



## Case Report

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**Corresponding Author:**

Woo Sung Jang MD, PhD

Department of Thoracic and Cardiovascular  
Surgery, Keimyung University School of  
Medicine, Dongsan Medical Center, 1035  
Dalgubeol-daero, Dalseo-gu, Daegu 42601,  
Korea

E-mail: whiteuri@dsmc.or.kr

## Hemodynamic Improvement after Surgical Intervention for Pannus in Prosthetic Mitral Valve

Kyungsub Song, Yun Seok Kim, Woo Sung Jang

Department of Thoracic and Cardiovascular Surgery, Keimyung University School of Medicine, Daegu, Korea

The indication of pannus removal in patients with mitral valve (MV) replacement has not been determined. In the present study, four patients underwent secondary open cardiac surgery for MV pannus removal concomitant with tricuspid annuloplasty. After the first open cardiac surgery, these patients presented with gradual elevation in the transmitral pressure gradient (TMPG) and pulmonary artery systolic pressure (PASP) with aggravation of tricuspid regurgitation related to pannus formation in the prosthetic MV. Notably, the function of the prosthetic valve was normal in all patients. We performed tricuspid annuloplasty concomitant with pannus removal in the prosthetic MV alone. Pannus in the prosthetic MV was successfully removed without valve replacement, and improvement was noted in hemodynamic parameters, including TMPG and PASP after the operation. Herein, we share our experience and opinions about pannus removal in the prosthetic MV concomitant with tricuspid valve surgery.

**Keywords:** Cardiac surgical procedure, Mitral valves

### Introduction

Pannus formation around the prosthetic valve is an important cause of prosthetic valve dysfunction. Pannus in the prosthetic mitral valve (MV) induces right ventricle (RV) loading and accelerated secondary tricuspid regurgitation (TR). However, the optimal timing of tricuspid valve surgery in patients with asymptomatic or minimally symptomatic severe TR related to MV pannus without prosthetic valve obstruction has not been established [1]. We analyzed the hemodynamic effects of prosthetic MV pannus and hemodynamic changes after MV pannus removal, reviewing our 4 cases.

Pannus in the prosthetic MV induces RV loading and accelerated secondary TR. Especially, in patients with severe TR and MV pannus, we thought that tricuspid valve (TV) surgery with MV pannus removal before the onset of severe symptoms or the development of RV dysfunction is a better treatment option than conservative management.

### Case reports

Between January 2013 and May 2022, 16 patients underwent pannus removal of a prosthetic valve in our medical center. Patients undergoing additional procedures other than tricuspid annuloplasty (TAP) and MV pannus removal were excluded from the study to exclude the hemodynamic effects of additional procedures. Thus, in the final cohort, four patients who underwent only MV pannus removal concomitant with TAP were included.

Four patients underwent MV replacement as an initial operation at the median age of 36 years (interquartile range [IQR], 30.8–38.8 years; Table 1). During the follow-up period in the outpatient clinic, we evaluated and compared changes in cardiac hemodynamic values with echocardiography. Compared with the normal functional state of patients after the first cardiac surgery, the mean pressure gradient (PG), pulmonary artery systolic pressure (PASP), and TR grade were found to be aggravated (Fig. 1) based on transthoracic echocardiography (TTE) findings (PG: median 4 mmHg, IQR 3.9–4.2 to median 5.5 mmHg, IQR 4.9–6.6; PASP: median 33.5 mmHg, IQR 24–33.3 to median 55 mmHg, IQR 51.5–57.0; median TR grade: moderate to moderate/severe). The func-

