ICU may not reflect access per se, as there are differences between facilities and countries in how ICUs are used, particularly admission criteria. The cost for the maintenance of an ICU is a barrier to the use of these services and has been discussed in other studies.^{7,9}

Another factor influencing the occurrence of deaths among women not admitted to an ICU is the failure to recognize the severity of the disease, delay in referral, and low level of access to the healthcare system. The second and third delay may also be a contributory factor to the deaths occurring in the ICU as women may be admitted in such severe conditions that they may not be able to be saved.¹⁰ This is a complex issue that involves more than the relationship between supply and demand; it is influenced by factors such as financing and acceptance by women seeking care.¹¹

There is an urgent need for health systems to correctly and quickly identify severely ill obstetric patients and prioritize their treatment according to severity, similar to the screening protocols routinely used in emergency departments to provide timely care to those in greatest need.¹²

Rather than the availability of ICU beds, the organization of maternity care in emergency rooms with standardization of criteria for the use of intensive care in order to provide equitable service is crucial for the efficiency of intensive care services in obstetrics.¹³

The use of intermediate obstetric care units could provide the required attention according to the severity of the case, with less intensive care than that provided by an ICU, but more discerning than that found in common hospital wards. This strategy could reduce other problems when managing obstetric patients. Intermediate care units do not need critical care professionals and are less difficult to manage than an ICU; the insufficient number of ICU beds could then be more rationally used and, finally, the high costs of using an ICU can be more balanced with a more optimized use. This strategy of managing severe obstetric patients is described as a strategy to offer equitable care for obstetric patients with lower costs than the use of an ICU¹⁴

The most common indication for ICU admission of obstetric patients throughout the world is hemorrhage, both antepartum and postpartum. Hypertensive disorders, pre-eclampsia and its related complications are also major contributory factors for such admissions.^[15,16] However, a huge variation exists between the developed nations and

the developing countries in the prevalence and incidence of ICU admission, which is mainly determined by various social, economic, and health infrastructures, as also policies and other factors, besides the clinical scenarios.^[17,18]

Causes of mortality and morbidity in pregnant patients that necessitate admission to the Intensive Care Unit

Organ system	Clinical indications
General / obstetric	Sepsis, severe pre-eclampsia and eclampsia, HELLP syndrome, amniotic fluid embolism
Cardiac	Valvular heart disease, rheumatic heart disease, CCF, severe hypertension, IHD, MI, peripartum cardiomyopathy, dysarrhythmias
Pulmonary	Severe asthma, severe pneumonia, ARDS, respiratory failure, pulmonary edema, pulmonary embolism
Endocrine	Diabetic ketoacidosis, thyrotoxicosis, pancreatitis
Renal	Acute pyelonephritis, renal failure
Gastrointestinal	Hepatic failure, HELLP syndrome
Hematological	Coagulation disorders, severe anemia
Surgical/Anesthetic complications	Anesthetic complications during surgery for LSCS, surgical complications on the table.

HELLP = Hemolysis, Elevated Liver Enzymes, Low Platelets, CCF = Congestive cardiac failure, IHD = Ischaemic heart disease, MI = Myocardial infarction, ARDS = Acute respiratory distress syndrome, LSCS = Lower segment caesarean section

Among these, postpartum hemorrhage remains the most common cause of ICU admission and has a higher mortality and morbidity among young parturients.^[19]

TRANSPORTATION:

There are no established guidelines in the Indian setup for the pre-hospital transportation of critically ill patients. Also, there are no uniform guidelines about equipping the ambulances as per international standards and a majority of the ambulances lacks even the basic monitoring gadgets required during transportation, such as, pulse oximetry, echocardiogram (ECG), non-invasive blood pressure, and so on.^[20]

A good IV access is an essential requirement for administration of any emergency drug during transportation, and an emergency tray containing all the life saving drugs should be available in the ambulances. The ventilator may or may not be available in such ambulances, but alternatively the Bains circuit with an attached connector to the oxygen cylinder can serve the purpose. The use of such a circuit can help in 'feeling' the compliance of the lungs and the timely estimation of any respiratory obstruction necessitating urgent suction to remove the secretions.

