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Role of Strain Echocardiography in Severe Aortic Stenosis with Preserved left Ventricular Function

Cardiology

KEYWORDS:

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ABSTRACT

Background : AS is one of the more common valvular heart disease .Prognosis is heavily dependent upon presence of LV(Left Ventricular) dysfunction .Strain echocardiography can detect early LV dysfunction even when conventional methods fail

Methods: All patients between the age of 18 to 80 with isolated severe aortic stenosis were included with diverse etiologies-Rheumatic, Degenerative and bicuspid aortic valve without significant involvement of other valves underwent clinical and echocardiographic examination and those who underwent AVR (aortic Valve Replacement)were also studied

Results : Total 45 patients were recruited .23 of whom underwent AVR . 23 were having degenerative ,15 had rheumatic etiology and 7 bicuspid Post AVR (Aortic Valve Replacement)there was a statically significant improvement in strain Parameters and LV mass (indexed) GLS global longitudinal strain averaged improved from 12.65 to 19.12 ($p<0.02$) LV mass regression with average mass of 153 +-5 to 129+-7 post AVR

*Conclusions :In isolated severe aortic stenosis of varying etiology Strain echocardiography plays an important role in early detection of LV dysfunction and adds prognostic valve after AVR. *

Introduction: Aortic stenosis is one of the commoner valvular heart diseases which affects diverse age groups and all races .The various etiologies are Congenital Bicuspid ,Rheumatic and degenerative .The management depends upon severity of aortic stenosis and symptoms (Angina, dyspnea and syncope) AVR (Aortic valve replacement) is the only therapeutic option. There is a huge difference in terms of mortality when AVR is done in those with preserved Left Ventricular junction and those with impaired ventricular function.

Chronic pressure overload imposed on Left ventricle causes increased mid wall stress which leads to LV hypertrophy ,however with disease progression when the mid wall stress keeps on increasing further and lv hypertrophy cannot adapt to LV stree, it leads to derangement in LV function due to impairment in LV geometry and performance changes. At that stage, AVR can reverse the LV hypertrophy and improve LV systolic performance and clinical outcome. Detection of subtle changes in LV systolic function (when LVEF is still preserved) may help in an earlier patient referral for AVR.

Strain imaging has demonstrated to be the most appropriate method to evaluate LV myocardial contractility properties and, accordingly, may enable a better characterization of subtle changes in LV performance in severe AS patients. Two dimensional speckle-tracking strain (2D-STI) imaging allows the angle-independent evaluation of myocardial strain and strain rate (Longitudinal). In addition effect of AVR in these strain parameters is currently unknown

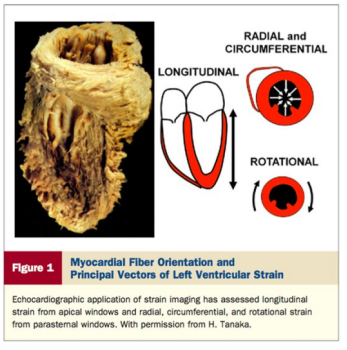

Figure 1 Myocardial Fiber Orientation and Principal Vectors of Left Ventricular Strain

Echocardiographic application of strain imaging has assessed longitudinal strain from apical windows and radial, circumferential, and rotational strain from parasternal windows. With permission from H. Tanaka.

Methods:

Study population and study protocol

All patients with severe aortic stenosis(Aortic Valve area < 1 cm2) of all etiologies (rheumatic ,bicuspid and between the age of 18 to 80 years of age.They should have minimal involvement of other valves

All patients were assessed echocardiographically at baseline with clinical as sessment as well

These patients were followed for a median one year and 23 of them underwent aortic valve replacement

Again echocardiographic assessment along with strain echocardiography was carried out.

Strain echocardiography was carried out using longitudinal strain in GE machine done by a single operator.

