# Farmaci Inotropi e Volumi in Terapia Intensiva

XVII Congresso Nazionale SIEC, Napoli, 16-18 aprile 2015

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# Contesto= Terapia Intensiva

Paziente

- ipoteso
- instabile
- ipoperfuso
- …

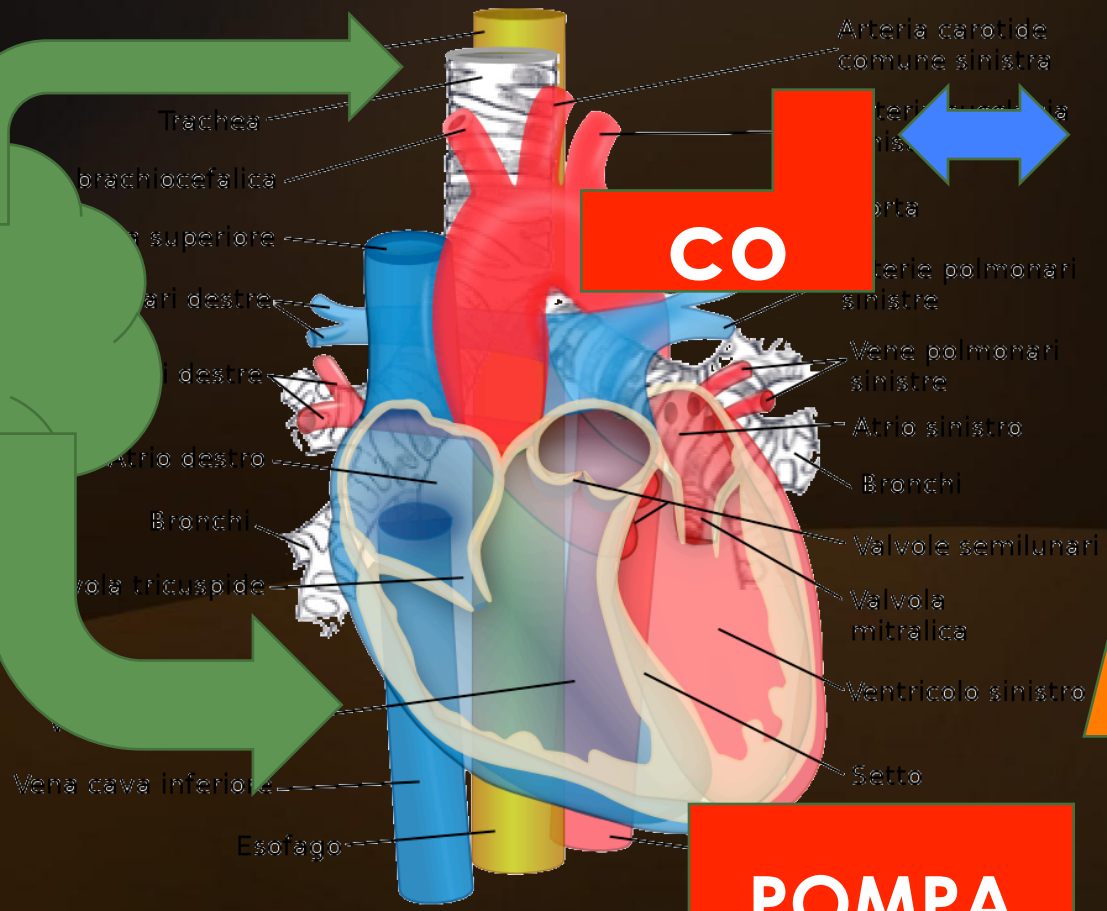
# Dov’è il problema???

# Dov'è il problema?

VOLEMIA

RITORNO VENOSO

CAPACITANZA VENOSA




CO

TONO VASCOLARE (POST-CARICO)

PERFUSIONE TESSUTALE

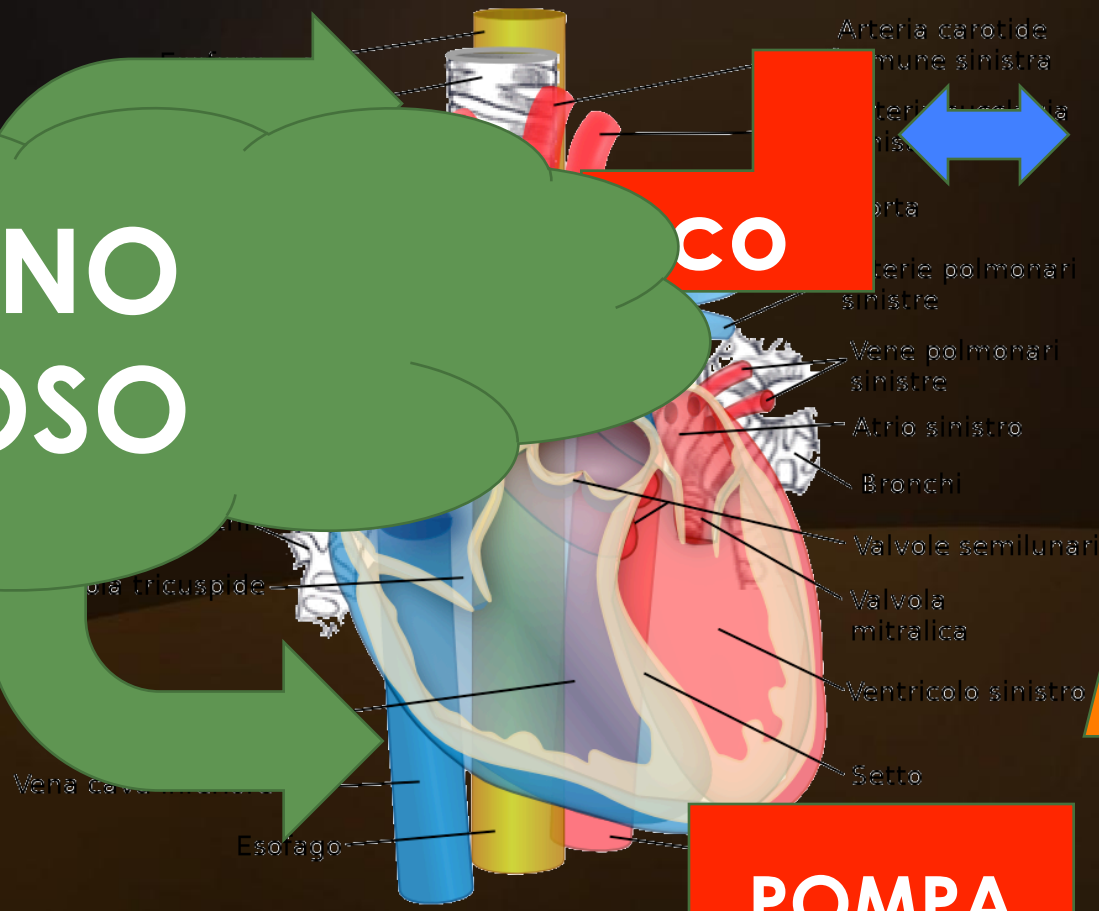
POMPA

# Dov'è il problema?

**VOLEMIA**

**RITORNO VENOSO**

CAPACITANZA VENOSA




TONO VASCOLARE (POST-CARICO)

**PERFUSIONE TESSUTALE**

**POMPA**

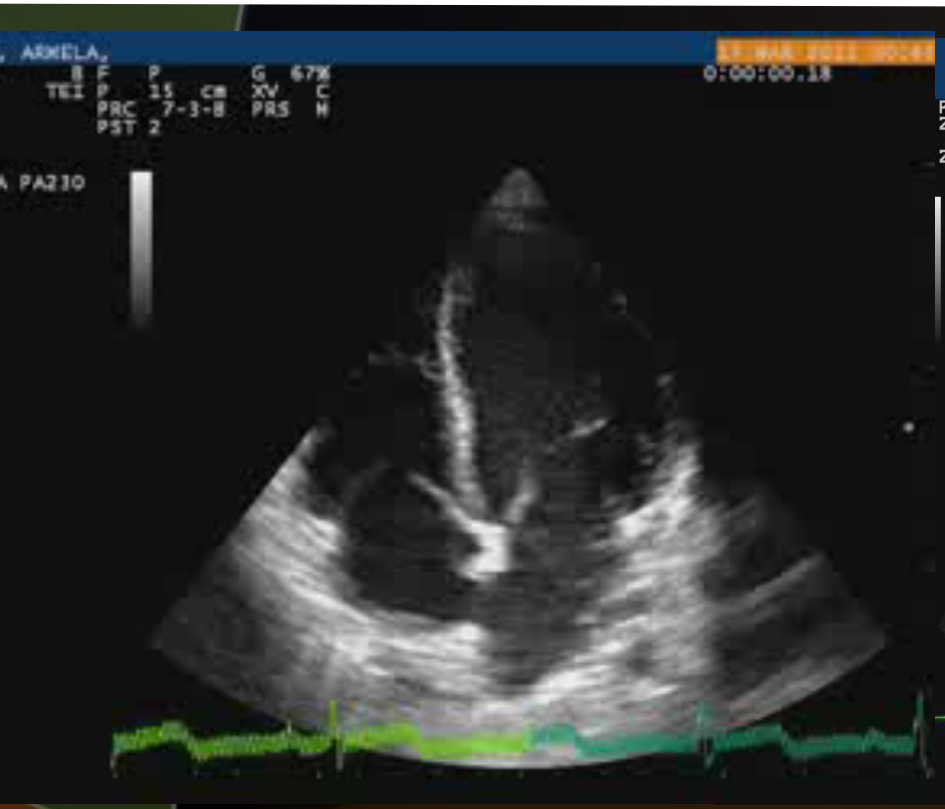
# Questi

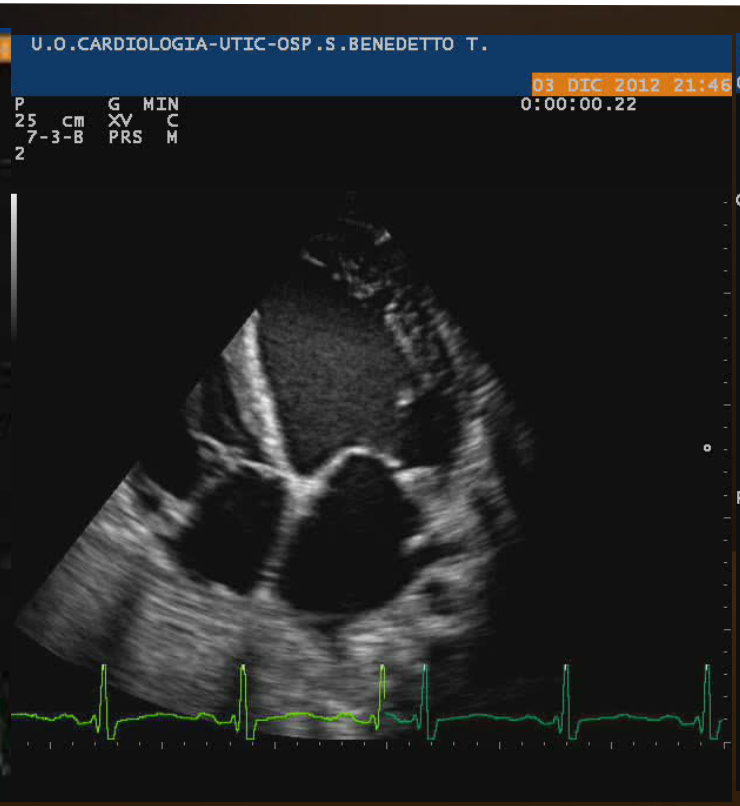
- What is the le cular function?
- What is the flu
- Is there any evi cardial effusion and card onade?

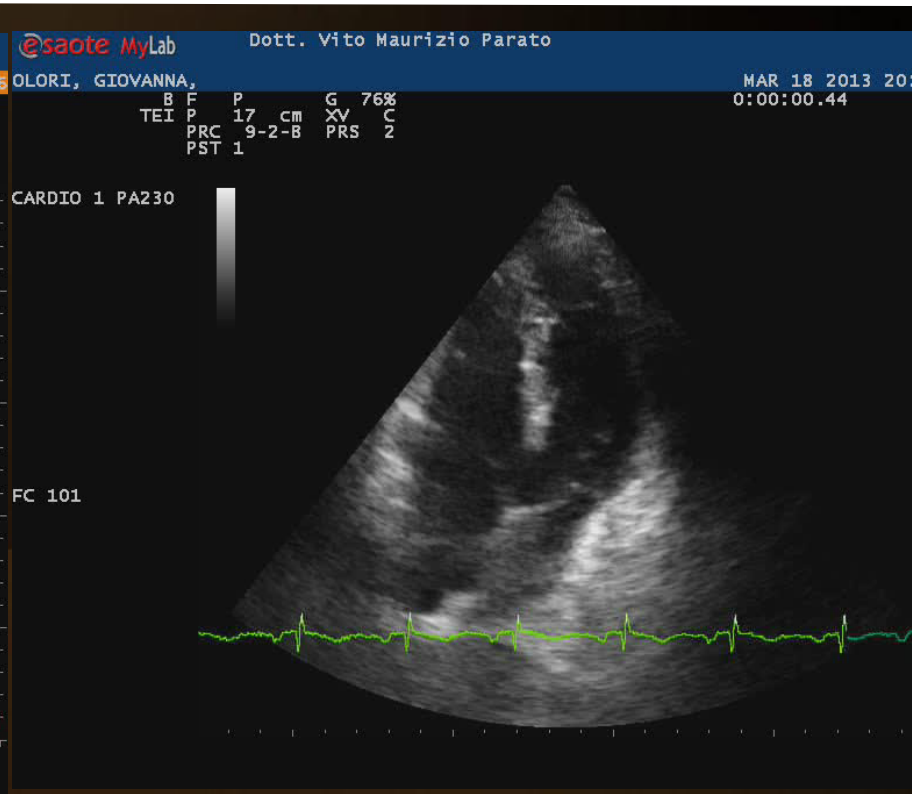
# Questions:

- **What is the left and right ventricular function?**
- What is the fluid status?
- Is there any evidence of pericardial effusion and cardiac tamponade?

