Good morning. I’m going to talk today about basic transthoracic echocardiography, focusing primarily on obtaining views which will allow you to identify important pathology in real time at the patient’s bedside.
During the next 15 minutes, I'm going to discuss the probe we use for basic echo, review some basic cardiac anatomy and orientation, talk about some of the principles of cardiac imaging, and finally spend some time going over the main TTE views.
During the next 15 minutes, I'm going to discuss the probe we use for basic echo, review some basic cardiac anatomy and orientation, talk about some of the principles of cardiac imaging, and finally spend some time going over the main TTE views.
So first - the probe:
So first - the probe:
For cardiac ultrasound, we generally use a small footprint phased array transducer, with a frequency of 2-5 MHz.

There are 2 main modes used in basic TTE:

1) Two-dimensional (2-D): examines the three-dimensional heart using acoustic windows and imaging planes to develop a series of standard 2-dimensional images.

2) Motion or M-mode: which produces one-dimensional information on a time-motion graph; information is displayed along a line representing the ultrasound beam direction; M-mode records the depth and motion of echoes arising from intracardiac structures relative to time.
Every probe has a marker (either a dot or a notch) that will correspond to the screen and which can help orient the operator to the image on the screen.
Every probe has a marker (either a dot or a notch) that will correspond to the screen and which can help orient the operator to the image on the screen.
There are four main movements of the probe which allow for image acquisition and adjustment. Sliding is placing the footprint of the probe on different points on the thoracic wall, without changing the rotation or tilt of the transducer. Movement of the transducer can be inferior, superior, lateral, or medial.
There are four main movements of the probe which allow for image acquisition and adjustment. Sliding is placing the footprint of the probe on different points on the thoracic wall, without changing the rotation or tilt of the transducer. Movement of the transducer can be inferior, superior, lateral, or medial.
Rocking is angling the probe on the plane of the marker (angling towards or away from the indicator): this brings the visualized structures more or less to the center of the scan sector, keeping the same plane of investigation.
Rocking is angling the probe on the plane of the marker (angling towards or away from the indicator): this brings the visualized structures more or less to the center of the scan sector, keeping the same plane of investigation.
Probe Manipulation

- SLIDING
- ROCKING
- TILTING
- ROTATION

Tilting refers to the “up and down” movement of the transducer from a fixed point on the chest wall, such that the footprint remains in the same place on the chest wall but the tail of the transducer is moved.
Probe Manipulation

- SLIDING
- ROCKING
- TILTING
- ROTATION

Tilting refers to the “up and down” movement of the transducer from a fixed point on the chest wall, such that the footprint remains in the same place on the chest wall but the tail of the transducer is moved.
Probe Manipulation

