Percutaneous Transcatheter Balloon Valvuloplasty of a Stenosed Bioprosthetic Tricuspid Valve

Toshinori KOMATSU[1)]*, Yusuke MIYASHITA[1)], Masafumi KANAI[1)]
Kunihiko SHIMIZU[1)], Naoyuki ABE[1)], Tatsuya USUI[1)], Izumi MIYAZAWA[1)]
Tamaki TAKANO[2)], Nobuyuki TOTSUKA[1)] and Jiro YOSHIOKA[1)]

1) *Department of Cardiology, Nagano Red Cross Hospital*
2) *Department of Cardiovascular Surgery, Nagano Red Cross Hospital*

Bioprosthetic tricuspid valve stenosis is extremely rare. We report the case of a 54-year-old man with a history of infectious endocarditis (IE) and two previous tricuspid valve replacements (TVRs). The first TVR at age 25 was performed secondary to IE using a Star-Edwards Ball Valve. The repeat-TVR using a St. Jude Medical Epic bioprosthesis was performed at age 51 due to severe ball valve stenosis. Repeat surgical valve replacement is an extremely high-risk procedure. Percutaneous transcatheter tricuspid balloon valvuloplasty (PTTBV) is an acceptable treatment option for symptomatic severe tricuspid valve stenosis. There have been few reports of successful PTTBV performed after bioprosthetic TVR. Successful treatment with PTTBV for bioprosthetic tricuspid valve stenosis was achieved without complications in this patient. We believe that PTTBV can be performed either as a destination therapy or as a bridge to TVR. *Shinshu Med J 67 : 289—292, 2019*

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Key words : percutaneous transcatheter tricuspid balloon valvuloplasty, stenosed bioprosthetic tricuspid valve, tricuspid valve replacement

I Introduction

There are few case reports of successful percutaneous transcatheter tricuspid balloon valvuloplasty (PTTBV) to manage bioprosthetic tricuspid valve (TV) stenosis. Reviews of previously reported cases have suggested that PTTBV for bioprosthetic TV stenosis is effective and is associated with low morbidity[1)]. However, the PTTBV technique is not established.

The present report describes the case of a Japanese man with bioprosthetic TV stenosis and two prior tricuspid valve replacements (TVRs) who was successfully treated with PTTBV without complications. In most cases, patients improve immediately after PTTBV ; however, the patient in this case experienced a gradual improvement.

* Corresponding author : Toshinori Komatsu
Department of Cardiology, Nagano Red Cross Hospital,
5-22-1 Wakasato, Nagano, Nagano 380-8582, Japan
E-mail : komatsu.toshinori@gmail.com

II Case Report

A 54-year-old man was admitted because of oliguria, exertional dyspnea, abdominal distension, and bilateral leg edema over the previous 2 months. He had a history of infectious endocarditis (IE) at age 20. TVR using a Star-Edwards Ball Valve was performed at age 25 for tricuspid stenosis (TS). He developed severe ball valve stenosis and underwent a repeat-TVR using a St. Jude Medical Epic bioprosthesis (27 mm) at age 51. On admission, physical examination revealed bilateral lower extremity edema and hepatosplenomegaly. There was a Levine III/VI diastolic rumble at the lower left sternal border. The electrocardiogram showed atrial fibrillation and echocardiography revealed severe TS with trivial regurgitation. The leaflets were thickened and immobile. The mean diastolic gradient across the tricuspid valve was 12.3 mmHg, with a peak gradi-

