Case Report:

Percutaneous transcatheter closure of a mitral paravalvular leak via anterograde approach without arteriovenous loop in a patient with double valve replacement

M. Boochi Babu,[1] D. Rajasekhar,[1] V. Vanajakshamma,[1] A. Chandra,[2] M. Hanumantha Rao,[3] M.L. Sreenivasa Kumar[1]

Departments of [1]Cardiology, [2]Cardiothoracic & Vascular Surgery, [3]Anaesthesiology, Sri Venkateswara Institute of Medical Sciences, Tirupati

ABSTRACT

Paravalvular leak (PVL) is a rare but potentially serious complication of surgically implanted prosthetic heart valves. Patients who have PVL can be asymptomatic or present with haemolysis, heart failure, or endocarditis. The gold-standard treatment for prosthetic-valve PVL is surgery to repair or replace the valve but carries higher operative risk compared to the initial procedure. In view of this, percutaneous transcatheter closure of PVL is becoming an increasingly attractive alternative strategy. In this report, we describe a case of mitral PVL in a patient with double-valve replacement, which was successfully closed using Cocoon duct occluder device (Vascular Innovations Co., Ltd, Thailand) via *ante-grade* approach, guided by transesophageal echocardiography (TEE) and fluoroscopy and without complete arterio-venous loop.

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INTRODUCTION

Paravalvular leak (PVL) may occur when there is an incomplete seal between a prosthetic valve and the surrounding cardiac tissue after surgical valve replacement. Redo surgery for PVL is associated with an increased risk of a recurrent leak, morbidity, and mortality.[1] Transcatheter closure of PVL is an evolving therapeutic option, particularly for patients who are non-surgical candidates and those who decline another surgical procedure. Percutaneous transcatheter closure of PVL is a technically challenging procedure and is not taken up in few centres. We describe our initial experience with PVL closure using a Cocoon device in a patient who had undergone double-valve replacement.

CASE REPORT

A 66-year-old man presented to the cardiology outpatient department, with exertional dyspnoea (New York Heart Association functional Class II).[2] He had undergone double-valve replacement with Edwards's Life Sciences bio-prosthetic valves two years ago for infective endocarditis affecting both aortic and mitral valves. Transthoracic two dimensional (2D-) echocardiography showed moderate mitral paravalvular regurgitation. Transoesophageal echocardiography (TEE) showed a defect 5 mm in diameter and in the 9^{0}'-clock position. Coronary angiography revealed normal epicardial coronary arteries and left ventricular angiography showed moderate degree of mitral insufficiency. After explaining the available treatment options with the patient, he was taken up for percutaneous closure of the defect.

Left ventricular angiogram was performed under general anaesthesia using a pig-tail catheter. The para-mitral valvular leak was seen in right anterior oblique (RAO) position at 30^{0} (Figure 1A). Transseptal puncture was done using a Mullins sheath and a Brockenbrough needle and position within the left atrium confirmed using contrast injection, pressure measurement, and oxygen saturation. After the left atrium was accessed, 5000 IU unfractionated heparin was administered to

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Corresponding author: Dr. M.L. Sreenivasa Kumar, Assistant Professor, Department of Cardiology, Sri Venkateswara Institute of Medical Sciences, Tirupati, India. **e-mail:** cardiologysvims@gmail.com

avoid intracardiac, valvular, or intracatheter thrombosis during the procedure. A Judkins right (JR) diagnostic catheter was advanced through the Mullins sheath into the left atrium through which a 0.035- inch 260 - cm Terumo floppy Glide wire (Terumo Medical Corp., Somerset, New Jersey) was passed to cross the defect and then through the aortic prosthesis until it reaches the proximal descending aorta (Figure 1B). The Glide wire was then exchanged for an Amplatz stiff wire (Cook Medical Inc., Bloomington, Indiana). The Mullins sheath was then removed and replaced with the 8-French Cook sheath (Cook Medical Inc., Bloomington, Indiana) which was advanced beyond the PVL (Figure 1C) into the left ventricle and the stiff wire was removed. Then 6/8 Cocoon duct occluder was loaded onto a delivery cable and deployed across the paravalvular leak (Figure 1D). After confirming position by using fluoroscopy, TEE, and LV angiogram (Figure 2) the device was released across the defect. Intraoperative TEE showed complete disappearance of PVL. The procedure time was 100 minutes, and fluoroscopic time was 29 minutes. The patient had uneventful recovery from anaesthesia. Both prosthetic valves functioned normally during the 5 days of post-procedure hospitalization. The transthoracic 2D- echocardiography performed during follow-up at the end of one month showed no mitral PVL (Figure 3).