# LV / RV function?






Normal

LV dysfunction

RV dysfunction

# Paradigma del Cardiologo

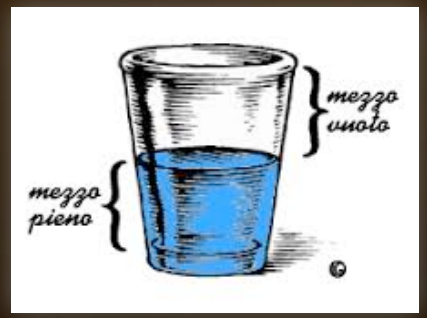
- Ipotensione/instabilità+ disfunzione sistolica (±severa)= **INOTROPI** (±diuretici)
- Volumi?????

# Questions:

- What is the left and right ventricular function?
- **What is the fluid status?**
- Is there any evidence of pericardial effusion and cardiac tamponade?

# COM'è IL PAZIENTE?

- PIENO?
- VUOTO?
- ½ PIENO? – ½ VUOTO?


**VOLUMI**

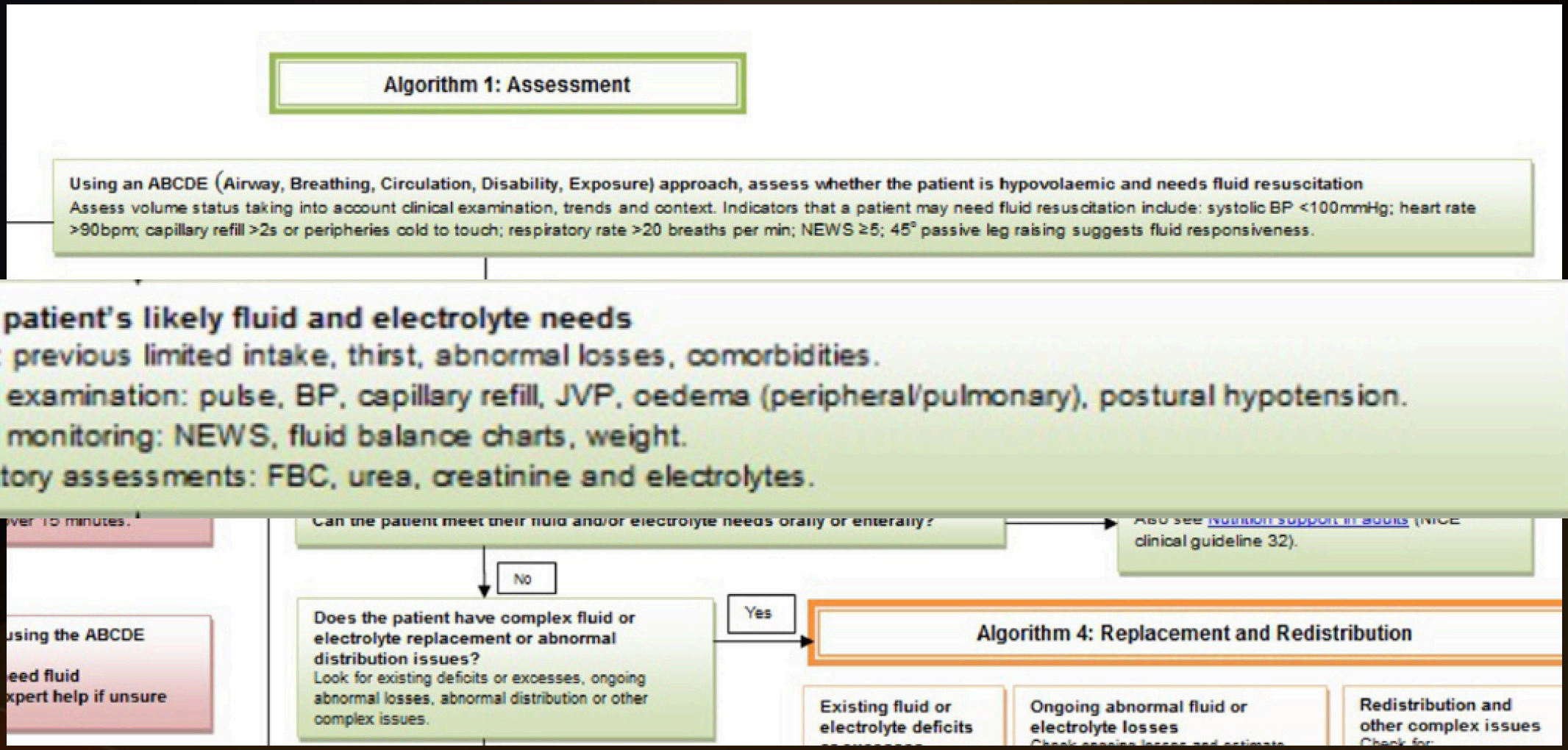
Il paziente che afferisce al cardiologo= NON è SEMPRE PIENO!!!!

# Does patient require fluid administration?

# Volumi

V.M. Parato, MD

# Intensivist GLs (NICE,2013)



# Does patient require fluid administration?

# Static Evaluation

**Signs of dehydration**

- Diminished skin turgor
- Thirst
- Dry mouth / dry axillae
- Hypernatremia, hyperproteinemia, elevated Hb hematocrit

**Circulatory signs of hypovolemia**

- Tachycardia
- Arterial hypotension
- Increased serum lactate

**Decreased renal perfusion**

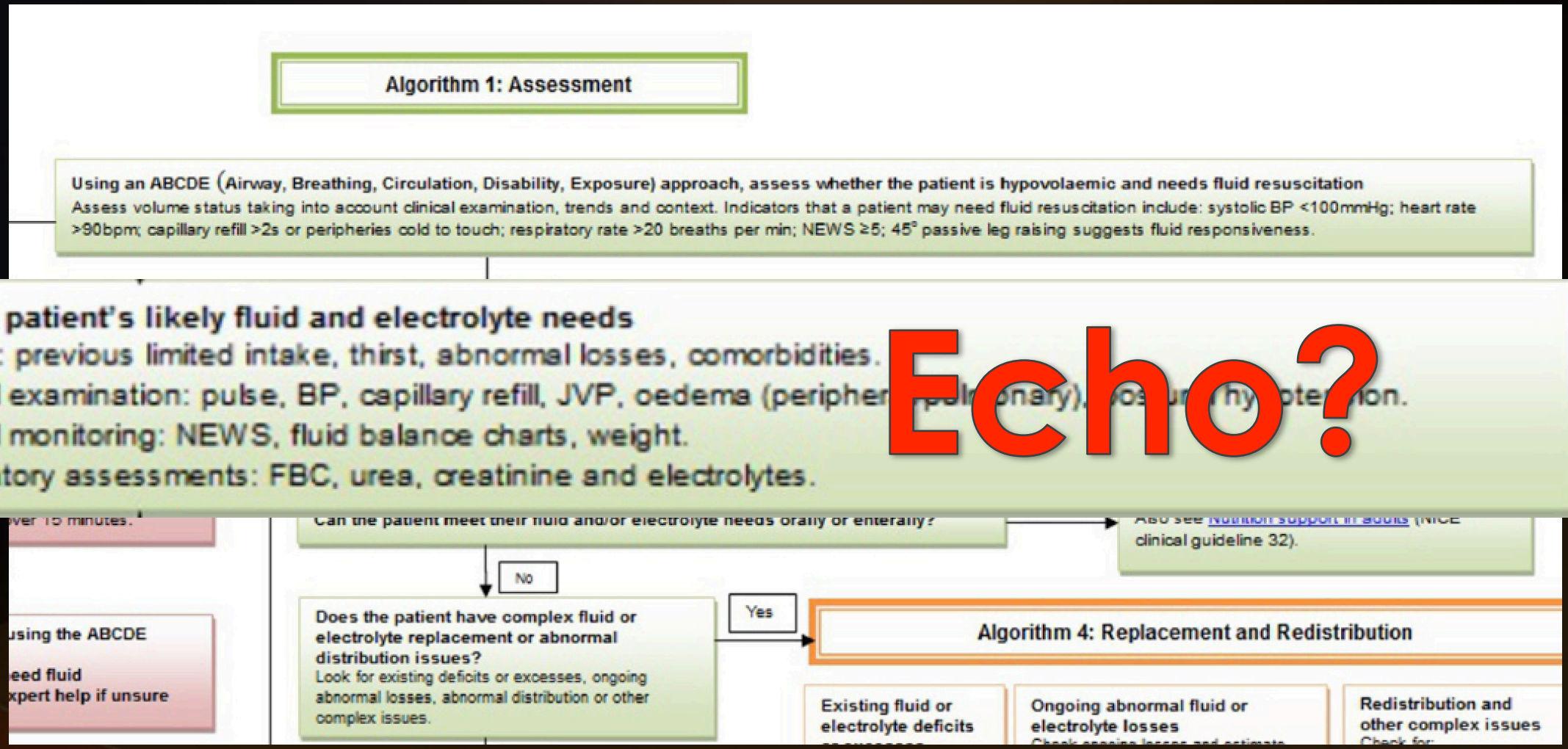
- Concentrated urine
- Metabolic alcalosys
- Increased blood urea nitrogen relative to creatinine concentration

## Does patient require fluid administration?

# Dynamic Evaluation

- Ortostatic hypotension
- Respiratory variations in arterial pressure or SV (mechanical ventilation)
- Passive leg raising→ response on BP
- Fluid challenge → response on BP

# Intensivist GL (NICE,2103)



The problem is

# How to perform an echo-evaluation of Fluid Responsiveness

# ACCF/ASE/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR – 2011 Appropriate Use Criteria for Echocardiography

## TTE in the Acute Setting

| Hypotension or Hemodynamic Instability | |
|---|---|
| **Hypotension or Hemodynamic Instability or uncertain or suspected cardiac etiology** | A (9) |

# Definition of Fluid Responsiveness

- The standard definition of volume responsiveness is a **>**15% increase in **cardiac output** in response to volume expansion..

