Predictors of Tricuspid Valve Anulus Dilation in a Heart Recipient Population

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ABSTRACT

Background. Tricuspid valve regurgitation in reported in >20% of heart recipients. It severity has not only clinical impact, but it is also associated with increased mortality. Risk factors for developing tricuspid valve dysfunction include allograft rejection, donor/recipient pericardial cavity mismatch, preoperative transpulmonary gradient and vascular resistance, biatrial anastomosis technique, and biopsy-induced injury. Tricuspid valve annulus distention is reported to causative factor for most common type of tricuspid valve dysfunction after heart transplantation. The aim of the study was to estimate possible early predictors for tricuspid valve regurgitation after orthotopic heart transplantation performed with standard Lower-Shumway technique on magnetic resonance imaging studies.

Methods. A total of 20 patients (18 men and 2 women) with a mean age of 45 ± 12 years were enrolled into the study. Echocardiographic evaluation followed by magnetic resonance studies were performed. The mean duration from time of transplantation was 34 ± 12 months. Magnetic resonance and echocardiographic imaging focused on tricuspid valve annulus diameter and atrium dimensions.

Results. The was a progressive distension of tricuspid valve annulus observed during the follow-up period. Mean tricuspid valve diameter increased from 3.0 ± 0.3 to 3.34 ± 0.3 mm ($P < .05$). There was a positive correlation observed between recipient native right atrium and overall right atrium diameter and tricuspid valve diameter distension.

Conclusions. Overall right atrium diameter and native recipient right atrium diameter were found to be a risk factor for tricuspid valve annulus distension.

TRICUSPID VALVE REGURGITATION in reported in >20% of heart recipients [1,2]. It severity has not only clinical impact, but also is associated with increased mortality [3]. Geometric distortion of tricuspid ring causes functional regurgitation. Risk factors for developing tricuspid valve dysfunction include allograft rejection, donor/recipient pericardial cavity mismatch, preoperative transpulmonary gradient and vascular resistance, biatrial anastomosis technique, and biopsy-induced [4–7].

Tricuspid valve regurgitation may progress within time after transplantation secondary to chamber dilation. The natural history of tricuspid valve leaflets coaptation ameliorates for ≤36 months after transplantation. Progressive deterioration is described thereafter. One of the most accepted explanations of tricuspid regurgitation is related to chordal damage secondary to repeated endomyocardial biopsies [8].

The aim of the study was to estimate possible early predictors for tricuspid valve regurgitation after orthotropic

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heart transplantation performed with standard Lower-Shumway (biatrial) technique on magnetic resonance imaging.

METHODS

Twenty patients (18 men and 2 women) with a mean age of 45 ± 12 years were enrolled into the study. All patients were transplanted with Lower-Shumway (biatrial) technique. Preservation methods included cold crystalloid cardioplegia (Custadiol HTK solution) and topical cooling. Triple-drug immunosuppressive therapy including tacrolimus, mycophenolate mofetil, and prednisolone were used in all patients for first years after procedure and double-drug therapy including tacrolimus and mycophenolate mofetil was continued thereafter. Owing to preoperative kidney dysfunction, induction therapy including basiliximab (Simulect, Novartis Pharmaceutical Corp) was applied in 9 cases.

Surveillance endomyocardial biopsies were scheduled weekly within first month after surgery, every 2 week after 2 months, and monthly for 4 months. Protocol endomyocardial biopsies were performed at 9 months and 1 year after the procedure.

Repeat 2-dimentional echocardiography imaging studies were performed routinely on the same day as endomyocardial biopsies were performed. All patients underwent echocardiographic examination while in the left lateral decubitus position in quiet respiration after 5 minutes rest. The tricuspid valve was examined in the parasternal short axis and apical 4-chamber views.

Magnetic resonance imaging (MRI) studies were performed during postoperative follow-up of 34 ± 12 months. Cardiovascular MR examination was performed on a 1.5-Tesla scanner with the use of a 6-channel phased-array body coil combined with a 6-channel spine matrix coil.