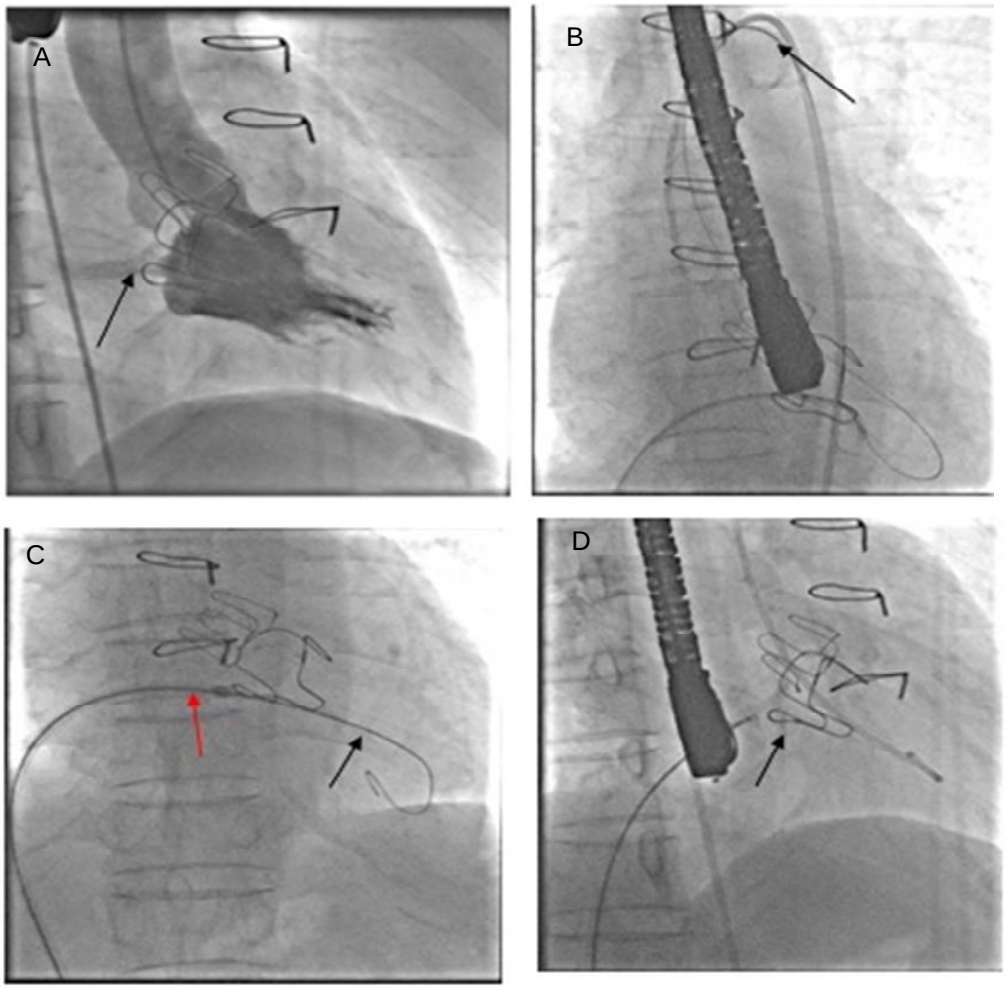

Figure 1: Left ventricular angiogram in right anterior oblique cranial view showing mitral regurgitation (black arrow) (**A**) LAO cranial view showing terumo floppy guide wire passed across the paravalvular defect and kept in descending aorta (**B**). LAO cranial view showing Cook sheath (red arrow) over Amplatz stiff guide wire (black arrow) kept in left ventricle (**C**). RAO cranial view showing device (arrow) deployment across the paravalvular leak (**D**)
LAO = left anterior oblique; RAO = right anterior oblique

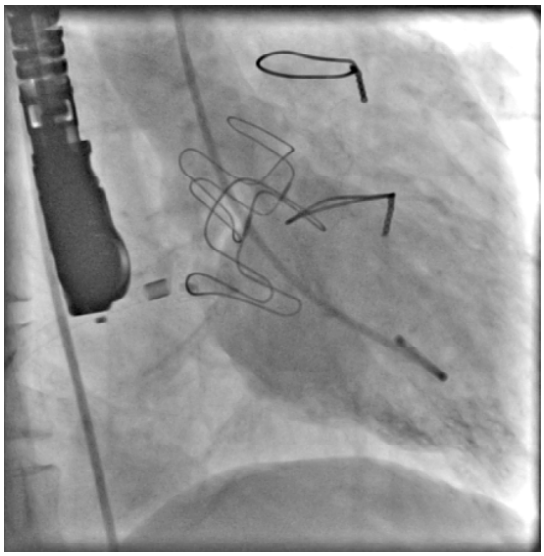

Figure 2: Left ventricular angiogram in right anterior oblique cranial view showing no residual leak across the device.

