Many patients who come to the cath lab have an echocardiographic study as part of their routine work-up. The ‘echo’ often contributes significantly to clinical decision-making before and during the cath procedure. Echocardiographic images are rich with information on left ventricular (LV) and valvular function, LV wall motion, pericardial fluid, atrial and ventricular chamber dimensions, evidence of prior myocardial infarction, and thickness of heart muscle due to hypertrophy or infiltrative diseases. Sometimes an urgent echo in the emergency room can add to the electrocardiogram (ECG) and change a ST-elevation myocardial infarction (STEMI) patient to non-cardiac diagnosis.

In most circumstances, the physicians and residents review the echo images prior to the cath procedure to identify important findings, and confirm questions about heart and valve function. Many times, the cath lab team has the echocardiographers come to the cath lab to help with structural heart procedures.

Figure 1. Diagrams of the 3 major echo planes of the heart (left). These echo planes cut the heart in the parasternal long axis (PSL, top) with echo image at far right. The short axis view (SA) is the middle and the apical (A4) chamber echo image is on the bottom. Image source: http://www.echoincontext.com/begin/skillb_08.asp

Figure 2. The echo probe and shape of the echo beam. The white paper triangle represents this beam.

Figure 3 (right). Use of paper planes to illustrate approximate positioning of the echo probe to see the 3 major echo views. Top left, apical 4-chamber view. Bottom left, parasternal long axis view. Bottom right is short axis view. Top left is approximate location of the heart and the 3 major imaging planes.
Basic Echocardiography

Continued from page 4

pericardiocentesis, and some complications of interventions. Other times, a basic bedside ultrasound machine (i.e. Sonosite) from the operating physician may suffice. In the post procedure period, echocardiograms may be ordered to establish a baseline image to follow over the ensuing months as the interventional treatments act to improve the patient’s heart health.

For those not formally studying echocardiographic imaging and its particular contributions to cardiology, the most confusing part of interpreting echo images is understanding how the image is acquired and what is shown. The purpose of this editor’s corner is to give the cath lab team unfamiliar with echo a framework through which to understand the basics and appreciate what can be seen from the 3 most common echocardiographic views. This brief discussion is not intended to be extensive nor exhaustive on the subject of echo. Echocardiography is a subspecialty within the specialty of cardiovascular disease that requires a complete course of study over several years. However, one has to start someplace.

The 3 echocardiographic views

The 3 most commonly used echocardiographic views are the apical 4-chamber (A4), parasternal long axis (PSL) and parasternal short axis (SA) views (Figure 1).

Before discussing what each plane shows, it is helpful to visualize how the planes of the heart are cut by the echo beam. The echo transducer is composed of an array of multiple vibrating crystals that create the ultrasound beam and receive the ultrasound reflections. The beam is controlled electronically to produce a triangular-shaped plane of imaging, with the tip of the triangle at the transducer opening to a wide base of the plane away from the transducer (Figure 2). To simplify how the beam is positioned on the patient, I use a piece of folded paper: This paper plane can then be moved to easily see how the beam cuts through the heart (Figure 3). To help remember how the imaging planes are used, a line drawing of the heart shows the 3 views (Figure 3, top right) in relationship to each other.

The apical 4-chamber view (A4)

Placing the echo probe at the apex impulse on the chest (near the tip of the left ventricle) in the 6th or 7th intercostal space approximately on the mid clavicular line, angling the beam upward toward the sternal notch, the heart is cut to reveal the 4 chambers (2 atrial and 2 ventricles, Figure 4a). The A4 view is shown in Figure 4b and displays the apex of the heart closest to the beam (top of the echo image) and the atria furthest away from the transducer, at the base or widest part of the triangular beam. The heart is displayed as if you are looking up from underneath, so that the right-sided structures are on the left side of the screen, similar to how we view x-ray images.

In addition to seeing the size and relative shapes of the 4 chambers, we can also appreciate the interventricular septum and part the atrial septum, although this is not as easily interpreted as normal. Normally, the right ventricle is smaller than the left ventricle, and the atria are smaller than the ventricles and about the same size relative to one another. The mitral and tricuspid valves are easily seen in this view, with color Doppler identifying significant abnormalities in flow. In addition, pericardial effusion can be seen on the entire septum from the base to the apex and the location of the obstructing septal muscle in this view.

The parasternal long axis view (PSL)

The probe is now moved up to the 3rd or 4th intercostal spaces adjacent to the left side of the sternum. The beam is directed on the long axis of the heart, aiming at the right shoulder (Figure 5a). The parasternal long axis view displays the heart cut from the sternum through to the inferior wall with the apex at the left side of the image (Figure 5b). At the top of the beam is the sternum, then the right ventricle overlying part of the LV and aorta. The cut through the long axis of the aorta shows the aortic valve that is connected to and contiguous with the anterior leaflet of the mitral valve. The LA is behind the aortic root. The interventricular septum can be easily measured. The apex of the LV is often cut off in this view.

