Echo In The Intensive Care Unit

Hypovolemic and septic Shock

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Cardiologist

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No disclosure

Objectives:

- Introduction.
- Fluid responsiveness in shocked patient.
- Heart lung interaction in mechanically ventilated patients.
- Diastology in septic shock.
- Speckle tracking in septic shock

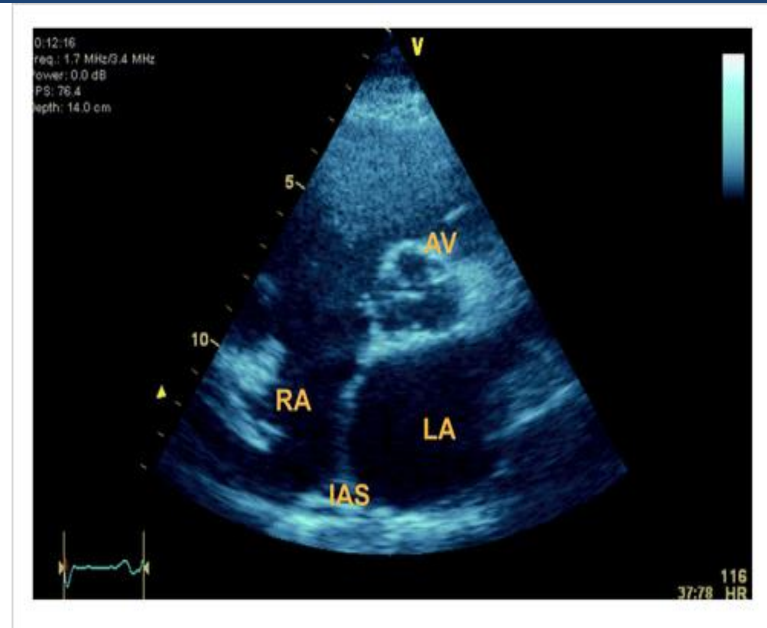
Shock is defined:

- Identify a source.
- Volume Status.
- Fluid responsiveness.
- Guide the treatment.

- This most commonly occurs when there is circulatory failure manifest as hypotension. “Undifferentiated shock” refers to the situation where shock is recognized, but the cause is unclear.

Hypovolemic shock

When hypovolemia is severe, 2D views can be impelling when they show collapse of the left ventricular walls at end-systole, the so-called **"kissing walls".**



-Fixed **bowing of the atrial septum** into the right atrium throughout the cardiac cycle implies elevated left atrial pressures and further fluid is not necessary .

Fluid responsiveness:

An increase of at least 15 % in cardiac output [CO] in response to a 500 mL bolus fluid challenge.

Assessment of volume responsiveness

- Constant parameters:
- CVP.
- PAOP.
- LVDEA.
- IVC diameter.

Both CVP and pulmonary alveolar occlusion pressure have been shown to have poor predictive value for predicting fluid responsiveness.

CVP is affected by a number of other physiologic derangements:

- Valvular regurgitation.
- Right ventricular dysfunction.
- Pulmonary hypertension.
- Variation in intrathoracic pressure with respiration.

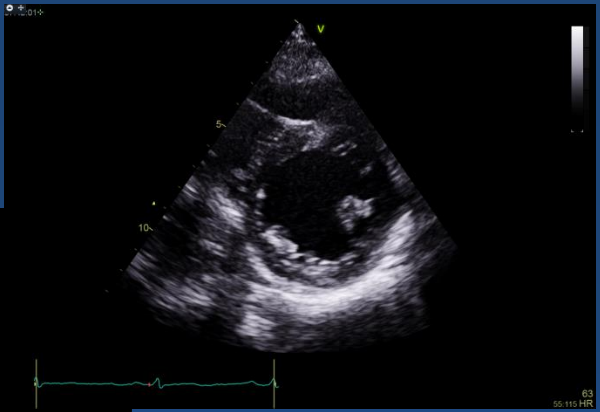
Mark E Mikkelsen, MD, MSCEDavid F Gaieski, MDNicholas J Johnson, MD

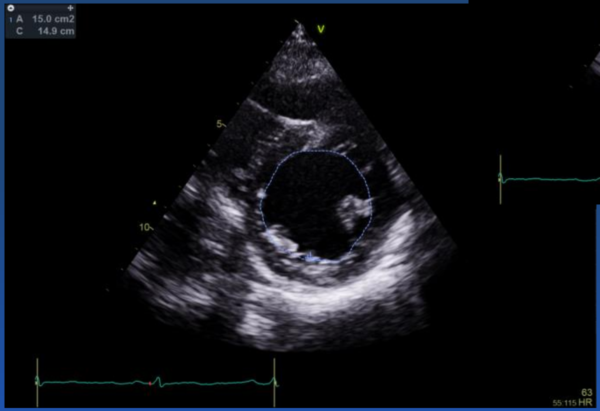
LVEDA:

- Left parasternal short-axis view, mid-papillary level
- Normal: 9.5–22 cm2; very low (<5.5 cm2/m2 BSA) Hypovolemia.

