Journal of Geriatric Cardiology (2015) 12: 683–686

Case Report · **Open Access** ·

Percutaneous transcatheter closure of mitral paravalvular leak via transarterial retrograde approach

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Abstract

Repeat surgery has usually been considered the first choice to solve paravalvular leaks of prosthetic valves, but it carries a high operative risk, a high mortality rate and an increased risk for re-leaks. Percutaneous closure of such defects is possible, and different approaches and devices are used for this purpose. For mitral paravalvular leaks, constructing an arterio-venous wire loop for delivering the closure device through an antegrade approach is the most commonly used technique. Transcatheter closure can also be performed through a transapical approach or retrograde transfemoral arterial approach. We present a case of 68-year-old man with a mitral paravalvular leak that was successfully closed using an Amplatzer® Duct Occluder II, via retrograde transfemoral arterial approach under three-dimensional transesophageal echocardiographic guidance, without the use of a wire loop. The initial attempt to cross the paravalvular defect was unsuccessful, but the obstacle was finally overcome by introducing complex interventional techniques.

J Geriatr Cardiol 2015; 12: 683–686. doi:10.11909/j.issn.1671-5411.2015.06.008

Keywords: Antegrade approach; Paravalvular leaks; Prosthetic valve; Retrograde approach; Wire loop

1 Introduction

Paravalvular leak (PVL) is a frequent complication after both surgical valve replacement and transcatheter valve implantation.[1] Although most PVLs are small, asymptomatic, and clinically benign,[1] larger PVLs, which usually have serious clinical consequences (heart failure, endocarditis) occur in 1% to 5% of patients who have undergone surgical valve replacement. The majority of clinically significant PVLs occur after mitral valve replacement surgery.[1] Surgical intervention is usually recommended in patients with symptomatic PVLs; however, reoperation is associated with a high mortality rate of approximately 16%.[2]

Percutaneous transcatheter closure has been applied to the treatment of PVLs using a variety of techniques, approaches, and devices, with reported initial technical success rates of 60%–90% and a need for repeated intervention in up to 40% of cases.[3–12] For mitral PVL, the antegrade approach to construct an arterio-venous wire loop to deliver the closure device is the most commonly used technique. The procedure can also be done through the transapical approach or the retrograde transfemoral arterial approach.[3–12]

Herein, we report a case of a 68-year-old man with a mitral PVL that was successfully closed using an Amplatzer® Duct Occluder II (ADO II) (AGA Medical Corp., Plymouth, MN, USA) via a retrograde transfemoral arterial approach under three-dimensional transesophageal echocardiographic (3D-TEE) guidance, and without the use of an arterio-venous wire loop.

2 Case Report

A 68-year-old man presented with progressive dyspnea and cough with blood-stained sputum for five days. He underwent surgery for mitral valve replacement with a 31 mm

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Received: June 17, 2015 **Revised:** September 11, 2015
Accepted: September 16, 2015 **Published online:** October 21, 2015

Carpentier-Edwards bovine pericardial valve and coronary artery bypass grafting with a great saphenous venous graft to the left anterior descending artery three months ago. He had permanent atrial fibrillation, rheumatoid arthritis and chronic obstructive airway disease, and received regular medical follow up. Five weeks after the surgery, he presented with an episode of acute pulmonary edema and bilateral pleural effusion, and was admitted. During admission, transthoracic echocardiography revealed normal ejection fraction of both ventricles and a mitral PVL that caused severe mitral regurgitation. Transesophageal echocardiography (TEE) was then performed and revealed that the mitral PVL was approximately 6 × 3 mm in diameter and was in one o'clock position (Figure 1). He was treated with diuretics and was discharged from the hospital after one week as the pulmonary edema and pleural effusion gradually subsided. After discharge, he experienced dyspnea with mild activity and developed repeated episodes of acute pulmonary edema and pleural effusion which required intermittent injection of loop diuretic in the following two months (New York Heart Association functional class III-IV). After we had explained the treatment options, including re-operation and transcatheter intervention, he agreed to undergo transcatheter closure of the defect. Because he declined the transapical approach and the defect would be difficult to approach through the antegrade transseptal approach, the retrograde transfemoral arterial approach was chosen.

