

Cardiac Ultrasound

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Cardiac Ultrasound

Image Acquisition

- Patient Preparation
 - Expose patient's entire chest to the xiphoid
- Patient Position
 - Supine
 - Subcostal window
 - IVC evaluation
 - Parasternal window
 - Left Lateral Decubitus
 - Raised arm above head



Cardiac Ultrasound

Introduction

- Why use US
 - Bedside, clinician-performed
 - More sensitive than physical exam
 - Quickly eliminate life threatening diagnosis
 - Pericardial effusion and tamponade
 - Guide resuscitation
 - Differentiate shock state
 - Able to estimate cardiac function
 - Ejection fraction
 - Cardiac standstill
 - Focal hypokinesis



Cardiac Ultrasound

Machine Setup

- Sector probe (cardiac probe)
 - 3.5 MHz
- Curvilinear probe (abdominal probe)
 - 3 to 5 MHz (or broadband)



Cardiac Ultrasound

Clinical Applications

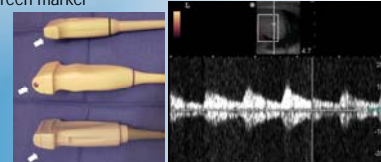
- Assessment of Patients presenting with:
 - Chest Pain
 - Dyspnea
 - Trauma
 - Cardiac arrest
 - Unexplained Hypotension
 - Unexplained Syncope



Cardiac Ultrasound

Machine Setup

- Probe Orientation (Standardization)
 - Probes are oriented on the body by a convention
 - Probes have a marker which corresponds to a marker on the screen
 - The marker must be oriented to correspond with the screen marker



Cardiac Ultrasound

- Probe Orientation
 - Abdominal Imaging
 - Towards the patient's **head**

US Physics

- Probe Orientation
 - Cardiac Imaging

Cardiac Ultrasound

- Probe Orientation
 - Abdominal Imaging
 - Towards the patient's **right**

US Physics

- Probe Orientation
 - Cardiac Imaging

Cardiac Ultrasound

- Probe Orientation
 - Cardiac Imaging
 - Towards the patient's **left**

US Physics

- Probe Orientation
 - Cardiac Imaging

Window	Probe Orientation
Subcostal (subxiphoid) Cardiac	Probe marker towards Left flank
Subcostal (subxiphoid) IVC	Probe marker towards Head
Parasternal Long	Patients Right shoulder
Parasternal Short	Patients Left shoulder
Apical 4 chamber	Probe marker towards Left flank

Cardiac Ultrasound

- Normal Anatomy
 - 4 chambers
 - Ventricles have papillary muscles
 - Mitral and Aortic Valves most commonly visualized on ultrasound

Cardiac Ultrasound

- Subcostal Window

Window: Subcostal

- RV Right Ventricle
- RA Right Atrium
- LA Left Atrium
- LV Left Ventricle
- Mv Mitral Valve
- Tv Tricuspid Valve

Cardiac Ultrasound

- Normal Anatomy
 - 3 Cardiac Windows
 - Each window provides different view of same structures
 - Some structures are visualized best in certain windows
 - Some calculations are made using certain windows
 - Rarely will any person have an adequate window in all three positions
- Windows
 - Subcostal / Subxiphoid (4 and 5 chamber and IVC)
 - Parasternal (long and short)
 - Apical (2, 4, and 5 chamber)

Cardiac Ultrasound

Cardiac Ultrasound

- Subcostal Window
 - Patient Position
 - Flat/supine
 - Probe Location
 - Epigastrium, subcostal
 - Pointed towards patient's left
 - Angle under ribs (hand flat on abdomen)

Cardiac Ultrasound

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Cardiac Ultrasound



Subcostal Window

- Advantages
 - Very useful view
 - Does not interfere with resuscitation/CPR
 - Useful in procedures (transvenous pacemaker)
 - Lungs do not inhibit view
- Disadvantages
 - Deeper depth needed
 - See structures with less detail, particularly the left side of heart
 - Difficult in patients with a protuberant abdomen
 - May have to use pressure to obtain adequate view