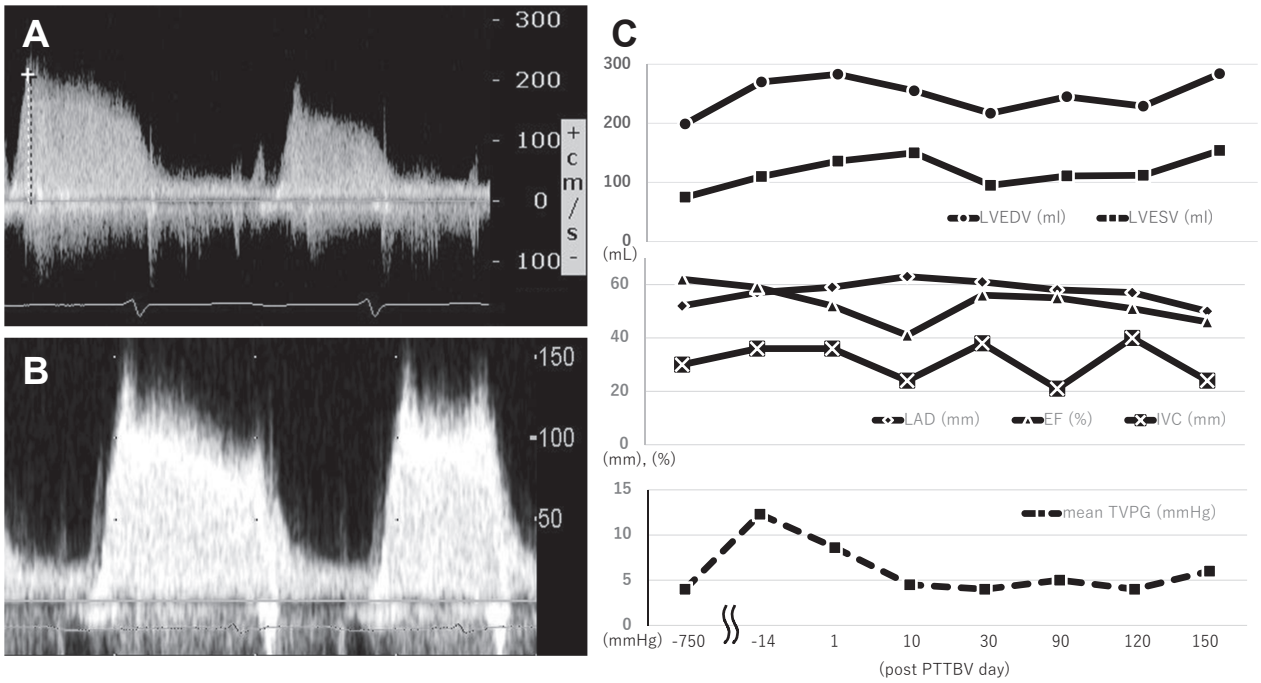


Fig. 1

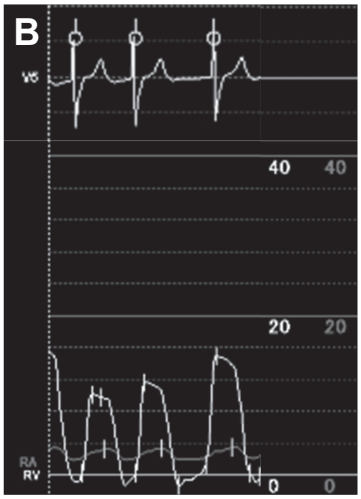
A : Parasternal short-axis tomogram at the aortic valve level showing tricuspid jet velocity recorded using continuous-wave Doppler. The jet velocity of 2.1 m/s corresponded to a maximum trans-tricuspid pressure gradient of 17.9 mmHg and a mean gradient of 12.3 mmHg.

B : After balloon valvuloplasty, the maximum trans-tricuspid pressure gradient decreased from 17.9 mmHg to 11 mmHg and the mean gradient decreased from 12.3 mmHg to 8.6 mmHg.

C : Ultrasonic Cardiogram (UCG) follow-up from repeat TVR to post-PTTBV day 150. Post-PTTBV values for LVEDP, LVESV, and mean TVPG gradually improved.

