Management of the critically-ill obstetric patient

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Abstract

From 2009 to 2012, 321 women in the United Kingdom died during or within six weeks of the end of their pregnancy, as a direct or indirect result of the pregnancy. Many received critical care input which varied from observation to multi-organ support. In many women death occurred despite optimal care, but in over half of cases there were opportunities missed that could have made a difference to outcome.

An understanding of the different types of organ support and treatment that are available, and when these are indicated is important for medical professionals caring for these unwell obstetric patients.

This review describes the technical aspects of organ support that can be provided in a critical care setting and the alterations in physiology occurring during pregnancy that influence the use of each treatment modality. Also addressed in more detail are conditions that can be life-threatening in pregnancy, together with key points about management of these conditions when they necessitate critical care support.

Keywords acute fatty liver of pregnancy; acute respiratory distress syndrome; amniotic fluid embolus; critical care; maternal mortality; sepsis; systemic inflammatory response syndrome

Introduction

Most pregnant women negotiate pregnancy, delivery and the postpartum period uneventfully. However, a minority become severely unwell with pregnancy-related conditions (e.g. eclampsia or acute fatty liver) or from pre-existing conditions that are worsened by physiological changes during pregnancy or delivery. Every year, peripartum women die from catastrophic events such as postpartum haemorrhage, sepsis, eclampsia, heart failure, intracranial haemorrhage and hepatic capsular rupture. Critical care has much to offer these women, not only during the management of life-threatening events, but also in optimising management of those at highest risk of developing these complications and intervening to prevent them from occurring at all.

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The most recent data from ICNARC (Intensive Care National Audit and Research Centre) showed that 12% of all women aged 16–50 years admitted to a critical care setting were either pregnant or had recently been pregnant (within 42 days of delivery). 'Recently pregnant' admissions outnumbered 'currently pregnant' women by around five-to-one. The overwhelming majority of 'currently pregnant' women (91%) who were admitted had non-obstetric pathologies, most commonly respiratory complications. In contrast, the majority of 'recently pregnant' women were admitted to critical care for obstetric reasons. The commonest diagnosis in this group was haemorrhage, affecting just over a third. In this report 'currently pregnant' and 'recently pregnant' women were much less likely to die than the non-pregnant population (acute hospital mortality of 2% compared 11%).

Audit findings from MBRRACE-UK (Mother and babies: reducing risk through audits and confidential enquiries across the UK) are a driving force for reducing pregnancy-related mortality. The most recent report confirms the incidence of direct deaths (obstetric causes) is continuing to fall, but the rate of indirect deaths (medical and psychiatric) remains unchanged. In the most recent report (2009–12), thrombosis, genital tract sepsis and haemorrhage were the main cause of deaths directly related to pregnancy. Though many women did not survive despite optimal care, in over 50 percent shortcomings were identified that may have contributed to the outcome. It is essential that those caring for obstetric patients understand what critical care can offer and how and when to utilise these services in a timely fashion when an obstetric patient becomes unwell.

Hospitalised patients may be classified according to the levels of care they require (Table 1). Though not universally employed, this system is referred to by guidance from the UK Department of Health, Royal College of Nursing, Intensive Care Society and National Institute for Clinical Excellence.

Critical care organ system support

The approach to organ support in the obstetric patient is similar to that in the general adult population in most cases, though some therapies need modification because of pregnancy. The physiological targets set for individual organ support modalities may be different in the presence of a viable fetus, in view of a reduced tolerance to physiological derangement. Knowledge of normal physiological parameters in the obstetric population at different gestations is vital to avoid inappropriate interventions for findings that are not pathological. For example, aggressive fluid resuscitation for presumed hypovolaemia in a patient with a systolic blood pressure of 90 mmHg and pulse of 100 beats per minute in the second trimester is not appropriate.

The decision to admit a patient to a critical care environment should not simply be determined by how ill the individual is; how unwell the patient may become and how quickly are of great importance. In the pregnant patient, deterioration may be precipitous and interventions for some types of organ support more complicated than in the non-obstetric population. Management of the airway is a particular concern. For this reason it may be reasonable to transfer a woman who is not yet critically ill to a higher level of care. The increasing use of early warning scores modified for the obstetric population helps to identify these