Cardiac Ultrasound



IVC Physiology

- Size is a dynamic variable
 - Related to the Central Venous Pressure
- IVC collapses during inspiration
 - Expansion of the chest cavity draws blood out of the IVC (pump action)
- IVC dilates during expiration

Cardiac Ultrasound

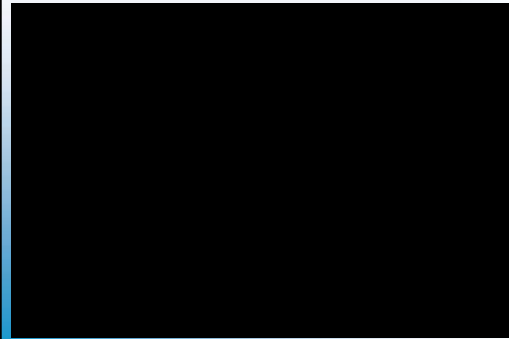


Subcostal IVC

- Patient Position
 - Flat/supine
- Probe Location
 - Epigastrium, slightly right of center
 - Pointed towards patient's head
 - Angle towards back (spine)



Cardiac Ultrasound



Cardiac Ultrasound



Subcostal (IVC)



IVC dilates normally during expiration



IVC collapses normally during inspiration

Subcostal IVC variation with respiration

IVC Inferior Vena Cava
RA Right Atrium
Hv Hepatic Vein
L Liver



Cardiac Ultrasound



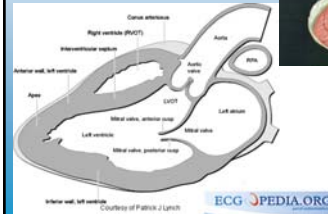
Cardiac Ultrasound

- Subcostal IVC
 - Advantages
 - Can correlate patient condition to central venous pressure
 - Differentiate shock states
 - Evaluate response to resuscitation
 - Disadvantages
 - Patient must be in supine position



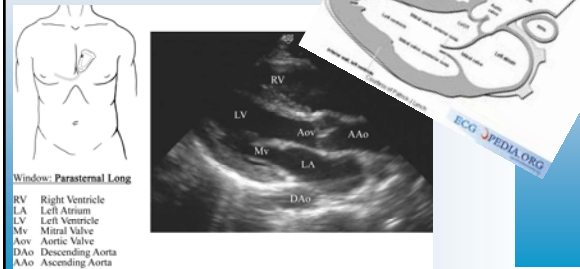
Cardiac Ultrasound

- Parasternal Long Axis



Cardiac Ultrasound

- Parasternal Long Axis



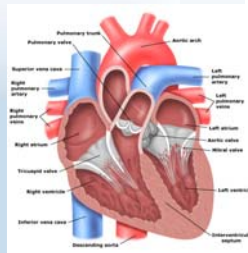
Cardiac Ultrasound

- Parasternal Window
 - Patient Position
 - Flat/supine
 - Two Views
 - Parasternal Long Axis
 - Parasternal Short Axis
 - Probe Location
 - 2nd/3rd intercostal space just left of sternum
 - Pointed towards patient's Left shoulder (long axis)
 - Pointed towards patient's Right shoulder (short axis)