Obstetric patients requiring intensive care can have a complicated clinical course as compared to non-pregnant patients during various surgical and medical emergencies. Factors such as hypoxemia, hypotension, severe infection, severe anemia, and so on, can influence the obstetric outcome as both the parturient and fetus become extremely vulnerable to these clinical insults.^[21] The diseases, both specific and non-specific to pregnancy, affect equally in terms of increasing the morbidity and mortality in obstetric patients.^[22] Respiratory diseases like acute exacerbation of asthma, pneumonitis, pulmonary edema, acute respiratory distress syndrome (ARDS), and acute lung injury can have serious implications both on the mother and the fetus, and special considerations during these episodes include maintaining oxygen saturation greater than 90%. Cardiovascular diseases, such as rheumatic heart disease, mitral stenosis, and other

valvular lesions can cause cardiac failure, which necessitates intensive care admission. Cardiac surgery during pregnancy is extremely challenging and should best be avoided, unless a life-saving procedure is required. Renal diseases like pyelonephritis can be accentuated in the presence of sepsis, which again propels the patient to the Intensive Care Unit. Coagulation disorders, hepatic derangements, including the HELLP syndrome, warrants urgent intensive care intervention in many instances as these disease entities can sometimes prove fatal. Neurological disorders can mimic the picture of eclampsia and the appropriate therapy involves a complete investigation profile. Gestational diabetes, thyroid disorders, and other endocrinal diseases can also be responsible for medical emergencies in obstetric patients requiring urgent critical care.[23,24]

MONITORING :

The simple monitoring parameters such as electrocardiogram (ECG), heart rate (HR), Non-invasive Blood Pressure (NIBP), SpO₂, and EtCO₂, which are routinely used in these setups must always be augmented with additional invasive monitoring during the admission of critically ill obstetric patients. It is extremely useful for measuring ventral venous pressure (CVP), pulmonary capillary wedge pressure (PCWP), systemic vascular resistance (SVR), cardiac output (CO), pulmonary artery (PA) pressure, and mixed venous oxygen saturation.[25]

COMORBID CONDITIONS:

Cardiac Diseases

Cardiac diseases are the most common cause of mortality among pregnant patients admitted in the ICU. Mortality can rise to as high as 50% among this subset of patients.[26] The challenges in these patients are further potentiated by significant cardiovascular and physiological changes. The increased CO, increased blood volume, increased red cell mass, and decreased hemoglobin and hematocrit values also contribute to the deterioration of heart ailments during pregnancy. Morbidity is further increased in cardiac pregnant patients with a potential risk of thromboembolic phenomenon, which can get precipitated by a higher incidence of atrial fibrillation or presence of prosthetic valves.[27] The maternal mortality and morbidity arising out of this deranged cardiac physiology is significantly influenced by various predictors, such as:-

A history of heart failure, transient ischemic stroke or severe arrhythmias, Severe valvular heart disease, New York Heart Association (NYHA) class II and above, Ejection fraction < 40%. These predictors and other potential risk factors determine the maternal outcome in critical conditions.[28] Other than just the maternal mortality, these cardiac disease entities can also compromise the neonatal status to a large extent resulting in intra-ventricular hemorrhage, pre-term delivery, and neonatal death.[29] Besides valvular heart diseases, peripartum cardiomyopathy is another major cause of maternal ICU admission, either in the last month of pregnancy or within five months of delivery.[30-32] Maternal mortality rises exponentially in peripartum cardiomyopathy (PPCM) to an extent of 50% and major risk factors for determining the incidence and mortality in PPCM include, but are not limited to, advanced maternal age, multiple gestation, pre-eclampsia, black ethnicity, and hypertension.[30-33] In obstetrical critical care, while analyzing the ECG pattern, the normal ECG changes such as sinus tachycardia, shortened PR and QTc interval, left axis deviation, and non-specific ST changes must be taken into consideration.

Pulmonary Diseases

Pulmonary edema, advanced chronic obstructive pulmonary disease, infections, and pulmonary embolism are among the major causes for respiratory failure, which necessitate the admission of pregnant patients to the ICU.[34-35] The incidence of pulmonary edema can be quite high to the extent of one in 1000 pregnancies.[36] The most common implicated underlying etiology includes cardiac diseases, non-judicious use of tocolytics, over-enthusiastic use of intravenous fluids, and to some extent pre-eclampsia. However, the most feared complication is ARDS, which should ideally be treated only in a dedicated obstetric ICU. Sepsis is the most common cause that puts the pregnant patient at risk of developing ARDS. It is worth mentioning the role of amniotic fluid embolism here, as it can increase the maternal mortality in a rapidly progressive manner. The spectrum of symptoms include sudden hypoxia, shock, coagulopathy, and cardiac arrest.

