

Report of the American Society of Echocardiography Committee on Nomenclature and Standards in Two-dimensional Echocardiography

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The Committee on Nomenclature and Standards in Two-dimensional Echocardiography of the American Society of Echocardiography recommends the following nomenclature and image orientations standards.

Nomenclature

Name of Technique

The Committee recommends that the name *two-dimensional echocardiography* be used to refer to the technique.

Transducer Location (fig. 1)

The Committee recommends that when the transducer is placed in the suprasternal notch that it be referred to as in the *suprasternal* location. When the transducer is located near the midline of the body and beneath the lowest ribs, the transducer should be referred to as in the *subcostal* location. When the transducer is located over the apex impulse, the Committee recommends that this be referred to as the *apical* location. If the term *apical* is used alone, it will be assumed that this refers to a left-sided apical position. The area bounded superiorly by the left clavicle, medially by the sternum and inferiorly by the apical region will be referred to as the *parasternal* location. If the term *parasternal* is used alone, it will be assumed to be the left parasternal location. In those unusual situations in which the apex impulse is palpated on the right chest, a transducer placed over the right-sided apex impulse will be referred to as in the *right apical* location. The region bounded superiorly by the right clavicle, medially by the sternum and inferiorly by the right apical region will be referred to as the *right parasternal* location.

Imaging Planes

Three orthogonal planes will be used to describe the imaging planes used to visualize the heart with two-dimensional echocardiography. The nomenclature recommended by the Committee is not based strictly on the sagittal, transverse and coronal planes used by anatomists to describe body orientation, but rather, on the manner in which the two-dimensional echocardiographic imaging planes transect the heart (fig. 2). The imaging plane that transects the heart perpendicular to the dorsal and ventral surfaces of the body and parallel to the long axis of the heart will be referred to as the *long-axis* plane. The plane that transects the heart perpendicular to the dorsal and ventral surfaces of the body, but perpendicular to the long axis of the heart, will be referred to as the *short-axis* plane. The plane that transects the heart approximately parallel to the dorsal and ventral surfaces of the body will be referred to as the *four-chamber* plane. Each of these three orthogonal planes should not be thought of as a single plane, but rather as a family of planes. For example, the long-axis plane is described as being "perpendicular to the dorsal and ventral surfaces of the body." However, any plane that is parallel to the long axis of the heart and is within 45° of the plane perpendicular to the dorsal and ventral surfaces of the body should be referred to as a long-axis plane.

Identification of Two-dimensional Images

The Committee recommends that two-dimensional images be identified by referring to the transducer location and the imaging plane. For example, if the transducer is placed in the parasternal location and oriented so that the imaging plane transects the heart parallel to the long axis of the heart, the Committee recommends that the resulting image be referred to as a *parasternal long-axis* view. As another example, if the transducer is placed in the apical location and oriented so that the four-chamber imaging plane is

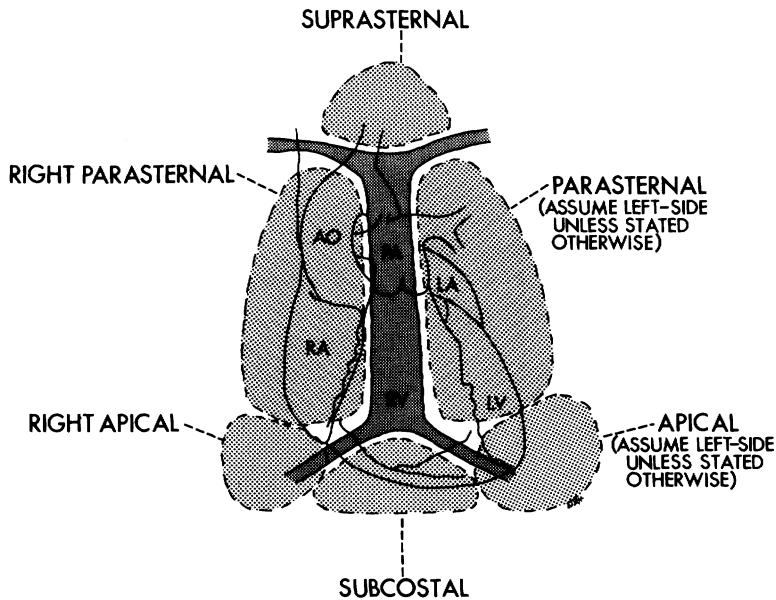
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These recommendations have been formally adopted by the American Society of Echocardiography.

