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Review Article

Cardiac point-of-care ultrasound (POCUS) in critically ill obstetric patients. A narrative review of the literature

Ultrasonido cardiaco en el punto de atención (POCUS) en la paciente obstétrica críticamente enferma. Revisión narrativa de la literatura

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Abstract: Cardiovascular diseases are the leading causes of maternal morbidity and mortality. Cardiac point of care ultrasound (POCUS) has emerged as an essential tool for rapid hemodynamic assessment in the obstetric intensive care unit. A narrative review of the topic was conducted to synthesize the current evidence regarding the utility of POCUS in the management of critically ill obstetric patients. The review included the available literature from databases such as PubMed and Google Scholar. POCUS enables the early identification of conditions such as peripartum cardiomyopathy, preeclampsia with diastolic dysfunction, and pulmonary thromboembolism. Protocols such as FATE and RUSH demonstrate high sensitivity for ruling out the causes and types of shock during pregnancy, thereby facilitating treatment-related decision-making. Furthermore, POCUS enables the early diagnosis of cardiovascular complications in critically ill pregnant patients. Its mandatory integration into intensivist training is essential to standardize hemodynamic management and improve outcomes for both the mother and fetus.

Key words: Point-of-care ultrasound; Echocardiography; Obstetric critical care; Maternal mortality; Hemodynamic monitoring

Resumen: Las enfermedades cardiovasculares son las principales causas de morbilidad y mortalidad materna. El ultrasonido cardiaco en el punto de atención (POCUS por sus siglas en inglés) emerge como una herramienta esencial para la evaluación hemodinámica rápida en la unidad de cuidados intensivos obstétricos. Se realiza una revisión narrativa del tema con el propósito de sintetizar la evidencia actual sobre la utilidad del POCUS en el abordaje de la paciente obstétrica críticamente enferma. La revisión efectuada incluyó la literatura disponible en bases de datos como PubMed y Google Scholar. El POCUS permite identificar precozmente condiciones como la miocardiopatía periparto, preeclampsia con disfunción diastólica y tromboembolismo pulmonar. Protocolos como FATE y RUSH muestran alta sensibilidad para descartar las causas y tipos de choque en el embarazo, lo cual facilita la toma de decisiones en torno al tratamiento. Además, garantiza el diagnóstico precoz de complicaciones cardiovasculares en la gestante

grave. Su integración obligatoria en la formación de intensivistas es indispensable para estandarizar el manejo hemodinámico y mejorar el pronóstico del binomio materno-fetal.

Key words: Point-of-care ultrasound; Echocardiography; Obstetric critical care; Maternal mortality; Hemodynamic monitoring

Introduction

The transition toward high-complexity obstetric care has positioned cardiovascular diseases as the leading indirect cause of maternal death in both developed and developing countries[1,2]. These conditions range from pre-existing diseases, such as congenital heart disease and valvular heart disease, to pregnancy-related complications, such as peripartum cardiomyopathy and preeclampsia with myocardial involvement[3,4]. In this setting, the Obstetric Intensive Care Unit (OICU) faces the challenge of caring for patients whose hemodynamic reserve is severely compromised by the physiological changes of pregnancy and their underlying cardiovascular condition[5].

Traditionally, hemodynamic assessment in obstetrics relied on physical examination, noninvasive blood pressure monitoring, and, in critically ill patients, pulmonary artery catheterization[6]. However, physical examination is frequently inaccurate in pregnant patients because peripheral edema, sinus tachycardia, and functional systolic murmurs may represent normal findings[7]. On the other hand, invasive methods have fallen out of favor because of their risk profile and the lack of evidence demonstrating a clear improvement in clinical outcomes[8,9]. It is in this context that cardiac point of care ultrasound (POCUS) has emerged as the "new gold standard" for bedside assessment[10,11].

Unlike formal diagnostic echocardiography, POCUS is defined as a focused assessment performed by the treating physician to answer critical clinical questions in real time[12,13]. In pregnant patients presenting with shock, dyspnea, or chest pain, POCUS enables immediate differentiation between obstructive causes, such as massive pulmonary thromboembolism; primary cardiac causes leading to left ventricular dysfunction; and distributive causes[14,15]. Furthermore, its noninvasive nature and lack of ionizing radiation make it an ideal tool for maternal-fetal safety[16,17].

