Clinical follow-up at half a year after transcatheter tricuspid valve

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Case Report

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Abstract

Approximately 80% of significant tricuspid valve regurgitation cases are secondary as a result of left ventricular dysfunction or serious mitral valve disease, which causes pulmonary hypertension, and right ventricular dysfunction[1]. In South Asia, most cardiac surgeons usually take a conservative treatment for secondary tricuspid valve disease or had a secondary thoracotomy operation. These reasons for choose conservative treatment or secondary thoracotomy operation of the secondary tricuspid valve disease are: 1. Most doctors considered that the progression of aggravation of tricuspid valve disease was comparatively slow, so the long-term benefit of the surgical therapy of tricuspid valve lesion was underestimated. 2. It is commonly believed that the secondary tricuspid insufficiency can be gradually remitted after left heart valve surgery. 3. Most cardiac surgeons choose secondary thoracotomy operation because it is more effective in solving secondary tricuspid valve and has better long-term benefits for patients, but the surgical trauma of secondary thoracotomy operation should also be considered. In the case, we hoped to provide some new ideas for surgical plan and postoperative review of secondary tricuspid valve disease.

Introduction

We report a case that a 68-year-old Chinese woman with replaced metal mitral valve suffers again severe tricuspid insufficiency. 15 years ago, the patient had a mechanical mitral valve replacement for severe mitral stenosis. In July 2021, the patient underwent transcatheter tricuspid valve replacement due to severe tricuspid regurgitation. Six months after the transcatheter tricuspid valve replacement, we compared changes before and after the transcatheter tricuspid valve replacement via heart color ultrasound, chest CT and chest MRI. We found positive changes for the patient before and after the surgery. In this case, We will expound the current situation of the transcatheter tricuspid valve replacement in China and this technology has more positive implications for secondary tricuspid valve disease in the future. Also in postoperative review, after transcatheter tricuspid valve replacement, we consider that postoperative MRI review has a good effect on the evaluation of the structure and morphology of the transcatheter replaced valve.

Case

A 68-years-old female patient, In 2006, she was diagnosed with severe mitral stenosis in Shanghai, and underwent mechanical mitral valve replacement via median sternotomy. She was diagnosed as severe tricuspid regurgitation in July 2021, the patient also had abdominal distension and a small amount of abdominal effusion before tricuspid valve surgery, and the preoperative tests showed that the patient had low liver function. Combined abdominal distension, ascites with liver function, we considered it was associated with the vena cava pressure increased due to severe tricuspid regurgitation. Preoperative heart color ultrasound (Fig. 1) showed that: After mechanical mitral valve replacement, no significant abnormality was observed in the mechanical valve function at the mitral valve, enlarged left atrium and right heart, the interventricular septum moved in the same direction as the left ventricular posterior wall,
Severe tricuspid regurgitation, the pulmonary systolic pressure was estimated to be 45 mmHg, mild pulmonary hypertension, left ventricular systolic function decreased. In July 2021, she underwent transcatheter tricuspid valve replacement via femoral vein path. Moreover, according to doctor's advice who received anticoagulation and other treatment after the Surgery. At four months after the transcatheter tricuspid valve replacement heart color ultrasound (Fig. 2) showed that: After mechanical mitral valve replacement and tricuspid interventional replacement, there was no obvious abnormality in the function of mechanical mitral valve, there was no obvious regurgitation after tricuspid valve replacement, and the average tricuspid valve pressure difference was about 6 mmHg, right atrium enlargement, left ventricular relaxation is reduced. At half a year after the transcatheter tricuspid valve replacement chest MRI (Fig. 3) showed that: Postoperative changes of the sternum showed thickening of the surrounding tissues, enlarged heart, after mechanical mitral valve replacement and tricuspid valve replacement, and replaced valves are structurally normal, a few fibrosis lesions in the lower lobes of both lungs. At half a year after the transcatheter tricuspid valve replacement chest CT (Fig. 4) showed that: Changes aftercardiac surgery, calculous cholecystitis is suspected, after mechanical mitral valve replacement and tricuspid valve replacement, and replaced valves are structurally normal. Comparing the changes before and after transcatheter tricuspid valve replacement, abdominal distension and liver function are in a better state. (Table 1)

Discussion

Surgical correction of secondary tricuspid valve disease has progressed over the years from primarily a conservative treatment to a more liberal approach with the idea of proactively preventing progression of disease. However, even today, there is not complete agreement on how much a patient can benefit from surgical correction of secondary tricuspid valve disease, and what type of surgery a patient is suitable for. Cardiac surgeons pointed out significant progression of secondary tricuspid valve disease in long-term follow-up of patients undergoing mitral valve surgery, increased morbidity, and increased early and late mortality in patients with tricuspid regurgitation. And tricuspid valve cycloplasty had the lowest risk of improvement in clinical symptoms, anatomical and hemodynamic changes, and survival[2–5]. But it's worth noting that the long-term effectiveness of conventional tricuspid valve surgery is not good, and about 40% of patients need retreatment 5 ~ 15 years after surgery, and the mortality rate of the conventional tricuspid valve surgery is high and the prognosis is unsatisfactory[6, 7]. For patients who have had transsternal heart valve surgery, if does another transsternal valve surgery again, the damage to the patient's body, the risk of operation and the prognosis will be greatly affected. Minimally invasive transcatheter tricuspid valve therapy provides a new treatment option for patients with tricuspid valve disease, and it's safety and effectiveness has been confirmed by some studies[8].

