# FOCUSED ULTRASOUND IN THE MANAGEMENT OF CARDIAC ARREST

## When Critical Ultrasound can make a difference

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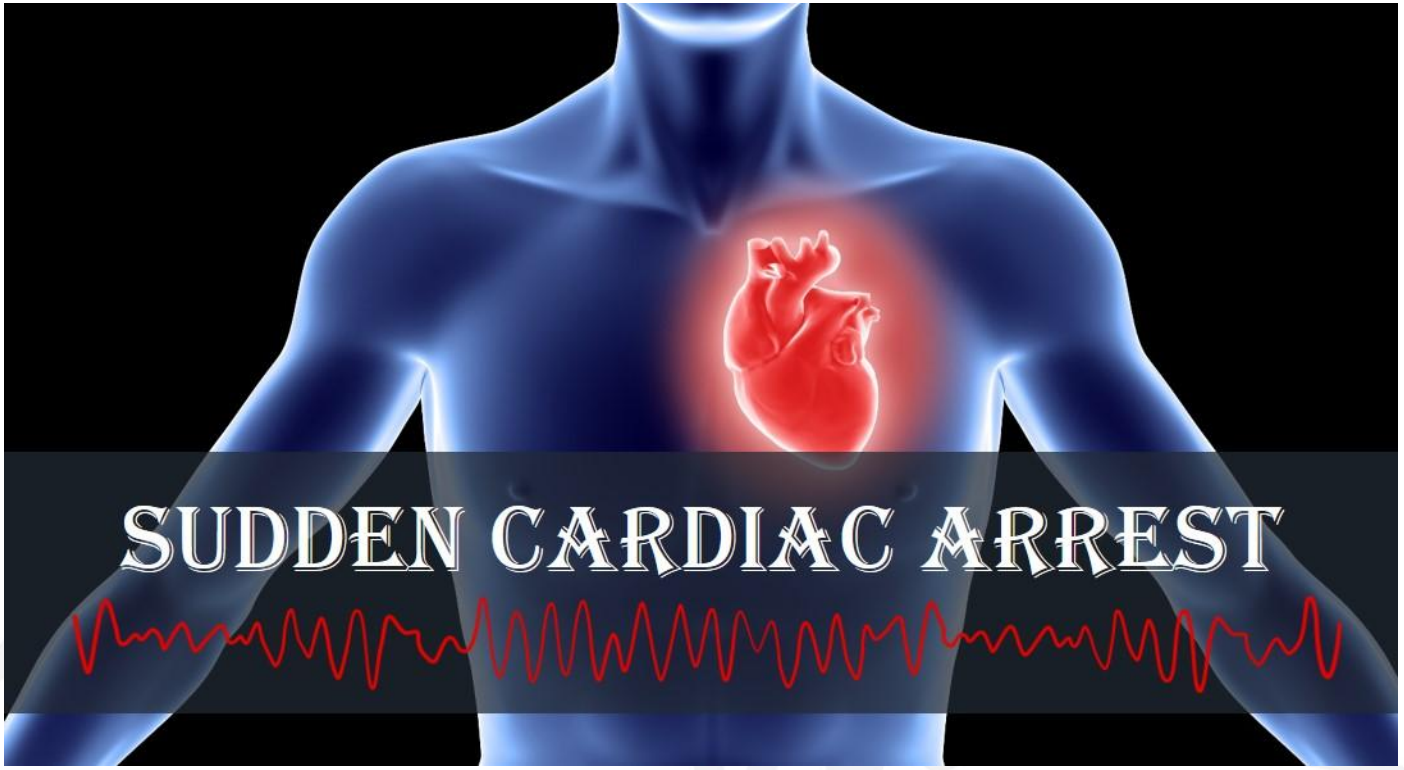
**NAPOLI 19.11.2016**

x congresso nazionale
simeu
NAPOLI 18-20 NOVEMBRE 2016

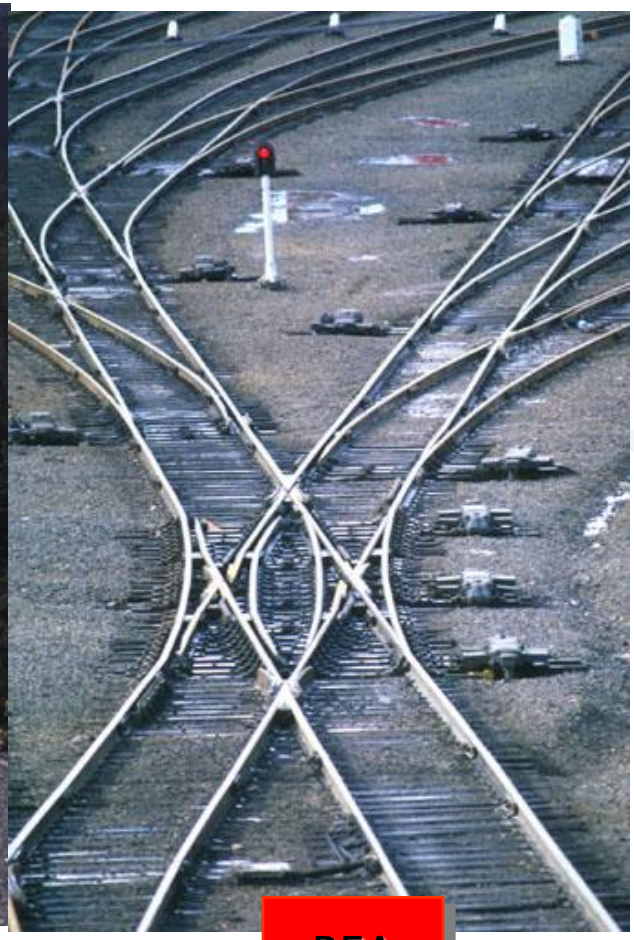



**a daily challenge for all physicians in Emergency & Critical Care**

# CARDIAC ARREST...

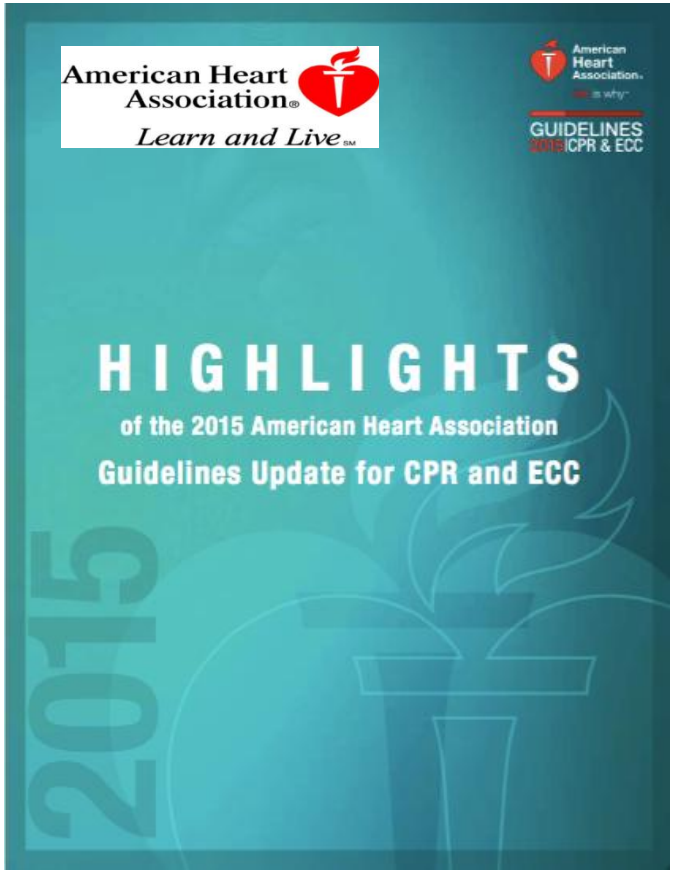
# NOT ALL THE SAME!

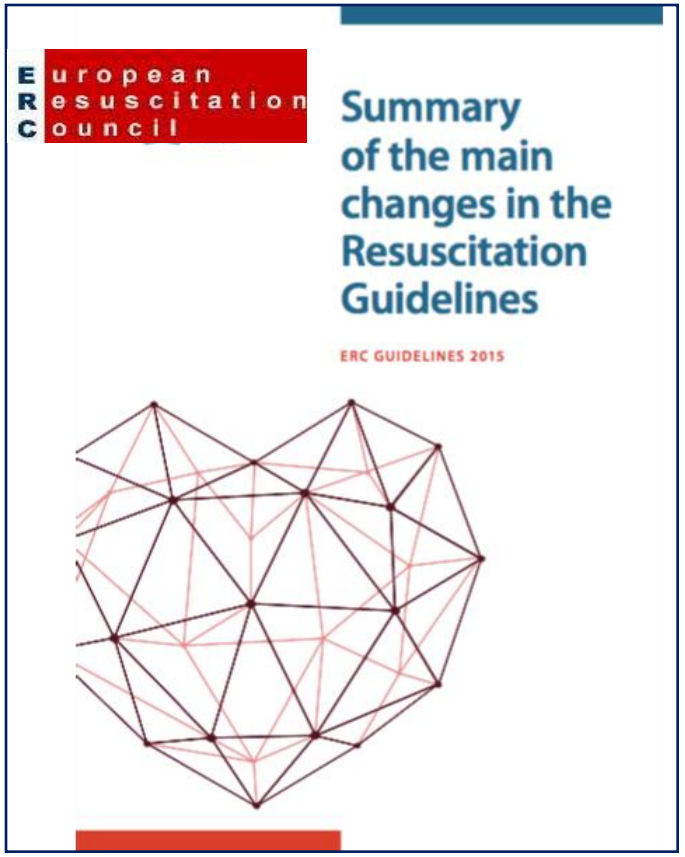
VF-VT



PEA

# 15.10.2015


American Heart Association®
Learn and Live℠
American Heart Association.
GUIDELINES 2015 CPR & ECC
HIGHLIGHTS
of the 2015 American Heart Association
Guidelines Update for CPR and ECC
2015


European Resuscitation Council
Summary of the main changes in the Resuscitation Guidelines
ERC GUIDELINES 2015

# 3 KEY-MESSAGES

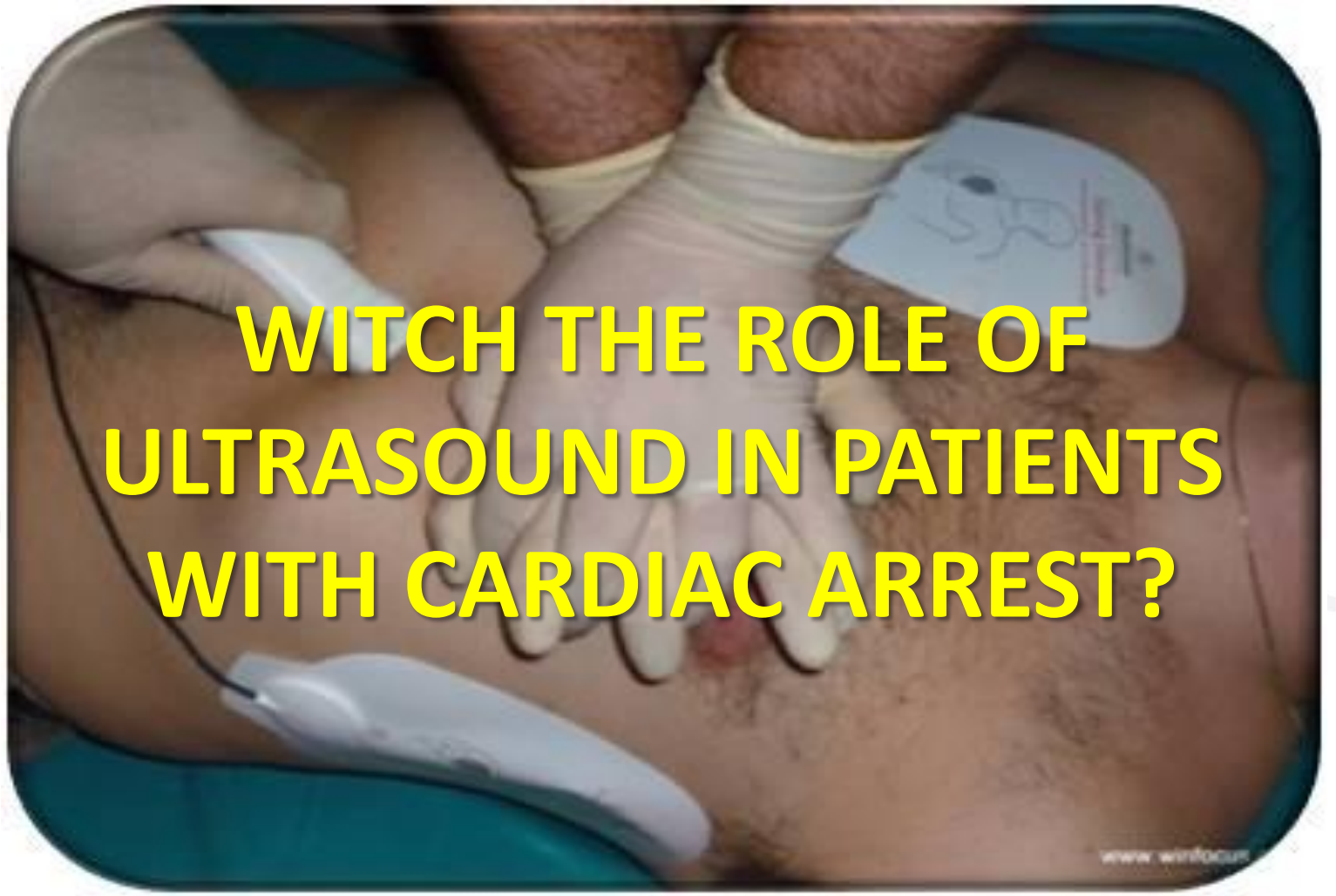
**TO OPTIMIZE CPR!**

**TO GO IN SEARCH OF VF!**

**TO RESEARCH FOR REVERSIBLE CAUSES !**

# GUIDELINES ON CPR

# IDENTIFYING AND TREATING REVERSIBLE CAUSES OF CARDIOPULMONARY ARREST


WITCH THE ROLE OF
ULTRASOUND IN PATIENTS
WITH CARDIAC ARREST?