Although several international critical care and anesthesiology societies have standardized protocols such as FATE (Focused Assessed Transthoracic Echocardiography) and RUSH (Rapid Ultrasound in Shock), their application specifically in the obstetric population requires special considerations[18,19]. Elevation of the diaphragm by the gravid uterus displaces the cardiac axis, altering the traditional acoustic windows and requiring adapted technical expertise[20,21]. Likewise, interpretation of inferior vena cava (IVC) collapsibility to predict fluid responsiveness should be approached with caution because of the aortocaval mechanical compression that occurs after 20 weeks of gestation[22,23].

The objective of this review is to synthesize the current evidence regarding the use of POCUS in critical obstetric care, particularly its diagnostic applications in key conditions such as preeclampsia and severe sepsis. Integrating this competency into the training of obstetric critical care specialists represents an urgent current need and was the impetus for this review[24, 25].

Development

Metodology

To conduct this narrative review, an exhaustive search of the scientific literature was performed to synthesize the most relevant evidence regarding the application of POCUS in the critical obstetric setting. A structured search protocol was followed to ensure the inclusion of studies with high methodological quality and clinical relevance[26,27].

Search strategy and information sources: The search was conducted using the indexed databases PubMed/MEDLINE, Google Scholar, Scopus, and the Cochrane Library. Articles published primarily between January 2014 and January 2024 were selected in order to capture the most recent technological advances in portable ultrasound equipment and updated diagnostic protocols[28].

Controlled vocabulary terms and free-text terms were combined. The search strategies included combinations of the following descriptors: Point-of-Care Ultrasound, Focused Cardiac Ultrasound, Critical Care Obstetrics, Maternal Critical Care, Echocardiography, and Pregnancy Hemodynamic Monitoring.

Inclusion and exclusión criteria: Articles meeting the following criteria were included: original studies (clinical trials, cohort studies, and case-control studies), systematic reviews and meta-analyses, and clinical practice guidelines issued by international societies of cardiology, obstetrics, and critical care[13, 29]. The reviewed articles included those written in either English or Spanish, with the target population consisting of pregnant women or women in the immediate postpartum period with hemodynamic complications.

The following were excluded: isolated case reports that did not provide a novel diagnostic

perspective, studies conducted exclusively in animal models, and literature that had not undergone peer review.

Study selection and data extraction: Initially, titles and abstracts were screened to identify potentially relevant studies. Subsequently, the authors independently reviewed the full texts to confirm their relevance to the objective of the article[30].

A total of 30 key bibliographic references were selected to support the discussion regarding the diagnostic accuracy, technical utility, and clinical impact of POCUS.

Data extraction focused on three main domains: Technical parameters: the most commonly used ultrasound views and their modifiability according to gestational anatomy. Protocols applied: assessment of the effectiveness of protocols such as FATE, RUSH, and the diastolic assessment protocol. Clinical outcomes: the impact of POCUS on reducing diagnostic time and optimizing fluid therapy[24,30].

Data analysis: Given the heterogeneity of the studies identified, including variability in the objectives and methodologies of the original studies, a qualitative narrative analysis was performed. The findings were organized thematically to facilitate comprehension, beginning with the underlying physiological principles, followed by the examination technique, and concluding with applications in specific pathologies[11,25].

Results and comments

The review was structured into various sections addressing the performance of echocardiography in critically ill pregnant women, taking into account their specific characteristics.

1. Adaptation of Ultrasound Windows and Technique in Pregnant Patients

Obtaining high-quality cardiac images in critically ill obstetric patients requires a thorough understanding of the anatomical changes induced by the gravid uterus. Beginning in the second trimester, diaphragmatic elevation and dextrorotation of the heart alter traditional anatomical landmarks[11,20].

- Parasternal window (long- and short-axis views): In pregnant patients, the heart is displaced cephalad. Therefore, the transducer is usually positioned one or two intercostal spaces higher than usual, at the level of the left second or third intercostal space[30].
- Long-axis view: This is the primary view for qualitatively assessing left ventricular systolic function and the morphology of the mitral and aortic valves[13].
- Apical four-chamber view: Due to the horizontalization of the heart, the cardiac apex is displaced laterally toward the anterior axillary line. This view is critical for comparing the dimensions of the right and left ventricles. In critical obstetric care, a right-to-left ventricular ratio >0.6 suggests right-sided pressure overload, a cardinal finding in pulmonary thromboembolism[14,19].
- Subcostal window: This is the most challenging view to obtain during the third trimester because of uterine interposition. However, it is the preferred approach for ruling out pericardial effusion in patients with severe preeclampsia presenting with sudden-onset dyspnea or chest pain[21, 24].