- SLIDING
- ROCKING
- TILTING
- ROTATION

Rotation refers to pivoting or twisting the transducer from a fixed position on the chest wall, clockwise or counterclockwise. For example, when in the parasternal long axis view, if you rotate the probe clockwise, the imaging plane changes to the parasternal short axis view.
Rotation refers to pivoting or twisting the transducer from a fixed position on the chest wall, clockwise or counterclockwise. For example, when in the parasternal long axis view, if you rotate the probe clockwise, the imaging plane changes to the parasternal short axis view.
Next we'll move to some basic cardiac anatomy and orientation.
Next we’ll move to some basic cardiac anatomy and orientation
As you all know, the heart sits in the mediastinum, with the most anterior structure being the RIGHT ventricle.
Here we see that the heart is actually in a tilted, or “off-axis” position in the chest, different from the typical anatomic axis you see when looking at a CT or MRI. This is important because when viewing the heart with ultrasound, you need to adjust your probe given the tilted position of the heart to adequately visualize the structures you are searching for.
Here we see that the heart is actually in a tilted, or “off-axis” position in the chest, different from the typical anatomic axis you see when looking at a CT or MRI. This is important because when viewing the heart with ultrasound, you need to adjust your probe given the tilted position of the heart to adequately visualize the structures you are searching for.
There are 3 main windows of the heart performed in basic transthoracic echo:
First - the subcostal window, which slightly to the RIGHT of the midline of the body under the xiphoid process, and utilizes the liver to create an acoustic window
Next - the parasternal window is the area bounded superiorly by the LEFT clavicle, medially by the sternum, and inferiorly by the apical region
Finally - the apical window is around the LEFT 5th intercostal space in the midaxillary line
There are 3 main windows of the heart performed in basic transthoracic echo:
First - the subcostal window, which slightly to the RIGHT of the midline of the body under the xiphoid process, and utilizes the liver to create an acoustic window
Next - the parasternal window is the area bounded superiorly by the LEFT clavicle, medially by the sternum, and inferiorly by the apical region
Finally - the apical window is around the LEFT 5th intercostal space in the midaxillary line
There are 3 main windows of the heart performed in basic transthoracic echo:
First - the subcostal window, which slightly to the RIGHT of the midline of the body under the xiphoid process, and utilizes the liver to create an acoustic window
Next - the parasternal window is the area bounded superiorly by the LEFT clavicle, medially by the sternum, and inferiorly by the apical region
Finally - the apical window is around the LEFT 5th intercostal space in the midaxillary line
There are 3 main windows of the heart performed in basic transthoracic echo:
First - the subcostal window, which slightly to the RIGHT of the midline of the body under the xiphoid process, and utilizes the liver to create an acoustic window
Next - the parasternal window is the area bounded superiorly by the LEFT clavicle, medially by the sternum, and inferiorly by the apical region
Finally - the apical window is around the LEFT 5th intercostal space in the midaxillary line
There are 3 main windows of the heart performed in basic transthoracic echo:
First - the subcostal window, which slightly to the RIGHT of the midline of the body under the xiphoid process, and utilizes the liver to create an acoustic window
Next - the parasternal window is the area bounded superiorly by the LEFT clavicle, medially by the sternum, and inferiorly by the apical region
Finally - the apical window is around the LEFT 5th intercostal space in the midaxillary line
Here you can see the positioning of the transducer for the three main TTE views
Outline

- The PROBE
- CARDIAC ANATOMY & ORIENTATION
- PRINCIPLES of CARDIAC IMAGING
- MAIN TTE VIEWS

Moving on to principles of cardiac imaging
Moving on to principles of cardiac imaging
CARDIAC IMAGING TIPS

- Mentally visualize the heart in the chest
- “Search the image” – always small movement
- One manipulation at once
- Confirm findings on more than one plane

- When starting out, it is helpful to visualize in your mind the position of the heart in the chest
- As you try to bring your image into good view, make small fine movements, one at a time, as very slight changes in position can change the plane of the image
- It is important to confirm findings in more than one plane
A useful way to understand spatial relationships between the various echocardiographic views and the concept of axis of visualization can be represented by these slices through a banana…. Bananas have a short axis, and 2 different long axes, depending on how you slice through it.
A useful way to understand spatial relationships between the various echocardiographic views and the concept of axis of visualization can be represented by these slices through a banana.... Bananas have a short axis, and 2 different long axes, depending on how you slice through it
A useful way to understand spatial relationships between the various echocardiographic views and the concept of axis of visualization can be represented by these slices through a banana. Bananas have a short axis, and 2 different long axes, depending on how you slice through it.
Here you can see the planes of visualization: long axis 1, long axis 2, and the short axis, which can be obtained from the positions I mentioned previously -- subxiphoid, parasternal, and apical -- simply by adjusting or rotating the probe.
Here you can see the planes of visualization: long axis I, long axis 2, and the short axis, which can be obtained from the positions I mentioned previously -- subxiphoid, parasternal, and apical -- simply by adjusting or rotating the probe.
Here you can see the planes of visualization: long axis 1, long axis 2, and the short axis, which can be obtained from the positions I mentioned previously -- subxiphoid, parasternal, and apical -- simply by adjusting or rotating the probe.
Here you can see the planes of visualization: long axis 1, long axis 2, and the short axis, which can be obtained from the positions I mentioned previously -- subxiphoid, parasternal, and apical -- simply by adjusting or rotating the probe.
From the subcostal position, you can view the heart in the long axis, as well as the short axis.
From the subcostal position, you can view the heart in the long axis, as well as the short axis.
From the subcostal position, you can view the heart in the long axis, as well as the short axis.
From the parasternal position, you have SAX and LAX planes of visualization, depending on how you rotate the probe in that position.
From the parasternal position, you have SAX and LAX planes of visualization, depending on how you rotate the probe in that position.
From the parasternal position, you have SAX and LAX planes of visualization, depending on how you rotate the probe in that position.
Finally, from the apical position, you can view the heart in both long axes but no short axis view.
Finally, from the apical position, you can view the heart in both long axises but no short axis view.
Apical Views

