

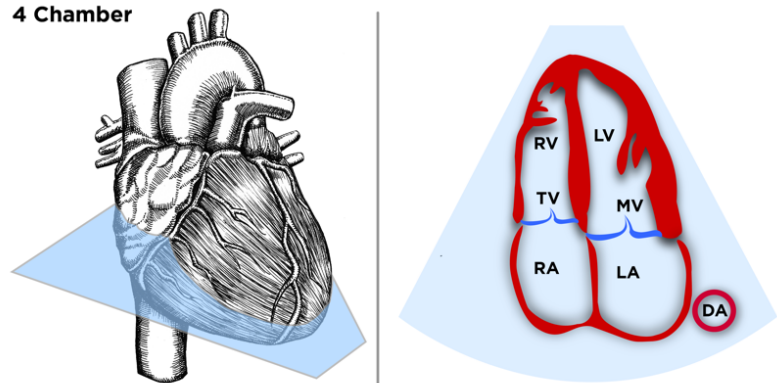
# 10

## Cardiac Ultrasound: Apical Views

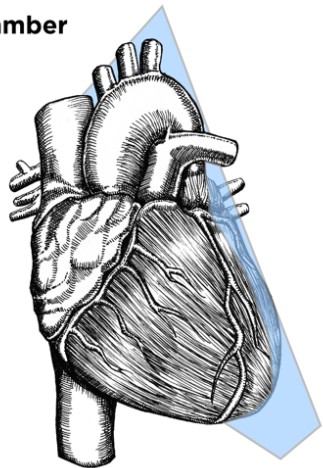


Apical Windows

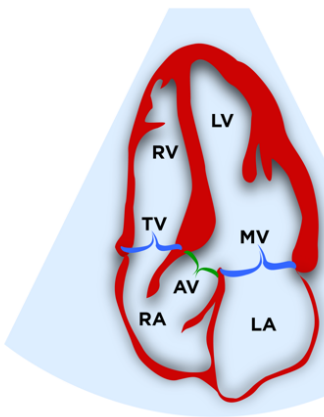
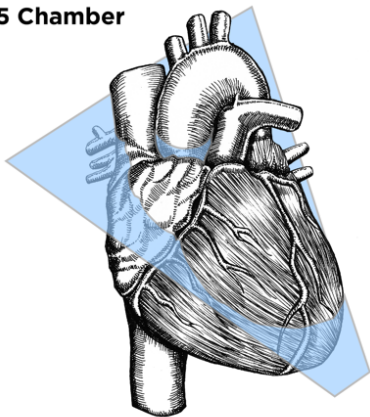
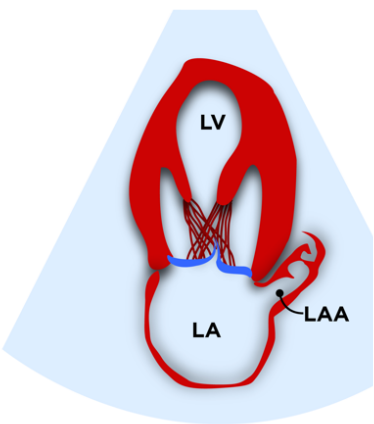
4 Chamber



2 Chamber



5 Chamber





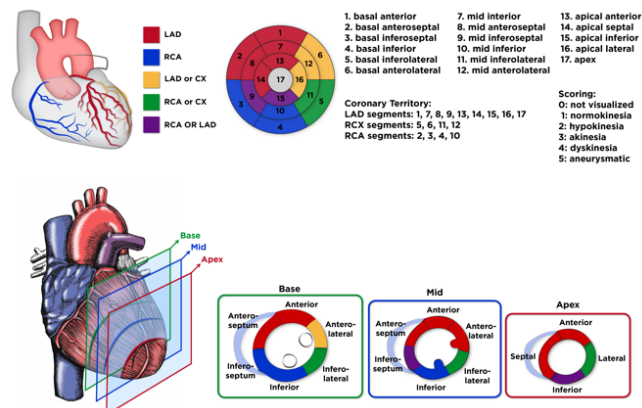
**III. CARDIAC:** Ultrasound is an excellent modality to assess cardiac function/abnormalities. Surface ultrasound can provide an excellent minimally invasive tool to determine the mechanisms of the patient's current hemodynamic status. Each subsection will cover a cardiac ultrasound technique used to answer these questions.

