

Before acquiring standard images, the following 3 images should be captured to assess the need to use Contrast agent

- *Apical 4 Chamber*
- *Apical 2 Chamber*
- *Apical 3 Chamber*
- Pre-screening may/may not include focused views of the LV and Apex
- These images are not required in situations where you already know if contrast is/is not being administered (ie. known shunt, unable to obtain consent, previous history of adverse event etc.)
- **Pre-screening imaging will improve workflow by allowing RPN to prioritize**

Standard image set to be obtained

1. Parasternal long axis (PLAX) of left ventricle (LV), left atrium (LA) and aorta (AO)
 - Initial image at maximum field depth to assess pleura and pericardium
 - Reduce depth to display only LV, LA, MV, AOV, and RV.
 - Perform off line measurements of LV and wall thickness
 - M-Mode through MV, AOV and Mid LV
 - Colour Doppler screening for MR, AR and suspected VSD (separate images for each structure)
 - Zoom view of LV outflow tract and AOV
 - Perform off line measurements of LVOT diameter and aortic root
 - Aortic root and ascending aorta (requires repositioning to a higher window)
2. Right ventricle (RV) inflow view
 - 2D loop for RV and TV structure
 - Colour Doppler screening for TR
 - CW Doppler screening for TR/determination of RVSP
3. Right Ventricular Outflow view:
 - 2D loop for long axis of PA
 - Colour Doppler screening for PS/PI
 - CW Doppler screening for PS/PI (CW >1.5 m/s then use PW Doppler to locate increase)

3. Parasternal short axis (PSAX) view

- 2D loop of LV at basal (mitral valve level), mid (papillary muscle level) and apical levels
- 2D loop at aortic valve level
- Zoomed 2D aortic valve view
- Colour Doppler aortic valve
- Colour Doppler screening for PS/PI
- CW Doppler screening for PS/PI (CW >1.5 m/s then use PW Doppler to locate increase)
- Colour Doppler screening for TR
- CW Doppler screening for TR/determination of RVSP
- Colour Doppler atrial and ventricular septum if suspected intracardiac shunts

4. Apical 4 chamber view

- 2D view at optimal depth to display all 4 cardiac chambers
 - Perform offline measurement of LA volume
- 2D view at decreased depth to show only LV, with attention to avoid foreshortening of the apex
 - Perform offline measurement of LV volumes (Simpson's)
- 3D full volume of focused LV (4 beat acquisition, trimmed to 1 or 2 beats). No analysis req'd.
- Reduced depth imaging, focus and sector size to show left ventricular apex (if indicated)
- Colour Doppler screening for MR and MV inflow
- CW Doppler across MV (displaying regurgitant flow)
- CW Doppler across MV (displaying forward flow)
- PW Doppler at mitral leaflet tips
- TDI of lateral and medial mitral annulus (not necessary if patient has mitral prostheses or repair)
- TDI of tricuspid annulus
- PW Doppler of pulmonary vein flow
- If MR quantification is required (study indication) or if MR is greater than mild, perform PISA with zoomed mitral annulus and color baseline adjustment
- Colour Doppler screening for TR
- Optimized off axis view of RV
- Future: 3D full volume of focused RV (4 beat acquisition, trimmed to 1 or 2 beats). No analysis req'd.

- TAPSE
- CW Doppler across TV for determination of RVSP
- Colour Doppler assessment of atrial and ventricular septum if suspected intracardiac shunts (an off-axis view of IAS may be required if ASD suspected)

5. Apical 5 chamber view

- 2D view to show all five chambers
- Colour Doppler screening for AI/AS
- CW Doppler across aortic valve (display forward +/- regurgitant flow as required)
- PW Doppler of LVOT

6. Apical 2 chamber view

- 2D loop to show LV and LA
 - Perform offline measurement of LA volume
- 2D view at smaller depth to show only LV, with attention to avoid foreshortening of the apex
 - Perform offline measurement of LV volumes (Simpson's)
- Colour Doppler screening for MR

