CARDIOLOGY SERVICES POLICY AND PROCEDURE

Subject: Transthoracic Echocardiogram (TTE) **Policy No.:** 1

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PURPOSE:
To outline the process for performing a transthoracic echocardiogram (TTE)

POLICY:
An echocardiogram is performed by a technician who has passed the Los Angeles County Department of Health Services echocardiography competency exam.

DEFINITION:
An echocardiogram is a non-invasive ultrasound examination to evaluate structures and function of the heart.

PROCEDURE:

I. Getting Started:

A. Check for previous studies and review key elements
B. Optimize instrument settings prior to starting study
C. Review order and verify indication for exam.
D. A verbal order may be used for stat echocardiography and a written order will be posted in Orchid as soon as possible. Stat echocardiogram should be called for true medical emergencies when the result will have immediate impact on management decisions.

II. Procedure Preparation:

A. Enter patient information into ultrasound system (from Orchid work list or manually).
B. Enter demographics, height, weight, blood pressure, technician's name, and other information as needed.

III. Patient Preparation:

A. Explain procedure to patients.
B. Verify patient ID
C. Apply electrodes and attach leads.

IV. Digital Capture

A. Ensure adequate ECG signal. For patients in sinus rhythm, 2-beat captures are used**.** For patient in atrial fibrillation or other irregular rhythms, 3-5 beat captures should be used as needed. When capturing a bubble contrast study, use 5-10 second loops.

B. If images are suboptimal (when two or more LV segments cannot be visualized adequately for the assessment of LV function and regional wall motion, or in settings in which the study indication requires accurate analysis of regional wall motion, or to evaluate for intraventricular thrombus), consider use of an ultrasound enhancing agent (contrast). Refer to Cardiology Policy on Echocardiogram with Contrast.
C. In general, obtain a 2D image of the view first to provide anatomic orientation.
D. Spectral Doppler and M-mode should be captured at a sweep speed of 50 mm/s speed. Use 25-50 mm/s speed to demonstrate respirophasic changes that require documentation of changes across several cardiac cycles and 100 mm/s speed when making timing measurements.
E. Optimize Doppler signals. Doppler display should occupy about 2/3 of scale for each velocity. Narrow aiming sector to optimize color and frame rate. Ensure proper setting of the scale, gain, filter, compress and reject with continuous-wave (CW) & pulsed-wave (PW) Doppler.

IMAGING PROTOCOL

I. Parasternal Long-Axis View

A. Rule out pericardial/pleural effusions and assess extracardiac structures by increasing depth, then reduce depth to assess cardiac structures. Digitally capture 2D views without color Doppler for routine dimensional measurements. Zoom in on aortic and mitral valves.
B. Measure left ventricular septal thickness, left ventricular end-diastolic dimension and posterior wall thickness in end-diastole at the level of the mitral valve chordae.
C. Measure left ventricular end-systolic dimension in end-systole at the level of the mitral valve chordate.
D. Measure aorta at level of the Sinus of Valsalva. The additional measurements of the diameters of aortic annulus, sinotubular junction, and mid ascending aorta are needed when abnormal aorta is suspected. A separate ascending aorta image may be required.
E. Measure the left atrial dimension in end-systole.
F. Perform color flow Doppler of aortic valve, mitral valve, and ventricular septum.

II. Right Ventricular Outflow Tract View

A. Capture 2D image
B. Perform color and CW Doppler of the pulmonic valve

III. Right Ventricular Inflow View

A. Capture 2D image first
B. Perform color Doppler of Tricuspid Valve for Tricuspid Regurgitation.
C. Measure Peak Tricuspid Regurgitant Velocity for calculation of RA/RV pressure gradient and estimate pulmonary pressure

IV. Parasternal Short-Axis View (Aortic Level)

A. Capture 2D images of aortic valve, tricuspid valve, pulmonic valve, and Left Atrium
B. Zoom in on aortic valve structure. Perform color Doppler
C. Perform color Doppler on pulmonic valve and pulmonary artery
D. Perform PW and CW Doppler across the pulmonic valve
E. Perform CW Doppler to obtain tricuspid regurgitant velocity to calculate Pulmonary Artery Systolic Pressure if Tricuspid Regurgitation is present

V. Parasternal Short-Axis View (Left ventricle)

A. Capture 2D images of left ventricle at basal, middle (papillary muscle), and apex levels
B. Zoom in on the mitral valve leaflet and perform color Doppler in the presence of mitral valve disease.