**"…When available for use by trained clinicians, ultrasound may be of use in assisting with diagnosis and treatment of potentially reversible causes of cardiac arrest"**

Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association®

Learn and Live℠


**…Immediate assessment of blood flow by Doppler ultrasound may reveal an actively contracting heart and significant blood flow. Any PEA patient with a Doppler-detectable blood flow should be aggressively treated…**

# ACEP Policy Statement

**EMERGENCY ULTRASOUND GUIDELINES 2008**

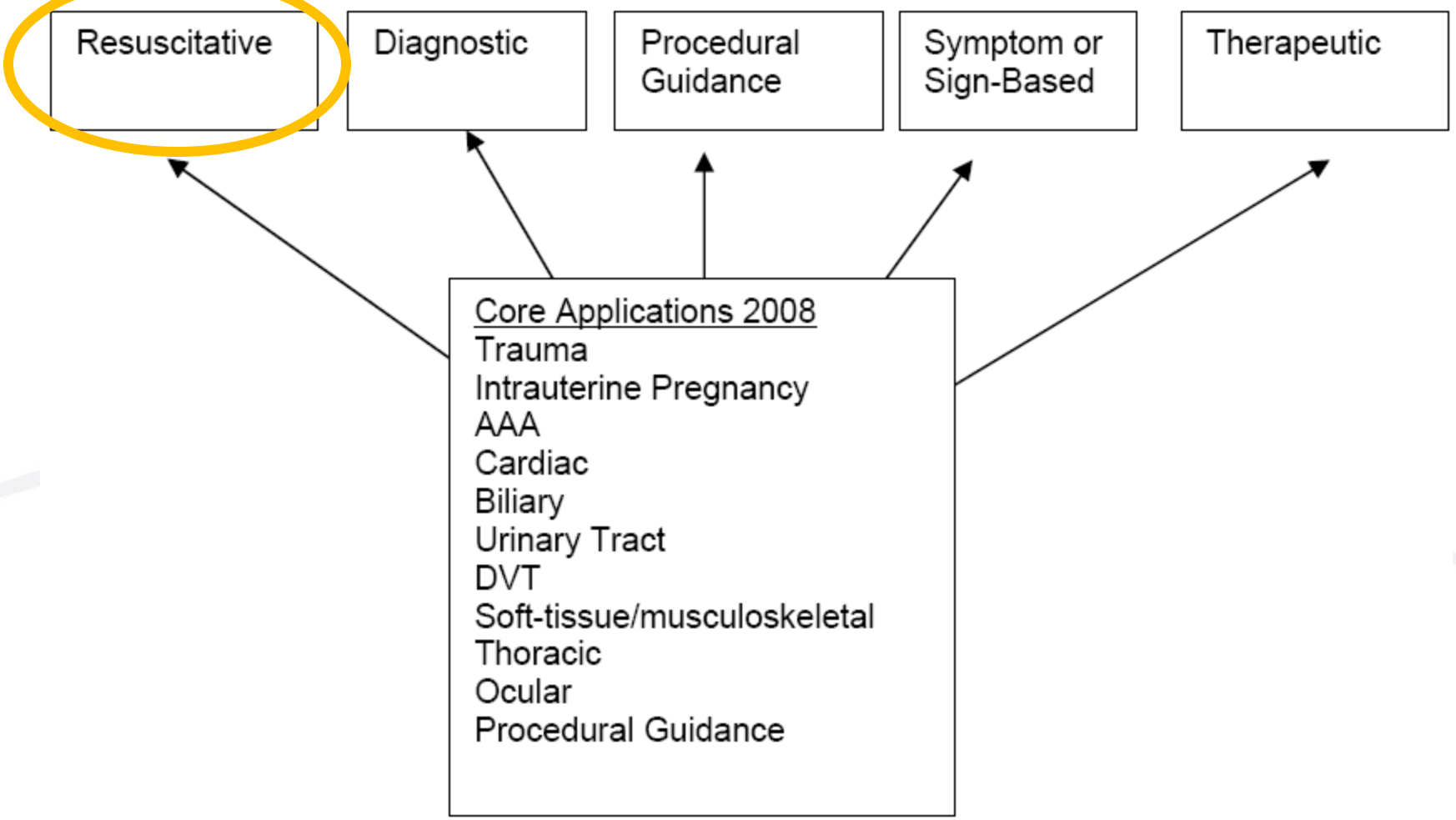
Emergency ultrasound can be classified into the following functional clinical categories:

1. *Resuscitative*: ultrasound use as directly related to an acute resuscitation
2. *Diagnostic*: ultrasound utilized in an emergent diagnostic imaging capacity
3. *Symptom or sign-based*: ultrasound used in a clinical pathway based upon the patient's symptom or sign (eg, shortness of breath)
4. *Procedure guidance*: ultrasound used as an aid to guide a procedure
5. *Therapeutic and Monitoring*: ultrasound use in therapeutics or in physiological monitoring

EMERGENCY ULTRASOUND GUIDELINES 2008

ACEP POLICY STATEMENT

**Figure 1. ACEP 2008 emergency ultrasound guidelines scope of practice.**



Resuscitation 59 (2003) 315–318

RESUSCITATION

# Emergency echocardiography to detect pericardial effu in PEA and near-PEA states☆

Resuscitation (2008) 76, 198–206

available at www.sciencedirect.com

ScienceDirect

Anaesthesiology Intensive Therapy
2015, vol. 47, no 5, 471–481
ISSN 0209–1712
10.5603/AIT.a2015.0072
www.ait.viamedica.pl

VIA MEDICA

REVIEWS

American Journal of Emergency Medicine (2005) 23, 459–462

ELSEVIER

Abstract

*Objectives:* Emergency
electric activity (PEA) o
effusion in patients in PE
patients with non-traum
period. Outcomes of pati
operation or autopsy. *Re*
were without cardiac ver

## Does the presence or abser

# Critical care ultrasound in cardiac arrest. Technological requirements for performing the SESAME-protocol — a holistic approach

Daniel Lichtenstein[1], Manu L.N.G. Malbrain[2]

http://dx.doi.org/10.4172/2155-9880.S10-003

Clinical & Experimental
Cardiology

Review Article Open Access

# Clinical Integrated Ultrasound in Peri Cardiac Arrest and Cardiac Arrest

**Roberto Copetti***

*Emergency Department, Latisana General Hospital, Latisana, Italy*

citation
ort–conformed

# Per quale causa?

Gian A. Cibinel, Alessandro Martini
Struttura Complessa Medicina e Chirurgia di Accettazione e d'Urgenza, Ospedale Edoardo Agnelli, ASL 10, Pinerolo (To)

*Con questo articolo, prosegue la pubblicazione di una serie di casi clinici presentati e discussi con orientamento prevalente alla fase diagnostica, seguendo i principi descritti in quattro articoli pubblicati su "Decidere in Medicina" negli ultimi mesi[1-4], relativi alla metodologia EBM dell'approccio integrato clinico-ecografico al paziente critico.*
*A partire dal presente caso, e per i successivi, saranno disponibili in formato digitale presso il sito delle Edizioni Medico Scientifiche le registrazioni ecografiche descritte e discusse nelle presentazioni (vedere nota al termine dell'articolo).*

arrest alert to sonograph
cy ultrasound examinatio
3 min). Three of these e

Raoul Breitkreutz, MD; Felix Walcher, MD, PhD; Florian H. Seeger, MD

# Transthoracic echocardiography for cardiopulmonary monitoring in intensive care

M. B. Jensen, E. Sloth, K. M. Larsen, M. B. Schmidt

ation in resuscitation management, a structured process of an advanced life support–conformed transthoracic echocardiography protocol to be applied to point-of-care diagnosis. The new 2005 American Heart Association/European Resuscitation Council/International Liaison Committee on Resuscitation guidelines recommended high-quality cardiopulmonary resuscitation with

graphic evaluation in resuscitation management examination is to improve the outcomes of cardiopulmonary resuscitation. (Crit Care Med 2007; 35[Suppl.]:S150–S161)

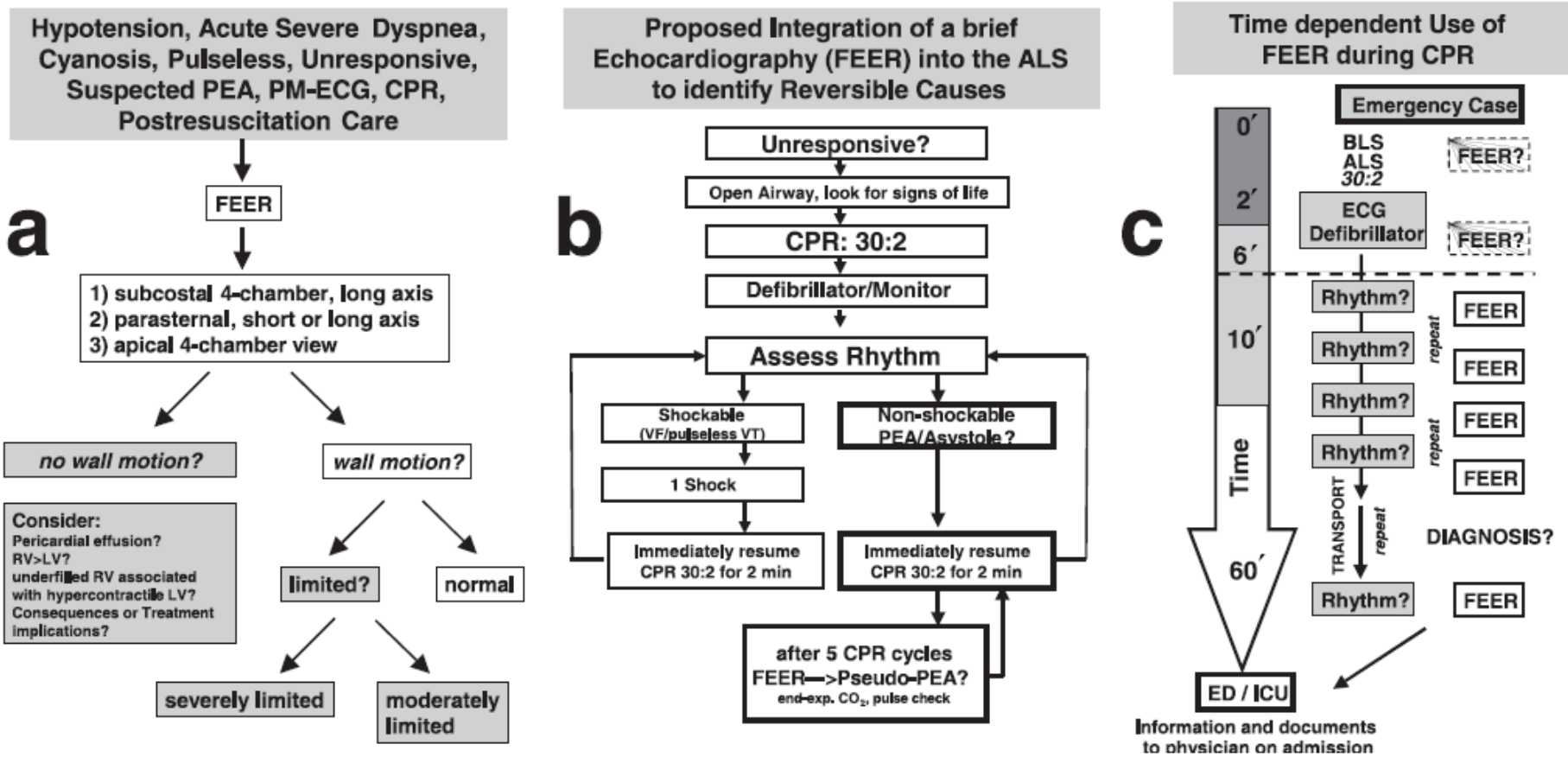
Key Words: emergency echocardiography; focused echocardiographic evaluation in resuscitation; resuscitation; cardiopulmonary resuscitation; algorithm; critical care ultrasound

# Cardiac Arrest and Hypotension Ultrasound protocols

| | UHP | AE JONES (UHP+) | TRINITY | FATE | FEER | BLUE | CAUSE | ACES | RUSH (SW) | RUSH (DM) | FEEL | CORE | SHoC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | 2001 | 2004 | 2002 | 2004 | 2007 | 2008 | 2008 | 2009 | 2009 | 2010 | 2010 | unpub (2010) | 2016 |
| WHO | Rose | Jones | Bahner | Jensen | Breitkreutz | Lichtenstein | Hernandez | Atkinson | Weingart | Mandavia | Breitkreutz | Wu | Atkinson |
| Cardiac | Yes | Yes | Yes | Yes | Yes | | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| ..SX | | Yes | AND | AND | AND | | OR | | AND | AND | AND | | |
| ..PSLA | | Yes | AND | AND | AND (or PSSA) | | OR | | AND | AND | AND | | |
| ..A4C | | Yes | | AND | AND | | OR | | AND | AND | AND | | |
| Lung | | | | Yes | | Yes | Yes | | Yes | Yes | | Yes | Yes |
| FAST | Yes | RUQ, PELVIS | Yes | | | | | Yes | Yes | Yes | | | |
| Aorta | Yes | Yes | Yes | | | | | Yes | Yes | Yes (and suprasternal) | | Yes | |
| IVC | | Yes | | | | | | Yes | Yes | Yes | | Yes | Yes |
| DVT | | | | | | | | | | Yes | | Yes | |
| ETT | | | | | | | | | | | | Yes | Yes |

# Focused echocardiographic evaluation in resuscitation management: Concept of an advanced life support–conformed algorithm (FEER)

Raoul Breitkreutz, MD; Felix Walcher, MD, PhD; Florian H. Seeger, MD



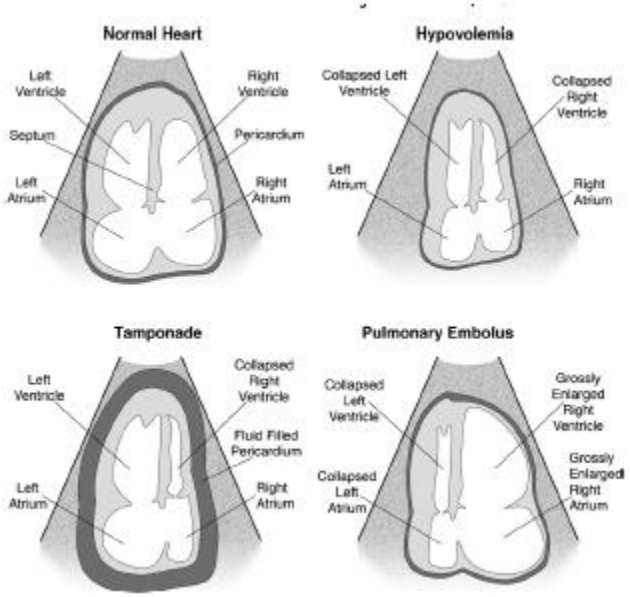

Crit Care Med 2007; 35[Suppl.]:S150–S161

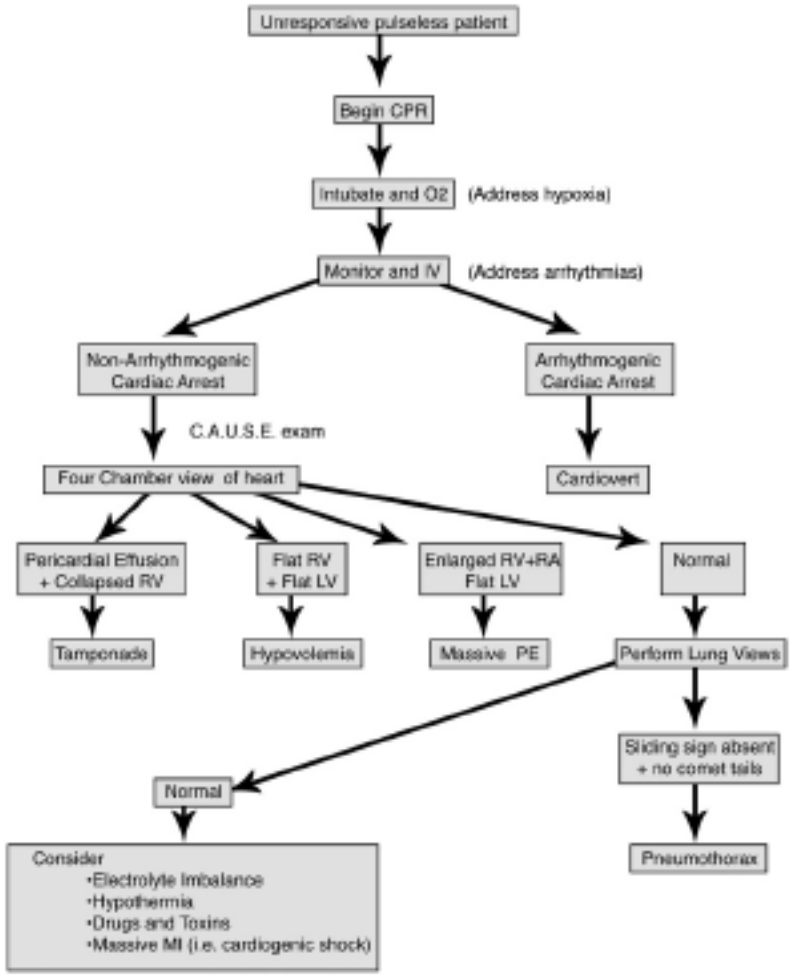
# C.A.U.S.E.: Cardiac arrest ultra-sound exam—– A better approach to managing patients in primary non-arrhythmogenic cardiac arrest☆