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NOMENCLATURE FOR TRANSDUCER LOCATION

FIGURE 1. Diagram indicating the nomenclature to describe the locations on the body from which echocardiographic studies can be obtained. AO = aorta; RA = right atrium; PA = pulmonary artery; RV = right ventricle; LA = left atrium; LV = left ventricle.

used, the Committee recommends that the resultant image be referred to as an *apical four-chamber* view.

Image Orientation Standards

In considering recommendations for image orientation standards, the Committee attempted to adopt standards that are compatible with image orientations presently used by clinicians. In addition, the Committee tried to develop image orientation standards

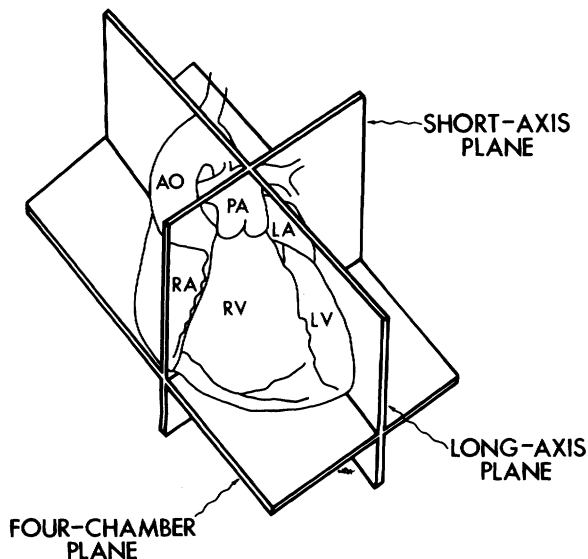
that result from transducer orientations that are consistent from one view to the next, and therefore, can be easily taught and explained both to experienced and inexperienced users of two-dimensional imaging equipment. With these two considerations in mind, the Committee recommends the following:

Index Mark

The Committee recommends that an index mark be placed on every two-dimensional imaging transducer. This index mark should be placed on the side of the transducer to indicate the edge of the imaging plane, i.e., the direction in which the ultrasound beam is being angled (fig. 3). The index mark should be located on the transducer to indicate the part of the image plane that will appear on the right side of the image display. For example, if the index mark is pointed in the direction of the aorta in a parasternal long-axis view, the aorta would appear on the right side of the image display (fig. 3).

Image Inversion Switch

Every ultrasound imaging unit should incorporate an image inversion switch. When the switch is in the "off" position, ultrasound signals returning from reflecting structures located near the surface of the ultrasound transducer will appear on the top of the image display. These signals will be referred to as *near signals*. Conversely, ultrasound signals returning from reflecting structures located far from the transducer will appear at the bottom of the image display. When the image inversion switch is moved to the "on" position, ultrasound signals returning from reflecting structures located near the surface of the transducer will appear on the bottom of the image display and signals from reflecting structures located far from the



TWO-DIMENSIONAL ECHOCARDIOGRAPHIC IMAGING PLANES

FIGURE 2. Diagram of the three orthogonal imaging planes used to visualize the heart with two-dimensional echocardiography. Abbreviations are as in figure 1.

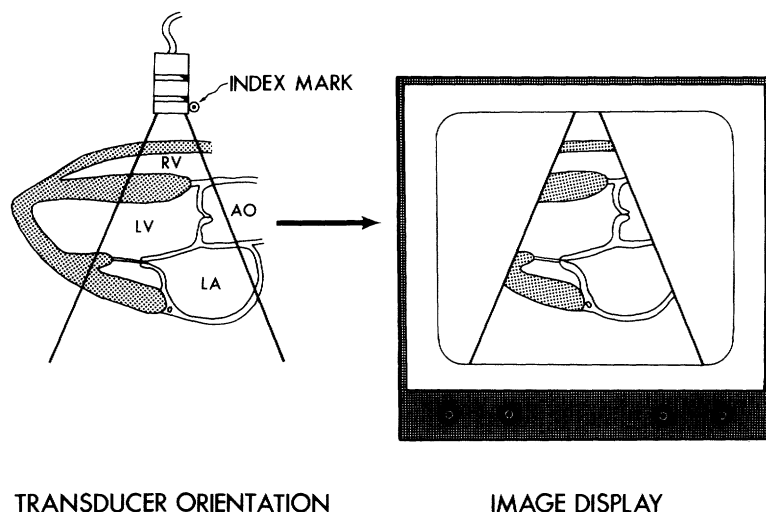


FIGURE 3. Illustration of the relation between the transducer orientation (as indicated by the direction of the index mark) and the orientation of the resulting image on the display. Abbreviations are as in figure 1.

transducer will appear at the top of the image display. Thus, moving the switch from the "off" to the "on" position will invert the near signals in the image from the top to the bottom of the display, but will not produce a change in the left-right orientation of the image. This image inversion switch will be used only in conjunction with the four-chamber imaging plane. When either the long-axis imaging plane or the short-axis imaging plane is being used, the image inversion switch will always be in the "off" position.

