

## First Percutaneous Tricuspid Valve Repair with MitraClip Device in Singapore

### Dear Editor,

Treatment of patients who have severe mitral regurgitation (MR) and tricuspid regurgitation (TR) is surgical repair or replacement. However, it becomes a therapeutic challenge in patients who are at prohibitive surgical risk. In such patients, percutaneous edge-to-edge repair of mitral valve with the MitraClip system (Abbott Vascular, Santa Clara, CA, USA) has demonstrated its clinical efficacy and safety. For the tricuspid valve, various percutaneous techniques are emerging rapidly.<sup>1</sup> We report a patient in cardiogenic shock from severe MR and TR who underwent percutaneous repair of both valves using the MitraClip system. This is the first successful percutaneous intervention of the tricuspid valve in Singapore.

### Case Presentation

A 68-year-old lady was transferred to our institution for further management of refractory heart failure from severe MR and TR. She had a history of primary biliary cirrhosis and underwent a living donor liver transplant in 2014, stage 3 chronic kidney disease, atrial fibrillation, moderate-to-severe functional MR and severe TR. She was initially admitted to 2 other institutions before transferring to our centre. Her hospital stay was stormy and prolonged (close to 3 months) with repeated intensive care unit (ICU) admissions for heart failure that required inotropes and mechanical ventilation as well as hospital-acquired pneumonia. In addition, her kidney function took a toll and required dialysis.

During our evaluation, she was in cardiogenic shock and was inotropic-dependent for 2 weeks. Echocardiography showed severe functional MR (Fig. 1A) from a dilated mitral annulus of 3.5 cm; tenting of mitral valve with restricted posterior leaflet motion; and massive functional TR (Figs. 2A-B) from a dilated tricuspid annulus of 4.5 cm with a central broad jet arising from incomplete coaptation between the anterior-septal leaflets and anterior-posterior leaflets. Using three-dimensional (3D) transoesophageal echocardiography (TEE) volumetric dataset, 3D-derived effective regurgitant orifice area (EROA) for TR was 1.09 cm<sup>2</sup> which would conventionally be classified as severe,<sup>2</sup> but would be considered massive based on a

new TR severity grading scheme proposed by Hahn and Zamorano.<sup>3</sup> Her left ventricle (LV) was dilated (LV end-diastolic diameter, 6.2 cm; indexed by BSA 3.6 cm/m<sup>2</sup>) with LV ejection fraction of 40%. Her right ventricle (RV) was also dilated (RV inlet diameter, 6.5 cm) with impaired systolic function (tricuspid annular plane systolic excursion, 1.3 cm; RV fractional area change, 16%). Additionally, there was flattening of interventricular septum during diastole indicative of significant RV volume overload. Coronary angiography showed minor coronary artery disease. She was evaluated by cardiac surgeons who deemed her too frail and high risk for open heart surgery (EuroSCORE II and STS scores for mortality were 25.9% and 56.6%, respectively).<sup>4,5</sup> After a heart team discussion, she was subsequently offered off-label use of the percutaneous MitraClip device to treat both severe MR and TR. Our aim was to stabilise her haemodynamic status and prevent further ICU admissions for heart failure.

The procedure was performed by a multidisciplinary team comprising interventional cardiologists, echocardiologists, a cardiac anaesthesiologist, nurses and a radio-grapher. The patient was placed under general anaesthesia and mechanically ventilated during the procedure. Our plan was to first treat the mitral valve and then the tricuspid valve. Vascular access was obtained through the right femoral vein. Transseptal puncture was performed under TEE guidance. A single MitraClip was deployed at the A2/P2 segment where the predominant MR jet was (Fig. 1B). This reduced the overall MR grade from 4+ to 2+ (Fig. 1C). The mean pressure gradient was 3 mmHg and the 3D mitral valve area was 2.9 cm<sup>2</sup>.

The steerable guide catheter (SGC) was withdrawn across the interatrial septum into the right atrium and positioned above the tricuspid valve leaflets. The clip delivery system was inserted with the blue line rotated 90 degrees anti-clockwise (miskey) and exited the SGC straddled. Using TEE and fluoroscopic guidance, the SGC was turned clockwise while the "A" knob was slowly turned to steer the clip towards the tricuspid valve. Using the tricuspid valve inflow-outflow view with X-plane, the clip was advanced across the tricuspid valve annulus and positioned at the coaptation between the anterior and septal leaflets.