Resuscitation (2008) **76**, 198–206

Caleb Hernandez[a], Klaus Shuler[a], Hashibul Hannan[a], Chionesu Sonyika[a], Antonios Likourezos[a,*], John Marshall[a,b]

| Aetiology | Sn % | Sp % |
|---|---|---|
| Tamponade | 96 | 98 |
| Hypovolemia | 88 | 81 |
| PE (RV disfunction) | 40-70 | 90-94 |
| Hypertensive PNX | 92 | 99 |



# Transthoracic echocardiography for cardiopulmonary monitoring in intensive care

*European Journal of Anaesthesiology* 2004; 21: 700–707

M. B. Jensen, E. Sloth, K. M. Larsen, M. B. Schmidt

210 ICU pts

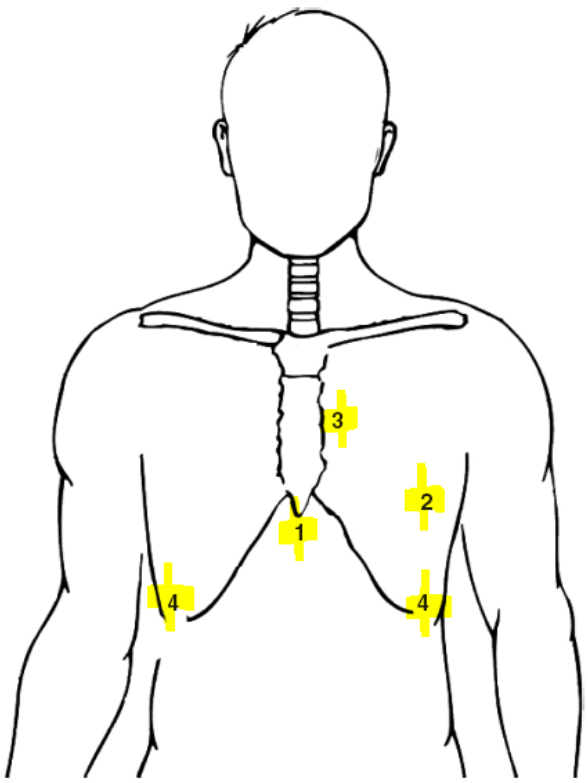



Figure 1.
*Transducer positions in the FATE protocol. (1) subcostal view; (2) apical view; (3) parasternal view; (4) pleural view.*

## *The FATE protocol* (Focus Assessed TE)

The FATE is performed from the four positions listed above (Fig. 1) in a rapid sequence with the following objectives:

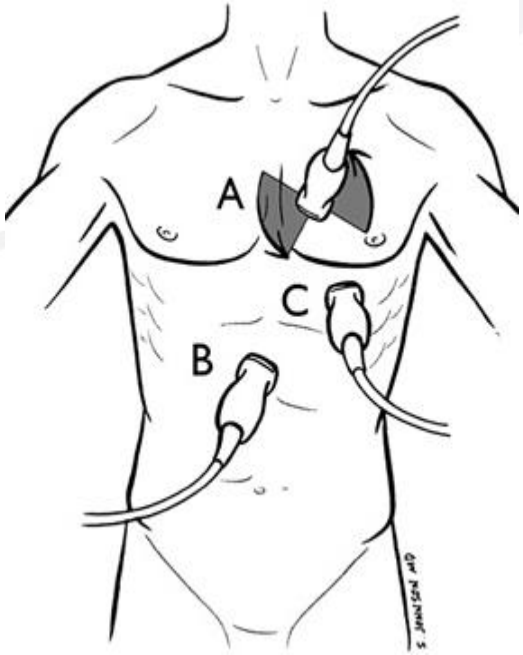
1. Exclude obvious pathology.
2. Assess wall thickness and dimensions of chambers.
3. Assess contractility.
4. Visualize pleura on both sides.
5. Relate the information to the clinical context.

Table 1. The monitoring value of FATE.

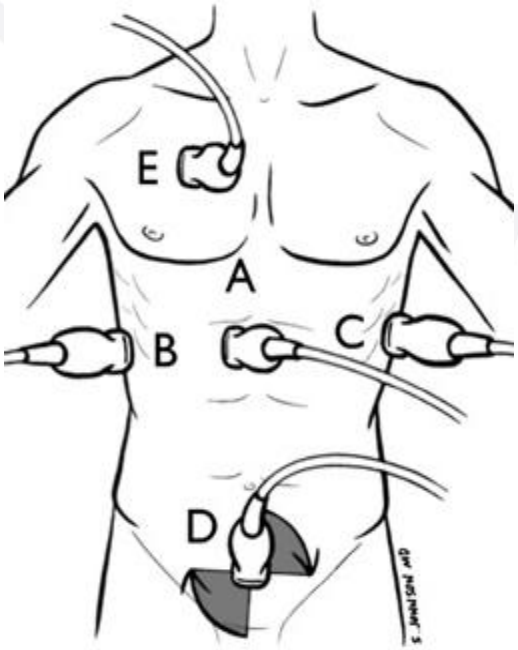
| | | |
|---|---|---|
| I | No image/too poor information | 6 (2.6%) |
| II | Support of available information | 83 (35.6%) |
| III | Added new information | 87 (37.3%) |
| IV | Added decisive information | 57 (24.5%) |
| Total | | 233 (100%) |

# The RUSH Exam:
## Rapid Ultrasound in SHock in the Evaluation of the Critically Ill

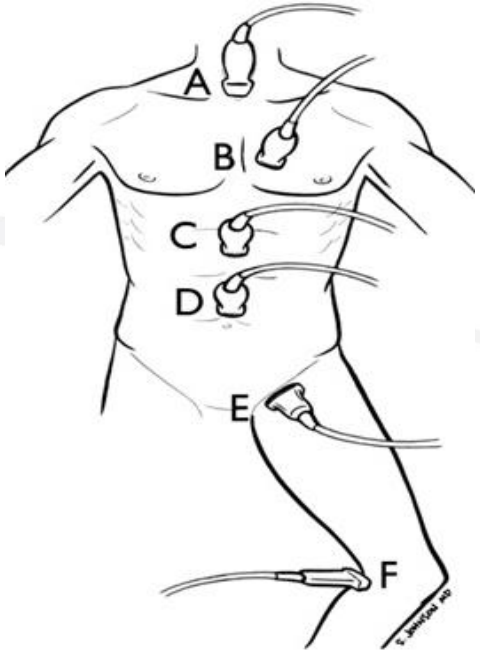
Phillips Perera, T.Mailhot, D. Riley, D. Mandavia




THE "PUMP"

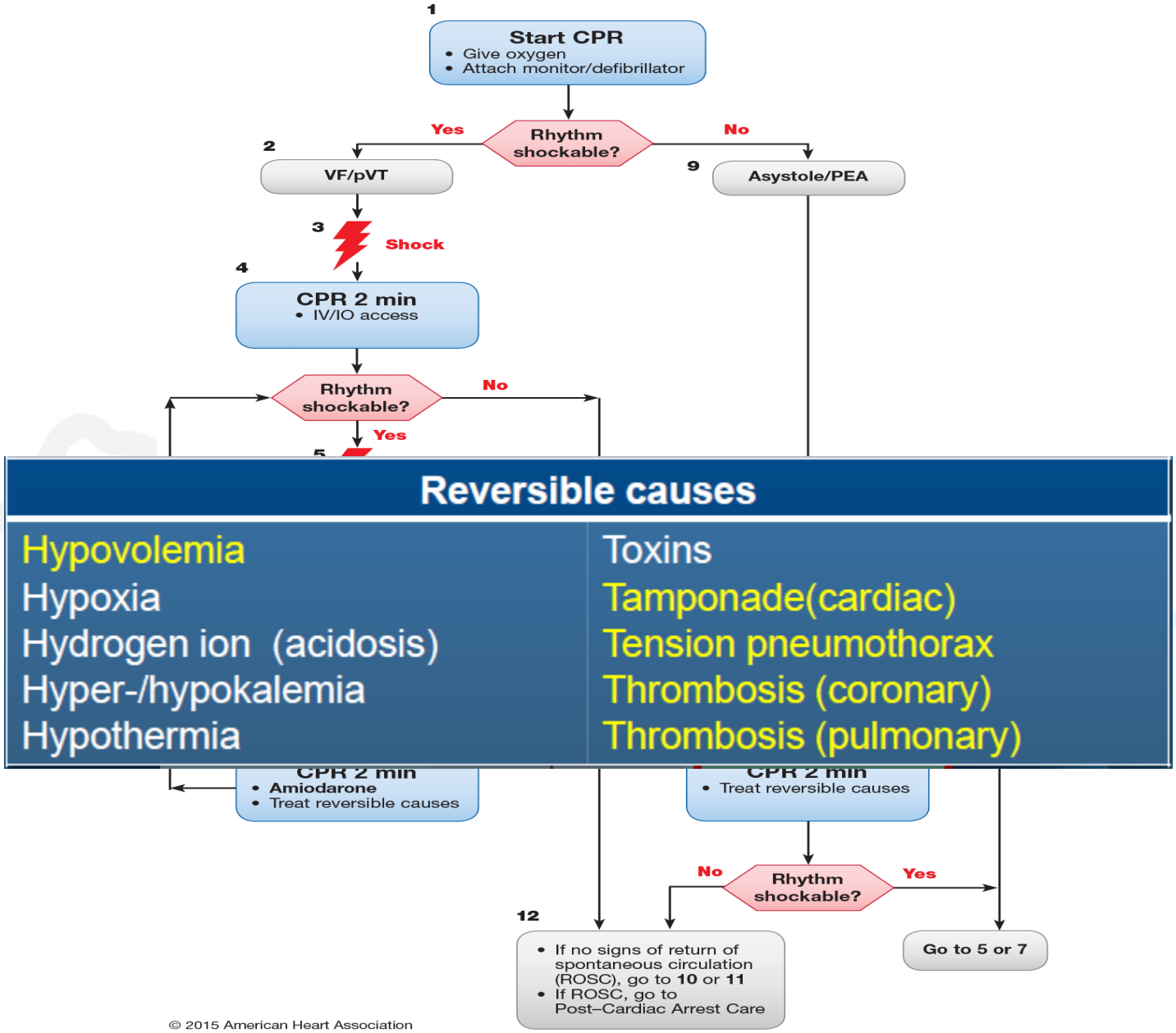



THE "TANK"




THE "PIPES"

# Adult Cardiac Arrest Algorithm—2015 Update

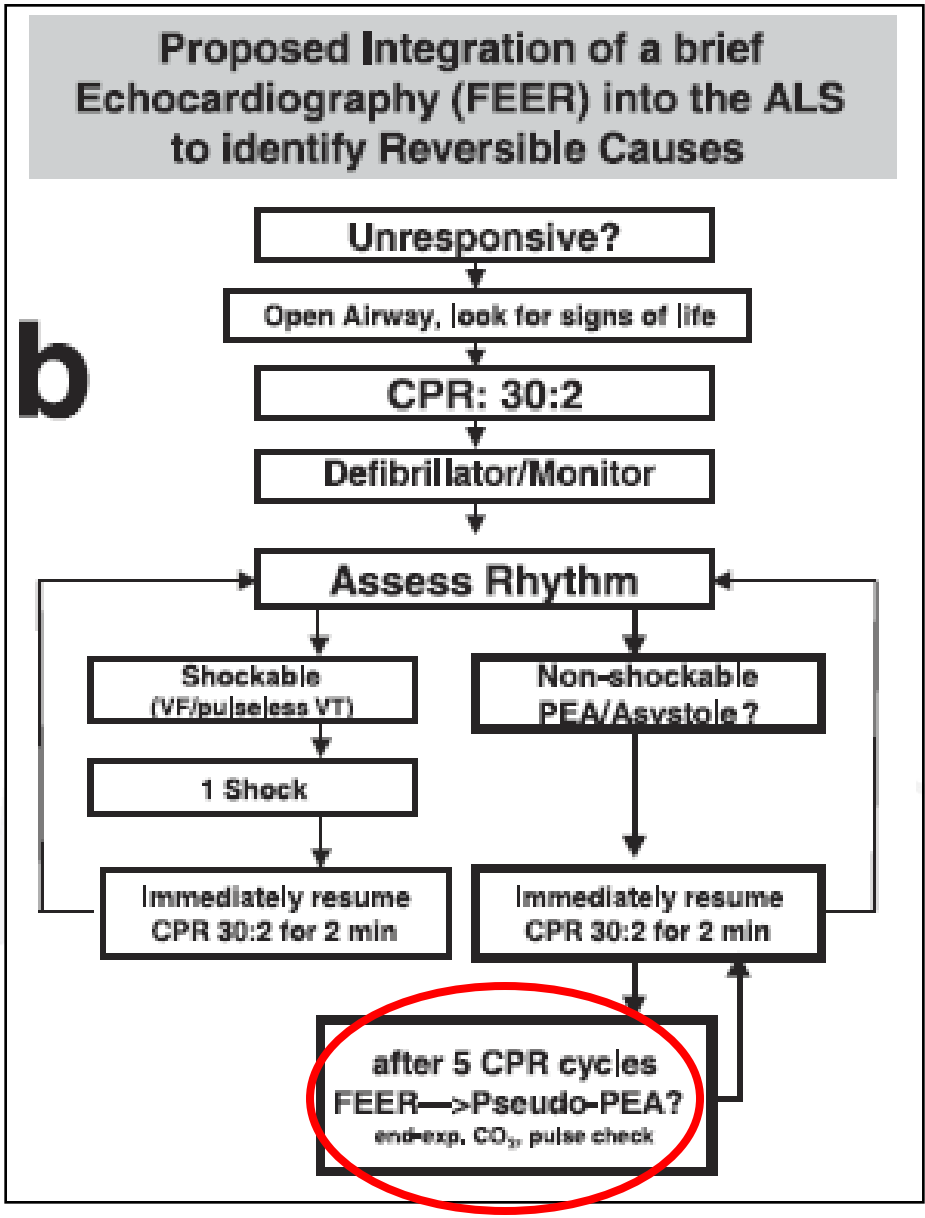


# Focused Echocardiographic Evaluation in Life support

**WHEN?**

**In case of PEA or Asystole**

N.B. before 5 cycles of CPR "High Quality" !



