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Review

Obstetric Medicine and Intensive Care: Maternal Critical Illness in Practice

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Abstract

Pregnant and postpartum women make up a small proportion of intensive care unit (ICU) admissions, but they require distinct, carefully adapted approaches to care. This review outlines these challenges and proposes general principles to address them, emphasising consultant-level multidisciplinary input and alignment with national standards for service organisation and escalation of care. Pregnancy-related physiological changes affect haemodynamics, ventilation, and renal function—all of which have implications for monitoring, treatment thresholds, and drug selection. The practical aspects of organ support are discussed, as well as imaging and contrast safety. It is emphasised that maternal stabilisation and timely critical diagnosis should take priority, and that pregnant women must not be disadvantaged in their access to life-saving interventions. The conditions that may lead to critical illness in obstetric patients are reviewed, with a discussion of the current evidence and clinical practice. Attention to psychological well-being and lactation support is underscored as an essential component of holistic recovery and long-term outcomes.

Keywords: critical care; pregnancy complications; sepsis; organ dysfunction; postpartum period

1. Introduction

Pregnant and postnatal women constitute a small fraction of intensive care admissions, yet, as highlighted in recent UK mortality reviews, their management presents unique and often complex challenges [1].

In the UK, around 2 in 1000 women are admitted to an intensive care setting during, or shortly after, pregnancy [2]. Many more are managed on maternity units, under the enhanced maternal care model [3]. With rising obesity and maternal age, assisted conception and multifetal gestation, more now become critically unwell in the peripartum period. International data demonstrate substantial variation in obstetric intensive care unit (ICU) admission rates, reflecting differences in case mix, critical care capacity, admission criteria, and models of enhanced maternal care. Recent European data report a median incidence of peripartum ICU admission of around 2.7 per 1000 deliveries, although rates vary widely between settings [4].

Pregnant and postpartum women must have the same level of access to critical treatments as non-pregnant patients. Care pathways should not disadvantage women because of pregnancy. Unfortunately, pregnant women are at a particular disadvantage when they need to access critical care, for several reasons. They are present in a variety of locations, where clinicians may be less familiar with critical illness in pregnancy and how to adapt early warning systems to pregnancy physiology. Critical care units are often separated geographically from maternity units and lack midwifery support. Conversely, midwives caring for sick women on maternity wards may have limited critical care training. The relative rarity of these cases also means intensive care unit teams may be less familiar with pregnancy-specific conditions and the safety of medications in pregnancy and breastfeeding. Although maternal safety should take priority, fetal condition and gestational age may complicate decisions about treatment and delivery. These challenges require practical systems for escalation, transfer, multidisciplinary communication, pregnancy-adapted monitoring, and coordinated maternal and fetal decision-making.

This article first discusses practical approaches to overcoming these challenges, alongside general principles relevant to the care of critically ill pregnant and postpartum women. It then outlines the physiological adaptations of pregnancy by organ system and considers how these influence organ support in critical care. Finally, it discusses selected conditions commonly encountered in critically ill pregnant and postpartum women, with emphasis on how pregnancy physiology alters clinical presentation, diagnostic interpretation, organ support, and management decisions, including pregnancy-specific considerations such as fetal assessment and timing of delivery.

2. Principles of Investigation and Management

2.1 Addressing Barriers to Care

Close multidisciplinary team (MDT) working is central to safe and effective care. This must be high level (involving consultant-level decision-makers) and timely (the MDT must be responsive to rapid changes in maternal con-

dition). Key specialities include critical care, obstetrics, anaesthesia, neonatology, and midwifery, with additional input from medical or surgical specialities. The MDT input should be an ongoing and adaptive process.

The optimal location for care is determined by the severity and trajectory of maternal illness, the anticipated need for delivery, and the local facilities. Some women can be appropriately managed in a maternity unit high-dependency area, where the skill mix can be enhanced by the critical care outreach team.

Clear escalation pathways are required between maternity and critical care services, with early involvement of senior decision-makers. A modified early warning system specific for pregnant women (such as a Modified Early Obstetric Warning Score/Modified Early Warning Score [MEOWS/MEWS] or a locally validated maternity early warning tool) should be used in place of the National Early Warning Score 2, which is not validated in pregnancy [5]. These tools account for pregnancy-related physiological changes and may improve recognition of deterioration, although reported sensitivity and specificity vary according to the scoring system, population, and outcome measured.

A seamless transition to intensive care units is likely to be required if the maternal condition worsens. Critical care outreach teams can play an important role in supporting recognition of deterioration and facilitating the transition between maternity and critical care settings. Pregnant and postpartum women requiring transfer should be managed according to the same standards applied to other critically ill adults. There should be agreed local protocols for transfer. National guidance recommends early senior multidisciplinary involvement, including senior review within one hour of deterioration, and emphasises that ongoing critical care should continue regardless of location if transfer delays occur. Detailed operational guidance regarding transfer processes, staffing, and escalation pathways is available within national enhanced maternal care guidance and is beyond the scope of this review [3].