VI. Apical Four-Chamber View

A. Capture 2D images of left ventricle (LV) structure and wall motion; avoid foreshortening of the LV. Using a narrow 2D sector and /or zoom to improve image quality to assess LV wall motion and thrombus. Adjust depth, focal point, probe setting (frequency) and gains to optimize images
B. Obtain 2D images of right ventricle (RV). Adjust transducer placement to ensure RV apex and free wall anatomy are in focus. Use a narrow 2D sector and/or zoom to improve image quality. Adjust depth, focal point, probe setting (frequency) and gains to optimize images.
C. Perform color Doppler and CW Doppler of Mitral Valve and Tricuspid Valve
D. Measure Peak Tricuspid Regurgitant Velocity for calculation of RA/RV pressure gradient and estimate pulmonary pressure
E. Perform PW Doppler of the Mitral Valve with the sample volume at the leaflet tips, measure E/A waves velocities
F. Perform tissue Doppler of lateral and septal mitral annulus to measure E', for E/E' ratio as needed
G. Measure LV volumes in diastole and systole to obtain an estimated ejection fraction. Include papillary muscle in tracing. Pay attention to apical alignment and mitral annulus. If calculated EF is significantly discordant with visual estimate, review, acquire and measure additional cardiac cycles.
H. Each of the above measurements will be frozen and then acquired.
I. Measurement of Left and Right atrium area as needed
J. Perform PW Doppler of pulmonary veins (sample volume 3-4 mm) as needed.

VII. Apical Five-Chamber View

A. Capture 2D image of left ventricle (LV) structure and wall motion.
B. Perform color Doppler, PW, and CW Doppler of left ventricular outflow tract (LVOT). Pay attention to the position of PW sample volume.

VIII. Apical Two-Chamber View

A. Capture 2D images of left ventricle (LV) structure and wall motion; avoid foreshortening of the LV.
B. Perform color Doppler of the mitral valve
C. Measure left atrial area and volumes as needed

IX. Apical Three-Chamber View (Apical Long-Axis View)

A. Perform 2 D image, take care not to foreshorten the image
B. Color flow Doppler of the Mitral Valve and the Aortic Valve
C. Perform PW/CW of LVOT /Aortic Valve (in presence or suspicious of aortic stenosis or calcification or LVOT obstruction. Pay attention to the position of PW sample volume.

X. Subcostal View

A. Perform 2D image
B. Perform Color Doppler of the Mitral and Tricuspid Valve and Interatrial and Interventricular Septa to look for shunt

C. Perform CW for the Tricuspid Regurgitant velocity to calculate pressure gradient as needed
D. Capture 2D images of the Inferior Vena Cava and observe for collapse (set for 3–5 seconds to appropriately capture). Include inspiration / expiration and "sniff" if needed.
E. Perform color and PW Doppler of Hepatic Vein/Inferior Vena Cava
F. Perform 2D subcostal short-axis view as needed (if parasternal view is not optimal)

XI. Suprasternal View

A. Perform 2D image of aortic arch as needed
B. Perform color Doppler, PW & CW Doppler as needed

XII. Right Parasternal View

A. Perform 2D image of the Ascending aorta as needed, especially if aortic dissection & aneurysm are suspected
B. Perform color Doppler and CW Doppler as needed for aortic stenosis

Additional off-axis 2D image/color Doppler imaging may be performed as needed to supplement standard views (eccentric mitral regurgitation, congenital heart disease, etc.).

SPECIAL CONDITIONS

I. Aortic Stenosis or Suspected Aortic Stenosis

A. Evaluate morphology and mechanism of aortic stenosis (e.g. bicuspid, rheumatic, calcified.) Obtain optimized view of the valve in the parasternal short-axis view.
B. Measure LVOT at the parasternal long-axis view. Zoom in on LVOT; adjust focal point and gain to optimize measurement of LVOT diameter.
C. In the apical 5-chamber view, obtain PW Doppler of aortic outflow with appropriate position of PW sample volume. Obtain CW Doppler of aortic outflow.
D. In the apical long-axis view, perform PW and CW Doppler of aortic flow.
E. Dedicated non-imaging CW Doppler in multiple locations, at the Apex, Suprasternal Notch, and Right Parasternal Border to obtain maximal velocity.
F. Trace the best Doppler wave form for calculation of aortic valve area using Continuity Equation. Three or more beats should be average for patients in sinus rhythm. At least 5 consecutive beats are averaged for patients with irregular rhythms. Special care must be taken to select representative sequences of beats and to avoid post-extrasystolic beats.
G. Pay attention to the size of LVOT, PW LVOT flow, ascending aorta and arch.

