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Implementing cardiac POCUS in obstetric patients during the preanesthetic period. Narrative review

Implementación del POCUS cardiaco en pacientes obstétricas durante el periodo preanestésico. Revisión narrativa

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Abstract

During the preanesthetic assessment of the obstetric patient, it is critical to assess the patient's cardiovascular baseline condition, identify any potential risks, and facilitate behavioral modification to develop an individualized management strategy aimed at minimizing complications. Cardiac point-of-care ultrasound (POCUS) is a valuable instrument for assessing the morphology and function of the heart prior to surgery. Cardiac POCUS is not designed to replace comprehensive transthoracic echocardiography, which is the realm of cardiovascular anesthesiology and cardiology. However, when used in conjunction with anamnesis, physical examination, electrocardiogram, and previous laboratory results, cardiac POCUS is a valuable adjunct in the diagnostic toolbox of anesthesiologists. It allows for direct visualization of the heart and great vessels, with added benefits of speed, availability, and low risk for the patient. The purpose of this manuscript is to explore and describe the advantages of cardiac POCUS in the preanesthetic period of obstetric patients and its potential value for anesthesiologists through the identification of potentially hazardous conditions that may require individualized preoperative management.

Key words: Cardiac POCUS; Echocardiography; Obstetric Anesthesia; Perioperative care; Perioperative medicine; Preanesthetic period; Anesthesia; Anesthesiology.

Resumen

Durante la valoración preanestésica de la paciente obstétrica, es fundamental evaluar la condición cardiovascular basal de la paciente, identificar riesgos potenciales y facilitar modificaciones conductuales para desarrollar una estrategia de manejo individualizada, dirigida a minimizar las complicaciones. La ecografía cardíaca a la cabecera del paciente (POCUS) es un instrumento valioso para evaluar la morfología y la función del corazón antes de un procedimiento quirúrgico. El POCUS cardiaco no está diseñado para sustituir a la ecocardiografía transtorácica formal, que corresponde al área de anestesiología cardiovascular y a la cardiología. Sin embargo, cuando se usa en conjunto con la anamnesis, el examen físico, el electrocardiograma y los resultados de exámenes de laboratorio previos, el POCUS cardiaco es un complemento valioso dentro del arsenal diagnóstico de los anestesiólogos. Permite la visualización directa del corazón y de los grandes vasos, con beneficios adicionales de velocidad, disponibilidad y bajo riesgo para la paciente. El objetivo del presente manuscrito es explorar y describir las ventajas del POCUS cardiaco durante el periodo preanestésico en pacientes obstétricas y su valor potencial para los anestesiólogos, a través de la identificación de condiciones eventualmente peligrosas que pudieran requerir un manejo preoperatorio individualizado.

Palabras clave: POCUS cardiaco; Ecocardiografía; Anestesia obstétrica; Cuidado perioperatorio; Medicina perioperatoria; Periodo preanestésico; Anestesia; Anestesiología.

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INTRODUCTION

The preanesthetic phase is essential during obstetric perioperative care, since it is during this period that risks are identified, and cautious steps are taken to enhance anesthetic management, thereby ensuring increased confidence and safety for both patients and practitioners. (1,2) A critical assessment of cardiac function must be conducted during this phase, since most of anesthetic and specific obstetric medications may have direct or indirect effects on the cardiovascular system, with significant consequences. (3)

During this phase, it is essential for the anesthesiologist to conduct a comprehensive review of the patient's anesthetic, cardiac, and obstetric history. This includes assessing the functional class using well-known scales such as NYHA (New York Heart Association classification), METS (Metabolic Equivalents in exercise testing), or DASI (Duke Activity Status Index) (4) and determining the risk of maternal cardiac complications using the CARPREG II (Cardiac Disease in Pregnancy Study Score) scale (5), albeit with some previously mentioned limitations. (6) Cardiovascular abnormalities must be identified during the physical examination, including but not limited to cyanosis, finger clubbing, and new murmurs. Important elements include an electrocardiogram or rhythm Holter for interpreting heart rhythm and a review of other relevant studies, including serological tests (troponins, natriuretic peptides), chest X-rays, magnetic resonance imaging, cardiac catheterization, and others, as required according to the specific circumstances. (7)