Limitation:

- Suboptimal image quality.
- Abnormal right heart.



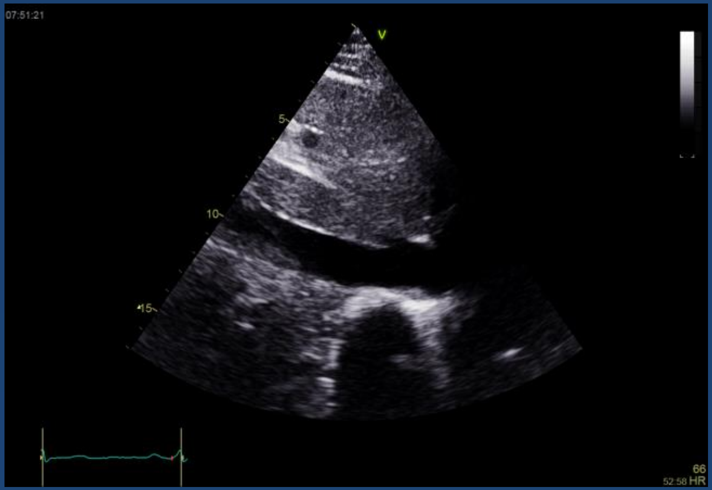


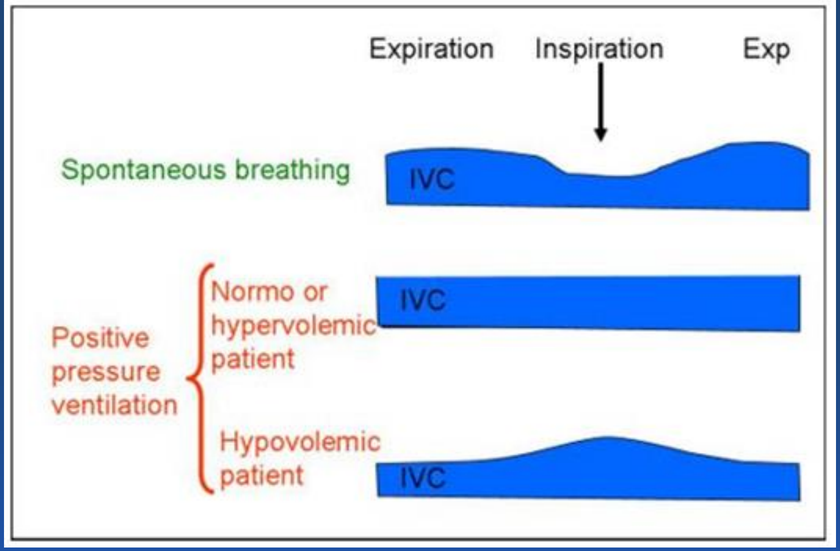
Leung JM, Levine EH. Anesthesiology 1994 Nov;81(5)1102-1109.

IVC:

Spontaneously breathing patients :
In these patients, the IVC diameter and respiratory variation reflects the pressure in the right atrium (RA).

Patients with mechanical ventilation
In these patients, the presence of respiratory variations of the IVC will help you to predict responders to volume challenge.



