Trans-catheter Closure of Mitral Para-valvular Leak in a Case of Hemolytic Anemia and Acute Kidney Injury, Using Zero Contrast

I-No Cheng[1], Cheng-Wei Lu[2,3], Jung-Cheng Hsu[1]

[1]*Division of Cardiology, Department of Medicine, Far Eastern Memorial Hospital, New Taipei City, Taiwan*
[2]*Department of Anesthesiology, Far Eastern Memorial Hospital, New Taipei City, Taiwan*
[3]*Department of Mechanical Engineering, Yuan Ze University, Taoyuan, Taiwan*

Abstract

Para-valvular leak (PVL), also known as para-valvular prosthetic regurgitation, is not a rare complication after surgical or trans-catheter valve replacement. Depending on the severity of the regurgitation, patients may be asymptomatic or display mild to severe symptoms of heart failure. The clinical course is sometimes worsened by accompanying hemolytic anemia. Considering the high risk of repeat- or double repeat surgery, the main treatment is to close the PVL via endovascular intervention. Here, we present a 63-year-old man with hemolytic anemia caused by PVL after repeated mitral valve replacement. The defect was treated successfully by trans-catheter closure with three Amplatzer Vascular Plug II, and zero contrast.

Keywords: para-valvular leak, hemolytic anemia, mitral, contrast, vascular plug

Introduction

Para-valvular leak (PVL), also known as para-valvular prosthetic regurgitation, is not a rare complication after surgical or trans-catheter valve replacement, affecting 6% to 15% of surgically implanted prosthetic valves and annuloplasty rings.[1-3] In most cases, tissue friability, especially infective endocarditis, is the major risk factor. Sewing sutures may cut the friable tissue during heart beat.[2] Para-valvular defects are often crescentic. Chronic PVL can lead to volume and pressure overload of the left ventricle (LV) and left atrium (LA), which ultimately develop into clinical heart failure. Increased red blood cell shear stress due to the turbulent flow with high velocity across the rough surface of the defect will cause mechanical trauma to the red blood cells. Subsequently, hemolytic anemia will worsen the clinical course and repeated blood transfusion will be required. Moderate to severe para-valvular leak (PVL) after both surgical and trans-catheter aortic valve replacement is associated with increased mortality.[4]

Case presentation

We present the case of a 63-year-old man with rheumatic heart disease and mitral stenosis, who presented with progressive dyspnea.

Address for correspondence: Dr. Jung-Cheng Hsu
Division of Cardiology, Department of Medicine, Far Eastern Memorial Hospital; No. 21, Sec. 2, Nanya S. Rd., Banciao Dist., New Taipei City 220, Taiwan
Tel: +886-2-8966-7000; Email: jungchenghsu@gmail.com

After thorough workup of his heart condition, including echocardiography, trans-esophageal echocardiography and cardiac catheterization, he received his first open heart surgery as xenograft mitral valve replacement in 2009 at another medical center in Taiwan. However, hemolytic anemia and suspected PVL were noted in 2013. Re-do surgery was suggested. He visited our outpatient department for a second opinion in Jun 2013 due to worsening exertional dyspnea, and infective endocarditis was suspected at that time, due to fever and bacteremia. Vancomycin and Rocephin were prescribed, although no vegetation was noted upon imaging. Re-do mitral xenograft replacement by thoracotomy was performed two months later after the complete course of antibiotics.

However, hemolytic anemia recurred 2 weeks after the surgery, which was complicated with acute kidney injury. No fever or bacteremia were noted. Trans-esophageal echocardiography revealed para-valvular leak at the posterior aspect of the mitral xenograft. We were consulted for trans-catheter closure of the mitral para-valvular leak.

On the day of the procedure in Sep 2013, after endotracheal general anesthesia, trans-septal puncture was performed under trans-esophageal echocardiography (TEE) guidance, using SL0 trans-septal catheter and BRK-1 needle. Thereafter we changed to the telescoping system, consisting of 6 French multi-purpose guiding catheter (100 cm) and 5 Fr Judgkin right 4 diagnostic catheter (125 cm). Regarding the fluoroscopic views, we used the right anterior oblique view to obtain the side view and the left anterior oblique-caudal view to get the en face view of the mitral xenograft (Figure 1A). 3D TEE showed the mitral PVL was occurring primarily from the posterior aspect of the mitral xenograft (Figure 2A). Under fluoroscopy and TEE guidance, we gently advanced the 0.035 inch Terumo soft wire to the para-valvular defect. After the wire passed, we snared the wire tip at the ascending aorta out to the sheath of the femoral artery to form the AV rail (Figure 1C, 1D). Under strong wire backup, we inserted a 5 French JR4 diagnostic catheter first, then 6 French MP guiding catheter into the left ventricle. We deployed the first Amplatzer vascular plug II (AVP II), 12 mm in size, at the site of the defect. However, the residual PVL was still significant, so we used the same technique to pass the 6 French MP guiding catheter again through the AV rail (Figure 2B). We deployed a second Amplatzer vascular plug II, this time 10mm in size, beside the first one (Figure 1E, 2C). Because of the crescentic shape of the defect, we had to place a third device to close the defect. This time, we changed to another shape of 6 Fr guiding catheter (SCR 3.5) to probe the wire crossing the residual PVL defect. We deployed the third Amplatzer vascular plug II, 10 mm in size, successfully (Figure 1F, 2D). Out of fear of worsening the patient's renal function, we used zero contrast during the whole procedure. Finally, the para-valvular leak was reduced to a minimum (Figure 2E). There was no evidence of interference between the AVPII and the mitral xenograft (normal trans-mitral pressure gradient).