Recently, point-of-care ultrasound (POCUS) has been integrated into the toolbox of cardiopulmonary evaluation techniques. (8) The use of ultrasound technology has gained significant popularity due to its undeniable benefits. These include no radiation exposure, decreasing costs and portability of ultrasound devices (even small enough to be carried in a pocket), flexibility for making assessments (allowing for repetitions), and the ability to take images in various positions (including lying, sitting, or prone) (9) without having to transfer patients to other areas of the hospital. Certain authors have even speculated that this technique might eventually replace the stethoscope in many circumstances. (10)

Cardiac POCUS, also known as focused cardiac ultrasound (FOCUS) in the medical literature, is a tool used for obtaining critical data via ultrasonography. (11) Some of its uses include the assessment of volume overload, biventricular function, and performing a thorough examination of the cardiac valves, chambers, and pericardium. (12) According to the American Society of Echocardiography, cardiac POCUS is an examination that focuses exclusively on image acquisition. In contrast, critical care echocardiography (CCE) utilizes expanded protocols that enable the acquisition of quantitative data through color and spectral Doppler, in addition to predominantly qualitative information obtained from such images. The formal transthoracic echocardiogram (TTE), on the other hand, is the most comprehensive study and is typically reserved for cardiovascular anesthesiologists or cardiologists. (13) However, in clinical practice, cardiac POCUS lacks specific boundaries. Hence, the methodology used depends on the device available and, naturally, the examiner's level of proficiency. (14)

The primary goal of cardiac POCUS during the preanesthetic phase is to acquire sensitive hemodynamic information in a noninvasive fashion, resulting in the establishment of baseline data prior to anesthesia, the identification of potential risks that may emerge during the perioperative phase, and the delivery of individualized management through the interpretation of future hemodynamic changes. In practice, it is not possible to make a recommendation concerning the ideal time or location to perform cardiac POCUS prior to surgery, since the preanesthetic period lasts for an undetermined period of time, from the moment the decision is made to perform surgery on a patient, until just a few minutes before anesthesia. Therefore, it is possible to perform the cardiac POCUS several days before, or just minutes prior to administering anesthesia in the operating room, intensive care unit, or delivery room, while obtaining vital information regarding the patient's status. This approach is consistent with the adage "a picture is worth a thousand words."

The objective of this narrative review is to examine and describe the advantages, disadvantages, and particular conditions under which cardiac POCUS may be beneficial during the pre-anesthetic phase. This approach makes it possible to expand the cardiac evaluation of obstetric patients and identify potentially dangerous conditions that result in adverse outcomes throughout the perioperative period.

Relevant articles were obtained through comprehensive searches in Medline PubMed, Embase, and Google Scholar using the following terms: obstetrics and POCUS, obstetrics and cardiac POCUS, or obstetrics and FOCUS, with no time restrictions. The title and abstract were evaluated for their applicability to this expert opinion.

Maternal morbidity and mortality from cardiac causes

According to the WHO, maternal mortality is defined as a direct cause of obstetric complications such as maternal hemorrhage and obstetric sepsis; these conditions are the most common causes of maternal mortality globally and account for 73% of deaths. Indirect causes can include diseases or conditions that are present before pregnancy worsens. These changes are not related to obstetric causes; however, body changes during pregnancy can increase the likelihood of cardiac complications. (15) Heart disease is the largest indirect cause of maternal mortality after direct causes and is involved in up to one third of maternal deaths, representing up to 4% of pregnancy complications and up to 16% of pregnancies in pregnant patients with pre-existing cardiac conditions. (16) In high-income countries such as the United States and the United Kingdom, cardiomyopathies and cardiovascular disease are the leading causes of death in pregnant patients. (17,18) In low- or middle-income countries, there are still underlying problems related to economic inequalities that result in barriers to timely access to health services; this leads to a significant underestimation of data, which implies that cardiovascular disease continues to be an important cause of maternal morbidity and mortality, as has been previously reported. (19) Furthermore, contemporary women are delaying the onset of pregnancy, a trend that contributes to an increase in the prevalence of chronic diseases that may give rise to cardiovascular complications. (20)