Where maternity and critical care units are geographically separated, systems should ensure timely bedside review by the relevant teams rather than reliance on remote advice alone. It should also be clear to critical care teams how to escalate obstetric or pregnancy-specific concerns, including readily accessible contact pathways for obstetric, anaesthetic, neonatal, and obstetric medicine support where available.

Critical care units should have a named lead for maternal critical care, and patients should be reviewed at least daily [6]. Prolonged Level 3 care (>48 hours) should prompt consideration of transfer to a regional or supra-regional centre [7]. In the UK context, this will usually be the relevant Maternal Medicine Network centre, with access to maternal critical care expertise and specialist input such as maternal-fetal medicine, obstetric medicine, obstetric anaesthesia, interventional radiology, cardiology, nephrology, and neonatal intensive care. Supra-regional transfer may be required where specialist tertiary-level input or organ support is needed, for example, extracorporeal membrane oxygenation (ECMO), liver intensive care, neurosurgical intensive care, or other highly specialised services. If transfer is delayed or not possible, ongoing critical care should continue regardless of location, with senior multidisciplinary input and advice from the relevant regional or supra-regional specialist teams.

2.2 Balancing Maternal and Fetal Considerations in Critical Care Decision-Making

Gestational age and fetal condition influence many aspects of maternal critical care, including fetal monitoring, timing and mode of delivery, and administration of antenatal corticosteroids. However, decisions should remain individualised and centred on maternal stabilisation, as optimisation of maternal physiology is the intervention most likely to improve fetal outcome.

At pre-viable gestations, management is usually directed entirely by maternal indications, with consideration given to avoidance of teratogenic agents where possible. As gestation advances and neonatal survival becomes increasingly likely, multidisciplinary discussions involving obstetrics, neonatology, anaesthesia, and critical care become increasingly important. Maternal health takes precedence regardless of the fetal gestational age. However, in conditions where delivery is expected to improve maternal outcome, gestational age may influence decision-making regarding the timing and mode of delivery. In these situations, the potential fetal benefit of prolonging a pregnancy to allow further maturation should be balanced against the risk of ongoing maternal deterioration and progressive organ dysfunction. This is particularly relevant in gestational disorders such as pre-eclampsia, where delivery of the placenta is the definitive treatment.

2.3 Diagnostic Considerations

Both gestational and non-gestational disorders must be considered in a critically unwell pregnant woman. The importance of making, and not simply excluding, a diagnosis in a critically unwell pregnant woman must be emphasised. Additionally, there are many symptoms that may be normal features of pregnancy (for example, nausea and vomiting in early pregnancy, constipation, and low back or pelvic pain). However, when a woman is unwell, these should not be assumed to be physiological—clinicians should remain curious and ensure appropriate assessment and investigation, particularly where symptoms are new, severe, progressive, or out of keeping with gestation.

2.4 Imaging, Radiation and Contrast

Pregnant women should receive the gold standard investigation unless there is a clear reason not to. Radiation doses in most single diagnostic imaging studies are well be-

low the 100 mGy deterministic threshold estimated to cause tissue damage. The risk of development of childhood cancer, however, increases with the fetal dose of radiation, but is so low for computed tomography (CT) of the head, chest, and liver that they should never be withheld due to pregnancy. Examinations with doses above 10 mGy, such as pelvic CT, carry an estimated risk of 1–5 additional childhood cancers per 1000, but may still be justified if delay would endanger the mother and if alternative modalities (magnetic resonance imaging or ultrasound) are not possible or as diagnostically useful [8,9].

There are no clear concerns regarding the use of iodinated contrast agents in pregnancy. Limited animal and human data have been reassuring, and theoretical concerns about possible neonatal hypothyroidism have not been demonstrated with the water-soluble agents used in routine diagnostic imaging. Nonetheless, current guidance recommends neonatal thyroid screening following in-utero exposure. However, since neonatal screening for hypothyroidism is routinely performed, this does not alter clinical practice [9].

Gadolinium should only be given if essential for maternal health. This is due to concerns about its molecular stability and recirculation in the amniotic fluid [10]. A Canadian population study has suggested an association with increased risk of rheumatological and inflammatory skin conditions in the fetus [11]. Interruption of breastfeeding is not required following administration of gadolinium contrast, and doing so may harm the breastfeeding relationship.

