The Basics of Echocardiography for PE
What the Vascular Specialist Should Know, and Is an Emergent Echo Necessary

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Disclosures

- No relevant financial relationships

Transthoracic Echocardiography (TTE) Review

- **Key TTE views to focus on right heart:**
  - Parasternal long axis (RV inflow and RV outflow/PA)
  - Parasternal short axis (multiple RV levels, PA)
  - Apical four chamber (RA/RV in multiple planes)
  - Subcostal view (IVC ± SVC, RA/RV, PA)

Questions for TTE in Acute PE

- **“Is there a PE?”**
  - Diagnostic
  - Overall sensitivity ~50-70%
  - PE diagnosis based on RVH, RVD, TRV
  - Need > 25% PA obstruction to manifest an echo correlate
  - difficult to exclude PE by TTE

- **“How severe is this PE?”**
  - Prognostic

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  - Diagnostic

- **“How severe is this PE?”**
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Right Heart Thrombi ("thrombus-in-transit") in ICOPER

- Duration of symptoms (2.2 v. 4.3 days)
- RVHK (64% v. 40%)
- p = 0.036

N=1,113 PE with TTE
n=42 with RHTh (4.0%)

On TTE, emboli can be visualized in:
- IVC, RA, RV, PA (proximal)

Echo Contribution to Etiology

- Venous thrombi
  - Mimic casts of deep veins
  - More homogenous echotexture
  - Smooth
- Consider alternate etiology if
  - Irregular shape or echotexture
  - Densely laminated
  - ? Attaching point

Non-Venous Thrombi: Echo DDx

- Non-venous thrombi
  - Liquefied thrombus
  - Tumors
    - Myxoma (LA>RA, septum, pendunculated)
    - PFE (valves, usually AV)
    - Hematologic
    - Sarcomas
    - Invasive from
      - Lung (hemangiosarcoma)
      - IVC (RCC)
  - Infective endocarditis
    - Valve vegetations

Questions for TTE in Acute PE

"Is there a PE?"
- Diagnostic
  - Overall sensitivity ~50-70%
    - difficult to exclude by TTE
  - Look for thrombus-in-transit
  - Non-venous emboli PE?
- Prognostic
  - Echocardiography in the Management of Pulmonary Embolism
    - JASE 2011;24:229.
    - Annals 2002;136:691.
    - AJM 2001;110:528.

"How severe is this PE?"
- Diagnostic
  - Overall sensitivity ~50-70%
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Risk Stratification

- Estimated prevalence (%)
  - Massive (High) 25%
  - Submassive (Int-high) 10%
  - Lower (Int-low) 5%
  - OHCA 2%


We never know the patient’s "baseline" - generally left with absolute, population based standards

Questions for TTE in Acute PE

"Is there a PE?"
- Diagnostic
  - Overall sensitivity ~50-70% - difficult to exclude by echo
  - Look for thrombus-in-transit
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"How severe is this PE?"
- Prognostic
  - RV/chamber sizes - RVEDD, RV/LV
  - RV function (HK)
  - Septal geometry - Quantitative measures
  - Hemodynamics - TRV, PASP

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Other Size Measures

- IVC: ? Hemodynamics
- RV/RA: dilatation
- PA: ? chronicity

RV Function

- No standard RV EF
  - RV FAC
  - 3D EF

"Non-volumetric" measures
- Global
  - MPI
  - RV sPAP
- Regional
  - S'
  - TAPSE
  - Acceleration time
  - Strain

We never know the patient’s "baseline" - generally left with absolute, population based standards

RV Function = research applications, time-consuming & operator dependent, & generally not validated across populations or in PE

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  - RV FAC
  - 3D EF

"Non-volumetric" measures
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  - MPI
  - RV sPAP
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Default to 2D analysis of RV
Prognostic Value of Echocardiography in Normotensive Patients With Acute Pulmonary Embolism

Tricuspid Annular Plane Systolic Excursion

- Measure of longitudinal RV excursion; assumes
  - Local ≈ global function
  - Base reflective of free wall and apex (specifically may not be true in disease)
- ↓ in PE, PAH, and CTEPH
- Operator/image dependent but has prognostic info

TAPSE in Normotensive PE Patients

- 411 PE pts
  - Age 64 ± 18
  - 58% submass, 41% low risk
  - 2% lytic
- Time to TTE
  - Admit: 193
  - <24h: 159
  - <72h: 59
- TAPSE ≤ 15
  - 20% PPV
  - 99% NPV

CT v. TTE for Submassive PE

- n=298, age 59 ± 17, 49% ♀, 90% Caucasian
- 104 had CT and TTE; 14 had composite outcome
- (+) RVS on CT
  - 5 Day Event
  - Subtotal
- (-) RVS on CT
  - 5 Day Event
  - Subtotal

Right Ventricular Systolic Pressure

TR as a function of RVSP
Summary: Roles of TTE in Acute PE

- Size and nature of thrombus (DDx)
- Location
  - Point of origin (may impact etiology)
  - Attachments (catheters, native anatomy)
  - Interference with RV function, tricuspid valve anatomy
- Hemodynamic consequences
  - RV dysfunction ± ischemia: dilatation, WMA, TAPSE, TDI/S', ? strain
  - Right sided pressures: above and TRV
  - Right sided overload: RVD, RAD, IVCD, HVD
  - Septal geometry: diastolic and systolic septal flattening
- DDx and Chronicity of Pulmonary HTN / RV Pathology
  - RVMI, r/o occult, congenital, shunt, LV disease
    - Other causes of dyspnea: LVSD, valvulopathy, effusions
  - Chronicity (RVH, ? PA size)

Using Echo in PE

- Assess contributing comorbidities
- Plan, guide interventions
- Any evidence of RV dysfunction
  - Exam
  - EKG
  - Troponin, NPs
- "High" clot burden (DVT)
- "Moderate" clot burden
- Neurologic symptoms
- ?, as TTE defines submassive v. lower risk
  - Predict low risk trajectory
  - TEE rarer, spared PFO during interventions

Vascular Specialists Should Know:

- TTE provides key information in describing thromboemboli and identifying RV dysfunction
  - Differential diagnosis
  - Prognosis and risk of decompensation
  - Therapeutic decisions and procedural guidance
  - Followup
- Need & timing based on clinical scenario, trajectory
- Caveats of TTE in PE: expertise required, lack of prior baseline, reference ranges, chronicity v. acuity

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