The post procedural course was smooth. Hemolytic anemia was eliminated and the symptoms of heart failure improved. The patient was discharged uneventfully. Trans-thoracic echocardiography one year later showed only minimal residual para-valvular mitral regurgitation (Figure 2F).

Discussion

Para-valvular leak (PVL), also known as para-valvular prosthetic regurgitation, is not a rare complication after surgical or trans-catheter valve replacement, and may cause heart failure and hemolytic anemia.[1-3] Optimal medical therapy and repeated blood transfusion are the only palliative treatment for significant PVL. Considering the high risk of repeat- or double repeat surgery, the main treatment is to close the PVL by endovascular techniques. Hence, in this case, we choose the trans-catheter closure of the mitral

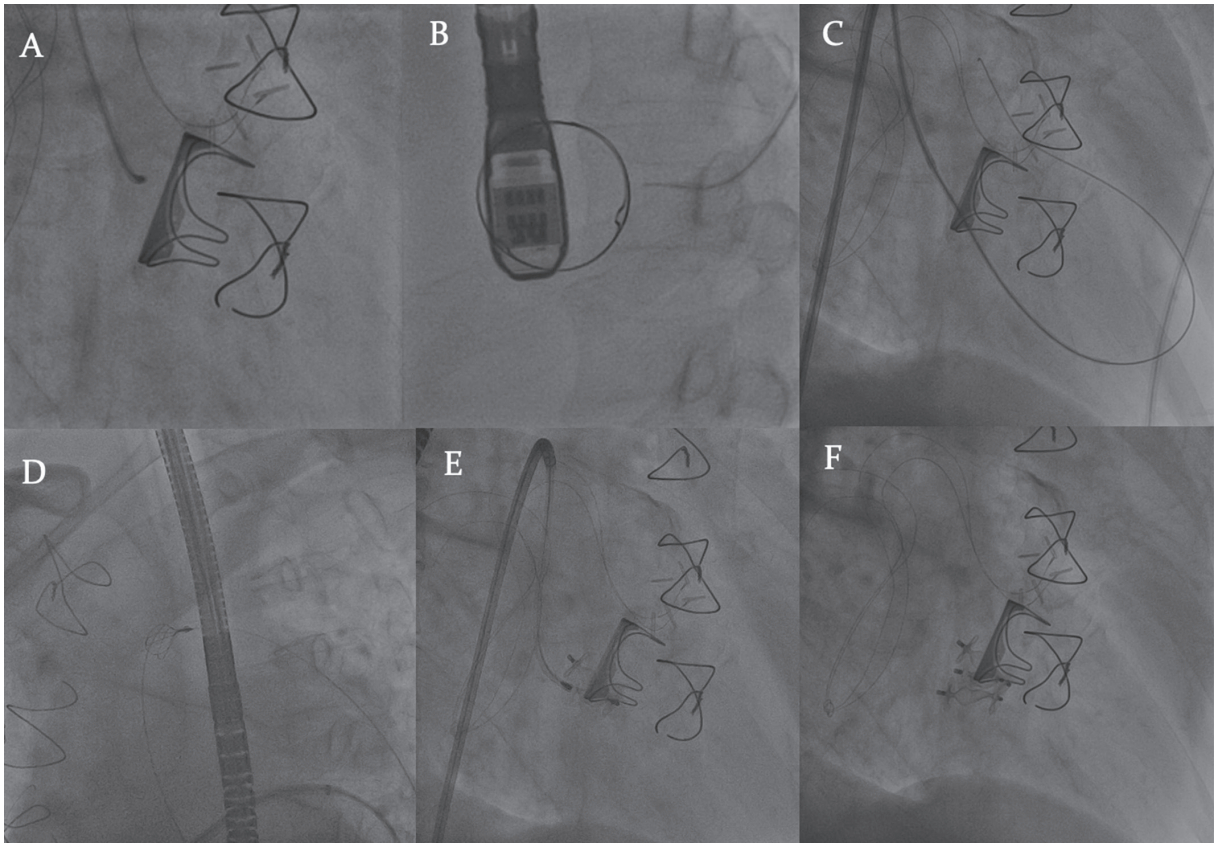

Figure 1. (A) Right anterior oblique fluoroscopy view, showing the side view of the mitral xenograft. (B) Left anterior oblique and caudal fluoroscopy view to show the en face view of the mitral xenograft. (C) Wire crossing the defect of the para-valvular leak through the telescoping system, consisting of 5Fr JR4 diagnostic catheter and 6F MP guide catheter. (D) Snaring the wire tip to form the AV rail. (E) Sequential deployment of the Amplatzer vascular plug II (AVP II). (F) Final result after deployment of 3 AVP IIs.

PVL with Amplatzer vascular plug II.

The techniques of trans-catheter closure of PVL have been discussed in previous articles.[5,6] The success rate is generally 80~90%, according to reports.[7,8] Conventional surgical treatment or trans-catheter mitral valve-in-valve (not mechanical valve) for PVL should be reserved for unsuccessful trans-catheter closure of PVL, including failure of the probing wire, failure of the guide catheter to cross, despite AV rail, or unstable prosthesis (rocking valve), etc.

Several procedural aspects should be discussed. We chose trans-septal access rather than retrograde trans-apical access because it is less invasive and carries less bleeding risk. There are advantages to using the trans-apical access, including easier wire probing (especially if the PVL defect is located at the medial aspect, or there is little room for device manipulation) and it is time saving. However, nowadays, we can get high puncture site guidance by TEE and use a steerable guide sheath to overcome difficulties if dealing with a medial PVL defect, and therefore, in our institute, trans-septal access is the first choice to treat mitral PVL.

Another issue is that we used the AV rail in this case. In some cases, we can insert the telescoping system (5 Fr JR4 in 6 Fr MP) into the left ventricle by only using a stiff or extra-stiff wire looping in the left ventricle. However, since