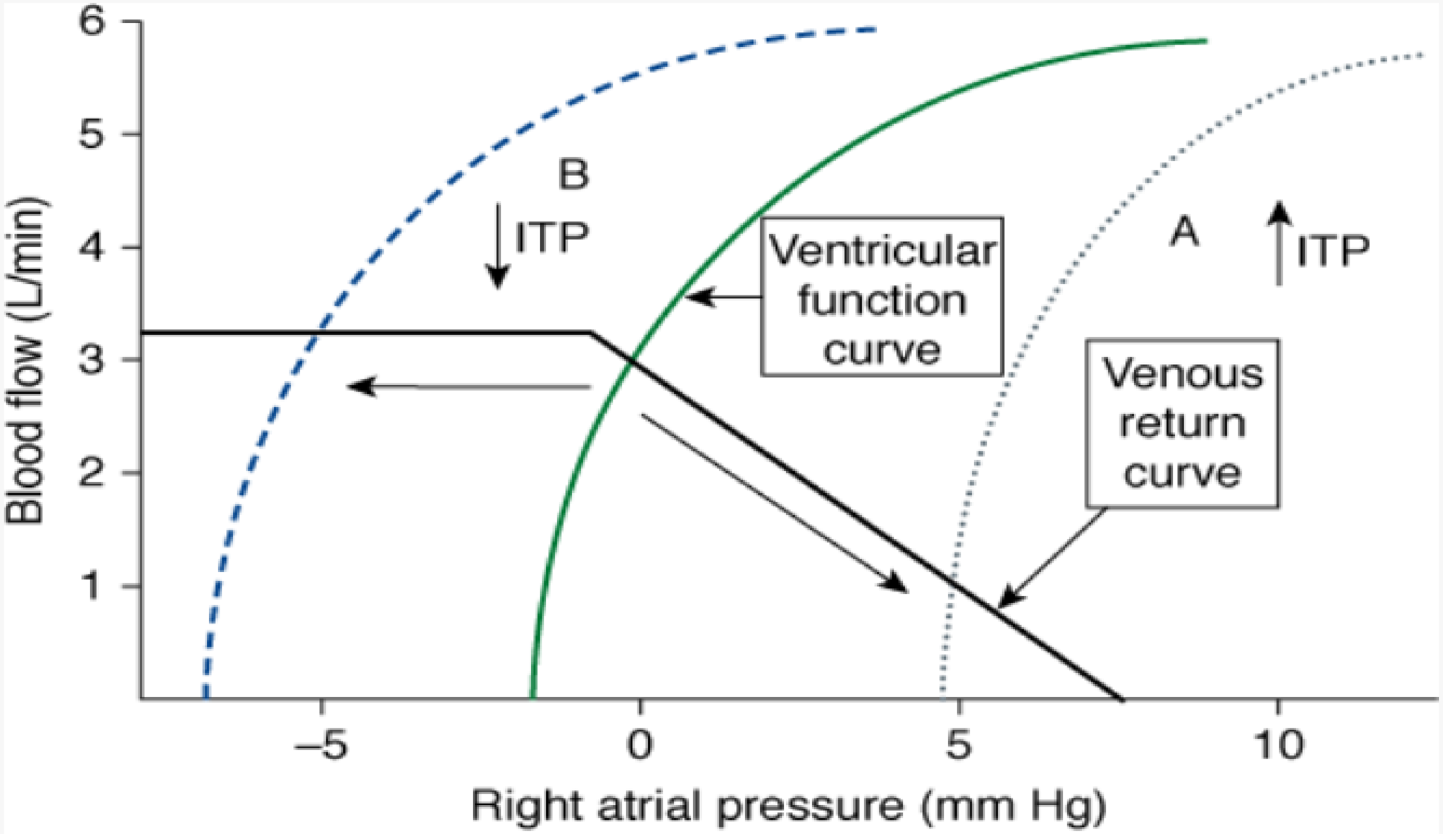


Assessment of volume responsiveness

- **Dynamic parameters.**
- Heart-lung interactions.
- Vena cava collapsibility.
- Respiratory variations of aortic blood flow
- Passive leg raising.

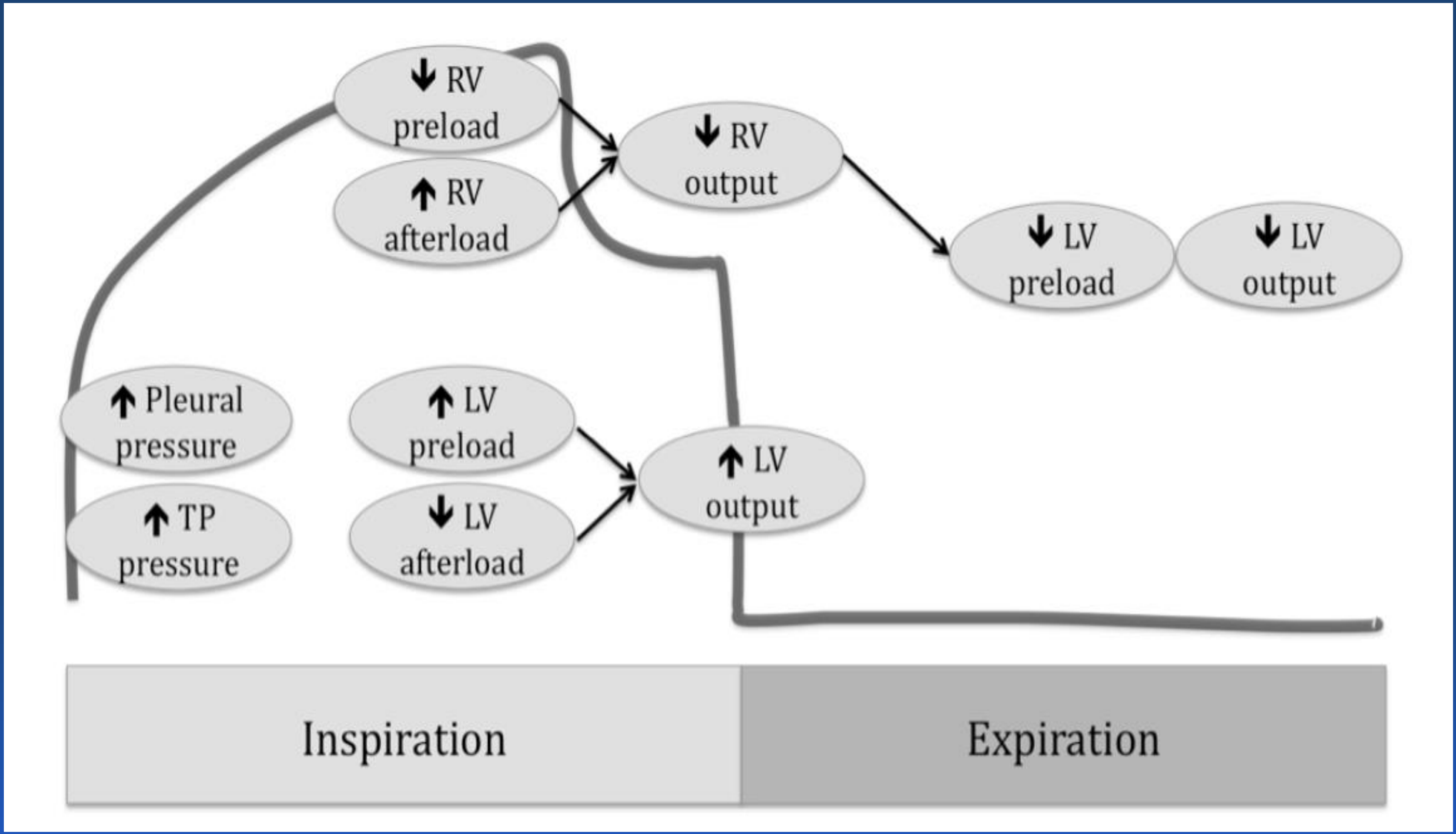
Ventricular function/Venous return curve:

FIGURE 36-4



Source: Tobin MJ: *Principles and Practice of Mechanical Ventilation, 3rd Edition*: www.accessanesthesiology.com

Heart-lung interactions



Adapted from Michard &Teboul (2000

Heart Lung interaction

- Paralyzed/passive on ventilator.
- Normal sinus rhythm.
- 8–10 mL/kg tidal volume.

- IVC Dispensability (Mechanical Ventilation).

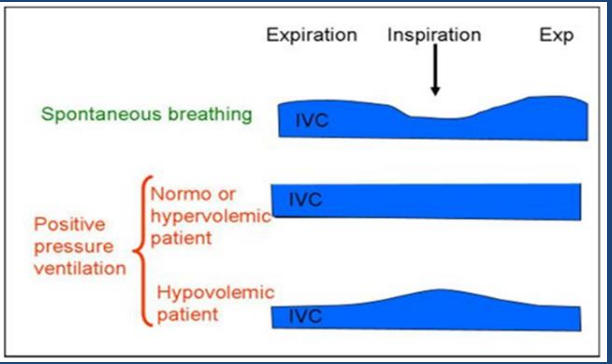
- SVC Collapsibility (Mechanical Ventilation).

- CO/SV/aortic velocity variability (Mechanical Ventilation).

IVC Dispensability (Mechanical Ventilation).

- **∆ IVC = (IVC max – IVC min) X 100 > 18 %.**
  IVC min

$$\Delta IVC = \frac{IVC_{max} - IVC_{min}}{IVC_{min}} \times 100 > 18\%$$



Caveats:

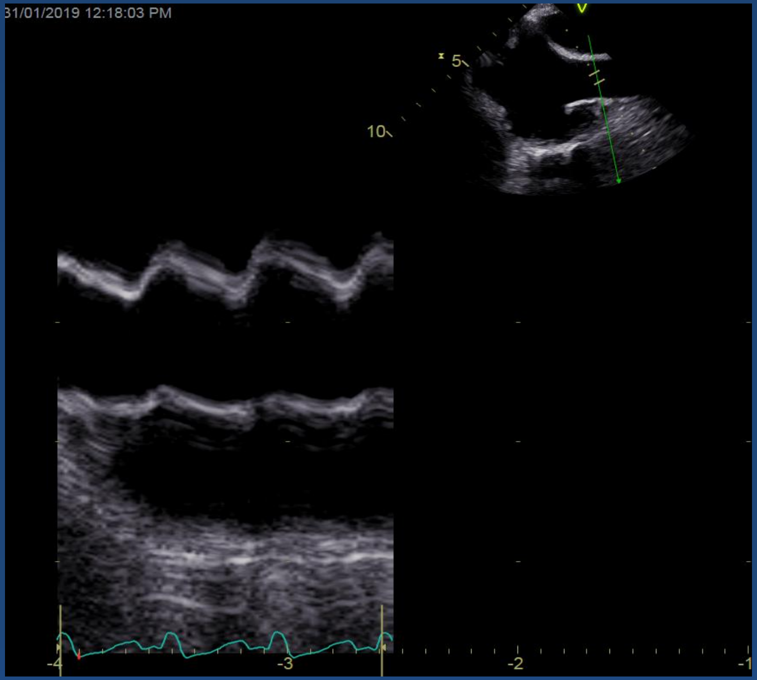
The view sometimes is suboptimal poor window.