### Apical Views:

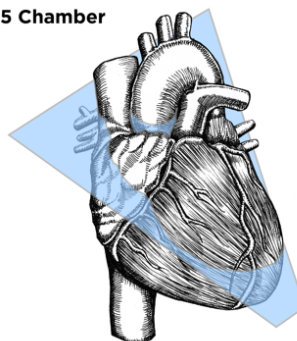
The apical window is used for routine Doppler examination of patients to evaluate valvular heart disease. This is because, in this view, the Doppler beam is as parallel as possible to the direction of assumed blood flow through the mitral, tricuspid valves, and aortic valves. By being parallel, it also allows the largest Doppler shift to be recorded and the strongest signals to be reflected back to the Doppler transducer. Continued practice repositioning probe in the various portions of the cardiac chambers accessible from the apical four chamber view will eventually provide the novice operator with an appreciation of the spatial locations and directions of normal and abnormal flows. Always remember that the heart chambers are actually three dimensional structures and an abnormal flow jet may be directed anywhere within this three dimensions. An experienced operator will be able to track an abnormal jet even if it is directed out of a standard two-dimensional plane by changing the angle, rotation, and tilt of the transducer.

Besides the assessment of the cardiac valves, the apical views allow for: 1) Assessment of diastolic function (to be discussed later, 2) assessment of RV size and function (to be discussed later also), 3) evaluation of LV segmental wall motion, 4) evaluation of LV thrombus, and 5) evaluation of left and right atrial size. There are three views from the apical window that are performed to obtain all information possible from this window. These views are: 1) Four-Chamber, 2) Five-Chamber, and 3) Two-Chamber views. The specifics of each of these views are detailed below.

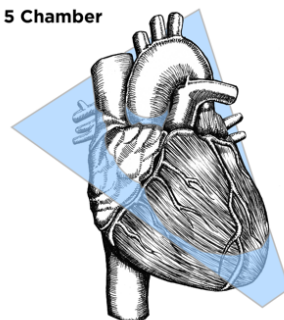
Regarding evaluation of LV segmental wall motion, the diagram below shows the walls of the LV (as well their coronary supply) that are visualized with each of the three views from the apical window.



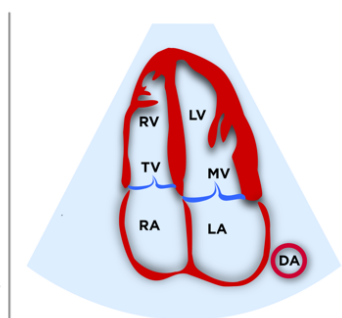
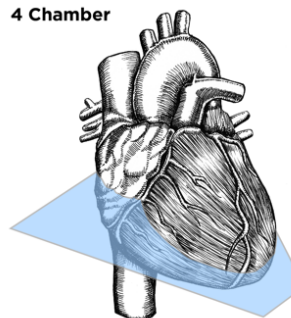
5 Chamber