Under general anesthesia, a 7F sheath was placed in the left common femoral artery. After heparinization, we used a 0.025-inch J-tipped guidewire (Terumo Glidewire®, Terumo Medical Corp., Somerset, NJ, USA) to cross the defect with

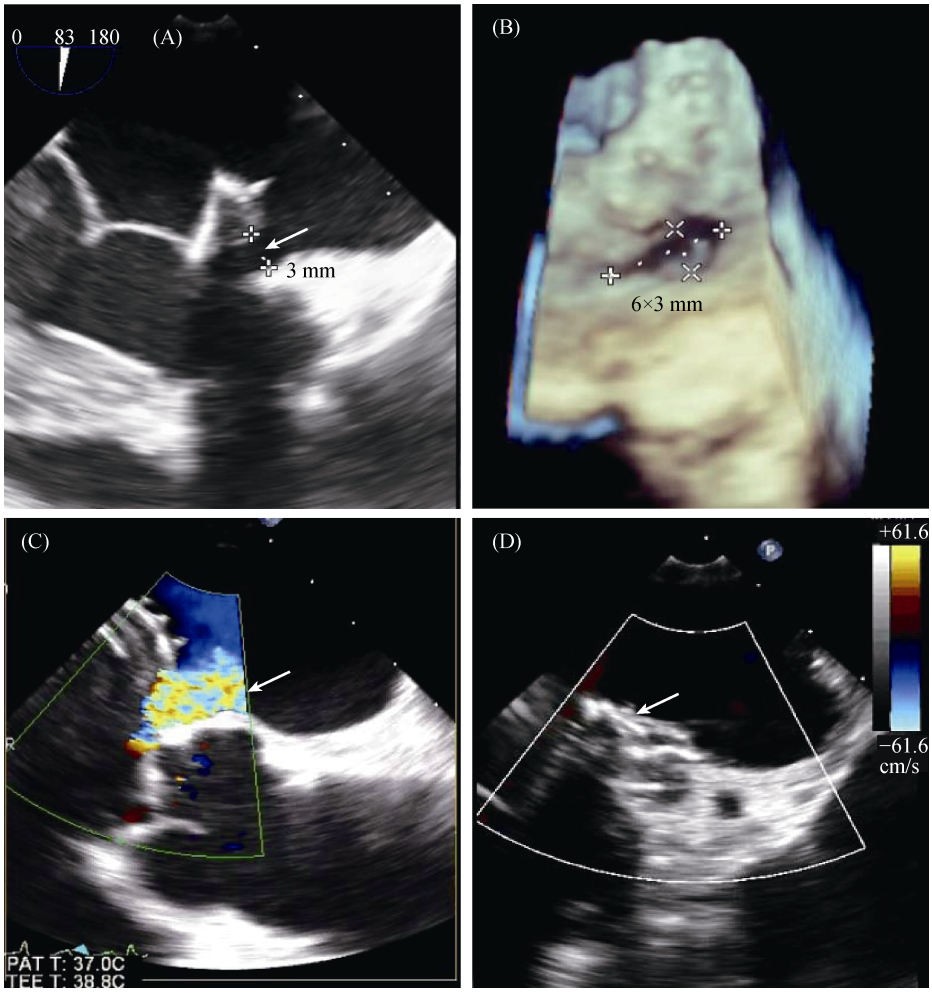

Figure 1. TEE images showing mitral prosthetic PVL and its sealing with occluder. (A): TEE image showing mitral prosthetic paravalvular defect (white arrow) approximately 3 mm in diameter; (B): 3D-TEE image showing the defect was approximately 6×3 mm in size and was in one o'clock position; (C): TEE color Doppler image showing mitral paravalvular regurgitation (white arrow); and (D): Introperative post-occluder TEE image showing the mitral PVL was sealed by ADO II (white arrow) and only minimal residual leak was observed. 3D-TEE: three-dimensional transesophageal echocardiography; ADO II: Amplatzer® Duct Occluder II; PVL: paravalvular leak; TEE: transesophageal echocardiography.