Falsely dilated IVC: RV failure, tamponade, pulmonary embolism, TR, pulmonary hypertension.

Falsely Collapsed IVC: increased intra-abdominal pressure, status asthmaticus.

SVC collapsibility:

- Needs TEE.
- Bi-caval view + upper esophageal view at great vessels (Long axis).



SVC Collapsibility Index:

(D max- D min/D max) X 100.

- SVC collapsibility index of >36%
- ---Fluid responsive.
-


31/01/2019 12:18:03 PM
91
5
10
129
HR


31/01/2019 12:18:03 PM
5
10
-4
-3
-2
-1


31/01/2019 12:24:37 PM
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98
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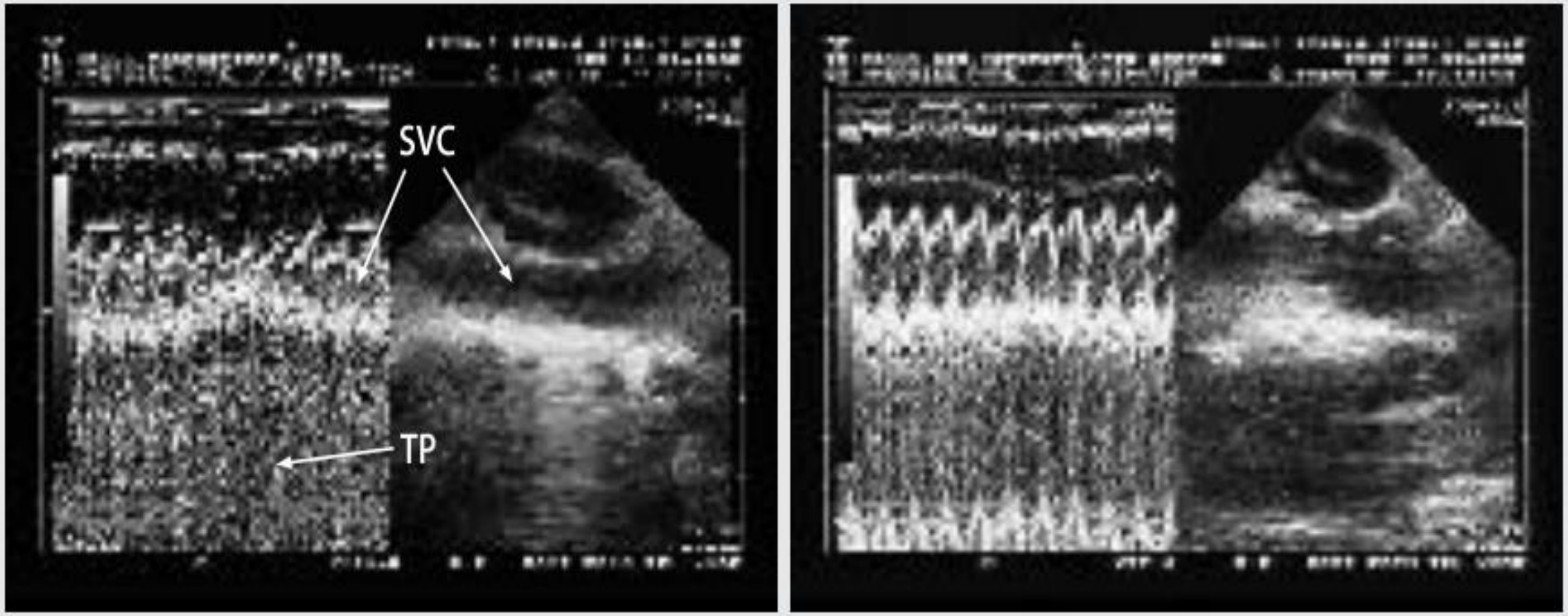
132
HR