Sepsis

Approximately 10% of total deaths occur due to sepsis in developed nations

like US, and account for one death per 8000 deliveries.[37] The major cause of higher mortality due to sepsis in obstetric patients of developing countries is the higher prevalence of septic abortions. The general consensus and current guidelines state that a pregnant patient having signs and symptoms of sepsis should be managed by following interventions irrespective of her nationality status: Early goal-directed therapy[38]

Tight control of hyperglycemia

Steroid therapy

Protein C

Symptomatic and supportive treatment

Diabetes

Tight glycemic control with insulin is recommended in diabetic patients as it has been well-established that exercising such control decreases mortality and the morbidity.[39,40] Pregnant women invariably develop resistance to insulin and as such there are high chances of developing maternal and neonatal hypoglycemia. The fluctuating blood sugar levels are more dangerous than sustained hyperglycemia and can cause numerous fetal complications such as macrosomia, still births, and severe refractory neonatal hypoglycemia. Tight glycemic control is associated with a better outcome.[41]

Current Status:

Currently there are no universal guidelines stating the management of critically ill obstetric patients. The application of the American College of Critical Care Management guidelines seems to be the most appropriate and is being followed to a major extent in most of the developing nations.[23] However, strict compliance and adherence to these protocols and guidelines is not feasible in a majority of these developing nations, due to numerous factors, including economic constraints, sociocultural beliefs, levels of education, attitude toward the criticality of clinical conditions, poor means of transportation and communication, and so on.[42] The concept of the newly built High Dependency Units (HDUs) or dedicated obstetrical ICU have been gaining popularity in recent times, and the services are coming up with giant leaps of progress in many developing nations. The success of such dedicated units depends largely on the coordinated efforts of various team members, including obstetrician, anesthesiologists, intensivists, pediatricians, and doctors from various surgical and medical super-specialties.[43] Our aims were to (i) propose a more practical definition of maternal critical care, (ii) discuss maternal mortality in the setting of limited accessibility of critical care units, (iii) provide some accessible tools to improve identification of obstetric patients who may become critically ill, and (iv) confront challenges in providing maternal critical care in resource-limited settings.

To improve maternal critical care, training programmes should embrace modern technological educational aids and incorporate new tools and technologies that assist prediction of critical illness in the pregnant patient. The goal must be improved outcomes following early interventions, early initiation of resuscitation, and early transfer to an appropriate level of care, whenever possible.

In the year 2000, the Department of Health of the United Kingdom recommended that the terms 'Intensive Care' and 'High Dependency' be replaced by 'Critical Care', as it focuses on the level of care that individual patients need, regardless of location.^[44] In this concept, also known as 'critical care without walls', each patient's care is subdivided into four levels,^[45] depending on the level of organ support and monitoring required, regardless of the diagnosis. The level of care required by the pregnant woman is classified from level 0 (normal ward care) to level 3 (support of two or more organ systems).^[46] This organ support is usually in the form of respiratory support (basic and advanced), cardiovascular support with inotropic agents, renal replacement therapy, or for other systems such as gastrointestinal, metabolic, haematological or neurological. Level 3 support would include ventilation, or basic respiratory support plus support of at least two other organ systems.

In addition to the level of care provided, a more recent classification of critical care units was proposed within a three-tiered structure: Level 1 describes the "physiologic stabilisation and short-term support of mild organ dysfunction", Level 2 includes "basic support of failing organ function", and Level 3 "complex, comprehensive support and management of organ dysfunction"[47]

Besides the level and structure of critical care units, the code of

practice of the physician divides critical care services into: (1) open critical care units, where any physician can prescribe or perform procedures, and management or consultation by a qualified intensive care physician is not mandatory; and (2) closed critical care units, where only the attending critical care physician or staff can prescribe and manage patients. The hybrid model (a combination of open and closed) allows all physicians to prescribe, but requires an on-site critical care physician to provide consultation, conduct rounds, or manage decisions related to patient care.^[48]

We will use the term “maternal critical care” (MCC)^[49] as a hybrid organisational model, since it reflects interdisciplinary care in any hospital area according to the severity of illness of the pregnant woman. This is in contrast to “obstetric critical care” that represents care by specialists in a dedicated area. Setting a low threshold for early admission of obstetric patients to an MCC model, could contribute to decreasing maternal mortality.^[50]

There is a lack of uniformity in definitions, identification and treatment of critically ill pregnant patients throughout the world, especially in RLS.^[51] Our aims were to (i) propose a practical definition of maternal critical care, (ii) describe challenges in the admission to, and provision of, MCC, (iii) outline accessible bedside assessment tools to improve identification of critically ill or at-risk obstetric patients, and (iv) discuss innovations addressing the challenges for provision of maternal critical care promptly and effectively.

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