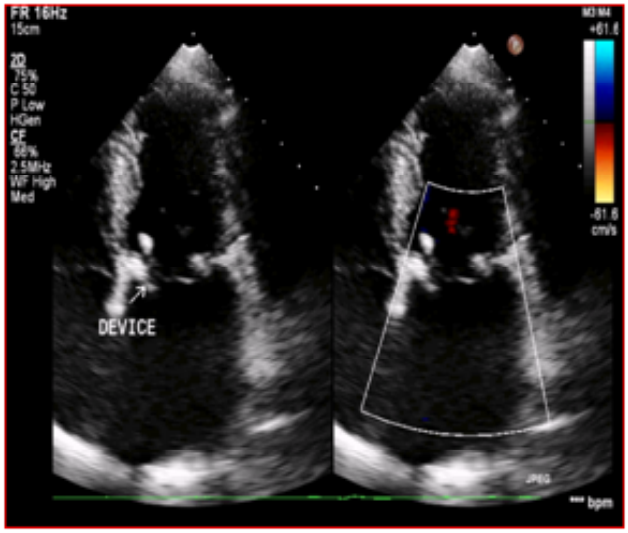

Figure 3: Transthoracic echocardiography apical four-chamber view showing device (arrow) and no paravalvular leak across the prosthetic mitral valve after device implantation in systole.

DISCUSSION

PVL is a relatively rare but serious complication of surgical replacement of mitral and aortic valves. Most of the PVLs are small, asymptomatic, and follow a benign clinical course. Larger PVLs can occur in 1% to 5% of patients with serious clinical consequences like heart failure, endocarditis and haemolysis.[3] Most of these clinically significant PVLs occur in association with prosthetic mitral valves.[4]

Though redo surgery is usually recommended in adult patients with symptomatic PVLs, it is associated with a mortality rate approaching 16%.[1] In addition, there is an increased recurrence of leaks.[5] Percutaneous transcatheter closure of PVLs was described first in 1992 using a double-umbrella device (Rashkind device).[6] The technique has slowly evolved over the following years, as an attractive alternative to redo-surgery in patients with appropriately suitable defects. The initial technical success rate has ranged from 60% to 90% and a need for repeat intervention has been reported in up to 40% of cases.[2]

Transcatheter closure of mitral PVLs can be achieved using three different approaches depending on the location of the defect and its dimensions; preferred access; and experience of the operator. The ante-grade approach via the femoral vein is the most common technique as it provides easy access to the lateral defects and sometimes to medial defects (like in the present case) after transseptal puncture. This technique avoids large arterial sheaths used for retrograde arterial technique. The retrograde transfemoral arterial approach is a suitable alternative, providing benefits in some cases like large defects with significant gradients across the PVL, that interfere with antegrade access against the shunt flow. The third approach is retrograde transapical that provides direct access to a mitral PVL located anywhere around the mitral annulus and is more useful in patients with both mitral and aortic prosthetic valves. The percutaneous transcatheter closure of mitral PVL using ante-grade technique is more complex than that of aortic PVL since it is necessary to form a complete AV loop with a long guide wire over which the delivery sheath is advanced. In patients with mitral PVL who also have aortic valve prosthesis, the guide wire can interfere with the aortic prosthesis and complicate the procedure. Hence, the transapical approach is preferred

by some interventional cardiologists in patients with both mitral and aortic prosthesis.

The Cocoon duct occluder, used in transcatheter closure of patent ductus arteriosus is made up of nitinol wire covered with platinum using nanofusion technology. As our patient had two prosthetic valves there was a risk of leaflet impingement due to the location of the PVL, We chose Cocoon ductal occluder which is more uniform with a single retention disk of limited size unlike a septal occluder with two large retention disks, reducing the risk of interfering with neighbouring prosthetic valve leaflet function.

Until now, very few cases of mitral paravalvular leaks were closed across the world using transcatheter percutaneous technique in patients who had undergone double-valve replacement.[7-11] To the best of our knowledge, this is the first report of percutaneous device deployment for closure of a mitral paravalvular leak from India via ante-grade approach in a patient who had undergone double-valve replacement without the construction of complete arterio venous wire loop, and the first case in which Cocoon duct occluder was used for that purpose. (An internet search of Google scholar, PubMed, Cochrane databases for the terms "Double valve replacement; Percutaneous Closure; Mitral Paravalvular Leak; Retrograde Approach without a wire loop; Cocoon duct occluder" did not yield any results of case reports till to date).

In spite of its progress, percutaneous transcatheter prosthetic PVL closures are one of the most challenging procedures facing interventional cardiologists today. The major challenge associated with transcatheter PVL closure is the lack of devices that are specifically designed to meet the anatomic and physiologic properties of PVLs. Till today, there are no devices approved by the United States of America (USA) Food and Drug Administration (FDA) for the closure of PVLs specifically. Hence, the devices that have been approved by the FDA for the closure of other cardiovascular defects (e.g., patent ductus arteriosus, ventricular septal defect, and atrial septal defect) are used in an off-label fashion for the closure of PVLs. In future, development of low profile, specific and adaptive devices that can conform to the variety of shapes of these defects is likely to materialize and will increase the procedural frequency and success.

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