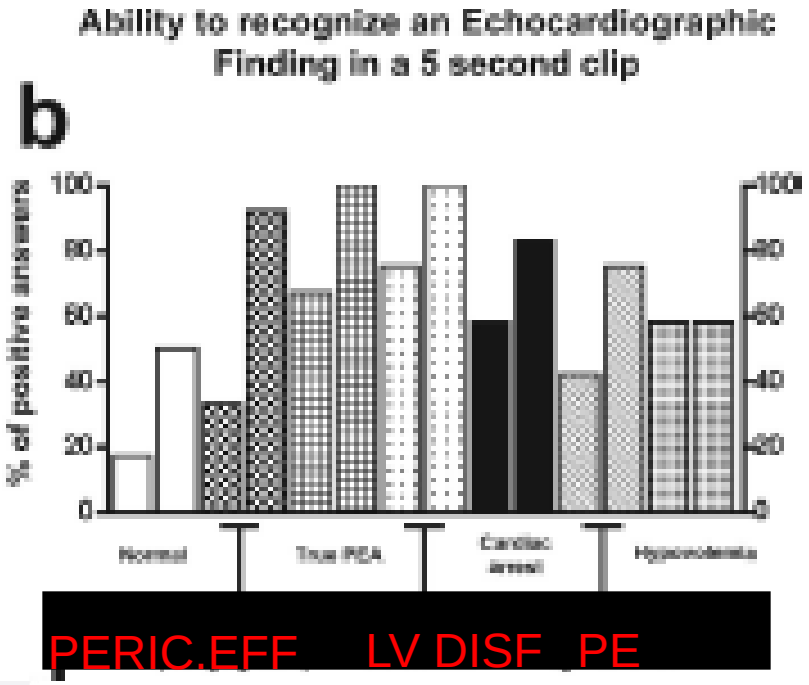

Breitkreutz et al.
CRIT CARE MED 2007; 35 (suppl ) s150-161

# Focused Echocardiographic Evaluation in Life support

## HOW LONG MUST PERFORM ULTRASOUND ?

<10 SEC

TIME RESEARCH OF PULSE



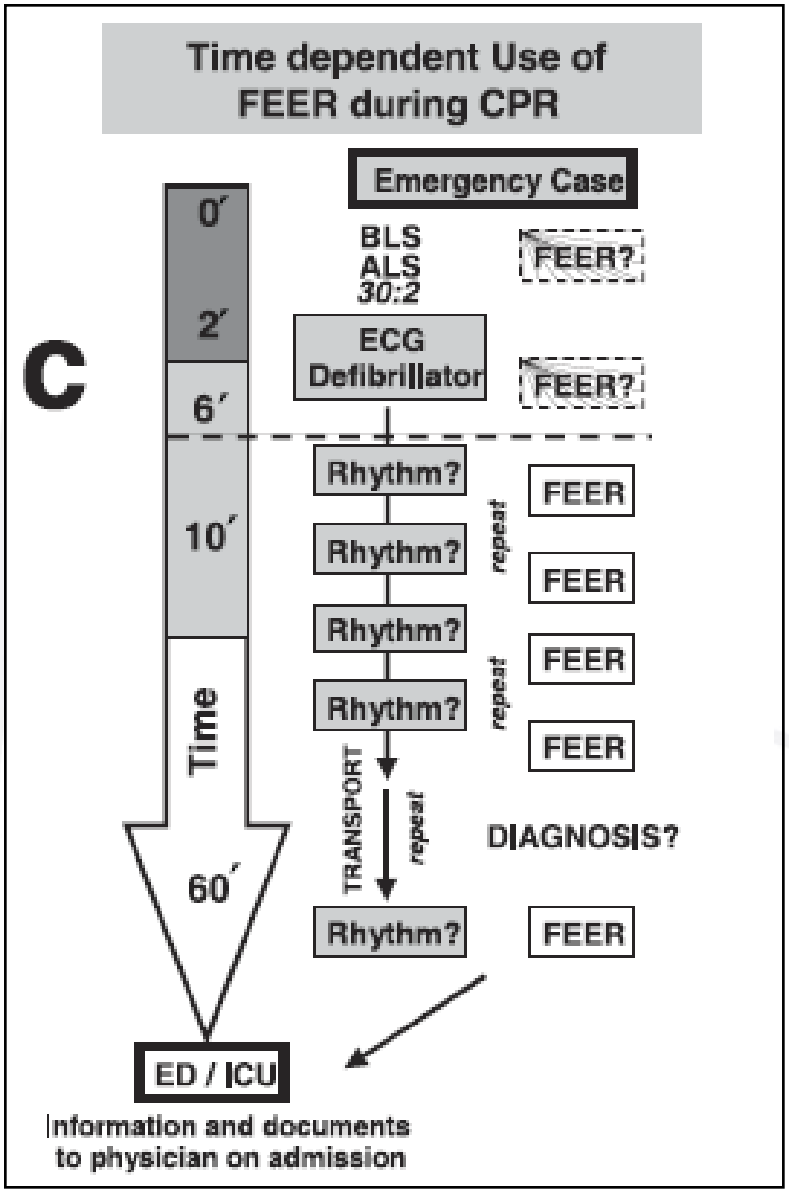

Emergency Echocardiography Simulation Test: a new tool for level-1 Trainee competency evaluation in critical care medicine
ESICM 2007 Congress (Abst)

Breitkreutz et al.
CRIT CARE MED 2007; 35 (suppl ) s150-161

# Focused Echocardiographic Evaluation in Life support

## WHEN REPEATE ULTRASOUND?

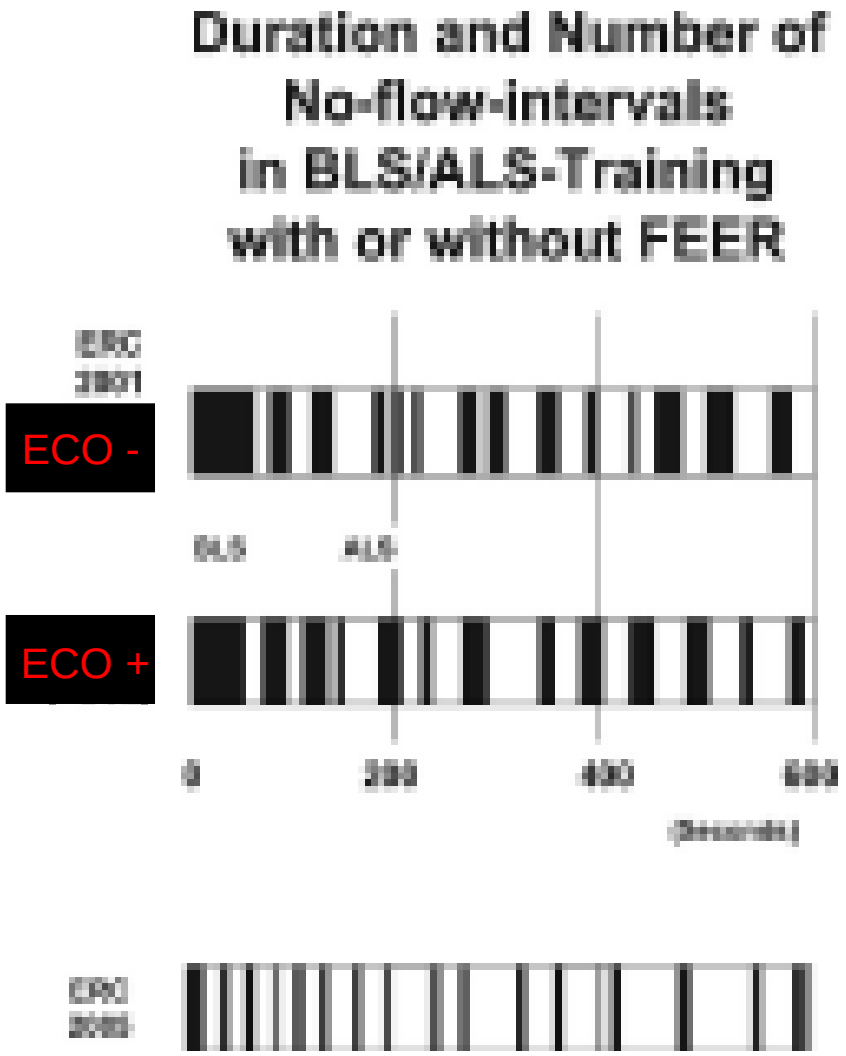
**WHEN YOU NEED!**
**AFTER 5 CYCLES AT LEAST**
**MORE**




Breitkreutz et al.
CRIT CARE MED 2007; 35 (suppl ) s150-161

# Focused Echocardiographic Evaluation in Life support

**Ultrasound causes to lose precious time during CPR?**



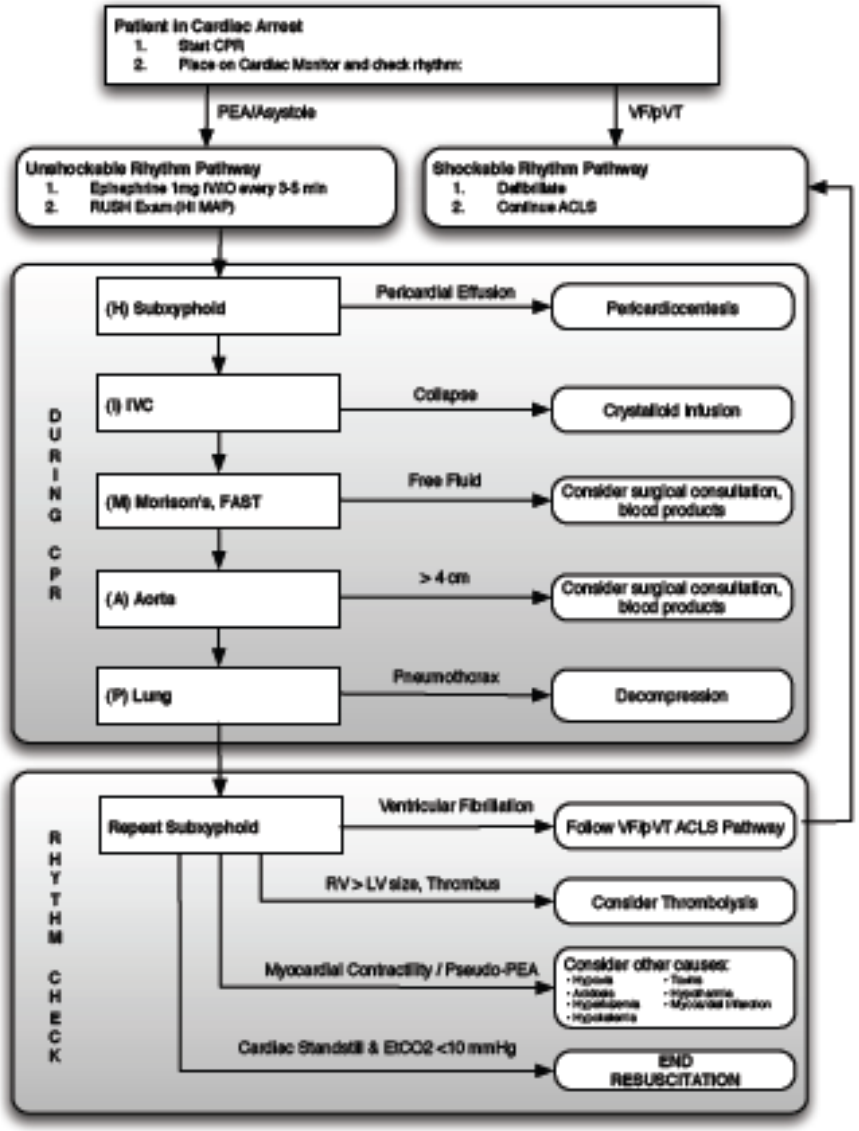

Breitkreutz et al.
CRIT CARE MED 2007; 35 (suppl ) s150-161

# HOW ?

DURING CPR

DURING CHECK RHYTHM

## The RUSH exam in Cardiac Arrest Resuscitation



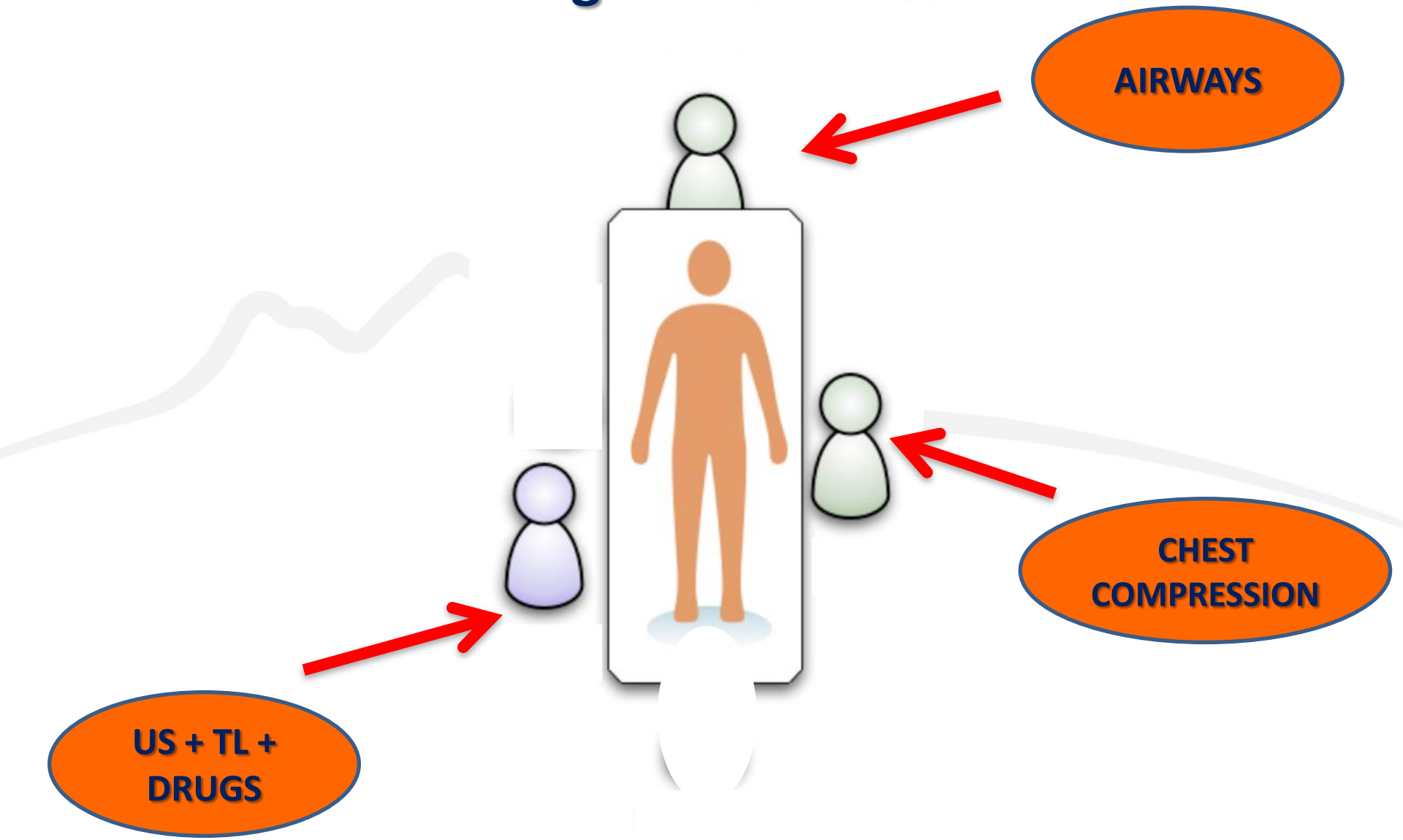

CARDIAC ARREST
=
CHAOS

# THE IMPORTANCE OF A STRATEGY

**To use Ultrasound effectively to guide resuscitation, it's important to have a predefined strategy to incorporate Critical Ultrasound into the flow chart of ACLS care.**

# Witch the roles and positions in a team during cardiac arrest?

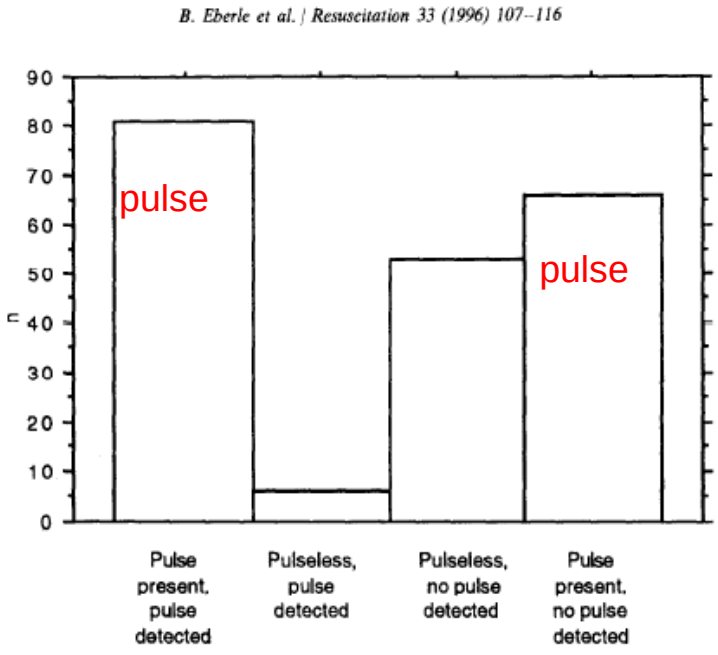
# Witch the roles and positions in a team during cardiac arrest?