Finally, from the apical position, you can view the heart in both long axises but no short axis view.
Now we will talk about the FIVE main views for basic echocardiography.
Now we will talk about the FIVE main views for basic echocardiography.
Basic views for focused echo

- **SUBCOSTAL 4 Chamber**
- **SUBCOSTAL Vena Cava**
- **PARASTERNAL Long Axis (LAX)**
- **PARASTERNAL Midpap Short Axis (SAX)**
- **Apical 4 Chamber (+2 ch & 3 ch)**

All of these views can be obtained from the three positions I mentioned previously:
- From the subcostal approach, you can obtain a 4 chamber view, as well as view of the vena cava
- From the parasternal approach, you can obtain the parasternal long axis view, as well as the parasternal short axis view
- From the apical position, you can obtain an apical 4 chamber view, as well as a 2 chamber view and a 3 chamber view depending on the movement of the probe
The subcostal 4 chamber view is obtained from positioning the probe just below the xiphoid, with the indicator aimed toward the patient’s LEFT flank. This approach is helpful in the technically difficult patient where parasternal and apical views are suboptimal.
This is the subcostal 4 Ch view, with the indicator aimed at the patient's LEFT flank or at about the 3 o'clock position. In this view anterior structures such as the RA and RV are at the top of the image. Posterior structures such as the LA and LV are seen toward the bottom of the screen. You can evaluate the 4 chambers, septum, mitral and tricuspid valves. You can also detect the presence and size of a pericardial effusion from this view.
This is the subcostal 4 Ch view, with the indicator aimed at the patient's LEFT flank or at about the 3 o'clock position. In this view anterior structures such as the RA and RV are at the top of the image. Posterior structures such as the LA and LV are seen toward the bottom of the screen. You can evaluate the 4 chambers, septum, mitral and tricuspid valves. You can also detect the presence and size of a pericardial effusion from this view.
Subcostal IVC

- **Indicator: Head**

From the subcostal position, you can also view the IVC by sweeping the transducer from the patient's midline toward the patient's right side, with indicator pointing towards the head.
Subcostal IVC

• Indicator: Head

From the subcostal position, you can also view the IVC by sweeping the transducer from the patient's midline toward the patient's right side, with indicator pointing towards the head.
In this view, you can see the IVC draining into the RIGHT atrium. You can glean some information about volume status and right-sided pressures by viewing the IVC in this position.
In this view, you can see the IVC draining into the RIGHT atrium. You can glean some information about volume status and right-sided pressures by viewing the IVC in this position.
In the parasternal long axis view, the transducer is placed in 3rd 4th 5th intercostal space to the LEFT of the sternum, with the indicator aimed at the RIGHT shoulder (at about 11 o'clock). The beam is oriented to the long axis of the LV.
Anterior structures such as the RV are seen at the top of the sector. The Left Ventricular outflow Tract can be seen. You can evaluate for problems with the aortic and mitral valves, dilatation of the LA, LV, and RV. You can also detect wall motion abnormalities in this view.
Anterior structures such as the RV are seen at the top of the sector. The Left Ventricular outflow Tract can be seen. You can evaluate for problems with the aortic and mitral valves, dilatation of the LA, LV, and RV. You can also detect wall motion abnormalities in this view.
Parasternal Midpapillary SAX

- Indicator: Left Shoulder

From the parasternal position, you can rotate the probe so that the indicator now faces the patient's LEFT shoulder and by tilting the probe you have the parasternal short axis view.
Parasternal Midpapillary SAX

