PROTOCOL: SHUNT STUDY

Inclusion Criteria

- Appointment type of 'TTE Shunt' or 'PHTN WITH SHUNT'
- Study ordered to rule out intracardiac or intrapulmonary shunt
- Referral of:
  - **Hereditary Hemorrhagic Telangiectasia (HHT)** regardless of whether the patient has had a prior shunt study *and* regardless of whether the result was positive or negative. Also perform PHTN protocol
  - **Pre-device lead extraction** to evaluate for risk of thrombus crossing an intracardiac defect during extraction
  - **Suspected stroke or cardiac source of embolism** where intra-cardiac shunting may be considered*
  - **Advanced liver disease** including cirrhosis (risk of hepatopulmonary syndrome) refer to the liver disease shunt protocol

Instructions

VALSALVA – Perform 1st

Instruct patient in the performance of the Valsalva maneuver

Obtain a 4 chamber view in the following order:

1) Instruct patient in the performance of the Valsalva maneuver
2) Obtain a 10-15 beat clip of the 4 chamber view in the following order:
3) **Stop respiration** with a held breath at neither inspiration nor expiration
4) Instruct patient to **Valsalva and hold strain**
5) **Inject** agitated saline
6) Valsalva strain until the **right heart is opacified**
7) **Release Valsalva** and ensure that images acquired include at least 8 beats after Valsalva is released

REST – Perform 2nd

Obtain a long clip of the 4-chamber view with agitated saline injection

Caveats and Tips

- ✓ Perform Valsalva on all shunt studies (including those to rule out intrapulmonary shunt)
- ✓ Sensitivity is enhanced with multiple injections. In stroke patients, perform 2-3 Valsalva saline injections (or more if patient's age is < 55)
- ✓ Use harmonic imaging
- ✓ Zoomed view of the atrial septum and pulmonary veins may help determine location of shunt
- ✓ Other patient positioning (sitting upright, standing, squat-to-standing) should be done as clinically indicated for diagnoses such as platypnea-orthodeoxia syndrome

PFO/ASD: visible in 1-3 beats
Intrapulmonary: visible in 4-8 beats

PROTOCOL: SHUNT STUDY, CONT.

EIMS & Epic Data

Epic Procedure: select the 'with contrast' option
EIMS Procedure Components: IV Agitated Saline

Impressions:

***Patients with right-to-left shunt and known or suspected stroke**

1) Add "Patent Foramen Ovale" statement *(under shunts, Patent Foramen Ovale)*
2) Modifiers:
    a. Direction of shunt
    b. Number of microbubbles seen in left heart chambers (<30 or ≥30)

Patients with unexplained RV enlargement, pulmonary hypertension, or hypoxia

1) Add "no right to left shunt" or "right to left shunt" *(under TEE, atrial septum/shunts folder)*. If shunt is present, note whether it is early or late. Suggestion of shunt location is at your discretion.
2) Use the following grading scale:

Semiquantitative Assessment of Agitated Saline Right-Left Shunts	
Severity Grade	**Echocardiographic Appearance of Microbubbles**
Normal	No bubbles visualized in the LA or LV
Trivial	Few microbubbles visualized in the LA or LV (*no more than 10*)
Grade 1 (mild)	Modest number of microbubbles visualized in the LA or LV without appreciable change in the density of the LV cavity
Grade 2 (moderate)	Microbubbles visualized in the LA or LV with <50% of the comparable density in the RA or RV
Grade 3 (severe)	Microbubbles visualized in the LA or LV with ≥50% of the comparable density in the RA or RV

LA, left atrium; *LV*, left ventricle; *RA*, right atrium; *RV*, Right ventricle.

See 9/22/2021 CIGR with Dr. Reeder for more information:
https://videoexchange.mayo.edu/media/Cardiac+Imaging+Grand+Rounds+-+September+22%2C+2021/1_0g4es2s9/16905081