Statistical analysis: Normal distribution of continuous variables was assessed with the Kolmogorov– Smirnov test. Continuous variables are expressed as Mean + standard deviation unless otherwise noted. Categorical data are expressed as numbers and percentages. Comparisons between baseline and follow-up were performed with

two-sided Student's t-test and Wilcoxon signed rank test for paired continuous data (normal and skewed data, respectively) and McNemar test for paired

categorical data. Comparisons between healthy controls, hypertensive patients with LV hypertrophy, and AS patients at baseline were performed by one-way analysis of the variance (ANOVA) and Kruskal– Wallis test, as appropriate. Afterwards,post hocanalysis was applied to adjust for inflation of the type I error with multiple tests. In addition, S-and-SR data in AS patients (before and at follow-up after AVR) and in controls were compared using the two-sided Student's t-test for unpaired data. Linear regression analysis was used to test the relationship between changes in LV S-and-SR and changes in LV mass and LV
afterload.

Intra- and interobserver reproducibility of S-and-SR measurements by 2D-STI analysis was determined by intraclass correlation coefficient and Bland– Altman analysis.(22) Intraobserver reproducibility was determined by repeating the S-and-SR measurements by one experienced reader in 25 randomly selected patients.

A second, blinded experienced reader performed the strain analysis in the same 25 patients, providing the interobserver reproducibility data. All statistical analyses were performed with SPSS software (version 15.0, SPSS Inc., Chicago, IL, USA). AP-value ,0.05 was considered statistically significant.

Results : Overall 45 patients were assessed out of whom 28 were males and and 17 were females

Baseline echocardiographic variables of all patients are given in Table 1

All patients had a significant increase their Left ventricle masses 162+- 7.1 .There is significant increase in mean and peak gradients .It was observed that post AVR there was a significant improvement in strain parameters .

Parameters	
LVEF	62 +-2
LV End systolic volume	117 +-3.2
LV Enddiastolic volume	54+-1.9
BSA(m2)	1.76+-.09
LV mass index	162+_7.1
E/e '	21+-1.9
Aortic valve Area	0.75=-0.08
Δ P peak	69+-1.8
Δ p mean	45+-3.4

23 of these patients underwent AVR and comparison between pre and post characteristics are given in table 2 as follows There is a significant improvement in longitudinal strain pre and post AVR 12.65+-0.8 increased to 16.15+-1.5 which is significant (p<0.04).There was also a statistically signicficant fall in LV mass index from 153+-6.8 to 129+-3.5 .(p<0.03)

	Pre AVR	Post AVR
LVEF	60.59 +- 1.6	63 +-1.5
Longitudinal Strain (%)	12.65+-0.8	16.12+-1.5
LV mass index	153+-6.8	129+-3.5
Δ P peak	76+-9.8	32+-2.8
Δ P mean	45+-1.2	11+-0.8

Discussion : The main finding of our study was that strain indices can be impaired patients with normal EF (Ejection fraction) however when patients are treated with Aortic valve replacement there is a significant improvement in these strain parameters as well.

It is well known that patients with aortic stenosis have reduced LV longitudinal systolic function despite normal LVEF (12-16). In hypertension it has been demonstrated that afterload per se affects longitudinal systolic function with a compensatory increased contribution to ventricular emptying from radial LV fibres thereby maintaining LVEF. In the present study this understanding was extended to patients with AS where we found GLS was associated with global LV afterload after adjustment for confounders. This finding agrees with the findings of Miyazaki et al. who demonstrated that GLS actually decreased as the Aortic stenosis severity increased.

The study demonstrated that GLS was dependent on LV hypertrophy and LV geometry, a finding that correlates well with previous studies, which have demonstrated that postoperative improvement in longitudinal systolic function is dependent on regression of LV hypertrophy. The mechanism is probably increased oxygen consumption of the hypertrophied LV. he increased levels of NTpro-BNP, higher E/e' and increased LAVi in patients with decreased GLS suggest that patients would have had a longer duration of heart failure symptoms prior to surgery, this was however not the case and further questions the unambiguity of symptom estimation. This is further challenged by the increased mortality/morbidity seen in patients with reduced global strain, as this suggests that surgery should be considered before the development of symptoms has occurred. Although not demonstrated in a randomized setting, the benefit of early surgery has been suggested in a study of 622 asymptomatic patients with AS, in whom survival was improved in those having AVR(25), even in patients who remained asymptomatic. The benefit of early surgery has further been suggested in a recent, small randomized study . Larger studies are though warranted.

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