"Super Responder" of Percutaneous Bicaval Valve Implantation for Severe Tricuspid Regurgitation: A Case Report

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ABSTRACT

Tricuspid Regurgitation (TR) surgical treatment is associated to high operative mortality, suboptimal long-term survival, and frequent TR recurrence after repair, especially in the elderly. This case report highlights our early experience of TricValve implantation in Indonesia, conducted on a 72-year-old male patient with severe tricuspid regurgitation and advanced right ventricular dysfunction. In this context, the TricValve system offers a promising, less invasive alternative. Despite previous pharmacological management, our patient had been readmitted multiple times due to refractory right heart failure. One month post-TricValve implantation, he showed significant symptomatic relief and stable cardiac function as evidenced by echocardiographic measurements. This case underscores the potential utility of the TricValve system in providing an effective, lower-risk treatment option for patients not suited for traditional surgical intervention.

Key Words: *Tricuspid Regurgitation; Percutaneous Bicaval Valve Implantation; TricValve; Super Responder.*

INTRODUCTION

Tricuspid regurgitation and right heart failure constitute a debilitating condition, often forming a vicious cycle wherein each can be both a cause and a consequence of the other.[1] The majority of tricuspid regurgitation cases are functional (85-90%), typically arising from left-sided heart disease or pulmonary conditions.[2]

Medically managed patients with tricuspid regurgitation might have worse outcomes than the patients who underwent tricuspid valve surgery.[3] However, some patients might have a higher risk when undergoing a tricuspid valve surgery procedure, either tricuspid valve repair or replacement.

Patients with tricuspid regurgitation who are managed solely through medical treatment may experience worse outcomes compared to those who undergo tricuspid valve surgery.[3,4] However, certain subgroups of patients, particularly the elderly and those with advanced right ventricular dysfunction, may encounter increased risks during tricuspid valve procedures, whether they entail valve repair or replacement.[5] Therefore, a transcatheter approach, employing the TricValve as a transcatheter bicaval valve system, may be

more suitable for managing some high-morbidity patients.[6]

This represents our initial experience of TricValve implantation in Indonesia, performed specifically on a patient with the aforementioned characteristics.

CASE ILLUSTRATION

A 72-year-old man with a five-year history of right-sided heart failure was admitted for treatment. He also had a medical history of hypertension and permanent atrial fibrillation, managed with a left atrial appendage closure. Despite pharmacological management using diuretics such as furosemide and spironolactone, his right heart failure remained refractory. The patient had been readmitted multiple times for recurrent bipedal edema. Furosemide use was consistently 40 mg twice daily. An echocardiographic assessment showed severe tricuspid valve regurgitation and reduced right ventricular function. Specific echo measurements included a left ventricular ejection fraction of 65.1% (assessed by the Teichholz method), globally normokinetic wall motion, no left ventricular hypertrophy, a tricuspid annular plane systolic excursion (TAPSE) of 2.6 cm, mild mitral regurgitation, and severe tricuspid regurgitation (TR Vmax 253 cm/s, TVG 26 mmHg). Additionally, dilation of the inferior vena cava (IVC) was noted. The right ventricle had a basal diameter of 5.7 cm, a mid-cavity diameter of 4.9 cm, and a length of 6.8 cm; the right atrial area was 34.6 cm^2 and had a length of 7.7 cm (**Figure 1**).

The patient was offered tricuspid valve surgery; however, he declined the surgical approach. Knowing that a minimally invasive