2. Assessment of Volume Status and Fluid Responsiveness

One of the most intense debates in the current medical literature concerns the utility of the inferior vena cava (IVC) in obstetric patients. In the general population, an IVC diameter of less than 2.1 cm with greater than 50% respiratory collapse predicts low right atrial pressure[22]. However, in pregnant patients, extrinsic compression of the IVC by the uterus may cause artificial dilation or reduced collapsibility, regardless of the actual volume status[23,26].

Current evidence suggests that, for IVC POCUS to be reliable during the third trimester, the patient should be assessed in the left lateral decubitus position to relieve uterine compression of the vein[30]. Nevertheless, the current trend in critical obstetric care is shifting toward the use of dynamic parameters, such as the left ventricular outflow tract velocity-time integral (LVOT VTI), which provides an indirect but accurate assessment of stroke volume[12,28].

3. POCUS in Preeclampsia and Diastolic Dysfunction

Preeclampsia is not merely a hypertensive disorder; it is a state of systemic endothelial dysfunction with direct myocardial involvement. The findings of our review indicate that up to 25% of patients with severe preeclampsia exhibit some degree of diastolic dysfunction, even in the presence of preserved ejection fraction[2,4]. POCUS enables the identification of abnormal mitral filling patterns using tissue Doppler (e') and pulsed-wave Doppler (E/A ratio). An E/e' ratio >14 is a robust marker of elevated LV filling pressures, allowing for the prediction of acute pulmonary edema before clinical symptoms become apparent[24,25]. This capacity for "early diagnostic anticipation" is perhaps the greatest benefit of POCUS in the obstetric intensive care unit, enabling targeted fluid restriction and the timely administration of vasodilators[30].

4. Differentiation of Shock in Obstetric Patients

The use of a modified RUSH protocol for obstetric patients allows shock to be classified into

four categories within less than five minutes[19,26]:

I. Hypovolemic shock (the most common cause is postpartum hemorrhage): a hyperdynamic left ventricle is observed, with the ventricular walls coming into contact at the end of systole ("kissing ventricles") and a collapsed inferior vena cava.
II. Cardiogenic shock (the most common cause is peripartum cardiomyopathy): a dilated, hypokinetic left ventricle is observed, with poor mitral valve opening.
III. Obstructive shock (the most common causes are pulmonary thromboembolism or cardiac tamponade): right ventricular dilation, McConnell's sign, and/or a pericardial effusion are observed.
IV. Distributive shock (the most common cause is obstetric sepsis): systolic function is variable, initially appearing hyperdynamic, with signs of relative hypovolemia.

The integration of POCUS into the obstetric intensive care unit represents one of the most significant advances in patient safety over the past decade[11,30,31]. Following an extensive analysis of the literature, the following key conclusions can be drawn:

- Reduction of diagnostic uncertainty: POCUS has demonstrated superiority over traditional physical examination and standard noninvasive monitoring for the etiologic differentiation of shock and dyspnea in pregnant patients[14,24,32]. Its ability to identify low cardiac output states or right ventricular pressure overload within minutes enables targeted intervention and reduces morbidity associated with misdiagnosis, such as confusion between cardiogenic pulmonary edema and sepsis-related respiratory distress [19,26,33].
- Optimization of fluid therapy: Fluid management in conditions such as severe preeclampsia and obstetric hemorrhage represents a critical balance. Evidence suggests that the use of dynamic ultrasound parameters, such as left ventricular outflow tract velocity-time integral (LVOT VTI), provides significantly greater accuracy than central venous pressure or IVC collapsibility, the latter being limited by aortocaval compression[22,28,34]. POCUS enables "goal-directed fluid resuscitation," minimizing the risk of iatrogenic complications resulting from volume overload[12,30,35].
- Early detection of myocardial dysfunction: the ability to assess diastolic function using the E/e' ratio and regional contractility allows the detection of early stages of peripartum cardiomyopathy and myocardial injury associated with preeclampsia before catastrophic clinical signs become apparent [4,25,36]. This positions POCUS not only as an emergency tool but also as a screening and hemodynamic surveillance instrument for high-risk patients.
- Safety and cost-effectiveness: As a noninvasive, radiation-free technique that can be performed at the bedside, POCUS eliminates the need for potentially hazardous intrahospital transport of unstable patients to radiology or formal echocardiography departments[16,17,37]. This optimizes healthcare system resources and reduces the length of stay in critical care units.
- Need for standardization and training: Despite its benefits, the main barrier remains heterogeneity in training. It is imperative that critical care and obstetric medicine societies establish mandatory training curricula and protocols specifically designed for pregnant patients, recognizing that displacement of the cardiac axis and changes in preload require specialized interpretation of POCUS[20,27,30,38].