Levitov A, Cardiology Research and Practice, 2012
Volume 2012

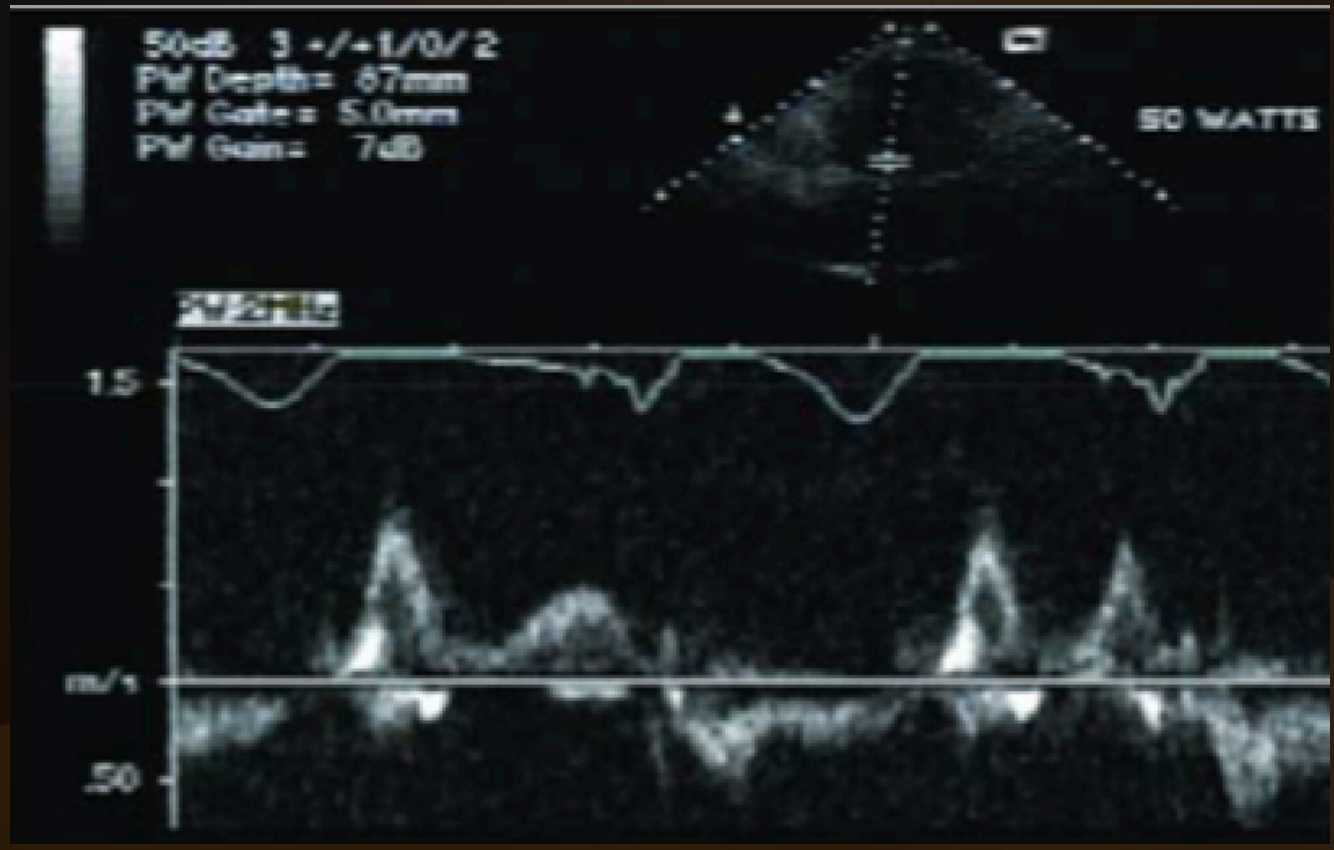
# Bedside Echocardiogram


- Static parameters
- Dynamic parameters

# Kissing Ventricles?

# Fluid responsiveness?

# Poor Diastolic Function




**Fluid responsiveness?**

Intensive Care Med (1998) 24: 147–151


ORIGINAL

J. Boldt
M. Lenz
B. Kumle
M. Papsdorf

# Volume replacement strategies on intensive care units: results from a postal survey

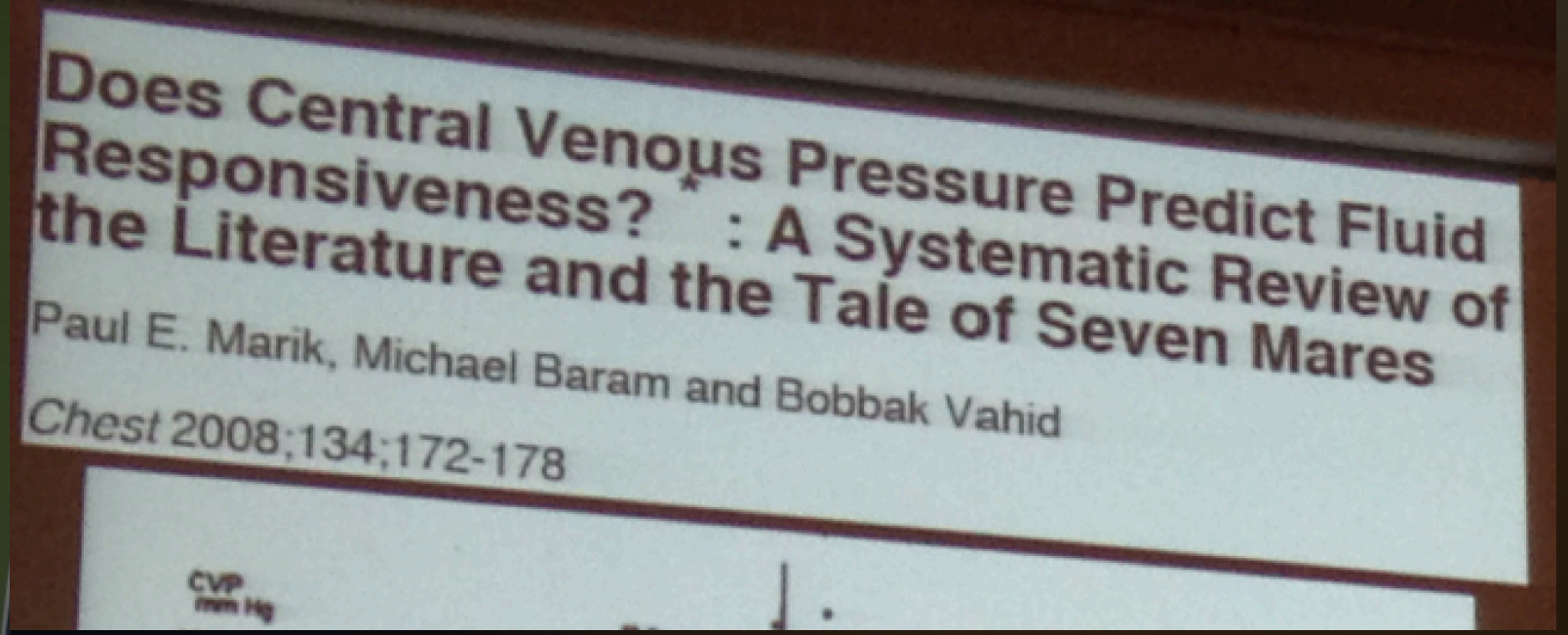

**Sondaggio effettuato tra 451 intensivisti:**
**il 93% utilizzava i valori di PVC come guida alla somministrazione di liquidi.**

1998

**Table 4** What are your indicators for volume replacement (diagnostic tools)? (*CVP* central venous pressure, *PCWP* pulmonary capillary wedge pressure, *COP* colloid osmotic pressure, $SvO_2$ mixed venous oxygen saturation, *pHi* gastric intramucosal pH, *TEE* transesophageal echocardiography, *ITBV* intrathoracic blood volume)

| "Tool" | No. (%) of ICUs[a,b] |
|---|---|
| Clinical experience | 215 (75.1) |
| CVP | 267 (93.3) |
| PCWP | 167 (58.3) |
| Miscellaneous | 158 (55.2) |
| Specified | 95 (33.2) |
| Blood pressure | 64 (22.3) |
| COP | 7 (2.4) |
| TEE | 5 (1.7) |
| "Shock index" | 4 (1.4) |
| "Swing" in blood pressure | 3 (1) |
| $SvO_2$ | 3 (1) |
| ITBV | 2 (0.7) |
| pHi | 1 (0.3) |

[a] Multiple answers (combinations) were given
[b] Percentages based on 286 responders

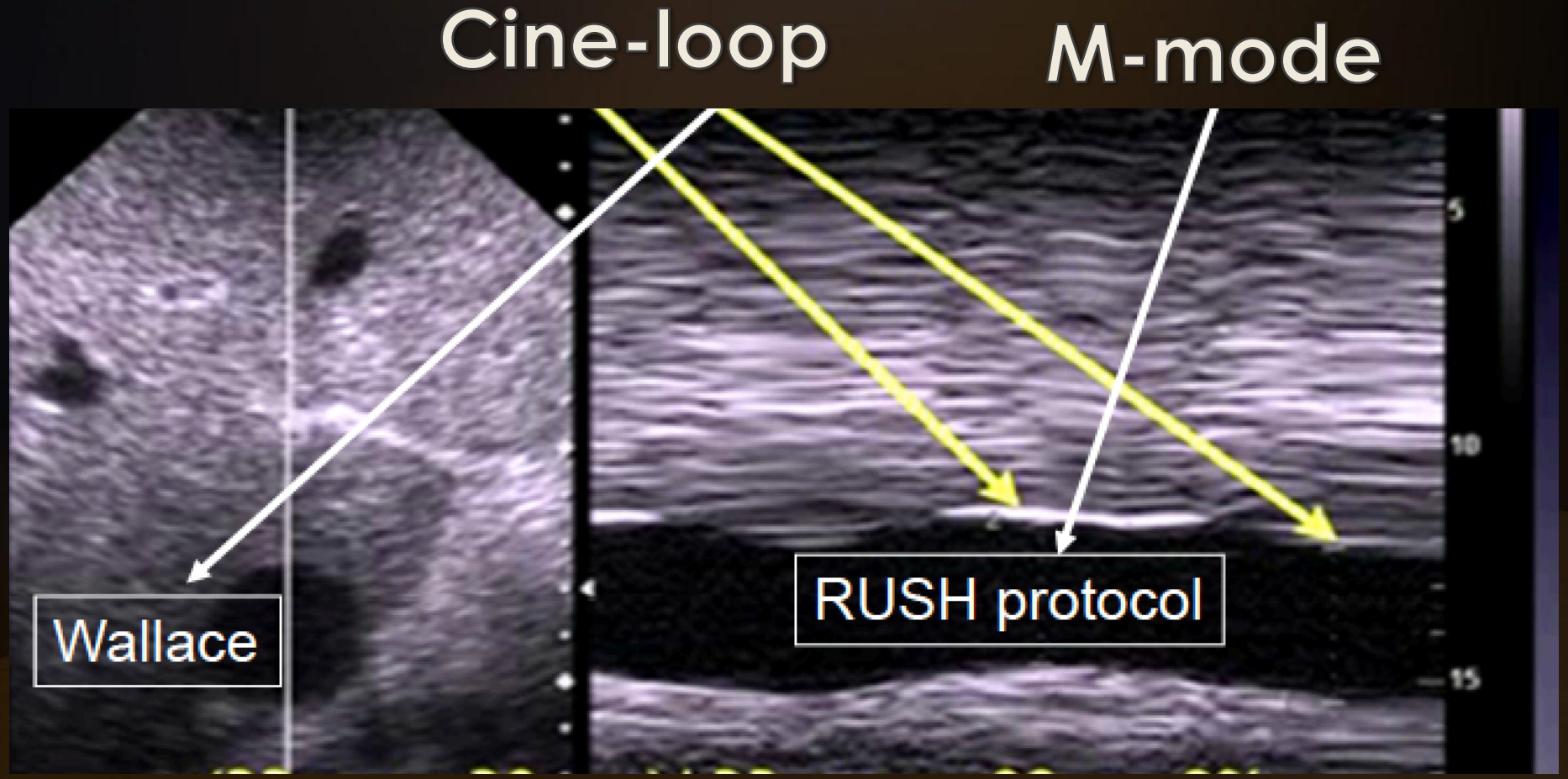



This review demonstrated a poor relationship between CVP and blood volume as well as the inability of CVP/delta-CVP to predict hemodymanic response to a fluid challenge. **CVP should not be used to make clinical decision regarding fluid management..**

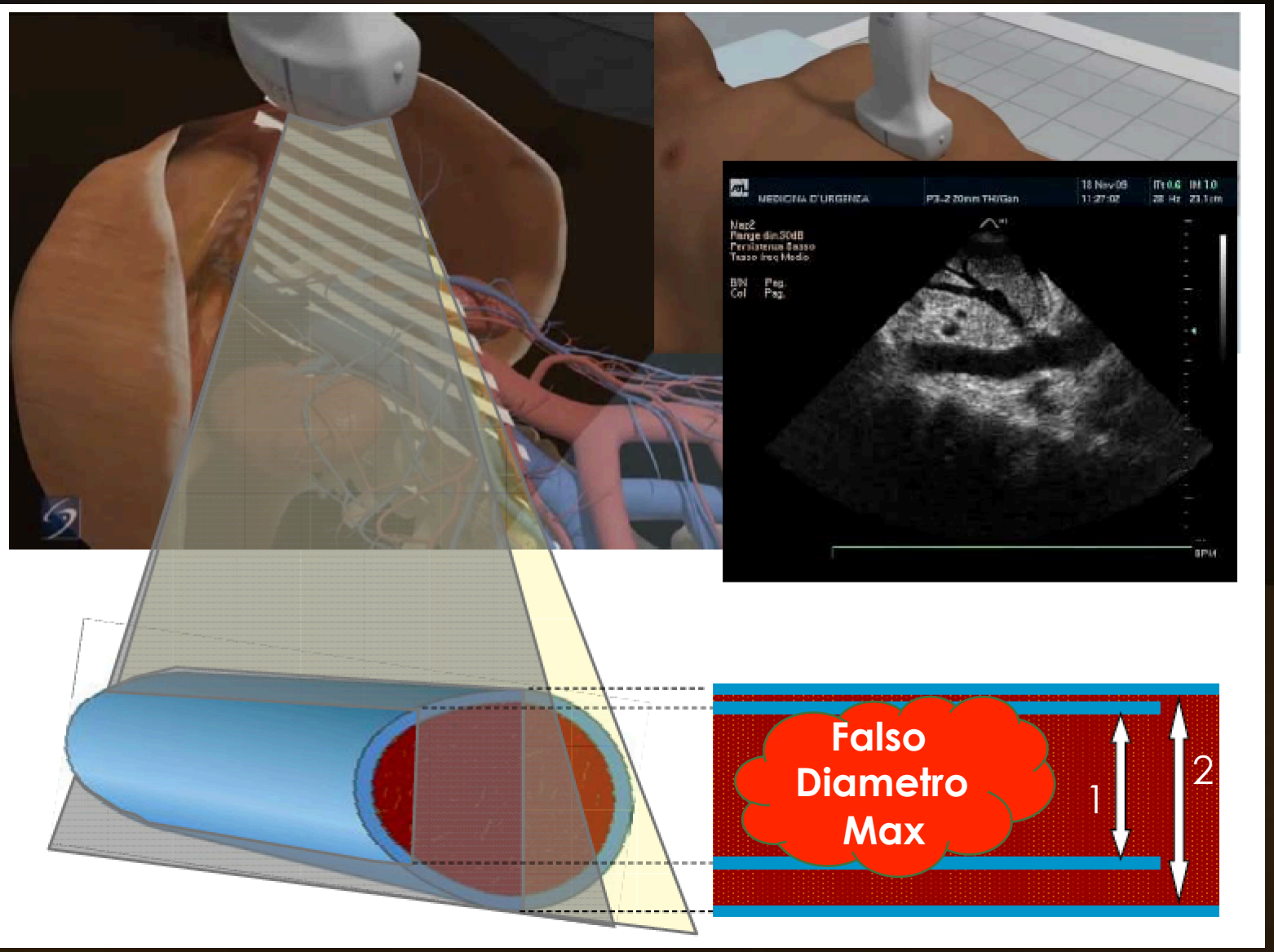
# La VENA CAVA INFERIORE

… un surrogato della PVC..