the support of a 5F Judkins right 4.0 (JR4) diagnostic catheter via the retrograde approach through the left femoral artery into the left atrium under the guidance of TEE and fluoroscopy. The diagnostic catheter was then exchanged with a 6F JR4 guiding catheter but it failed to cross the defect. Therefore, we introduced another 0.035-inch guidewire into the left atrial cavity, but the guiding catheter still failed to cross the defect despite the support with double wires (Figure 2B). To provide more support, the standard 0.035-inch guidewire was replaced with a 260-cm long 0.035-inch J-tipped Amplatzer® Super Stiff guidewire (AGA Medical Corp., Plymouth, MN, USA) and we introduced a 5F multipurpose guiding catheter inside the 6F JR4 guiding catheter over the guidewire as a mother-in-child catheter technique (Figure 2C). Finally, the 6F JR4 guiding catheter crossed the defect. An Amplatzer® Duct Occluder II (AGA Medical Corp., Plymouth, MN, USA) (waist diameter, 6 mm; length, 4 mm; disc diameter, 12 mm) was advanced through the 6F JR4 guiding catheter and deployed after confirmation of proper device positioning by TEE (Figure 2E). Subsequent TEE showed that the paravalvular leak was sealed and only minimal residual leak was observed (Figure 1D). The patient was discharged 5 days after the procedure and the post-procedural course was uneventful during six months of follow-up.

3 Discussion

PVL is a complication of valve replacement surgery caused by the incomplete apposition of the sewing ring to the native tissue.[1] PVLs may be detected in almost half of patients who have undergone surgical valve replacement.[1] Most PVLs remain asymptomatic, but 1%–5% of patients with prosthetic valves present clinically significant PVLs.[1] Surgery is the standard treatment for symptomatic PVLs, but it is associated with significant operative mortality and morbidity, as well as a high rate of recurrence of leak.[2] Therefore, the percutaneous transcatheter approach is widely accepted by both surgeons and patients. Transcatheter closure of PVLs has been performed in selected high-risk patients at relatively few centers, by using various types of devices for more than 20 years.[3–12] Successful closure of the defect has been achieved in the majority of patients with success rates ranging from 59%–82%.[3–12]

Transcatheter closure of a PVL requires a careful case selection and can be considered if the defect has an appro-