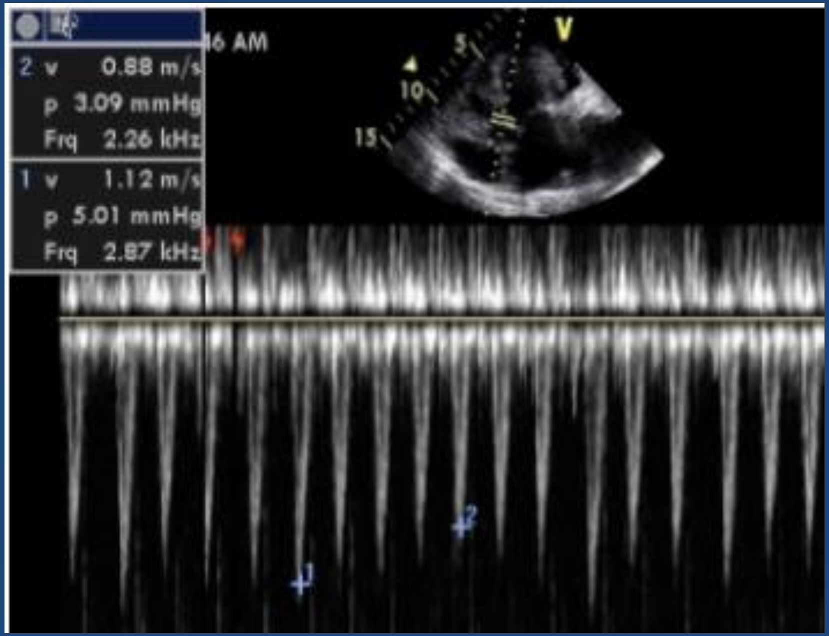


a CI 2.5 l/min/m^2 b CI 4.9 l/min/m^2

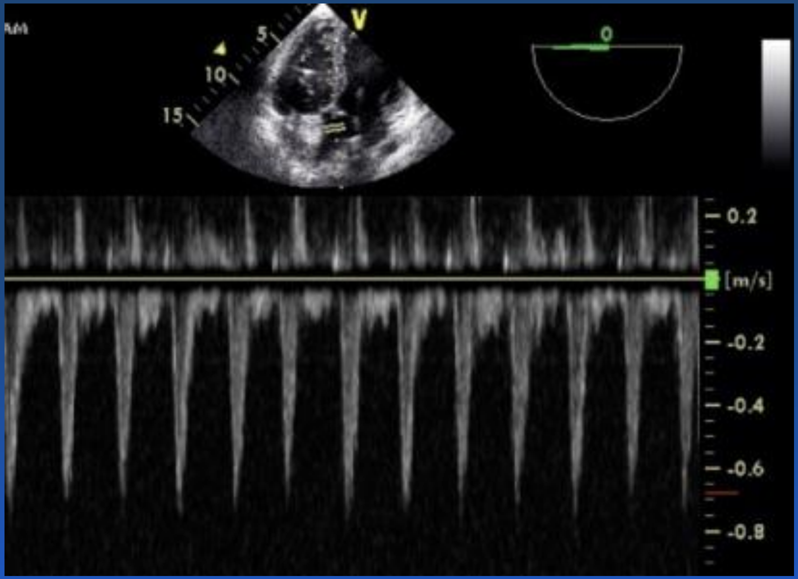
collapsibility index above 36% could predict significant increase in cardiac output after blood volume expansion with a sensitivity of 90% and a specificity of 100%

A. Vieillard-Baron and F. Jardin

Stroke Volume Variability:



$$V\Delta peak = \frac{(Vpeak_{MAX} - Vpeak_{MIN})}{(Vpeak_{MAX} + Vpeak_{MIN})/2} * 100\%$$



A pre-bolus threshold of 12% discriminates between responders and non-responders.

Hatem Soliman Aboumarie Hospital practitioner, Royal Brompton and Harefield NHS/EuroEcho imaging conference 2018.

Passive leg raising:

IT gives an auto bullous of fluid 300-500 ml.

Done in spontaneously ventilated patient.

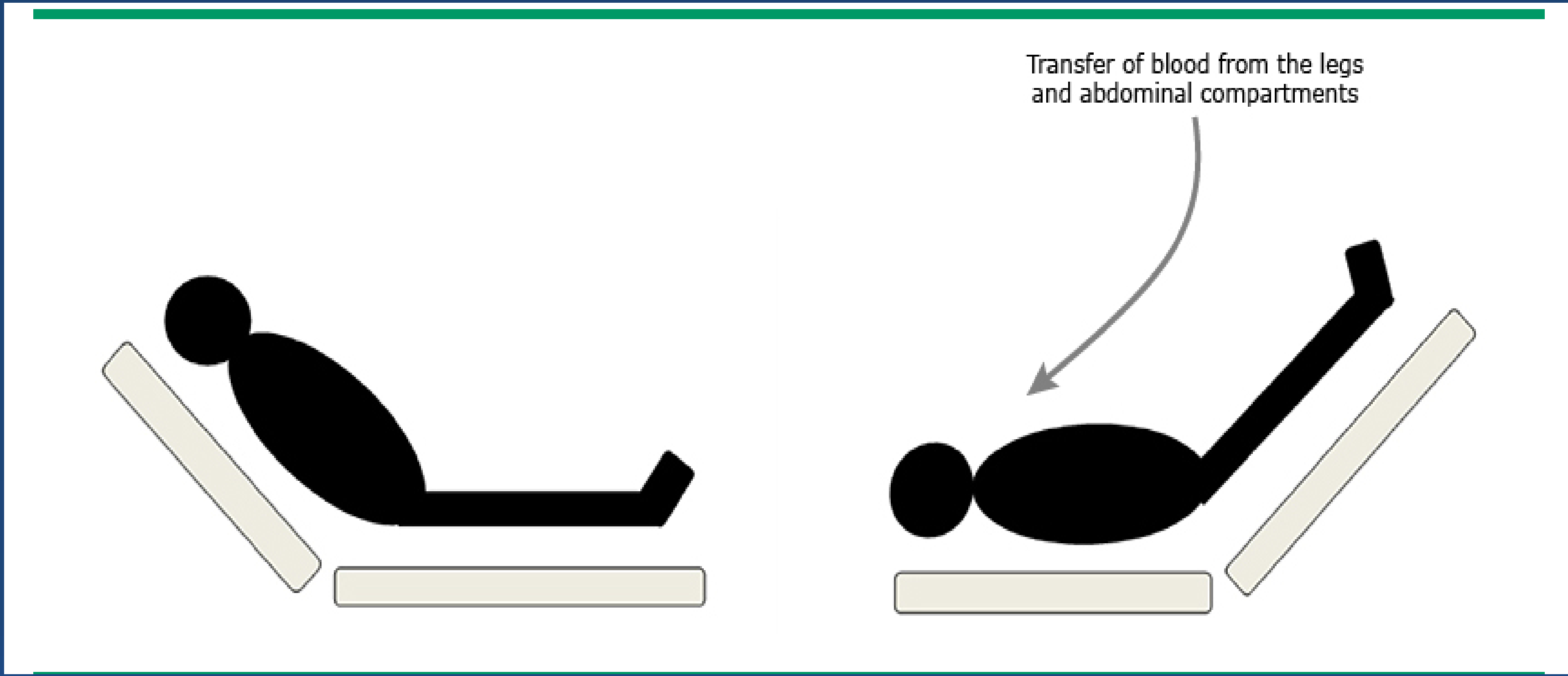
Maintain privacy.