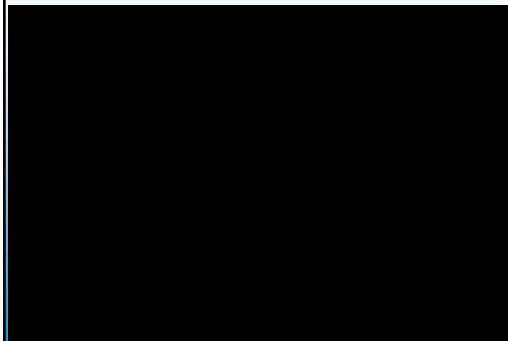


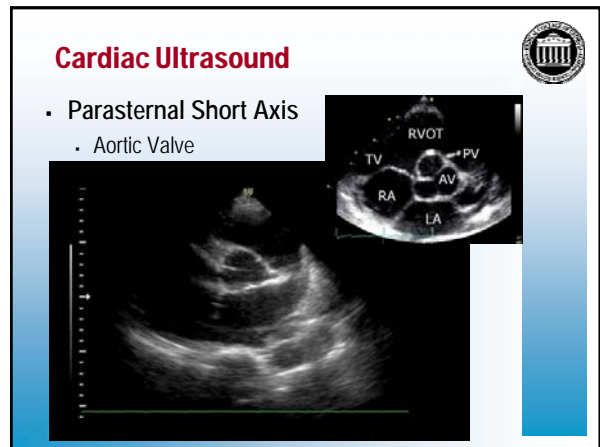
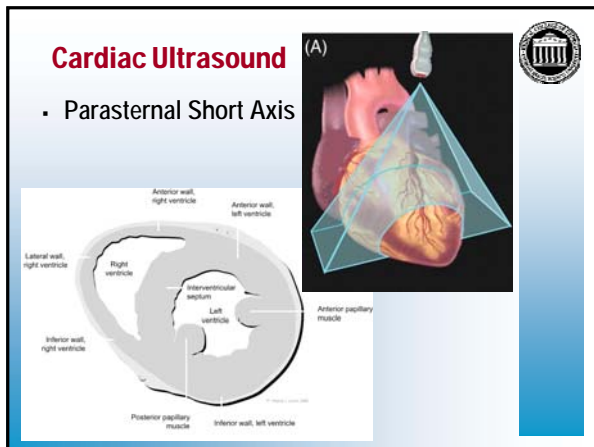
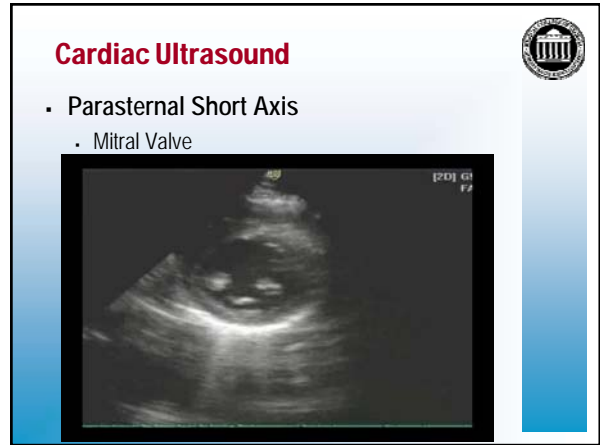
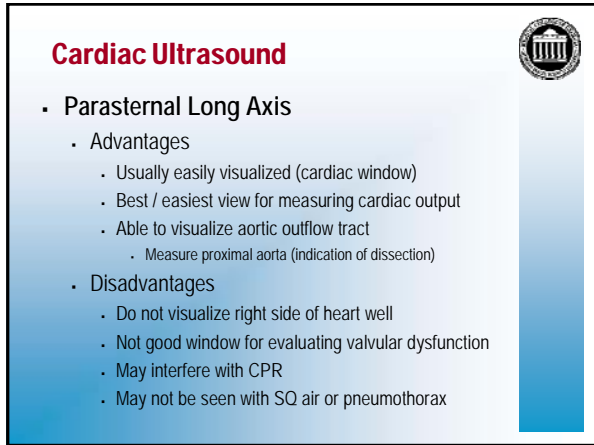
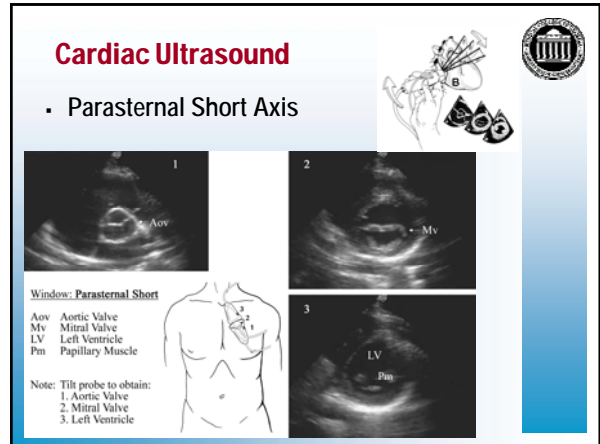
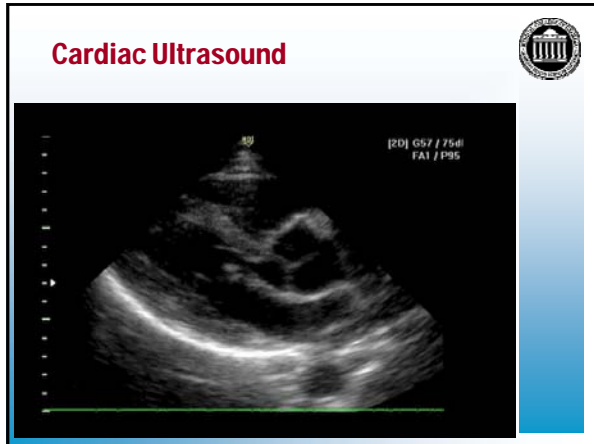
Cardiac Ultrasound

