LV Assessment of Coronary Perfusion and Wall Motion

Intraoperative myocardial ischemia monitoring for patients undergoing cardiac or non-cardiac surgery has undergone several iterations over the years. Initially, anesthesiologists relied on data from ECG treadmill stress testing where ST segment changes (elevation or depression) in leads V5 or II were standard for picking up ischemia.

In the early 1980s it was postulated that changes in the pulmonary artery waveform at wedge position (appearance of a systolic V-wave) or an increase in the unwedged PA pressure tracing was thought to be an earlier, more specific ischemia warning that preceded the ECG ST segment changes.

Throughout all the attempts to use technology to detect myocardial ischemia in the patient under general anesthesia, it was the hope of the clinical anesthesiologist that rapid detection and treatment would lead to better outcomes.

In animal studies that are referenced from the 1930s, myocardium that becomes ischemic alters its contraction. The development of myocardial ultrasound and specifically TEE for the operating room environment has allowed clinicians to now visualize changes in myocardial contraction that could be a reflection of ischemia.

In the operating room TEE examination of the LV requires obtaining at least 5 views: Mid-esophageal 4 chamber, Mid-esophageal 2-chamber, Mid-esophageal long axis, Transgastric Basal short-axis (aka ‘fishmouth view’) and Transgastric mid-papillary short axis. It is these 5 views that we will focus on as it is these views where most of the literature has been written on coronary distribution. The 2013 Comprehensive TEE Guidelines point out that there are 6 other views where the LV can be examined and perhaps, of these 6 views, a Transgastric apical short-axis view should be included in all LV TEE exams.

For the beginning echocardiographer assessment of regional wall motion abnormalities is, in my opinion, one of the more difficult skills to acquire. Despite technical innovations in the ultrasound equipment, where attempts have been made to make it easier to determine wall motion and changes during an operation, most practicing cardiac anesthesiologists still rely on a qualitative method in determining changes in myocardial contraction.

And most clinical anesthesiologists rely sole on the transgastric mid-papillary short axis view as this is the one view where distribution of all 3 coronary arteries can be seen.

Figure 1 illustrates the 17 segments in which the LV is divided that came from a consensus committee of the ASE and the European Society of Echocardiography in 2005. By adhering to this approach to evaluating the LV, newer developments in imaging (ultrasound, MRI, CT) could use a standard language when communicating LV function. In situations where the transgastric short axis is poorly visualized, it is
important to learn and understand the coronary distribution of the mid-esophageal views.

Two years ago at this conference I asked one of the directors if they had any easy ways to learn coronary relationships between the LV transgastric views and the LV midesophageal views. There was no easy path other than time of focused thought and study of these images. While struggling myself to understand this, it was clear that the transgastric views seemed easy to understand and logical in their labeling—It was the midesophageal views that were difficult for me to understand. The key to understanding them was the realizing which walls were opposite each other in these 3 views:

1. Midesophageal 4 chamber view, the septal and lateral LV walls are opposite.
2. Midesophageal 2 chamber view, the inferior and anterior walls are opposite.
3. Midesophageal long axis view, the inferolateral and anteroseptal walls are opposite.

Once this was understood, it was then easy to remember that the basal segments are nearest the mitral valve and the mid segments are above the apical segments in these midesophageal views and to correlate the transgastric views accordingly.

From Figure 1, note that the interolateral, inferoseptal, and apical lateral segments showed most variability in coronary distribution. However MRI studies are showing that the variability of coronary distributions are more variable than we realize.

Regional wall motion abnormalities are graded according to 5 categories. In grading regional wall motion abnormalities the echocardiographer must look not only on LV motion “inward” but also on myocardial thickening. This is particularly important where patients are being paced—the LV may not move inward but it will thicken.

The 5-scale grading of Regional Wall Motion Abnormalities:
Grade 1—Normal--->30% shortening and thickening
Grade 2---Mild Hypokinesis---10-30% shortening and thickening
Grade 3---Severe Hypokinesis--<10% shortening and thickening
Grade 4---Akinesis—No shortening or thickening
Grade 5---Dyskinesis---Segment moves opposite and some thinning.

Although a 2 grade change is needed to diagnose ischemia, any RWMA in the operating room is usually considered ischemia.
Figure 1—17 LV Segment Model with Coronary Distributions

Modified from References 3, 5, and 6: Note: The apical views can also be obtained by a transgastric apical short axis view.
References:


