

Position Statement on the Use of Point-of-Care Ultrasound in Cardiovascular Medicine – 2026: Executive Summary

Development: Department of Cardiovascular Imaging of the Brazilian Society of Cardiology (DIC-SBC)

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Keywords

Ultrasonography; Echocardiography; Point-of-Care Systems; Shock; Heart Failure; Venous Thrombosis; Emergencies

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Manuscript received August 5, 2026; revised August 5, 2026;

accepted August 5, 2026

Editor responsible for the review: Marcelo Tavares

DOI: <https://doi.org/10.36660/abcimg.20260103i>

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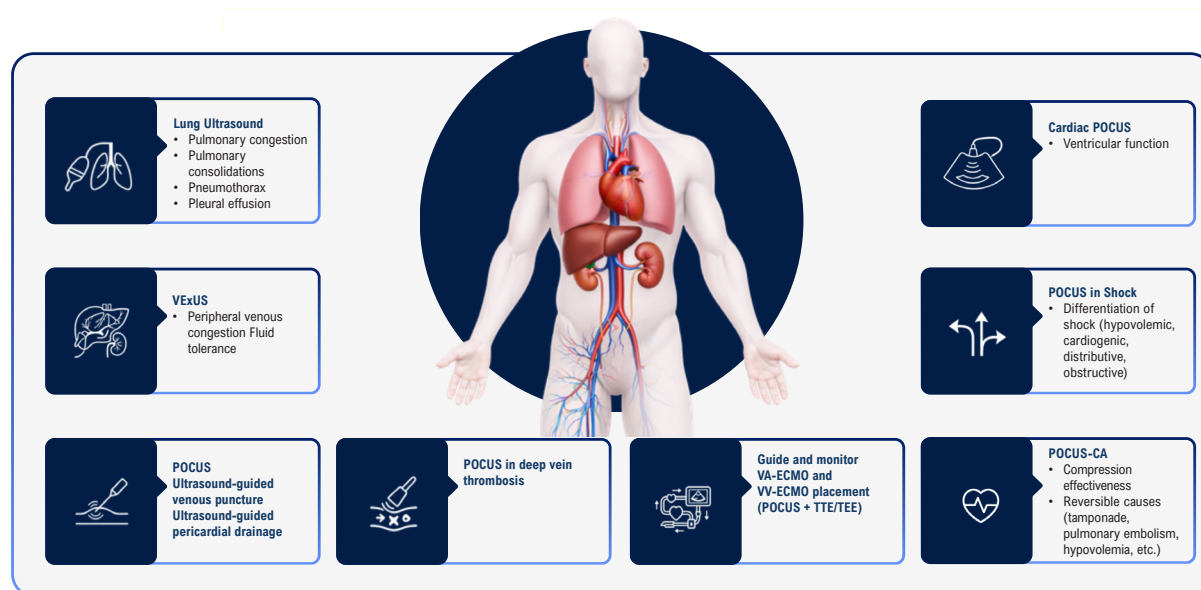
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Central Illustration: Position Statement on the Use of Point-of-Care Ultrasound in Cardiovascular Medicine – 2026: Executive Summary



The spectrum of cardiovascular POCUS, applications and integrated analysis of findings. Answering focused bedside questions.

Arq Bras Cardiol: Imagem cardiovasc. 2026;39(3):e20260103

PE: Pulmonary embolism; POCUS: Point-of-care ultrasound; TEE: Transesophageal echocardiography; TTE: Transthoracic echocardiography; US: Ultrasound; VA-ECMO: Venoarterial extracorporeal membrane oxygenation; VExUS: Venous Excess Ultrasound Score; VV-ECMO: Venovenous extracorporeal membrane oxygenation.

Abstract

Point-of-care ultrasound (POCUS) is one of the most significant innovations in contemporary cardiovascular clinical practice, serving as an extension of the bedside physical examination. This executive summary outlines the Position Statement from the Department of Cardiovascular Imaging of the Brazilian Society of Cardiology (DIC-SBC), published in 2026, covering the key domains of cardiovascular POCUS application: cardiac assessment, lung ultrasound, assessment of systemic venous congestion (VExUS), screening for deep vein thrombosis, management of circulatory shock, short-term mechanical circulatory support, emergency medicine applications, cardiorespiratory arrest, and ultrasound-guided procedures. Fundamental concepts regarding training, certification,

and ethical and legal aspects relevant to the Brazilian context are discussed. This document emphasizes that POCUS does not replace a comprehensive diagnostic echocardiogram, but rather adds substantial clinical value when performed by properly trained professionals within structured protocols.

1. Introduction and Concept

Point-of-care ultrasound (POCUS) is defined as the use of ultrasound as an adjunct to the clinical examination, focused on answering an urgent clinical question at the bedside. In the cardiovascular context, it encompasses anatomical and functional assessment of the heart, lungs, and blood vessels in both inpatients and outpatients, from neonates to adults.¹⁻³

The main advantages of POCUS are portability, low cost, and accessibility. It can be used by properly trained cardiologists, critical care physicians, emergency physicians, and pediatricians in emergency departments, intensive care units (ICUs), operating rooms, and hard-to-reach settings. The miniaturization of equipment, with screens the size of a smartphone, and the advent of artificial intelligence (AI) to guide transducer positioning have progressively expanded its clinical application.

It is fundamental to distinguish POCUS from a comprehensive diagnostic echocardiogram. POCUS is used to answer specific, immediate clinical questions and does not replace a comprehensive echocardiographic assessment when the latter is indicated.⁴

2. Equipment, Training, and Certification

2.1. Equipment

The ideal equipment for POCUS should allow for image acquisition in one- and two-dimensional modes, spectral Doppler, and color flow mapping, using variable-frequency transducers and offering DICOM-format storage capabilities. Handheld devices perform adequately for most applications.

2.2. Structured Training

The Department of Cardiovascular Imaging of the Brazilian Society of Cardiology (DIC-SBC) has proposed the AcQUIRE protocol (AcQUISition, Interpretation, and documentation of REsults), organized into three progressive levels of competence:

- **Level 1** (N = 30 exams; 2 weeks of training): Identification of key cardiac structures, acquisition of standard views, qualitative recognition of abnormalities, and documentation in the medical record.
- **Level 2** (N = 50 exams; 4 weeks of training): Understanding of POCUS protocols for differential diagnosis of shock and respiratory failure, in addition to assessment of fluid responsiveness and systemic congestion.
- **Level 3** (N = 70 exams; 12 weeks of training): Advanced assessment of valves, cardiac output (CO), filling pressures, and ultrasound-guided procedures.

