

# A Practical Approach to Echocardiographic Imaging in Patients with Hypertrophic Cardiomyopathy

Resting and stress echocardiographic assessment of patients with hypertrophic cardiomyopathy (HCM), or concern for HCM, should follow HCM specific imaging protocol. The following is a practical resource to help develop HCM imaging protocols and provides technical guidance for image and measurement acquisition in this cohort.

## TECHNICAL CONSIDERATIONS FOR PERFORMING A RESTING ECHOCARDIOGRAM ON PATIENTS WITH HCM

### Parasternal

**B-Mode long axis LV**



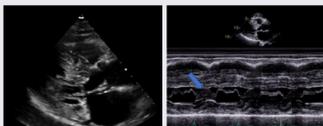
**2D measurements end diastole.**

- IVS-end diastole.
- LV diameter-end diastole.
- PW-end diastole.

Tips:

- Measure only compacted myocardium (exclude RV structures).
- Cross-reference with PSAX views.

**B-Mode M-Mode Long axis LV**



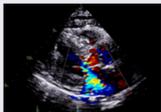
**Evaluate for SAM of the MV leaflets.**

- Evaluate leaflet tips throughout the cardiac cycle.
- M-mode may assist with evaluating timing of SAM (blue arrow).

Tips:

- Scroll slowly through the image to define degree of SAM.

**Color Doppler Long-axis LV focus on MV**



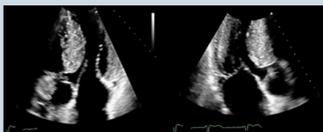
**Evaluate for MR.**

Tips:

- MR is typically posteriorly directed when related to SAM.
- If MR is anteriorly directed, evaluate closely for intrinsic valve disease.

### Apical

**B-Mode 5C and 3C**

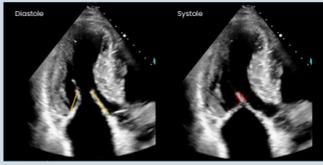


**Focus on MV to evaluate for SAM.**

Tips:

- Note length of the MV leaflets in diastole if LVOTO.
- Note severity of SAM.

**B-Mode Measurement of MV leaflets 2D measurements 3C**



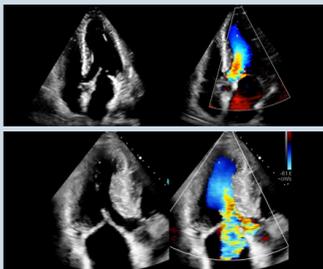
**Measurement of MV leaflets 2D measurements.**

- Measure total length of the anterior and posterior leaflets of the MV (gold lines) from annulus to leaflet tip in end diastole.
- Measure the anterior and posterior residual leaflet coaptation length (red lines) in the first frame of systole.

Tips:

- A3C view is often the optimal view to measure MV leaflets.
- PLAX view is an alternative option.

**Color Doppler 5C and 3C**

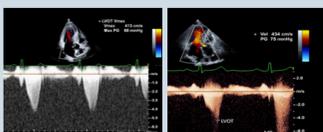


**Define level of obstruction with color Doppler.**

Tips:

- Set ROI to cover the entire LV from apex to the aortic valve to define location of obstruction.
- Compare the B-mode and color Doppler image simultaneously to define the location of obstruction.

**CW Doppler 5C and 3C**



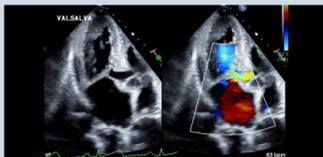
**Quantify the severity of obstruction at rest. CW Doppler measurement.**

- Peak dynamic gradient.
- Label, noting location of obstruction "e.g. resting LVOT gradient."

Tips:

- MR signal can contaminate the LVOT flow acceleration.
- To evaluate for contamination, move the transducer more laterally and angulate the probe to align the CW Doppler beam through the LVOT and aorta, avoiding the left atrium.
- Obtain and label LVOT jet then sweep the probe into the MR jet to highlight differences in velocities and Doppler profiles between the two jets.

**Provocative maneuvers B-mode and Color Doppler 5C and 3C**

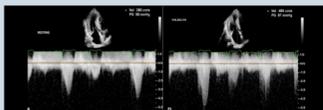


**Assess level of dynamic obstruction while patient performs a provocative maneuver (Valsalva) in both the A5 and A3 chamber views**

Tips:

- Practice the maneuver with the patient.
- Define the best probe position to obtain optimal imaging during provocation.
- Record a cine clip while the maneuver is being performed with B-mode and color Doppler to define whether SAM occurs/worsens or whether there is another location of worsening obstruction.

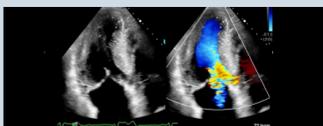
**Provocative maneuvers CW Doppler 5C and 3C**



**Quantify the severity of obstruction with provocation. CW Doppler measurement:**

- Peak dynamic gradient.
- Label, noting location of obstruction and maneuver (e.g. LVOT gradient with Valsalva).

