

Incorporating Multiorgan Point-of-care Ultrasound into Obstetric Emergency Treatment Protocols


 CME
Credits

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INTRODUCTION

Medical history records and physical examinations involving the inspection, palpation, percussion, and auscultation of different organs play an essential role in the decision-making process for disease diagnosis, management, and intervention in clinical medicine. However, advances in biomedicine and mechanical technology have led to an increasing number of traditional clinical examination methods being replaced. For example, medical ultrasound is being increasingly applied in various medical specialties. Bedside point-of-care ultrasonography (POCUS) performed by a clinician is often used to answer focused clinical questions instantly and to support decision-making in patient management.^[1] In emergency and critical care medical settings, POCUS applied for patient examination primarily includes cardiac, lung, and abdominal ultrasounds used for the clinical assessment of specific symptoms or signs such as hypotension, shock, dyspnea, or chest pain.^[2] Numerous structured protocols incorporating multiorgan POCUS (MOPOCUS) have also been proposed to guide assessment processes. In obstetrics and gynecology, a high-risk pregnancy can quickly develop into an obstetric emergency requiring urgent intensive care. However, although medical ultrasound is extensively applied in clinical obstetrics for maternal–fetal health care, POCUS protocols established in this field are generally limited to only the imaging of the fetus and pelvic organs. The incorporation of maternal POCUS into critical obstetric settings has the potential for preventing cardiovascular-associated maternal mortality.^[3] This thus indicates that maternal POCUS should be incorporated into baseline obstetric ultrasound to ensure the more efficient diagnosis, treatment, and evaluation of obstetric emergencies; doing so can ensure that high-risk pregnant

women obtain the same standard of care as their nonpregnant critical counterparts. Accordingly, the objective of this article is to present an avant-garde perspective on the incorporation of MOPOCUS into structured routine care protocols for the management of major obstetric emergencies, including postpartum hemorrhage (PPH), preeclampsia, and maternal sepsis; this can help clinicians and researchers more clearly understand the applicability of MOPOCUS in the clinical decision-making process for the management of obstetric emergencies.

POINT-OF-CARE ULTRASONOGRAPHY AND MULTIORGAN POINT-OF-CARE ULTRASONOGRAPHY IN OBSTETRICS

The World Federation for Ultrasound in Medicine and Biology defined POCUS as “ultrasound performed by the clinician providing care, which is brought to the location where the patient is receiving care.”^[1] Because POCUS offers the advantages of convenience and rapidity, enables immediate patient classification and triage, supports timely therapeutic decisions, and enables optimization of treatment outcomes, it was originally applied specifically in emergency medicine. Its application was then expanded to numerous specialties in clinical settings. POCUS has been applied in emergency medical services and has been incorporated into such protocols as the Focused Assessment with Sonography in Trauma protocol to facilitate the identification of intrapersonal fluid, pericardial fluid, hemothorax, and pneumothorax; the Bedside Lung Ultrasound in Emergency protocol to facilitate the search for pleural effusion, lung parenchyma, and pneumothorax;

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the Rapid Ultrasound for Shock and Hypotension protocol to narrow the differential and identify the etiology of a shock; the Focused Assessment Transthoracic Echocardiography protocol; and the Focused Echocardiography in Emergency Life Support protocol.^[2]

Although the majority of obstetric patients complete delivery without incident, pregnancy is a potentially high-risk condition involving unique physiologic processes. Approximately 1% of maternity patients experience emergency or critical situations that require intensive care, with the most common of these situations being obstetric hemorrhage, preeclampsia, embolic disease, and sepsis. Most obstetric emergencies occur in the postpartum period and involve systemic pathophysiological processes that require a multidisciplinary and multiorgan approach for timely and comprehensive evaluation and intervention. Nonbedside assessment and consultation processes are often insufficient to guide prompt diagnosis and management of critically ill obstetric patients. This article proposes several common critical obstetric scenarios in which MOPOCUS can be employed by obstetricians to complete a systematic multiorgan assessment while a patient is being rescued [Figure 1]. Applying MOPOCUS in such scenarios can help emergency teams make precise clinical decisions.

MULTIORGAN POINT-OF-CARE ULTRASONOGRAPHY IN POSTPARTUM HEMORRHAGE PROTOCOLS

PPH is the leading cause of maternal death worldwide and is most commonly caused by uterine atony.^[4] PPH is typically diagnosed on the basis of clinical manifestations and the hemorrhagic status of the parturient. The management and treatment principles of PPH include early recognition and exploration of the cause, emergency resuscitation, and timely surgical intervention. Uterine atony is considered a potential early indicator of massive vaginal bleeding. However, intra-abdominal vascular bleeding that occurs after a cesarean