This methodology includes an introductory theoretical-practical course (4 hours of online lectures and 8 hours of hands-on training with mannequins), practical training supervised by a qualified echocardiographer, assessment using a standardized checklist, and annual revalidation requiring a minimum score of 70% (Supplement 1). In order to maintain competence, professionals must perform at least 10 exams per month.⁵

2.3. Ethical and Legal Aspects in Brazil

Cardiovascular POCUS should be considered a bedside medical procedure, which does not replace a comprehensive diagnostic echocardiogram. Professionals who perform the

procedure assume civil liability for the actions taken, including the decision to perform, technical execution, interpretation, and documentation in the medical record.⁶

In Brazil, training in POCUS remains limited in undergraduate and medical residency curricula, resulting in inconsistent professional qualifications.⁷ There is a persistent lack of standardized procedure coding and clear reimbursement policies in both the Brazilian Unified Health System (SUS) and the supplementary health sector. Regulation by the Federal Council of Medicine, in coordination with medical specialty societies, is a priority to ensure legal protection for professionals and patient safety. Integration with telehealth strategies, specifically the *Programa Telessaúde Brasil Redes* (Brazil Telehealth Networks Program) and the *Ação Estratégica SUS Digital* (Digital SUS Strategic Action), strengthens the use of tele-POCUS as a tool to expand access to specialized cardiovascular assessment.

3. Cardiac POCUS

3.1. Main Echocardiographic Views

Cardiac POCUS utilizes five main echocardiographic views (Figure 1):

1. **Parasternal long-axis view:** assessment of global contractility, pericardial effusion, chamber dimensions, and regional wall motion.
2. **Parasternal short-axis view:** global contractility, regional wall motion, and pericardial effusion.
3. **Apical 4-chamber view:** global contractility, regional wall motion, and chamber dimensions.
4. **Subcostal view:** pericardial effusion, chamber dimensions, and global contractility.
5. **Subcostal inferior vena cava (IVC) view:** assessment of IVC and hepatic vein distensibility.

3.2. Assessment of Left Ventricular Systolic Function

Cardiac POCUS employs a qualitative approach to assess left ventricular (LV) systolic function; this method is more intuitive and clinically relevant than traditional quantitative methods (Simpson, Teichholz), which are more time-consuming and do not yield greater accuracy in emergency settings.⁸ The assessment considers endocardial excursion and myocardial thickening, classifying function into four categories (Table 1). Semiquantitative tools such as MAPSE (mitral annular plane systolic excursion) and EPSS (E-point septal separation) can serve as complementary measures. AI demonstrates good correlation with automated ejection fraction when image acquisition is adequate.⁹

3.3. Right Ventricular Assessment

Cardiac POCUS aids in the rapid diagnosis of conditions affecting the right ventricle (RV). RV enlargement is assessed by means of the RV/LV ratio: when the RV area exceeds two thirds of the LV area, it suggests enlargement and significant overload; when the RV/LV ratio is ≥ 1.0 , the finding suggests major overload.¹⁰ Lateral tricuspid annular

Ultrasound Views in Cardiac POCUS			
Window	Image	Transducer position	Best view for:
Parasternal long-axis Third intercostal space Left parasternal line Transducer marker toward the right shoulder			• Global contractility • Pericardial effusion • Chamber dimensions • Regional wall motion
Parasternal short-axis Third intercostal space Left parasternal line Transducer marker oriented toward the left shoulder			• Global contractility • Pericardial effusion • Segmental contractility • Chamber dimensions
Apical 4-chamber Left mid-clavicular line Apical impulse Transducer marker toward the left			• Global contractility • Chamber dimensions • Regional wall motion • Pericardial effusion
Subcostal Midline Below the xiphoid process Marker toward the left			• Pericardial effusion • Chamber dimensions • Global contractility
Subcostal IVC Midline Below xiphoid process Marker toward the left			• IVC distensibility • Hepatic vein distensibility

Figure 1 – Main views used in cardiac POCUS, with respective transducer positions and structures assessed. AO: aorta; IVC: inferior vena cava; POCUS: point-of-care ultrasound; LA: left atrium; LV: left ventricle RA: right atrium; RV: right ventricle.

plane systolic excursion (TAPSE < 1.7 cm) indicates RV systolic dysfunction and has prognostic value in patients with acute pulmonary embolism.¹¹ In the context of acute pulmonary embolism, RV dilation with septal flattening (D-shape) and McConnell's sign (present in only 12%–20% of cases) can assist in diagnosis.

3.4. Cardiac Tamponade

POCUS is a highly valuable tool for the early detection of cardiac tamponade, whose classic clinical signs (Beck's

triad) are not always present. Figure 2 provides an overview of the key findings. IVC distension with minimal respiratory variation and right atrial (RA) collapse during ventricular systole have high sensitivity; RV diastolic collapse is the most specific finding for filling restriction. Differentiation between pericardial and pleural effusion in the parasternal long-axis view is based on the relationship with the descending aorta; effusions anterior to the descending aorta are pericardial, whereas posterior effusions are pleural.¹²

Special Article

3.5. Advanced POCUS: LVOT VTI and E/e' ratio

Stroke volume is calculated as the product of the left ventricular outflow tract (LVOT) velocity–time integral (VTI)

Table 1 – Qualitative assessment of left ventricular systolic function

Normal	Thickening of most LV segments, with endocardial displacement toward the center of the LV.
Hyperdynamic	Increased endocardial excursion and myocardial thickening, leading to partial or total systolic obliteration of the LV
Reduced systolic function	Reduced endocardial excursion and myocardial thickening.
Severe dysfunction	Severely reduced endocardial excursion and myocardial thickening.