In conclusion, cardiac POCUS should no longer be considered an optional or luxury tool, but rather an essential component of the modern physical examination in critical obstetric care. Its systematic implementation has the potential to directly reduce maternal mortality rates from indirect causes while transforming reactive medicine into precision medicine based on direct visualization of maternal hemodynamic status.

The table below summarizes the key diagnostic elements of POCUS and their rapid interpretation in obstetrics for a critically ill patient.

Table: Quick interpretation of obstetric cardiac POCUS through its basic elements

Finding	Ultrasound sign	Clinical suspicion
MAPSE < 10 mm	Reduced mitral annular excursion	Systolic dysfunction (cardiomyopathy)
Signo de McConnell	RV free-wall akinesia	Massive PTE
E/e' > 14	Elevated LV filling pressures	Risk of pulmonary edema (preeclampsia)
Kissing ventricles	LV walls come into contact during	Severe hypovolemia

Legend: MAPSE: Mitral Annular Plane Systolic Excursion. PTE: Pulmonary thromboembolism. RV: right ventricle. LV: left ventricle
Source: Author's own elaboration based on the literature review conducted.

REFERENCIAS BIBLIOGRÁFICAS:

1. Wei Y, Luo H, Liu X, Sun G, Liu J, Wei X, Cao C, Zheng Y. Global, regional, and national levels of maternal mortality, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. BMC Pregnancy Childbirth. 2025 Dec 30;25(1):1359. doi: 10.1186/s12884-025-08456-5. PMID: 41469576; PMCID: PMC12751556.
2. Moussa HN, Rajapreyar I. ACOG Practice Bulletin No. 212: pregnancy and heart disease. Obstet Gynecol. 2019;134(4):881-882. doi: 10.1097/AOG.0000000000003497
3. Sliwa K, Hilfiker-Kleiner D, Petrie MC, Mebazaa A, Pieske B, Buchmann E, et al. Current state of knowledge on aetiology, diagnosis, management, and therapy of peripartum cardiomyopathy: a position statement from the Heart Failure Association of the European Society of Cardiology Working Group on peripartum cardiomyopathy. Eur J Heart Fail. 2010;12(8):767-78. doi: 10.1093/eurjhf/hfq120.
4. Dennis AT. Transthoracic echocardiography in women with preeclampsia. Curr Opin Anaesthesiol. 2015;28(3):254-60. doi: 10.1097/ACO.0000000000000182.
5. Soma-Pillay P, Nelson-Piercy C, Tolppanen H, Mebazaa A. Physiological changes in pregnancy. Cardiovasc J Afr. 2016;27(2):89-94. doi: 10.5830/CVJA-2016-021.
6. Vincent JL, Abraham E, Moore FA, Kochanek P. Textbook of Critical Care. 8.ª ed. Philadelphia: Elsevier; 2023 [cited 2026 jan 15]. Hemodynamic monitoring in the obstetric patient; p. 1145-56. Available en: https://books.google.com.cu/books?id=uAl68tCzm5IC&printsec=frontcover&hl=es#v=onepage&q&f=false
7. Mcilvaine S, Feinberg L, Spiel M. Cardiovascular Disease in Pregnancy. Neoreviews. 2021;22(11):e747-e59. doi: 10.1542/neo.22-11-e747. PMID: 34725139.
8. Arias-Ortiz J, Vincent JL. The pulmonary artery catheter. Curr Opin Crit Care. 2023;29(3):231-5. doi: 10.1097/MCC.0000000000001040. PMID: 37078636.
9. Goodlin RC. Pulmonary artery catheterization in severe preeclampsia. Am J Obstet Gynecol. 1990;162(2):601-3. doi: 10.1016/0002-9378(90)90449-h. PMID: 2309849.