A changes in CO (AV VTI) 12 % indicate fluid responder.

Careful in:

Patient with multiple trauma.

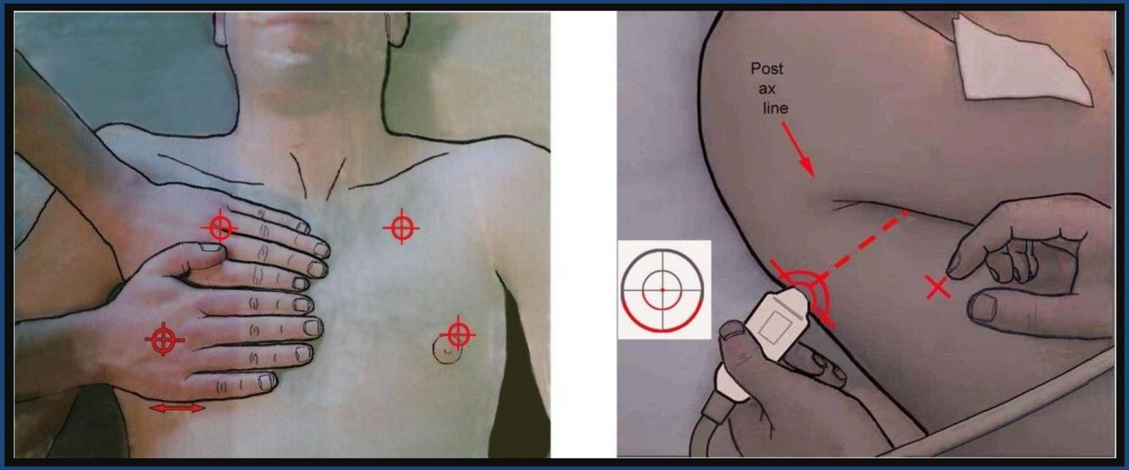
Abdominal compartment.

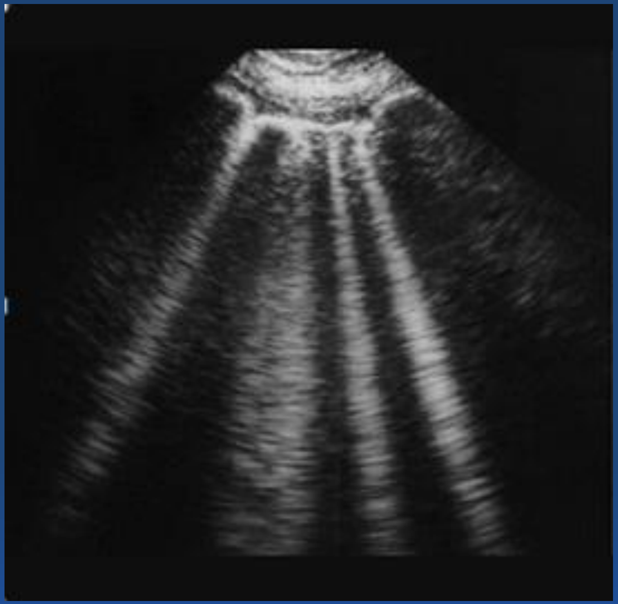


A changes in CO (AV VTI) 12 %
indicate fluid responder.