Several high-risk cardiac conditions should be considered in maternal patients, as they have the potential to complicate the course of pregnancy. These conditions include valvular disease, cardiomyopathies, congenital heart disease, and pulmonary hypertension. (18) Major adverse cardiac events, such as arrhythmias, heart failure, and anesthetic complications, can significantly impact morbidity and mortality. (21,22) To establish a baseline condition and implement prompt and individualized management strategies for pregnant patients, cardiac POCUS can be utilized to assess all of these disorders prior to anesthesia. This approach takes advantage of the exceptional safety profile of ultrasound technology, while mitigating the risks associated with more invasive alternatives.

Physiological changes during pregnancy

Cardiovascular changes develop in obstetric patients starting in the first trimester and peaking in the second trimester, followed by a plateau in the third trimester and a return to baseline levels approximately six weeks after delivery. The plasma volume increases 1.5 times versus the baseline, as does heart rate, which increases to an average of 115 beats per minute, both of which result in an increase in cardiac output of 30 to 50% at the end of pregnancy. This increase in plasma volume occurs in a greater proportion of patients than the increase in the mass of red blood cells, resulting in relative anemia. The mean arterial blood pressure is reduced by 10 to 20 mmHg due to decreased vascular resistance, which is caused by vasodilation induced by hormonal changes and the high-flow, low-resistance placental circuit. During the third trimester, compression of the vena cava is caused by the gravid uterus.

Complications can occur during labor and the postpartum period due to unanticipated changes. These may include decompression of the vena cava, disruption of the low-resistance placental circuit, prolonged or forceful Valsalva maneuvers, and significant blood loss under specific circumstances. These sudden shifts lead to variations in the preload, which may be excessive for some patients (e.g., those with a substantially reduced left ventricular ejection fraction (LVEF) or pulmonary hypertension), and afterload (e.g., increasing aortic shear forces). These changes during pregnancy may cause restrictions that endanger the lives of both the mother and the fetus, especially in patients with preexisting cardiac conditions(23).

Changes in the echocardiogram of pregnancy

Under normal conditions, the echocardiogram of the obstetric patient reveals several mechanical and physiological changes. Mechanical changes are primarily caused by uterine compression. For instance, diaphragmatic elevation causes the heart to relocate anteriorly and laterally, facilitating the acquisition of parasternal and apical windows while inevitably obstructing the subcostal window. Physiologically, changes are a result of the hormonal fluctuations that occur. No significant alterations are noted in the LVEF (23); however, marginal enlargement of the left atrium and increased thickness and diastolic dimensions of the left ventricular wall are detected, all of which remain within the normal range. It has also been reported that increased cardiac output causes an increase in Doppler velocities in the left and right outflow tracts (as measured by the velocity time integral (VTI) – see below). Nonetheless, hemodynamics can be altered by mechanical compression of the vena cava, particularly during the final stages of pregnancy, which can impact preload and afterload.

The valves could be susceptible to minor defects in coaptation, which may lead to slight regurgitation that is considered normal, accompanied by a marginal increase in the trans-valvular gradients. Finally, a considerable proportion of pregnant women may experience mild pericardial effusion during the final stages of pregnancy, which is associated with fluid retention. Due to its benefits and safety profile, echocardiography has been the diagnostic gold standard for accessing the heart in pregnant patients; consequently, cardiac POCUS is a viable alternative during the preoperative phase (24) (Table 1).

Conditions in which cardiac POCUS may be important in the preoperative phase of pregnancy

During the preanesthetic phase, visual recognition of the cardiac morphology is possible using cardiac POCUS. (25) The Rapid Obstetric Screening Echocardiography (ROSE) protocol (26) is a cardiac ultrasound technique documented for emergent obstetric patients, with a particular focus on hypotensive postpartum patients. It comprises an examination sequence that looks for short and long axis parasternal views, as well as apical 4- and 5- chamber views. The subcostal view is not recommended for the initial technique since it may result in compression of the inferior vena cava (IVC) due to the supine position. Neither the suprasternal view is advised due to the discomfort associated with thyroid enlargement. Nonetheless, there is a need to establish whether the advantages outweigh the risks. The subcostal window provides visual access to the IVC and inferior aorta, whereas the suprasternal view enables visualization of the aortic arch, pulmonary artery, and veins, both of which provide vital hemodynamic and vascular information.