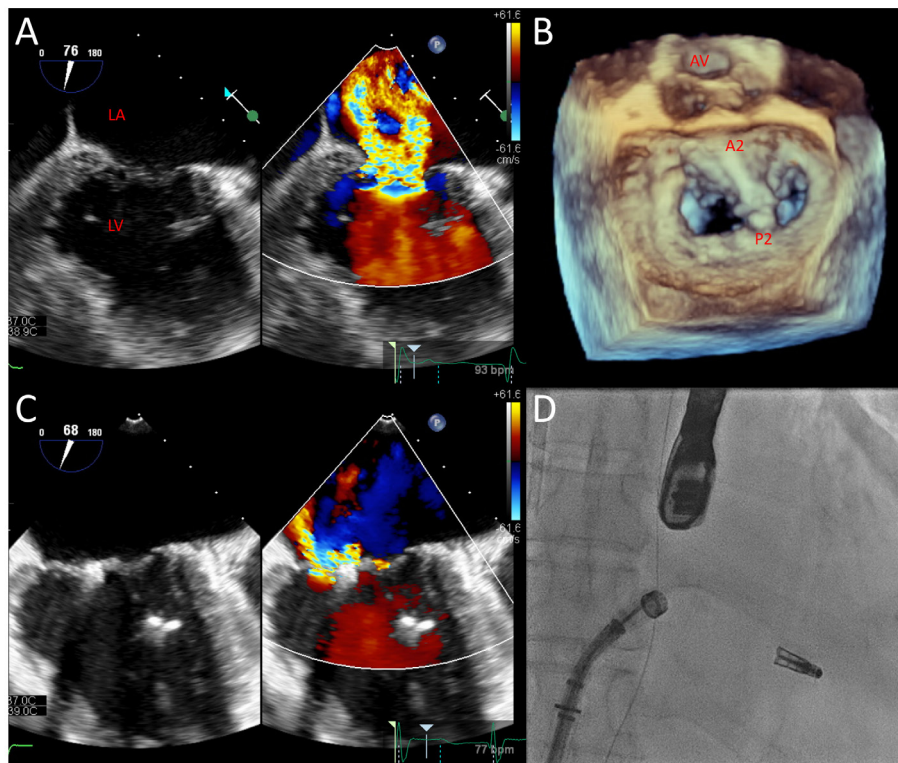


Fig. 1. A: Preprocedural transoesophageal echocardiogram in the intercommissural view shows 4+ functional mitral regurgitation with a central jet. B: Three-dimensional view of the mitral valve (surgical view from left atrium) shows deployment of single MitraClip to the A2/P2 segment. C: Reduction of overall mitral regurgitation grade to 2+. D: Fluoroscopic view of deployed MitraClip. AV: Aortic valve; LA: Left atrium; LV: Left ventricle

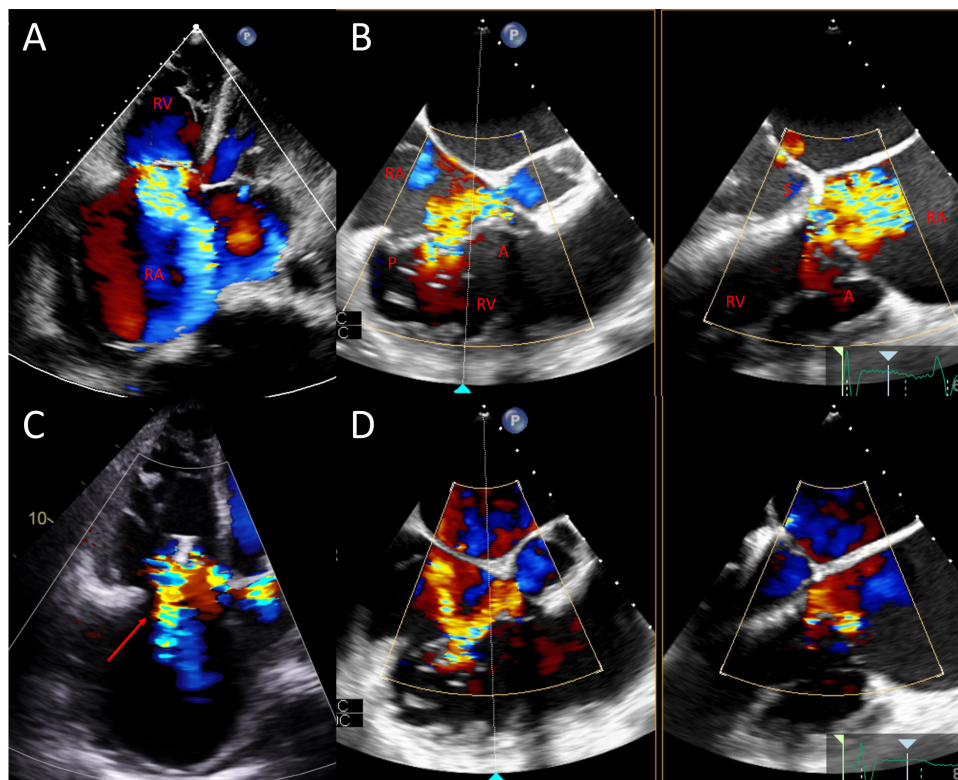


Fig. 2. Preprocedural massive tricuspid regurgitation in (A) transthoracic apical 4-chamber and (B) transoesophageal tricuspid valve inflow-outflow view with X-plane. C and D: Clip was deployed between the anterior and septal leaflets with reduction in tricuspid regurgitation (red arrow). A: Anterior tricuspid leaflet; P: Posterior tricuspid leaflet; RA: Right atrium; RV: Right ventricle; S: Septal tricuspid leaflet

We applied manual compressive pressure over the anterior precordium to enhance tricuspid leaflets approximation during grasping of tricuspid leaflets. Anterior and septal leaflet grasp was imaged with adequate tissue seen within the clip before deployment (Figs. 3A-C). TR severity was reduced from massive to moderate (Figs. 2C-D). The 3D-derived EROA for TR was reduced from 1.09 cm<sup>2</sup> to 0.59 cm<sup>2</sup> at the end of the procedure (46% reduction). Final mean trans-tricuspid valve gradient was 1 mmHg.

