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Severe regurgitation due to perforation of the mitral–aortic intervalvular fibrosa 3 years after aortic valve replacement

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We report the case of a 91-year-old man with severe symptomatic mitral regurgitation (MR), referred for assessment of percutaneous edge-to-edge repair 3 years after bioprosthetic aortic valve replacement (AVR). Detailed transthoracic, trans-oesophageal (TEE), and three-dimensional (3D) echocardiography showed a perforation in the subaortic curtain leading to severe regurgitation from the left ventricular outflow tract to the left atrium, which was undiagnosed on previous two-dimensional echocardiography. This regurgitation might be iatrogenic in origin after AVR in the absence of previous known endocarditis. This case highlights the utility and added value of 3D TEE in identifying the mechanism of MR.

Keywords Perforation • Iatrogenic • Aortic valve replacement • 3D echocardiography

Background

There are several possible aetiologies for mitral regurgitation (MR). Most of these are related to abnormal leaflets (organic) or annular dilatation (functional). Some degree of MR is found in as much as 61–90% of patients undergoing aortic valve replacement (AVR) for aortic stenosis (AS).[1] There is a reduction in MR in up to >80% of patients after AVR, when the aetiology is functional.[1] New MR or progression of pre-existing MR is an uncommon finding after AVR, occurring in 4–14% of patients.[1] There are rare cases reported in which there is a regurgitant jet originating from the mitral–aortic curtain in association with endocarditis.[2–6] Most of these cases show involvement of the anterior mitral leaflet with a perforation. A connection between the left ventricular outflow tract and the left atrium after aortic valve surgery without signs of endocarditis and structurally normal mitral valve leaflets is even more unusual.[7]

Case report

A 91-year-old man was referred from a neighbouring hospital with severe symptomatic MR for assessment regarding percutaneous edge-to-edge mitral valve repair. His history revealed hypertension, type 2 diabetes mellitus, and chronic renal failure. He underwent AVR for severe AS using a 23 mm Labcor bioprosthesis in 2007 and required implantation of a VVIR permanent pacemaker for post-operative complete heart block. Pre-operative coronary angiography was normal. At the regular follow-up at the outpatient clinic, the prosthesis showed no signs of failure and the quality of life was very good. Three months before referral to our hospital, the patient developed shortness of breath upon exercise and orthopnoea. At the outpatient clinic of his regular hospital, severe MR was noted, which was thought to be the reason for his symptoms. Because of his co-morbidities and age, correction of MR by a percutaneous approach was suggested. He had recently developed new onset atrial fibrillation. There had not been a period of fever or malaise after the aortic valve surgery, but recently, he had been admitted with pneumonia and *Escherichia coli* septicaemia. Two-dimensional (2D) transthoracic (TTE) and trans-oesophageal echocardiography (TEE) were performed prior to referral. From these echocardiographic findings, he was diagnosed with a well-seated bioprosthetic AVR with a peak gradient of 25 mmHg and no aortic regurgitation, severe MR with severely dilated left atrium, and moderate concentric left ventricular hypertrophy with normal systolic function. There was also severe

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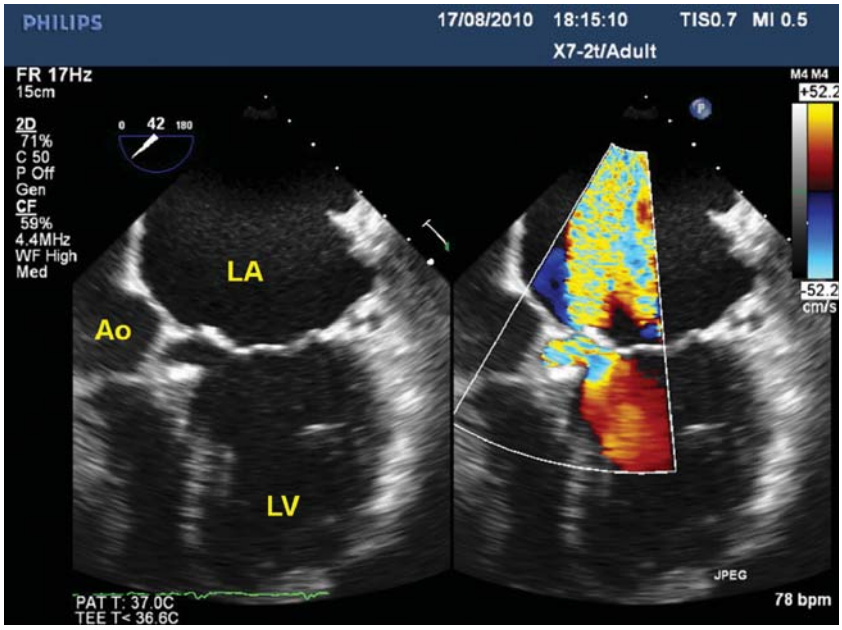

Figure 1 Trans-oesophageal echocardiogram: four-chamber view in which a jet originating in the left ventricular outflow tract causes severe regurgitation in the left atrium. LA, left atrium; Ao, aorta; LV, left ventricle.