Videos 1 to 13 (Supplement 2) provide examples. LV: left ventricle.

and the LVOT area. In healthy individuals, the LVOT VTI ranges from 18 to 22 cm at heart rates between 55 and 95 bpm. Variations in LVOT VTI reflect changes in stroke volume and guide real-time therapeutic decisions.¹³ An average E/e' ratio > 14 has high specificity for elevated left atrial pressure (LAP) and a strong association with fluid intolerance; an E/e' ratio < 8 has good accuracy for predicting LAP < 18 mmHg.¹⁴

4. Lung Ultrasound

4.1. Basics and Artifacts

Lung ultrasound (LUS) relies on artifacts generated from the pleural line. Under normal conditions, aerated lungs produce **A-lines** (horizontal reverberation artifacts). Thickening of interalveolar spaces or filling of alveoli with fluid or inflammatory material generates **B-lines** (vertical artifacts propagating across the entire ultrasound field). Table 2 describes the main findings and their interpretation.

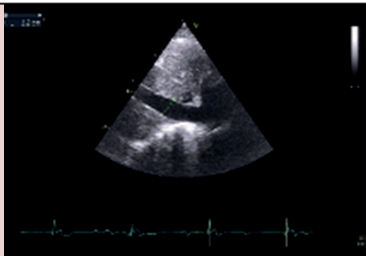
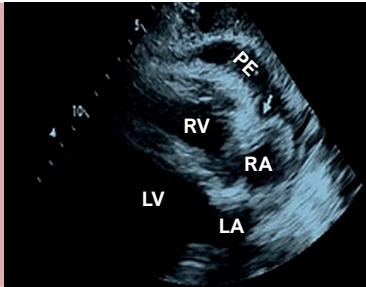
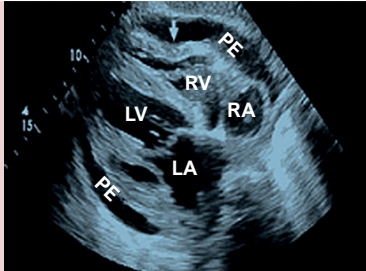
Inferior vena cava distension*		• High sensitivity • Low specificity • Easily identified • Good interobserver agreement
Right atrial collapse during ventricular systole		• High sensitivity • Low specificity • Good interobserver agreement
Right ventricular collapse during ventricular diastole		• Low sensitivity • High specificity • Better interobserver agreement in advanced stages⁵⁰

Figure 2 – Key findings of cardiac tamponade on POCUS. *IVC distension may be absent in cardiac tamponade associated with severe hypovolemia. Other findings may contribute to diagnosis, including leftward shift of the interventricular septum during inspiration (part of the physiology of pulsus paradoxus). 12 IVC: inferior vena cava; LA: left atrium; LV: left ventricle; PE: pericardial effusion; RA: right atrium; RV: right ventricle.

4.2. Examination Protocols

Three main protocols are recommended according to the clinical context (Figure 3):

- **BLUE protocol** (Bedside Lung Ultrasound in Emergency): divides each hemithorax into three quadrants (two anterior and one posterolateral basal [PLAPS point]). The **B-profile** (≥ 3 B-lines per quadrant with preserved pleural sliding) indicates pulmonary congestion, with a sensitivity of 97% and a specificity of 95%.¹⁵ Recommended in emergency settings.
- **8-quadrant protocol**: recommended for grading and longitudinal monitoring of congestion in patients with heart failure, without compromising time or accuracy.¹⁶
- **12-quadrant protocol**: includes the posterior chest region; indicated for interstitial syndromes such as pneumonia due to SARS-CoV-2 infection.

Table 2 – Description of the most frequent lung ultrasound findings and their interpretation

Finding	Descrição	Significado
Pleural line	Hyperechoic curvilinear line beneath the ribs.	Interface between the parietal and visceral pleurae.
Pleural sliding	Sliding of the visceral pleura over the parietal pleura during respiration.	Rules out pneumothorax and pleural adhesions.
A-lines	Horizontal reverberation artifacts originating from the pleural line.	Aerated lung (normal), COPD, or pneumothorax (with loss of pleural sliding).
B-lines	Vertical artifacts originating from the pleural line that extend across the entire ultrasound field.	Accumulation of hydrostatic and/or inflammatory fluid or fibrosis in the interlobular septa and alveoli.
Z-lines	Static vertical artifacts that do not extend to the bottom of the field.	No pathological significance. Should be differentiated from B-lines.
Lung point	Transition point between pleural sliding and the absence of movement.	Pathognomonic for pneumothorax. The more lateral the lung point, the larger the pneumothorax.
Lung pulse	Rhythmic movement of the pleura synchronized with the heartbeat.	Rules out pneumothorax in the absence of pleural sliding.
Barcode sign (stratosphere sign)	Horizontal lines across the entire M-mode ultrasound field.	Indicative of pneumothorax.
Plankton sign	Mobile punctate echoes within the fluid.	May indicate infection or hemothorax; may appear after aggressive diuretic therapy.
Septated (loculated) effusion	Debris, fibrin strands, and septations.	Complex effusion; suggestive of infection, abscess, empyema, or fibrosis, hindering pleural drainage.
Air bronchograms	Hyperechoic punctate echoes trapped within bronchi and surrounded by consolidation.	When mobile (dynamic), suggestive of pneumonic consolidation; when static, suggestive of atelectasis.
Shred sign	Irregular, deep subpleural hyperechoic line separating the consolidated zone from the partially aerated zone.	Present in non-translobar consolidations, most frequently associated with pneumonia.
Curtain sign	Overlapping of aerated lung during respiration, obscuring the image of the liver or spleen.	Aerated lung bases at the point of analysis.
Jellyfish sign	Segment of collapsed lung exhibiting undulating movement within a large pleural effusion.	Compressive atelectasis.
Subpleural consolidation	Small subpleural hypoechoic area (triangular, circular, or polygonal).	Pulmonary embolism, atelectasis, infection, hemorrhage, or neoplasm.
Translobar consolidation	Absence of air in the lung, presenting a solid-organ texture (hepatization).	Pneumonia or atelectasis.

COPD: chronic obstructive pulmonary disease.