# DIAGNOSTIC GAPS IN ALS


During CPR, in any situation, rescuers are almost always **unaware of myocardial function**, in both the presence and absence of circulation

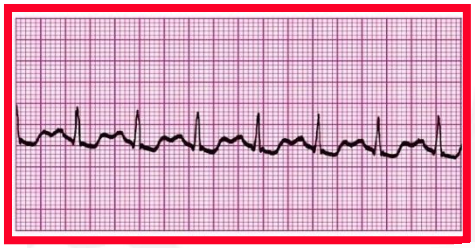
# CAROTID PULSE AND ACCURACY OF HIS RESEARCH




| | |
|---|---|
| Sensitivity | 90% |
| Specificity | 55% |
| Accuracy | 65% |

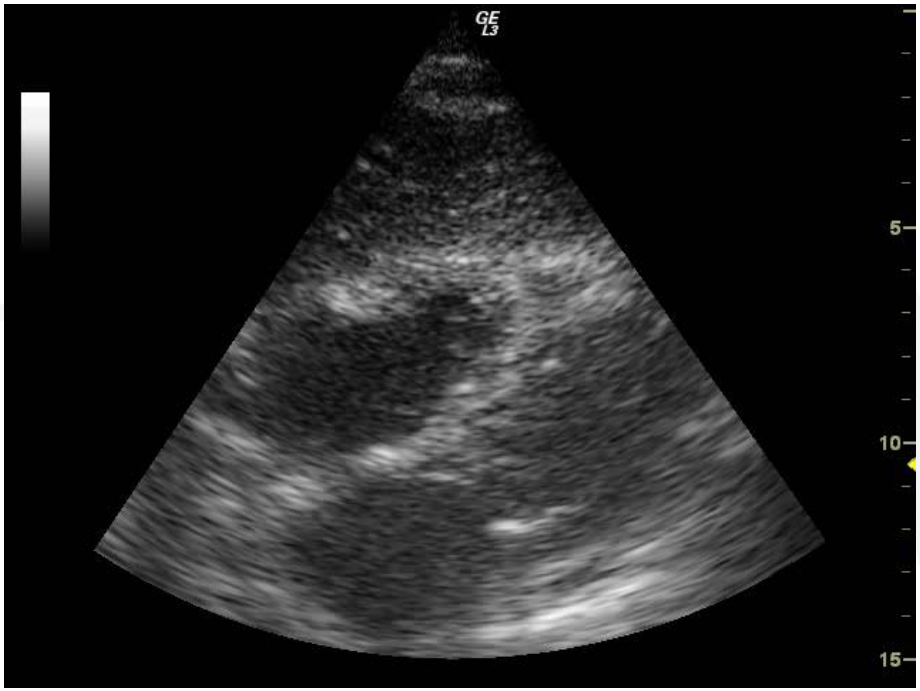
Eberle, et al Checking the carotid pulse check: diagnostic accuracy of first responder in patients with and without a pulse. Resuscitation 1996

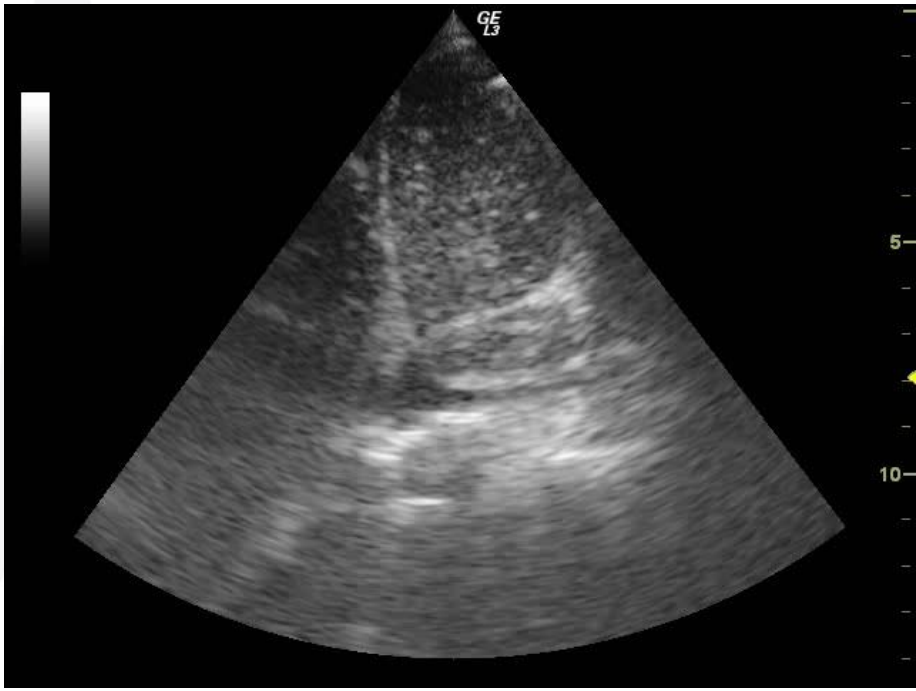
# Identification of reversible causes with A STRUCTURED APPROACH




- ***History***
  - Pre arrest clinical setting
  - Pre arrest symptoms
  - Drugs
  - Toxine
  - Past and present illness
  - Trauma