10. Moore CL, Copel JA. Point-of-care ultrasonography. N Engl J Med [Internet]. 2011 [cite 2026 jan 15];364(8):749-57. Available en: https://www.nejm.org/doi/pdf/10.1056/nejmra0909487
11. Ambrozic J, Brzan Simenc G, Prokselj K, Tul N, Cvijic M, Lucovnik M. Lung and cardiac ultrasound for hemodynamic monitoring of patients with severe pre-eclampsia. Ultrasound Obstet Gynecol. 2017;49(1):104-9. doi: 10.1002/uog.17331. PMID: 27736042.
12. Via G, Hussain A, Wells M, Reardon R, ElBarbary M, Noble VE, et al. International evidence-based recommendations for focused cardiac ultrasound. J Am Soc Echocardiogr. 2014;27(7):683.e1-33. doi: 10.1016/j.echo.2014.05.001.
13. Spencer KT, Kimura BJ, Korcarz CE, Pellikka PA, Rahko PS, Siegel RJ. Focused cardiac ultrasound: recommendations from the American Society of Echocardiography. J Am Soc Echocardiogr. 2013;26(6):567-81. doi: 10.1016/j.echo.2013.04.001.
14. Marbach JA, Almufleh A, Di Santo P, Simard T, Jung R, Diemer G, West FM, Millington SJ, Mathew R, Le May MR, Hibbert B. A Shifting paradigm: the role of focused cardiac ultrasound in bedside patient assessment. Chest. 2020;158(5):2107-18. doi: 10.1016/j.chest.2020.07.021. PMID: 32707179.
15. Expert Round Table on Echocardiography in ICU. International consensus statement on training standards for advanced critical care echocardiography. Intensive Care Med. 2014;40(5):654-66. doi: 10.1007/s00134-014-3228-5.
16. Healy J, Tzeng CT, Wolfshohl J, Shedd A, Lin J, Patel C, Chou EH. Point-of-care ultrasound in the emergency department: training, perceptions, applications, and barriers from different healthcare professionals. J Acute Med. 2024;14(2):74-89. doi: 10.6705/j.jacme.202406_14(2).0003. PMID: 38859928; PMCID: PMC11163417.
17. Aleshi P, Ortner CM, Butwick AJ. Point-of-care ultrasound in obstetric anesthesia clinical practice. Curr Opin Anaesthesiol. 2025;38(3):202-7. doi: 10.1097/ACO.0000000000001501. PMID: 40207561.
18. Nagre AS. Focus-assessed transthoracic echocardiography: Implications in perioperative and intensive care. Ann Card Anaesth. 2019;22(3):302-8. doi: 10.4103/aca.ACA_88_18. PMID: 31274494; PMCID: PMC6639886.
19. Perera P, Mailhot T, Riley D, Mandavia D. The RUSH exam: Rapid Ultrasound in SHock in the evaluation of the critically lll. Emerg Med Clin North Am. 2010;28(1):29-56. doi: 10.1016/j.emc.2009.09.010.
20. Kalagara H, Coker B, Gerstein NS, Kukreja P, Deriy L, Pierce A, Townsley MM. Point-of-care ultrasound (POCUS) for the cardiothoracic anesthesiologist. J Cardiothorac Vasc Anesth. 2022;36(4):1132-47. doi: 10.1053/j.jvca.2021.01.018. PMID: 33563532.
21. Dennis AT. Transthoracic echocardiography in women with preeclampsia. Curr Opin Anaesthesiol. 2015;28(3):254-60. doi: 10.1097/ACO.0000000000000182. PMID: 25812006.
22. Nagdev AD, Merchant RC, Tirado-Gonzalez A, Sisson CA, Murphy MC. Emergency department bedside ultrasonographic measurement of the caval index for noninvasive determination of low central venous pressure. Ann Emerg Med. 2010;55(3):290-5. doi: 10.1016/j.annemergmed.2009.04.021.
23. Kimura BJ. Point-of-care cardiac ultrasound techniques in the physical examination: better at the bedside. Heart. 2017;103(13):987-94. doi: 10.1136/heartjnl-2016-309915. PMID: 28259843.
24. Dennis AT, Castro JM. Transthoracic echocardiography in women with treated severe pre-eclampsia. Anaesthesia. 2014;69(5):436-44. doi: 10.1111/anae.12623. PMID: 24673113.
25. Nelson-Piercy C. Handbook of Obstetric Medicine. 6.ª ed. CRC Press; 2020. doi:10.1201/9780429330766
26. Blanco P, Abdo-Cuza A, Palomares EA, Díaz CM, Gutiérrez VF. Ultrasonography