- Parasternal Window
 - Expected Structures
 - Long Axis
 - Long axis view of Left Ventricle
 - Left ventricular out flow tract
 - Mitral and Aortic Valve
 - Short Axis
 - Cross section view of
 - Left Ventricle, Aortic valve, Mitral valve



Cardiac Ultrasound





Cardiac Ultrasound

- Parasternal Short Axis
 - Clinically correlate wall motion abnormalities

Segment Model for Wall Motion Abnormalities

A	Anterior	- LAD
AL	Anterolateral	- LAD
AS	Anteroseptal	- LAD
IL	Inferolateral	- Circumflex Artery
I	Inferior	- RCA
IS	Inferoseptal	- RCA
RV	Right Ventricle	

Window: Cardiac Parasternal Short

Basal

Mid

Apical

Cardiac Ultrasound

- Parasternal Short Axis
 - Advantages
 - Usually easily visualized (cardiac window)
 - Correlates (orthogonal view) with PS Long Axis
 - Good view for wall motion abnormalities
 - Gross estimation of ejection fraction (EF)
 - Disadvantages
 - Have to pan probe to see all structures

Cardiac Ultrasound

- Parasternal Short Axis
 - Left Ventricle

Cardiac Ultrasound

- Apical Window
 - Patient Position
 - Left lateral decubitus position
 - Probe Location
 - Palpate PMI (point of maximal impulse)
 - Place probe at PMI with indicator pointed towards Left

Cardiac Ultrasound

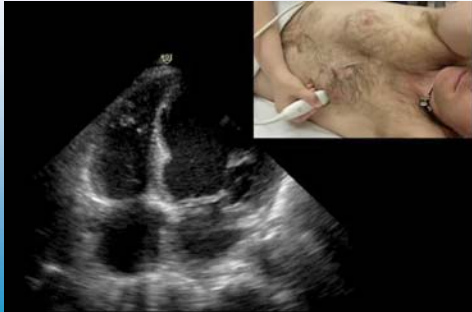
Cardiac Ultrasound

- Apical Window
 - 4 Chamber View

Window: Apical

RV	Right Ventricle
RA	Right Atrium
LA	Left Atrium
LV	Left Ventricle
Mv	Mitral Valve
Tv	Tricuspid Valve

Cardiac Ultrasound



Cardiac Ultrasound



- Pearls
 - Most patients do not have an adequate view of the heart in all windows
 - Move the probe to create the ideal image
 - Anatomy is variable
 - Correlate anatomy and structures to clinical data to improve patient care

Cardiac Ultrasound



Cardiac Ultrasound



- Time for Hands-On Practice
- Questions?



Cardiac Ultrasound



- Apical Window
 - Advantages
 - Can visualize all 4 chambers at same time
 - Important in gauging enlargement of chambers
 - With decubitus positioning, heart is superficial structure
 - Good detail, usually obtainable window
 - Since in axial plane to probe
 - Good window for Doppler evaluation of blood flow through valves
 - Disadvantages
 - Have to position patient, may not be possible in all patients