II. Aortic Regurgitation

A. Evaluate morphology and mechanism of aortic regurgitation (e.g. bicuspid, rheumatic, calcified).
B. Perform color Doppler for jet direction and measure vena contracta.
C. Measure CW Doppler of aortic regurgitation jet.
D. Perform color Doppler of descending aorta flow in suprasternal and subcostal views to check for Diastolic Flow Reversal
E. Assess for concomitant aortic stenosis.
F. Assess for aortopathy by measuring aortic root and ascending aorta dimensions. Measure Doppler in suprasternal view for coarctation.

III. Mitral Stenosis

A. Pay attention to morphology including leaflet thickening, annular calcification and subvalvular apparatus.
B. Trace CW of Mitral Valve Inflow for mean and peak pressure gradients. For patient in atrial fibrillation or other irregular rhythms, 3-5 beat captures should be used as needed.
C. Obtain deceleration slope of CW Doppler at 100 mm/sec for measurement of pressure half-time.
D. In short axis, obtain optimized view at leaflet tips and trace mitral orifice for valve area by planimetry.
E. Measure left atrial size.
F. Estimate pulmonary pressure.

IV. Mitral Regurgitation

A. Evaluate morphology and mechanism of mitral regurgitation (e.g. rheumatic, myxomatous, degenerative, chordal rupture, papillary muscle dysfunction, apical tethering)
B. Perform color Doppler for jet direction and measure vena contracta. Calculate effective regurgitant orifice (ERO) by PISA method: Baseline shift of color Doppler to reduce aliasing velocity to approximately 30-40 cm / sec. Measure aliasing radius from first blue / red aliasing interface to regurgitant orifice (PISA shell) in the frozen color Doppler image.
C. Measure pulmonary venous flow for systolic blunting or flow reversal.

V. Tricuspid Regurgitation

A. Evaluate morphology and mechanism of tricuspid regurgitation (annular dilation, right ventricular dysfunction, device lead)
B. Perform color Doppler for jet direction
C. Obtain PW Doppler of hepatic vein for systolic blunting or flow reversal
D. Measure Tricuspid regurgitation velocity with CW Doppler. Use highest velocity obtained to assess RV-RA gradient to estimate pulmonary systolic pressure.

VI. Prosthetic Valve

A. Note type and size of prosthesis (from char or patient card)
B. Evaluate prosthetic valve structure (bioprosthetic, mechanical) and stability (well-seated, rocking).
C. Measure peak and mean gradient by CW Doppler
D. Perform color Doppler and CW Doppler for valvular regurgitation. Note location of regurgitant jet (intravalvular, paravalvular)
E. Evaluate for thrombus, pannus, or vegetation.

VII. Pericardial Effusion

A. Evaluate for RV and RA collapse by 2D in multiple views (parasternal, apical, subcostal)
B. Assess respiratory variation in mitral and tricuspid valve inflow using PW Doppler at 25-50 mm/min speed
C. Evaluate size and respiratory changes in Inferior Vena Cava flow.

VIII. Hypertrophic Cardiomyopathy

A. Measure LV wall thickness including maximal septal thickness. Evaluate for systolic anterior motion of mitral valve and for mitral regurgitation.

B. Use PW Doppler in left ventricular and along the LVOT to elicit location of flow acceleration
C. Perform CW Doppler to obtain maximal intraventricular or LVOT pressure gradient

REPORTING

A. The TTE images will be uploaded to the electronic medical record by the technician. The cardiologist will enter the findings into the electronic medical record.
B. See Policy and Procedures B856 for Reporting Critical Results and Significant Medical Imaging Results.

REFRENCES:

INTERSOCIETAL ACCREDITATION COMMISSION (https://intersocietal.org)