Fluid Responsiveness & Tolerance

REFERENCE

DEFINITIONS

- Fluid responsive (FR): a 10–15% increase in cardiac output when fluid is administered
- FR does not mean fluid is 'needed' — only that cardiac output will increase with volume
- Fluid tolerance (FT): the absence of harm (e.g., pulmonary edema) when fluid is given
- Only about 50% of septic patients are FR, but FR can be assessed in most patients
- Clinical parameters (hourly urine output, MAP) lag and do not reliably predict FR
- Predicting FR allows parsimonious fluids: less fluid balance, shorter vasopressors, lower renal failure risk

HOW TESTS WORK

- Some measurements predict FR in isolation (respiratory variation in PPV or LVOT VTI)
- Others must be combined with a CHALLENGE maneuver (NICOM or EtCO2 with passive leg raise)
- End-tidal CO2: increased cardiac output delivers more CO2 to the lungs, raising exhaled CO2
- Pulse oximetry waveform analysis is analogous to arterial-line PPV measurement

THRESHOLDS & PERFORMANCE

- ΔEtCO2 ≥5% with PLR predicts FR; ΔEtCO2 <2 mmHg is unlikely FR; combine with PLR, not micro-bolus
- EtCO2 method: good performance (AUROC 0.85) in ventilated patients; not in spontaneous breathing
- Pleth variability 15% predicts FR — performance poor (AUROC 0.63), limited studies
- IVC distensibility >15% is the best threshold; performance poor overall (AUROC 0.69–0.71)
- IVC may perform better in intubated patients without spontaneous breaths; complete IVC collapse may be more sensitive
- LVOT VTI increase >15% predicts FR with good performance (AUROC 0.92), but may be technically difficult
- Static LV end-diastolic area ('kissing papillary muscles' is the extreme): performance poor (AUROC 0.64)

POCUS & TOLERANCE

- Lung A-line predominant pattern suggests fluid tolerance — a bolus can be given without pulmonary edema risk
- Sonographic lung changes precede other signs of volume overload
- Carotid VTI: similar to LVOT VTI but easier to measure, facilitating repeat measurements
- VeXUS protocol integrates portal, hepatic, and renal vein Doppler with other POCUS measures; studies ongoing
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Take Home Message:

Fluid responsiveness means cardiac output will rise with volume — not that fluid is needed; test before you give, and check tolerance too.

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