Postprocedural care was uneventful and she was successfully weaned off inotropic support. She underwent a period of rehabilitation and was discharged home.

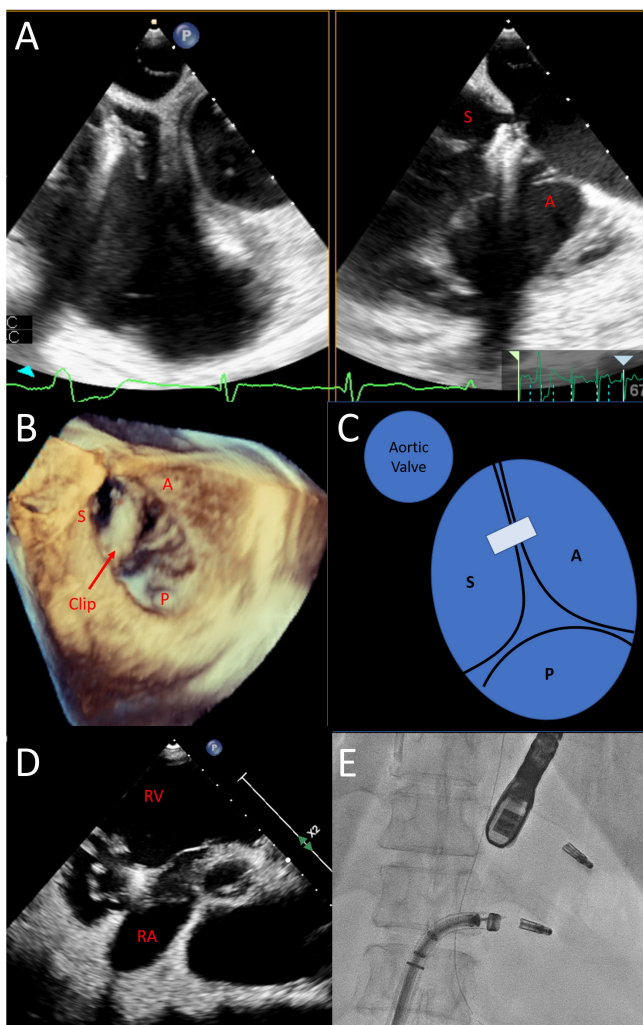


Fig. 3. A: Grasping of anterior and septal leaflets was imaged with adequate tissue seen within the clip before deployment. B: Three-dimensional view (surgical view from right atrium) of clip deployment. C: Schematic diagram of clip deployment. D: Modified short axis view on transthoracic echocardiogram shows stable deployment of clip between anterior and septal leaflets. E: Final fluoroscopic view shows deployment of clips in mitral (superior) and tricuspid (inferior) valves. A: Anterior tricuspid leaflet; P: Posterior tricuspid leaflet; RA: Right atrium; RV: Right ventricle; S: Septal tricuspid leaflet

## Discussion

The past decade has seen rapid advancement in structural heart interventions that have expanded treatment options for patients with aortic, mitral, pulmonary and even tricuspid valve disease. Severe TR has been shown to be associated with significant mortality and morbidity.<sup>6,7</sup> Thus far, treatment options for severe TR are limited. Medical management is restricted mostly to the use of diuretics which provides symptomatic relief but does not prevent disease progression. Surgical repair or replacement is reserved for patients with severe TR undergoing left-sided valve surgery and those with isolated TR who are symptomatic despite optimal medical therapy.<sup>8,9</sup> However, the benefit of isolated surgery on prognosis is not clear and perioperative mortality is high.

Additionally, the prognostic impact of surgical tricuspid valve repair in patients with concomitant functional TR undergoing left-sided open heart surgery is also not clear.<sup>10</sup> Currently, multiple percutaneous techniques to address TR have been developed to address this unmet need.<sup>1</sup> The most widely used is edge-to-edge repair technique using the MitraClip system and its safety and feasibility have been demonstrated in several overseas studies.<sup>11-13</sup> Favourable short-term outcomes (6 months and 30 days) have been seen in reduction of TR severity and improvement in functional status even as we await results from larger studies with longer-term outcomes.<sup>12,13</sup>

Our case is the first successful percutaneous intervention of the tricuspid valve in Singapore using the MitraClip system. It paves the way for future transcatheter therapies in tricuspid valve repair. The tricuspid valve is no longer the “forgotten valve” and patients with severe TR who are not candidates for open valve surgery could now be treated with the use of catheter-based techniques.

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