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Geometric and Functional Change of Both Ventricles after Atrial Ventricular Septal Defect Closure

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The secundum type atrial septal defect (ASD) is a relatively common congenital heart defect. The long-standing left to right shunt causes right ventricular (RV) volume overload and pulmonary vascular changes resulting in later RV pressure overload. Also it causes and results in reduced left ventricular (LV) preload, leading to a decrease in cardiac output. Therefore, in patients with significant ASD shunts, the RV chamber distends and the septum deviates toward the LV, resulting in a compressed LV. Transcatheter or surgical closure of the defect causes reverse remodeling of the both ventricles. However, such adaptation may take long time and can be in completion in adult patients.

Standard echocardiographic studies in ASD patients showed higher RV dimensions with lower LV dimensions.[1] Also higher global RV systolic function indices such as tricuspid annular plane systolic excursion (TAPSE) and RV ejection fraction (EF) were reported in ASD patients. After ASD closure, the RV shrink and the LV expand dramatically in 24 hours and show further change slowly after that time. Neither show further significant diameter change after 1 month.[2] All of the RV systolic functional parameters including TAPSE, RVEF RV fractional area change and RV myocardial performance index were worsened immediately after the closure, and improved again at first month follow-up. This biphasic change by time may be due to a delayed change in RV mass in the face of acute volume reduction. Assessment of the RV function in ASD patients remained difficult as conventional echocardiographic parameters such as EF, which may not represent the contractility of a dilated, volume and pressure overloaded RV.

Myocardial deformation parameters such as strain and strain rate are closely related to the intrinsic myocardial contractility and allow regional function analysis.[3] Interestingly, previous studies shows that there are some regional differences regarding the extent and the time course of deformational changes.[2] The regional heterogeneity in RV wall thickness and curvature may explain some of the variance in RV regional deformation.

In ASD patients, RV lateral longitudinal strain is higher and RV septal strain is similar (or slightly higher) compared with healthy controls.[2][4][5] The difference between the septal and lateral wall deformation can be explained with the fact that 2 dimensional speckle tracking could not distinguish between right sided and left sided component of the septum. However, there is no difference of strain rate in ASD patients compared with healthy controls and this finding has demonstrated in some studies,[3][6][7] that systolic strain rate is mainly related to the change in contractility, whereas systolic strain primarily determined by the stroke volume and more dependent on volume overload. After the closure, strain and strain rate of most segments excluding apical lateral segment decrease immediately.

Transcatheter device closure, an attractive alternative to cardiac surgery, has been increasingly performed and offered as a primary therapy for the secundum ASD. Also it is good for evaluation the pure effect excluding cardiopulmonary bypass effect regarding to volume unloading after ASD closure.

Lower apical strain values shows strong correlation with systolic pulmonary arterial pressure and global RV systolic function indices. The prognostic value of changes in systolic strain over time was notable especially in patients with severe pulmonary arterial hypertension.[8] An individual improvement > 5% in RV strain at follow-up was correlated with better pulmonary hemodynamics, improved clinical status, and less evidence of right heart failures, and it also predicted greater long-term survival that was incremental over clinical factors and choice

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of therapy.

Rare data are available on the impact of ASD closure on LV deformation. LV systolic twist was significantly reduced in patients with ASD mainly due to the heterogonous basal rotation. LV basal rotation improved significantly while apical rotation remained unchanged after transcatheter ASD closure.[9] Since the LV twist is defined as the LV apical rotation relative to the basal rotation, and the basal rotation was improved, it is observed a significant increased LV twist after ASD closure.

This study also showed similar findings that the lateral longitudinal strain of RV was higher in ASD patients and decreased after ASD closure.[10] However, in terms of regional difference, there were somewhat different compared with previous studies.

References

1. Wu ET, Akagi T, Taniguchi M, Maruo T, Sakuragi S, Otsuki S, Okamoto Y, Sano S. *Differences in right and left ventricular remodeling after transcatheter closure of atrial septal defect among adults. Catheter Cardiovasc Interv 2007;69:866-71.*
2. Eroglu E, Cakal SD, Cakal B, Dundar C, Alici G, Ozkan B, Yazicioglu MV, Tigen K, Esen AM. *Time course of right ventricular remodeling after percutaneous atrial septal defect closure: assessment of regional deformation properties with two-dimensional strain and strain rate imaging. Echocardiography 2013;30:324-30.*
3. Missant C, Rex S, Claus P, Mertens L, Wouters PF. *Load-sensitivity of regional tissue deformation in the right ventricle: isovolumic versus ejection-phase indices of contractility. Heart 2008;94:e15.*
4. Jategaonkar SR, Scholtz W, Butz T, Bogunovic N, Faber L, Horstkotte D. *Two-dimensional strain and strain rate imaging of the right ventricle in adult patients before and after percutaneous closure of atrial septal defects. Eur J Echocardiogr 2009;10:499-502.*
5. Bussadori C, Oliveira P, Arcidiacono C, Saracino A, Nicolosi E, Negura D, Piazza L, Micheletti A, Chessa M, Butera G, Dua JS, Carminati M. *Right and left ventricular strain and strain rate in young adults before and after percutaneous atrial septal defect closure. Echocardiography 2011;28:730-7.*
6. Weidemann F, Jamal F, Sutherland GR, Claus P, Kowalski M, Hatle L, De Scheerder I, Bijnens B, Rademakers FE. *Myocardial function defined by strain rate and strain during alterations in inotropic states and heart rate. Am J Physiol Heart Circ Physiol 2002;283:H792-9.*
7. Jamal F, Bergerot C, Argaud L, Loufouat J, Ovize M. *Longitudinal strain quantitates regional right ventricular contractile function. Am J Physiol Heart Circ Physiol 2003;285:H2842-7.*
8. Hardegree EL, Sachdev A, Villarraga HR, Frantz RP, McGoon MD, Kushwaha SS, Hsiao JF, McCully RB, Oh JK, Pellikka PA, Kane GC. *Role of serial quantitative assessment of right ventricular function by strain in pulmonary arterial hypertension. Am J Cardiol 2013;111:143-8.*
9. Dong L, Zhang F, Shu X, Zhou D, Guan L, Pan C, Chen H. *Left ventricular torsional deformation in patients undergoing transcatheter closure of secundum atrial septal defect. Int J Cardiovasc Imaging 2009;25:479-86.*
10. Ko HK, Yu JJ, Cho EK, Kang SY, Seo CD, Baek JS, Kim YH, Ko JK. *Segmental analysis of right ventricular longitudinal deformation in children before and after percutaneous closure of atrial septal defect. J Cardiovasc Ultrasound 2014;22:182-8.*