中文題目:左心房形變在嚴重器質性二尖瓣逆流患者之心功能分級及預後預測的應用

英文題目: Left atrial deformation links to functional capacity and predicts prognosis in

severe primary mitral regurgitation

作者: 楊荔丹 [1] 施志遠 [2] 劉嚴文 [1] 李貽恆 [1] 蔡良敏 [1] 陳志鴻 [1] 羅傳堯 [3] 蔡惟全 [1]

服務單位: 成大醫院內科 [1] 永康奇美醫院內科 [2] 成大醫院外科 [3]

Background: Among the patients with significant valve disease undergoing surgery, severe

primary mitral regurgitation (MR) is the leading cause in western countries. The timing of

surgery for chronic severe MR is critical, with the symptom of heart failure being the most

important determinant for prognosis and currently a major indication for surgery. Cardiac

remodeling due to chronic MR affects both left atrium (LA) and left ventricle (LV). LV

enlargement and dysfunction are well known poor prognostic factors and cause severe

symptoms. However, the role of LA remodeling represented by strain and strain rate on

functional capacity and the prognostic effects has been little studied in chronic primary MR. A

novel method using 2-dimensional (2D) speckle tracking echocardiography (STE) for LA

deformation analysis by measuring longitudinal strain and strain rate is feasible clinically. We

hypothesized that LA dysfunction caused by LA remodeling plays a role in the occurrence of

heart failure symptoms and impacts the prognosis in patients with chronic severe MR. The

aim of this study was to investigate the effects of LA deformation by 2D STE on the

functional capacity and prognosis in this population.

Methods: A total of 136 consecutive patients with chronic severe primary MR and a preserved LV systolic function (LVEF$\geqq$ 55%) in the outpatient clinic who were referred for an echocardiography examination were screened. The exclusion criteria were (1) MR secondary to a dilated LV and LV dysfunction (functional MR), (2) ischemic MR, (3) presence of significant valvular heart disease other than MR (including mitral stenosis and aortic regurgitation or stenosis), (4) congenital heart disease, (5) previous history of cardiac surgery for mitral valve, and (6) inadequate or incomplete echocardiography images. The remaining 110 patients (mean age 57±16 years, 55% men) with severe primary MR formed our study group. Symptoms of heart failure were classified by using the New York Heart Association (NYHA) functional classification. Global peak LA longitudinal strain (LASp), peak strain rate in reservoir phase (LASRr), and in conduit phase (LASRc) were identified using the 2D STE.

Results: There were 35 (32%) patients classified in NYHA I, 62 (56%) in NYHA II, and 13 (12%) in NYHA III. LASp (29.9±8.9, 25.2±10.1, 18.8±6.4 %; p = 0.002), LASRr (2.5±0.5, 2.3±0.7, 2.0±0.8 s^{-1}; p = 0.055), and LASRc (-2.4±0.7, -2.1±0.8, -1.7±0.5 s^{-1}, p = 0.015) as well as age, presence of atrial fibrillation (AF), LV mass index, and estimated pulmonary artery systolic pressure were relevant to stepwise decline in NYHA functional class (I to III). After multivariate analysis, only LASp (OR 0.891, 95%CI 0.796-0.997, p = 0.044) was

independently associated with severe HF symptoms (NYHA III). Age (OR 1.081, 95%CI 1.033-1.132, p = 0.001) and diabetes mellitus (OR 10.379, 95% CI 1.008- 106.83, p = 0.049) significantly correlated with decreased LASp. Among a total of 97 asymptomatic or mildly symptomatic (NYHA I or II) severe primary MR patients (54.6% men, 56±16 years), 20 (20%) patients reached the composite end-points (heart failure progression or admission, new AF, stroke, mitral valve repair or replacement) after a mean follow-up period of 8.4 ± 7.8 months. LV end-systolic dimension (3.5 ± 0.5 vs. 3.3 ± 0.5 cm; p = 0.07), early trans-mitral velocity to tissue Doppler mitral annular early diastolic velocity ratio (E/e') (13.4 ± 4.6 vs. 11.2 ± 3.6; p = 0.028), LASp (23.6 ± 9.4 vs. 27.7 ± 9.9 %; p = 0.098) and LASRc (-1.9 ± 0.6 vs. -2.2 ± 0.8 1/s; p = 0.092) were different between patients with and without end-points. After Cox regression analysis controlling AF status, only LASp (OR 0.93, 95% CI 0.876-0.993, p = 0.029) was independent factor for the occurrence of end-points. By dividing subjects into 2 groups with equal patient numbers (cutoff values LASp 25.4 %), the Kaplan-Meier survival curves showed significant differences in terms of the composite endpoints.

