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Authors

Mojadidi, Mohammad Khalid
Tobis, Jonathan M

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LETTER TO THE EDITOR

Patent Foramen Ovale and Atrial Septal Defect: Utility of Alternative Imaging Modalities for the Diagnosis of Patent Foramen Ovale and Atrial Septal Defect

Dear Editor,

We read with interest the article "Patent Foramen Ovale (PFO) and Atrial Septal Defect (ASD)" by Hari et al.¹ The article is a review describing the anatomy and embryology of the atrial septum and the diagnosis of PFO and ASD using echocardiography. The authors mention the importance of transesophageal echocardiography (TEE) in visualizing the atrial septal anatomy, measuring the degree of right-to-left shunting (RLS), and determining the type and size of the closure device preprocedure. For the readers of *Echocardiography*, we would like to provide additional information on the accuracy, optimal protocol, advantages, and limitations of the different imaging modalities that are commonly used for the diagnosis of intracardiac RLS.

Transthoracic echocardiography (TTE) is the most commonly used method for diagnosing cardiac RLS due to its low cost and easy availability. Conventional TTE has a low sensitivity of 49% but a high specificity of 99% when compared with TEE.² A recent review comparing different protocols used in conventional TTE found that utilizing different contrast agents, different microbubble cutoffs for a positive study, and different cardiac cycle cutoffs did not alter the accuracy of conventional TTE.² Harmonic imaging capability improves the sensitivity of TTE while compromising specificity.^{3,4} The accuracy of TTE harmonic imaging may be enhanced by the addition of blood to the agitated saline contrast, injection of contrast immediately before the provocation maneuver (as opposed to during), and when the test is considered positive for RLS by the appearance of ≥ 1 microbubble in the left atrium within 3 cardiac cycles.⁴ TTE, with or without harmonic imaging, is limited by its inability to accurately assess the atrial septal anatomy. The Valsalva maneuver causes inflation of the lungs and shifting of the diaphragm which results in a transient loss of image as bubbles cross the interatrial septum; this may partly explain the lower accuracy of TTE.⁵

Transcranial Doppler (TCD) bubble study may be preferable for detecting RLS due to its low cost, high accuracy, and noninvasive nature. TCD indirectly assesses for a RLS by injection of agitated saline contrast and detection of bubbles after a provocation maneuver through insonation of the middle cerebral arteries. When compared to TEE, TCD has a sensitivity of 97% but a lower specificity of 93% likely due to its inability to differentiate between cardiac and pulmonary RLS. A recent review observed that using different contrast agents, changing the timing and type of provocation maneuvers and insonating unilateral versus bilateral middle cerebral arteries did not affect the accuracy of TCD for detecting RLS.⁶ However, increasing the microembolic threshold for a positive TCD to 30 microbubbles significantly improves the specificity of TCD without compromising sensitivity compared to the diagnosis of PFO by heart catheterization.⁷

As Hari et al mentioned, TEE is essential for visualizing the atrial septal anatomy, measuring RLS severity and determining the type and size of a potential closure device. However, 10% of PFOs may still be missed with TEE. A recent meta-analysis comparing the diagnostic accuracy of TEE to confirmation by autopsy, cardiac surgery, and/or cardiac catheterization demonstrated TEE to have a sensitivity of 89% and specificity of 91%.⁸ TEE has the limitation of being time-consuming, uncomfortable for the patient, and has a low risk of esophageal bleeding or perforation.

We recommend utilizing TCD as an initial screening test with TEE used as a subsequent confirmatory test. In stroke patients, TEE is still essential for the diagnosis of other etiologies of stroke including an intracardiac thrombus and to assess the left atrial appendage or the presence of aortic disease.

Disclosures:

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Mohammad Khalid Mojadidi, M.D.* and
Jonathan M. Tobis, M.D., F.A.C.C.†

*Division of Cardiology, University of Florida
College of Medicine, Gainesville,
Florida

†Program in Interventional Cardiology, Division
of Cardiology, David Geffen School of Medicine,
University of California at Los Angeles, Los
Angeles, California

References

1. Hari P, Pai RG, Varadarajan P: Echocardiographic evaluation of patent foramen ovale and atrial septal defect. *Echocardiography* 2015;32(Suppl 2):S110–S124.
2. Mojadidi MK, Winoker JS, Roberts SC, et al: Accuracy of conventional transthoracic echocardiography for the diagnosis of intracardiac right-to-left shunt: a meta-analysis of prospective studies. *Echocardiography* 2014;31:1036–1048.
3. Madala D, Zaroff JG, Hourigan L, et al: Harmonic imaging improves sensitivity at the expense of specificity in the detection of patent foramen ovale. *Echocardiography* 2004;21:33–36.
4. Mojadidi MK, Winoker JS, Roberts SC, et al: Two-dimensional echocardiography using second harmonic imaging for the diagnosis of intracardiac right-to-left shunt: a meta-analysis of prospective studies. *Int J Cardiovasc Imaging* 2014;30:911–923.
5. Mojadidi MK, Gevorgyan R, Tobis J: A comparison of methods to detect and quantitate PFO: TCD, TTE, ICE and TEE. In: Amin Z, Tobis J, Sievert H, Carroll J (eds): *Patent Foramen Ovale*. London: Springer, 2015, pp. 55–65.
6. Mojadidi MK, Roberts SC, Winoker JS, et al: Accuracy of transcranial Doppler for the diagnosis of intracardiac right-to-left shunt: a bivariate meta-analysis of prospective studies. *JACC Cardiovasc Imaging* 2014;7:236–250.
7. Spencer MP, Moehring MA, Jesurum J, et al: Power m-mode transcranial Doppler for diagnosis of patent foramen ovale and assessing transcatheter closure. *J Neuroimaging* 2004;14:342–349.
8. Mojadidi MK, Bogush N, Caceres JD, et al: Diagnostic accuracy of transesophageal echocardiogram for the detection of patent foramen ovale: a meta-analysis. *Echocardiography* 2014;31:752–758.