Levels of critical care with examples

Level of care	Types of patient	Obstetric examples
Level 0	Normal ward care in an acute hospital	• Low risk mother
Level 1	Patients at risk of their condition deteriorating Those recently relocated from higher levels of care whose needs can be met on an acute ward with support from critical care	• Risk of haemorrhage • Women with underlying cardiac or other medical conditions
Level 2	Single organ support or postoperative care Those stepping down from higher levels of care	• Severe hypertension in pre-eclampsia requiring intravenous antihypertensives • Liver failure in HELLP or AFLP • Non-invasive ventilation e.g. pulmonary oedema or sickle cell chest crisis
Level 3	Advanced respiratory support alone Basic respiratory support together with support of at least two organ systems	• Invasive mechanical ventilation in severe Influenza • Renal replacement therapy in addition to basic respiratory and cardiovascular support

Table 1

women, though there appears to be considerable heterogeneity in use across the UK.

Cardiovascular

At the simplest level, more intensive monitoring is available in critical care environments. Both non-invasive (frequent measurement of blood pressure, continuous cardiac monitoring and oxygen saturations, meticulous fluid balance) and invasive (arterial lines, central venous pressure monitoring) monitoring can aid fluid resuscitation, blood product therapy and correction of electrolyte disturbances.

Patients receiving vasoactive drugs may have continuous invasive monitoring of blood pressure using an indwelling arterial cannula. Agents commonly used to support the circulation include norepinephrine (a vasopressor predominantly causing peripheral vasoconstriction) and dobutamine (an inotrope mainly increasing the force of cardiac contraction). Many such drugs have to be given into a central vein via a central venous catheter, which also allows measurement of central venous pressure (CVP). Mechanical techniques to support the failing heart include intra-aortic balloon pumps and ventricular assist devices.

Various techniques exist for measuring cardiac output including oesophageal Doppler probes (in sedated, intubated patients) and lithium dilution cardiac output (LiDCO). Pulmonary artery catheters are now used infrequently, since there is a lack of evidence of a beneficial effect on outcome to support their routine use and they carry risks of significant complications. Transthoracic echocardiography is increasingly employed by critical care physicians as a non-invasive means for serial assessment of the circulation. The main limitation of this technique in the obstetric population is that poor acoustic windows may compromise the quality of the information obtained.

From 20 weeks of gestation, cardiac output may fall by 30−40% when supine as a consequence of aortocaval compression. Positioning of the critically-ill obstetric patient is therefore of particular importance. Manoeuvres such as manually displacing the uterus, tilting the patient onto her left side or using a Cardiff wedge may improve venous return and relieve cardiovascular compromise to a degree.

Respiratory and airway

Changes in pulmonary physiology in pregnancy are driven by hormonal influences (primarily progesterone) and the physical effects of diaphragmatic splinting by a gravid uterus on ventilatory mechanics. Taken together with concomitant circulatory changes and increased oxygen consumption, pregnant women develop hypoxaemia very readily. At induction of anaesthesia in a pregnant woman at term desaturation may quickly follow muscle relaxation and apnoea, especially in obese patients whose functional residual capacity is severely reduced. Additionally, endotracheal intubation is more likely to be problematic in obstetric patients, with failed intubation a significant risk. Oedema of upper airway tissues can distort anatomy, restricting the view available on direct laryngoscopy. Pregnant women are at high risk of aspiration even if fasted due to delayed gastric emptying and incompetence of the lower oesophageal sphincter. Effective cricoid pressure is therefore employed to reduce the risk of reflux and aspiration. Prophylactic oral antacids are recommended prior to induction of anaesthesia.

In addition to supplemental oxygen therapy, non-invasive approaches are available to support the patient with respiratory failure. Type 1 respiratory failure (hypoxaemia with a normal or low partial pressure of carbon dioxide, $PaCO_2$) develops as a result of ongoing perfusion of regions of lung tissue affected by processes such as pneumonia which render them ineffective for gas exchange. This causes ‘shunting’ of deoxygenated blood through the lungs and hypoxaemia that cannot be completely corrected with supplemental oxygen. Continuous positive airway pressure (CPAP) through a tight-fitting mask or hood, with the provision of a variable fraction of inspired oxygen (FiO_2), can be helpful in this setting to ‘recruit’ regions of lung to contribute to gas exchange. Problems such as bibasal atelectasis and pulmonary oedema may respond well to CPAP.

Type 2 respiratory failure carries the additional problem of hypercapnia and results from processes which reduce the amount of air that is physically breathed in and out. The $PaCO_2$ is inversely related to minute ventilation (the product of respiratory rate and tidal volume). Respiratory muscle weakness from exhaustion, severe metabolic acidosis or neurological disorders