UpToDate®

Lung ultrasonography/B lines:





Advocates of the concept of "fluid tolerance"

Daniel Lichtenstein Breathe 2017;13:100-111

Septic shock and speckle tracking

Left ventricular global longitudinal strain is independently associated with mortality in septic shock patients.

Chang WT[1], Lee WH[2], Lee WT[2,3], Chen PS[2,3], Su YR[4], Liu PY[2], Liu YW[5], Tsai WC[6].

⊕ Author information

Abstract

PURPOSE: Conventional echocardiography may not detect subtle cardiac dysfunction of septic patients. Two-dimensional left ventricular (LV) global peak systolic longitudinal strain (GLS) can detect early cardiac dysfunction. We sought to determine the prognostic value of GLS for septic shock patients admitted to intensive care units (ICUs).

METHODS: We prospectively included 111 ICU patients with septic shock. A full medical history was recorded for each patient, and LV systolic function, including GLS, was measured. Our endpoints were ICU and hospital mortality.

RESULTS: The ICU and hospital mortalities were 31.5% (n = 35) and 35.1% (n = 39), respectively. There was no significant difference in LV ejection fraction of the non-survivors and the survivors; however, upon ICU admission, the non-survivors exhibited GLSs that were less

CONCLUSIONS: These findings suggest that combining GLS and the APACHE II score has additive value in the prediction of ICU and hospital mortalities and that GLS may help in early identification of high-risk septic shock patients in ICU.

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Septic shock and Diastology

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www.jcdronline.org | www.journalonweb.com/jcdr

Original Article

Relation of Echocardiographic Parameters to Outcome of Patients with Severe Sepsis and Septic Shock

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ABSTRACT

Background: Myocardial dysfunction is one of the most important features of sepsis. The presence of cardiac dysfunction in sepsis has been associated with high mortality rate in septic patients. **Material & Methods**: This was prospective, observational cohort (patient with severe sepsis and septic shock) study conducted over period of one year in medical

death compared to survived population ['p'= 0.0218 and 0.0329]. **Conclusion**: Diastolic dysfunction was common and a major predictor of mortality and outcome in severe sepsis and septic shock and was well correlated with APACHE-II score. Present study favors to use echocardiography as an ideal monitoring, tool in the septic patient for goal-oriented therapy for better outcome.

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Key words: Myocardial dysfunction, Sepsis, APACHE-II score, Echocardiographic parameters, Septic shock.

Patil C et al.: Echocardiography in severe sepsis and septic shock

Left-ventricular global longitudinal systolic strain and strain rate can predict sepsis outcome: comparison between speckle-tracking echocardiography and tissue-Doppler imaging

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Background

Strain imaging, by either tissue-Doppler imaging (TDI) velocity converted to strain or strain rate or by two-dimensional speckle-tracking echocardiography (STE) analysis, is used to evaluate abnormal left-ventricular (LV) mechanical activation patterns in sepsis.

Objective

The aim of this study was to predict sepsis outcomes using LV strain and strain-rate measurements as well as to establish a comparison between STE and TDI.

Patients and methods

This study included 32 patients (43.7±13.7 years, 21 males) [13 patients with sepsis (group 1) and 19 patients with severe sepsis/septic shock (group 2)] and a subset of 10 controls (36.5±8.7 years, eight males). In the first 24 h, color-TDI was performed for LV 16 segments, and Doppler flow profiles were reanalyzed using STE to retrieve LV peak global longitudinal systolic strain (GLSS) and global longitudinal systolic strain rate (GLSSR), which were averaged for the whole segment.

Results

Compared with the controls, ejection fraction (%EF) of both groups were comparable, but GLSS showed increased values (−17.5±2.9 vs. −20.2±1.6%, $P<0.05$ by STE; and −14.9±2.6 vs. −19.7±1.8%, $P<0.001$ by TDI) and for GLSSR

Conclusion

LV GLSS and GLSSR obtained using STE were more specific and showed a better correlation with both Acute Physiology and Chronic Health Evaluation II and %EF rather than TDI in predicting mortality.

predict mortality was 0.9 (95% confidence interval: 0.32–0.48), with best cutoff value at −16.8% (sensitivity: 100%, specificity: 86%), and the area under the curve for GLSS-TDI was 0.76% (95% confidence interval: 0.1–0.44), with best cutoff value at −14.9 (sensitivity: 100%, specificity: 82%).

Conclusion

LV GLSS and GLSSR obtained using STE were more specific and showed a better correlation with both Acute Physiology and Chronic Health Evaluation II and %EF rather than TDI in predicting mortality.

Conclusion

- Echo is not needed for diagnosis of shock, however it has a role in identifying the cause and guide the management.
- Static parameters have limited values compared with dynamic parameters.
- Among the dynamic parameter the SVC collapsibility is the most accurate (If TEE is feasible).
- Speckle tracking and abnormal Diastology have a correlation with the APATCE II score as predictors for morality in septic shock.

Thank you