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Echocardiography

The Challenge of Integrated Echocardiographic Approach in Percutaneous Closure of Paravalvular Leak

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Paravalvular leak after prosthetic mitral valve surgery may lead to symptomatic mitral regurgitation and hemolytic anemia requiring reoperation. Percutaneous closure of paravalvular leaks is a relatively recent technique still considered a challenging procedure burdened by possible complications, to be offered only to poor redo surgical candidate patients. Multimodality imaging is advocated to plan and guide the procedure, to minimize the risk of complications. We report on a case of dehisced prosthetic mitral valve in which transthoracic real time three-dimensional echocardiography was used to locate the dehiscence area and characterize mitral paraprosthesis leak, whereas intracardiac echocardiography was used to guide and monitor the percutaneous closure procedure. (Echocardiography 2011;28:E168-E171)

Key words: dehisced prosthetic mitral valve, intracardiac ultrasonography, percutaneous closure, paravalvular leak, real time 3D echocardioagraphy

Paravalvular leak (PVL) is not an uncommon complication of prosthetic valve surgery, with clinically significant regurgitation occurring in 2–5% of patients.[1] PVL are twice as likely to occur with mitral than with aortic prosthesis, promoting factors being annulus calcification and previous infective endocarditis. Small leaks without hemolysis are managed with medical therapy, whereas repeat surgery, either resuturing or replacing the original prosthesis, remains the treatment of choice for symptomatic mitral regurgitation, particularly when associated with heart failure, hemolytic anemia or functional decline. Reoperation is associated with markedly higher morbidity and mortality than the initial procedure, related to increased age and comorbidities. Patients who are poor surgical candidates may be offered percutaneous closure of PVL, which can result in paravalvular regurgitation reduction and clinical improvement.[2]

In the case we report on, transthoracic real time three-dimensional echocardiography (RT3DE) was used to characterize mitral prosthesis pathology and precisely locate the dehiscence area, whereas intracardiac echocardiography (ICE) was used to guide the device placement and assess the functional results of the percutaneous closure procedure.

Disclosures: None.

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Case Report:

An 88-year-old man was admitted to hospital for abdominal pain and jaundice. Blood tests evidenced anemia with signs of hemolysis. The patient had undergone mitral valve replacement in 1990, and redo replacement in 2004 for prosthesis dysfunction. Transthoracic echocardiography evidenced severe mitral regurgitation due to PVL, severe pulmonary hypertension and preserved left ventricular (LV) systolic function; transesophageal echocardiography (TEE) and RT3DE demonstrated that PVL was due to detachment of about one-quarter of the prosthetic ring (Fig. 1, movie clip S1). Because of the high risk of redo cardiac surgery, the percutaneous treatment option was discussed with the patient who gave his informed written consent to the procedure. Percutaneous PVL closure was performed under ICE guidance (Acuson AcuNav 8F Ultrasound catheter, Siemens Medical Solutions USA, Inc., Mountain View, CA, USA): ICE probe, introduced via left femoral venous access was positioned in midinferior right atrium with some clockwise rotation and left steering so as to insonate mitral annulus and locate the dehisced segment (Fig. 2A, movie clip S2). Right anterior oblique (RAO) ventriculography confirmed severe PVL. A right Judkins catheter and a 0.035-inch 260-cm Terumo stiff Glidewire hydrophilic coated guidewire (Terumo Medical Corporation, Somerset, NJ, USA) was used to cross the leak, and a 14x5mm Amplatzer Vascular Plug III (AGA Medical, Plymouth, MN, USA) was advanced through the leak and released. ICE