5 Chamber

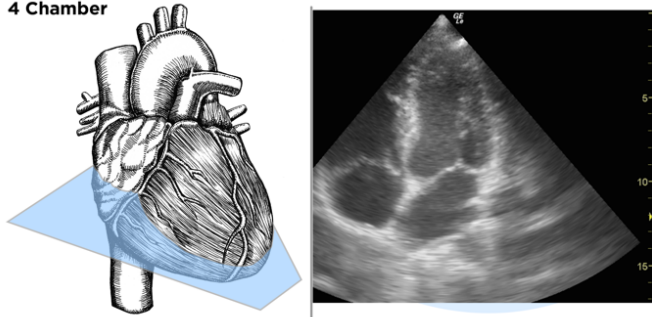


4 Chamber

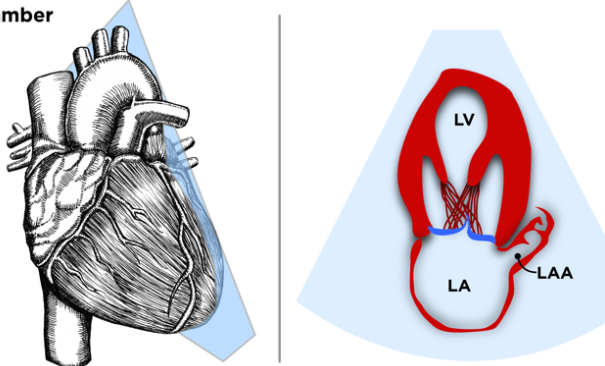




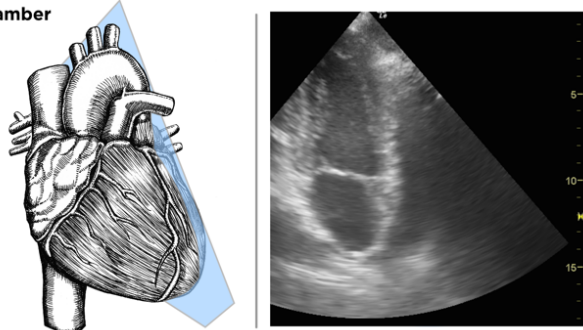
4 Chamber



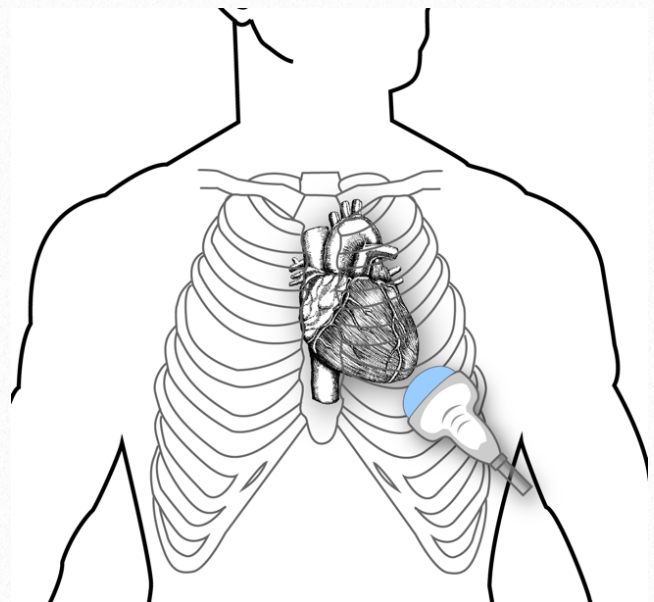
2 Chamber



2 Chamber



One of the most important measurements that can be obtained from this window is **left atrial (LA) size** (also discussed in left parasternal LAX view chapter). As previously discussed, the LA is a storage vessel for volume to the LV. In diastole the LV pressure reduces such that flow can move forward from the atrium. However, in any situation when the LV end diastolic pressure is elevated (diastolic dysfunction, severe aortic regurgitation, frequent episodes of tachycardia, severe systolic dysfunction, etc.), that pressure is relayed to the LA. The LA handles this increased pressure is by dilating so it can hold more volume, and therefore generate the necessary pressure to fill the left ventricle. Because of this, the LA size is regarded as the HgA1c of the heart since it is a marker for elevated left ventricular end diastolic pressures. From the apical four chamber view, one may obtain the di-



ameter of the LA and determine if it is dilated (see table below).

**Patient Position Apical Window Views:** Left-Lateral with L arm extended

**Probe type:** phased array cardiac probe

**Probe position:** The apical window is usually found in the left lateral portion of the chest at the apex of the heart. This can sometimes be located by placing your hand lightly in area of the apex and feeling for the point of maximal intensity (PMI). The PMI will serve as your starting point; however, small adjustments will need to be made to the transducer



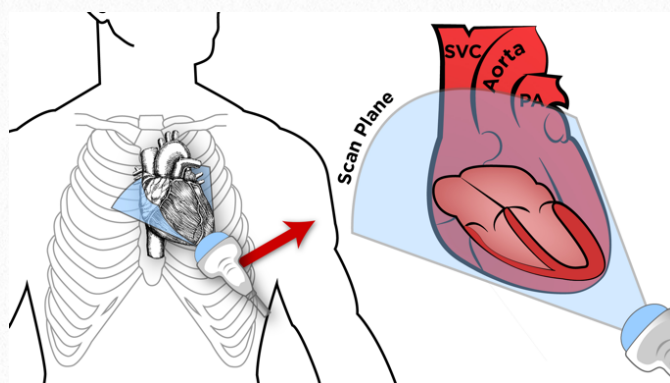
location to optimize your image. Another good starting point is to go one to two rib spaces below, but in the same plane as, the nipple.

**4-chamber (4C) view:** The transducer is placed at the cardiac apex with the marker dot pointing down to the 3 o'clock position. This gives the typical 'heart-shaped' 4-chamber view (see image on the right). All four cardiac chambers are visualized in the 4C view along with the mitral and tricuspid valves. Ventricular and atrial size can be assessed using 2D echo. Color flow and spectral Doppler can be used to assess for valvular regurgitation and stenosis (discussed in another chapter). Left ventricular diastolic function can be assessed by applying pulsed wave Doppler to the mitral valve and pulmonary veins (discussed in separate chapter). In this view, the right ventricular free wall, inter-ventricular septum, and left lateral wall can be assessed for systolic motion.