Let me introduce the status quo of China's autonomous development of the minimally invasive transcatheter tricuspid valve therapy in recent years. 1. Valvular leaflet involution technique: The Dragon Fly-T system uses one or more clamps to clamp the tricuspid lobes via the femoral vein to reduce regurgitation. The spherical spacer deployed in the center can reduce the central reflux in the flap, and the
size of the central spacer can be adjusted according to the needs during the operation to adapt to a
variety of anatomical structures, reducing the time to change the type or model of the flap, and improving
the success rate of the operation\cite{9}. 2. K-Clip Tricuspid valve Repair System. By simulating the surgical
Kay repair procedure\cite{10}, a clamping device is implanted in the posterior tricuspid valve ring via jugular
approach, reducing the posterior tricuspid valve ring to reduce the feasibility and safety of TR(Tricuspid
Regurgitation) demonstrated in early animal trials, and K-Clip is expected to be a novel device for
valvuloplasty to help patients with severe TR at high surgical risk\cite{11}. 3. Lu X-Valve is an in situ
interventional tricuspid valve replacement device independently developed in China, which is fixed by
anterior valve clamping key and ventricular septal anchoring needle to avoid damage to the structure
around the valve ring. 46 TR patients who could not receive surgery were included in the preliminary
clinical trial, and the success rate of surgery was 97.8%. All the implanted valves were in place, and the
mortality rate was 17.4% at the follow-up 6 months after surgery. The remaining 38 patients had valve in
place, and the symptoms of most patients were significantly improved, and peripheral edema and ascites
were significantly reduced\cite{12,13}; this is also the procedure adopted by the patient in this case.

To sum up, these patients with severe tricuspid insufficiency often have high mortality and complications
due to terrible somatic condition and low cardiac function, and the treatment of these patients is an
intractable problem in cardiac surgery\cite{14}. Transcatheter interventional treatment of tricuspid valve
lesions, with little trauma, quick recovery, wide indications, the advantages of this technology in China has
developed rapidly in recent years. Existing transcatheter devices for the treatment of tricuspid valve
disease have their own limitations in clinical application, and there is a lack of targeted follow-up
evaluation. We think that in this case, for the patient who already had left heart valve surgery and then
developed severe tricuspid valve disease, the adoption of the transcatheter tricuspid valve therapy is
constructive. In addition, we found in clinical work that MRI has certain advantages in the review after
cardiac valve surgery. Not only does it not require angiogram agents, but it can do fluid imaging. The
morphology and structure of the replaced valve were also evaluated more accurately via postoperative
MRI examination. We consider that reexamination, especially MRI examination, combined CT with color
doppler echocardiography, that is positive significance for postoperative comprehensive evaluation of
replaced tricuspid valve. It is hoped to provide some new ideas for auxiliary examination after cardiac
valve operation.

**Declarations**

**Ethical Approval**

Ethical approval is not required for this Case report. Written informed consent was obtained from the
patient.

**Competing interests**
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. All authors have no conflicts of interest to declare.

**Authors’ contributions**

All authors made a significant contribution to the work reported, whether that is in the study design, execution, acquisition of image, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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**Availability of data and materials**

Data sharing is not applicable to this case report as no datasets were generated or analyzed during the current study.

**References**


**Table 1**

<table>
<thead>
<tr>
<th>Before and after transcatheter tricuspid valve replacement</th>
<th>Pre-operation</th>
<th>Postoperation in 3 months</th>
<th>Postoperation in half a year</th>
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<td>ALB</td>
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<td>32.2g/L</td>
<td>37.1g/L</td>
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<tr>
<td>ALT</td>
<td>96U/L</td>
<td>68U/L</td>
<td>52U/L</td>
</tr>
</tbody>
</table>

**Figures**
Figure 1

Preoperative heart color ultrasound, in the arteriovenous phase, severe tricuspid regurgitation can be seen.

Figure 2

At four months after surgery heart color ultrasound, in the arteriovenous phase, the effective descent of tricuspid regurgitation can be seen.
Figure 3

At half a year after surgery chest MRI. We used MRI to review the valve status of patients undergoing tricuspid valve replacement via transcatheter. As it can see, in MRI, the different cross section of the heart are shown that the shape and structure.

Figure 4
At half a year after surgery, chest CT features that the shape and structure of the replaced tricuspid valve has not changed dramatically, and the structure and position are normal.