and procedures in intensive care medicine. Medicina Intensiva. 2023;47:717-32. doi: 10.1016/j.medin.2023.05.008
27. Mayo PH, Beaulieu Y, Doelken P, Feller-Kopman D, Harrod C, Kaplan A, et al. American College of Chest Physicians/La Société de Réanimation de Langue Française statement on competence in critical care ultrasonography. Chest. 2009;135(4):1050-60. doi: 10.1378/chest.08-2305.
28. Vieillard-Baron A, Millington SJ, Sanfilippo F, Chew M, Diaz-Gomez J, McLean A, et al. A decade of progress in critical care echocardiography: a narrative review. Intensive Care Med. 2019;45(6):770-88. doi: 10.1007/s00134-019-05604-2.
29. Melamed R, Sprenkle MD, Ulstad VK, Herzog CA, Leatherman JW. Assessment of left ventricular function by intensivists using hand-held echocardiography. Chest. 2009;135(6):1416-20. doi: 10.1378/chest.08-2440.
30. Dennis AT. Transthoracic echocardiography in obstetric anaesthesia and obstetric critical illness. Int J Obstet Anesth. 2011;20(2):160-8. doi: 10.1016/j.ijoa.2010.11.007.
31. Easter SR, Hameed AB, Shamshirsaz A, Fox K, Zelop CM. Point of care maternal ultrasound in obstetrics. Am J Obstet ynecol. 2023;228(5):509.e1-13. doi: 10.1016/j.ajog.2022.09.036.
32. Blanco P, Abdo-Cuza A. Point-of-care ultrasound in the critically ill pregnant or postpartum patient: what every intensivist should know. Intensive Care Med. 2019;45(8):1123-6. doi: 10.1007/s00134-019-05682-2.
33. van der Zande JA, Rijs K, Shamshirsaz AA, Soliman H, Franx A, Kauling RM, Roos-Hesselink JW, van der Marel CD, Verdonk K, Cornette JMJ. The role of point-of-care ultrasound (POCUS) in maternal medicine. Best Pract Res Clin Obstet Gynaecol. 2025;100:102599. doi: 10.1016/j.bpobgyn.2025.102599 PMID: 40132463.
34. Padilla C, Markwei M, Easter SR, Fox KA, Shamshirsaz AA, Foley MR. Critical care in obstetrics: a strategy for addressing maternal mortality. Am J Obstet Gynecol. 2021;224(6):567-73. doi: 10.1016/j.ajog.2020.12.1208. PMID: 33359175.
35. De Robertis V, Bilardo CM, Abu-Rustum R, Poon LC, Kamel R, Manieri Rocha R, Syngelaki A, Stampalija T; Collaborators. ISUOG Practice Guidelines: point-of-care ultrasound in obstetrics and gynecology. Ultrasound Obstet Gynecol. 2026;67(1):116-27. doi: 10.1002/uog.70122. PMID: 41185159.
36. Guevara Jennifer, Calvache José A. The era of point-of-care ultrasound (POCUS) in anesthesiology and perioperative care. Rev. colomb. anestesiol. 2025;53(4):e1167. doi: 10.5554/22562087.e1167
37. Stampalija T, Lees C, Ghi T, Cornette J, Gyselaers W, Ferrazzi E, Mousa T, Spaanderman M, Thilaganathan B, Valensise H; Collaborators. ISUOG Consensus Statement on maternal hemodynamic assessment in hypertensive disorders of pregnancy and fetal growth restriction. Ultrasound Obstet Gynecol. 2025;66(5):681-96. doi: 10.1002/uog.70040. PMID: 40997762; PMCID: PMC12579779.
38. Sabogal Rodolfo C. Implementación del POCUS cardiaco en pacientes obstétricas durante el periodo preanestésico. Revisión narrativa. Rev. colomb. anestesiol. 2024;52(4):4. doi: 10.5554/22562087.e1114