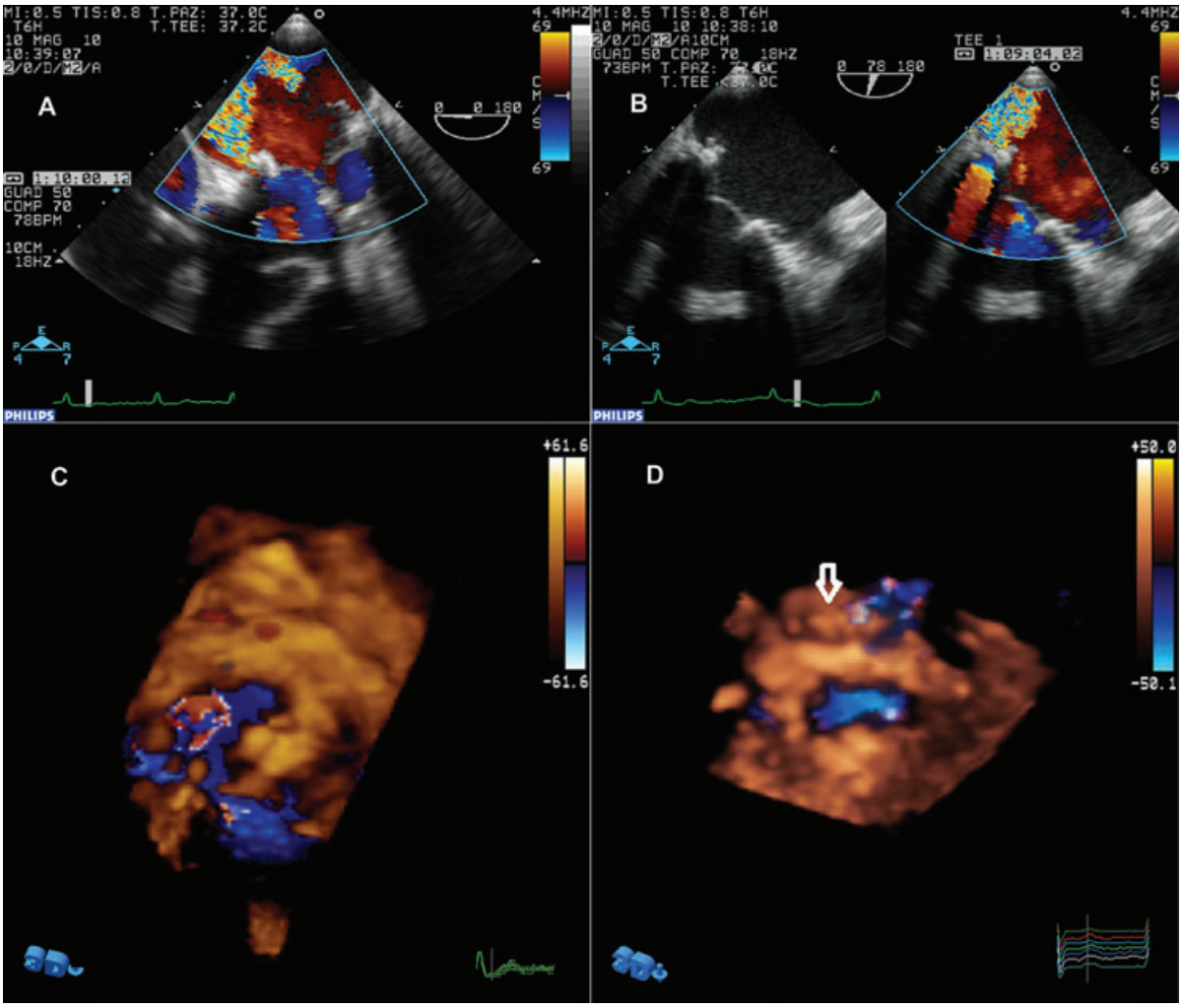

Figure 1. Transesophageal and transthoracic real time three-dimensional echocardiographic imaging. Identification and localization of the dehiscence area of the paravalvular leak was first accomplished with transesophageal echocardiography: the regurgitant jet was seen between 0° (panel A) and 75° (panel B) scan angle. At transthoracic real time 3D color Doppler echocardiography the position of the paraprosthetic leak was confirmed (panel C), whereas the device deployed through the leak (arrow) and the reduction of the regurgitant jet (panel D) were documented after the percutaneous closure procedure.

imaging documented the entire release procedure and the significant mitral regurgitation reduction (Fig 2B-C, movie clip S3). Final RAO ventriculography checked device stability and position and ICE and RT3DE confirmed significant reduction of paravalvular regurgitation (movie clips S3 and S4). The patient had an uneventful recovery with significant reduction of symptoms and haemolysis.

Discussion:

Valve replacement is the second most common type of cardiac surgery after coronary artery bypass grafting; the prosthetic valve is sutured onto valve annulus: rupture of one or more stitches securing the prosthesis to the valvular ring may eventually cause PVL. In most cases, postoperative leaks are mild and have no clinical consequences; otherwise, leak size, and morphology determine the subsequent clinical presentation and the severity of heart failure. Symptoms may be also due to hemolytic anemia as a result of hemolysis in the high shear stress regurgitant jet. Medical therapy is the first line treatment: afterload reduction is used to control heart failure and repeated blood transfusions may be needed to treat hemolytic anemia.

