THE IVC DON’T LIE.

PHILIPPE ROLA

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• I run an urban community hospital ICU in Montreal.
• I’m a #FOAMed supporter, @ThinkingCC on twitter and blog at thinkingcriticalcare.com.
• I dislike recipe-based medicine.
COI - NONE!
THE IVC
Area: \( a \times b \times \pi \)
\[ A_\bigcirc = 3 \times 5 \times 3.14 \]
\[ = 47.1 \text{ unit}^2 \]

Volume of a cylinder:
\[ V = \pi r^2 h \]
Evidence tables: Inferior vena cava collapsibility index (IVC-CI)

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Correlation of IVC Diameter and Collapsibility Index With Central Venous Pressure in the Assessment of Intravascular Volume in Critically Ill Patients

Central venous pressure correlates with inferior vena cava collapsibility index in patients treated in intensive care unit

Inferior vena cava diameter and collapsibility index: A practical non-invasive evaluation of intravascular fluid volume in critically-III patients

Background: Intravascular volume monitoring is an important tool for assessing and maintaining fluid balance in critically-ill patients. However, the non-invasive assessment of intravascular fluid volume remains challenging. The inferior vena cava (IVC) has been studied as a possible indicator of intravascular fluid volume, with measurements including diameter and collapsibility index (IVC-CI). This study aimed to correlate IVC diameter and IVC-CI with central venous pressure (CVP) and assess their utility in critically-ill patients.

Methods: A retrospective analysis of critically-ill patients was conducted. IVC diameter and IVC-CI were measured using ultrasonography. CVP was recorded at the time of IVC measurement. The correlation between IVC diameter, IVC-CI, and CVP was assessed using statistical methods.

Results: A total of 50 critically-ill patients were included in the study. A significant correlation was found between IVC diameter, IVC-CI, and CVP. The IVC-CI was found to be a more sensitive indicator of intravascular fluid volume than IVC diameter.

Conclusion: The IVC-CI shows promise as a non-invasive indicator of intravascular fluid volume in critically-ill patients. Further studies are needed to validate these findings in a larger patient population.

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ORIGIANAL ARTICLE

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Made Wiryana,1 I Made Gede Wiha

ABSTRACT

Inferior vena cava diameter and collapsibility index: A practical non-invasive evaluation of intravascular fluid volume in critically-III patients

Source: PubMed
SO HOW SHOULD WE DO IT?

- Short axis view from RA to sub-hepatic IVC.
- Long axis across same span.
- Eyeball the IVC for size and variation.
- Classify broadly (empty-mid-full...maybe really full)
Full IVC in SAX with “Staghorn” appearance
Philippe Rola @ThinkingCC · Dec 23

#POCUS poll 1 of 2, please answer both and RT! Is the ivc below:

- 71% Full-ish
- 7% Normal-ish
- 2% Empty-ish
- 20% Can’t tell

55 votes · 1 day left
Re:above

24% Full-ish
18% Normal-ish
21% Empty-ish
37% Can’t tell

34 votes • Final results
Three-Dimensional Inferior Vena Cava for Assessing Central Venous Pressure in Patients with Cardiogenic Shock

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Background: The inferior vena cava (IVC) has a complex three-dimensional (3D) shape, but measurements used to estimate central venous pressure (CVP) remain based on two-dimensional (2D) echocardiographic imaging. The aim of this study was to investigate the accuracy of IVC size and collapsibility index obtained by 3D echocardiography for assessing CVP in patients with cardiogenic shock.

Methods: Eighty consecutive echocardiographic examinations performed in 33 patients (mean age, 72 ± 15 years; mean left ventricular ejection fraction, 19 ± 10%) admitted for cardiogenic shock were prospectively included. Two-dimensional and 3D images of the IVC were acquired simultaneously with invasive measurement of CVP, both at rest and during a sniff test. IVC diameters, 3D IVC area, and IVC collapsibility index (IVCCI) were assessed. The eccentricity index was computed from 3D data as the ratio of maximum to minimum IVC diameter. A cutoff value of 10 mm Hg for CVP defined patients with euolemic hemodynamic status.

Results: At rest, IVC diameter averaged 23 ± 7 mm by 2D imaging and 25 ± 8 × 19 ± 7 mm by 3D imaging. The IVC had an eccentric shape (eccentricity index = 1.3) that increased when CVP was ≤10 mm Hg and during the sniff test (P < .001). IVC measurements by 2D and 3D imaging were correlated with CVP. The best correlation was obtained with IVCCI derived from 2D diameters (r = −0.69) and 3D area of 50% for IVCCI, 11 examinations were misclassified by 2D imaging and intraobserver reproducibility for IVC area was 7 ± 6% and 5 ± 3%, respectively.