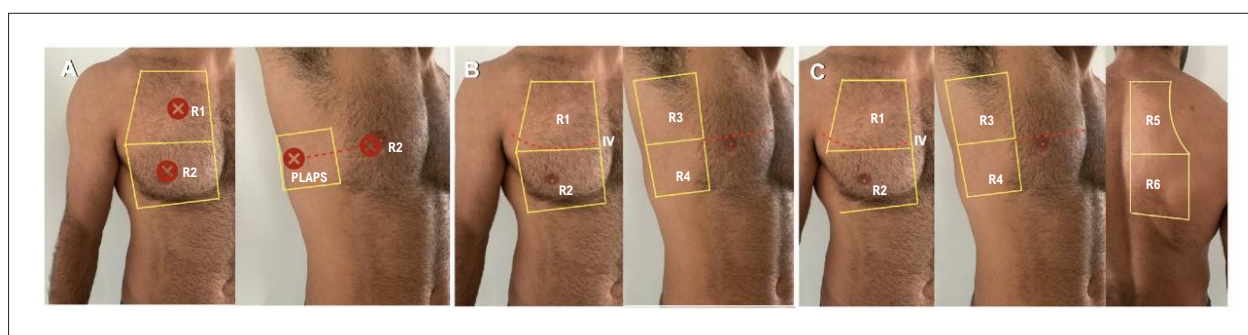


Figure 3 – Recommended lung ultrasound protocols. A – BLUE protocol¹⁵; B – 8-quadrant protocol¹⁷; C – 12-quadrant protocol.¹⁸
Note: See the references for further details. BLUE: Bedside Lung Ultrasound in Emergency; PLAPS: posterolateral alveolar and/or pleural syndrome.

4.3. Main Applications

- **Pulmonary congestion:** LUS detects extravascular lung fluid with diagnostic performance equivalent to that of BNP measurement and superior to that of chest radiography.¹⁹ The Brazilian Heart Failure Guideline recommends (class I, level C) the integrated use of LUS and echocardiography to assess congestion in patients with acute heart failure.²⁰
- **Pleural effusion:** LUS shows 93% accuracy for detecting pleural effusion, versus 47% for chest radiography.¹⁵ The Balik method estimates volume by multiplying the greatest distance between the parietal pleura and the lung tissue during expiration (in cm) by 200, resulting in an estimate in mL.
- **Pneumothorax:** Sensitivity of 90% and specificity of 98%.²¹ The absence of pleural sliding is the finding with the highest sensitivity; lung point is the only pathognomonic finding.
- **Pulmonary embolism:** A triangular subpleural consolidation in the posterobasal regions is a suggestive finding. Triple POCUS (cardiac + venous + pulmonary) demonstrated a sensitivity of 90% and a specificity of 86% for pulmonary embolism in a multicenter study involving 357 patients.²²

5. VExUS: Assessment of Systemic Venous Congestion

5.1. Introduction and Relevance

Patients with RV failure, pulmonary hypertension, or fluid overload frequently develop systemic venous congestion, leading to reduced arteriovenous gradient, elevated capillary hydrostatic pressure, and interstitial edema. This mechanism causes organ (especially kidney) dysfunction, perpetuating a vicious cycle of morbidity and mortality.²³ Venous excess ultrasound (VExUS) has emerged as a reliable, reproducible method with good interobserver agreement for quantifying this congestion.²⁴

5.2. Protocol and Grading

VExUS sequentially analyzes the following four components (Figure 4):

1. **IVC:** Measured 2 cm proximal to the IVC–RA junction, during end-expiratory apnea. IVC < 2 cm: VExUS grade 0 (no congestion). IVC ≥ 2 cm: proceed to analysis of the remaining components.
2. **Hepatic vein (pulsed-wave Doppler):** Three patterns:
 - Type 1 (normal): S wave > D wave
 - Type 2 (increased RA pressure): S wave < D wave
 - Type 3 (markedly increased RA pressure): reversed S wave
3. **Portal vein (pulsed-wave Doppler):** Classified by pulsatility fraction:
 - Type 1: oscillation < 30%
 - Type 2: oscillation 31%–50%
 - Type 3: oscillation > 50% or flow reversal
4. **Renal interlobar vein (pulsed-wave Doppler):**
 - Type 1: continuous flow
 - Type 2: biphasic flow
 - Type 3: monophasic flow

Final grading:

- Grade 0: IVC < 2 cm
- Grade 1: IVC ≥ 2 cm + type 1 or 2 patterns, in any combination
- Grade 2: IVC ≥ 2 cm + one type 3 waveform
- Grade 3: IVC ≥ 2 cm + two or more type 3 waveforms

5.3. Clinical Evidence and Applications

The original study by Beaubien-Souligny et al.²⁶ validated the score in 145 postoperative cardiac surgery patients, demonstrating a significant association with subsequent acute kidney injury (hazard ratio = 3.69; 95% confidence interval [CI]: 1.65–8.24; p = 0.001). Subsequent studies have demonstrated its applicability in cardiorenal syndrome, complex hyponatremia, acute coronary syndromes, non-

Quantification of systemic venous congestion – VExUS

Step 1:

IVC analysis



If IVC ≥ 2 cm,
proceed to step 2

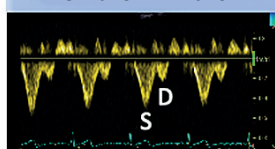


Step 2:

Hepatic vein
analysis

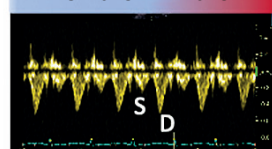
Type 1

S wave > D wave



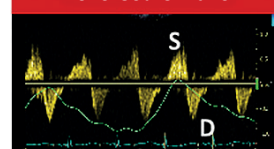
Type 2

S wave < D wave



Type 3

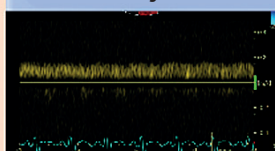
Reversed S wave



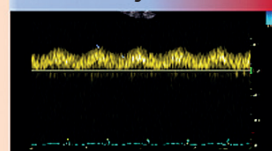
Step 3:

Portal vein
analysis

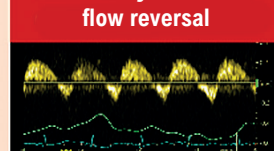
Pulsatility < 30%



Pulsatility 30%-50%



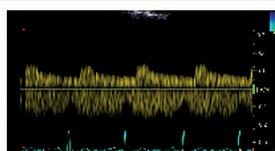
Pulsatility > 50% or
flow reversal



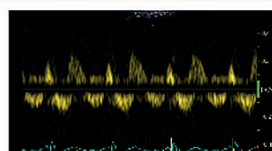
Step 4:

Interlobar renal
vein analysis

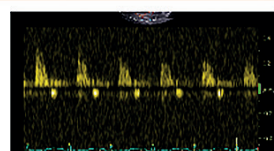
Continuous flow



Biphasic flow



Monophasic flow



Step 5: Integrate data and grade

GRADE 0

Absence of congestion
IVC < 2 cm

GRADE 1

Mild congestion
IVC ≥ 2 cm + any
combination of type 1
and type 2 waveforms

GRADE 2

Moderate congestion
IVC ≥ 2 cm +
one type 3 waveform

GRADE 3

Severe congestion
IVC ≥ 2 cm + two or
more type 3 waveforms

–

Right atrial pressure

+

Figure 4 – VExUS grading: when the IVC diameter is greater than 2 cm, three grades of venous congestion are defined based on the severity of changes observed in hepatic, portal, and renal interlobar vein flow; these should ideally be recorded during end-expiratory apnea. IVC: inferior vena cava; VExUS: venous excess ultrasound. Adapted from Koratala et al.²⁵

cardiac perioperative assessment, and pediatric patients in the ICU.²⁷⁻³⁰

VExUS does not assess the need for fluid replacement, but it is a key indicator of fluid tolerance, identifying cases where discontinuing fluid resuscitation or removing fluid would be beneficial. VExUS 0 or 1: fluid-tolerant; VExUS 2 or 3: fluid-intolerant.

6. POCUS in Deep Vein Thrombosis

POCUS for the assessment of proximal deep vein thrombosis (DVT), performed by appropriately trained professionals in urgent and emergency settings, currently has a **grade I recommendation and level B evidence**.

The extended compression protocol, also known as three-point compression ultrasound, is currently recommended (Figure 5), supported by the European Society of Intensive Care Medicine consensus and the American College of Emergency Physicians' emergency ultrasound guidelines.³¹ DVT diagnosis is established by visualizing a thrombus (intraluminal echogenic material) or identifying venous incompressibility. In acute thrombosis, incompressibility often precedes visualization of the thrombus (Figure 5).

A meta-analysis by Pomero et al.³³ demonstrated a sensitivity of 96.1% (95% CI: 90.6%–98.5%) and a specificity of 96.8% (95% CI: 94.6%–98.1%) for compression ultrasound performed by emergency physicians. The examination is performed in under 5 minutes, reducing diagnostic delays and the need for unnecessary comprehensive scans.

The technical sequence evaluates the saphenofemoral junction, the area 1–2 cm distal to the saphenofemoral junction, the proximal and mid-to-distal segments of the femoral vein in the thigh (at 2–3 cm intervals), and the popliteal vein. The linear transducer (5–10 MHz) is positioned transversely over the vein, with progressive compression to assess for complete collapse.⁵

7. POCUS in Patients with Circulatory Shock

7.1. Diagnostic Approach

POCUS is the method of choice for the initial hemodynamic assessment and monitoring of patients with circulatory shock, allowing for diagnosis of hemodynamic profile within 2 minutes, even when performed by non-specialists.³⁴ The proposed approach integrates the BLUE, cardiac POCUS, and adapted EGLS protocols, addressing five sequential key questions:

- a. **Is there tamponade?** Investigate for moderate to severe pericardial effusion, dilated IVC with minimal respiratory variation, and diastolic collapse of the right heart chambers (swinging heart).
- b. **Is the patient hypovolemic?** A hyperdynamic LV (kissing walls) or small-diameter IVC (≤ 10 mm) with collapse throughout the respiratory cycle. Lungs without B-lines (A-pattern).
- c. **Is important LV systolic dysfunction the cause of shock?** Significant LV systolic dysfunction associated

with pulmonary congestion (B-profile on LUS) and/or systemic venous congestion (dilated IVC). Pure cardiogenic shock is unlikely to be the primary cause of instability in the presence of a normal lung pattern.

- d. **Are there signs of RV distension (*cor pulmonale*)?** RV > 60% of the LV (mild *cor pulmonale*); RV = LV (moderate); or RV > LV (severe), with septal flattening (D-shape) and dilated IVC.
- e. **Is there pneumothorax?** Absence of pleural sliding and presence of a lung point.

Figure 6 shows the complete diagnostic algorithm.

7.2. Fluid Responsiveness and Fluid Tolerance

Fluid responsiveness (FR) is defined as an increase in CO > 10%–15% induced by an increase in preload. The main parameter for estimating CO via POCUS is the LVOT VTI (normal: 18–22 cm at a heart rate of 55–95 bpm).

- **Passive leg raising (PLR):** An increase in VTI of $\geq 10\%$ induced by PLR predicts an increase in CO following fluid infusion with 84% accuracy.³⁵ PLR can be performed in patients under spontaneous or mechanical ventilation. Intraobserver variability of VTI measurements ($\pm 11\%$) should be considered. Changes > 20% are more likely to represent true FR.
- **Expiratory and inspiratory pause maneuvers (TOEF/TOIF):** The sum of the absolute variation ($\geq 13\%$) in LVOT VTI during combined TOEF and TOIF maneuvers has shown 93% accuracy in predicting FR; this approach is reserved for more experienced practitioners.³⁶
- **Fluid tolerance:** Assessed via the presence of B-lines on LUS (pulmonary congestion) and the VExUS score (systemic venous congestion). VExUS 0 or 1: fluid-tolerant; VExUS 2 or 3: fluid-intolerant.

8. POCUS in Short-Term Mechanical Circulatory Support

POCUS plays a multifaceted role in short-term mechanical circulatory support, encompassing initial patient assessment, guidance of cannulation, continuous hemodynamic monitoring, and early detection of complications.

8.1. Intra-Aortic Balloon Pump

Transesophageal echocardiography (TEE) is preferable to fluoroscopy for guiding intra-aortic balloon pump insertion because it allows for real-time visualization, is portable, and does not utilize ionizing radiation. Correct positioning requires the tip of the intra-aortic balloon to be located approximately 2 cm distal to the origin of the left subclavian artery. TEE also allows for the exclusion of primary contraindications (significant aortic regurgitation, aortic dissection) prior to insertion.