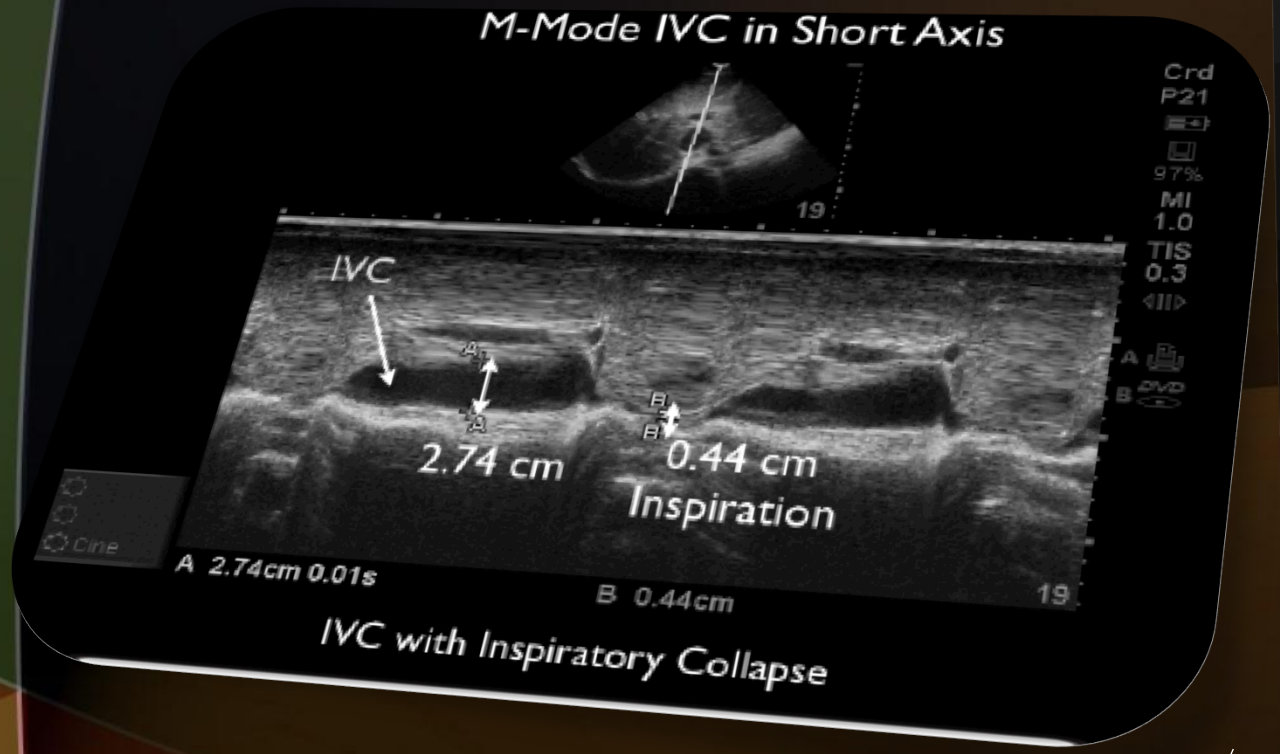
# Come misurare la VCI?

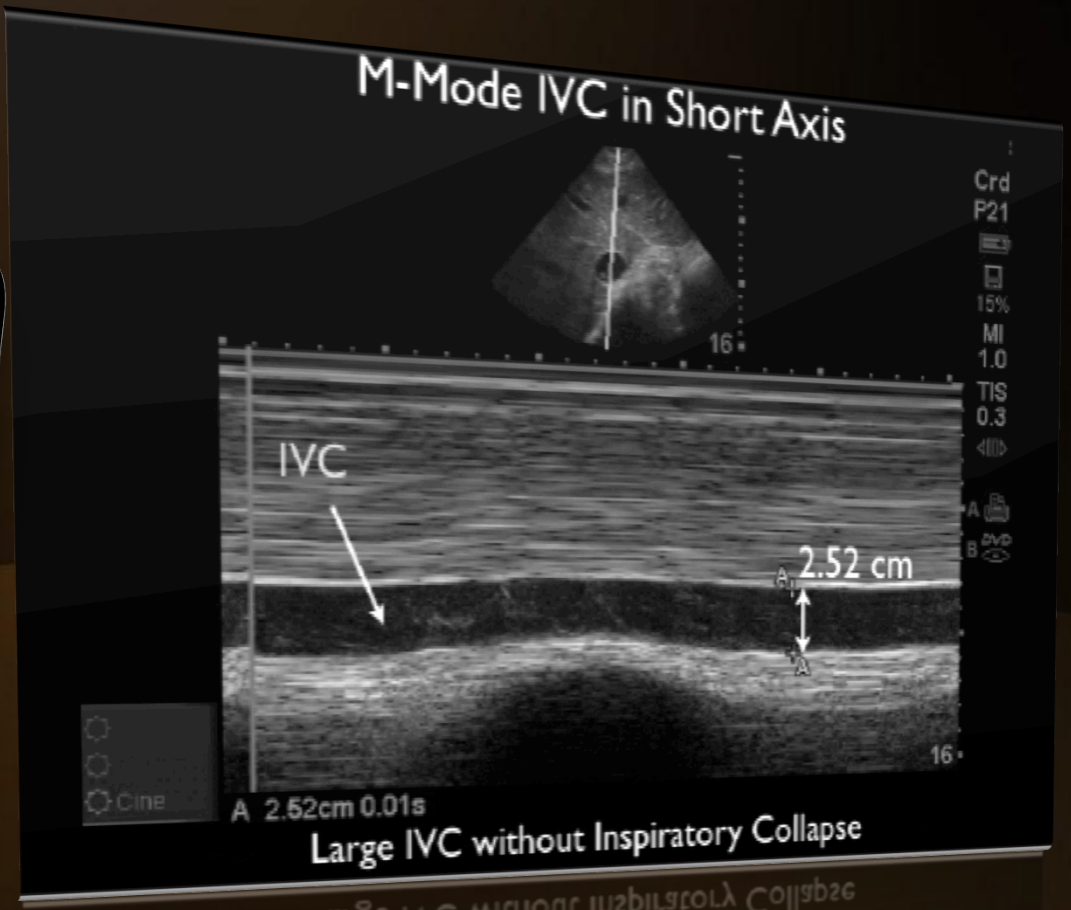


# Come misurare la VCI?

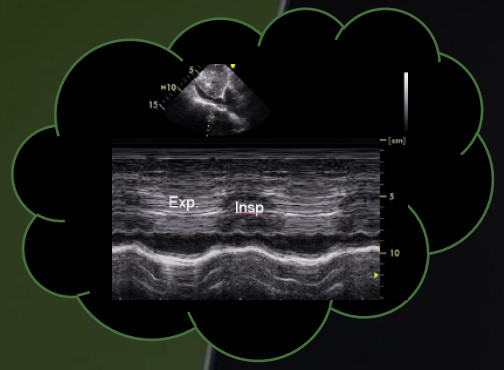


# Echo - IVC assessment




Indice di **collassabilità** %=[( ∅ max – ∅ min)/ ∅ max] x 100




# VCI= 80% del ritorno venoso

| Diametro (cm) | Collasso Inspiratorio (%) | PAD (stima PVC) |
|---|---|---|
| <1.5 | ≥50% | 0-5 mmHg |
| >1.5 | ≥50% | 6-10 mmHg |
| >1.7 | ≤50% | 10-15 mmHg |
| >1.7 | No collasso | >15 mmHg |

Risente di: 1) postura; 2) variazioni respiratorie; 3) ventilazione meccanica

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association.

# Reat-time inferior vena caval ultrasonography: normal and abnormal findings and its *use in assessing right-heart function.*

G S Mintz, M N Kotler, W R Parry, A S Iskandrian and S A Kane

*Circulation* 1981;64:1018-1025

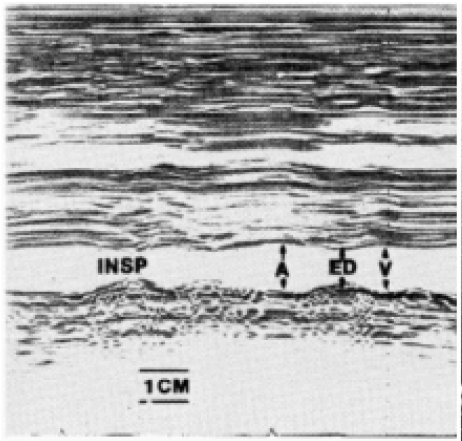



FIGURE 2. *Time-motion study of in over one complete respiratory cycle, dimension) and the V wave is 15 mm graphic events and subsequent IVC pu systole. Between expiration (EXP) a*

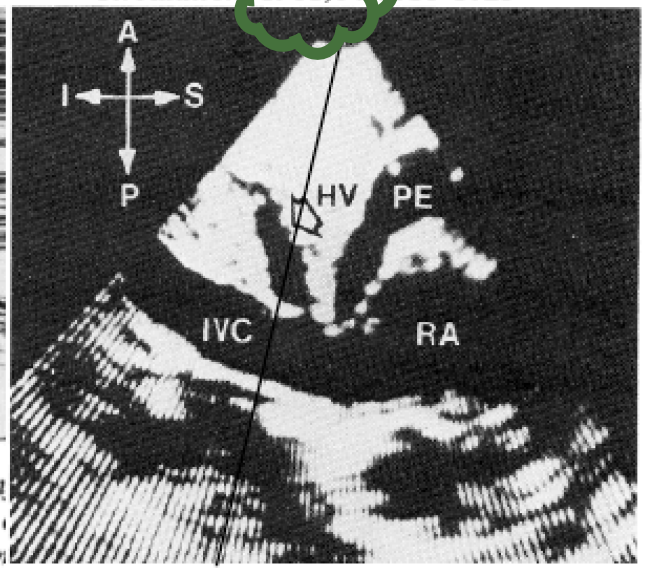
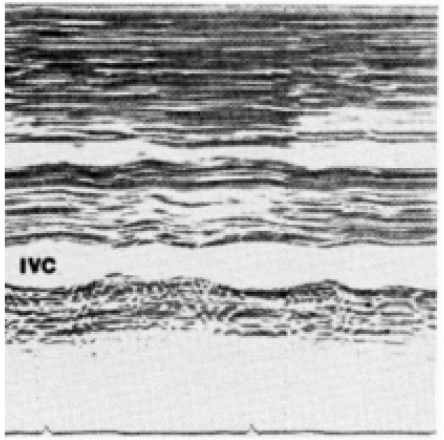



FIGURE 1. *With the transducer placed in the subcostal position, the inferior vena cava (IVC), hepatic veins (HV), and right atrium (RA) can be visualized. A time-motion study of IVC pulsation is recorded below the level of the hepatic veins. PE = pericardial effusion; A = anterior; P = posterior; I = inferior; S = superior.*




*al subject. When averaged (meaned) A wave is 15 mm (120% of ED IVC cal delay between the electrocardio- occurs during ventricular (electrical) es 50%.*

# Caution

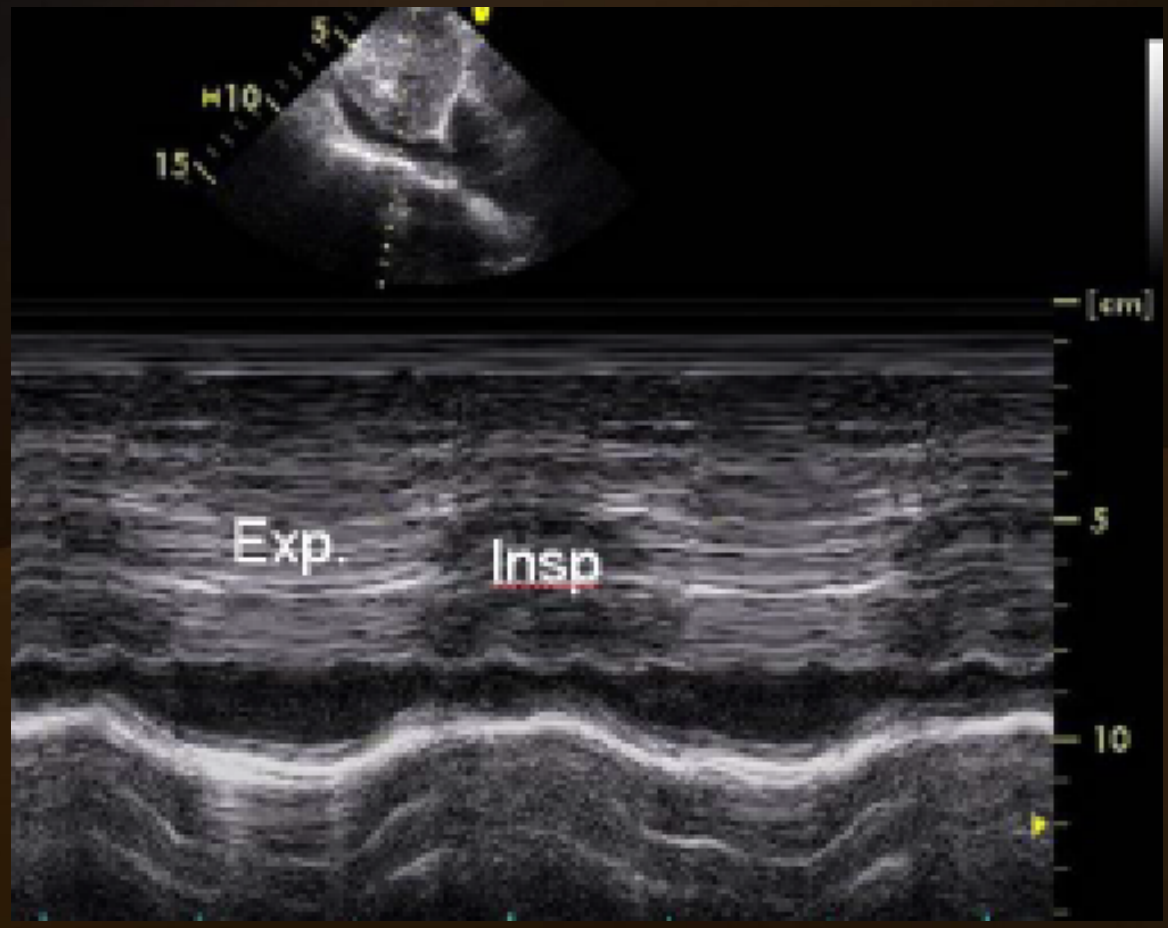
- Interpretation of caval physiology is hindered by conditions that restrict the physiologic variability of the IVC, such as
- **liver cirrhosis** and fibrosis
- **masses** causing external compression, and
- elevated **intra-abdominal pressure**.