Transducer Orientation

When orienting the transducer during the performance of a two-dimensional echocardiographic study, the transducer index mark should always be pointed either in the direction of the patient's head or to the left side of the patient. The image orientations that result from following this transducer orientation strategy are summarized below.

Long-axis Views

The long axis of the heart can be viewed from either the apical, parasternal or suprasternal locations. Figure 4A illustrates long-axis views of the left ventricle obtained from these three transducer locations using the strategy that the index mark is always pointed toward the patient's head. Figure 5A illustrates the image that will appear on the image display when the transducer is oriented in the apical long-axis view with the transducer index mark pointing toward the patient's head. In this view, the apex of the heart is visualized at the top of the image display, the aorta at the bottom, the right ventricle to the right, and the posterior wall of the left ventricle to the left of the image display. When the parasternal long-axis image is obtained, the transducer index mark will also be pointing toward the patient's head. The resulting image display is illustrated in figure 5B. In this image, the right ventricle appears at the top of the image display, the apex of the heart to the left, the aorta to the right and the posterior wall at the bottom of the image display.

This image orientation is identical to that previously recommended by the American Society of Echocardiography. When the suprasternal long-axis view is obtained, the transducer mark also will be pointing to the patient's head. The resulting image display is illustrated in figure 5C. In this image, the aorta will appear at the top of the image display, the posterior wall of the left ventricle on the right side, the apex of the heart in the lower left, and the right ventricle on the left side of the image display. By making small changes in transducer orientation, the ascending aorta, transverse aorta (including major arterial branches), descending aorta and pulmonary artery also can be visualized in a *suprasternal long-axis* view. The long-axis views of the heart can be obtained from any of the three transducer locations by simply sliding the transducer from one transducer location to the next (fig. 4A). The transducer index mark is always pointed toward the patient's head, so this sliding motion does not result in the transducer being rotated 180° during any portion of the sweep from the apical location to the suprasternal location. In addition, it should be noted that all three long-axis views of the heart are similar to views that would be seen by an operator sitting on the left side of a supine patient and looking at the cross-sectioned heart from patient's left side.

Short-axis Views

The short-axis views of the heart (fig. 4B) can be obtained from either the parasternal or the subcostal locations. (Short-axis views also can be obtained from the suprasternal location but will not be discussed in this report.) The *parasternal short-axis* view is obtained with the transducer index mark pointing to the patient's left side (fig. 6A). If the heart is viewed in this manner at the level of the papillary muscles, the ventricular septum will appear at the top of the image display, the lateral papillary muscle to the right, the medial papillary muscle to the left, and the posterior left ventricular free wall at the bottom. This image