8.2. Venoarterial Extracorporeal Membrane Oxygenation

Echocardiography is essential across the four phases of venoarterial extracorporeal membrane oxygenation (ECMO)

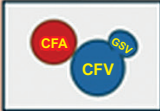
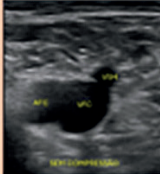
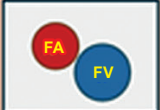
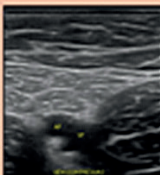
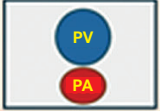
EXAMINATION SEQUENCE	DESCRIPTION	IMAGE/DIAGRAM
Patient positioning	Supine position with external rotation of the lower limb and slight knee flexion.	
View at the saphenofemoral junction	Position the transducer in the inguinal region at the level of the SFJ. Obtain images with and without compression, observing complete vein collapse.	   
View distal to the saphenofemoral junction	Position the transducer in the inguinal region, 1–2 cm distal to the SFJ. Obtain images with and without compression, observing complete vein collapse.	 
Femoral vein views	Position the transducer on the proximal and mid-to-distal thigh segments. Obtain images with and without compression, observing complete vein collapse every 2–3 cm.	   
Popliteal vein view	Position the transducer in the popliteal fossa. Obtain images with and without compression, observing complete vein collapse.	   

Figure 5 – Sequence of views for the extended three-point compression ultrasound protocol.³² CFA: common femoral artery; CFV: common femoral vein; FA: femoral artery; FV: femoral vein; GSV: great saphenous vein; PA: popliteal artery; PV: popliteal vein; SFJ: saphenofemoral junction.

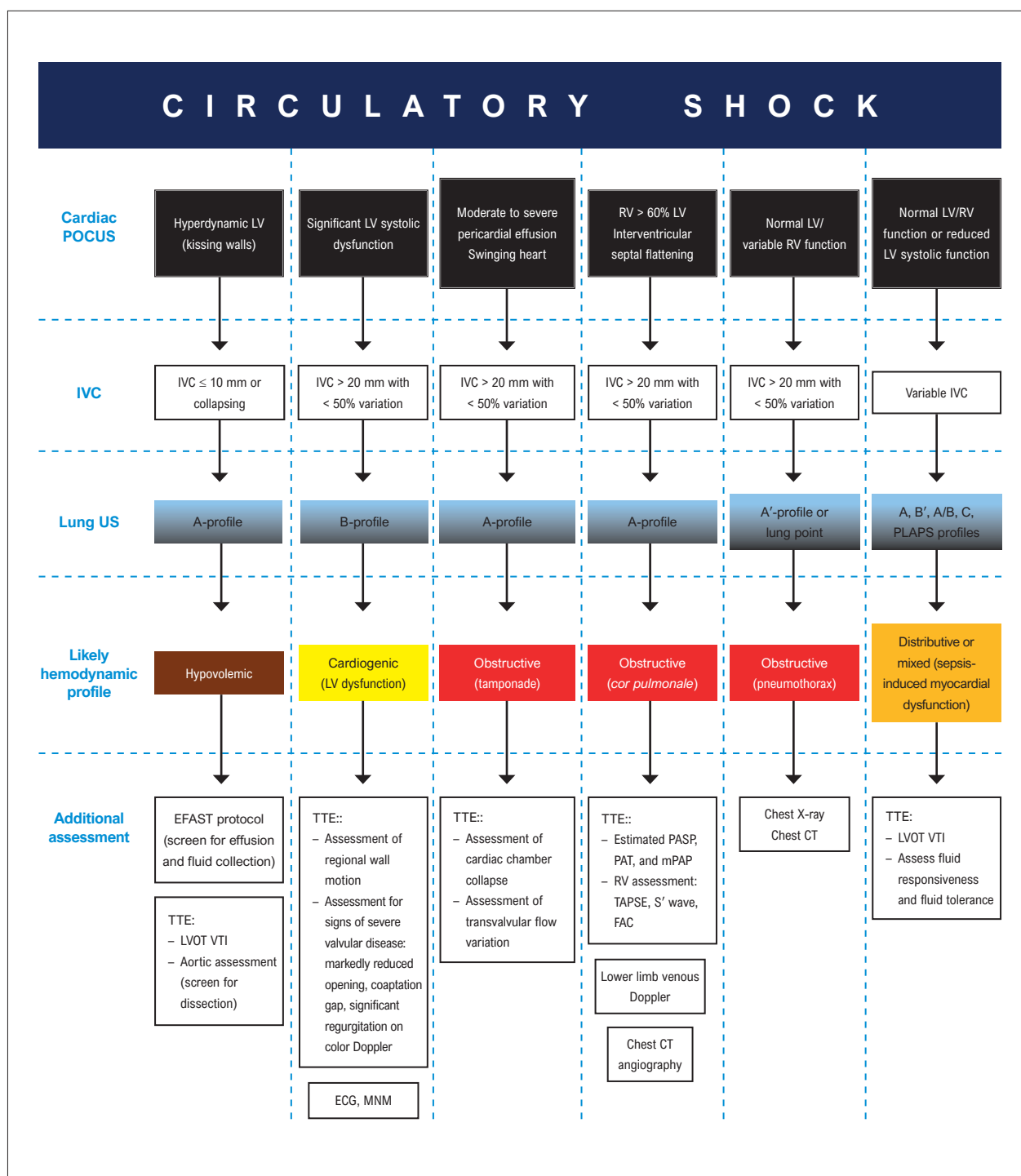


Figure 6 – Initial diagnostic algorithm for circulatory shock based on POCUS. CT: computed tomography; ECG: electrocardiogram; FAC: fractional area change; IVC: inferior vena cava; LV: left ventricle; LVOT: left ventricular outflow tract; MNM: myocardial necrosis markers; mPAP: mean pulmonary artery pressure; PASP: pulmonary artery systolic pressure; PAT: pulmonary acceleration time; PLAPS: posterolateral alveolar and/or pleural syndrome; POCUS: point-of-care ultrasound; RV: right ventricle; TAPSE: tricuspid annular plane systolic excursion; TTE: transthoracic echocardiogram; VTI: velocity-time integral. Adapted from the EGLS, BLUE, and EFAST protocols.

support: pre-cannulation, cannulation and initiation, monitoring for malfunction, and weaning. Special attention must be paid to the absence of aortic valve opening during peripheral support; this finding indicates blood stasis, risk of thrombosis, and the need for LV decompression strategies. All patients on acute mechanical circulatory support should undergo daily echocardiography, with additional focused exams in the event of acute hemodynamic deterioration.³⁷

Beside cardiovascular echocardiography for venovenous and venoarterial ECMO across the pre-cannulation, cannulation and initiation, malfunction, and weaning phases requires a highly specialized approach with well-defined protocols, extending beyond the scope of basic POCUS.