Conclusions: In patients with chronic severe MR, LASp linked to the severity of HF symptoms. Age and diabetes mellitus contributed to a decreased LASp. As for those patients without significant symptoms, reduced LASp was correlated with worse prognosis.

Table 1. Clinical characteristics of the study population

	Total N = 110	NYHA I N = 35	NYHA II N = 62	NYHA III N = 13	p-value
Age (years)	57.3±16.5	50.2±13.4	59.7±17.0	64.8±6.1	0.004
Male	60 (54.5%)	24 (68.6%)	29 (46.8%)	7 (53.8%)	0.117
HR (beats/min)	76.0±17.3	72.1±14.6	74.5±12.6	93.2±30.4	0.347
Hypertension	73 (66)	17 (49)	45 (73)	11 (85)	0.019
Diabetes mellitus	12 (11)	1(3)	10(16)	1 (8)	0.122
Atrial fibrillation	12 (11)	0 (0)	8(13)	4 (31)	0.007
Prevalent CAD	7 (6)	1 (3)	5 (8)	1 (8)	0.442
Current smoker	12 (11)	4 (11)	5 (8)	3 (23)	0.298
Hyperlipidemia	43 (39)	12 (34)	24 (39)	7 (54)	0.341

HR = heart rate; NYHA = New York Heart Association functional classification; CAD = coronary artery disease

Data are expressed as mean ± SD or number (%).

Table 4. Predicting factors for severe heart failure symptoms (NYHA III)

	Odds ratio	95% confidence interval	*p* value
LASp	0.891	0.796- 0.997	0.044

LASRf	0.591	0.210- 1.660	0.318
LASRc	3.178	0.878- 11.495	0.078
LVMi	1.020	0.999- 1.041	0.059
PASP	1.020	0.991- 1.050	0.183
Hypertension	0.467	0.078-2.801	0.405

*adjusted for age and status of atrial fibrillation

NYHA = New York Heart Association functional classification; LASp = peak positive strain of left atrium; LASRf = strain rate in left atrial filling phase; LASRc = strain rate in left atrial conduit phase; LVMi = left ventricular mass index; PASP = pulmonary arterial systolic pressure.

Table 5. Predicting factors for a low LASp*

	Odds ratio	95% confidence interval	p value
Atrial fibrillation	1.947	0.286- 13.256	0.496
Age	1.081	1.033- 1.132	0.001
Hypertension	2.897	0.881- 9.523	0.080
Diabetes mellitus	10.379	1.008- 106.832	0.049
LVMi	.979	0.957- 1.002	0.068
LAVi	1.018	0.983- 1.054	0.318

*Low LASp was defined as lower than the median level (23.9%).

LASp = peak positive strain of left atrium; LVMi = left ventricular mass index; LAVi = left

atrial volume index.

Figure 1. The Predicting Power of LASp in the Stepwise Decline of NYHA Functional Class.
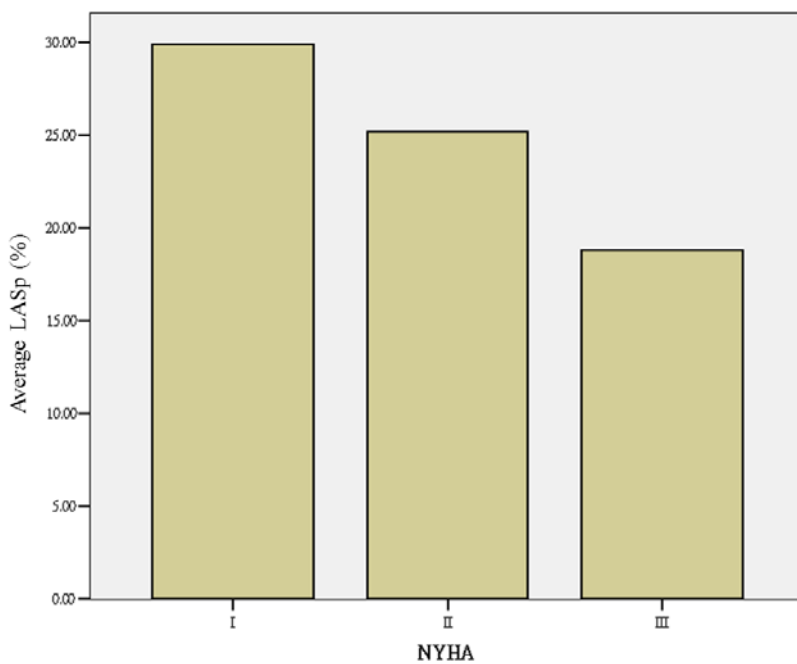

Figure 2. The Kaplan-Meier survival curves showed significant differences in terms of the

composite endpoints.

Kaplan-Meier survival curves

LASp $\geqq$ 25.4%

LASp < 25.4%

Cumulative survival

Time to end-points (months)