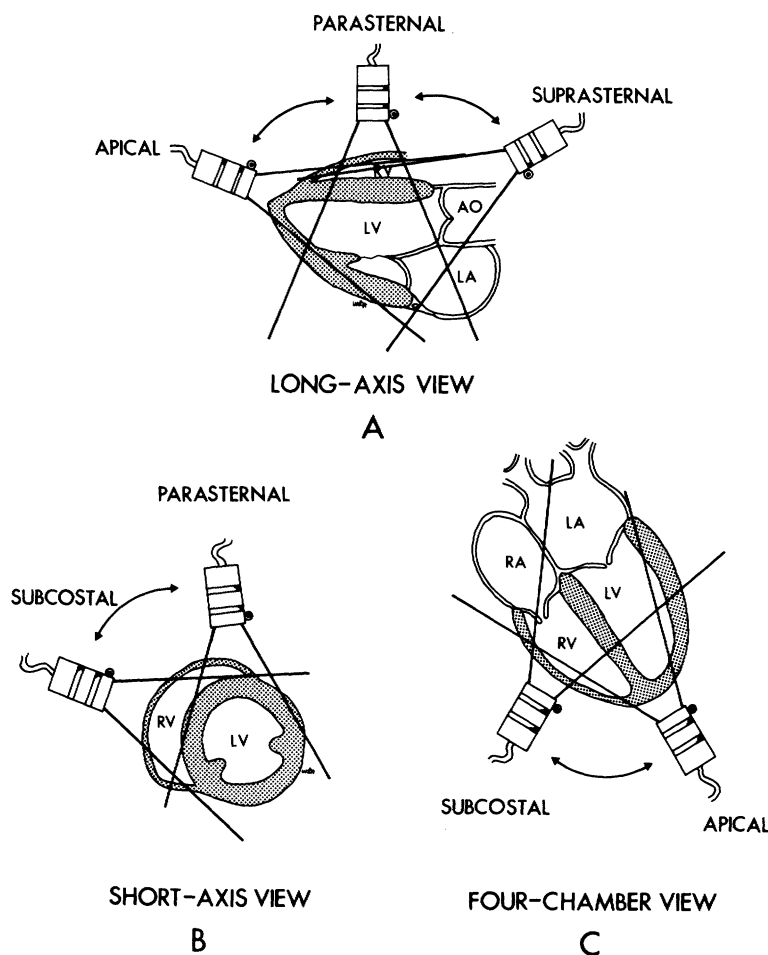


FIGURE 4. Diagram of the transducer orientations used to obtain long-axis views (A), short-axis views (B) and four-chamber views (C) of the heart. Note that the transducer index mark is always pointed either in the direction of the patient's head or the patient's left side. Abbreviations are as in figure 1.

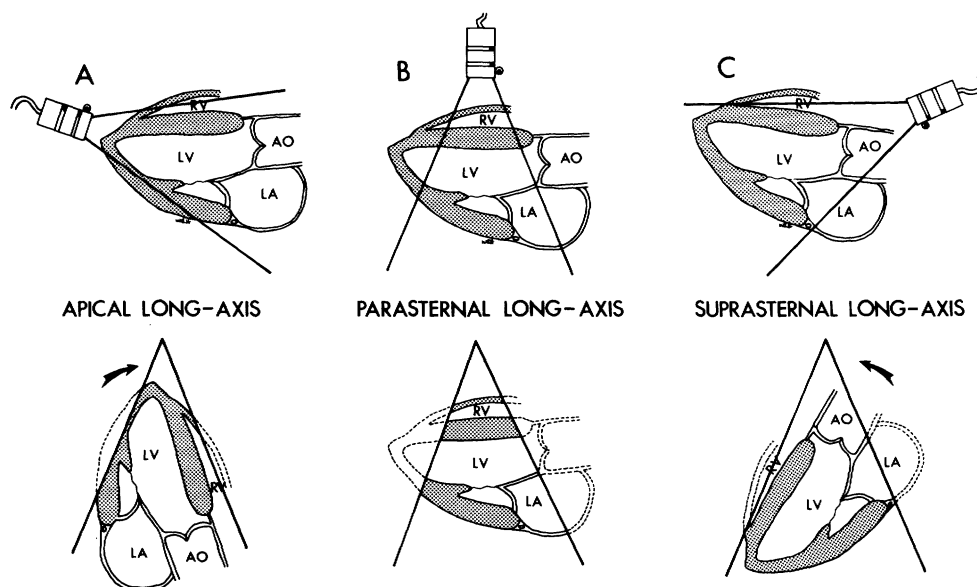


FIGURE 5. Illustration of the long-axis, two-dimensional images that result when the transducer is used to visualize the apical long-axis view (A), parasternal long-axis view (B), and suprasternal long-axis view (C). These images were obtained with the transducer index mark pointing to the patient's head, as illustrated in figure 4A. Abbreviations are as in figure 1.