2.5 Psychological Support

Psychological morbidity is a recognised risk after critical illness, and women admitted to critical care during pregnancy or the postpartum period face additional challenges, including birth trauma, separation from their baby, disruption to early parenting, and loss of the expected postnatal experience. Although evidence specifically quantifying rates of post-traumatic stress disorder (PTSD) following maternal critical care admission remains limited, severe maternal morbidity is associated with increased risk of post-traumatic stress symptoms, substance misuse, and suicidality [12]. Qualitative data from women requiring maternal critical care also highlight the distress associated with separation from their babies and difficulties maintaining contact during admission [2].

Separation may occur because of maternal illness severity, neonatal admission, infection control requirements, or the physical separation of maternity, neonatal, and critical care services. Whenever feasible, teams should prioritise keeping mother and baby together or facilitating regular contact. Practical measures may include early reciprocal visits between ICU and neonatal units, facilitated skin-to-skin contact, photographs, video calls, exchange of scented cloths, and transfer of expressed breast milk where appropriate. These measures may support maternal well-being and bonding when direct care of the baby is not possible.

Early input from psychology and specialist perinatal mental health services should be considered. Screening for anxiety, depression, birth trauma, and post-traumatic stress symptoms should form part of follow-up, with clear referral pathways for ongoing support. Screening tools may include obstetric-specific measures such as the City Birth Trauma Scale or ICU-specific tools such as the UK-Post-Traumatic Stress Syndrome 14-Questions Inventory (UK-PTSS-14) [13]. Routine screening for depression and anxiety forms part of standard antenatal and postnatal maternity care and should be complemented by reassessment following critical illness. Women should be offered a follow-up review with a clinician experienced in critical care follow-up, supported by the midwifery and obstetric team [3]. Finally, partners and families should be actively included and ideally offered hospital accommodation.

2.6 Lactation Support

For critically ill women who are unable to breastfeed directly, regular hand or mechanical milk expression should be encouraged where clinically appropriate, with specialist lactation support [7]. This may help maintain lactation during periods of maternal illness, neonatal illness, or separation. Expressed milk may also provide a way of maintaining maternal-infant connection when direct feeding is not possible. If the mother is sedated, milk expression is usually only performed if prior consent has been given.

Medication safety during breastfeeding should be assessed using specialist resources such as LactMed (https://www.ncbi.nlm.nih.gov/books/NBK501922/) and UK Teratology Information Service (https://uktis.org/). Depending on maternal medications and clinical status, expressed breast milk may be suitable for storage and later use following specialist review. Where direct breastfeeding is not feasible, expressed breast milk, donor milk, or formula feeding may be appropriate alternatives depending on clinical circumstances and maternal preference. Privacy should be considered where possible, as single-room accommodation or other measures to support privacy may facilitate breastfeeding, expression, family presence, and bereavement care.

3. Physiological Adaptations to Pregnancy and Considerations for Organ Support

3.1 Circulatory System

Pregnancy increases cardiac output by up to 50%, driven by higher stroke volume and heart rate. At the same time, systemic vascular resistance decreases, primarily due to the effect of progesterone. Blood volume increases while oncotic pressure falls, predisposing to iatrogenic fluid overload, particularly in preeclampsia or sepsis.

Expanded blood volume may mask the early signs of hypovolemia [14].

Aortocaval compression in later pregnancy can impair venous return, particularly when supine, so patients should generally be positioned in the left lateral decubitus position during surgery or while in critical care, or with uterine displacement if supine, either through left tilt or manual displacement of the uterus.

Vasoactive drugs should be selected according to the underlying shock physiology, rather than on the basis of pregnancy-specific concerns alone. The priority is restoration of maternal tissue perfusion, as uteroplacental perfusion depends on adequate maternal cardiovascular function. Hypotension may reflect vasodilatory, hypovolaemic, obstructive, or cardiogenic shock, and management should therefore be tailored to the underlying shock phenotype.

Noradrenaline is commonly used as a first-line vasopressor in vasodilatory shock. Vasopressin may be considered in refractory vasodilatory shock or circulatory collapse, particularly where catecholamine requirements are escalating, although consideration should be given to its structural homology with oxytocin and potential effects on uterine tone. In cardiogenic shock, inotropes or inodilators such as dobutamine, levosimendan, or milrinone may be required according to the underlying haemodynamic profile and can be used in pregnancy when clinically indicated [15,16]. Adrenaline remains appropriate in cardiac arrest and selected severe shock states and should not be withheld if clinically indicated, although fetal arrhythmias have been reported. Ephedrine has historically been widely used in obstetric practice but is associated with fetal acidosis and is generally less favoured than noradrenaline or phenylephrine in contemporary practice [17].