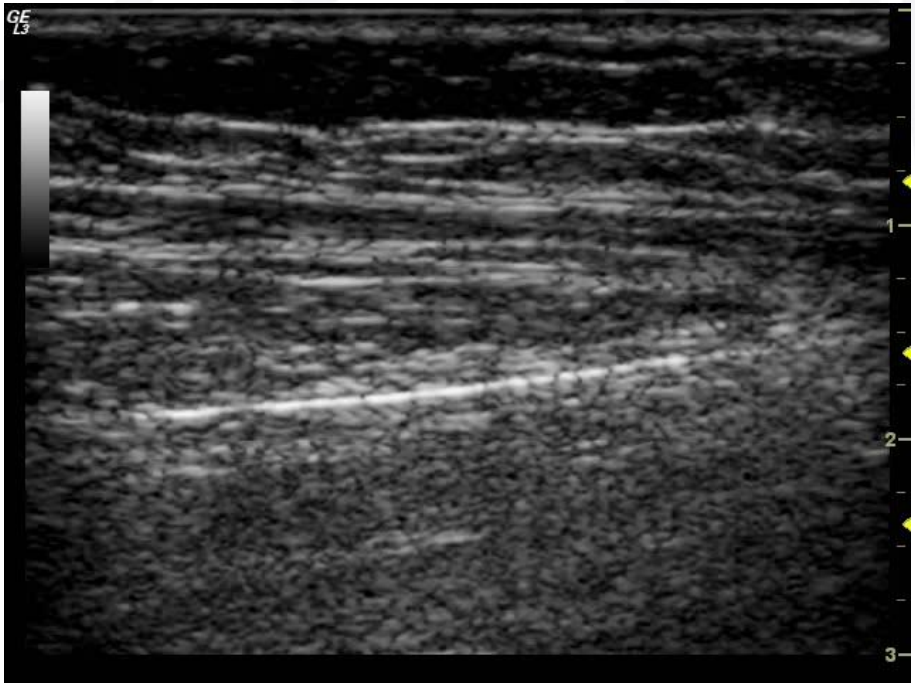
# HYPOVOLEMIA



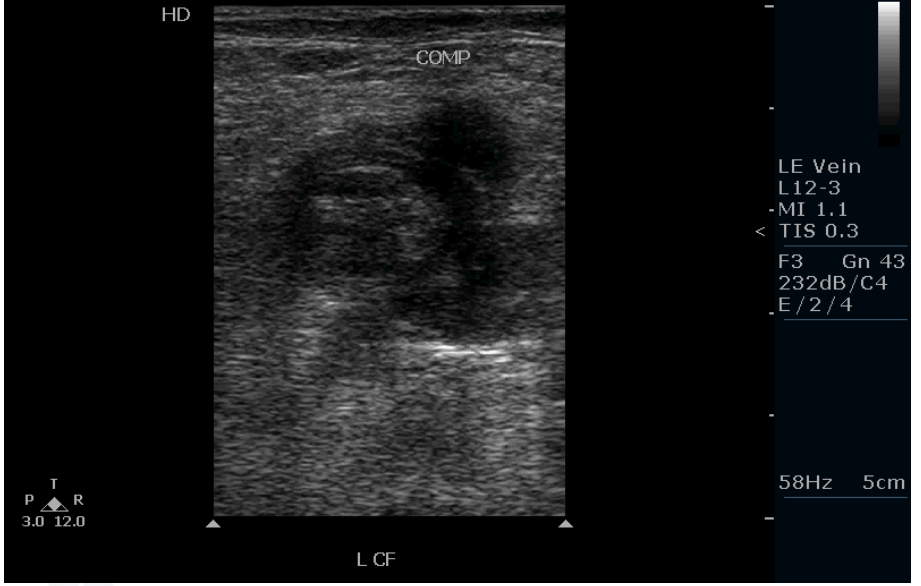



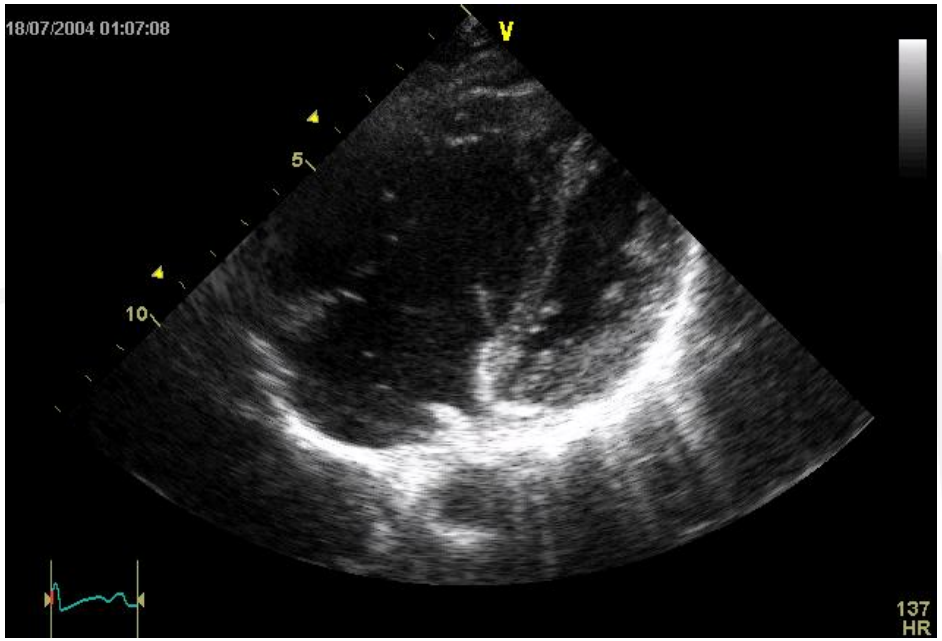
# CARDIAC TAMPONADE

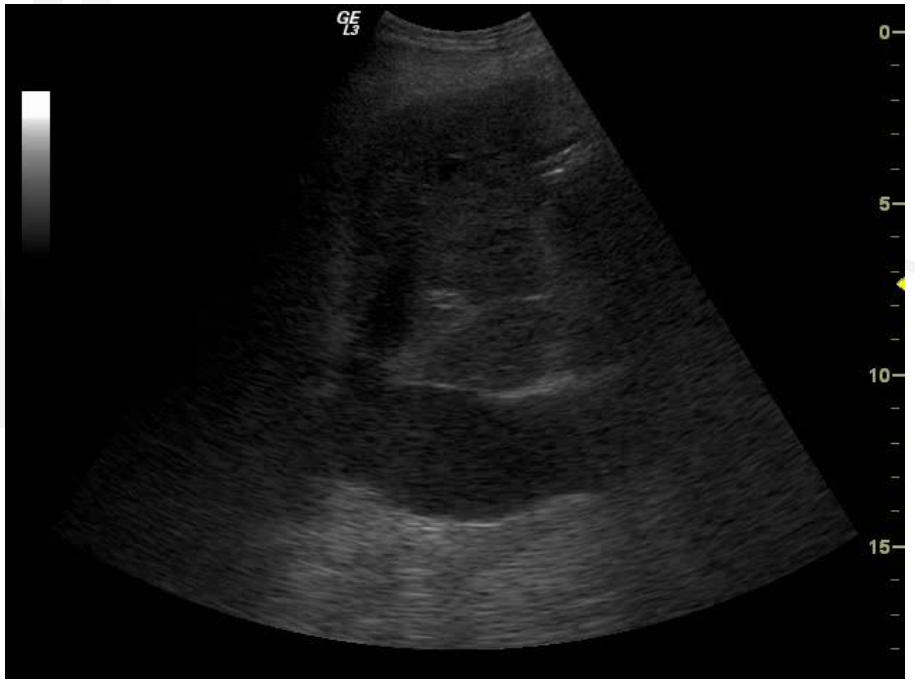
# PNEUMOTHORAX

# PULMONARY EMBOLISM



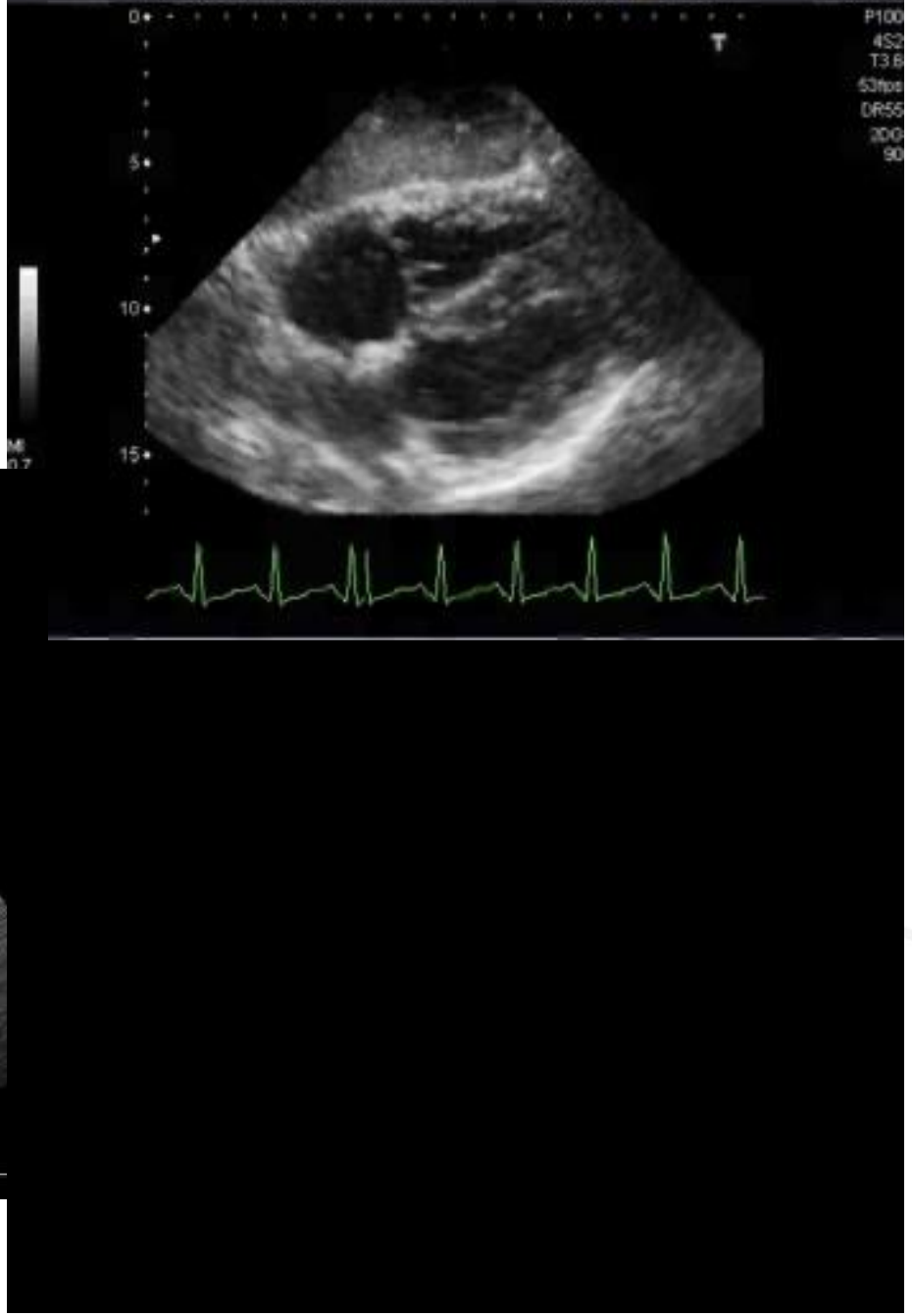



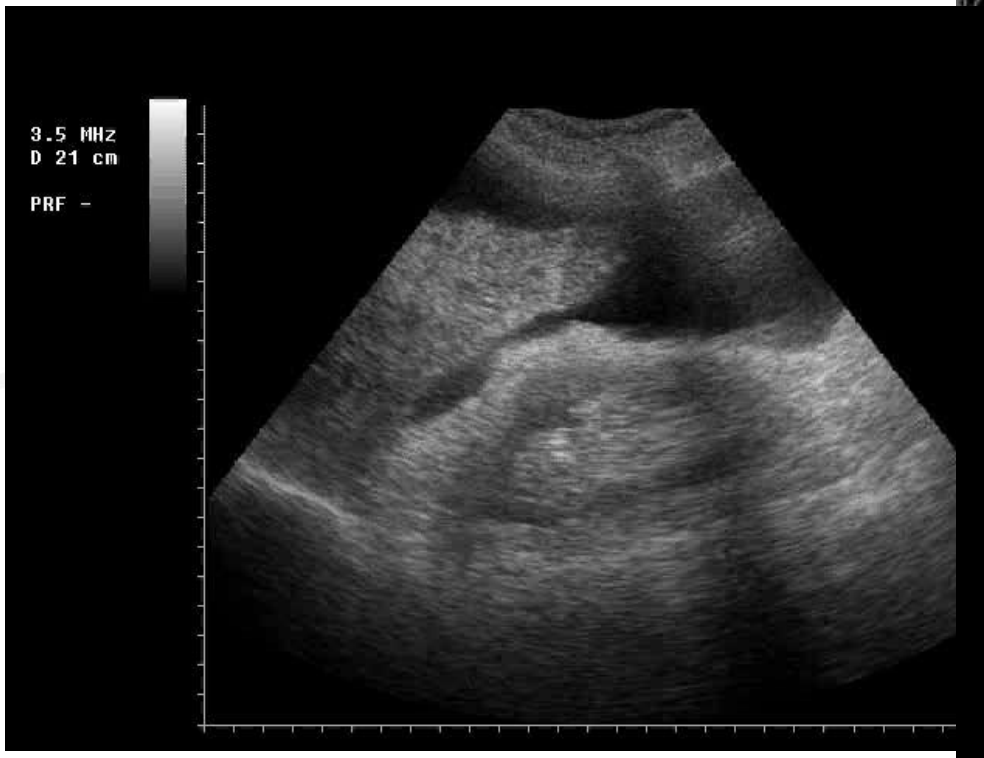



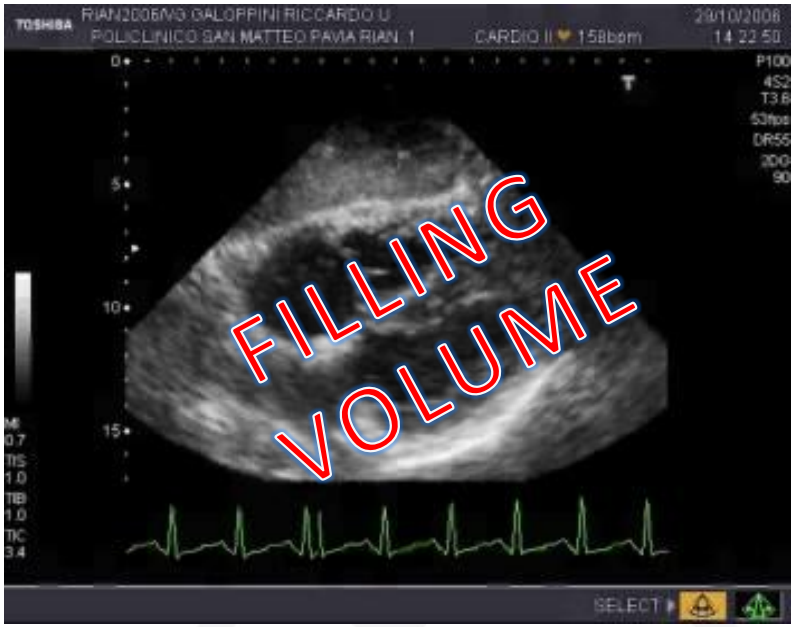
# PULMONARY EDEMA & CARDIOGENIC SHOCK

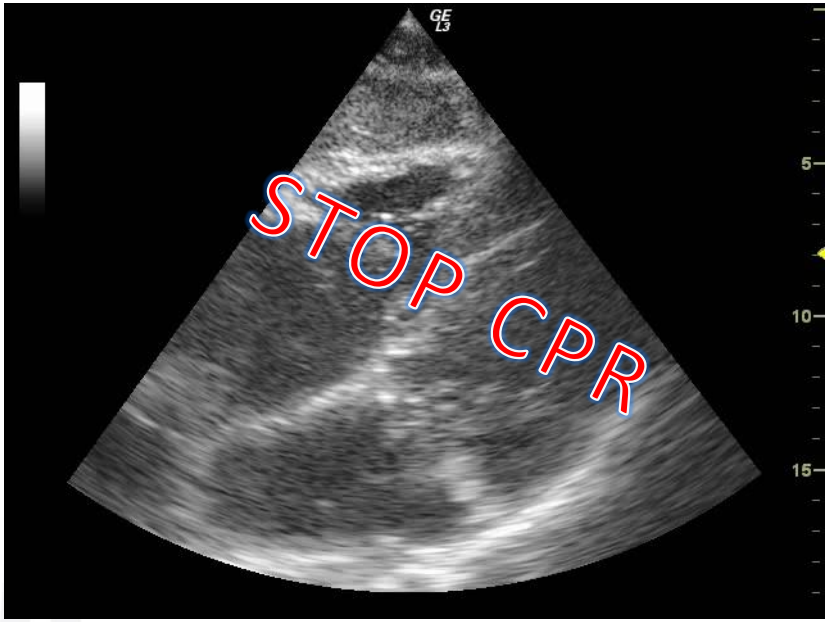
[redacted]

