

Diagnosis of Patent Foramen Ovale: Concordance between Transthoracic and Transesophageal Echocardiography Using Agitated Saline

Patent foramen ovale (PFO) is found in up to 25% of adults in the general population. (1) Most PFOs are discovered incidentally and have no significant clinical consequences. However, association of PFO has been reported with various clinical conditions, such as cryptogenic stroke, migraine, decompression sickness and platypnea–orthodeoxia syndrome. In turn, cerebral ischemic events represent 70% to 80% of cerebrovascular disease. However, in approximately 40% of cases these conditions have no identifiable cause. (1) It is likely that POF is responsible in these cases, since in those subjects diagnosed with cryptogenic stroke, the probability of having POF is 4 times higher than in control subjects. (2) There are several studies and maneuvers to improve the diagnostic results of this condition. Transesophageal echocardiography (TEE) has been considered the method of reference. (2) However, the results from recent studies show false negative results secondary to intubation and to the difficulty in performing the Valsalva maneuver under moderate sedation. (3) Moreover, Marriott et al. reported that transthoracic echocardiography (TTE) can be used as a diagnostic tool for PFO associated with agitated saline contrast, with sensitivity and specificity similar to those of TEE. (4) These arguments led us to study the concordance between TTE and TEE for the diagnosis of PFO.

A total of 45 consecutive patients were included, who consulted the Neurology Unit at our center due to stroke of unknown origin. Among these patients, 22 (49%) were men. Transthoracic and transesophageal echocardiography was performed, sensitized with agitated saline and Valsalva maneuver.

A right-to-left shunt attributed to PFO was found in 42% of the patients at rest and in 53% with Valsalva maneuver. When evaluating the concordance among the four study variants, TTE and TEE, with and without Valsalva maneuver, a kappa value of 0.64 (Fleiss' kappa) was found. The best correlation between both

Table 1. One-to-one concordance analysis

Concordance	Kappa	95% CI	p
TTE at rest and TTE with Valsalva	0.69	0.48-0.87	< 0.001
TTE at rest and TEE at rest	0.73	0.49-0.91	< 0.001
TTE at rest and TEE with Valsalva	0.60	0.35-0.82	< 0.001
TTE with Valsalva and TEE at rest	0.43	0.14-0.69	0.003
TTE with Valsalva and TEE with Valsalva	0.73	0.50-0.91	< 0.001
TEE at rest and TEE with Valsalva	0.69	0.45-0.91	< 0.001

TTE: Transthoracic echocardiography. TEE: Transesophageal echocardiography.

Table 2. Severity of right-to-left shunt

PFO	TTEr (n)	%	TTEv (n)	%	TEEr (n)	%	TEEv (n)	%
Absent	25	55.6	20	44.4	25	55.6	21	46.7
Mild	8	17.8	6	13.3	10	22.2	13	28.9
Moderate	3	6.7	4	8.9	3	6.7	3	6.7
Severe	9	20.0	15	33.3	7	15.6	8	17.8

PFO: Patent foramen ovale. TTEr: Transthoracic echocardiography at rest. TTEv: Transthoracic echocardiography with Valsalva. TEEr: Transesophageal echocardiography at rest. TEEv: Transesophageal echocardiography with Valsalva.

studies was observed with the Valsalva maneuver (kappa 0.73), the worst being between TTE with Valsalva and TEE at rest (kappa 0.42) (Table 1).

When the degree of shunt severity with both methods was analyzed, it was indeed low with TEE (severe TTE 33.3% versus 17.8% with TEE) (Table 2).

Some authors suggest that this discrepancy may be due to the difficulty in performing the Valsalva maneuver when the patient is under sedation. (3) The fact that our patients were not sedated during the study did not affect shunt quantification. It suggests that other mechanisms, such as intubation, may be involved in atrial hemodynamic changes. (5) Atrial septal aneurysm (ASA) was detected in 49% of the study patients with both methods. Sixty-eight percent of patients with ASA were diagnosed PFO with TTE, and 63% with TEE.

Patient tolerance to TEE without sedation was good in 87% of the patients and moderate in 13%. The quality of the acoustic window in TTE was positive in 80% of the cases, and deficient in 20%.

The good concordance between TTE and TEE found in our study confirms similar findings from other authors. (6)

The limitations in our study include the lack of blinded studies compared with other studies, since the physician performing the TTE was the same that then performed the TEE, and was aware of the results of the first study.