Percutaneous closure of PVL, a relatively recent technique first proposed by Lock et al.,[3] can be an alternative treatment at least as an end stage therapy in high surgical risk patients, whose symptoms are not adequately palliated by medical therapy. Being considered as a life-treating

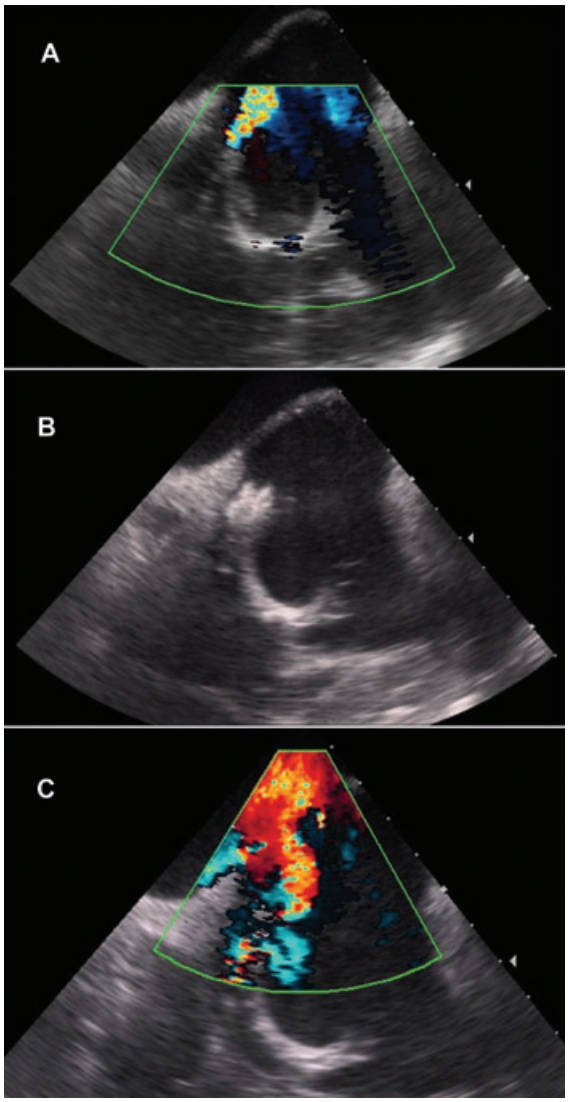

Figure 2. Intracardiac ultrasound monitoring of the percutaneous closure procedure. The regurgitant jet is visualized at 11 o'clock in standard view (panel A); the position of the device after deployment was checked (panel B); residual regurgitant jet was assessed at the end of the procedure (panel C).

therapy, this procedure has been used only in high selected patients who cannot be submitted to reoperation due to comorbidities and age. As a consequence, available outcome data are scarce and nonunivocal, limited to small number of patients and isolated case reports.

PVL procedure may be unsuccessful; possible complications depend either on patient's clinical condition and comorbidities, or to technical difficulties and leak size or morphology characteristics. They comprise obstruction of the prosthetic valve from the device occluding the PVL, dislodgement of the device, complications at the vascular access, due to contrast administration, anaphylaxis.[4] To minimize complications, detailed structural evaluation of the prosthesis and leak morphology is needed, and multimodality imaging is advocated to this purpose. Echocardiography is central to any integrated imaging approach, contributing greatly to expand multimodality itself.

In a series of 27 cases, Cortès and colleagues demonstrated that TEE performed during PVL percutaneous closure represented an important guide during defect crossing and positioning the device. Moreover in their series TEE allowed for visualization of the correct deployment of the device, checking for normal prosthetic function before the release of the device.[5]

RT3D TEE is gaining popularity as the most powerful noninvasive method of evaluating structural heart defects.[6] In mitral prosthetic valve dehiscence, it is known to be superior over 2D TEE[7] in that it provides additional information about the complex 3D anatomy, spatial orientation and size of the dehiscence, helps in planning the corrective procedure[8] and in facilitating procedural success. [9] As an alternative or integrative method, ICE has emerged as an effective option to improve detail definition and guide percutaneous interventional procedures.[10]

Conclusion:

In the case of percutaneous PVL closure we presented the multimodality echocardiographic approach was based on 2D TEE and transthoracic RT3DE to identify PVL anatomic characteristics and mitral prosthesis morphology, whereas ICE was used to position the catheter through the target PVL and to guide correct deployment of the occlusive device.

Transcatheter mitral PVL closure is today one of the most challenging procedures facing interventional cardiologists. The combined use of up-to-date echocardiographic techniques, as we did for our patient, can help minimize complications and make this procedure safer and safer so that it can be offered confidently as an alternative to redo surgery to most PVL patients.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Movie clips S1, S2, S3, S4, and S5.

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