# TRAUMA

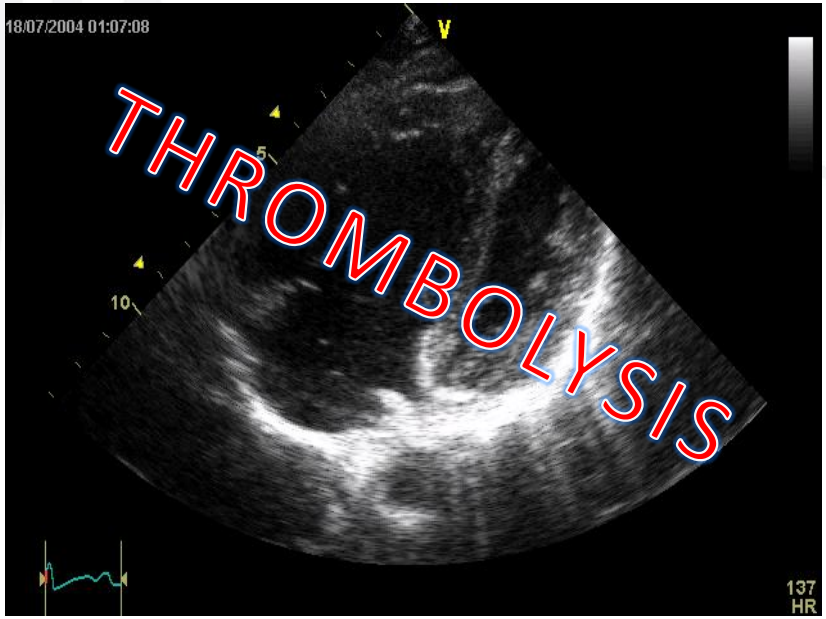


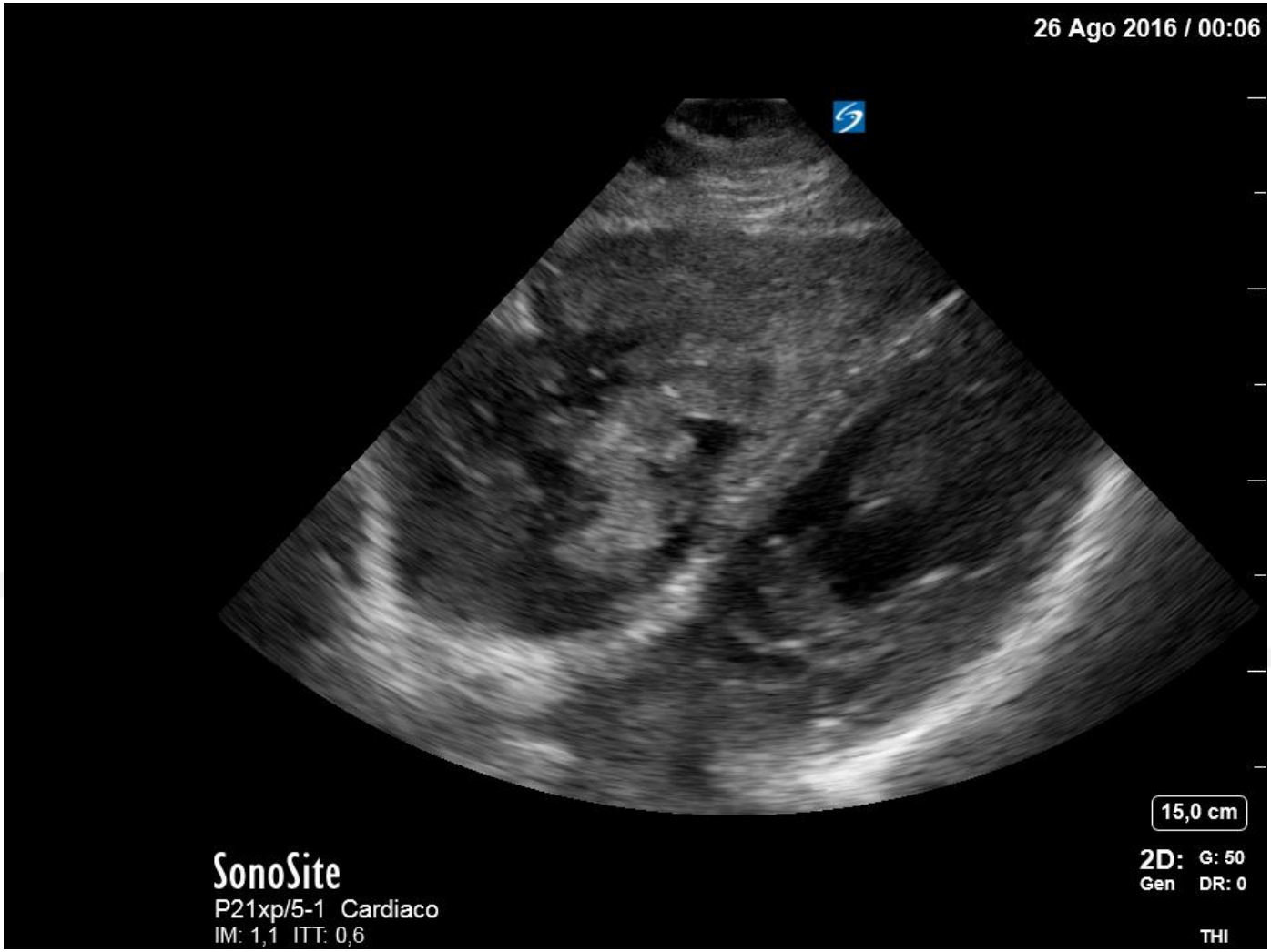

FILLING
VOLUME


STOP CPR


PERICARDIO-
CENTESIS

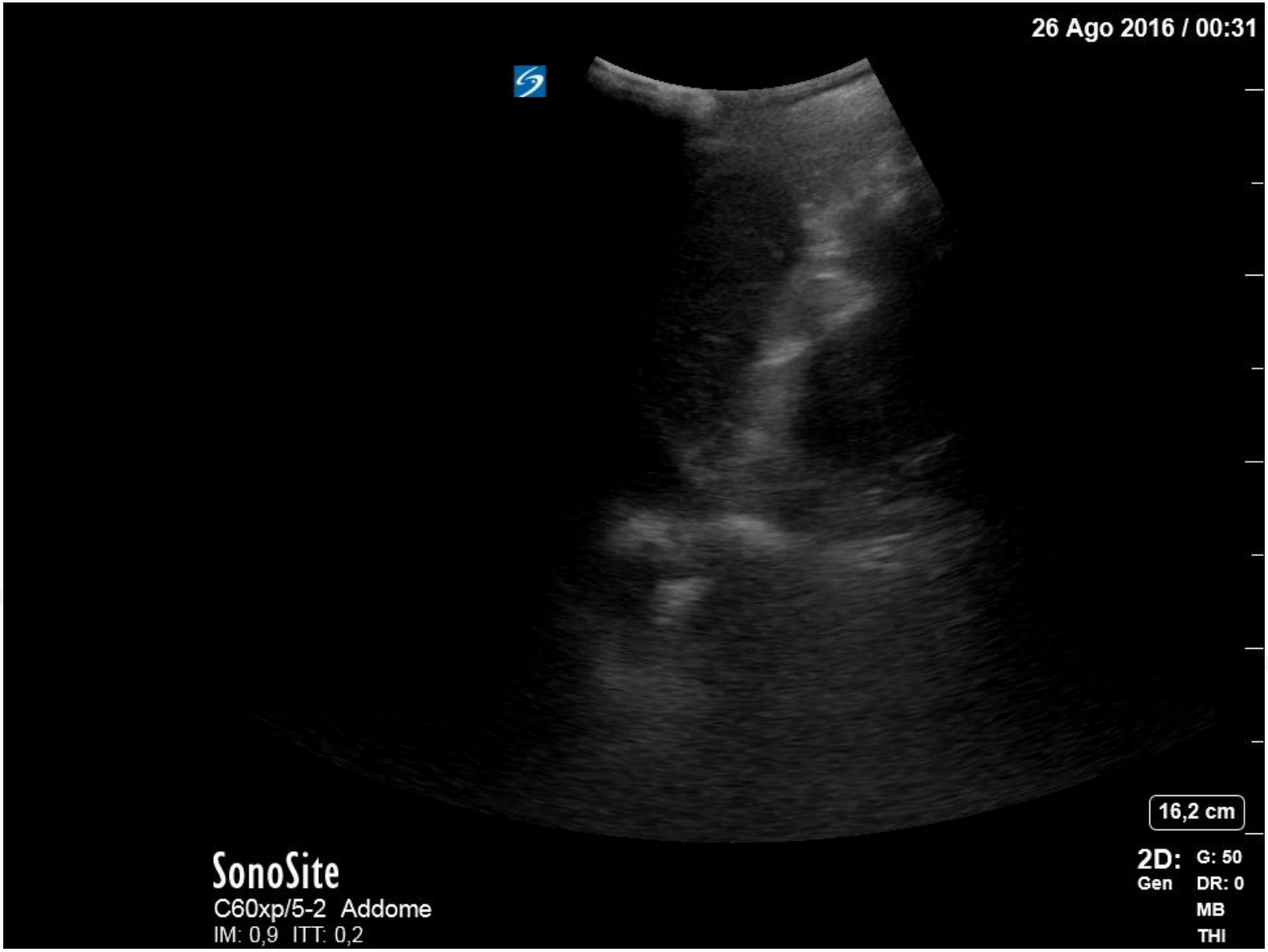

18/07/2004 01:07:08
THROMBOLYSIS

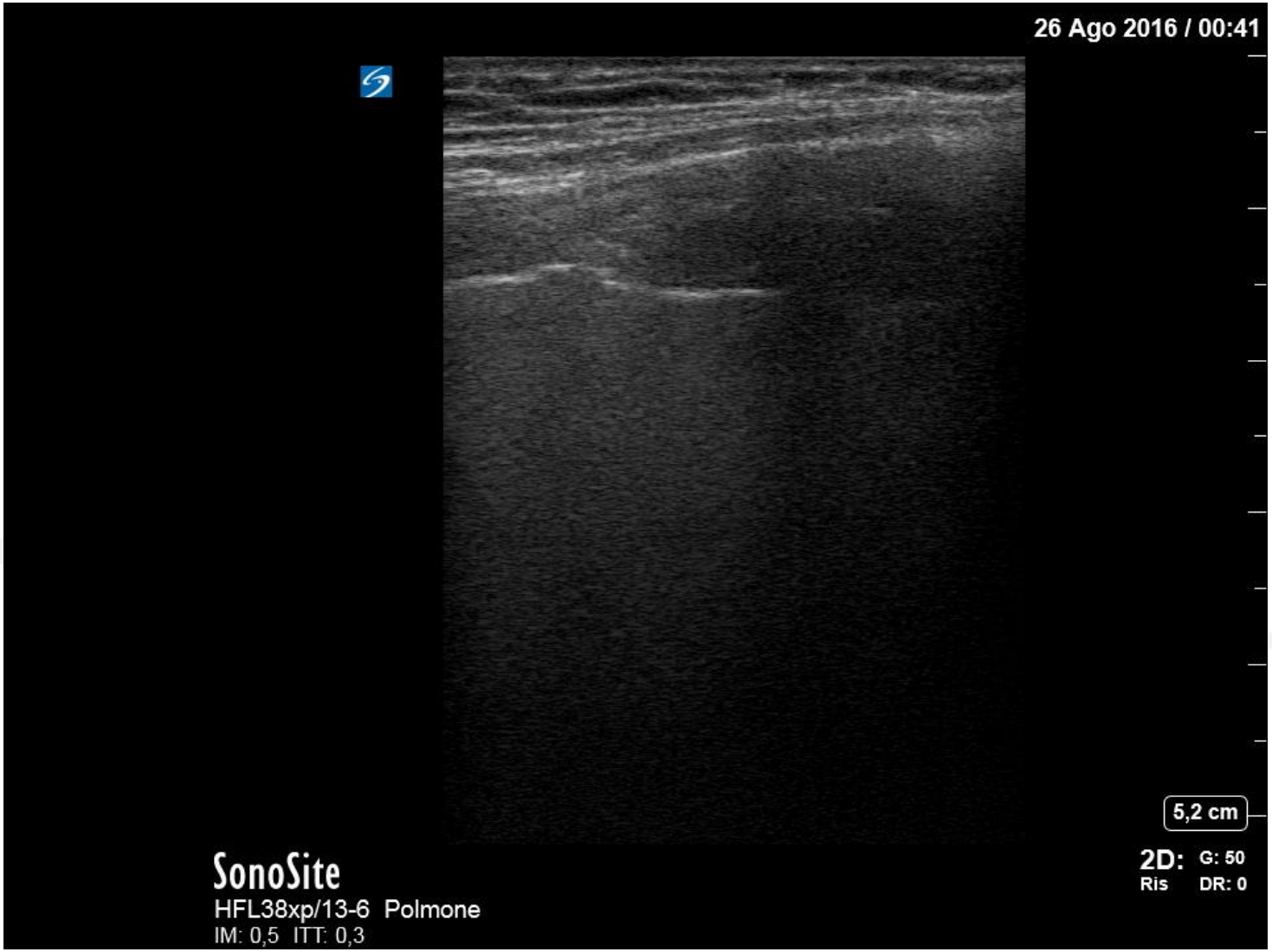
# A clinical case of a short time ago…


26 Ago 2016 / 00:06
15,0 cm
2D: G: 50
Gen DR: 0
THI
SonoSite
P21xp/5-1 Cardiaco
IM: 1,1 ITT: 0,6


26 Ago 2016 / 00:06
15,0 cm
SonoSite
P21xp/5-1 Cardiaco
IM: 1,1 ITT: 0,6
2D: G: 50
Gen DR: 0
THI


26 Ago 2016 / 00:30
16,2 cm
SonoSite
C60xp/5-2 Addome
IM: 0,9 ITT: 0,2
2D: G: 50
Gen DR: 0
MB
THI


26 Ago 2016 / 00:31
16,2 cm
SonoSite
C60xp/5-2 Addome
IM: 0,9 ITT: 0,2
2D: G: 50
Gen DR: 0
MB
THI


26 Ago 2016 / 00:41
5,2 cm
SonoSite
HFL38xp/13-6 Polmone
IM: 0,5 ITT: 0,3
2D: G: 50
Ris DR: 0


26 Ago 2016 / 00:42
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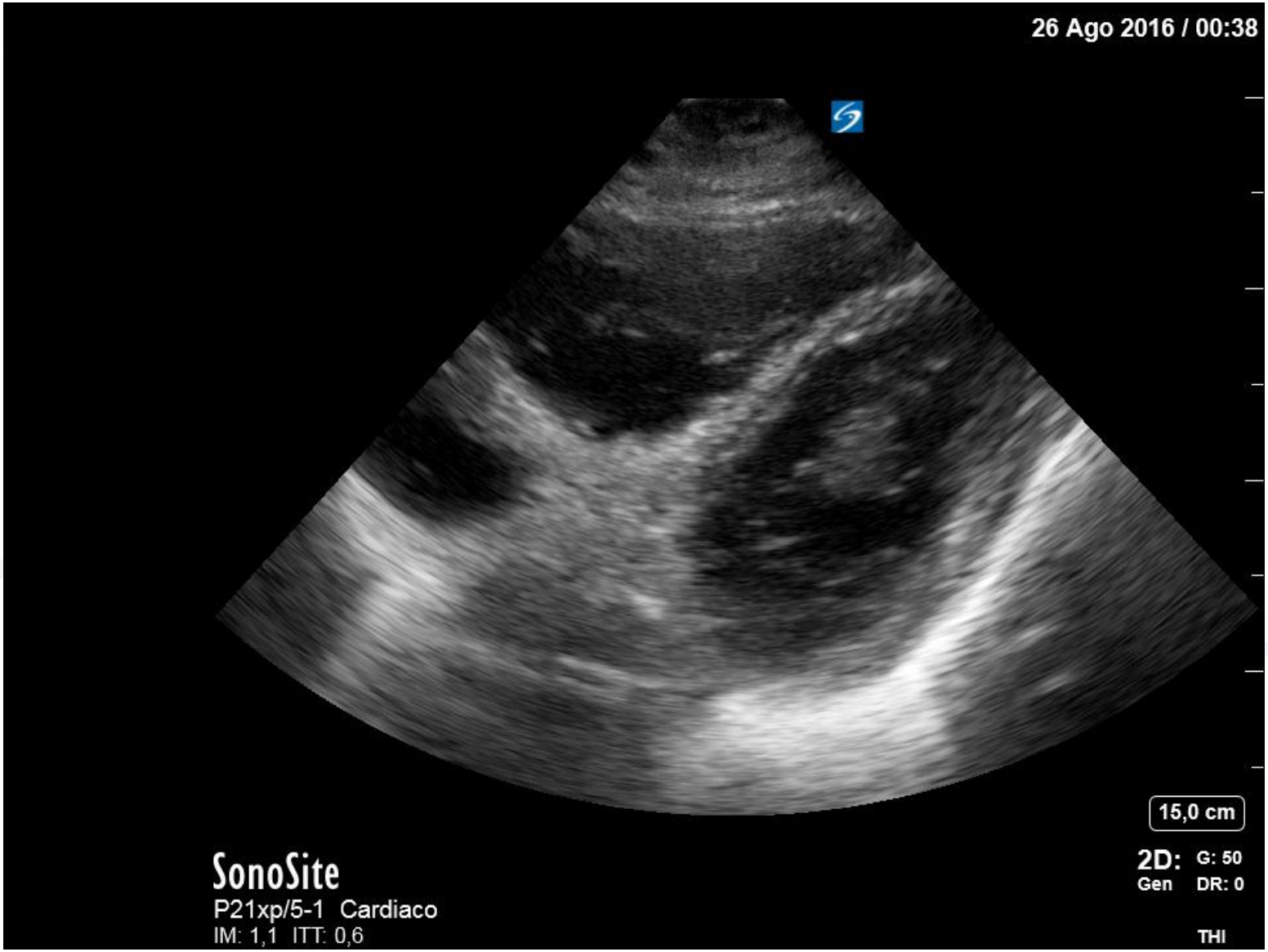
IM: 0,5 ITT: 0,3
2D: G: 50
Ris DR: 0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15,0 cm
2D: G: 50
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THI
SonoSite
P21xp/5-1 Cardiaco
IM: 1,1 ITT: 0,6


26 Ago 2016 / 00:35
15,0 cm
2D: G: 50
Gen DR: 0
THI
SonoSite
P21xp/5-1 Cardiaco
IM: 1,1 ITT: 0,6

# Ultrasound guided chest compressions during cardiopulmonary resuscitation

P Benato, M Zanatta*, V Cianci

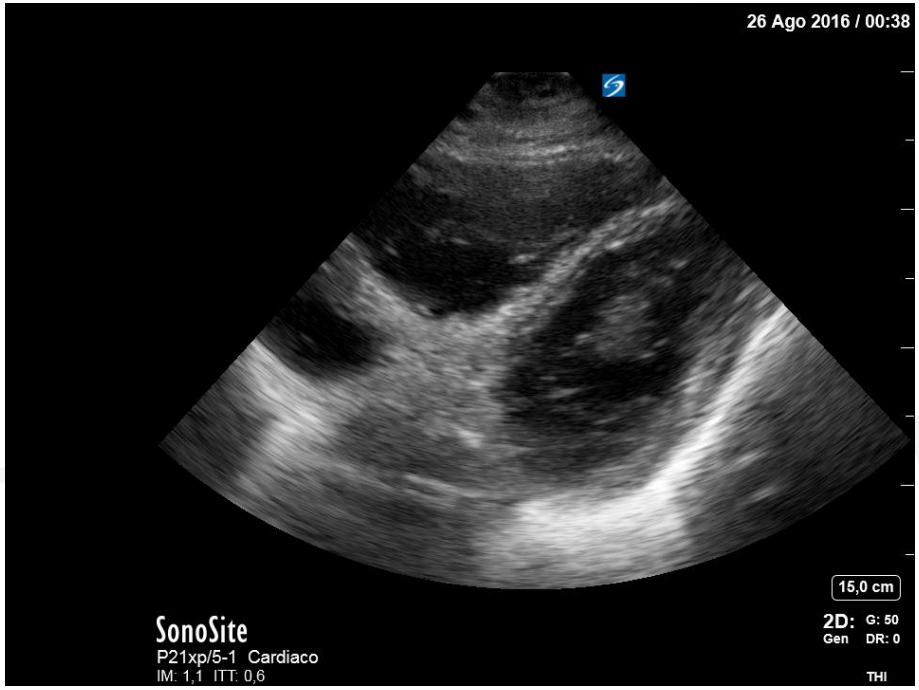
*From* 10th WINFOCUS World Congress on Ultrasound in Emergency and Critical Care Kuala Lumpur, Malaysia. 16-19 November 2014

RESUSCITATION
OFFICIAL JOURNAL OF THE EUROPEAN RESUSCITATION COUNCIL
european resuscitation council