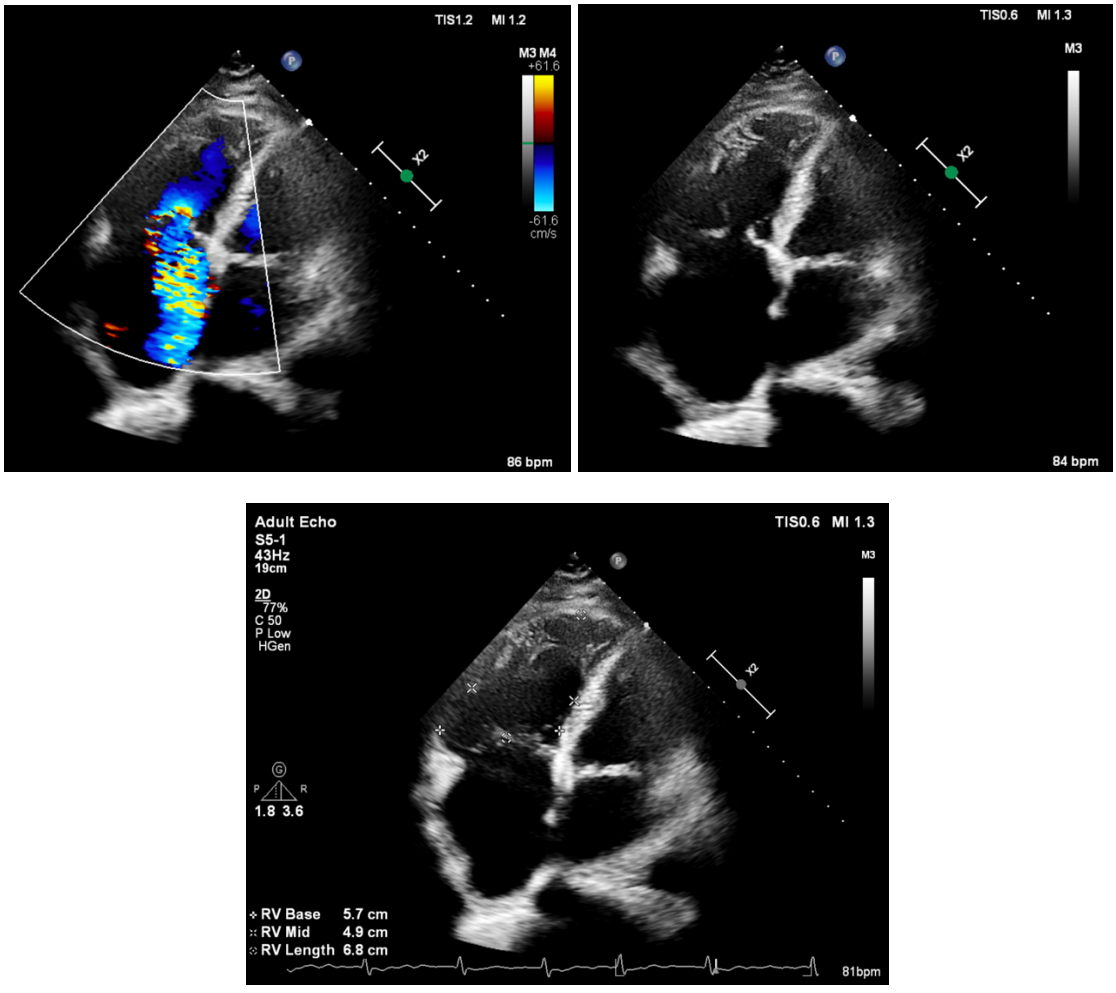

Figure 1. Pre-implantation of TricValve system. Upper Left: Severe functional tricuspid regurgitation; Upper Right: coaptation gap 8.5 mm; Lower image: RV base, mid, and length size.

procedure such as TricValve system placement existed, the patient preferred this procedure over the surgical approach. Consequently, the cardiac team decided to place a TricValve stent in an attempt to manage and prevent further deterioration of the patient's right ventricular function. A CT scan procedure was performed for TricValve sizing **(Figure 2)**. Based on the sizing, the TricValve was placed without any difficulties during the procedure **(Figure 3)**.