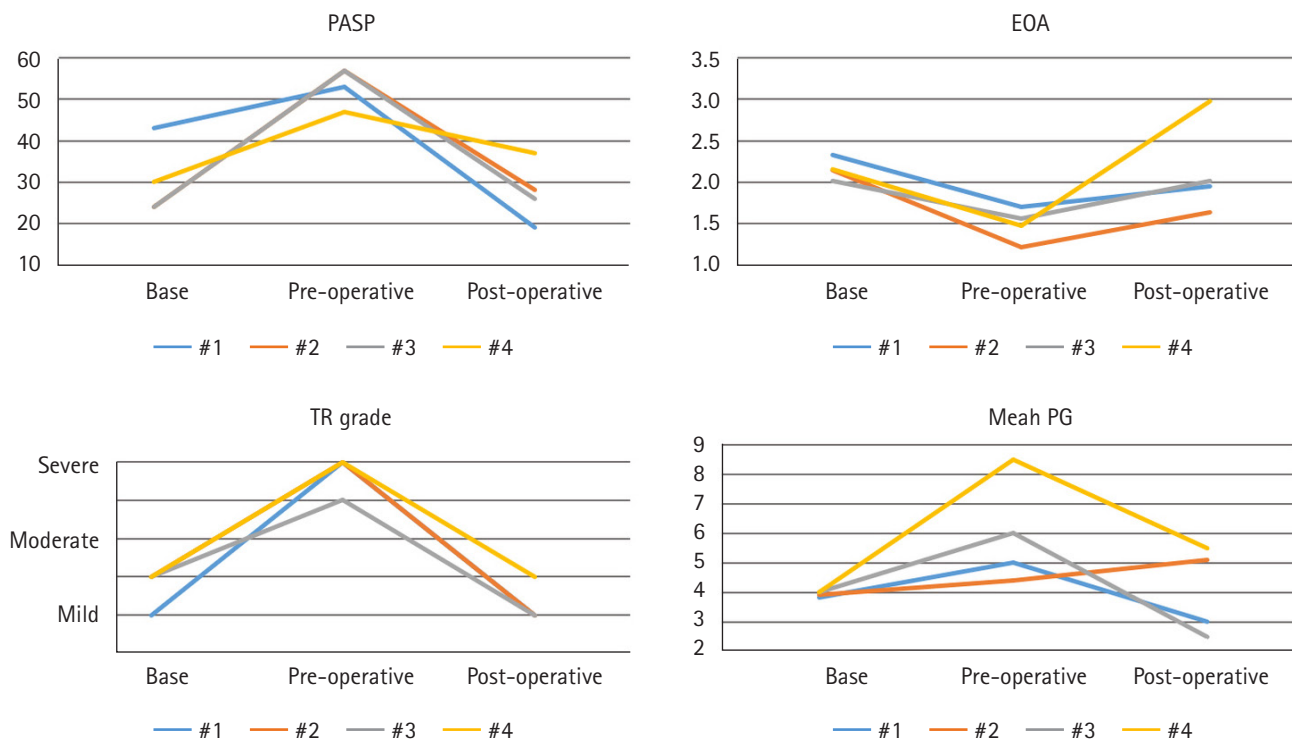
tion of the prosthetic MV was normal; however, effective orifice areas was decreased (median 2.17 cm<sup>2</sup>, IQR 2.1–2.2 to median 1.5 cm<sup>2</sup>, IQR 1.4–1.6). The function of right ventricle was seen to be conserved on TTE scan. Moreover, on cardiac computed tomography (CT) scan, subvalvular pannus was detected in the prosthetic MV (Fig. 2A, B). The cardiac rhythm of the four patients was permanent atrial fibrillation. Laboratory and sonography findings of Patient 1 indicated congestive hepatopathy, and the patient complained of pitting edema in both lower limbs. Patients 2, 3, and 4 presented with the complaint of dyspnea on exertion (DOE) (New York Heart Association class I–II) and pitting edema in both lower limbs.