Haemodynamic monitoring in pregnancy should follow the same principle as in non-pregnant patients and should focus on defining the mechanism of shock and assessing response to treatment. Transthoracic echocardiography is valuable in pregnancy, as it can identify left or right ventricular dysfunction, valvular disease, evidence of pulmonary hypertension, pericardial disease, and features of hypovolaemia or fluid intolerance, although it requires appropriate expertise [18]. Non-invasive cardiac output monitors have been used in pregnancy and postpartum, but require cautious interpretation because pregnancy physiology differs from the populations in which many devices were validated [19,20]. Lithium dilution techniques are validated post-partum in patients with pre-eclampsia and may be used in the second and third trimesters, but are generally avoided if possible in the first trimester due to theoretical fetal safety concerns [19]. The use of passive leg raising as a dynamic test cannot be recommended in later pregnancy because of aortocaval compression [21]. Repeated clinical assessment, echocardiography where available, and trends in perfusion markers are therefore central to management. Specific haemodynamic targets should be individualised according to maternal physiology, underlying pathology, and evidence of end-organ and uteroplacental perfusion.

Delivery may improve maternal haemodynamics in cases of severe cardiac decompensation in later pregnancy, but decisions regarding timing and mode of delivery should remain individualised and multidisciplinary, taking into account maternal cardiovascular stability, gestational age, and fetal condition.

3.2 Airway and Respiratory System

Airway management in pregnancy carries a higher risk, largely due to delayed gastric emptying, reduced sphincter tone, and mucosal oedema. Guidelines for the management of difficult airways in pregnancy have been produced and suggest interventions to mitigate these risks [22].

Decreased functional residual capacity due to the enlarging uterus, as well as increased oxygen consumption, increases the risk of hypoxia [23]. Higher levels of progesterone result in increased minute ventilation and a decrease in partial pressure of arterial carbon dioxide ($PaCO_2$), resulting in chronic respiratory alkalosis. Maintaining a partial pressure of arterial oxygen (PaO_2) of $>$9 kPa allows sufficient oxygen transfer to the fetus [17]. Permissive hypercapnia has not been validated in pregnancy, and there are limited data to guide this practice in the obstetric population [23], whereas over-ventilation and hypocapnia may impair uterine blood flow.

Pregnancy is not an absolute contraindication to prone positioning. Suitability varies with body habitus rather than strict gestation limits; however, its use also requires appropriate expertise and staffing to ensure correct positioning and avoidance of abdominal compression, and should therefore be individualised according to local capability [24,25]. Fetal monitoring should be considered in prolonged use.

Delivery of the fetus in an attempt to improve the maternal respiratory condition is not routinely recommended, but there may be benefit to the fetus in persistent maternal hypoxia depending on gestation. Caesarean delivery carries a higher risk in the setting of respiratory failure. Timing of delivery is therefore a multidisciplinary decision that must consider both maternal and fetal factors [23].

The management of acute bronchospasm is the same as in non-pregnant patients. All routinely used therapies, including nebulised β_2-agonists and anticholinergic agents, systemic corticosteroids, and intravenous magnesium sulfate, can be used in pregnancy. As with all critical illness in pregnancy, maternal stabilisation takes priority, and escalation to ventilatory support should follow standard indications if required [26].

Extracorporeal membrane oxygenation has been used extensively in the Coronavirus Disease 2019 (COVID-19) pandemic and is generally safe in well-selected pregnant patients. Outcomes are favourable compared to the gen-

eral population [27]. Despite this, ECMO is underutilised in pregnancy. A recent Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries (MBRRACE) Saving Mothers Lives report highlighted the often inequitable application of referral criteria and calls for pregnancy-specific ECMO referral guidelines [1].

3.3 Haematological System

Pregnancy induces hypercoagulability through an increase in clotting factors, as well as a decrease in fibrinolysis. Venous thromboembolism (VTE) prophylaxis is needed in all critically unwell patients unless there is a clear contraindication [28]. For therapeutic anticoagulation, low molecular weight or unfractionated heparin is preferred. Doses around delivery should be carefully considered with input from the obstetric and anaesthetic team. Heparin infusions should be monitored with anti-Xa assays, rather than activated partial thromboplastin time (aPTT). This is because of increased factor VIII in the third trimester, which results in a low aPTT despite increasing anticoagulation 'apparent heparin resistance' [29].

3.4 Renal System

Glomerular filtration rate rises in pregnancy, which results in lower serum creatinine levels. Protein excretion increases. A protein-creatinine ratio of >30 mg/mmol is abnormal in pregnancy [30]. The risk of acute kidney injury (AKI) rises in the third trimester and postpartum. A creatinine of >77 µmol/L is abnormal in pregnancy, in addition to the usual criteria for AKI [31]. Pregnancy-specific causes of AKI include pre-eclampsia, ureteric damage during delivery, and postpartum haemorrhage. Non-gestational causes must always be considered, including rarer causes which are nonetheless more common in pregnancy, including thrombotic microangiopathies.