TVR : tricuspid valve replacement ; PTTBV : percutaneous transcatheter tricuspid balloon valvuloplasty ; LVEDP : end-diastolic volume ; LVESV : left ventricular end-systolic volume ; LAD : left atrial dimension ; EF : ejection fraction ; IVC : inferior vena cava ; mean TVPG : mean tricuspid valve pressure gradient

ent of 17.9 mmHg and an estimated tricuspid valve area of 0.8 cm^2 **(Fig. 1A-C)**. His left ventricular ejection fraction was preserved. The initial therapy consisted of a diuretic and dopamine, but he became anuric and hypotensive. He had not taken his warfarin for a long time, so we restarted warfarin therapy. Continuous hemodiafiltration and a continuous infusion of dopamine (> 10 mcg/kg/min) were required to maintain his renal function and blood pressure. Repeat surgical valve replacement was discussed, but he was considered to be high-risk for morbidity and mortality[2]. The patient was also not willing to undergo another cardiac operation. We decided to perform PTTBV to reduce the gradient across the bioprosthetic tricuspid valve after obtaining approval from the ethics committee. During the right heart catheterization, the mean diastolic gradient across the tricuspid valve, right atrial pressure, and right ventricular end-diastolic pressure were measured and found to be 4.4, 13, and 11 mmHg, respectively **(Fig. 2A, C)**. The valve was dilated sequentially using a 10×40 mm Mustang™ Balloon Dilatation Catheter (Boston Scientific, Marlborough, MA, USA), followed by a 14×40 mm XXL Balloon Dilatation Catheter (Boston Scientific) under fluoroscopic guidance **(Fig. 3A-C)**. There were no immediate complications. Tricuspid regurgitation was not observed, but the tricuspid gradient did not change immediately. However, after PTTBV, his symptoms gradually improved, body weight decreased from 68kg to 62 kg, the diastolic rumble improved from Levine Ⅲ / Ⅵ to Ⅰ / Ⅵ, lower extremity edema was improved, and catecholamine administration was tapered. Moreover, three days



C

	Pre	Post (POD14)
mean RAP (mmHg)	13	2
s-RVP (mmHg)	41	13
RVEDP (mmHg)	11	1
max d-PGTV (mmHg)	7	3.5
mean d-PGTV (mmHg)	4.4	2.4

Fig. 2

A：Before percutaneous transcatheter tricuspid balloon valvuloplasty (PTTBV), the mean diastolic pressure gradient across the tricuspid valve (d-PGTV) is 4.4 mmHg. The mean right atrial pressure is 12 mmHg, and the right ventricular end-diastolic pressure is 9 mmHg.

B：After PTTBV day14, the mean d-PGTV, the mean right atrial pressure and the right ventricular end-diastolic pressure decreased.

C：Comparison of pre- and post-PTTBV RHC data. Post-PTTBV the RHC parameters did not immediately improve ; however, on post-PTTBV day14, the patient's symptoms and RHC data improved.

RAP : right atrial pressure ; s-RVP : systolic right ventricular pressure ; RVEDP : right ventricular end-diastolic pressure ; d-PGTV : diastolic pressure gradient across the tricuspid valve ; RHC : right heart catheterization

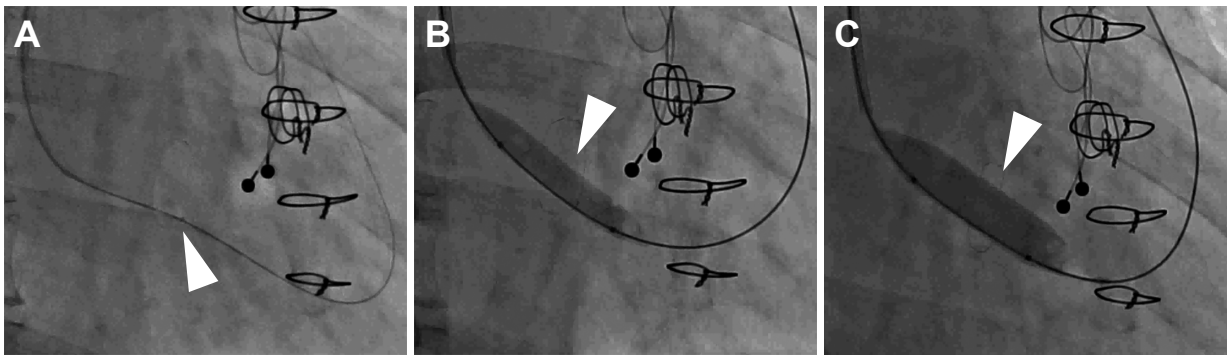


Fig. 3

A：Fluoroscopic image demonstrating the 0.035- inch guide wire that was passed through the stenotic bioprosthetic valve (arrow-head).

