Ultrasound
Emergency cardiac sonography

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Focused Questions:

What is the Lung profile?

Pericardial fluid and tamponade physiology present?

Left and right ventricle function poor, normal, or hyperdynamic?

IVC variation and size?

Probe: Low frequency phased array
Introduction

How to see the heart and why does the intensivist want to see the heart

Pulmonary edema is a lung diagnosis (must integrate lung in emergent evaluation of heart)

RACE (Maclean)

FEER (Breitkreutz 2007)

FATE

FOCUS
Introduction

Measurements rarely made; visual medicine but can use M-mode for documentation purposes

Heart routes: Parasternal, apical, subxiphoid

Knowing all views important in critical care because very patient dependent as to which is optimal
Anatomy of the ultrasound views

Parasternal long/short

Apical

Subxiphoid
Contractility (systolic function)

M mode left ventricular shortening fraction normally 28-38% in Parasternal short axis view at or slightly below mitral valve level = dimension in diastole - dimension in systole divided by diastolic dimension

Diastolic dysfunction hard to detect

LV contractility field large in subtleties, preload and afterload status, cardiac window positioning, operator experience

CHECK LUNG for B profile bilateral suggestive of pulmonary edema

Squeeze of the pump

Determination of global left ventricular function

LV walls: visual calculation of % change from diastole to systole

Ejection Fraction: Radionuclide imaging and visual determination roughly equivalent

Amico AF. Am Heart J. 1989
Squeeze of the pump

**Good/hyperdynamic contractility**: walls almost come together and almost obliterate ventricular cavity during systole

**Poor contractility**: walls move little and heart may be dilated

**Anterior leaflet of mitral valve**: in normal state will vigorously touch septum during ventricular filling (best in parasternal long view axis)

Vignon. Chest. 1994
Video

Perera P. "http://www.sound-bytes.tv"
Perera P. "http://www.sound-bytes.tv"
Strong Contractility

Left Ventricle

Perera P. "http://www.sound-bytes.tv"
Perera P. "http://www.sound-bytes.tv"
Video

Perera P. "http://www.sound-bytes.tv"
Video

Perera P. "http://www.sound-bytes.tv"
Squeeze of the pump

Segmental wall motion abnormalities?
Squeeze of the pump

Segmental wall motion abnormalities?

Again, can we do this?

EP's can...estimate of LV contractility

Identification of cardiogenic shock leads to earlier revascularization

Hyperdynamic in early sepsis, hypovolemia

Repeated evaluations, changes in contractility over time

Right heart failure

Acute right heart failure shows early RV dilation, displacement of septum, and tricuspid regurgitation.

Absence of B profile in patient with acute respiratory failure indicates right heart anomalies expected.

Once in Parasternal short axis at mitral valve level, slight angulation/fanning superiorly should allow you to view pulmonary valve level and evaluate main pulmonary trunk for thrombus.
Strain of the pump

Assessment of right ventricular strain

Normal LV:RV = 1 to 0.6

Optimal views: parasternals and apical... Subxiphoid can be used but need to 'fan' through RV

RV dilation: acute pressure rise in pulmonary circuit (large central pulmonary embolus classic example)

Interventricular septum right to left toward LV signal high pressures within pulmonary artery

Jardin F. Chest. 1997
Jardin F. J Am Coll Card. 1987
Strain of the pump
Strain of the pump

Gradual increase?

Dilation of RV and thickening or hypertrophy of RV wall
How can we use this

Sensitivity of right heart dilation is moderate but specificity and positive predictive value high in appropriate clinical scenario, especially hypotension

Correlates with poorer prognosis

TPA?

Unstable for CT

Becattini C. Intern Emerg Med. 2007
Effusion around the pump

Grades

Small less than 10 mm

Moderate 10-15 mm

Large greater than 15 mm
Effusion around the pump

Tamponade or not?

Hallmark: RV free wall inversion, best recognized during diastole

Right atrial inversion during systole (more common and early finding)

Increased respiratory variation of mitral or aortic inflow velocities (greater than 25%)

Dilated inferior vena cava with decreased inspiratory collapse

ASE Committee Recommendations. Am Soc Echocardiography. 2005
Can **We** do this?

At times, information and disorders noted are vast and may surpass your ability to appreciate and integrate

American Society of Echocardiography / American College of Emergency Medicine Consensus Statement: the ability to assess global LV function, detect pericardial effusions, and right heart dilation are **within the scope** of emergency physicians

Labovitz AJ. Focused cardiac ultrasound in the emergent setting: a consensus statement of the American Society of Echocardiography and ACEP. J Am Soc Echocardograph. 2010
Effusion around the pump
Perera P. "http://www.sound-bytes.tv"
Parasternal Long Axis-Pleural Effusion
Video

Perera P. "http://www.sound-bytes.tv"
Perera P. "http://www.sound-bytes.tv"
Video

Perera P. "http://www.sound-bytes.tv"
Video

Perera P. "http://www.sound-bytes.tv"
Effusion around the pump - tamponade
Video

Perera P. "http://www.sound-bytes.tv"
Video Perera P. "http://www.sound-bytes.tv"

Tuesday, November 10, 15
Can **we** do this?

EP's with limited training can -- effusion

Tamponade a bit harder, but...
hypotension + pericardial effusion * concerning

**Pericardiocentesis** -- Mayo Clinic -- 1127 procedures
Distance to effusion least and size maximal
Apical position -- 80%, subxiphoid 20%

Tsang T. Mayo Clinic Proc. 2002
Video

Perera P. "http://www.sound-bytes.tv"
Perera P. "http://www.sound-bytes.tv"
Right heart failure

Segmental wall motion abnormalities requires more expertise

Valvular diseases can be suspected but gold standard is TEE

Intracavitary thrombosis and tumors can be identified

Intracavitary devices (PA cath, ECMO)

Role is to rule out stuff previously reviewed in this lecture