Strain of the Left Ventricular Myocardium by 2D Speckle Tracking Echocardiography Predicts Cardiac Events and Mortality in Patients with Advanced Chronic Kidney Disease; a 3–year follow–up Study.

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The authors have no financial conflicts of interest to disclose concerning the presentation.
Background-1

Left ventricular (LV) dysfunction is one of the major determinants for prognosis in patients with chronic kidney disease (CKD).

*NEJM 2004, 351; Alan S. Go et al.*
Recent echocardiographic studies have shown that **strain** analysis of the myocardium is a very sensitive method for predicting clinical outcomes in various heart diseases.

Coronary artery disease; *Circulation: Cardiovascular Imaging* 2011;4
Mitral regurgitation; *Eur Heart Journal Cardiovascular Imaging* 2012 Jul
Aortic stenosis; *Eur Heart Journal Cardiovascular Imaging* 2012 Jun
Transplant heart; *J Am Soc Echocardiogr.* 2012 Jun

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Aim

We sought to clarify prognostic value of the peak systolic strain of the LV myocardium in patients with advanced CKD.
Patients

37 patients with advanced CKD on HD

Mean age, 68 ± 14 years old.

Men, n = 23/ Women, n = 14

All patients underwent echocardiography at the time of enrollment.
Methods

Echocardiography

LVM (left ventricular mass)/BSA

LV EDV (end-diastolic volume)/BSA

LV EF (ejection fraction)

CI (cardiac index)

Strain imaging
LV Peak Systolic Strain by 2D Speckle Tracking
LV Peak Systolic Strain by 2D Speckle Tracking
LV Peak Systolic Strain by 2D Speckle Tracking

2D Speckle Tracking

Longitudinal Strain Curve in Each Segment
LV Peak Systolic Strain by 2D Speckle Tracking

2D Speckle Tracking

Peak Systolic Strain

Longitudinal Strain Curve in Each Segment
LV Peak Systolic Strain by 2D Speckle Tracking

2D Speckle Tracking

Peak Systolic Strain

Longitudinal Strain Curve in Each Segment

Red Color = Good Strain
Bull’s Eye Map of the LV Peak Systolic Strain in Each 17 Segment
Bull’s Eye Map

Peak systolic strain in each 17 segment of the LV myocardium is depicted as color code from the base to the apex circumferentially.
Follow-up and End Point

All patients were followed up for more than 3 years.

Primary end point was any of the cardiac events (CHF, sudden death, AMI, UAP, PCI, CABG).

At the end point we compared all echocardiographic parameters at enrollment between the patients with cardiac events and those without it.

Among the patients with fair LV strain and those with reduced LV strain, Kaplan–Meier analysis of cardiac event and all–cause mortality were analyzed.
Cardiac Event Free-Survival Rate at 3-year Follow-up

No cardiac event
N = 17 (46%)

Cardiac event
N = 20 (54%)

Mean follow up period was 1242 ± 325 days.
Comparison of Baseline Demographic Characteristics between Advanced CKD Patients with and without Cardiac Events

<table>
<thead>
<tr>
<th></th>
<th>No cardiac event</th>
<th>Cardiac event</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years old)</td>
<td>68.0 ± 14.3</td>
<td>68.5 ± 13.2</td>
<td>NS</td>
</tr>
<tr>
<td>Gender (male/female)</td>
<td>10/7</td>
<td>13/7</td>
<td>NS</td>
</tr>
<tr>
<td>Body Surface Area (m²)</td>
<td>1.54 ± 0.16</td>
<td>1.47 ± 0.19</td>
<td>NS</td>
</tr>
<tr>
<td>Body Mass Index (Kg/m²)</td>
<td>19.8 ± 2.3</td>
<td>20.7 ± 4.2</td>
<td>NS</td>
</tr>
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</table>
Comparison of Conventional Echocardiographic Findings between Advanced CKD Patients with and without Cardiac Events

<table>
<thead>
<tr>
<th></th>
<th>No cardiac event (n = 17)</th>
<th>Cardiac event (n = 20)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVM/BSA (g/m²)</td>
<td>163 ± 38</td>
<td>185 ± 61</td>
<td>NS</td>
</tr>
<tr>
<td>LV EDV (mL)</td>
<td>133 ± 37</td>
<td>128 ± 49</td>
<td>NS</td>
</tr>
<tr>
<td>LV EF (%)</td>
<td>66 ± 11</td>
<td>63 ± 18</td>
<td>NS</td>
</tr>
<tr>
<td>Cardiac index (L/min/m²)</td>
<td>3.7 ± 0.8</td>
<td>4.2 ± 1.5</td>
<td>NS</td>
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Comparison of the Left Ventricular Systolic Strain between Advanced CKD Patients with and without Cardiac Events

- **Anteroseptum, Posterior wall (Long Axis View)**
  - No Cardiac Event: 18.3 ± 4.4%
  - Cardiac Event: 13.8 ± 4.2%

- **Septum, Lateral wall (4-Chamber View)**
  - No Cardiac Event: 17.3 ± 4.1%
  - Cardiac Event: 13.8 ± 4.7%

- **Anterior, Inferior wall (2-Chamber View)**
  - No Cardiac Event: 19.4 ± 4.1%
  - Cardiac Event: 15.1 ± 5.2%

**Statistical Significance:**
- P < 0.005
- P < 0.05
Comparison of the Global LV Systolic Strain between Advanced CKD Patients with and without Cardiac Events

- **No cardiac event**: 18.2 ± 4.3%
- **Cardiac event**: 14.0 ± 4.5%

*P < 0.001*
The Incidence of Cardiac Events in Patients with Fair LV Strain and Those with Reduced LV Strain

Incidence of Cardiac Events (%)

- 7/20 (35%) Fair LV strain
- 13/17 (76%) Reduced LV strain (strain < 14%)

p < 0.05
Kaplan–Meier Analysis of Cardiac Event with Regard to Left Ventricular Systolic Strain Obtained by 2D Speckle Tracking Echocardiography

Freedom from Cardiac Event

Days after Echocardiographic Examination

*Wilcoxon test
The Incidence of All-cause Mortality within 3 years in Patients with Fair LV Strain and Those with Reduced LV Strain

Incidence of Mortality (%)

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<tr>
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<th>Incidence [Mortality]</th>
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<tbody>
<tr>
<td>Fair LV strain</td>
<td>2/20 (10%)</td>
</tr>
<tr>
<td>Reduced LV strain</td>
<td>8/17 (47%)</td>
</tr>
</tbody>
</table>

p < 0.001

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Kaplan–Meier Analysis of Survival Rate with Regard to Left Ventricular Systolic Strain Obtained by 2D Speckle Tracking Echocardiography

P<0.001*

*Wilcoxon test
Bull’s Eye Map of the LV Peak Systolic Strain in Each 17 Segment

Control Subject

CKD patient with Cardiac Event
Conclusion

In patients with advanced CKD, systolic strain of the LV myocardium measured by 2D speckle tracking echocardiography is a more powerful predictor of clinical outcomes than the conventional echocardiographic indices.