The indications for renal replacement therapy (RRT) in pregnancy are similar to those in non-pregnant individuals, except with regard to urea: due to the impact of uremia on fetal health, serum urea >16 mmol/L is an indication for RRT [31].

3.5 Sedation and Analgesia

No consensus exists on the optimal sedative regimen in pregnancy. Sedation should follow the same principles as in non-pregnant critically ill patients, using the lowest effective dose and avoiding over-sedation where possible. Propofol is widely used in both critical care and obstetric anaesthesia and may be used in pregnancy when clinically indicated. Benzodiazepines are also commonly used in critical care, although prolonged exposure may contribute to maternal delirium and neonatal sedation or withdrawal close to delivery. Data regarding dexmedetomidine use in pregnancy remain limited. As with all sedative agents in pregnancy, the potential maternal benefits of adequate sedation, ventilation, and organ support generally outweigh theoretical fetal risks in critically ill patients. Exposure close to delivery may result in neonatal sedation, respiratory depression, or neonatal withdrawal syndrome. Neonatal support should therefore be available at delivery.

Systemic non-steroidal anti-inflammatory drugs (NSAIDs) are advised against after 20 weeks of gestation due to the risk of premature closure of the ductus arteriosus [32]. Databases like UKTIS and LactMed offer up-to-date safety information on drug use during pregnancy and breastfeeding.

4. Conditions Commonly Encountered in Critically Ill Pregnant Women

The following section describes several major causes of maternal critical illness encountered in intensive care practice. This list is not intended to be exhaustive; rather, conditions have been selected for clinical relevance, frequency, and contribution to maternal morbidity and mortality, and are used to illustrate how the principles of organ support, investigation, and multidisciplinary management outlined above are applied in practice.

Across these conditions, the unifying challenge in maternal critical care is that pregnancy significantly alters physiology across multiple organ systems. Critical illness occurs when pathological processes disrupt these adapted physiological states and lead to organ dysfunction. Management therefore focuses on supporting and restoring maternal physiology while accounting for pregnancy-specific factors that influence assessment, monitoring, and organ support.

4.1 Sepsis and Infections in Pregnancy

Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection [33]. In pregnancy, physiological adaptations affecting cardiovascular, respiratory, renal, and immune function may alter both the presentation of sepsis and the interpretation of standard clinical and biochemical markers; for example, mild tachycardia, mild leukocytosis, and reduced serum creatinine may occur in normal pregnancy.

During pregnancy, the maternal immune system undergoes significant qualitative adaptations to balance protection against infection with tolerance of the fetus. While pregnancy is not associated with global immunosuppression, these changes are associated with increased susceptibility to, and altered presentation of, certain infections, which may progress rapidly to severe disease and sepsis.

The most common organisms in sepsis-related maternal deaths are *Group A Streptococcus* and *Escherichia coli* [34]. Women may develop critical illness from sepsis or organ dysfunction arising out of organ-specific infections, or from invasive pathogens (Table 1, Ref. [34,35,36,37]). Presentation may be atypical due to physiological changes.

Early goal-directed therapy with fluid resuscitation, vasopressors, broad-spectrum antibiotics, and source con-

Table 1. Common infections in critically ill pregnant and post-partum women.

Pathology	Description
Infections by organ system involved	
Chorioamnionitis	An infection of the amniotic fluid and membranes, which is often associated with maternal fever, tachycardia, and fetal distress. Mixed gram-positive and gram-negative infections are common (see *Group A Streptococcus*). Delivery is indicated [35].
Endometritis	Typically occurring after caesarean delivery, this can present with fever, pelvic pain, and abnormal uterine bleeding. It is usually a polymicrobial infection, often involving anaerobes, and requires broad-spectrum antibiotic therapy.
Respiratory infections	Pregnant women are at higher risk of complications from influenza and COVID-19. In severe COVID-19 infection, steroids and monoclonal antibodies are indicated. Prophylactic or therapeutic anticoagulation should be considered, taking into account the risk of thromboembolism in more severely ill women and the timing of delivery. Tocilizumab should be strongly considered, and there is no evidence of fetal harm, but this should be an MDT decision with involvement of obstetricians and infection specialists [36].
Urinary tract infections (UTIs)	Increased incidence in pregnancy, and can progress to pyelonephritis and sepsis.
Disseminated infection by pathogen	
Herpes simplex	Primary infection in pregnancy is common (around 2% of pregnancies) but, rarely, especially if infection occurs in the third trimester, may result in disseminated disease, which has a mortality rate of up to 50%. Vesicles may be absent or disseminated, and there may be visceral hepatitis or central nervous system involvement and deranged coagulation [37].
Invasive *Group A Streptococcus*	Pregnant and post-partum women are at increased risk of developing invasive *Group A Streptococcus*. It can progress rapidly from ascending infection of the genital tract [34].