Statistical Analysis

The relationship between analyzed parameters was assessed by Pearson's linear correlation coefficient. The assumption of data compliance with the normal distribution was checked the Shapiro-Wilk test. The significance of assessed coefficients was tested by the Student *t* test. Tests were considered significant at $P < .05$. The analysis was performed with the use of statistical package Statistica (StatSoft, Inc.).

RESULTS

There were no deaths or acute rejection episodes observed in the study group population during follow-up. Good graft function during the follow-up period was the inclusion criterion. All patients remained clinically stable and enjoyed normal life. There were New York Heart Association functional class I (16 patients) and II (4 patients).

At a mean time of 34 ± 12 months after surgery, good tricuspid valve function with good leaflets coaptation was observed. Although in 3 cases in early postoperative mild to moderate tricuspid regurgitation was diagnosed, no regurgitation was observed in latter period. There was a significant dilatation of tricuspid valve annulus noticed throughout the study period. It distended from 3.0 ± 0.3 to 3.4 ± 0.3 cm ($P < .05$) 3 years after heart transplantation. Detailed data are presented in Table 1. There was no correlation found between tricuspid valve annulus distension and donor and recipient height (172 ± 6 vs 176 ± 6 cm) or weight (74 ± 8 vs 78 ± 7 kg).

Table 1. Magnetic Resonance and Echocardiographic Imaging Results (n = 20)

Parameters	Mean ± SD
Right atrium diameters (area)	
Overall area (cm^2)	26.03 ± 5.26
Donor atrium area (cm^2)	19.28 ± 4.1
Native atrium area (cm^2)	7.21 ± 3.00
Tricuspid valve annulus	
1 month after surgery (mm)	3.0 ± 0.3
3 years after surgery (mm)	3.34 ± 0.30
Right ventricle parameters	
End-diastolic volume (mL)	120 ± 21
End-systolic volume (mL)	49 ± 14
Ejection fraction (%)	69 ± 11
Right atrium diameters (area)	
Overall area (cm^2)	26.80 ± 7.51
Donor atrium area (cm^2)	20.43 ± 7.18
Native atrium area (cm^2)	7.12 ± 1.90
Right ventricle parameters	
End-diastolic volume (mL)	113 ± 17
End-systolic volume (mL)	47 ± 11
Ejection fraction (%)	61 ± 8

On MRI performed 34 ± 12 months after surgery, mean left atrium area was 27 ± 8 mm^2. The overall right atrial diameter was 26 ± 5 mm^2 and it was composed of 7.21 ± 3.01 mm^2 native atrium and 19.28 ± 4.10 mm^2 of donor atrium. On MRI, the left ventricular end-diastolic volume was 113 ± 17 mm^3 and end-systolic volume was 47 ± 11 mm^3. The left ventricular ejection fraction was 61 ± 8%. On MRI, the right ventricular end-diastolic volume was 120 ± 21 mm^3 and the end-systolic volume was 63 ± 9 mm^3. The right ventricular ejection fraction was 69 ± 11%.

Bases on echocardiographic studies and MRI, we found a positive correlation between recipient native right atrium and overall right atrium diameters and tricuspid valve distention during postoperative follow-up (Figs 1 and 2).

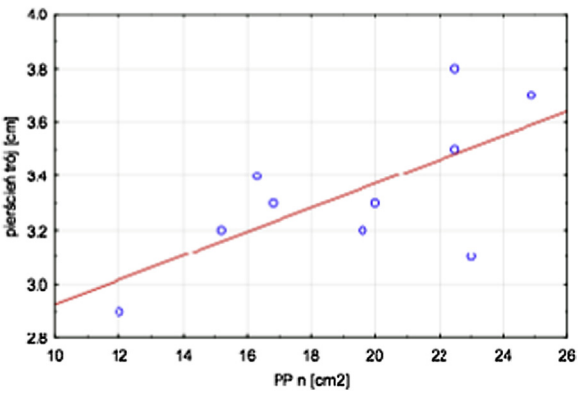

Fig 1. Correlation between tricuspid valve annulus diameter (*y* axis) and native right atrium area (*x* axis).