7. Apical 3 chamber view (long axis view)

- 2D loop to show LV, LA and Aorta
- Colour Doppler assessment of MV and AOV (separate images for each structure)
- CW Doppler assessment of aortic valve if stenotic, replaced or repaired
- CW Doppler assessment of mitral valve if stenotic, replaced or repaired
- PW Doppler of LVOT if required for AV assessment of outflow tract

8. Subcostal view

- 2D view of 4 chambers
- Zoomed 2D and colour Doppler assessment of IAS

- IVC with sniff to show respiratory variation using 2D view (8-10 cardiac cycles). **M-mode is not required but may give supplementary information.**
- Hepatic Venous colour and PW for patients with > mild TR
- 2D view of Abdominal Aorta
- Colour Doppler assessment in Abdominal aorta (use low flow or lower colour scale to improve filling)
- PW Doppler assessment of abdominal Aorta (for patients with > mild AI use low filters and decrease scale to fully demonstrate diastolic flow reversal)
- Subcostal short axis view (if parasternal views are suboptimal, particularly if AV or PV morphology has not been clearly demonstrated)

9. Suprasternal views of aorta

- 2D view of ascending and descending aorta
- Colour Doppler assessment of ascending and descending aorta
- CW Doppler assessment of ascending and descending aorta
- PW Doppler assessment of descending aorta for patients with > mild AI (use low filters and decrease scale to fully demonstrate diastolic flow reversal)

10. Perform CW Blind Probe Doppler (*in the 3 standard imaging windows - apex, right parasternal and suprasternal*) in all patients with aortic stenosis and prosthetic aortic valves.

Additional imaging may be required to complement the Standard Protocol:

- Agitated saline
- Atrial Fibrillation or irregular rhythm
- Dilated Coronary Sinus
- Left Ventricular Outflow Tract Obstructions
- ASD
- Left Ventricular Assist Device (LVAD)
- Tamponade, Pericardial Effusion, Post Pericardiocentesis
- Definity™ Contrast injection
- TAVR
- Constriction
- Amyloidosis
- PFO closure device
- RAMP protocol *coming soon

1. **Agitated Saline Contrast** should be completed on patients when:

- Ordered as a bubble
- Colour at IAS is suspicious for shunt and no bubble was previously done
- Indication is:
 - Rule out cardiac source of emboli, TIA or stroke
 - If patient under 70 – to be done routinely
 - If patient over 70 – only if the physician asks
 - Unexplained right heart dilatation or unexplained pulmonary hypertension
 - Suspected/rule out pulmonary arteriovenous malformations
 - Atrial septal device/ PFO closures or surgical repair- see protocol #11 for details
 - Dilated CS (undiagnosed)- see protocol #5 for details

Note: If this patient previously had a good quality bubble study including Valsalva this does not usually need to be repeated

- RPN/fellow will obtain IV access and inject saline. Technologists should not perform injection of agitated saline as it is not in their scope of practice.

- **Imaging with Agitated Saline Contrast**
 - use view with the best image quality (4ch or off axis 4ch)
 - adjust machine to acquire 15-20 cycles
 - perform a second acquisition to capture Valsalva release if required

1. **Consider imaging with Definity™ Contrast** if:

- requested by the referring physician
- suboptimal image quality
 - 2 or more contiguous myocardial segments are not visualized
 - EF difficult to assess accurately (on axis views)
- suspected LV thrombus
- apical wall motion abnormality, apical HCM
- non-compaction
- myocardial rupture/pseudoaneurysm
- RV not well visualized

○ **Imaging with Definity™ Contrast**

- Consider acquiring 3 to 5 cardiac cycles per view
- Ensure that optimal 2D images have already been acquired, in particular:
 - Focused images of the LV with a smaller depth- 4ch, 2ch, 3ch
 - Focused images of the LV apical region (focus at apex).
- Use Contrast LVO protocol with appropriate settings. Use frequency that gives the clearest imaging (HarmRes, HarmGen, HarmPen).
- Views should be annotated or marked appropriately
- Focused images of the LV with a smaller depth- 4ch, 2ch, 3ch (focus at mitral annulus)
- Focused images of the LV apical region (focus just below apex).
- Consider acquiring a sweep through the apical region
- Image off axis views of RV if suspected RV dysfunction or if indicated
- Acquire additional views as needed for example, PLAX, PSSAX, Subcostal.