We performed TAP for severe TR with concomitant pros-

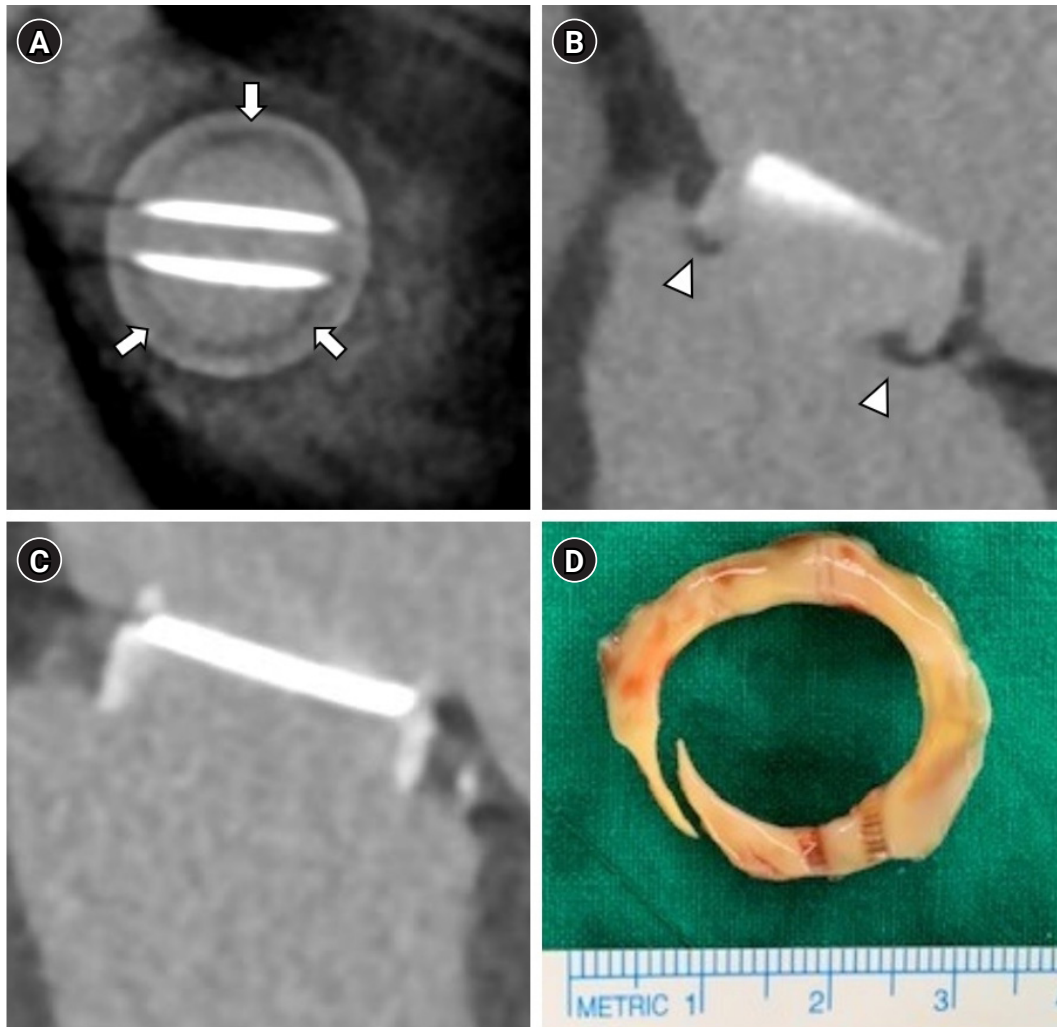
**Table 1.** Patients characteristics and information about first and second cardiac surgery

Patient No.	Previous valve replacement			Age at 2 <sup>nd</sup> cardiac surgery (Interval between 1 <sup>st</sup> and 2 <sup>nd</sup> surgery)	Mitral valve approach
	Sex/Age(years)	Month/Year	Operation (valve)		
1	F/31	6/1986	MVR (DM: 29 mm)	57 (26)	Trans-aortic
2	F/30	3/1991	MVR (St. Jude: 29 mm)	61 (31)	Trans-septal
3	F/41	4/1991	DVR (CM: 29 mm/CM: 21 mm)	62 (21)	Left atriotomy
4	M/54	8/1999	MVR (ET: 29 mm)	69 (15)	Trans-septal

MVR, mitral valve replacement; DM, Duromedics; DVR, double valve replacement; CM, Carbomedics; ET, Edwards-TEKNA.