COVID-19, Coronavirus Disease 2019; MDT, multidisciplinary team.

trol is essential, with management focused on restoration of maternal perfusion and organ function.

Hydrocortisone in refractory shock follows the same indications as in non-pregnant patients, with glycaemic monitoring [34]. Intravenous immunoglobulin neutralises exotoxins in staphylococcal and streptococcal sepsis and can be used. Epidural and spinal anaesthesia should be avoided in peripartum sepsis [36].

Delivery is indicated for obstetric source control such as chorioamnionitis, but sepsis alone is not otherwise an indication for delivery.

Causes other than bacterial infection should be considered if the clinical sepsis syndrome does not respond in the expected way, with ongoing deterioration despite appropriate antibiotic therapy, including viral infection, haemophagocytic lymphohistiocytosis (HLH), and other rarer causes such as malignancy and mitochondrial disorders.

4.2 Hypertensive Disorders of Pregnancy

Pre-eclampsia is a serious multisystem disorder affecting 3% to 8% of pregnancies. It arises from abnormal placentation and typically manifests after the 20th week of pregnancy. Release of pro-inflammatory factors leads to widespread endothelial dysfunction and vasoconstriction [38]. Pre-eclampsia with severe features is among the most common obstetric indications for antenatal and postnatal intensive care admission. It may present as the primary reason for critical illness or coexist with other conditions requiring intensive care unit support. Pre-eclampsia may also develop de novo in women admitted to critical care for other indications; therefore, regular monitoring for new-onset hypertension and proteinuria is essential, with pregnancy-specific thresholds applied (blood pressure $\geq$140/90 mmHg considered abnormal) [39,40].

Initially, 'mild' disease can rapidly progress to pulmonary oedema, severe and progressive organ dysfunction (renal, hepatic, and coagulation), neurological features (eclampsia, posterior reversible encephalopathy syndrome), placental abruption and intrauterine death. Early onset disease (<34 weeks) carries the highest risks. Pre-eclampsia is frequently diagnosed post-natally and may worsen initially before resolving.

HELLP (haemolysis, elevated liver enzymes and low platelets) syndrome is a severe manifestation of pre-eclampsia and has a maternal mortality of 1–25% and perinatal mortality of 10–60% [41]. Hypertension and proteinuria may be mild or absent. In severe cases, and especially if abdominal pain is a feature, imaging may be required to exclude hepatic haematoma and/or capsular rupture. Acute fatty liver of pregnancy (AFLP) is sometimes considered in the differential, but is much rarer. AFLP is a mitochondrial hepatopathy of late pregnancy. There is typically a prodrome of abdominal pain, malaise and often symptoms of

transient diabetes insipidus. The Swansea criteria [42] are sensitive for diagnosis, but non-specific as features overlap with severe liver disease of other aetiologies [43].

Other thrombotic microangiopathies (TMAs) can mimic preeclampsia and HELLP syndrome. These disorders are characterised by microangiopathic haemolytic anaemia and ischaemic injury to organs, and include thrombotic thrombocytopenic purpura (TTP), atypical haemolytic uraemic syndrome (aHUS), and secondary TMAs. Failure of the disorder to improve with delivery should raise suspicion and provoke discussion with a specialist centre with expertise in these conditions.

Management of pre-eclampsia in the critical care setting focuses on blood pressure control, fluid balance management, seizure prevention, and discussions to facilitate timely obstetric decision-making. Decisions regarding timing and mode of delivery, antenatal corticosteroids, and the use of magnesium sulfate for fetal neuroprotection should be made in conjunction with senior obstetric input [40].

Target blood pressure is under 135/85 mmHg, but excessive blood pressure lowering may lead to placental hypoperfusion and should be avoided. Volume expansion is not recommended and may worsen pulmonary oedema, but if using hydralazine as an antihypertensive, a bolus of crystalloid is usually given. When establishing epidural or spinal analgesia, the patient should not be routinely preloaded, but consideration should be given to overall volume status. Endotracheal intubation, for example, to facilitate caesarean section, may precipitate severe hypertension [40].

In the event of seizure, administer intravenous magnesium sulfate, as there is good evidence that its use halves the likelihood of seizure recurrence. Alternative anticonvulsants should not be used, but persistent seizures may require the use of diazepam and intubation/ventilation and neuroimaging to exclude cerebral haemorrhage. Magnesium sulfate prophylaxis should be considered in pre-eclampsia with severe features or neurological features such as headache, clonus, or scotomata [40].