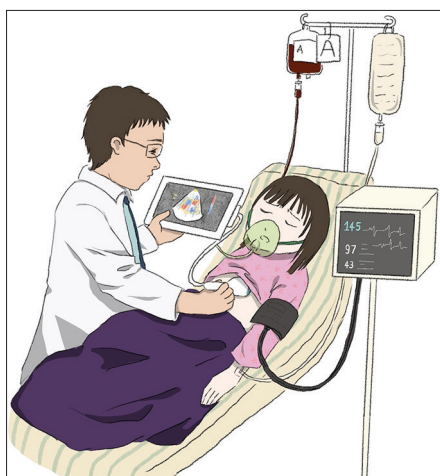


Figure 1: Conceptual MOPOCUS model that can be incorporated into the clinical management framework for obstetric emergencies. MOPOCUS: Multiorgan point-of-care ultrasound

section or operative vaginal delivery may not be detected early, which often leads to the diagnosis of PPH being delayed. The risk of severe PPH-related complications increases if a prompt definitive surgical intervention is not provided. Furthermore, in cases of intra-abdominal bleeding, interventions for uterine atony do not have long-lasting effects and instead increase the risk of coagulopathy due to undetected and persistent bleeding. POCUS could assist in achieving a prompt PPH evaluation, thereby leading to timely and accurate etiological exploration that could reduce the incidence of major morbidity or maternal mortality. Incorporating MOPOCUS into PPH protocols in labor and delivery units can enable the holistic assessment of intra-abdominal bleeding caused by pelvic organ trauma; specifically, it can enable the assessment of the placenta and uterine cavity, bilateral hypochondria, and the pouch of Douglas. Furthermore, MOPOCUS can be used to determine the diameter of the inferior vena cava, which can aid in evaluations of a patient's blood volume status.

MULTIORGAN POINT-OF-CARE ULTRASONOGRAPHY IN PREECLAMPSIA PROTOCOLS

Preeclampsia is a multifocal syndrome that is typically characterized by new-onset hypertension and proteinuria in the second half of pregnancy. Preeclampsia is responsible for 60,000 maternal deaths worldwide each year.^[5] Women with severe preeclampsia are 10–30-fold more likely to develop severe complications such as pulmonary edema, cerebrovascular accidents, coagulopathy, bleeding, and multiorgan failure. During pregnancy, maternal cardiac output, heart rate, and stroke volume increase, whereas vascular resistance decreases. However, cardiac filling pressure remains unchanged. Moreover, the development of preeclampsia is associated with increased cardiac output, mild vasoconstriction that leads to increased cardiac filling pressure, and impaired diastolic function. Fluid resuscitation is thus essential for managing a preeclampsia emergency; this is because during preeclampsia events, hypovolemia exacerbates organ failure, and volume overload can lead to pulmonary edema. To optimize preeclampsia treatment outcomes, POCUS can be incorporated into clinical management processes to enable the noninvasive monitoring of a patient's hemodynamics. Basic MOPOCUS in preeclampsia protocols includes cardiac ultrasound, lung ultrasound, and venous ultrasound. These ultrasound techniques are used to differentially diagnose the cardiogenic, pulmonary, and thromboembolic causes of preeclampsia. In addition, POCUS can be used to evaluate the diameter of the optic nerve sheath, which can facilitate the task of determining whether cerebral edema has caused elevated intracranial pressure.

MULTIORGAN POINT-OF-CARE ULTRASONOGRAPHY IN MATERNAL SEPSIS PROTOCOLS

Maternal sepsis is a life-threatening condition that involves organ dysfunction caused by infection during pregnancy,

childbirth, puerperium, or postabortion. Identifying maternal sepsis for appropriate and timely interventions has the potential to save millions of maternal lives.^[6] Unrecognized or inadequately managed maternal infections can lead to sepsis, death, or disability and an increased likelihood of neonatal infection and adverse outcomes. Pregnancy-related physiological, immune, and organic changes make pregnant women more susceptible to infection than does the general population, and the signs and symptoms of infection and sepsis can be difficult to identify, which leads to delays in maternal sepsis recognition and intervention. Serial POCUS can be used to identify the cause of maternal sepsis in a timely manner, which can improve therapeutic management. MOPOCUS in maternal sepsis protocols includes cardiac ultrasound, lung ultrasound, renal ultrasound, and abdominal ultrasound examinations and can be used to quickly identify the cause of sepsis and infectious diseases that can occur during pregnancy, such as endocarditis, pneumonia, acute pyelonephritis, and cholecystitis. After a diagnosis of maternal sepsis has been established, POCUS can be used continually to guide and monitor treatment and resuscitative efforts.

CONCLUSION

More than three decades have passed since POCUS began to be incorporated into emergency medicine, anesthesiology, and intensive care medicine workflows. However, with the exception of fetal ultrasound, ultrasonography has not been incorporated into maternal care in maternal–fetal medicine. Obstetricians have the necessary skills and equipment to conduct ultrasound procedures, and precise care is required for

the considerable maternal population of the world. Therefore, obstetric MOPOCUS protocols must be developed, and MOPOCUS should be incorporated into obstetric clinical guidelines and curricula. Furthermore, further study should be initiated to optimize maternal quality of care and reduce maternal morbidity and mortality.

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Conflicts of interest

There are no conflicts of interest.

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