9. POCUS in Emergency Settings

9.1. Chest Pain

POCUS aids in the differential diagnosis of life-threatening conditions in patients with chest pain, including pulmonary embolism, pneumothorax, and pericardial diseases. The identification of pericardial effusion has an accuracy of over 95%, even when performed by emergency physicians with adequate training.³⁸ Assessment of the aorta in suspected dissection and analysis of regional LV wall motion to identify acute coronary syndrome require advanced training and should be performed by cardiovascular imaging specialists.

Regarding diagnosis of pulmonary embolism, the combination of cardiac findings (RV dilation, McConnell's sign, D-shaped septum), pulmonary findings (triangular subpleural consolidation), and vascular findings (noncompressible proximal DVT) has shown a specificity of over 95% (Table 3). In patients with hemodynamic instability, cardiac POCUS should be the first tool employed, given that the absence of signs of RV overload can rule out massive pulmonary embolism as a possible cause.

9.2. Dyspnea and Hemodynamic Instability

LUS is a key tool for rapid assessment of patients with dyspnea. The presence of ≥ 3 B-lines in a single intercostal space suggests significant pulmonary congestion, with distribution and severity correlating with the clinical presentation. Integrated use of the VExUS protocol to assess systemic venous congestion complements the management of patients with hemodynamic instability and/or organ dysfunction, particularly regarding risk stratification for acute kidney injury.

9.3. Peripheral Edema

POCUS is useful for investigating specific causes of peripheral edema, especially DVT, complementing LUS (pulmonary congestion) and VExUS (systemic venous congestion) in differential diagnosis.

Table 3 – POCUS as an aid to diagnosis of pulmonary embolism³²

Finding	Interpretation	Observations
Deep vein thrombosis	Visualization of a thrombus in a noncompressible deep vein (femoral, popliteal, etc.)	Highly suggestive of pulmonary embolism if associated with respiratory symptoms
RV dilation	RV diameter > LV diameter (RV/LV > 1) in parasternal or apical views	Suggestive of RV pressure overload (sign of massive/submassive embolism).
McConnell's sign	Hypokinesis of the basal and mid-portions of the RV free wall with apical sparing	Highly suggestive of pulmonary embolism (specificity ~94%).
Interventricular septal flattening	Shift of the interventricular septum toward the LV during diastole	Indicates RV pressure overload.
Pulmonary hypertension	Estimated PASP	Can be calculated based on peak tricuspid regurgitation velocity.
Thrombus in transit	Direct visualization of thrombus in the right heart chambers	Specific, but low sensitivity. Differential diagnosis includes embolic masses, such as tumors and vegetations.
Pulmonary artery thrombus	Direct visualization of thrombus in the main pulmonary artery or its branches (rare)	Specific, but low sensitivity (more common in central pulmonary embolism).
Pleural effusion	Fluid in the pleural cavity (usually small to moderate)	Nonspecific, but common in pulmonary embolism
Triangular subpleural consolidations	Suggestive of pulmonary infarction	Patients with pulmonary embolism without pulmonary infarction may show a normal LUS pattern.

LUS: lung ultrasound; LV: left ventricle; PASP: pulmonary artery systolic pressure; RV: right ventricle.

10. POCUS during Cardiopulmonary Arrest

POCUS during cardiopulmonary arrest (POCUS-CPA), when performed by a trained operator, allows assessment of the quality of chest compressions, diagnosis of reversible causes of arrest (hypovolemia, tension pneumothorax, pulmonary embolism, and cardiac tamponade), monitoring of interventions, and assessment of the response to treatment.³⁹ The method also provides relevant prognostic data regarding the likelihood of return of spontaneous circulation (Figure 7).

The **CASA** (Cardiac Arrest Sonographic Assessment) protocol is the only one that has demonstrated a reduction in the duration of interruptions for rhythm checks, and it is recommended for routine implementation.⁴⁰

Technical aspects: A phased-array transducer (3.5–5 MHz) is recommended. Images should be acquired during the 10-second pause for rhythm assessment and analyzed throughout the resuscitation cycle. The subcostal view is the recommended initial approach. Subcostal images can be acquired during chest compressions to assess their effectiveness.

Reversible causes identified by POCUS-CPA:

- **Cardiac tamponade:** A dilated IVC prompts further assessment; differential diagnosis from pleural effusion is based on the relationship to the descending aorta.
- **Pulmonary embolism:** Sudden RV dilation (RV/LV ≥ 1:1), D-shaped septum.
- **Tension pneumothorax:** Absence of pleural sliding, stratosphere sign, lung point.
- **Hypovolemia:** Complete ventricular collapse and IVC collapse.

Important limitation: The use of POCUS-CPA remains subject to uncertainty, as it has not yet demonstrated a significant impact on patient prognosis, primarily due to the lack of a universal protocol definitively incorporated into advanced cardiovascular life support.

11. Ultrasound-Guided Procedures

11.1. Vascular Access

Ultrasound-guided catheter placement is safer than the “blind” (unguided) technique. The dynamic (real-time) technique is preferred, as it increases accuracy, reduces the number of attempts, and decreases complications. Two puncture planes can be used:

- **Short-axis:** Technically more accessible; the limitation is the inability to continuously visualize the needle tip.
- **Long-axis:** Allows direct visualization of the needle tip along its entire trajectory, offering greater control and safety, although it is technically more challenging.

The main sites for ultrasound-guided puncture are the internal jugular vein, femoral vein, and subclavian vein.

11.2. Ultrasound-Guided Pericardiocentesis

When performed by experienced professionals with appropriate training, ultrasound-guided pericardiocentesis presents major event rates of 0.3% to 3.9% and minor event rates of 0.4% to 20%, compared to a morbidity of ~20% and mortality of 6% with the traditional “blind” subxiphoid technique.⁴¹ The parasternal apical window is the most frequently used (66% of cases in the Mayo Clinic series). Correct catheter placement is confirmed by the injection of 5 mL of agitated saline.