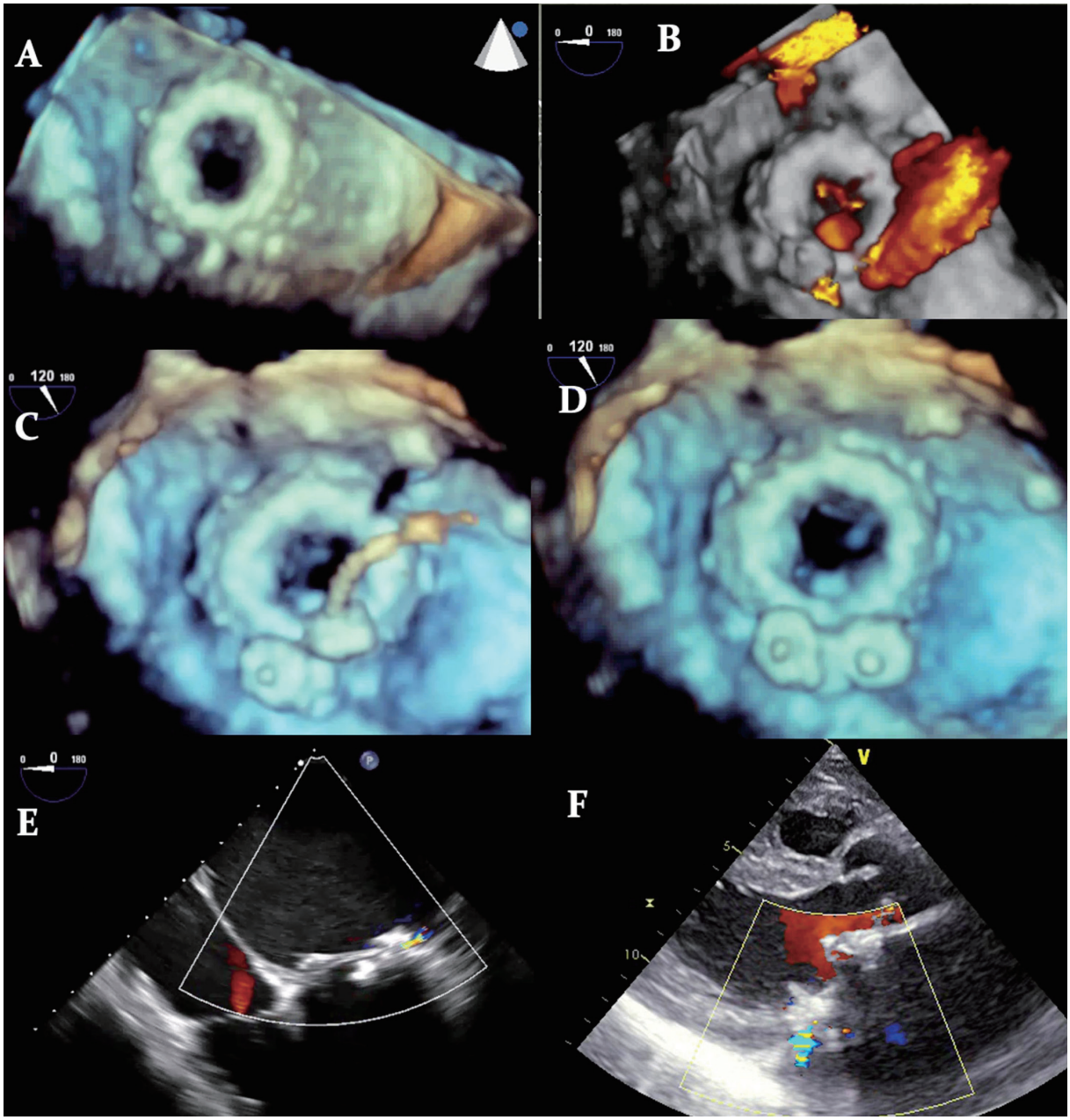

Figure 2. (A) 3D trans-esophageal echocardiography shows para-valvular defect at posterior aspect of mitral xenograft (white and red arrows indicate different orifices of the mitral regurgitation jet). (B) 3D trans-esophageal echocardiography color view shows the residual para-valvular leak after deployment of the first AVP II. (C) Deploying the second AVP II (3D trans-esophageal echocardiography). (D) Final result after deployment of the third AVP II. (E) Trace residual para-valvular leak after the procedure (2D trans-esophageal echocardiography). (F) Follow-up trans-thoracic echocardiography, one year after the procedure.

we met strong resistance in this case we decided to set up the AV rail. In this case, we sequentially deployed the three Amplatzer vascular plugs II by repeatedly passing the wire through the PVL defect. Maybe this was not a good idea, but it was our first case in 2013. In subsequent cases of PVL in our institute, we tried simultaneous deployment (kissing device) or sequential deployment without losing the AV rail. However, we did learn that if the PVL was still significant, we could pass the wire despite having already deployed an occluding device (AVP II). The actual defect of mitral PVL is usually crescentic. If we had had Amplatzer vascular plug III, we could have perhaps closed the defect more efficiently. Through the combination of fluoroscopy and TEE guidance, no contrast was needed for this kind of procedure, thus minimizing the risk of renal function deterioration.