• Indicator: Left Shoulder

From the parasternal position, you can rotate the probe so that the indicator now faces the patient’s LEFT shoulder and by tilting the probe you have the parasternal short axis view.
In this view, the LEFT ventricle appears in the middle of the image with the papillary muscles projecting into the LV cavity. During systole, as the LV contracts, the interventricular septum and other walls thicken, and the LV cavity diminishes concentrically. In this view, you can evaluate systolic function and look for regional wall motion abnormalities.
In this view, the LEFT ventricle appears in the middle of the image with the papillary muscles projecting into the LV cavity. During systole, as the LV contracts, the interventricular septum and other walls thicken, and the LV cavity diminishes concentrically. In this view, you can evaluate systolic function and look for regional wall motion abnormalities.
Switching to the apical 4 chamber view now, the probe is placed at the point of maximal impulse as palpated on the chest wall, usually somewhere around the 5th intercostal space in the mid-axillary line.
From this position, you should have a view of all 4 chambers of the heart, as seen here.
From this position, you should have a view of all 4 chambers of the heart, as seen here.
Next, from the apical 4 chamber, to obtain the apical 2 chamber view, rotate the indicator 90 degrees to face the patient's head.
Next, from the apical 4 chamber, to obtain the apical 2 chamber view, rotate the indicator 90 degrees to face the patient's head.
In the apical 2 ch view, the probe is looking up at the heart through the LA and LV.
In the apical 2 ch view, the probe is looking up at the heart through the LA and LV.
And finally, we obtain what we call a 3 ch view by further rotating the probe 30 degrees so that the indicator is now aimed at the patient's RIGHT shoulder.
And finally, we obtain what we call a 3-ch view by further rotating the probe 30 degrees so that the indicator is now aimed at the patient's RIGHT shoulder.
From this 3 ch view, you can get a good view of the LEFT atrium, LEFT ventricle, and the Ascending Aorta. This view can be particularly helpful for evaluating the Left ventricular outflow tract, the LV cavity, the mitral valve, and the true apex of the LV.
From this 3 ch view, you can get a good view of the LEFT atrium, LEFT ventricle, and the Ascending Aorta. This view can be particularly helpful for evaluating the Left ventricular outflow tract, the LV cavity, the mitral valve, and the true apex of the LV.
Basic views for focused echo

S4CH

SIVC

PLAX

PSAX

A4CH
Basic views for focused echo

S4CH

SIVC

PLAX

PSAX

A4CH

© WINFOCUS  CRITICAL CARE ECHOCARDIOGRAPHY
Basic views for focused echo

S4CH

SIVC

PLAX

PSAX

A4CH
Basic views for focused echo

- S4CH
- SIVC
- PLAX
- PSAX
- A4CH
Basic views for focused echo

S4CH

SIVC

PLAX

PSAX

A4CH

© WINFOCUS CRITICAL CARE ECHOCARDIOGRAPHY
Basic views for focused echo

S4CH

SIVC

PLAX

PSAX

A4CH

© WINFOCUS CRITICAL CARE ECHOCARDIOGRAPHY
The FATE protocol (Focused Assessed TTE) includes the subcostal, left parasternal, and apical windows for evaluation of cardiac function during resuscitation. In addition, it includes pleural ultrasound at the bases of the lungs to evaluate for pneumothorax, hemothorax, or pleural effusion.
and the M mode which produces one dimensional information on a time-motion graph

We talked about how the heart is tilted off axis in the chest cavity and therefore you need to manipulate your probe to capture planes of visualization

We reviewed the different planes of visualization - the short axis and 2 long axis views - that can be obtained from three basic positions on the chest wall

Finally, we reviewed the 5 main views utilized in basic TTE.
The PROBE

CARDIAC ANATOMY & ORIENTATION

PRINCIPLES of CARDIAC IMAGING

MAIN TTE VIEWS

and the M mode which produces one dimensional information on a time-motion graph
We talked about how the heart is tilted off axis in the chest cavity and therefore you need to manipulate your probe to capture planes of visualization
We reviewed the different planes of visualization - the short axis and 2 long axis views - that can be obtained from three basic positions on the chest wall
Finally, we reviewed the 5 main views utilized in basic TTE.