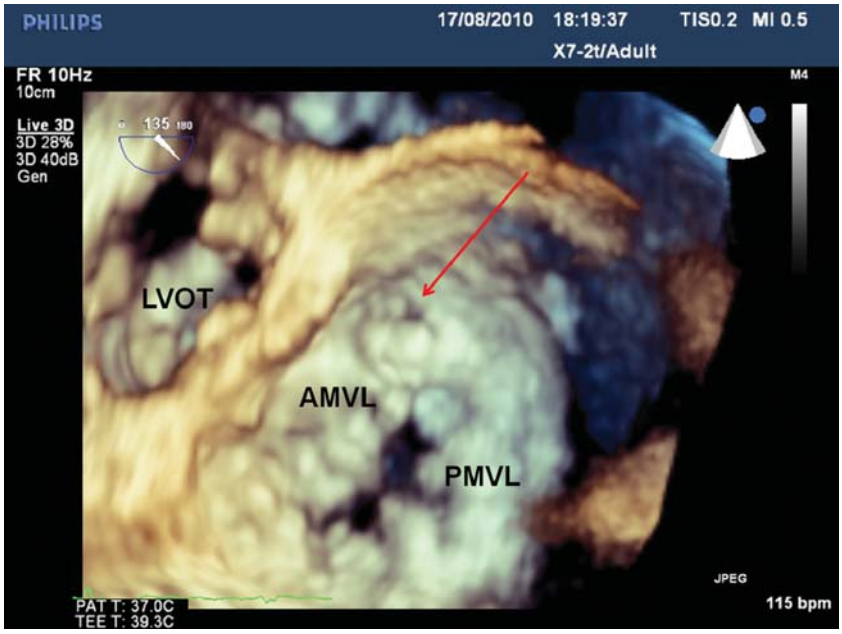

Figure 2 Trans-oesophageal three-dimensional echocardiogram: view from superior looking at the mitral valve and annulus showing the orifice (red arrow) of the perforation medial and adjacent to the anterior mitral valve leaflet. LVOT, left ventricular outflow tract; AMVL, anterior mitral valve leaflet; PMVL, posterior mitral valve leaflet.

tricuspid regurgitation with pulmonary artery systolic pressure of 55 mmHg and dilation of the right atrium and ventricle. There were no clinical or echocardiographic features of infective endocarditis.

Assessment for percutaneous mitral valve repair at our hospital requires a repeat and detailed TTE, TEE, and three-dimensional (3D) echocardiogram to determine the patient's anatomical suitability for the edge-to-edge technique (Mitraclip®). On