In conclusion, trans-catheter closure of mitral para-valvular leak is feasible and should be the first choice of therapy, given the risks of re-do cardiac surgery. Nowadays, we prefer to use Amplatzer vascular plug II to close a mitral para-valvular leak. A dedicated occluding device would be warranted to make this procedure more efficient and safe. Long-term follow-up of these patients is needed for future direction.

References

1. Rallidis LS, Moyssakis IE, Ikonomidis I, et al. Natural history of early aortic paraprosthetic regurgitation: a five-year follow-up. *Am Heart J* 1999;138(2 pt 1):351-7.
2. Ionescu A, Fraser AG, Butchart EG. Prevalence and clinical significance of incidental paraprosthetic valvar regurgitation: a prospective study using transoesophageal echocardiography. *Heart* 2003;89: 1316-21.
3. Généreux P, Head SJ, Van Mieghem NM, et al. Clinical outcomes after transcatheter aortic valve replacement using valve academic research consortium definitions: a weighted meta-analysis of 3,519 patients from 16 studies. *J Am Coll Cardiol* 2012;59:2317-26.
4. Kodali SK, Williams MR, Smith CR, et al. PARTNER Trial Investigators. Two-year outcomes after transcatheter or surgical aortic-valve replacement. *N Engl J Med* 2012;366:1686-95.
5. Eleid MF, Cabalka AK, Malouf JF, et al. Techniques and outcomes for the treatment of paravalvular leak. *Circ Cardiovasc Interv* 2015 Aug;8(8):e001945.
6. Gafoor S, Franke J, Bertog S, et al. A quick guide to paravalvular leak closure. *Interv Cardiol* 2015; 10(2):112-7
7. Sorajja P, Cabalka AK, Hagler DJ, et al. The learning curve in percutaneous repair of paravalvular prosthetic regurgitation: an analysis of 200 cases. *JACC Cardiovasc Interv* 2014; 7:521-9.
8. Ruiz CE, Jelnin V, Kronzon I, et al. Clinical outcomes in patients undergoing percutaneous closure of periprosthetic paravalvular leaks. *J Am Coll Cardiol* 2011;58:2210-7.