Seif D, J Ultrasound Med 2012; 31

# Dynamic Parameters

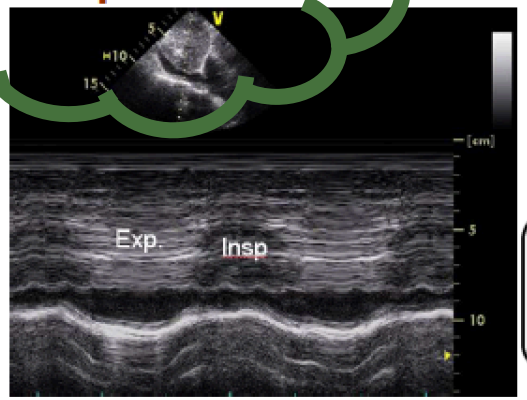
# Fluid Responsiveness

## VCI?

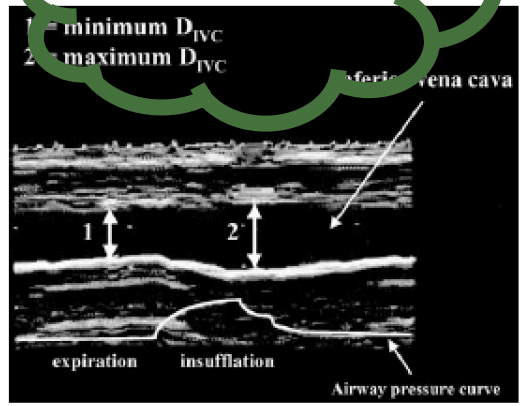


# Tipo di pazienti

In respiro spontaneo




Ventilati

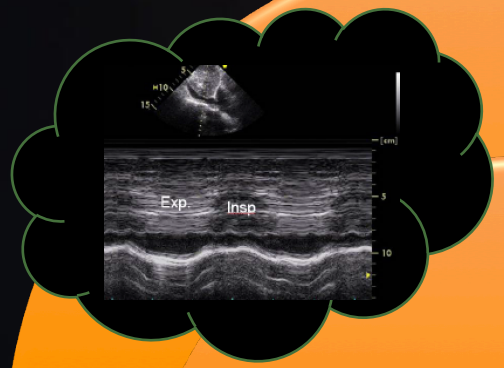


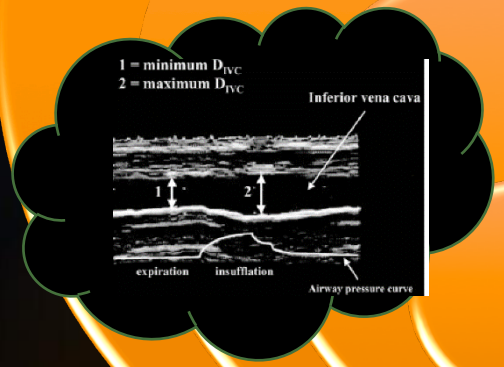

IVC respiratory variation

- Inspiration effect
  - Collapse
    - • Low CVP
      • Deep inspiratory effort (acute asthma, COPD exacerbation, acute respiratory failure)
  - No variation
    - High CVP (no fluid responsiveness)
- Insufflation effect
  - Dilation
    - Fluid responsiveness
  - No variation
    - No fluid responsiveness

Feissel et al. - Intensive Care Med (2004) 30:1834–1837

# VCI e responsività ai LIQUIDI

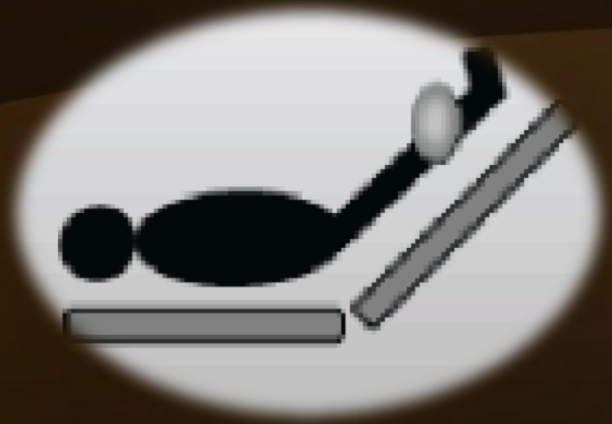



- Respiro Spontaneo= collaso inspiratorio → responsività ai liquidi
- Respiro Spontaneo= no variazione → NO responsività ai liquidi
- Ventilati= dilatazione in insufflazione→ responsività ai liquidi
- Ventilati= NO variazioni → NO responsività ai liquidi

Feissel et al. Intensive Care Med, 2004

# Passive Leg Raising (PLR)



Crit Care Med. 2006 May;34(5):1402-7.

# Passive leg raising predicts fluid responsiveness in the critically ill.

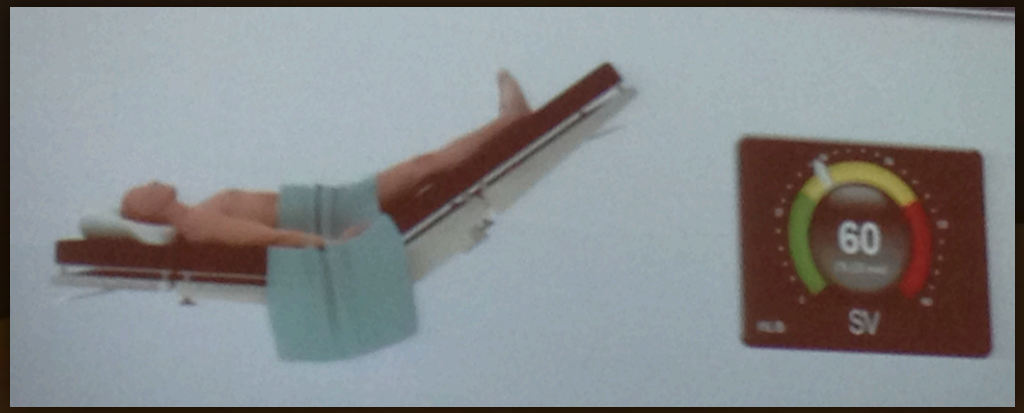
Monnet X[1], Rienzo M, Osman D, Anguel N, Richard C, Pinsky MR, Teboul JL.

Author information

## Abstract

**OBJECTIVE:** Passive leg raising (PLR) represents a "self-volume challenge" that could predict fluid response and might be useful when the respiratory variation of stroke volume cannot be used for that purpose. We hypothesized that the hemodynamic response to PLR predicts fluid responsiveness in mechanically ventilated patients.

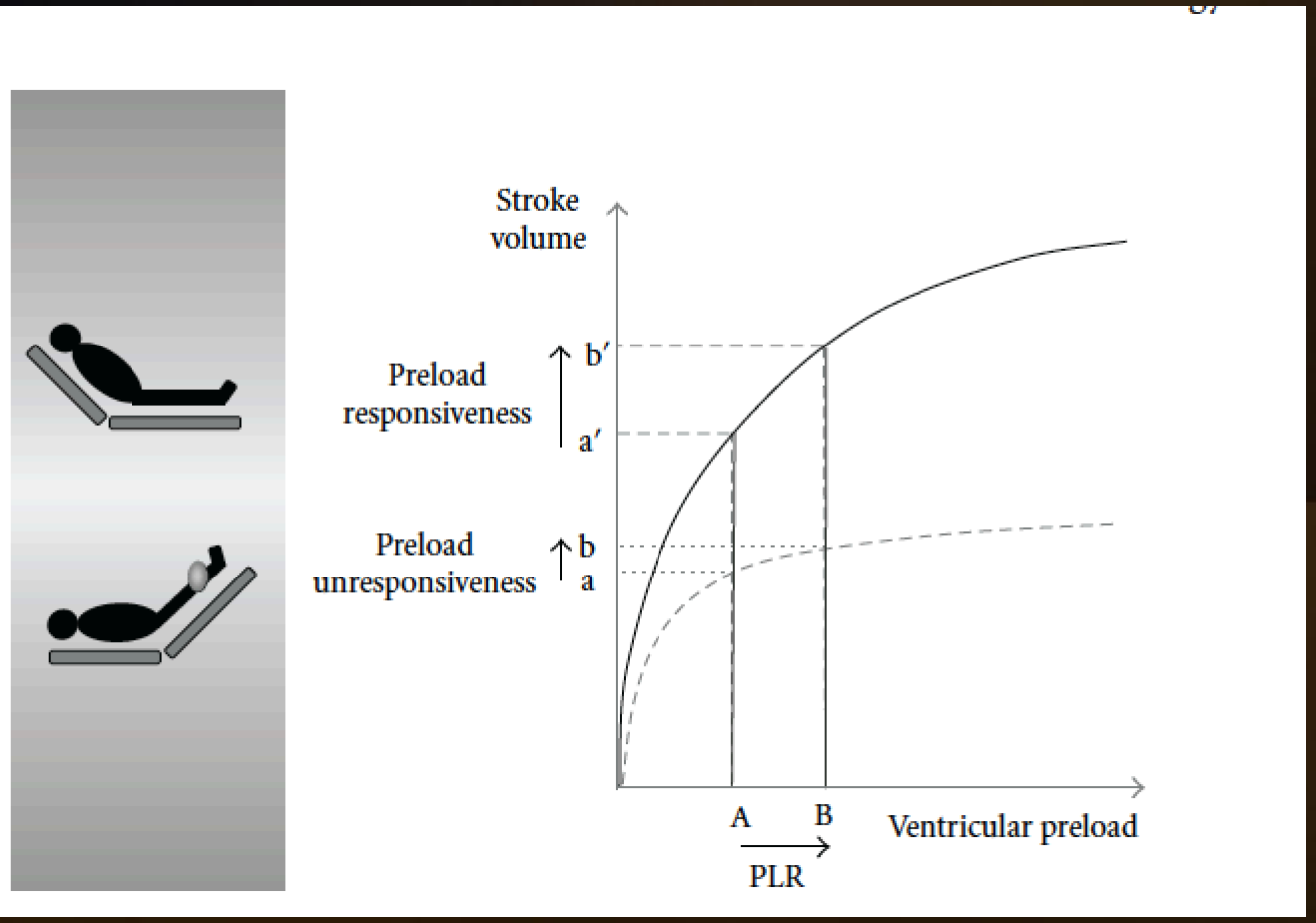
# Passive Leg Raising **(PLR)** is a TEST that predicts whether cardiac output will increase with **VOLUME expansion**!




**Monnet X**, Crit Care Med 2006, 34:1402–1407.

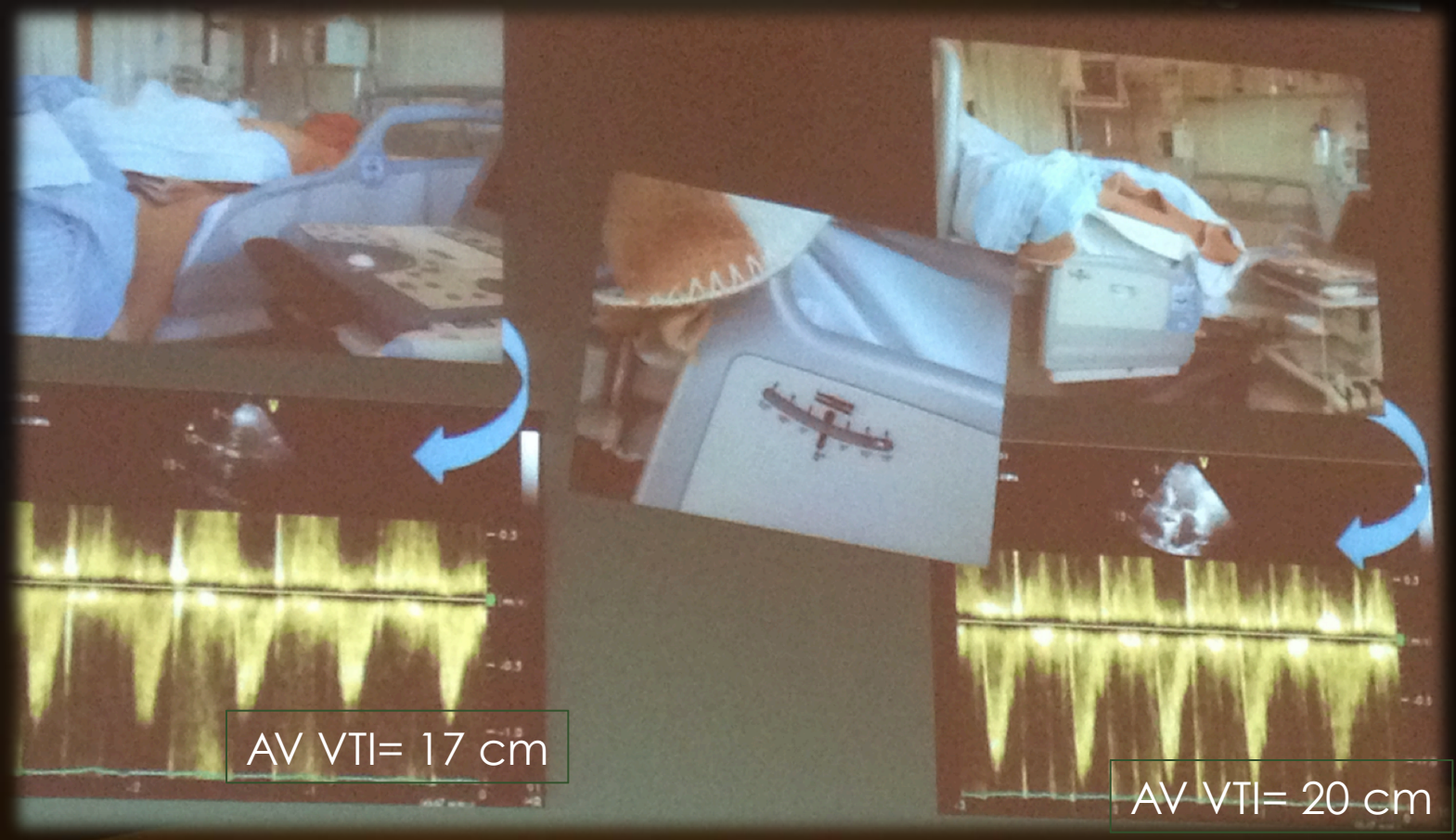
# PLR maneuver

mobilizes about 300–500mL of blood from the lower limbs to the intrathoracic compartment and reproduces the effects of similar volume fluid bolus