Letter to the Editor

**Ultrasound guided chest compressions during cardiopulmonary resuscitation**

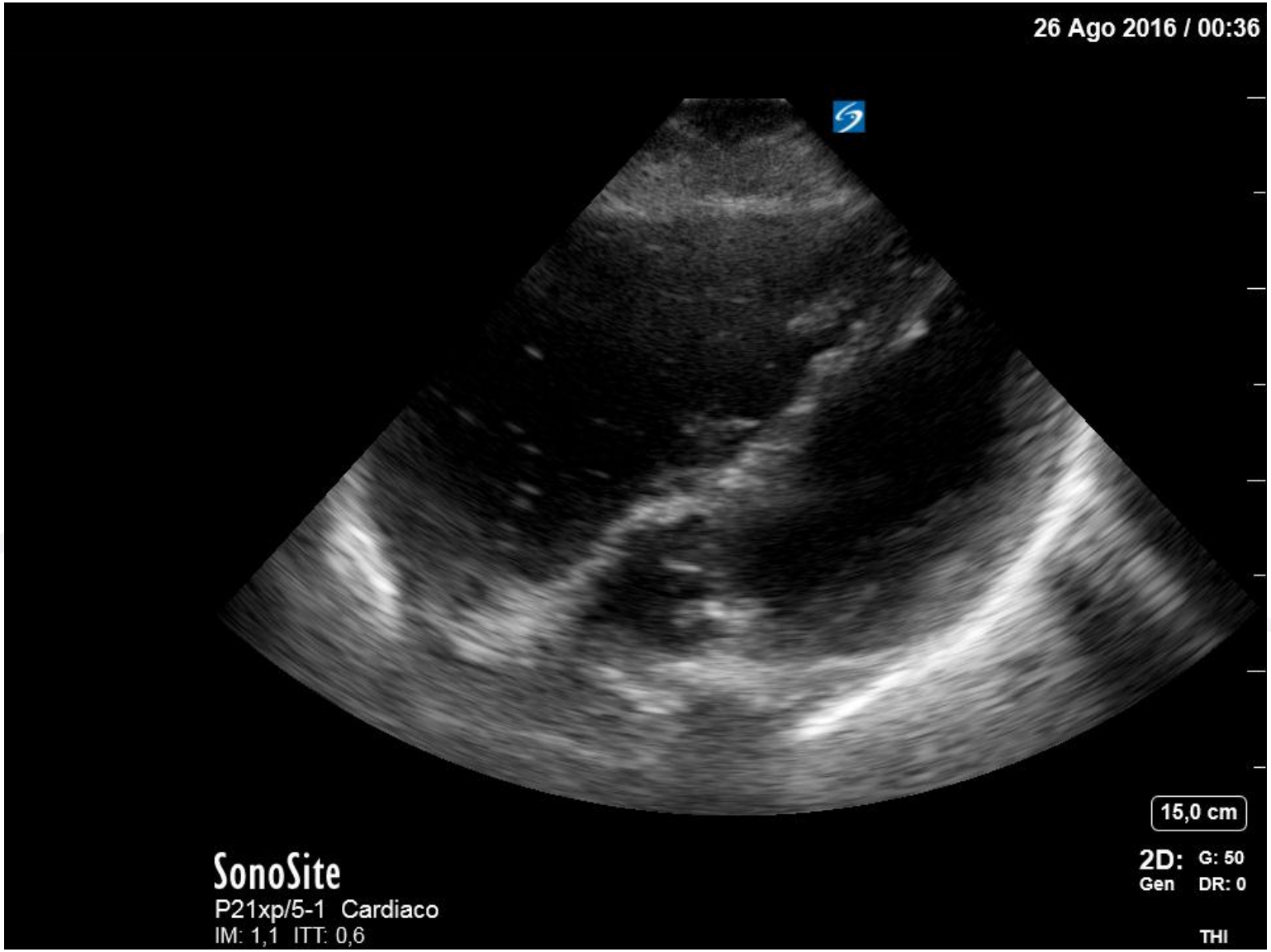
Resuscitation 87 (2015) e13–e14





**BEFORE**

**AFTER CHANGE HANDS POSITION**


26 Ago 2016 / 00:36
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THI
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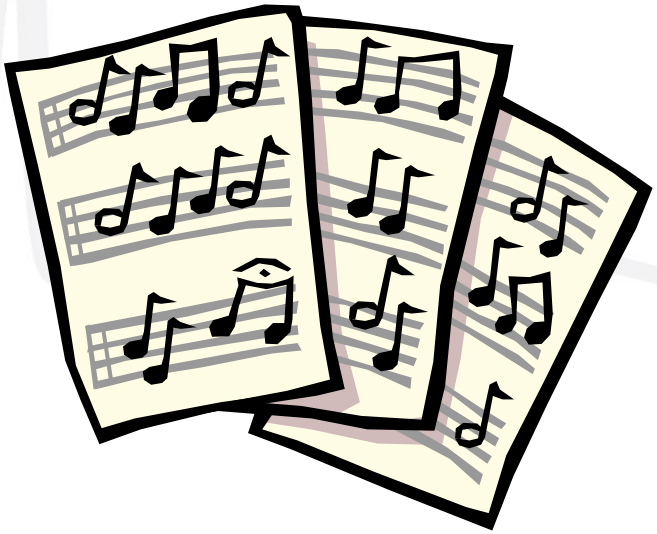
P21xp/5-1 Cardiaco
IM: 1,1 ITT: 0,6


26 Ago 2016 / 00:58
15,0 cm
2D: G: 50
Gen DR: 0
THI
SonoSite
P21xp/5-1 Cardiaco
IM: 1,1 ITT: 0,6

# The big questions…


- ❑ Is there cardiac activity ?
- ❑ Is there a cardiac tamponade?
- ❑ What is the overall profile of the heart kinetic?
- ❑ How is the LV function?
- ❑ Is there a picture suggestive for acute pulmonary heart?
- ❑ What is the profile of IVC?
- ❑ Have the lungs a profile "dry" or "wet"?
- ❑ Is there a PNX?

# The resuscitation team leader



# Ultrasound-enhanced management and level of scientific evidence in cardiac arrest?

**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

**Worksheet author(s)**

| | |
|---|---|
| Amanda Hanson, MD, FRCPC | **Date Submitted for review:** February 3, 2010 |

**Clinical question.**

**ALS-CPR&A-003B "In adult in cardiac arrest (pre-hospital [OHCA], in-hospital [IHCA]) (P), does the use of ultrasound (including trans-thoracic and trans-esophageal echocardiography) during cardiac arrest (I) compared with standard CPR (C), improve any outcomes (eg. ROSC, survival) (O)"**

**Is this question addressing an intervention/therapy, prognosis or diagnosis?** intervention

**State if this is a proposed new topic or revision of existing worksheet:** new topic

**Search strategy (including electronic databases searched).**

- EMBASE -- "Ultrasound" OR "Echocardiography" AND "Cardiac Resuscitation" OR "ACLS" OR "CPR" OR "Cardiac Arrest"
- Pubmed – "Echocardiography"(Mesh) OR "Echocardiography, Trans-esophageal" (Mesh) OR "Ultrasonography" (Mesh) AND "Cardiopulmonary Resuscitation" (Mesh) OR "Advanced Cardiac Life Support" (Mesh) OR "Death, Sudden, Cardiac" (Mesh). Also searched for "Related Articles" to each article that appeared relevant.
- Cochrane -- "Echocardiography"(Mesh) OR "Echocardiography, Trans-esophageal" (Mesh) OR "Ultrasonography" (Mesh) AND "Cardiopulmonary Resuscitation" (Mesh) OR "Advanced Cardiac Life Support" (Mesh) OR "Death, Sudden, Cardiac" (Mesh).
- Hand search of references of all relevant articles
- Last search: September 2009 yielded 47 papers

- **State inclusion and exclusion criteria**

Exclusion criteria – not relevant studies, animal studies, reviews, case reports, letters

Inclusion criteria – We searched for all peer-reviewed studies that described the use of ultrasound in cardiac arrest.

**REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:**

Ultrasound has been utilized for diagnostic and procedural guidance at the bedside of the critically ill patient for nearly 3 decades. Unfortunately, few studies have looked at its specific role in guiding the resuscitation of the patient in cardiac arrest. Instead, the research focuses on three primary areas:

1. The use of ultrasound to diagnose treatable causes of cardiac arrest and the prevalence of these conditions (eg. pneumothorax, pericardial effusion, volume depletion, pulmonary embolus). The bulk of studies, however, look at patients who are not in cardiac arrest.
2. The use of ultrasound to guide procedures which maybe performed in the patient in cardiac arrest (eg. central line placement, pericardiocentesis, transvenous pacer placement). Again, the vast majority of studies looking at the use of ultrasound for procedural guidance are done in patients who are not in cardiac arrest.
3. Ultrasound determination of cardiac standstill as an indication to terminate resuscitative efforts. Although these studies are performed in patients in cardiac arrest, the benefits of ultrasound are largely related to decreased resource use and emergency department patient flow, NOT improved patient outcomes.

Although there is great potential for the use of ultrasound to benefit the patient in cardiac arrest, there are no studies confirming improved outcomes at this time. Future research questions might include: Does ultrasound detection of

# Focused echocardiographic evaluation in life support and peri-resuscitation of emergency patients: A prospective trial

R. Breitkreutz, S. Price, H.V. Steiger, F.H. Seeger, H. Ilper, H. Ackermann, M. Rudolph, S. Uddin, M.A. Weigand, E. Müller and F. Walcher Resuscitation, 2010, Vol. 81, 1527-33

230 patients

| Pre-FEEL diagnosis | Post-FEEL diagnosis | Survived to admission | Died on scene |
|---|---|---|---|
| Suspected PEA ( *n* = 51) | – | 22 (43%) | 29 (57%) |
| | Pseudo-PEA ( *n* = 38) (wall motion present) | 21/38 (55%) | 17/38 (45%) |
| | True-PEA ( *n* = 13) (no wall motion present) | 1/13 (8%) | 12/13 (92%) |
| Suspected asystole ( *n* = 37) | – | 13/37 (35%) | 24/37 (65%) |
| | Wall motion present ( *n* = 13) | 9/37 (24%) | 4/37 (11%) |
| | No wall motion present ( *n* = 24) | 4/37 (11%) | 20/37 (54%) |
| Pooled suspected PEA and asystole ( *n* = 88) | – | 35/88 (40%) | 53/88 (60%) |
| | Wall motion present | 30 (34%) | 21 (24%) |
| | No wall motion present | 5 (6%) | 32 (36%) |


WINFOCUS

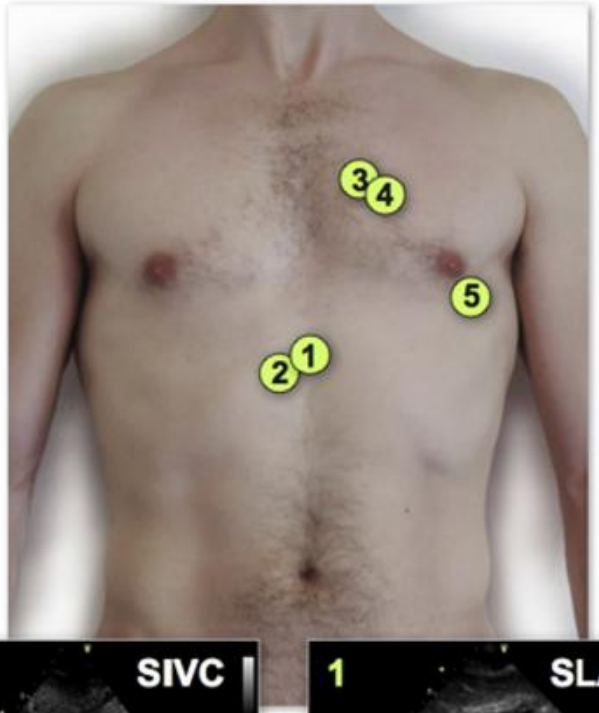
World Interactive Network Focused on Critical UltraSound

# International Evidence-Based Recommendations for Focused Cardiac Ultrasound

Gabriele Via, MD, Arif Hussain, MD, Mike Wells, MD, BSc, BSc Hons, MBBCh, FCEM, Dip PEC, Robert Reardon, MD, Mahmoud ElBarbary, MD, Vicki E. Noble, MD, James W. Tsung, MD, MPH, Aleksandar N. Neskovic, MD, PhD, FESC, FACC, Susanna Price, MD, MBBS, BSc, MRCP, EDICM, PhD, FFICM, FESC, Achikam Oren-Grinberg, MD, MS, Andrew Liteplo, MD, RDMS, Ricardo Cordioli, MD, Nitha Naqvi, MD, MSc, MRCPCH, Philippe Rola, MD, Jan Poelaert, MD, PhD, Tatjana Golob Gulič, MD, Erik Sloth, MD, PhD, DMSc, Arthur Labovitz, MD, FACC, Bruce Kimura, MD, FACC, Raoul Breitkreutz, MD, Navroz Masani, MBBS, FRCP, Justin Bowra, FACEM, CCPU, Daniel Talmor, MD, MPH, Fabio Guarracino, MD, Adrian Goudie, BMedSci(Hons), MBBS, FACEM DDU, Wang Xiaoting, MD, Rajesh Chawla, MD, FCCM, Maurizio Galderisi, MD, Micheal Blaivas, MD, FACEP, FAIUM, Tomislav Petrovic, MD, Enrico Storti, MD, Luca Neri, MD, and Lawrence Melniker, MD, MS, International Liaison Committee on Focused Cardiac UltraSound (ILC-FoCUS) for the International Conference on Focused Cardiac UltraSound (IC-FoCUS)

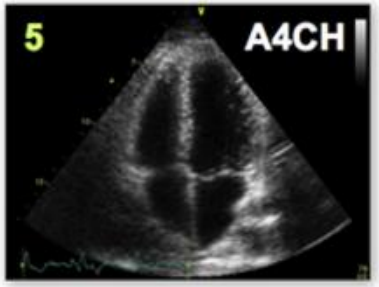
**2014**

# FoCUS








*For patients in cardiac arrest, the subcostal view may be attempted first. If not sufficient to image the heart, the apical four-chamber view or parasternal long-axis view may be attempted next, as long as conforming to ALS protocol. It is recommended that FoCUS examination images and videos be stored.*

34. *In the setting of cardiac arrest, FoCUS is more accurate than electrocardiography for determining mechanical cardiac function.*

[1A: Strong Recommendation, with Very Good Agreement; Level A Evidence]

35. *In the setting of cardiac arrest, FoCUS changes management.*

[1A: Strong Recommendation, with Very Good Agreement; Level A Evidence]

38. *In the setting of cardiac arrest, FoCUS is more accurate than the physical examination for diagnosing the cause of cardiac arrest.*

[1B: Strong Recommendation, with Good Agreement; Level B Evidence]

39. *In the setting of cardiac arrest, FoCUS is more accurate than the physical examination for assessing cardiac function.*

[1A: Strong Recommendation, with Very Good Agreement; Level A Evidence]

*37. In the setting of cardiac arrest, FoCUS improves outcome.*

[NO Recommendation, NO Agreement; Level C Evidence]

# Ultrasound During Cardiac Arrest

| 2015 Recommendations—Updated | Class |
| --- | --- |
| Ultrasound (cardiac or noncardiac) may be considered during the management of cardiac arrest, although its usefulness has not been well established | Class IIb, LOE C-EO |

# Ultrasound During Cardiac Arrest

| 2015 Recommendations—Updated | Class |
| --- | --- |
| If a qualified sonographer is present and use of ultrasound does not interfere with the standard cardiac arrest treatment protocol, then ultrasound may be considered as an adjunct to standard patient evaluation | IIb, LOE C-EO |

American Heart Association. American Stroke Association.

International Liaison Committee on Resuscitation ILCOR

# CONCLUSIONS

1. US is helpful in identification or exclusion of some reversible causes of cardiac arrest & shock (hypovolemia, cardiac tamponade, pneumothorax , pulmonary embolism, …)
2. US should be integrated in ALS algorithm
3. Potential US role in diagnosis / prognosis of cardiac arrest but not enough scientific evidences on outcome

# CARDIAC ARREST & CRITICAL ULTRASOUND

## Future perspectives

- Simulation, training, skylls, team work
- Multicenter US-applied research projects
- CPR-US consensus conference


YES, BECAUSE TO LOOK
IS BETTER!

X congresso nazionale

# simeu

NAPOLI 18-20 NOVEMBRE 2016

SOCIETÀ ITALIANA MEDICINA D'EMERGENZA-URGENZA · SIMEU ·

## Il volto della Medicina di Emergenza-Urgenza:

identità professionale e servizio pubblico.

# THANK YOU.
# Vito Cianci

## SPECIAL THANKS TO ALL MY FANTASTIC TEAM!

x congresso nazionale
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