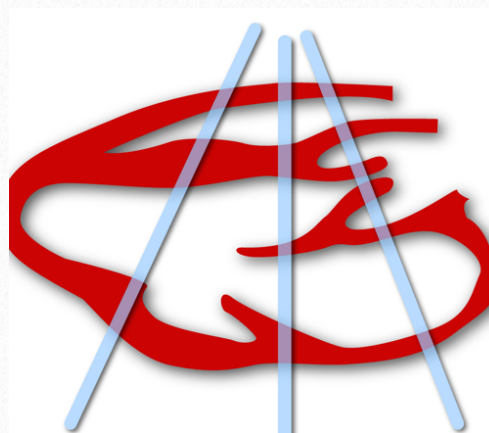
This view allows one to evaluate **RV function** as it provides a good view of the RV chamber. One can assess RV function using this view in 3 ways. One is by looking at the fractional area change of the RV chamber from diastole to systole (normal change is > 30%). It is important to note that normal RV diameter is less than 4.2 cm at the base and less than 3.5 cm at the mid level. The second method is by looking at the movement of tricuspid annulus in systole -TAPSE (tricuspid annular plane systolic excursion). This is done by measuring the distance of the tricuspid annulus to the right ventricular outflow tract in diastole compared to systole. Normal function is a distance change of more than 1.6cm. Finally one can use pulse wave doppler to assess the velocity of motion of the tricuspid annulus in systole. The PW signal is placed directly on the lateral portion of the tricuspid annulus and the velocity of the tissue motion towards the probe during systole is measured. Normal velocity is > 15cm/sec.

**5-chamber (5C) view:** By altering the angulation of the transducer so the ultrasound beam is angled more anteriorly towards the chest wall, a '5-chamber' view is obtained. Specifically, this is done by decreasing the angle between the probe and the skin. The 5th 'chamber' is not a chamber at all, but rather is the conglomerate image of the left ventricular outflow tract (LVOT), aortic valve, and ascending aorta. This view is useful in assessing aortic stenosis (AS) and aortic insufficiency (AI).

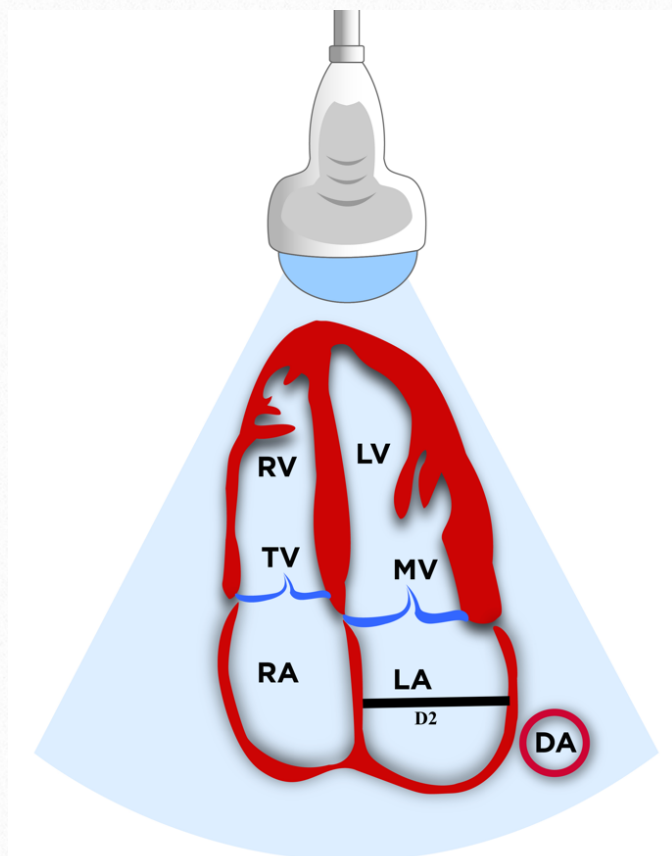
**2-chamber (2C) view:** By rotating the transducer counter-clockwise 90 degrees on the cardiac apex (**from 3 o'clock to 12 o'clock**) it is possible to obtain the 2-chamber view which shows different segments of the left ventricle (LV) (see diagram above for LV wall segments for each view). In the 2C view, the left ventricle, mitral valve, and left atrium are seen. The inferior and anterior walls of the left ventricle can be assessed for systolic function. Using color flow and spectral Doppler, the mitral valve can be assessed for regurgitation and stenosis. PLEASE NOTE that this view may be difficult secondary to the size of the footprint of the probe and the ribs.



Left Atrial Size:







	Normal	Mild	Moderate	Severe
LA diameter (cm)	2.7-4	4.1-4.6	4.7-5.2	> 5.2
LA area (cm <sup>2</sup> )	<20	20-30	30-40	>40