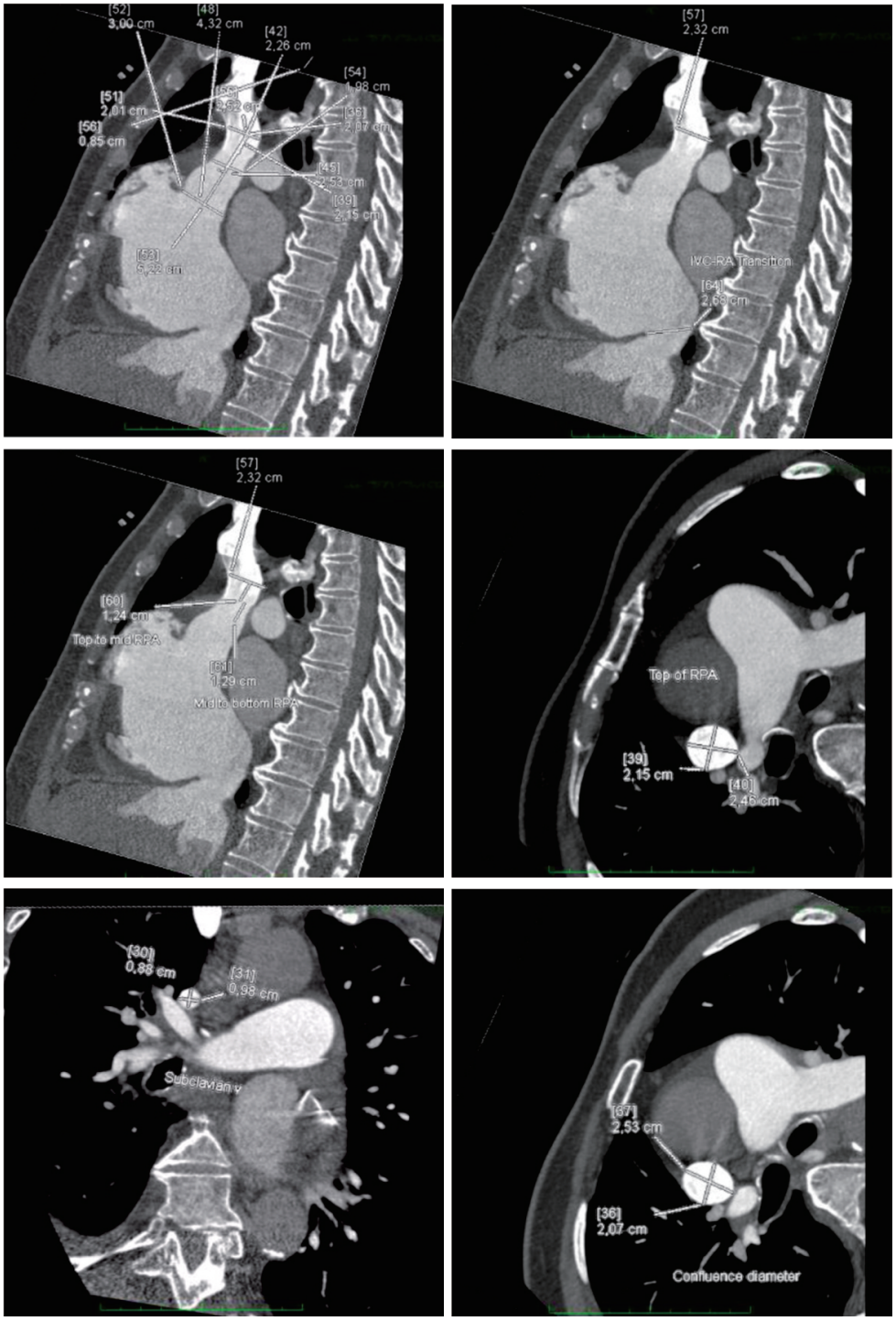

Figure 2. Sizing of the SVC and IVC for TricValve Implantation

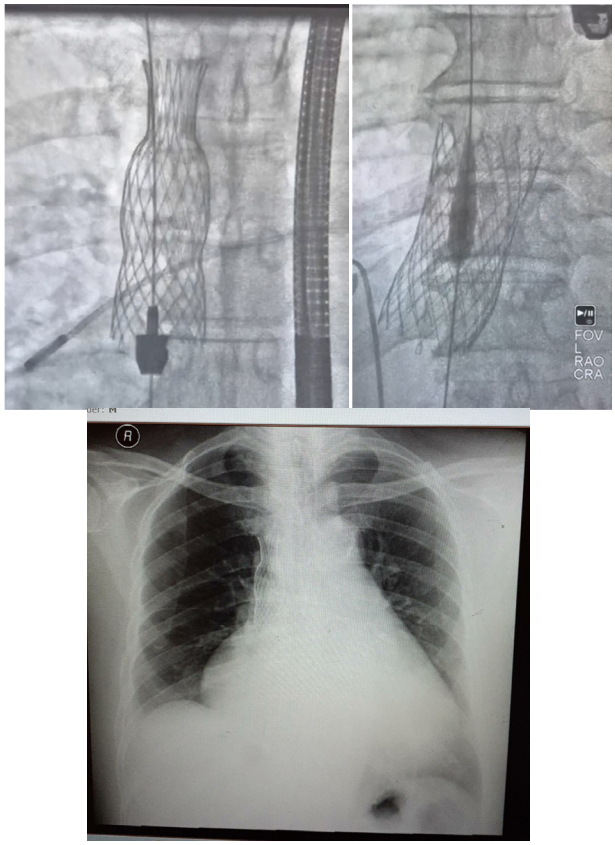

Figure 3. Post Implantation of the TricValve Procedure. Upper Left: SVC Valve; Upper right: IVC Valve; Bottom: chest x-ray after TricValve System Implant.