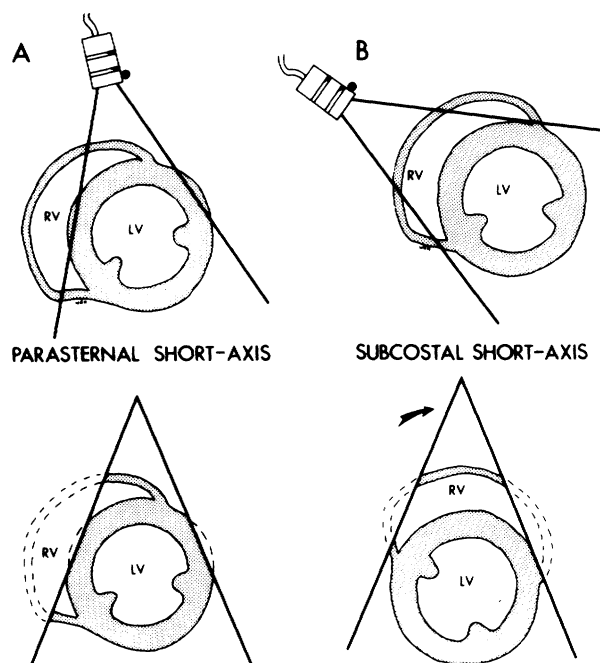


FIGURE 6. Diagram of the short-axis, two-dimensional images that result when the transducer is used to visualize the parasternal short-axis view (A) and the subcostal short-axis view (B). These images were obtained with the transducer index mark pointing to the patient's left side, as illustrated in figure 4B. RV = right ventricle; LV = left ventricle.

orientation is identical to that previously recommended by the American Society of Echocardiography. The *subcostal short-axis* view is also obtained with the transducer index mark pointing to the patient's left side (fig. 6B). If the heart is being imaged at the level of the papillary muscles, the right ventricle will appear at the top of the image display, the posterior free wall will appear in the lower left, the lateral papillary muscle will appear in the lower right, and the anterior free wall will appear on the right side of the image display. The short-axis views of the heart can be obtained from either the parasternal location or the subcostal location by simply sliding the transducer from one transducer location to the other (fig. 4B). Since the transducer index mark is pointing to the patient's left side in both views, it is not necessary to rotate the transducer 180° in order to go from the parasternal short-axis view to the subcostal short-axis view. In addition, it should be noted that both short-axis views of the heart are similar to views that would be seen by an operator sitting close to the patient's left hip and looking up at the cross-sectioned heart through the cardiac apex.

Four-chamber Views

The four-chamber views of the heart can be obtained with the transducer located either in the apical or subcostal locations (fig. 4C). The apical four-chamber view is obtained with the transducer index mark

pointing toward the patient's left side. Two options are recommended for displaying the resulting image (fig. 7A). Option 1 involves moving the image inversion switch to the "on" position to invert the near signals of the image from the top to the bottom of the image display. Doing so will result in an image in which the apex of the heart appears on the bottom of the image display, the left ventricle appears on the right side, the right ventricle appears on the left side and the atria appear at the top of the image display. This image orientation is similar to that which would be seen by an operator sitting close to the patient's left hip and looking directly down at the cross-sectioned heart. Option 2 involves leaving the image inversion switch in the "off" position so that the near signals of the image remain at the top of the image display. The resulting image will have the apex of the heart at the top and the atria at the bottom of the image display. As in option 1, the left ventricle appears on the right side and the right ventricle on the left side of the image. Option 2 results in the cross-sectioned heart being viewed from behind the patient. It should be emphasized that option 1 and option 2 result in the same left-right orientation of the image. The only difference between the two is that in option 1, the near signals of the image are located at the bottom of the image display and in option 2, they are located at the top. The subcostal four-chamber view is also obtained with the transducer index mark pointing to the patient's left side (fig. 7B). As in the apical four-chamber view, two options are recommended for displaying the image. In option 1, the near signals of the image are placed at the bottom of the image display by using the image inversion switch. In the resultant image, the right ventricle appears at the bottom of the image display, the apex of the heart appears on the right side, and the atria appear on the left side of the image display. This view is similar to the view that would be seen by an operator sitting close to the patient's left hip and looking directly down at the cross-sectioned heart. Option 2 involves leaving the near signals of the image at the top of the image display. In this image orientation, the right ventricle appears at the top of the image display, the apex of the heart appears on the right side, and the atria appear on the left side of the image display. As in the apical four-chamber view, option 2 results in the cross-sectioned heart being viewed from behind the patient. Again, option 1 and option 2 result in the same left-right orientation of the image. Also, both the apical and subcostal four-chamber views are obtained with the transducer index mark pointing to the patient's left side. Therefore, it is possible to slide from the apical four-chamber view to the subcostal four-chamber view without having to rotate the transducer 180°.