Note: RPN/fellow will obtain IV access and inject contrast. Technologists should not perform injection of contrast as per LHSC Policy

See LHSC Echo Lab Contrast Lab Procedures

For more information on Contrast Imaging Procedures, Machine settings and Administration refer to the Echo Lab Policy and Procedure Manual or online at <http://www.definityimaging.com/main.html>

3. Atrial Fibrillation or Irregular Rhythm

- Doppler- measure 3-5 consecutive beats from the window that yields the highest velocities

4. TAVR

- blind probe from all three standard views
- PW of the LVOT in multiple locations
- ensure that the AVA and gradients complement each other, repeat views/measurements if discordant

5. Dilated Coronary Sinus

- Suspicious for persistent left superior vena cava
- Bubble study should be performed with the IV in the **left arm**
- Image from Apical 4ch, angle posteriorly to view the coronary sinus, use a long loop to capture location of bubble entry

6. Constriction/ Rule out Constriction

- 8-10 beat 2D loop to show septal motion with respirometer
- M-mode of PSLA- LV with respirometer and slow sweep speed (25 mm/s) to show septal motion
- Perform Doppler with respirometer and slow sweep speed (25 mm/s):
 - PW of hepatic vein (show diastolic forward/reverse flow; scale approx. 20-40 cm/s without aliasing)
 - PW of tricuspid and mitral valves

7. Left Ventricular Outflow Tract Obstructions (HOCM/SAM/post MVR/AVR,r/o HOCM)

- PW Doppler screening of LV cavity and LVOT at multiple locations, as needed for assessment of LVOT obstruction, use 5 ch and 3ch, using High PRF
- Show location of SV on 2D image (without colour)
- Valsalva to be performed on PW and CW (not req'd in patients with resting gradient >60 mmHg)
- PSSA with colour and 2 ch cavity with colour may help to locate the obstruction

8. Tamponade, Pericardial Effusion

- Req'd for moderate/large effusions or small/trace effusions when tachycardia is present
- Off axis views including LV apex to assess for circumferential effusion
- M-Mode through RVOT on PSSA asses for diastolic collapse
- 2D zoom of RA to assess for RA collapse
- Perform Doppler with respirometer and slow sweep speed (25 mm/s):
 - PW of tricuspid and mitral valves
 - PW LVOT
 - PW hepatic vein
- Subcostal view
 - M-Mode through RV to assess for diastolic collapse
- **Post Pericardiocentesis or F/U effusions**
 - Limited protocols are **COMING SOON

9. Amyloidosis/ Rule out Amyloidosis

- Acquire one PSLA and one Apical 4ch view with Harmonic imaging OFF

10. ASD

- If suspicious for sinus venosus ASD (ie. dilated rt side, no obvious ASD), then show bicaval view in subcostal (show IVC and SVC entering RA)

11. PFO Closure Device

- Post PFO closure device <6 months- no bubble required unless ordered
- Echoes at 6 months and 1 year- bubble done routinely
- Echoes beyond this, only if ordered as a bubble or for indication of stroke/cardiac source/MI

12. Left Ventricular Assist Device (LVAD)

- document on report the Type of assist device and speed
- PSLA/PSSA
 - M-mode of the AV with slow sweep speed (show frequency of AV opening)
 - LV apical (inflow) cannula position- colour and PW where possible
 - Aortic (outflow) cannula position- colour and PW where possible
- Apical
 - LV apical (inflow) cannula position- colour, PW and CW where possible
- Limited protocol for RAMP study- **COMING SOON

Completing the study

Following image acquisition the sonographer should:

- Review images to confirm that all the necessary information has been obtained
- Notify the reading physician if any questions, concerns or high/undetermined risk conditions are present before the patient leaves the lab
- Ensure that the demographic information listed above is correctly entered in Cerner/ISCV.
- Complete a preliminary report in ISCV following Preliminary reporting guidelines and Required Measurements.