A visual assessment of the cardiac morphology is beneficial to conduct a preliminary visual assessment; this includes an examination of the heart's anatomy and the exclusion of various pathological conditions including dilated, hypertrophic, restrictive, or unclassified cardiomyopathies, such as a noncompacted ventricle. (27,28) Left ventricular function can be established by eyeballing (29) or measuring the LVEF with the biplanar Simpson technique. (30) Interpretations of the LVEF values should be made within a clinical context, taking into consideration the influence of preload, afterload, inotropes, and vasopressors.

The right ventricle (RV) must not be larger than the left ventricle. Visual estimation of RV function and objective measurements such as tricuspid annular plane systolic excursion (TAPSE) or fractional area change (FAC) are practical approaches. (31,32) Magnetic resonance imaging, considered the gold standard for RV ejection fraction determination, may not always be accessible, particularly during pregnancy.

It is essential to promptly ascertain the integrity and motion of the valves. (33) Some findings may indicate degenerative valvular diseases resulting in stenosis or regurgitation; this applies to both native and prosthetic valves. However, with prosthetic valves, this approach may not always be feasible, and in most situations, transesophageal echocardiography may be required. Additional significant conditions that warrant consideration include infectious endocarditis, masses, thrombi, and nonbacterial thrombotic endocarditis. (34) Severe valvular dysfunction increases the risk of cardiogenic pulmonary edema and type 2 pulmonary hypertension; therefore, anesthesiologists must closely monitor these pathologies. In higher-risk instances, more complex strategies, which are beyond the capabilities of POCUS, are necessary.

Table 1. Normal echocardiographic findings in the obstetric population.

Elevation of the diaphragm and anterolateral relocation of the heart
Left ventricle ejection fraction remains unchanged.
Mild enlargement of the dimensions of the left atrium and ventricle
Doppler velocity increases corresponding to a rise in cardiac output
Minor defects in valvular coaptation
Mild pericardial space effusion

Source: Author.

Quantitative information that can be obtained by cardiac POCUS in specific situations

The estimation of left ventricular (LV) filling pressures is accomplished by calculating the E/e' ratio, which is the ratio of the peak early transmitral flow velocity (E) and the early tissue relaxation velocity (e') using tissue Doppler. Normally, values fall below 8, while a value greater than 15 is considered a significant increase in LV filling pressure. (35) When there is a risk of cardiac failure with preserved ejection fraction, as in patients with pulmonary oedema due to severe preeclampsia, among other situations, this parameter is also important. (36) Unfortunately, tissue Doppler imaging is exclusive to higher quality ultrasonography equipment and is not available for portable models.

The determination of the VTI is an automatic calculation that involves computing the distance travelled by a blood volume sample within a cross-sectional area during a specific period of time (e.g., heartbeat). Determination of VTI is typically feasible using pulsed Doppler at the level of the left ventricular outflow tract in a 5-chamber apical window. Furthermore, this may also be accomplished at the level of the right ventricular outflow tract in the aortic position within a short-axis parasternal window. Assuming that the cross-sectional area, which in this case is the outflow tract, has a constant cylindrical structure, VTI can be used as a surrogate for cardiac output. (28,37) Cardiac POCUS enables a diagnostic approach to a hyperdynamic or low output state and to monitor fluid or inotrope responses. (38,39) VTI has been recently suggested as a predictor of hypotension before spinal anesthesia for caesarean section. (40)

The IVC is a legitimate parameter for assessing hemodynamics and fluctuations in blood volume as a result of the interaction between the heart and lungs. (41) Traditionally, hypovolemia has been defined as an IVC diameter less than 1 cm and a collapsible vein with respiration. Conversely, a vein diameter exceeding 2 cm and lacking collapsibility may suggest elevated right atrial pressure (RAP) which - depending on the clinical context - may be the result of hypervolemia or other conditions including decompensated heart failure and cardiac obstructive disorders (e.g., tamponade). (42) The low interoperator variability and the ability to repeat IVC ultrasound on demand contribute to its versatility during perioperative evaluation. Recent reports suggest that obtaining IVC images from obstetric patients through the right upper quadrant transhepatic window may be simpler and quicker than obtaining IVC images through the subcostal window. (43) Zieleskiewics et al. proposed a simple algorithm to assess fluid response and dyspnea in obstetric patients (44); however, this algorithm is yet to be validated due to the limited quality of the evidence in this area regarding obstetric patients; therefore, these parameters should be used with caution. (45–48)

A "kissing Heart" is another sign potentially indicating hypovolemia. It is predominantly observed in the short axis parasternal window at the end of systole, where the mitral pillars converge. This observation can be interpreted as the collapse of the left ventricle due to inadequate filling pressure. (49) Patients with bleeding disorders, such as those experiencing severe obstetric hemorrhage (e.g., placenta accreta, or uterine rupture), frequently experience significant volume shifts. Therefore, cardiac POCUS can estimate volume status using systematic approaches (50).

Cardiac POCUS can be used to examine patients with a prior history of pulmonary hypertension. These alterations include assessment of the right ventricular hypertrophy and thickness, flattening of the interventricular septum, determination of significant tricuspid regurgitation, estimating the left atrial dimensions, and, in more advanced cases, determination of the E/e' ratio and peak velocity at the level of the right ventricular outflow tract (51), to establish whether the hypertension is pre- or postcapillary. (52,53)

As previously mentioned, a large proportion of pregnant patients typically present with pericardial effusion. (54) Assessing the pericardial space to identify effusions and its size is critical: mild (less than 1 cm thick), large (greater than 2 cm thick), or even a tamponade effect (e.g., in trauma bay). Additionally, it is possible to establish the presence of partitions, detritus, or septa due to a chronic or infectious pathology.

Other conditions that may be recognized using cardiac POCUS during the preanesthetic period

Obstetric sepsis is a major cause of maternal mortality. (55) One of its manifestations is septic cardiomyopathy, which may be induced by the release of cardiodepressant catecholamines (e.g., interleukin 6, tumor necrosis factor, and obstetric sepsis factor). These substances trigger cardiac muscle damage, oxidative stress, and mitochondrial dysfunction. (56) Septic cardiomyopathy can be identified by several cardiac manifestations, ranging from hyperdynamic ventricles characterized by high cardiac output, or diastolic dysfunction with high left ventricular filling pressures, to severe ventricular dysfunction.(57,58)

Peripartum cardiomyopathy is a diagnosis of exclusion that predominantly occurs toward the end of the third trimester and even after delivery. It is characterized by left ventricular dysfunction, with the majority of patients presenting with an LVEF of less than 35%, and some exhibiting overt symptoms of heart failure. (16) Severe cases may progress to cardiogenic shock, spontaneous echo contrast and intracavitary thrombi (59); some patients may even require ventricular assist devices. Cardiac POCUS may proof to be valuable for the timely detection of this condition, and to ensure appropriate management of pregnant patients. It is also important to rule out alternative causes of left ventricular dysfunction, such as cardiomyopathy secondary to chemotherapy drugs. (60)

Pulmonary venous thromboembolism (PE) can occur at any time during pregnancy or during the postoperative period. When PE is suspected, the following ultrasound findings may be detected: right ventricular dilation, interventricular septum flattening and paradoxical movement (cor pulmonale), and in advance conditions, McConnell's sign.(61) In rare occasions, pulmonary artery dilation and thrombus in transit have been reported.

Amniotic fluid embolism is an unusual complication of pregnancy that, in some series, has a mortality rate exceeding 50%. Uncertainty surrounds its pathophysiology; however, maternal exposure to amniotic fluid or fetal debris is suspected to be a possible cause. Wiseman et al. concluded in a recent systematic review that right ventricular dysfunction, dilation, and abnormal systolic movements were the most prevalent echocardiographic findings. The authors emphasize that these findings can be obtained promptly via cardiac POCUS (62).