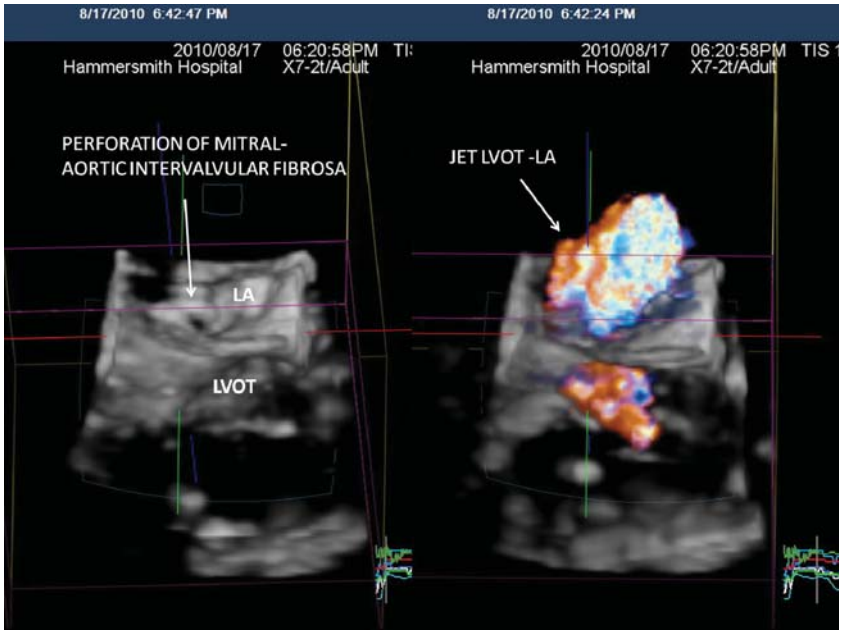

Figure 3 Transesophageal three-dimensional full volume echocardiogram showing the perforation of the mitral–aortic intervalvular fibrosa (left) and the regurgitant jet from the left ventricular outflow tract to the left atrium (right). LVOT, left ventricular outflow tract; LA, left atrium.

echocardiography, we saw two regurgitation jets in the left atrium: one MR jet with a central origin and one jet originating adjacent to the medial commissure of the mitral valve. There was extensive calcification of the mitral annulus. The first jet was quantified as mild MR and qualified as functional MR due to annular dilatation. The second jet originated medial to the mitral annulus and was quantified as severe regurgitation, with systolic flow reversal in the left upper pulmonary vein. The aortic bioprothesis was functioning normally and showed no paravalvular regurgitation. Three-dimensional TEE demonstrated an orifice medial and adjacent to the anterior leaflet. There was pre-valvular acceleration originating in the left ventricular outflow tract (*Figure 1*). With 3D echocardiography, this orifice could easily be identified and clearly seen in the left atrial (surgical) view (*Figure 2*) and with 3D full volume (*Figure 3*).

The patient, thus, was turned down for percutaneous edge-to-edge repair of the MR on anatomical grounds and referred back to his own cardiologist. Percutaneous closure of the defect might still be possible using an Amplatzer® device as used for the closure of paravalvular jets, which shows some anatomical similarities, pending further assessment.

Discussion

This case exemplifies the utility and added value of 3D TEE in the diagnosis of the mechanism of MR. Perforation of the aortic–mitral curtain possibly due to an inadvertent suture placement is a rare complication of AVR, but has been described before.[8]

The differential diagnosis would also include perforation secondary to an episode of undiagnosed endocarditis, with abscess formation in the aortic–mitral curtain, which caused perforation to the left ventricular outflow tract and left atrium. However, this seems less likely here, although he did have pneumonia with *E. coli* septicaemia several months prior to his referral. TTE and TEE imaging at that time failed to show any vegetations or abscess, neither were there any clinical signs of endocarditis leading up to the patient's referral.

To our knowledge, the only other report concerning a perforation of the subaortic curtain after previous AVR described a case in which 2D echocardiography was suggestive of a perforation of the mitral valve. The real aetiology, the perforation of the mitral–aortic intervalvular fibrosa, was only discovered during surgery.[7] In our case, we were able to discover the aetiology of the regurgitation before proceeding to invasive procedures.

This case report also emphasizes the potential pivotal role of 3D TEE and demonstrates the added value of this technique next to 2D TTE and TEE. Three-dimensional echocardiography has emerged in recent years and has proved its beneficial value in numerous procedures, such as percutaneous closure of paravalvular leaks, atrial septal defects and ventricular septal defects, transcutaneous aortic valve implantation, and percutaneous techniques for mitral valve repair.[9–11] With 3D TEE, it is possible to lower radiation exposure during invasive percutaneous procedures and to demonstrate additional pathology not seen at 2D TEE, such as ruptured chordae tendineae in MR. Moreover, by using 3D echocardiography after standard TTE and TEE, it is possible to obtain detailed images of the structures of interest and to view abnormalities from different points of view, using off-line cropping techniques. Three-dimensional colour imaging also makes it possible to further delineate the pathophysiological mechanism underlying MR and has the potential to improve characterization of mitral regurgitant jets and the estimation of MR severity.[12–16]

Three-dimensional modelling software provides assessment and measurement of the annular circumference, annular major and minor diameters, and annular height, which can aid surgical planning for mitral valve repair.

In conclusion, this case demonstrates the diagnostic importance of 3D echo in determining the exact mechanism of MR and plan further treatment. One can argue that 3D echo techniques should be part of the standard procedure in all patients to ensure high diagnostic accuracy and anatomical information. This is particularly relevant to patients being considered for percutaneous procedures.

Conflict of interest: none declared.

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