4.3 Cardiac Conditions

Cardiac disease is a leading cause of death in pregnancy [1]. Left ventricular systolic dysfunction in pregnancy may occur due to underlying cardiomyopathy or be tachyarrhythmia-related. Cardiomyopathy can also present de novo due to ischaemic or dilated cardiomyopathy, or as peripartum cardiomyopathy (PPCM). PPCM is characterized by a reduced ejection fraction and symptoms of heart failure in the last weeks of pregnancy or the first few months after delivery (including following miscarriage or termination) and is a diagnosis of exclusion [44].

Diagnosis of cardiac failure or arrhythmias may be delayed because symptoms such as breathlessness, palpitations, fatigue, and peripheral oedema can initially be attributed to normal pregnancy.

Management follows standard heart failure strategies, including mechanical support if refractory shock occurs, if necessary, as a bridge to transplantation [16]. For PPCM, bromocriptine may be used in some centres [45]. Life-threatening arrhythmias should be managed as for non-pregnant patients, and electrical cardioversion is safe in pregnancy. Routine use of amiodarone is contraindicated due to its adverse fetal effects, but it can be used in situations of haemodynamic instability [46].

Valvular disease, particularly mitral or aortic stenosis, may decompensate with the haemodynamic changes of pregnancy. Medical management in severe mitral stenosis requires rate control and preload optimization, and consideration of anticoagulation. Percutaneous mitral balloon commissurotomy is preferred in those with elevated pulmonary arterial pressures or advanced heart failure. In severe aortic stenosis, balloon valvuloplasty or valve replacement should be considered [16].

Delivery may improve maternal haemodynamics in selected cases of severe cardiac decompensation in later pregnancy by reducing the haemodynamic burden of pregnancy. However, delivery itself may carry substantial risk in women with unstable heart failure or cardiogenic shock, and decisions regarding timing and mode of delivery should be individualised according to maternal cardiovascular stability, gestational age, fetal condition, and the anticipated effect of delivery on maternal physiology.

4.4 Pulmonary Embolism (PE)

Pulmonary embolism is a leading cause of maternal morbidity and mortality and remains the commonest direct cause of maternal death in the UK [1]. Pregnancy and the postpartum period are associated with a hypercoagulable state, venous stasis, and vascular injury, resulting in a significantly increased risk of venous thromboembolism, particularly in the postnatal period. Massive or submassive PE can rapidly overwhelm the physiologically adapted cardiovascular system of pregnancy, resulting in acute right ventricular failure and cardiovascular collapse, and therefore represents a time-critical diagnosis in pregnant and postpartum women [47].

Diagnosis may be challenging because clinical features such as tachycardia and dyspnoea may overlap with normal pregnancy physiology. However, sudden or progressive breathlessness, pleuritic chest pain, syncope, hypoxia, marked or persistent tachycardia at rest, or haemodynamic instability should prompt urgent assessment for pulmonary embolism.

Treatment of PE requires immediate anticoagulation. Low molecular weight heparin (LMWH) is preferred, and changes in weight, and therefore dose, around delivery should be considered [29]. In women also at high risk of bleeding, unfractionated heparin infusion may be preferred, and/or an inferior vena cava filter may be considered. In cases with haemodynamic instability, thrombolytic therapy

has been recommended in women with a low risk of bleeding [48]. A review of the outcomes of 37 patients who underwent systemic thrombolysis in pregnancy reported a major bleeding rate of 18% [49]. Catheter-directed thrombolysis may also be used in pregnancy and should be considered for women with a high risk of bleeding in whom systemic therapy is contraindicated [50].

Delivery is not routinely indicated solely because of pulmonary embolism, although severe maternal hypoxia or haemodynamic compromise may influence multidisciplinary decision-making regarding timing and mode of delivery. In cases of massive PE with obstructive shock, delivery may improve maternal haemodynamics by reducing aortocaval compression and cardiovascular demand. Persistent maternal hypoxia may also lead to delivery being considered for fetal indications, depending on gestation. However, caesarean delivery may carry substantial additional risk in the setting of cardiorespiratory instability, and decisions should therefore be individualised according to maternal condition, gestational age, fetal status, and obstetric factors.

4.5 Amniotic Fluid Embolism

Amniotic fluid embolism (AFE) is a rare but catastrophic obstetric emergency that occurs when amniotic fluid, fetal cells, or other debris enter the maternal circulation, triggering an acute systemic inflammatory and anaphylactoid response. It typically presents with rapid onset of hypoxia and cardiovascular collapse, followed by coagulopathy and disseminated intravascular coagulation. Maternal morbidity and mortality are high. Management is primarily focusing on haemodynamic stabilization, advanced airway and ventilatory support, and correction of coagulopathy [51]. When women collapse intrapartum, AFE is often quickly suspected; however, there is a wide range of causes that may lead to intrapartum collapse, so it is important to remain vigilant about the differential diagnosis.