One month following the procedure, the patient no longer experienced ascites or bipedal edema. Post-procedure echocardiographic measurements showed a stable left ventricular ejection fraction of 69.1% (assessed by the Teichholz method), globally normokinetic wall motion, and a TAPSE of 2.5 cm. The TricValve stent was well-positioned and functional. Measurements of the right ventricle were as follows: basal diameter 5.1 cm, mid-cavity diameter 4.6 cm, and length 7.3 cm; the right atrial length was 8.29 cm (**Figure 4**). Meanwhile, three months of echocardiography evaluation showed reduced right atrial size (length 7.3 cm) **(Figure 5).** Additionally, after three months, furosemide is given only if necessary.

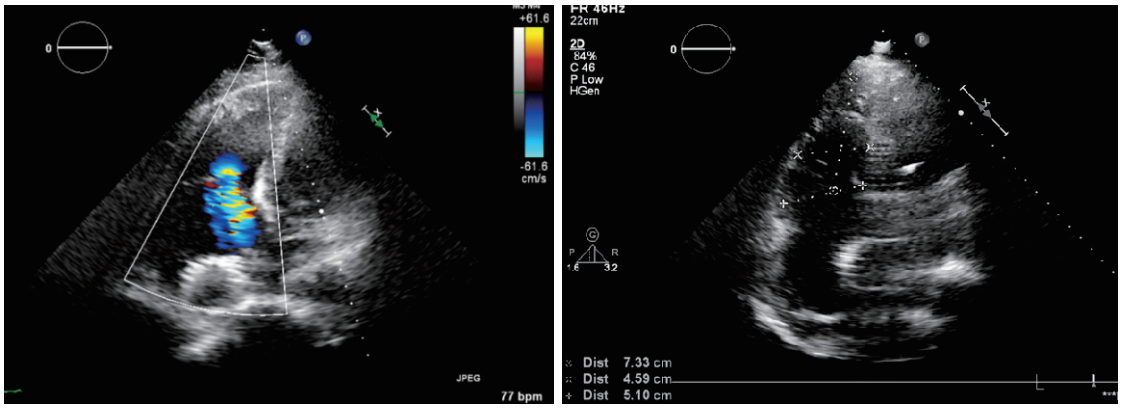

Figure 4. Post-implantation of TricValve system. Left: Moderate functional tricuspid regurgitation with the presence of TricValve system; Right: RV base, mid, and length size.

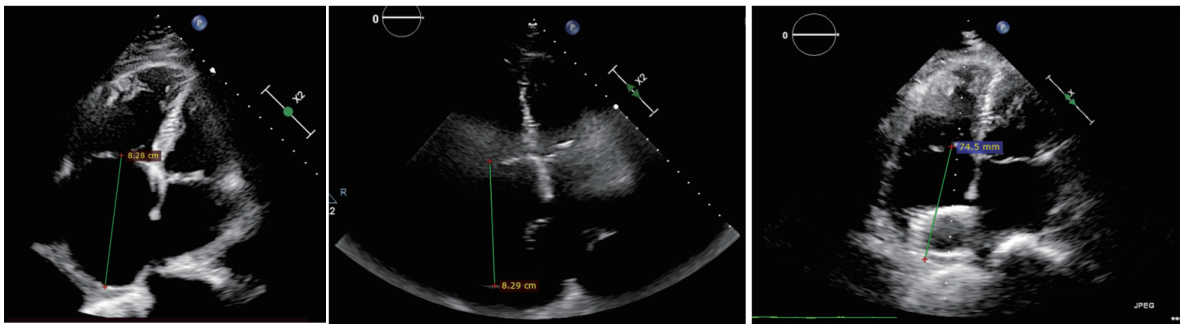

Figure 5. The length of right atrial. Top left: before implantation; Top right: one month after implantation; Bottom: 3 months after implantation.