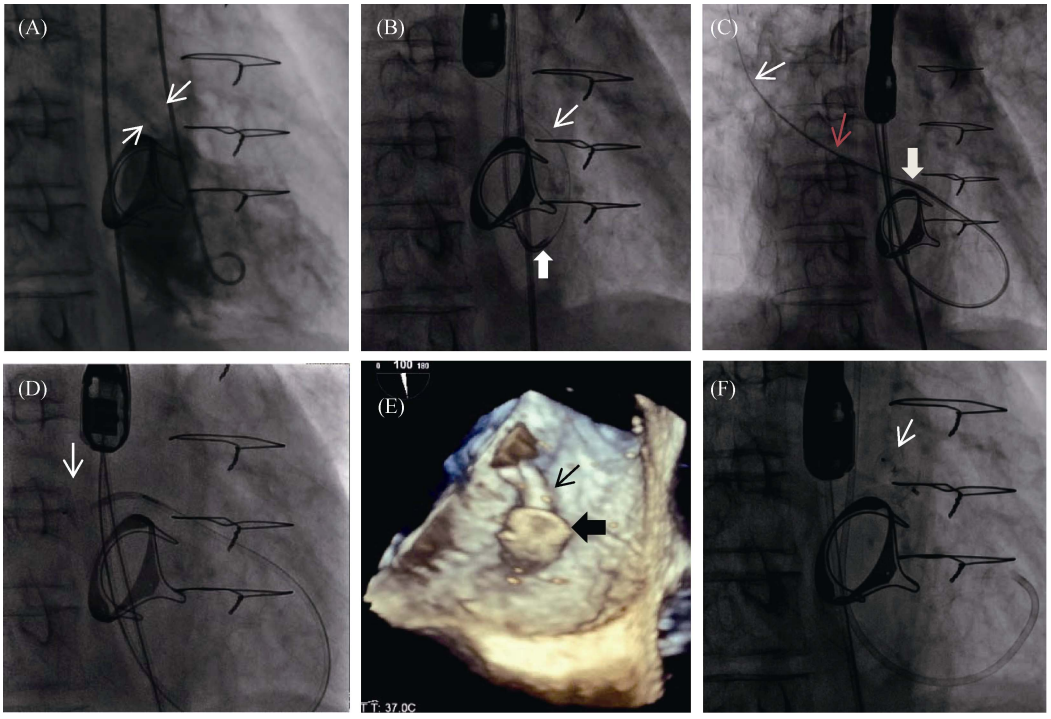

Figure 2. Fluoroscopic and 3D-TEE images showing mitral PVL and its sealing with occluder. (A): The left ventriculogram demonstrating severe mitral regurgitation (white arrows); (B): Fluoroscopic image showing the 0.025 inch J-tipped guidewire (white arrow) crossing through the PVL defect from the left ventricle to the left atrium but the 6F JR4 guiding catheter (bold white arrow) failed; (C): Fluoroscopic image showing the support of 0.035-inch Amplatzer® Super Stiff guidewire (white arrow) and 5F multipurpose guiding catheter (red arrow) as a mother-in-child catheter technique, the 6F JR4 guiding catheter (bold white arrow) crossed the defect; (D & F): deployment of ADO II guided by fluoroscopy (white arrow pointing ADO II) and (E): 3D-TEE (black arrow pointing 6F JR4 guiding catheter, bold black arrow pointing ADO II). 3D-TEE: three-dimensional transesophageal echocardiography; ADO II: Amplatzer® Duct Occluder II.

priate geometry. Combined 2D and 3D echocardiography enable delineation of PVLs and are the standard techniques for pre-procedural diagnostic imaging.[1,4,9,13] Moreover, real-time 3D-TEE plays a major role in procedural guidance, provides appreciation of both the complex 3D anatomy and the spatial orientation of PVLs, enables the confirmation of the passage of guidewire and delivery catheters as well as the positioning of occluder devices.[1,4,9,13] In this report, we share our experience in using advanced imaging technologies to overcome the technical challenges associated with this complex procedures, and confirm that visualizing the 3D anatomy of the defect and its spatial orientation relative to surrounding structures is critical to the success and the safety of intracardiac device implantation.

Transcatheter closure of PVLs can be performed using an antegrade or retrograde approach, depending on defect location, preferred access, and operator experience.[1,3-7,9,12] For mitral PVLs, the antegrade approach via the femoral, but not jugular, vein is commonly used.[1,3,4,9] But, the effectiveness of the antegrade approach is dependent on the anatomic location of the defect. Higher success rates (83%) have been reported for posteriorly located defects; however, the success rate has been lower when the defect is in the septal or anterior position, as in our case.[1,3,4,9] Although the transapical approach allows access to defects in all anatomic locations, it need thoracostomy and apical puncture.[10-12] Our case demonstrated that the retrograde approach without establishing an arterio-venous wire loop is a suitable alternative for transcatheter mitral PVL repair.

The long-term clinical success ultimately depends on the limitations associated with using existing devices for PVL closure.[1,4,13,14] Amplatzer® family of devices are the most frequently used devices for PVL closure. In order to achieve procedural and clinical success, it is crucial that a device with the most appropriate characteristics be chosen following a careful examination of the PVL anatomy and the relationship of the defect to surrounding structures.[1,3–9,11,13] Currently, there is no device available that is specifically designed to address PVLs. Various devices reported in the literature have been approved for closing other cardiovascular defects and were adopted in an "off-label" fashion.[1,3–9,11,13] The Amplatzer® Vascular Plug III occluder device has been claimed to be specifically designed for PVL closure.[8,11] The success rate is much higher in European and Canadian centers where Amplatzer® Vascular Plug III is available.[8,11] The Occlutech PVL devices (Occlutech GmbH, Istanbul, Turkey), which are also designed specifically for mitral and aortic PVLs and their initial results in humans seem very promising.[10]

In conclusion, we reported a rare case of percutaneous ADO II device deployment for closure of a mitral PVL via a retrograde approach without constructing an arteriovenous wire loop. Our experience demonstrated that with the use of 3D-TEE guidance, transcatheter closure of mitral PVLs by using the aforementioned approach is a suitable alternative to surgical reoperation and other approaches in high-risk patients with appropriate defect geometries.

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