**Color Doppler 3C, 4C, and 5C**



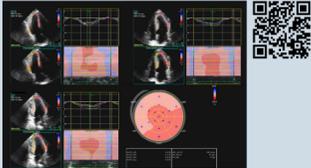
**Evaluate change in MR.**

**Evaluate for midcavity obstruction.**

- Color Doppler reveals flow aliasing in the midventricle.
- CW Doppler shows narrow flow acceleration in early systole (yellow arrow) with a signal void in midsystole (blue arrow) and an aortic closure click at end systole (red arrow), followed by further flow in early diastole as blood is released from the high-pressure apical aneurysm into the LV chamber (white arrow).

### Strain

**Strain**



**Measure global longitudinal strain.**

- Record parametric "bull's-eye" segmental strain map to assess for regional patterns in strain.
- Regional longitudinal strain is reduced at sites of hypertrophy and fibrosis.

Tips:

- Ensure apical views are not foreshortened.
- Confirm that tracking is moving with the walls to show areas of decreased strain.

### Ultrasound Enhancing Agents (UEA)

**UEA 4C, 2C, 3C**



Tips:

- Use to evaluate apical hypertrophy or those with mid/distal cavity obstruction to evaluate for apical aneurysm.
- Can improve accuracy of measured wall thickness in some cases.

## TECHNICAL CONSIDERATIONS FOR PERFORMING A STRESS ECHOCARDIOGRAM ON PATIENTS WITH HCM

- The primary clinical utility of stress echocardiography in HCM is to identify occult LVOTO and dynamic MR.
- UEA should not be utilized in the HCM stress echocardiography protocol as MV imaging is compromised
- Medical therapies (such as Beta-blockers) should not be withheld prior to testing at the physiological response to exercise while taking medical therapy is clinically important.

### Pre-exercise

**B-Mode 5C, 3C**



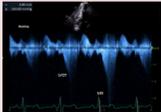
- Evaluate for level of obstruction (SAM with LVOTO vs midcavity vs none).
- Determine which view (5C or 3C) optimally evaluates the MV and LVOT gradient and record cine clip.

**Color Doppler 5C and 3C**



- Set color Doppler ROI over the LV and LA to assess the level of obstruction and degree of MR.
- This can be performed with B-mode imaging using Color Compare.

**Color Doppler 5C and 3C**



**Perform CW Doppler across the LVOT and measure the peak gradient.**

- Document the heart rate.
- If there is concern for contaminating MR, sweep the Doppler beam from the LVOT into the MR and label.

**CW Doppler A4C**

**Evaluate and measure peak velocity across the tricuspid valve.**

**B-Mode Apical Views 4C, 2C, 3C, PLAX LV, PSAX LV**



**Perform routine LV exercise stress echocardiography views.**

### Post-exercise

**B-Mode 5C, 3C**



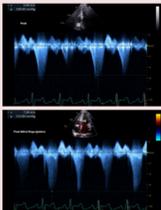
- Quickly evaluate for SAM.
- UEA should not be used as the MV is the structure of interest and it will not be seen with UEA.
- \*begin with the best view for evaluation of SAM and LVOT gradient identified during rest imaging.

**Color Doppler**

Same as prior view.

- Set color Doppler ROI over the LV and LA to assess the level of obstruction and degree of MR.
- This can be performed at the same time as the B-mode imaging using Color Compare.

**CW Doppler post-exercise imaging sequence**



Same as prior view.

**Place CW Doppler across the LVOT and measure the peak gradient.**

- Perform as quickly as possible from the time imaging begins using B-mode and color Doppler data to align the Doppler beam.
- If there is concern for contaminating MR, sweep the Doppler beam from the LVOT into the MR and label.

**B-Mode 5C or 3C**

(REPEAT using the second apical view)

- Quickly evaluate for SAM.

**Color Doppler 5C or 3C**

(REPEAT using the second apical view)

- Set color Doppler ROI over the LV and LA to assess the imaging sequence level of obstruction and degree of MR. This can be performed with B-mode imaging using Color Compare.

**CW Doppler 5C or 3C**

(REPEAT using the second apical view)

- Perform CW Doppler across the LVOT and measure the peak gradient.

**CW Doppler 4C tricuspid valve**

**Evaluate and measure peak velocity tricuspid valve.**

**B-Mode Apical 4C, 2C, 3C, PLAX LV, PSAX LV**

**Perform routine LV exercise stress echocardiography views.**

#### Abbreviations:

2C = Two-chamber	GLS = Global longitudinal peak systolic strain	PLAX = Parasternal long-axis
2D = Two-dimensional	HCM = Hypertrophic cardiomyopathy	PSAX = Parasternal shortaxis
3C = Three-chamber	LA = Left atrial, atrium	PW = Pulsed-wave
3D = Three-dimensional	LV = Left ventricular, ventricle	ROI = Region of interest
4C = Four-chamber	LVEF = Left ventricular ejection fraction	RV = Right ventricular
5C = Five-chamber	LVOT = Left ventricular outflow tract	SAM = Systolic anterior motion
ASE = American Society of Echocardiography	LVOTO = Left ventricular outflow tract obstruction	SRT = Septal reduction therapy
CW = Continuous-wave	MR = Mitral regurgitation	TTE = Transthoracic echocardiography
	MV = Mitral valve	UEA = Ultrasound-enhancing agent

