

The Role of Point-of-Care Ultrasound (POCUS) in improving maternal outcomes: An overview

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ABSTRACT

Point-of-care ultrasound (POCUS) has become a transformative tool in obstetric medicine, enabling accurate diagnosis and monitoring. Its uses include assessing respiratory and cardiac issues, abdominal pain, vascular emergencies, and undifferentiated shock during pregnancy. Its portability and real-time visualization allow for immediate treatment decisions. As non-radiologists expand their skills, POCUS has the potential to significantly improve maternal outcomes. This overview highlights some current protocols, clinical applications, and evidence supporting the integration of POCUS into routine obstetric care.

INTRODUCTION

Maternal mortality and morbidity continue to be significant global health challenges, especially in low- and middle-income countries (LMICs). Early diagnosis and prompt treatment of critical pregnancy conditions are essential. POCUS has transformed bedside diagnostics by providing immediate, actionable clinical insights, particularly in resource-limited settings. This overview examines how POCUS can improve maternal care by demonstrating its clinical value in various obstetric and medical emergencies. Obstetricians and gynecologists are well-positioned to adopt POCUS, as they can quickly learn it using their existing ultrasound expertise.

POCUS PROTOCOLS

Several POCUS protocols have been developed over the years for emergency medicine and critical care; many have been adapted for specific clinical specialties and situations, often with variations of the original protocol names. The basic protocols aim to answer yes/no questions, such as whether the left ventricle is contracting effectively. However, as these basic protocols evolve and the sonographer's skillset improves, more advanced measurements become possible, providing additional clinical information obtained at the bedside.

The most well-known POCUS protocols include the following: The Extended Focused Assessment with Sonography in Trauma (E-FAST) was originally developed and used in trauma cases to detect intra-abdominal bleeding caused by blunt force injuries. It has now been expanded to include thoracic conditions such as hemothorax with or without tamponade, hemothorax, and pneumothorax. The E-FAST has been integrated into the Advanced Trauma Life Support (ATLS) framework for trauma care. It is performed alongside resuscitative efforts and can be repeated if the initial assessments are negative. ^(1, 2)

Professor Eric Sloth developed the Extended Focus Assessed Transthoracic Echo (E-FATE) in 1989. The protocol aims to provide a straightforward and quick method for evaluating cardiac function in peri-operative and critical care settings using four standard transthoracic echocardiographic views. ^(3, 4)

Daniel Lichtenstein created the Bedside Lung Ultrasound in Emergency (BLUE) protocol in the late 1990s to assess dyspnea. Using a standardized set of lung ultrasound findings, the protocol develops profiles based on artifact patterns and signs, each linked to a specific lung condition. It has proven to be highly accurate in diagnosing pneumonia, pulmonary edema, pneumothorax, and other respiratory conditions. ^(5, 6)

The original POCUS protocols were integrated into other protocols that include additional views, such as the Rapid

Ultrasound Assessment of Shock (RUSH) protocol. This protocol offers a comprehensive evaluation of the heart, lungs, inferior vena cava (IVC), and abdomen to identify the cause of undifferentiated shock in patients. ⁽⁷⁾

Essentially, the clinical applications remain the same, and the fundamental principles behind these protocols can also be applied in obstetric care. However, a dedicated obstetric POCUS protocol has not yet been established.

CLINICAL APPLICATIONS

1. Lung ultrasound and Dyspnea in pregnancy

Lung ultrasound (LUS) surpasses physical exams and chest X-rays, often approaching the accuracy of CT scans in certain cases. Research indicates that LUS is especially effective at diagnosing pneumonia (sensitivity 91-96% for LUS versus 57-73% for chest X-rays), pleural effusions (sensitivity 83-100% for LUS with volumes as small as 50ml), and pneumothorax (sensitivity 9.6% for LUS compared to 68.8% on supine chest X-ray).

Pregnant patients with dyspnea can be quickly evaluated using POCUS, which reduces exposure to ionizing radiation and allows for prompt, appropriate treatment. It also assists in monitoring and documenting pathological findings until they are fully resolved. ⁽⁸⁾

2. Cardiac Ultrasound and Maternal Heart Disease

Cardiac disease contributes to 1-4% of maternal morbidity and mortality. In LMICs, rheumatic heart disease remains prevalent. Cardiac POCUS can be crucial for screening and detecting asymptomatic valvulopathies and other conditions, such as rheumatic mitral stenosis and regurgitation, peripartum cardiomyopathy, pulmonary embolism, aortic dissection, and cardiac tamponade. During acute emergencies—such as postpartum collapse, undifferentiated shock, pregnancy-related tachycardia, dynamic left ventricular outflow obstruction, and sudden-onset heart failure—cardiac POCUS is extremely useful in determining the likely cause.