The image orientation standards recommended by the Committee are intended as a general framework for describing two-dimensional images, realizing that not all images can be described without ambiguity by the present system without additional descriptive information. For example, the two-chamber view described by Schiller et al. (Circulation 60: 547, 1979)

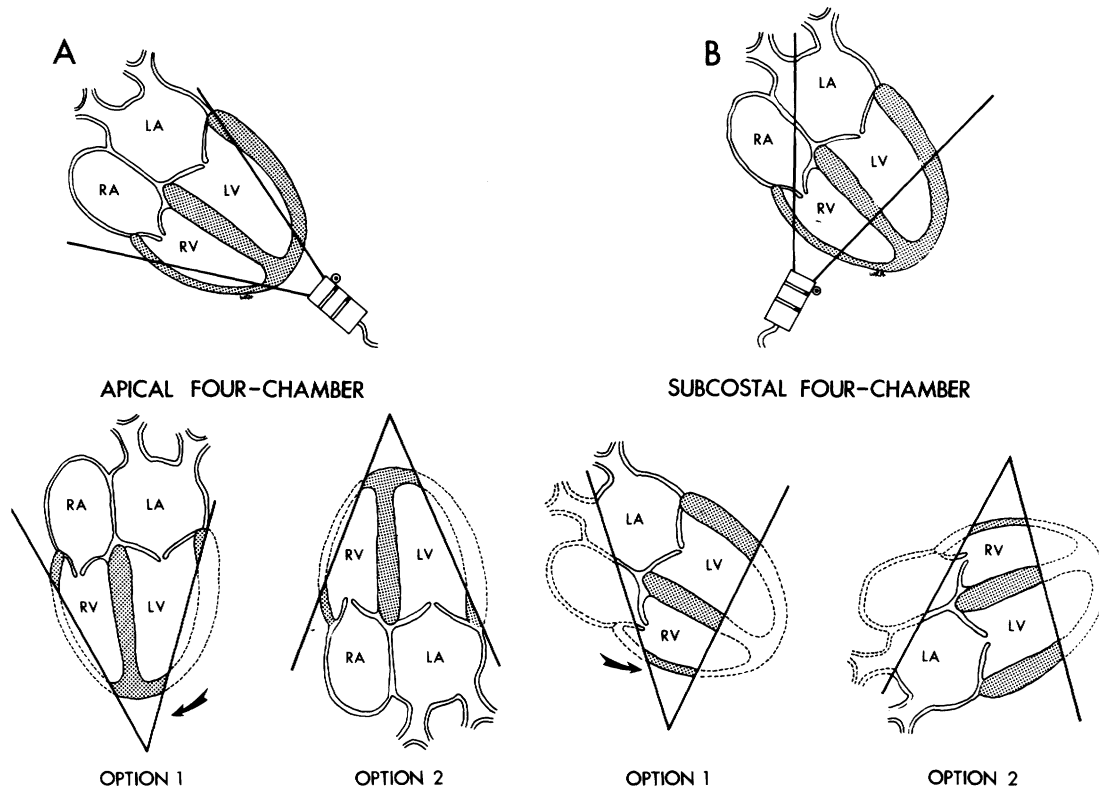


FIGURE 7. Four-chamber, two-dimensional images that result when the transducer is used to visualize the apical four-chamber view (A) and the subcostal four-chamber view (B). These images were obtained with the transducer index mark pointing to the patient's left side, as illustrated in figure 4C. Two options are included for each four-chamber view. In each case, option 1 is produced by activation of the image inversion switch, which results in the near signals of the image being inverted from the top to the bottom of the display. Abbreviations are as in figure 1.

is not precisely described by the image orientation standards alone. The two-chamber view is a variant of the apical long-axis view of the heart, in which the transducer is rotated clockwise (when viewed from the handle). By rotating the transducer clockwise, the image plane transects the heart lateral to the junction of the lateral border of the right ventricle and the anterolateral left ventricular free wall. The resulting image does not visualize the right ventricle and, hence, was referred to as the two-chamber view. Although not all views can be precisely identified by the present nomenclature alone, these alternate views can be identified by stating the image plane and transducer location that most closely corresponds to the image and using additional descriptive information in parentheses. For example, the two-chamber view could be

described as an *apical long-axis view (clockwise rotation)*. Alternatively, the two-chamber view could be described as an *apical long-axis view (two-chamber view)*.

Because of the complicated anatomy displayed by two-dimensional imaging of the heart, and the need to easily understand the image orientation, it is important that standard nomenclature and image orientations be adopted. The Committee believes that by adopting nomenclature and image orientation standards, the technique of two-dimensional imaging of the heart will be advanced and communication between laboratories will be improved. In addition, these standards should be helpful to those who are seeing two-dimensional images of the heart for the first time.