Levitov A, Cardiology Research and Practice, 2012

# Echo-PLR




**Variazione in VTI di LVOT>15%= responsività ai liquidi**

$\Delta$VTI= 100 x (20-17)/20+17/2= 15%

Levitov A, Cardiology Research and Practice, 2012

Monnet and Teboul *Critical Care*
DOI 10.1186/s13054-014-0708-5

CRITICAL CARE

EDITORIAL

# Passive leg raising: five rules, not a drop of fluid!

Xavier Monnet[1,2*] and Jean-Louis Teboul[1,2]

Monnet X, Critical Care, 2015

# PLR= 5 rules

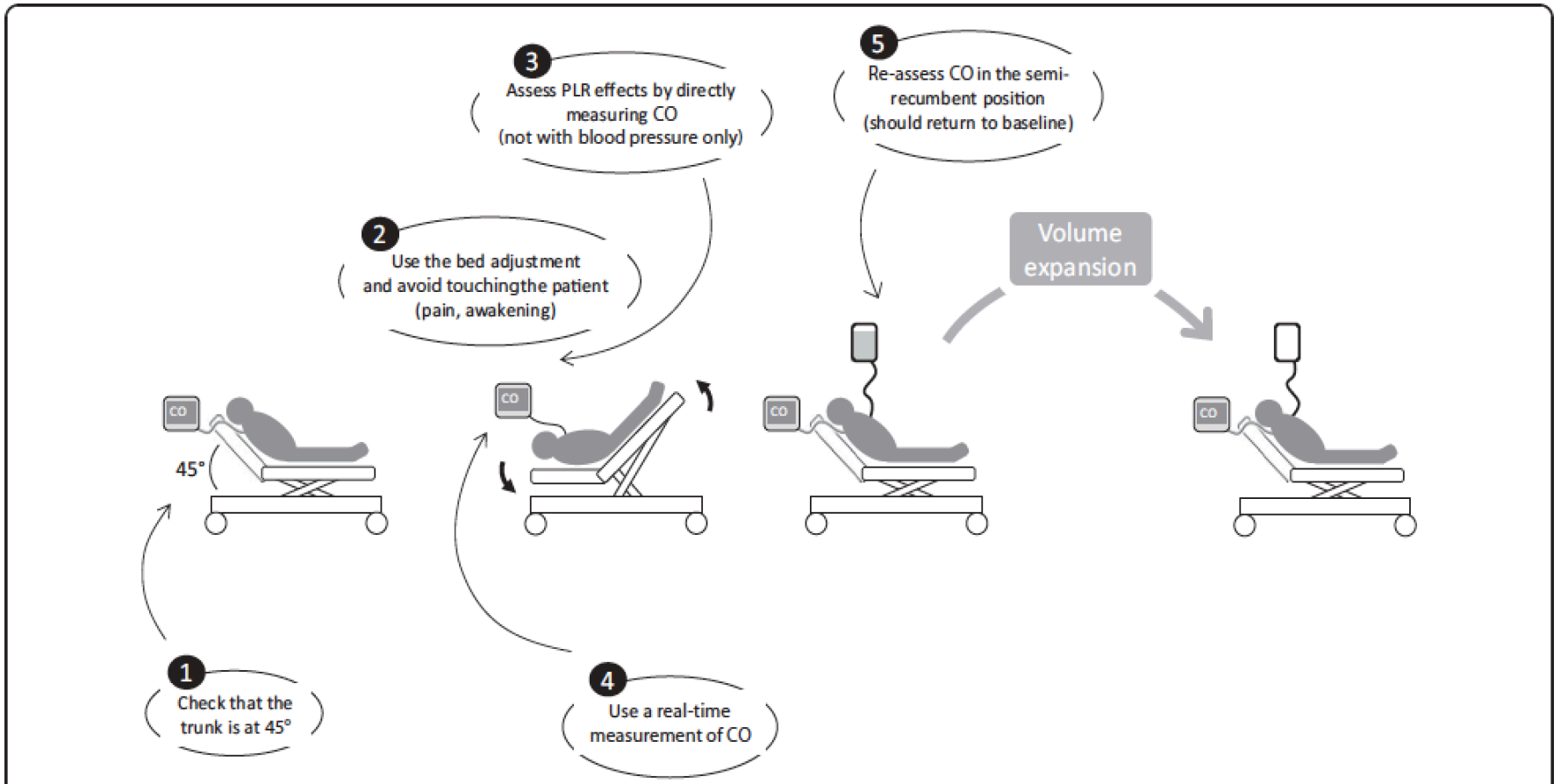



**Figure 1 The best method for passive leg raising, indicating the five rules to be followed.** CO, cardiac output; PLR, passive leg raising.

Monnet X, Critical Care, 2015

Intensive Care Med. 2010 Sep;36(9):1475-83. doi: 10.1007/s00134-010-1929-y. Epub 2010 May 26.

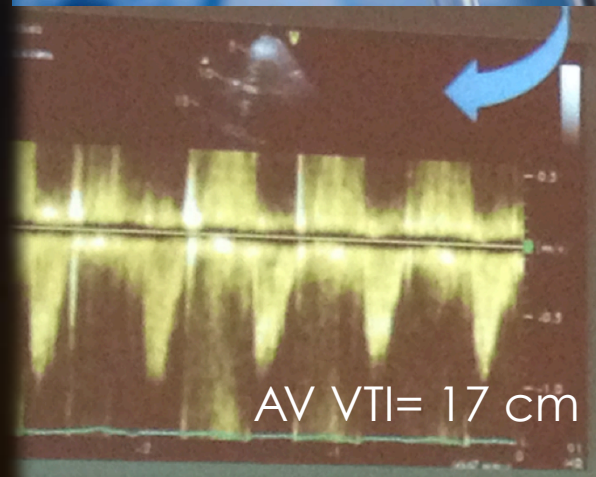
**Diagnostic accuracy of passive leg raising for prediction of fluid responsiveness in adults: systematic review and meta-analysis of clinical studies.**

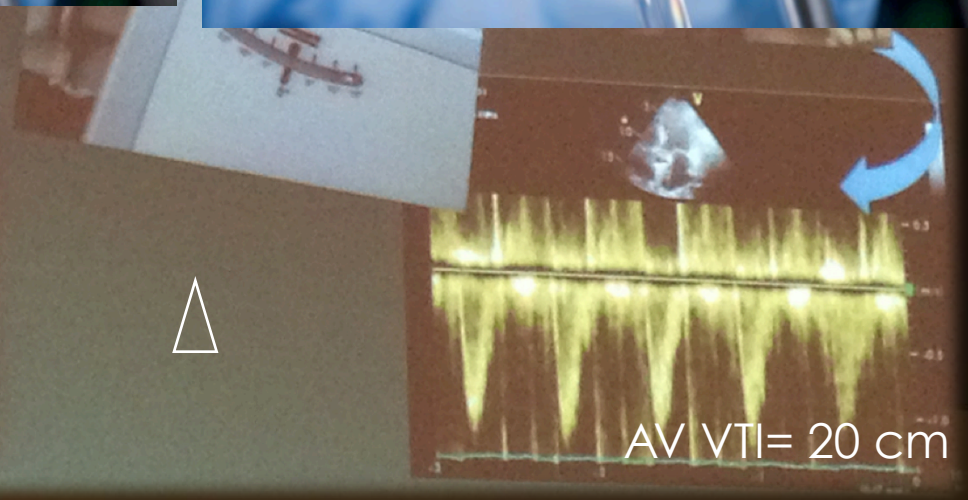
Cavallaro F[1], Sandroni C, Marano C, La Torre G, Mannocci A, De Waure C, Bello G, Maviglia R, Antonelli M.

PLR-induced changes in **CO** predict fluid responsiveness regardless of

- **ventilation mode**
- **cardiac rhythm**
- **technique of measurement**

Fluid Bolus (500 mL)

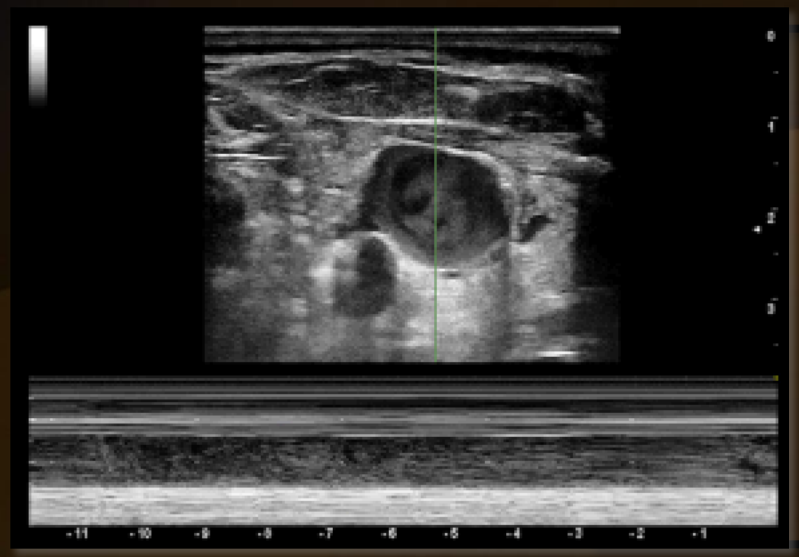


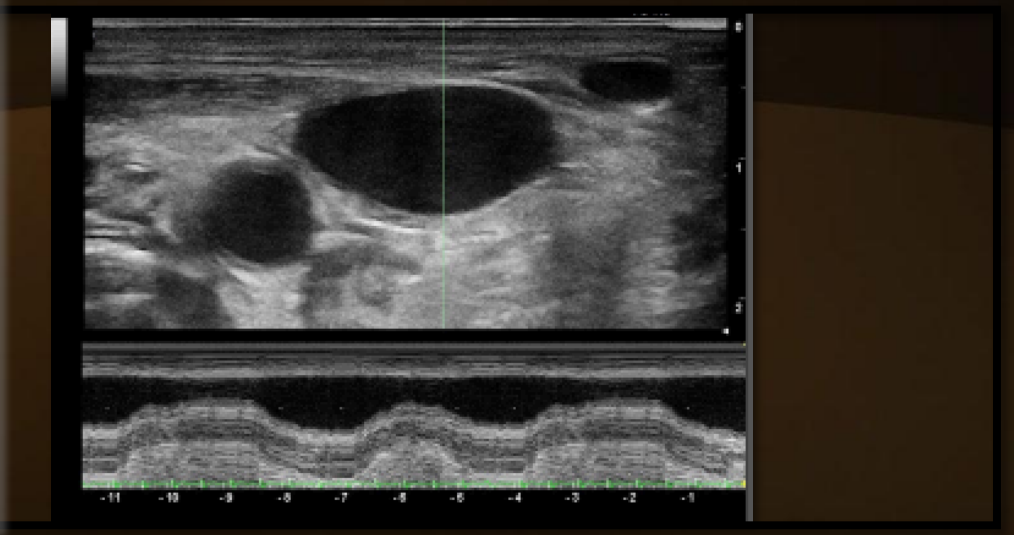




**Variazione in VTI di LVOT>15%= responsività ai liquidi**

Levitov A, Cardiology Research and Practice, 2012

# Internal Jugular Vein (IJV)





**Critical Care**

BioMed Central
The Open Access Publisher



# Jugular vein distensibility predicts fluid responsiveness in septic patients

*Critical Care* 2014, **18**:647 doi:10.1186/s13054-014-0647-1

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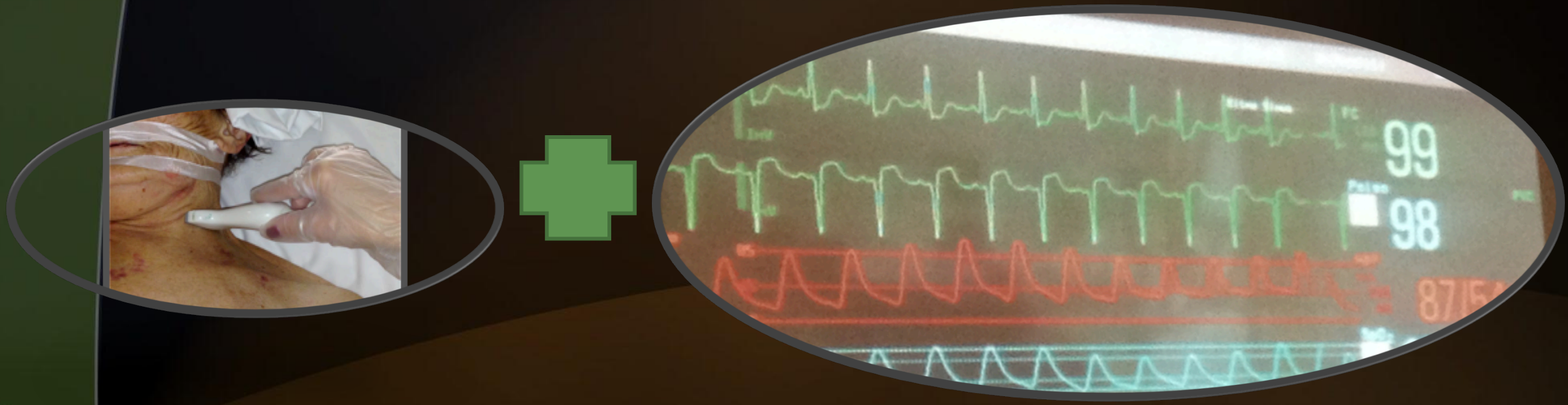
Luana Magliacane (luanam84@hotmail.com)
Michael R Pinsky (pinskymr@upmc.edu)