It is also useful for evaluating hypertension during pregnancy, helping the clinician determine if it is chronic (by observing left ventricular hypertrophy) or identify poor prognostic or high-risk indicators in pre-eclampsia, such as diastolic dysfunction and B-lines that indicate potential pulmonary edema.

Cardiac views include the parasternal long- and short-axis, apical four-chamber, subxiphoid views, and IVC assessment. The IVC assessment during pregnancy presents unique challenges because it is larger early on but decreases as pregnancy progresses. After 16 weeks, the IVC size remains unchanged

when the mother is in a supine position but increases when she is in the left lateral decubitus position. This demonstrates that, although POCUS protocols can be used during pregnancy, a thorough understanding of physiological changes is essential for accurately interpreting images and clinical findings.⁽⁹⁻¹²⁾ It is also important to acknowledge the limitations the gravid uterus places on obtaining subxiphoid views; thus, knowing how to get the relevant images from other views is crucial.

3. Abdominal POCUS in Obstetrics

Using the principles of the E-FAST protocol, the obstetric practitioner can apply this method to evaluate the abdomen for signs of occult postpartum hemorrhage and suspected uterine rupture in trauma cases. Right upper quadrant pain is notoriously difficult to assess, and pregnancy and abdominal POCUS can help quickly diagnose cholelithiasis. In cases of HELLP syndrome, prompt detection of a hepatic subcapsular hematoma is possible by performing a right upper quadrant view according to the E-FAST protocol. Basic renal ultrasound can also aid in identifying hydronephrosis and hydroureter, as well as detecting bladder abnormalities.⁽¹³⁾

4. Undifferentiated Shock and Maternal Cardiac Arrest

The RUSH protocol enables quick identification of shock causes, helping clinicians distinguish between hypovolemic shock, cardiogenic shock, obstructive causes (such as pulmonary embolism and tamponade), and septic shock. This guides the clinician in deciding whether to administer fluids, vasopressors, or inotropes based on ultrasound findings. POCUS has also become a valuable tool during cardiopulmonary resuscitation to determine if there is true asystole, fine ventricular fibrillation, or return of spontaneous circulation. It assists in evaluating the effectiveness of cardiac compressions by checking femoral artery pulsations with Doppler ultrasound. Additionally, it helps identify reversible causes of arrest (part of the H's and T's algorithm in Advanced Cardiac Life Support).⁽⁷⁾

5. Deep Venous Thrombosis in Pregnancy

POCUS is a helpful tool for diagnosing deep vein thrombosis (DVT) in pregnant patients, particularly for proximal lower extremity DVT. While standard compression ultrasound may not visualize isolated pelvic DVT, POCUS can identify indirect signs of thrombosis such as increased venous diameter, resistance to compression, and reduced phasicity. In pregnant patients, DVT frequently occurs in the left iliofemoral vein, and POCUS aids in diagnosing it.^(13,14)

6. Obstetric Emergencies

As previously mentioned, POCUS is invaluable for diagnosing and managing obstetric emergencies such as postpartum hemorrhage, related hemodynamic assessments, pre-eclampsia complications, and acute abdominal conditions during pregnancy. Diagnosing amniotic fluid embolism (AFE) is particularly challenging for clinicians, and cardiac POCUS can assist in the initial evaluation. However, it may be difficult to distinguish between the ultrasound findings of an acute PE and those of AFE, as they often appear quite similar in cardiac ultrasound.⁽¹²⁾

TRAINING AND IMPLEMENTATION

Maternal POCUS improves clinical exams, reduces diagnostic delays, and enhances obstetricians' existing ultrasound skills for a more comprehensive systemic assessment. Wide adoption of POCUS requires structured training and credentialing programs specifically designed for obstetricians and obstetric-related conditions and findings. As maternal medicine becomes more multidisciplinary, proficiency in POCUS should be a key component of ongoing

professional development.

CONCLUSION

Integrating POCUS into routine antenatal and emergency care is both practical and impactful. POCUS is a valuable addition to clinical skills that enhances the diagnosis and treatment of many maternal conditions. Its portability, quick deployment, and accuracy make it a vital tool for improving maternal outcomes, especially in high-risk or resource-limited settings. Support from institutions for training and routine use will be essential to unlock its full potential.

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