The parasternal long axis view (PSL)

The probe is now moved up to the 3rd or 4th intercostal spaces adjacent to the left side of the sternum. The beam is directed on the long axis of the heart, aiming at the right shoulder (Figure 5a). The parasternal long axis view displays the heart cut from the sternum through to the inferior wall with the apex at the left side of the image (Figure 5b). At the top of the beam is the sternum, then the right ventricle overlying part of the LV and aorta. The cut through the long axis of the aorta shows the aortic valve that is connected to and contiguous with the anterior leaflet of the mitral valve. The LA is behind the aortic root. The interventricular septum can be easily measured. The apex of the LV is often cut off in this view.

The short axis view (SA)

With the probe remaining at the same location as the PSL view, the probe is rotated 90 degrees (Figure 6a), cutting the long axis perpendicularly like a sliced
broad slice, producing short axis slices along the PSL. (Figure 6b) The SA view shows the right ventricle closest to the echo beam as in the PSL, but cut perpendicularly. The interventricular septum can be easily seen dividing the RV and LV. The LV is normally circular, and varies in size and thickness as the cuts of the SA move from the base to apex of the heart. Figures 6c and 6d show SA cuts through the mitral valve and then deeper into the LV to show the cut at the level of the papillary muscles.

The SA views are excellent to assess regional LV contraction, LV thickness, motion of the septum, size of the RV, and motion of the mitral valve. The SA view is often used to measure the opening area of the mitral valve.

I use this method to introduce echocardiography to the residents in the coronary care unit. I hope this brief demonstration will help you understand the basic echo images, and what they can show us as our patients enter the cath lab for our coronary and structural heart disease interventions.

---

**Letter to the Clinical Editor**

Re: “Is This a True STEMI ECG? Typical and Atypical Findings,” Clinical Editor’s Corner, May 2013

Dear Dr. Kern,

Thank you for highlighting in the Editor’s Corner the atypical presentation of a patient with an ECG showing ST elevation and reciprocal changes and discussing the spectrum of STEMI ECGs encountered in clinical practice. We wanted to bring to your attention one possible diagnosis in the 26-year-old patient with localized ST elevation and regional wall motion abnormalities discussed in the article.

Linked angina is a concept that has been described initially by Froment in 1955 as “les angors coronariens intriques” and later coined by Dr. Shirley Smith and Dr. Cornello Papp in 1962. This has been reported as a coronary syndrome intertwined with symptoms of symptoms of GERD, gastric or duodenal ulcer, hialus hernia, spinal arthritis or left mammary pain. This is proposed to be due to the afferent paths from the somatic and visceral sources entering the spinal cord at the same levels as afferent path for cardiac pain. Von Bergman in 1932 and Daley in 1957 demonstrated that distention of the lower end of the esophagus in an anesthetized dog causes 50% reduction in coronary blood flow. Similar findings were observed by Cullen and Reese after distention of the common bile duct.1

More recently (comparatively), in a study by Chauhan et al, a significant drop in coronary blood flow measured by Doppler wires was seen after esophageal acid stimulation using hydrochloric acid in patients with previous CAD. No effect was seen when saline solution was used, and this effect of acid was not seen in patients with transplanted hearts in the same study. The ECG changes associated with such change are unknown.2

Even though cases have been reported of myocarditis with localized changes, the diagnosis in this patient is not certain. Linked angina could be one possible explanation and if so, his symptoms may be relieved with treatment of the underlying GERD if present.

**References**


Kameel Farag, MD, FACC
Professor of Medicine, Division of Cardiology, Veterans Affairs Medical Center, Long Beach, CA

Nirmal Sunkara, MD
Fellow in Cardiology, UC Irvine Medical Center, Irvine, CA

Dear Drs. Sunkara and Farag,

Thank you for your erudite letter regarding a possible alternative diagnosis in the young man with STEMI ECG and normal coronary angiography and thought to be myocarditis with regional wall motion abnormality. I’m sure the readers will be interested to learn about “linked angina,” an obscure concept that I’ve never heard of until now. However, to me one of the most interesting aspects of this issue is the association between GERD and myocardial ischemia which indeed is arising in recent research discussions; specifically, that treating GERD may improve outcomes in patients with CAD. Despite your thoughtful conjecture, this young man did not have GERD, but I agree that a trial of antacids is certainly worthwhile.

MK