Coronary heart disease is an uncommon condition among premenopausal women, but its incidence tends to increase with gestational age. The risk increases fourfold in expectant mothers as compared to non-pregnant patients. (63) In addition to electrocardiographic and serological findings, it is also possible to rapidly identify regional disorders in the left ventricular regional wall motion during cardiac POCUS, primarily hypokinesia or akinesia, which may indicate the involvement of a particular vascular territory. (64,65)

Hypertrophic cardiomyopathy (HCM) is an uncommon condition in pregnant patients (66), with an estimated prevalence of 1 in every 500 people in the general population (67), and may be potentially underdiagnosed. (68) This is a mandatory consideration in cases suggestive of electrocardiographic changes and with abnormal thickening of the left ventricular wall, in addition to the identification of a generally small ventricular cavity on cardiac POCUS, particularly in the absence of hypertension, valvular disease, or athlete status. The LVEF is typically normal in patients with HCM; however, it can decline with time.

In specific cases, the anterior mitral leaflet may abruptly migrate and contact the septum due to atypical thickening, resulting in the formation of a Venturi effect. This may result in obstruction of the left ventricular outflow tract and the formation of high-pressure gradients in the outflow tract (e.g., gradients exceeding 50 mmHg with continuous Doppler). Prompt management of the hemodynamic consequences is mandatory. Although pregnancy is generally well tolerated by the majority of patients with HCM, there have been reports of an elevated risk of cardiovascular and obstetric complications in this population. (68)

Noncompacted cardiomyopathy, also known as "spongy myocardium," is a condition with unknown etiology which is likely congenital. It can be recognized by a "bilayer" ventricle with numerous internal trabeculations, primarily in the apex and middle portion of the ventricle. This condition may exhibit a wide range of presentations throughout pregnancy(27), including asymptomatic individuals, palpitations, dyspnea, arrhythmias, and overt heart failure, which is the most frequently observed symptom. Echocardiography is the diagnostic gold standard for this pathology. (69)

Congenital heart diseases are assessed using the modified WHO risk classification. (70) Patients in grades I and II are classified as having minimal obstetric risk, while those in grades III and IV have severe morbidity and a high risk of maternal mortality, respectively (e.g., severe stenosis of the aortic or mitral valves or Eisenmenger syndrome); pregnancy should be avoided in the presence of these conditions. (71)

As a result of medical breakthroughs, it is conceivable that a significant proportion of individuals with congenital heart disease will survive into adulthood and in many cases, reach reproductive age. To ensure that these patients' cardiac, anesthetic, and obstetric needs are adequately met, the American Heart Association has recently stated that these patients be treated in specialized care centers staffed with trained personnel and adequate resources, preferably a pregnancy heart team (which comprises cardiologists, obstetricians, and obstetric and cardiothoracic anesthesiologists, among others). (70) However, low-middle-income countries continue to face challenges in providing optimal medical services due to poor adherence to preconception risk stratification, contraceptive methods, and prenatal control. These patients may face potential hazards associated with surgery and anesthesia during the course of their pregnancy. (71)

Patients with NYHA functional class II or higher, cyanosis, LVEF less than 30%, gross valvular heart disease, previous cardiac events such as arrhythmias or strokes, heart failure, Marfan syndrome (e.g., severe aortic dilation), and Eisenmenger

Table 2. Pre-anesthetic cardiac POCUS in obstetric high-risk patients.