*Guarracino F, Crit Care, 2014*

# Results

- There is a reliability of **IJV distensibility during respiratory cycle** on detecting fluid responsiveness of ventilated patients..
- a threshold value of **16.4%** IJV distensibility has a sensitivity of 80% and a specificity of 85% in mechanically ventilated septic patients..
- Similarly, **PPV** (Pulse Pressure Variation) threshold values of **12.5%** have been reported in the literature to discriminate between R and NR with similar sensitivity and specificity.

# IJV distensibility + PPV




*Guarracino F, Crit Care, 2014*

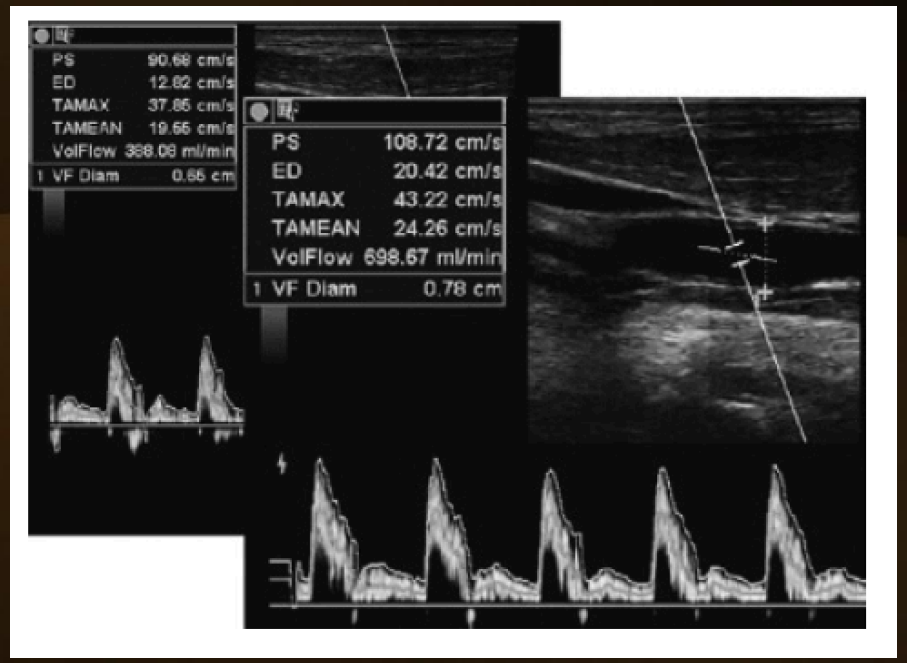
# Conclusions

- Ultrasound evaluation of **IJV distensibility** is a simple, easy, and readily accessible bedside measure that predicts volume responsiveness in critically ill ventilator-dependent septic patients.
- Importantly, the combined use **of IJV distensibility with PPV increases the predictive value** of these two volume responsiveness parameters.

Guarracino F, Crit Care, 2014

# Respirophasic **carotid artery peak velocity** variation as predictor of fluid responsiveness in mechanically ventilated patients with coronary artery disease

(YL Kwak, Anaesth, 2014)



# Be careful

- .. about **50%** of hemodynamically unstable ICU patients are volume responsive..

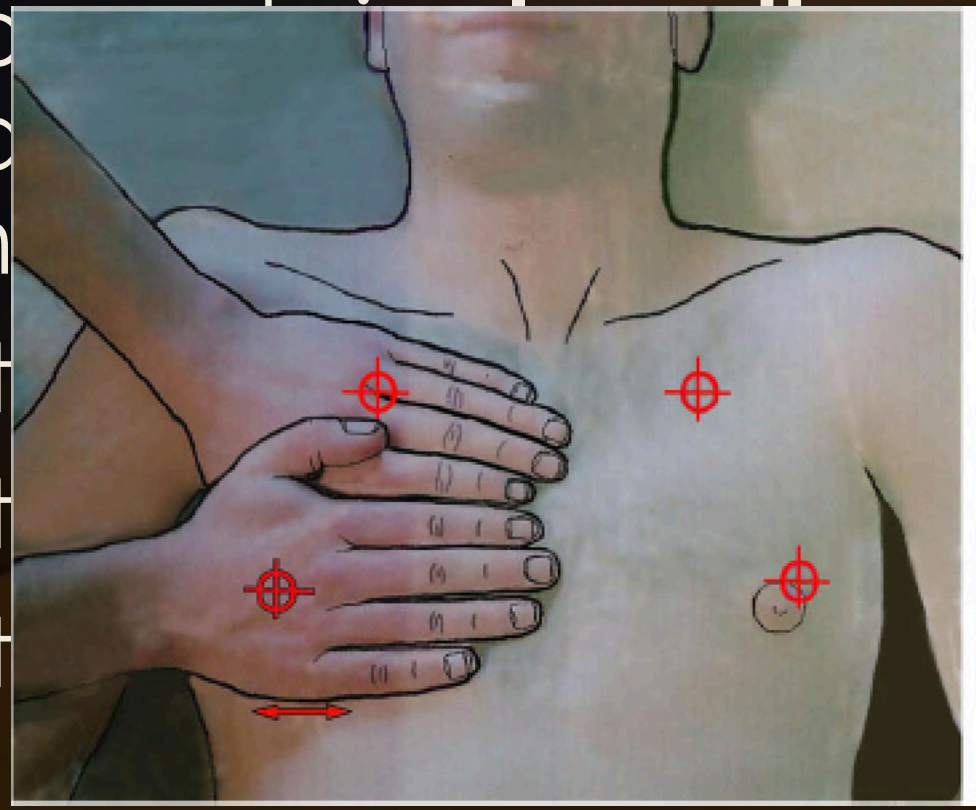
- Fluid resuscitation is not without serious and possibly **lethal complications**.
- Those complications may be related to preexisting conditions such as **systolic or diastolic heart failure**, cor pulmonale, or the development of sepsis-related cardiac dysfunction..

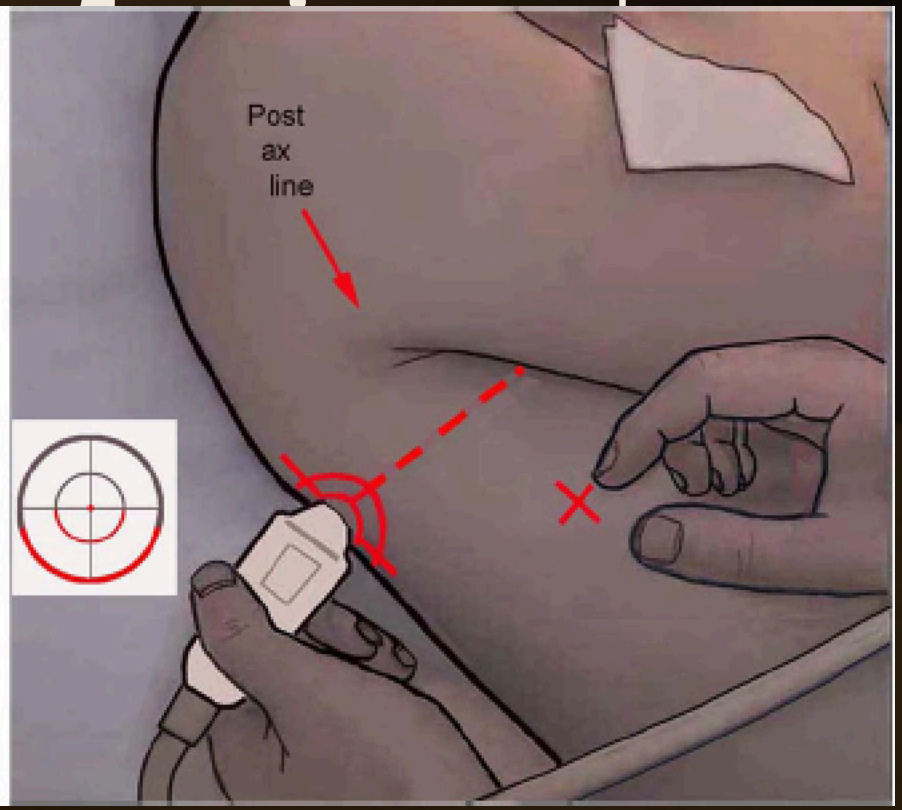
- Persistent hypotension after initial fluid resuscitation is common and poses the dilemma of whether the patient should receive additional fluid boluses or a **vasopressor** agent should be initiated..

