Pulmonary Hypertension and Pulmonary Embolism: Role of Echo

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Japan

My home

Japan

U.S.A

Hawaii Island
Economy class syndrome

New seats
Case 1

- 66 Female presents with acute onset of chest pain.
- She had no medical history.
- Shortness of breath and chest pain.

2 years ago  Admission
66 y.o. female with acute onset of chest pain and pulmonary hypertension

Your recommendation is...

1. Follow up
2. Coronary angiography
3. Delayed enhancement MRI
4. Contrast CT
Case 1 summary

- Paradoxical septal motion
- McConnell's sign
- Estimated PA pressure: elevated
- Deep vein thrombus
- Pulmonary emboli

Diagnosis: Acute pulmonary embolism with deep vein thrombus

Decision

- This Patient started an anticoagulant therapy.
In the 170 people indirectly killed by the earthquake, 24% had spent one night or more in a vehicle. The 15% of these people had DVT.

New onset of DVT

Total: 51 patients
Sheltering in vehicles: 42 patients
Elder is high risk

Occurrence rate of DVT

Days after the earthquake

Occurrence rate of DVT
Risk factors of DVT in Kumamoto

- Age (>70 years old)
- Use of sleeping pill
- Leg swelling

Occurrence rate of DVT

Echo – Early in the management of PE and PH

2014 ESC guideline for PE
Summary (1)

- Sheltering a vehicle is a risk of DVT, we always check the history of patients.
- Age (>70 years old), use of sleeping pill and leg swelling were risk factors of DVT in the earthquake situation.
- We need a screening test using echocardiography in patients with any high risk.
Echocardiographic assessment in PH

- Pulmonary arterial pressure (PAP)
- RV size
- RV function

Estimation of systolic PAP

\[
TRPG = 4 \times TR-V^2
\]

\[
RVSP = TRPG + RAP
\]

Without PS: PASP = RVSP
Sniff test

“Take several quick, short sniff, as if you have a stuffy nose.”

Klein and Garcia, Diastology

<table>
<thead>
<tr>
<th>IVC size (mm)</th>
<th>Sniffing % collapse</th>
<th>RA pressure (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 21</td>
<td>&gt; 50%</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>&lt; 50%</td>
<td></td>
</tr>
<tr>
<td>&gt; 21</td>
<td>&gt; 50%</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>&lt; 50%</td>
<td>15</td>
</tr>
</tbody>
</table>

Five Pitfall of TR-PG

Small TR

2.7 m/sec: TR-PG: 29 mmHg

IVC collapse  Estimated PAP: 32 mmHg
Small TR

Pitfall

1) Small tricuspid valve regurgitation
Gain, take a haircut

Pitfall

2) Over or under gain
3) Inadequate angle
Laminar

Echo underestimates

Pitfall

4) Laminar flow
Case 2

- 48 y.o. female
- With a history of ventricular septal defect.
- She had no symptom.
- She presented for a second opinion regarding diagnosis of pulmonary hypertension (family doctor diagnosed).

Echocardiography
Question 2

A 48 year old female with small VSD.

Your diagnosis is...

1. Pulmonary hypertension
2. Dilated cardiomyopathy
3. Heart failure with preserved EF
4. Additional test required
Question 2

A 48 year old female with small VSD.

Your diagnosis is...

1. Pulmonary hypertension
2. Dilated cardiomyopathy
3. Heart failure with preserved EF
4. Additional test required

Tricuspid Pouch
Echocardiography

Shunt flow

Bounced flow

Echocardiography

TR velocity

Shunt flow
TR-PG pitfall

Case summary

- VSD with shunt V: 5.5 m/sec
- Tricuspid pouch
- TR-V: 2.5 m/sec

The recommendation is observation.
5) Misunderstand TR

Summary (2)

Pitfalls for TR are...

1) Small tricuspid valve regurgitation
2) Over or under gain
3) Inadequate angle
4) Laminar flow
5) Misunderstand TR
RV systolic function

- Fractional area change (FAC)
- TAPSE
- RV S’
- RV strain

<table>
<thead>
<tr>
<th></th>
<th>Normal value</th>
<th>Lower</th>
<th>upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVEDA cm²</td>
<td>18 (16-19)</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>RVESA cm²</td>
<td>9 (8-10)</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>RVFAC %</td>
<td>49 (47-51)</td>
<td><strong>35</strong></td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>TAPSE</td>
<td>cm/s</td>
<td>23 (22-24)</td>
<td>16</td>
</tr>
<tr>
<td>RV S’</td>
<td>cm/s</td>
<td>15 (14-15)</td>
<td>10</td>
</tr>
</tbody>
</table>
RV strain

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Abnormality cut off</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV strain %</td>
<td>-29</td>
<td>-20%</td>
</tr>
</tbody>
</table>

Prognosis

211 patients with acute PE who underwent echocardiography in intensive care unit.

<table>
<thead>
<tr>
<th>Echocardiographic parameter</th>
<th>Unadjusted</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td></td>
</tr>
<tr>
<td>RA systolic dimension</td>
<td>1.50</td>
<td>1.05-2.20</td>
</tr>
<tr>
<td>(per 1-cm change)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LV EDD (per 1-cm change)</td>
<td>0.41</td>
<td>0.22-0.77</td>
</tr>
<tr>
<td>LVEF (per 10% change)</td>
<td>0.44</td>
<td>0.23-0.84</td>
</tr>
<tr>
<td>RV/LV EDD ratio (per 0.1</td>
<td>1.16</td>
<td>1.02-1.32</td>
</tr>
<tr>
<td>change)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated RVSP per 10 mm Hg</td>
<td>1.40</td>
<td>1.10-1.80</td>
</tr>
<tr>
<td>change)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum TR jet velocity</td>
<td>1.46</td>
<td>1.08-1.99</td>
</tr>
<tr>
<td>(per 1 m/sec change)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVC collapsibility</td>
<td>0.25</td>
<td>0.10-0.67</td>
</tr>
<tr>
<td>(presence)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Simple parameters (ratio of RV to LVEDD, RVSP, TAPSE, IVC collapsibility) were associated with mortality.
Prognosis

575 patients with PH or suspected PH who underwent strain imaging echocardiography.

RV free-wall strain in a powerful predictor of the clinical outcome of patients with known or suspected PH.


Summary (3)

PE Echo Findings

- Increased RV size
- New/worsened TR
- RV Thrombus
- Regional wall motion: McConnell’s sign
- Increased PAP
- RV dysfunction
Take Home Message

• Screening for the high risk population.
• Consideration for the pitfall for TR.
• Utility of several RV parameters.

Thank you for your attention!!