Approach	Findings	Certain obstetrics- associated conditions.
Visual estimation of cardiac morphology	· Normal heart · Hypertrophic cardiomyopathy · Restrictive cardiomyopathy · Declassified cardiomyopathy	· e.g., spongy myocardium
Left ventricular function and dimension	· Eyeballing · Simpson's biplane · Left ventricle filling pressure	· Peripartum cardiomyopathy · Heart failure with preserved ejection fraction · Sepsis cardiomyopathy · Coronary heart disease
Right ventricular function and dimension	· Eyeballing · Tricuspid annular plane excursion (TAPSE) · Fractional area change (FAC)	· Pulmonary embolism · Amniotic fluid embolism · Pulmonary hypertension · Right ventricular failure for any other etiologies
Valve assessment	· Integrity · Motion	· Infectious (e.g., vegetations) · Non-infectious thrombotic lesion · Masses · Coaptation defects
Fluid status	· Inferior vena cava mechanics · Velocity time integral (VTI)	· Hypovolemia · Hemorrhagic disorders · Hypervolemia · Right atrial pressure elevation
Pericardial assessment	· Fluid in the pericardial space	· Tamponade (e.g., trauma bay, rheumatology or infectious diseases)

Source: Author.

syndrome, among others, are all considered at high risk. (72) While the primary purpose of cardiac POCUS is not to diagnose or stratify congenital heart disease, it can be utilized to estimate the size of the defect, assess atrial enlargement, analyze overload and biventricular function, and quantify shunts (e.g., color Doppler) to establish a preanesthetic state and implement a suitable strategy (Table 2).

Additional conditions requiring medical care in pregnant individuals, and which have the potential to impact the heart (73) include acute HELLP syndrome, myocarditis, aortic dissection, stress cardiomyopathy (also known as Takotsubo syndrome), fatty liver of pregnancy, thrombotic microangiopathy of pregnancy, and maternal substance abuse involving alcohol, cocaine, heroin, and others. (74) Each of these conditions is amenable to evaluation using cardiac POCUS, with the ability to change the anesthesia plan.

Limitations of cardiac POCUS in obstetric patients.

Cardiac POCUS is not devoid of limitations. High-quality evidence is scarce in obstetric anesthesia, and the true impact on mortality is unknown. It is practically impossible to establish a direct correlation between POCUS and the outcomes, since to a large extent such outcomes are contingent upon the clinician's expertise. Moreover, the existing body of literature contains many protocols that are primarily focused on emergency and intensive care settings. This complexity hinders the ability to conduct research in this area and may even restrict the application of these tools.

Achieving the technical proficiency necessary for image acquisition in cardiac POCUS is relatively easy. However, accurate interpretation requires expertise and in-depth understanding of the pathophysiological circumstances; this highlights the potential for erroneous management decisions resulting from erroneous interpretation. (75) For this reason, it is important to educate residents and practitioners in different anesthesiology and intensive care programs in the use of these tools, which can contribute to optimize the diagnosis and management of this special patient population (76), with an emphasis on the growing complexity of obstetric morbidity. This approach shall have a global impact on preventable maternal mortality, a goal advocated by organizations such as the World Health Organization. (77)

While handheld devices offer numerous benefits, including portability, simplicity of use, and the ability to be synchronized with a smartphone or tablet in various situations, their image quality is still inferior to that of conventional equipment. In summary, as anesthesiologists develop expertise in this domain and technologies improve, all of these limitations will eventually be conquered.

CONCLUSIONS

Cardiac POCUS is a readily available and feasible tool that can be used to improve the preoperative cardiovascular assessment of obstetric patients, in addition to the patient's medical record, physical examination, and previous laboratory results. Various potentially dangerous cardiac conditions may be detected allowing the anesthesiology staff to optimize management in an expeditious manner during the entire perioperative phase. While cardiac POCUS is not designed to replace comprehensive echocardiography, which remains the domain of expertise of cardiovascular anesthesiologists and cardiologists, it may play a valuable role, particularly in situations where access to these specialties is limited or in areas where they are not available. There is a lack of evidence in this field, probably due to the heterogeneity of the obstetric population and the recent availability of these data; further studies with improved methodological quality are required. Nevertheless, considering recent advancements in ultrasound technology, the clinical benefits of cardiac POCUS are evident; as a result, the stethoscope may become obsolete in the near future. Nowadays, obtaining preoperative cardiac POCUS data in complex obstetric preanesthetic scenarios is considered a fundamental aspect of good practice.

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Conflict of interests

None declared by the author.

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