11.3. Assessment of the Full Stomach

Gastric POCUS assesses the quantity and quality of gastric contents prior to procedures such as TEE, enhancing safety by identifying a full stomach containing liquid (anechoic appearance of the distended gastric antrum) or solid matter (heterogeneous appearance with hyperechoic areas). This assessment is particularly relevant in conditions associated with gastroparesis (diabetes, obesity, hemodynamic instability).

12. Final Considerations and Future Perspectives

Cardiovascular POCUS represents a natural extension of contemporary physical examination, with proven potential to positively impact clinical decision-making in emergency, intensive care, and outpatient settings. Responsible adoption of this technology requires clear legal regulation, standardized training with competency certification, adequate supervision, and continuous quality monitoring.

In Brazil, the incorporation of cardiovascular POCUS into the SUS faces significant structural barriers, including limited availability of equipment, irregular training, lack of standardized care flows, and logistical challenges; however, there are growing opportunities through telehealth programs, federal funding (SUS Digital, FINEP), and state funding (FAPERJ). Handheld devices priced at USD 4,000 to 6,000 represent a viable alternative for expanding access in regions with limited infrastructure.

It is likely that the advent of AI for image interpretation, automatic B-line counting, and the development of integrated algorithms will significantly expand the use of POCUS in emergency medicine, intensive care, and cardiology. The future of cardiovascular medicine will likely involve POCUS as an integral component of bedside clinical assessment, yet always interpreted in light of the clinical history, physical examination, and other patient data.

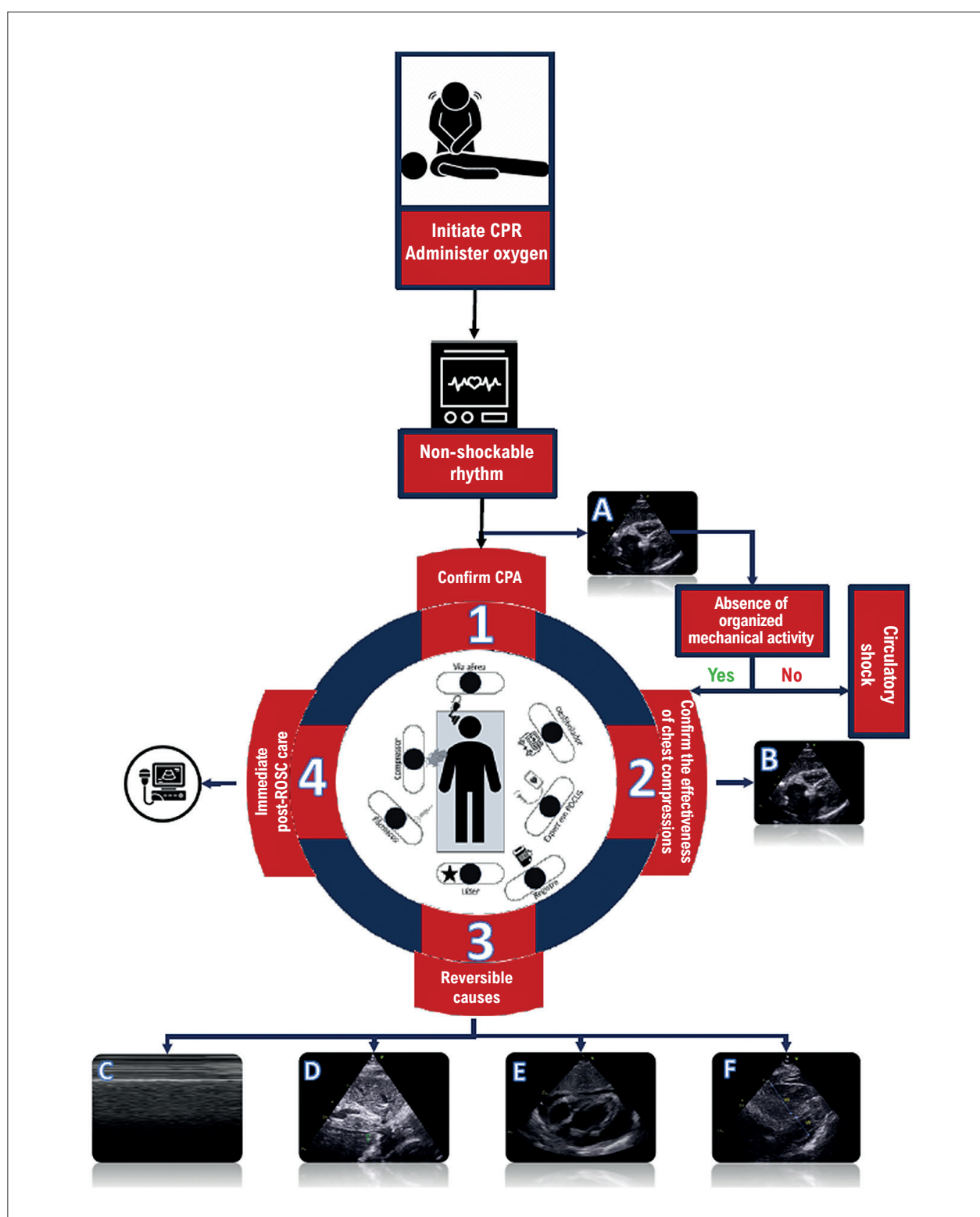


Figure 7 – Utility of POCUS-CPA. The illustration in the center depicts the team positioning suggested in this statement for performing POCUS-CPA. The subcostal view allows rapid confirmation of CPA versus cardiac mechanical activity and of shockable versus non-shockable rhythm (panel 1), as well as assessment of the effectiveness of chest compressions (panel 2B). It is possible to identify reversible causes, such as tension pneumothorax (panel 3C), hypovolemic shock (panel 3D), cardiac tamponade (panel 3E), and signs of pulmonary embolism (panel 3F). After ROSC, a targeted assessment can be performed to investigate other causes (panel 4). CPA: cardiopulmonary arrest; CPR: cardiopulmonary resuscitation; ROSC: return of spontaneous circulation.

Special Article

Position Statement on the Use of Point-of-Care Ultrasound in Cardiovascular Medicine – 2026: Executive Summary

The report below lists declarations of interest as reported to the SBC by the experts during the period of the development of these statement, 2025/2026.

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*Supplemental Materials

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