B：Initial balloon valvuloplasty is performed by manual inflation of a balloon with a diameter of 10×40 mm.

C：Final balloon inflation is performed by manual inflation of a balloon with a diameter of 14×40 mm.

post PTTBV, he did not need hemodialysis.

Fourteen days later, another right heart catheterization was performed. The mean diastolic gradient across the tricuspid valve, right atrial pressure, and right ventricular end-diastolic pressure decreased to 2.4, 2, and 1 mmHg, respectively **(Fig. 2B, C)**. His renal function gradually improved and he was discharged in stable condition, remaining well at his 6-month follow-up. He had no symptoms, but there was a gradual worsening of his EF, left ventricular end-diastolic volume, and left ventricular end-systolic volume **(Fig. 1C)**.

Ⅲ Discussion

PTTBV can be considered in patients with severe, symptomatic, native TS without TR, as a class Ⅱb

guideline indication[3]. Few PTTBV cases have been reported[1], but, to the best of our knowledge, gradual improvement after a PTTBV procedure has never been reported. The number of years since the original bioprosthetic tricuspid valve implantation in patients who underwent PTTBV ranged from 0.5 to 40 years (mean, 11.2±10.3 yr. median, 9.0 yr.)[1]. Our patient developed TS in only 3 years. We hypothesized that the small diastolic gradient across the TV and insufficient warfarin effect may have affected the thrombogenesis of the bioprosthetic valve. Bioprosthetic valve dysfunction results from leaflet calcification, thrombosis, pannus ingrowth or vegetation. Balloon valvuloplasty works by crumbling thrombus, tearing leaflets and perforating cusps, as seen in vitro, in studies performed on stenotic porcine bioprosthetic valves[4].

Almost all cases of PTTBV have been successful, with only one unsuccessful procedure reported[1] ; however, other cases with unfavorable results may exist, but may not have been published. A variety of interventional techniques were used in previous reports, with balloon sizes ranging from15 to 30 mm. We used a 14 mm balloon because we had no previous PTTBV experience and were concerned about potential complications. We supposed that the use of a small size balloon led to insufficient thrombus crumbling. Therefore, TS improved gradually after PTTBV. Since RV pressure was decreased, the possibility of the effect of hemodialysis and diuretic cannot be denied **(Fig. 2C)**. While PTTBV may be a reasonable therapeutic option for stenotic bioprosthetic TVs, in some cases the effects have lasted only a few months. It is unclear why our patient's ejection fraction (EF) worsened temporarily after the PTTBV. At present, our patient is asymptomatic ; however, he has experienced a gradual worsening of his EF, left ventricular end-diastolic volume and left ventricular end-systolic volume **(Fig. 1C)**. Therefore, we must continue long-term follow-up of this patient.

Ⅳ Conclusion

Bioprosthetic TV stenosis is rare. Successful treatment without complications has been achieved with PTTBV in patients with bioprosthetic TV stenosis. PTTBV could be an alternative to operative valve replacement in high-risk surgical patients.

Ⅴ Conflict of Interest

The authors declare no conflict of interest.

References

1) Rana G, Malhotra R, Sharma A, Kakouros N : Percutaneous valvuloplasty for bioprosthetic tricuspid valve stenosis. Tex Heart Inst J 44 : 43-49, 2017
2) Jaganathan R, Armstrong S, Al-Alao B, David T : The risk and outcomes of reoperative tricuspid valve surgery. Ann Thorac Surg 95 : 119-124, 2013
3) Nishimura RA, Otto CM, Bonow RO, Carabello BA, Carabello BA, Erwin JP 3rd, Guyton RA, O'Gara PT, Ruiz CE, Skubas NJ, Sorajja P, Sundt TM 3rd, Thomas JD : 2014 AHA/ACC guideline for the management of patients with valvular heart disease : a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 63 : e57-185, 2014
4) Waller BF, McKay C, VanTassel J, Allen M : Catheter balloon valvuloplasty of stenotic porcine bioprosthetic valves : Part Ⅱ : mechanisms, complications, and recommendations for clinical use. Clin Cardiol 14 : 764-772, 1991

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