Conclusions: In patients with cardiogenic shock, IVCCI from area by 3D echocardiography is more accurate to evaluate CVP. (J Am Soc Echocardiogr 2018;31:1034-43.)

Clinical Implications

Compared with standard 2D echocardiography, 3D IVC imaging provided a better assessment of IVC shape and seemed to be more accurate to estimate CVP. In our population, IVCCI derived from 3D area was best correlated with invasive CVP, and the cutoff of 50% seems to be particularly accurate to identify low and high CVP values. In the setting of cardiogenic shock, the correlation between changes in IVCCI and in CVP may be particularly interesting for adapting fluid and diuretic doses. Furthermore, reproducibility of 3D IVC area measurement was acceptable for clinical use.
ONE VIEW IS NO VIEW!
• The IVC is my friend

• I don’t care about volume responsiveness (...or at least not much.)
If I had an hour to solve a problem and my life depended on it, I would use the first 55 minutes determining the proper questions to ask.

Albert Einstein
ASK THE RIGHT QUESTIONS

or look like a muppet
SO WHAT ARE THE RIGHT QUESTIONS?

• Do I have a massive PE? (not unless I’m full+)
• Do I have tamponade? (not unless I’m full+)
• Do I have a tension pneumothorax? (not if I’m not full+)
• Should I stop giving fluids? (if I’m full, most probably, because I’m probably not volume tolerant)
• Do I need to check for venous hypertension? (if I’m full, yes!)
• Am I volume depleted? (if I’m really small, maybe, but you have to correlate w/cardiac POCUS to r/o hyperdynamic state and physical exam to r/o significant vasodilation)
• Am I volume responsive? (if I’m small or mid-sized with respiratory variation, probably)
THE PROBLEM WITH THE QUEST FOR FLUID RESPONSIVENESS...
FLUID RESPONSIVENESS

YOU HAVE BEEN TERMINATED
**Respiratory**
- Pulmonary edema ↑
- Pleural effusion ↑
- Altered pulmonary and chest wall elastance (cfr IAP ↑)
- \( \text{paO}_2 \downarrow \text{paCO}_2 \uparrow \text{PaO}_2/\text{FiO}_2 \downarrow \)
- Extra vascular lung water ↑
- Lung volumes ↓ (cfr IAP ↑)
- Prolonged ventilation ↑
- Difficult weaning ↑
- Work of breathing ↑

**Central nervous system**
- Cerebral edema, impaired cognition, delirium
- ICP ↑ CPP ↓ IOP ↑
- ICH, ICS, OCS

**Cardiovascular**
- Myocardial edema ↑
- Conduction disturbance
- Impaired contractility
- Diastolic dysfunction
- CVP ↑ and PAOP ↑
- Venous return ↓
- SV ↓ and CO ↓
- Myocardial depression
- Pericardial effusion ↑
- GEF ↓ GEDVI ↑ CARS ↑

**Hepatic**
- Hepatic congestion ↑
- Impaired synthetic function
- Cholestasis ↑
- Cytochrome P 450 activity ↓
- Hepatic compartment syndrome

**Gastrointestinal/visceral**
- Ascites formation ↑
- Gut edema ↑
- Malabsorption ↑ ileus ↑
- Bowel contractility ↓
- IAP ↑ and APP (=MAP-IAP) ↓
- Success enteral feeding ↓
- Intestinal permeability ↑
- Bacterial translocation ↑
- Splanchnic microcirculatory flow ↓
- ICG-PDR ↓, pH↓

**Abdominal Wall**
- Tissue edema ↑
- Poor wound healing ↑
- Wound infection ↑
- Pressure ulcers ↑
- Abdominal compliance ↓

**Renal**
- Renal interstitial edema
- Renal venous pressure ↑
- Renal blood flow ↓
- Interstitial pressure ↑
- Salt + water retention ↑
- Uremia ↑ GFR ↓ RVR ↑
- Renal CS

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*From The Fluid Academy*
2 COGNITIVE PARADIGMS:

FLUIDS ARE BETTER THAN PRESSORS.

ALL SHOCK BENEFITS FROM MAXIMIZING CARDIAC OUTPUT.
TAKE-HOME MESSAGES:

THE IVC IS YOUR FRIEND TOO.

JUST ASK IT THE RIGHT QUESTIONS.

LESS IS OFTEN MORE.
QUESTIONS?

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Thank you!