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Echocardiography Evaluation in Myocarditis

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Myocarditis: definition

- Myocarditis is an inflammatory disease of the myocardium diagnosed by established histological, immunological and immunohistochemical criteria.

- Inflammatory infiltrate within myocardium with myocyte degeneration and necrosis of non-ischaemic origin.

### Myocarditis classification

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Cell type</th>
<th>Clinical Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virus</td>
<td>Lymphocytic</td>
<td>Acute</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Fiant cell type</td>
<td>Fulminant</td>
</tr>
<tr>
<td>Fungi</td>
<td>Eosinophilic type</td>
<td>Chronic</td>
</tr>
<tr>
<td>Rickettsia</td>
<td>Granulomatous type</td>
<td></td>
</tr>
<tr>
<td>Spirochetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protozoa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drugs, chemical subst</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sarcoidosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allergy, autoimmune, collagen disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation, heat stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown cause, idiopathic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th>Fulminant (n = 11)</th>
<th>Acute (n = 43)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flu-like illness within 4 weeks</td>
<td>100% (11)</td>
<td>21% (9)</td>
</tr>
<tr>
<td>Fever within 12 weeks</td>
<td>91% (10)</td>
<td>23% (10)</td>
</tr>
<tr>
<td>Acute onset of symptoms</td>
<td>100% (11)</td>
<td>56% (24)</td>
</tr>
<tr>
<td>NYHA Functional Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>73% (8)</td>
<td>58% (25)</td>
</tr>
<tr>
<td>3</td>
<td>27% (3)</td>
<td>26% (11)</td>
</tr>
<tr>
<td>2</td>
<td>0% (0)</td>
<td>16% (7)</td>
</tr>
<tr>
<td>1</td>
<td>0% (0)</td>
<td>0% (0)</td>
</tr>
</tbody>
</table>

NYHA = New York Heart Association.
Functional and structural abnormalities on cardiac imaging (echo/angio/CMR)

New, otherwise unexplained LV or RV structure and function abnormality:

• Regional wall motion or global systolic or diastolic abnormality
• With or without ventricular dilatation
• With or without increased wall thickness
• With or without pericardial effusion
• With or without endocavitary thrombus

Abnormal LV structure and function in myocarditis: fulminant vs acute myocarditis

Fulminant myocarditis (n=11)

Acute myocarditis (n=43)

Felker, G.M , 2000

<table>
<thead>
<tr>
<th>Parameters (Normal value)</th>
<th>Myocarditis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fulminant</td>
</tr>
<tr>
<td>FS % (28 - 41 %)</td>
<td>17 ± 7 %</td>
</tr>
<tr>
<td>Septal thickness (&lt; 1 cm)</td>
<td>1.2 ± 0.2</td>
</tr>
<tr>
<td>LV dimension (&lt; 5.0 cm)</td>
<td>5.3 ± 0.9</td>
</tr>
</tbody>
</table>

Role of Speckle tracking echo in myocarditis: beyond EF (Hsiao, J. F. et al., 2013)

Decrease in longitudinal strain by 2-dimensional speckle tracking echo to detect left ventricular dysfunction before the occurrence of changes in left ventricular ejection fraction
Speckle Tracking Echo help to identify intramyocardial inflammation (Escher, F, 2013)

With EMB inflammation at follow up (6 mos)

With no EMB inflammation at follow up (6 mos)

Speckle tracking echo in myocarditis for prognostication (Hsiao et al., 2013)

- For every 1% decline in longitudinal strain or circumferential strain, the HRs (95% CIs) were 1.26 (1.10–1.47) and 1.34 (1.14–1.63), respectively;
- for every 0.1 s$^{-1}$ decline in longitudinal strain rate or circumferential strain rate, the HRs (95% CIs) were 1.43 (1.09–1.89) and 1.52 (1.19–2.01), respectively (p < 0.01).

Using Echocardiography in critically ill COVID-19 patients

• Pts with Covid-19 developed acute respiratory failure and subsequent circulatory dysfunction include the rapid progress of lung injury, fluid overload, lung consolidation, and mechanical ventilation for hypoxemia

• The echocardiographic features related to the severity of disease and cardiovascular complications

Echocardiography in myocarditis due to Covid-19: case report (Irabien, 2020)

A, electrocardiogram on admission showing diffuse concave ST-segment elevation, PR-segment


A echocardiogram showing severe bi ventricular failure, diffuse myocardial edema and pericardial effusion
Role of Echocardiography in pts with Covid-19:

• Useful tool for the fast screen of circulatory status, identifying the types of shock.
• Monitoring during the respiratory and hemodynamic management.
• Guiding the treatment of nCoV pneumonia patients, which is especially feasible, convenient, and advantageous in critically ill patients.

### Echocardiography feature in Covid-19

<table>
<thead>
<tr>
<th>Features</th>
<th>Echocardiographic manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperdynamic cardiac function</td>
<td>Increase of cardiac output (CO) and ejection faction (EF) of the left ventricular (LV), with/without the decrease of peripheral vascular resistance</td>
</tr>
<tr>
<td>Acute stress-induced (takotsubo) cardiomyopathy</td>
<td>LV segmental contraction abnormalities and apical ballooning</td>
</tr>
<tr>
<td>Right ventricular (RV) enlargement and acute pulmonary hypertension</td>
<td>The end-diastolic area of right ventricular/left ventricular &gt; 0.6. The interventricular septum protruded to the left ventricle, showing the “D-sign.” Decreased systolic and/or diastolic function of RV, changes in frequency and rhythm of pulmonary blood flow, tricuspid valve regurgitation.</td>
</tr>
<tr>
<td>Diffuse myocardial inhibition</td>
<td>Decreased systolic and/or diastolic function of the whole heart.</td>
</tr>
</tbody>
</table>

Hyperdynamic cardiac function

- Cardiac stress response to systemic inflammatory response,
- Increase of LV preload by fluid resuscitation,
- Decrease of LV afterload by reduced peripheral vascular resistance

Stress Cardiomyopathy in COVID-19 Disease

3 cases report

dyskinesia of the left ventricle apex (apical ballooning) and basal wall hypercontractility with systolic dysfunction.

- elevated levels of circulating plasma catecholamines and its metabolites,
- microvascular dysfunction,
- inflammation,
- estrogen deficiency,
- spasm of the epicardial coronary vessels, and aborted myocardial infarction

Right ventricular dilatation and acute pulmonary hypertension in COVID-19 Disease

**McConnell’s sign:** This is the finding of hypokinesis of the RV free wall with preserved contractility at the apex.

- The increase in pulmonary vascular resistance caused by hypoxia, pulmonary vasospasm, hypercapnia and inflammation;
- fluid overload;
- unsuitable mechanical ventilation parameter setting.

The interventricular septum protruded to the left ventricle, showing the “D-sign.”

Direct myocardial inhibition

- Severe hypoxia, long term of anoxia and inflammation.
- The circulatory failure is often caused by diffuse cardiodepression after arrest.
- The decrease of vascular tension caused by lactic acidosis.
Conclusion

• Echocardiography may aid in the clinically relevant classification of patients with histologically proven myocarditis, predicting deterioration and overall event-free survival.

• Role of Echocardiography in Covid-19:
  • Useful tool for the fast screen of circulatory status, identifying the types of shock.
  • Monitoring during the respiratory and hemodynamic management.
  • Guiding the treatment, which is especially feasible, convenient, and advantageous in critically ill patients.
Terima kasih