

The Three-dimensional Morphological Changes of tricuspid Valve in Children after Transcatheter Closure of Atrial Septal Defect

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Background: The closure of secundum type atrial septal defect (ASD) provides an decrease and normalization of originally volume overloaded right ventricular (RV) volume in ASD patients. However, three-dimensional (3D) morphological change of tricuspid valve (TV) remains unclear by this change of RV volume coming along with ASD transcatheter closure.

Objectives: The purpose of this study is to characterize the 3D morphology of TV in ASD patients comparing to those in normal subjects and to assess the 3D geometric change of TV by ASD closure, using real-time 3D echocardiography.

Methods: 11 children underwent ASD transcatheter closure with Amplatz septal occluder (ASO) (age: 8.3 ± 3.6 , Qp/Qs: 2.4 ± 0.6). Their RV full-volume data of 3D echocardiography were recorded on hard disk by iE33 (Phillips Healthcare, Andover, MA) with X7-2 and X3-1 probe, before ASO, at one to 3 days and 6-12 months after ASO, respectively. The right ventricular dimension was measured with conventional 2D images. Tricuspid 3D morphology were analyzed and quantified by the off-line analyzing software: REALVIEW® (YD Ltd., Osaka, Japan) after obtaining 3D volume data by QLAB (Phillips). We measured annular area (AA) and circumference (AC), maximum tenting length (TeL), tenting volume (TeV), tenting area (TeA) at mid-systole, and compared those before and after ASO. These values were compared with those of age-matched normal controls (10 cases), after correction by body surface area.

Results: ASD patients before ASO had larger TeV and TeA than controls (0.81 ± 0.4 vs. $0.54 \pm 0.3 \text{ cm}^3/\text{m}^2$, 7 ± 1.5 vs. $5.4 \pm 1.2 \text{ cm}^2/\text{m}^2$, $p < 0.01$). Comparing values before and after ASD closure, AA, AC and TeA were significantly decreased at 6-12 months after ASO (AA: 5.7 ± 1.3 vs $4.1 \pm 0.9 \text{ m}^2/2$, TeA: 7.0 ± 1.5 vs $5.1 \pm 1.1 \text{ cm}^2/2$, $p < 0.05$). The other TeL and TeV were also decreased at long after ASO but statistically not significant.

Conclusions: Children with ASD demonstrate larger TeV and TeA than normal because of the enlargement of TV annulus and leaflet. Comparing values before and after ASO, an decrease of all 3D morphometric parameters of TV, (especially AA, AC, and TeA) was presented after ASO as reduced RV volume. Since TeL and TeV shows no significant change, these changes of TV shape may improve coaptation of TV valve and reduce tricuspid regurgitation.