We have been unable to set a valid pattern to quantify shunt severity. In our study, we have assumed the severity according to the number of bubbles counted. We have used a subjective value for tolerance assessment.

In conclusion, and based on our findings and their limitations, the use of TTE to identify PFO, a potential source of stroke of unknown origin, provides diagnostic results that are very similar to those of TEE. The use of agitated saline and Valsalva maneuver facilitate diagnosis. If these findings are confirmed with studies including a greater number of patients and more statistical power, transesophageal echocardiography, a semi-invasive method, would be restricted to patients with bad acoustic window limiting transthoracic echo-

cardiography, to define the anatomy of the atrial septum when planning a percutaneous closure, or as a complementary test in case of atrial fibrillation.

Conflicts of interest

None declared.

(See authors' conflicts of interest forms on the website/Supplementary material).

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Percutaneous Mitral Valve Repair with MitraClip™ in a Patient with Ischemic Mitral Regurgitation

Treating severe or secondary ischemic mitral regurgitation (MR) is a challenge, since surgical valve repair has not shown conclusive benefits and is associated with high rate of recurrence and need for another surgical repair. (1) While international guidelines suggest a surgical approach when combined with coronary bypass surgery, valve repair in isolation is not recommended, particularly for patients with high perioperative risk. (2, 3) Thus, a significant number of patients with severe functional MR do not undergo surgery, resulting in an ominous prognosis. We report the case of an 83-year-old male patient with history of coronary artery disease (coronary bypass surgery

in 1999 and percutaneous intervention in 2009) and renal failure (dialysis since 2009), who was referred to our department due to MR associated with Class III dyspnea and 3-month history of Class IV episodes. Baseline transthoracic echocardiography showed severe central jet (segment A2-P2) (3+), left atrial enlargement (62 mm), preserved left ventricular systolic and diastolic diameters (51 and 32 mm) with impaired inferior wall motion and left ventricular ejection fraction of 54% (Figure 1 A). A non-invasive functional study ruled out myocardial ischemia. In order to repair the valve disease, the case was raised to the surgeons, who ruled out the intervention due to its high risk (Society of Thoracic Surgeons [STS] Score 25.2; logistic EuroSCORE 32.7%). Given the unlikely good patient progress if valve regurgitation was not corrected, MitraClip™ (Abbott Vascular) was implanted to repair the mitral valve. The device consists of a cobalt-chromium clip covered with polyester, with two arms that are opened and closed simultaneously to grasp the leaflets of the mitral valve, mimicking the open chest edge-to-edge technique developed by Alfieri et al. (4) Under general anesthesia, venous (right femoral vein with 8-Fr introducer) and arterial (left femoral with 6-Fr introducer) access was performed, followed by anticoagulation with heparin sodium. A 0.035-inch super stiff guidewire was advanced to the right atrium followed by the Mullins set, placing a pigtail catheter at the level of the aortic valve as reference. Transseptal puncture was guided with transesophageal echocardiography (TEE) to ensure the puncture site was distant enough from the mitral valve plane to facilitate manipulation of the device in the left atrium. Immediately following puncture, the guidewire was advanced to the pulmonary vein and the interatrial septum was dilated with a 5.0×40 mm balloon. The transseptal catheter was then removed and subsequently exchanged for a 24-Fr delivery catheter (22 Fr at its distal end) with the clip attached to the distal end. The clip was then orientated to the left atrium through the mitral valve, and was positioned in the ventricle. With the help of TEE, the device was carefully pulled back, and both leaflets were grasped (Figure 2 A & B). Once in place, the clip was closed. Finally, after confirming its adequate positioning, absence of significant atrioventricular gradient (should

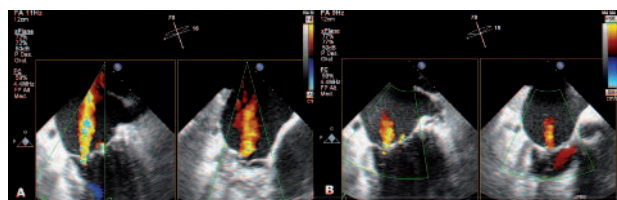


Fig. 1. Mid esophageal four chamber TEE view (X-plane) showing severe mitral regurgitant jet (A). After the implantation, reduction of the jet to a mild degree is observed (B).