DISCUSSION

The majority of tricuspid valve (TV) anomalies are secondary, accounting for 49 percent of all causes.[7] Tricuspid regurgitation can manifest as a result of the malcoaptation of the tricuspid valve due to physiological causes such as left-sided heart failure, mitral stenosis or regurgitation, primary pulmonary disease, pulmonic valve stenosis, or even hyperthyroidism. [8] Left untreated, tricuspid regurgitation can cause reduced stroke volume and cardiac output due to underfilling of the left ventricle. This alone can lead to increased mortality—34% for five-year survival in patients with severe tricuspid regurgitation and HFrEF.[9,10] Progression of tricuspid regurgitation can be especially high in patients with pulmonary hypertension and atrial fibrillation, which occurred in this patient.[11]

A surgical approach should be considered when medical therapies like diuretics, ACE inhibitors, or angiotensin receptor blockers are no longer effective for the patient, preferably before the onset of RV dysfunction. Performing the surgery late, particularly when RV function is already deteriorating and is accompanied by concomitant comorbidities resulting from RV failure, may provide a mortality risk of 20-30% or more for these patients.[12] Nonetheless, research suggests that isolated TV surgery is associated with a high mortality and morbidity rate. The rate of complications was 31%, and in-hospital mortality approached 10%. Moreover, the prognosis for people with functional tricuspid regurgitation is poorer than for those with organic tricuspid regurgitation.[7]

Two self-expanding valves designed specifically for SVC and IVC implantation in low-pressure circulation are included in the TricValve System. The SVC valve is a tapered, belly-shaped device intended to anchor in an enlarged, tapered SVC arrangement. In contrast, the IVC valve is deployed at the diaphragm level and protrudes into the RA. While both devices are constructed from bovine pericardium, the atrial stent's inner portion is coated with a polytetrafluoroethylene skirt. It is intended to minimize caval backflow, hence alleviating symptoms of severe tricuspid regurgitation such as peripheral edema, hepatomegaly, and ascites.[13] Based on the Tricus Euro study, this approach resulted in 97% technical success, 0% of 6-month cardiac death, and persistent functional improvement.[14]

We classified the patient as a "good responder" in the context of TricValve implantation due to: (1) Enhancement of clinical symptoms: patients exhibit a marked reduction in clinical symptoms, such as dyspnea, peripheral edema, and fatigue, with the reduction in the New York Heart Association (NYHA) functional classification scale; (2) Reduction in diuretic dependence: patient able to decrease the dosage or frequency of diuretic usage without experiencing a recurrence of edema or fluid accumulation; and (3) Improvement in Quality of Life: The patient's subjective assessment of an enhanced quality of life post-procedure.

Aside from the functional improvements, structural changes were also observed in our evaluation three months post-procedure. The reduction in right atrial size may be attributed

to the decrease in tricuspid regurgitation. This decrease in regurgitation volume into the right atrium indirectly reduced the pressure and volume in the right atrium. With improved tricuspid function, blood flow from the right atrium to the right ventricle became more efficient, thereby reducing the volume of blood "trapped" in the right atrium. Considering these findings, reverse remodeling of the right atrium may have occurred in this case. However, as of now, no studies have presented findings identical to ours.

Patient with TricValve is recommended to take an anticoagulant for a lifetime. In this patient because of permanent Atrial Fibrillation, he already implanted left atrial appendage closure for stroke prevention and changed his anticoagulant to antiplatelet (clopidogrel), but after implanting this TricValve system, he has to take anticoagulant again for life.

Despite the functional and structural improvements observed, it is crucial to consider the long-term management of anticoagulation, particularly in elderly patients, due to the increased risk of bleeding in this population, while ensuring the continued efficacy of the TricValve system. Age-related physiological changes, such as reduced renal clearance and increased vascular fragility, predispose older adults to higher bleeding risks. Moreover, comorbid conditions like hypertension, chronic kidney disease, and a history of gastrointestinal bleeding exacerbate these risks. Polypharmacy, common in elderly populations, further complicates anticoagulation management due to potential drug-drug interactions. Frailty and the increased likelihood of falls also contribute to the heightened bleeding risk.[16] Our patient had permanent atrial fibrillation with history of LAA occluder implantation, had been on clopidogrel as antiplatelet. Trivalve implantation necessitates reintroduction for anticoagulant for a lifetime, rather than warfarin, apixaban was used to minimize the risk of bleeding.

CONCLUSION

In our elderly patient with a complex medical history, including hypertension and atrial fibrillation, the transcatheter bicaval valve system demonstrated promising outcomes for managing severe tricuspid regurgitation and right ventricular dysfunction.

CONFLICT OF INTEREST

The authors have no conflicts to disclose.

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