**Fig. 1.** Transthoracic echocardiographic (TTE) findings before and after redo cardiac surgery. Base: TTE findings after the first operation. All patients were normal functional state. PASP, pulmonary artery systolic pressure; EOA, effective orifice area; TR, tricuspid regurgitation; PG, pressure gradient.



**Fig. 2.** Pre- and post-operative cardiac computed tomography (CT). (A, B) Pannus in prosthetic mitral valve (arrow and arrowhead). (C) Cardiac CT after pannus removal operation. Pannus was completely removed. (D) Removed pannus tissue.

thetic MV pannus removal, indications for cardiac surgery were severe TR. Surgery was indicated based on the following findings: DOE, congestive hepatopathy, and continuously aggravating RV after load (PASP, mean PG). The median interval from the initial operation to redo surgery was 24 years (IQR 19.5–28 years). All operations were performed through a median sternotomy. With the patient under moderate hypothermic cardiopulmonary bypass and cardioplegic cardiac arrest, pannus was completely removed from the prosthetic valves through aortic valve opening, left atriotomy, and trans-septal approaches, respectively (Table 1). We then performed TAP with an MC 3 ring. We decided to do not redo-mitral valve replacement because the function of the prosthetic mitral valve was normal. Pannus under the prosthetic MV ring was clearly resected in all patients.

After the operation, the pannus was completely removed in all patients on cardiac CT (Fig. 2C, D). The mean PG and PASP were improved in the immediate postoperative period, and prosthetic MV function was normal on TTE (Fig. 1). The median length of intensive care unit stay and hospital stay was 2.5 (IQR 1.75–3.25) days and 12 (IQR 10–14.3) days, respectively. All patients were discharged from the hospital without any complications. Patient 1 died due to sepsis caused by pneumonia 1 year after the pannus removal operation, whereas the other patients have remained in good health till date (follow-up period: 3 months, 8 years, and 9 years, respectively). All patients were treated with anticoagulation therapy using warfarin (target international normalized = 2.5–3.0), and there were no complications associated with anticoagulation therapy or thrombosis.

## Discussion

Pannus formation in the prosthetic MV was known to occur slowly, and clinical symptoms present 2-3 decades after the initial operation [2,3]. Subvalvular pannus in the prosthetic MV usually does not cause prosthetic valve dysfunction, and the reoperation rate for pannus in the prosthetic MV is approximately 0.3%.

However, slow-growing MV pannus continuously increases the transmitral PG of prosthetic MV and PASP. Eventually, RV loading related to MV pannus results in severe TR, but the timing of the intervention for severe TR related to MV pannus has not been determined. In this report, we performed TAP and removal of MV pannus before the onset of RV distension or RV failure, as continuously increasing PASP and transmitral PG results in RV dysfunction. Recent studies have reported that MV pannus removal without MV replacement is a safe option and effectively improves left heart hemodynamics by reducing transmitral PG and PASP [4,5]. In addition, early TV surgery before the onset of severe RV dysfunction or end-organ damage with either hepatic or renal dysfunction shows good surgical outcomes [6,7]. In this study, we showed that removal of MV pannus without reoperation of the MV replacement decreases transmitral PG and PASP, and pannus was completely removed in all patients.

As a result, when severe TR develops with an increase in transmitral PG or PASP without prosthetic MV dysfunction, pannus formation in the prosthetic MV should be evaluated using cardiac CT. If pannus formation occurs, MV pannus removal without redo-MV replacement is a feasible option when performing TR repair for severe TR patients.

## Acknowledgements

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## Ethics approval

This study was exempted from review by the Institutional Review Board of the Dongsan Hospital, Keimyung University School of Medicine approved the study (IRB File No. 2022-08-071, August 23, 2022). Written informed consent was obtained from the patients to participate in the study.

## Conflict of interest

The authors have nothing to disclose.

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## ORCID

Kyungsub Song, <https://orcid.org/0000-0002-6556-2261>

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