4.6 Rheumatological Conditions

Granulomatosis with polyangiitis (GPA), microscopic polyangiitis, rheumatoid arthritis (RA), systemic lupus erythematosus, and antiphospholipid syndrome can all lead to severe organ dysfunction and require critical care support. The management of these conditions in critical care requires close collaboration between intensivists, haematologists, rheumatologists, and obstetricians.

High-dose corticosteroids, cyclophosphamide or rituximab may be required for aggressive vasculitis and lupus nephritis and can be given in pregnancy with specialist multidisciplinary team guidance.

Catastrophic antiphospholipid syndrome (cAPS) is a rare but life-threatening form of antiphospholipid syndrome that can be triggered by pregnancy. Diagnosis is often delayed because this may occur postpartum, and the features may overlap with those of HELLP syndrome. It is associated with widespread thrombotic events, including venous and arterial thrombosis, sequential organ failure, and pregnancy complications such as recurrent miscarriage, preeclampsia, and placental insufficiency [52].

4.7 General Themes

In practice, critically ill pregnant and postpartum women present with a wide range of underlying diagnoses, with pregnancy adding complexity to assessment and coordination of care rather than altering core management principles. Across diagnoses, common themes emerge: the need for timely recognition, pregnancy-specific monitoring thresholds, appropriate organ support, and early senior multidisciplinary decision-making.

5. Knowledge Gaps and Limitations of the Evidence

The evidence base underpinning the management of critically ill pregnant and postpartum women remains limited. Historically, pregnant women have been excluded from many clinical trials, particularly in critical care, resulting in a reliance on observational studies, case series, registry data, and extrapolation from non-pregnant populations.

Important areas of uncertainty include how best to apply standard critical care risk stratification and organ dysfunction scores, such as the Sequential Organ Failure Assessment (SOFA) score, in pregnancy. While SOFA and obstetrically modified SOFA-based tools have shown prognostic value in obstetric critical care and maternal sepsis populations, no currently available scoring system has demonstrated sufficient diagnostic accuracy to be used alone for the identification of severe maternal outcomes [53,54]. Their role in supporting risk stratification and escalation decisions in non-ICU maternity settings therefore remains an important area for further study. Similarly, practices such as permissive hypercapnia, non-invasive haemodynamic monitoring, prone positioning, and ECMO referral thresholds are supported by limited pregnancy-specific data and require individualised, multidisciplinary decision-making.

For rare conditions such as catastrophic antiphospholipid syndrome, amniotic fluid embolism, and disseminated viral infections, evidence is largely derived from case reports, case series, and systematic reviews of observational data. These limitations underscore the need for pregnancy-inclusive research, improved national and international registries, and pregnancy-specific critical care guidance to support equitable, evidence-informed care.

6. Conclusion

Pregnant and postpartum women should have equitable access to the full range of critical care interventions, embedded within institutional protocols and applied thoughtfully in pregnancy. Optimal management

depends on timely, consultant-level multidisciplinary collaboration, with pragmatic decisions about the location of care and clear pathways for escalation and transfer. Pregnant women are vulnerable to both gestational and non-gestational causes of critical illness, and diagnostic certainty must be pursued with the same urgency as in any other critically ill patient. Psychological and lactation needs should be supported alongside physiological recovery, so that maternal critical care safeguards long-term well-being as well as acute survival.

Key Points

• Pregnant and postpartum women represent a small but high-risk population within critical care, with physiological adaptations, pregnancy-specific conditions, and service configuration factors contributing to diagnostic and management complexity.

• Optimal care of the critically ill obstetric patient depends on timely, senior multidisciplinary collaboration, pregnancy-adapted monitoring thresholds, and equitable access to standard critical care investigations and organ support.

• Many principles of organ support are similar to those used in non-pregnant patients, but must be modified to account for pregnancy physiology, fetal considerations, and limited pregnancy-specific evidence.

• Significant knowledge gaps persist due to the historical exclusion of pregnant women from clinical trials, underscoring the need for pregnancy-inclusive research and pragmatic, evidence-informed clinical decision-making.

Availability of Data and Materials

Not applicable.

Author Contributions

JB and CF contributed substantially to the conception and design of the manuscript. JB drafted the initial manuscript. Both authors contributed to revising the manuscript critically for important intellectual content. Both authors approved the final version for publication and agreed to be accountable for all aspects of the work, and for ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

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Conflicts of Interest

The authors declare no conflicts of interest.

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