# Extra-vascular Water

**Lung ultrasound examination** is perfo
conc
meth

- (1) t
- (2) t
- (3) t

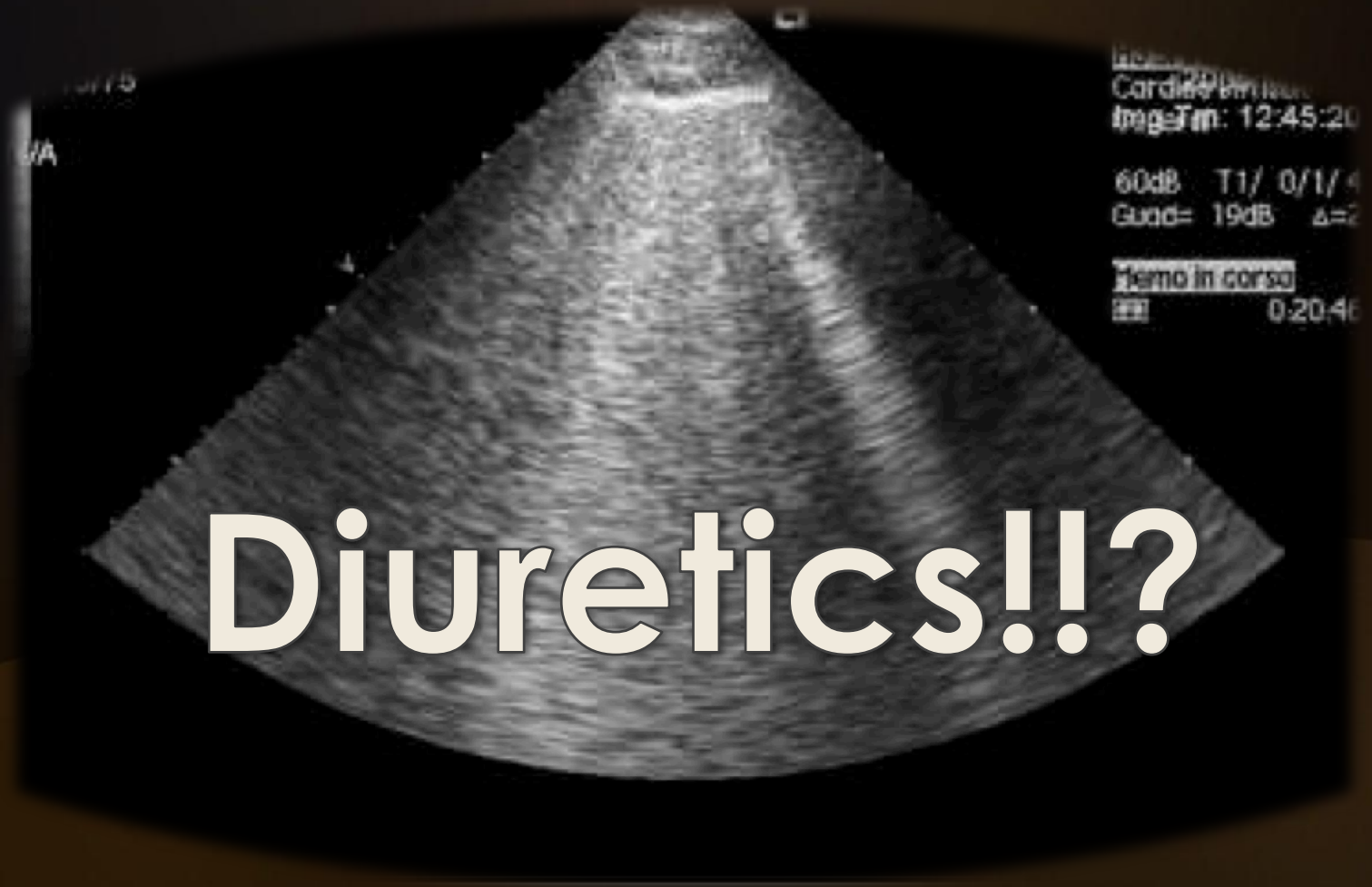




# Lung sonography

- The finding of a **B-pattern** should restrict the use of fluid…

# Echo Comet Score




# Diuretics!!?

Laurent Zieleskiewicz, Anesthesiology, 2014

# Questions:

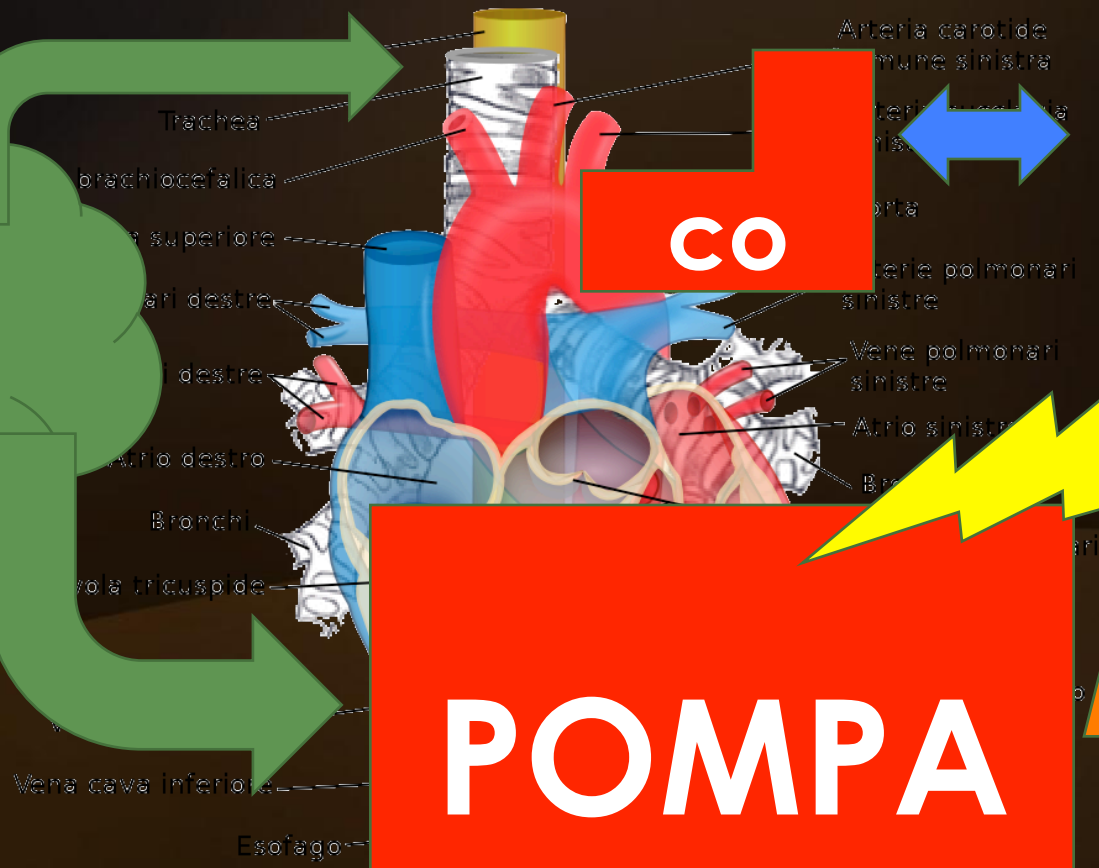
- What is the fluid status?
- **What is the left and right ventricular function?**
- Is there any evidence of pericardial effusion and cardiac tamponade?

# Dov'è il problema?

**VOLEMIA**

**RITORNO VENOSO**

CAPACITANZA VENOSA




**CO**

TONO VASCOLARE (POST-CARICO)

**POMPA**

**PERFUSIONE TESSUTALE**

# Ipotensione-Ipoperfusione

$SVcO_2$ (CVC)<70%

Leg elevation (1 min)

Fluid responsive

- variazione VCI
- flusso aortico doppler (PLR)
- variazione gittata
- **variazione traccia arteriosa sistolica±IJV**
- variazione onda pulsossimetrica

SI

FLUIDO= 250-500 mL
Emazie se Hb<8

NO

**Inotropi Vasocostrittori**

- Noradrenalina
- Dobutamina
- Dopamina
- Levosimendan
- Vasodilatatori

# Ipotensione-Ipoperfusione

Leg elevation (1 min)

Fluid responsive

SI

FLUIDO= 250-500 mL
Emazie se Hb<8

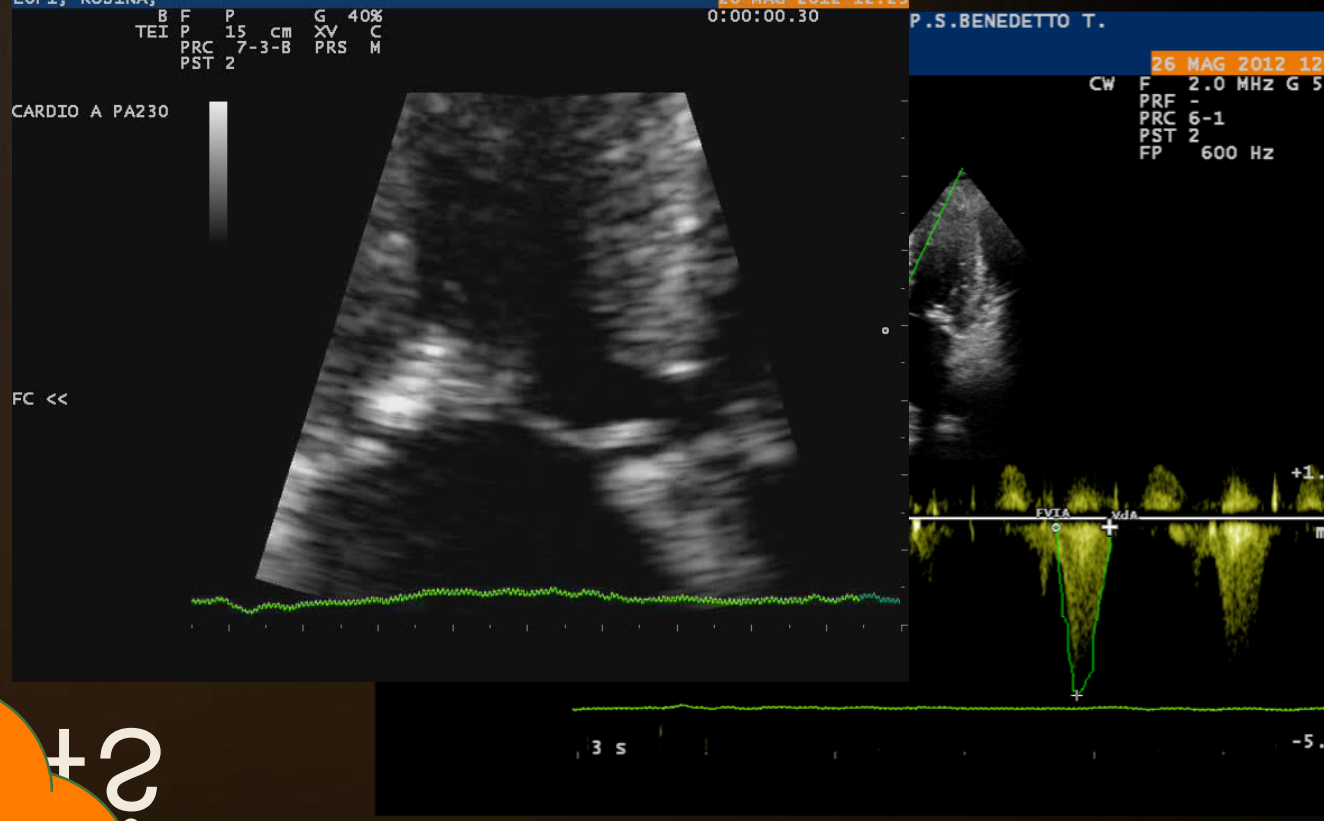
- Variazione VCI
- Flusso aortico doppler
- Variazione Gittata
- Variazione traccia arteriosa sistolica
- Variazione onda pulsossimetrica

## Inotropi

- Noradrenal
- Dobutam
- Dopamin
- Levosimend
- Vasodilatatori

# Inotropic Therapy

- Be careful!!

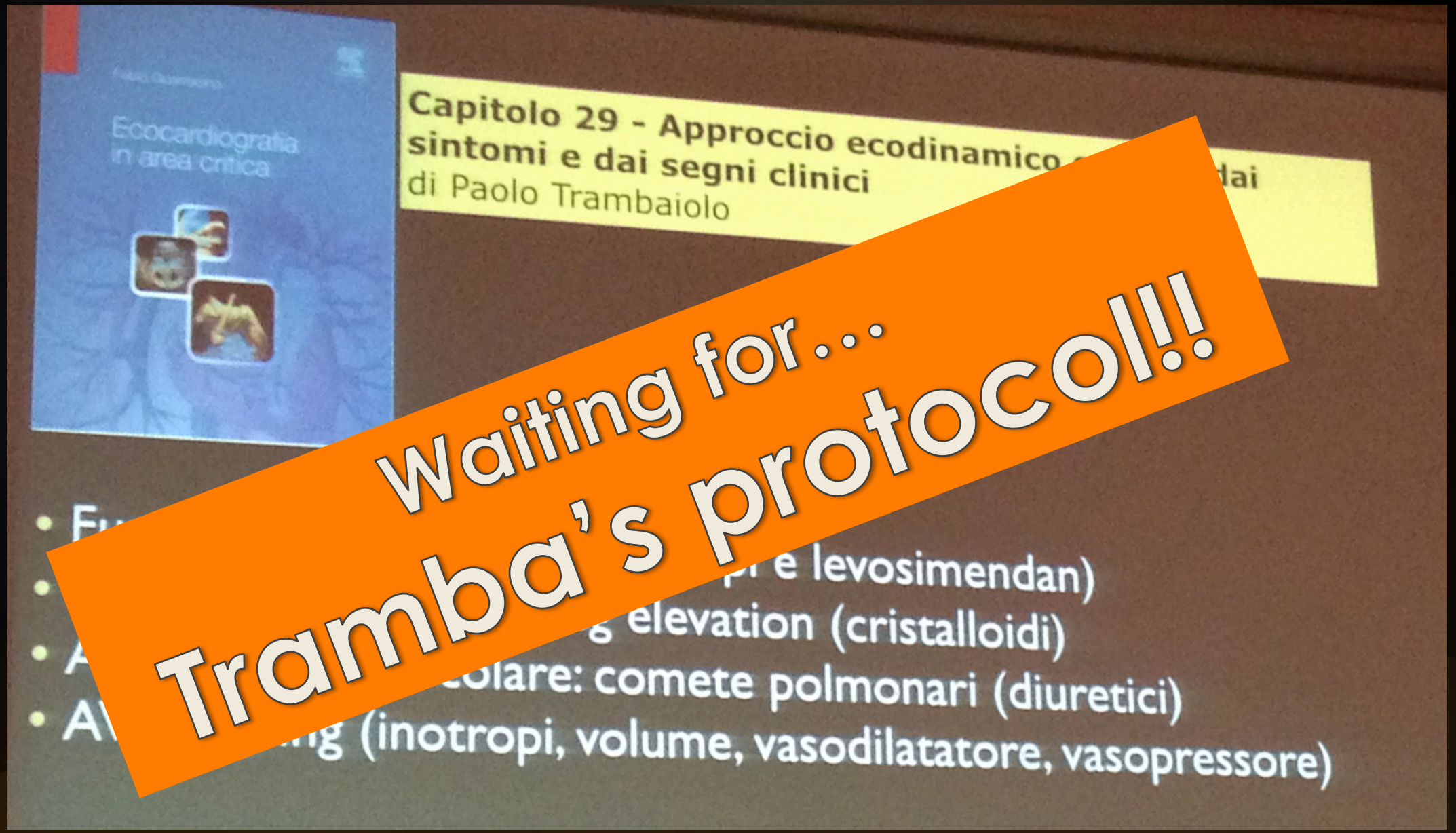

- LVOT … +?
- SA …

- Stop inotropic drug?
- B-blocker?
- Fluids?….

**Ipotensione**
**Ipoperfusione**

# ..tra fluidi e inotropi.. che fare?

- Funzione Ventricolare SN e DX (kissing ventricles?)
- VCI (variazioni respiratorie)
- Vena Giugulare Interna (distensibilità) ±PPV
- PLR  o bolus (VCI, LVOT-VTI variazioni)
- LUNG ultrasound (B-pattern? **DIURETICI?**)
- **FLUIDI** se responsività
- **INOTROPI** se non responsività
- ATTENZIONE agli INOTROPI (LVOT gradient?)
- **AV-coupling**
- Tieni gli occhi aperti= controlli **SERIATI**!


Ecocardiografia in area critica
Capitolo 29 - Approccio ecodinamico
sintomi e dai segni clinici
di Paolo Trambaiolo
Waiting for…
Tramba's protocol!!
levosimendan)
elevation (cristalloidi)
comete polmonari (diuretici)
(inotropi, volume, vasodilatatore, vasopressore)

SIEC Marche

# GRAZIE PER L'ATTENZIONE!.. e Grazie Paolo!

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