CARDIAC MR IN TIMES OF COVID-19

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DISCLOSURE OF POTENTIAL CONFLICTS OF INTEREST

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COVID-19 is a disease caused by a novel virus, Severe Acute Respiratory Syndrome CoronaVirus 2/SARS-CoV-2.

SARS-CoV-2 is more contagious than regular influenza.

COVID-19 is a substantial risk for
- Elderly
- Patients with pre-existing chronic diseases and cardiovascular risk factors (hypertension, diabetes)
- Immunosuppressed patients
- Healthcare staff (!)
COVID-19 is a global pandemic and will involve across all countries.

The rapid spreading of COVID-19 and the required political and societal response significantly affect social life, economy, and healthcare.
COVID-19 - THE DISEASE

COVID-19

- The virus enters cells through the ACE2 receptor, that is prevalent in the lungs and the heart (also in kidneys, esophagus, bladder, ileum).

- After an incubation period of 4-6 days, typical symptoms are sore throat, dry cough, fever, myalgia, loss of smell/taste. The first symptom of severe disease is dyspnea.

- In vulnerable people, the virus can lead to extensive, necrotic inflammation in the lungs, with poor prognosis.

Zheng et al. Nature Cardiol Rev 2020
There is a high incidence of acute myocardial injury.

Myocardial injury is associated with poor prognosis and should be aggressively treated.
MYOCARDIAL INJURY IN COVID-19

**ST Segment Elevation**
- Myopericarditis should be strongly considered in patient with chest pain, ECG changes, and biomarker elevation. Maintain a low threshold to assess for cardiogenic shock in this setting.
- Use bedside TTE and possibly CCTA to triage cases prior to cardiac catheterization. Consider a conservative strategy in appropriately selected cases.
- Consider bedside pulmonary artery catheterization and bedside IABP placement. IABP may be preferred device for cardiogenic shock due to lower management requirements.
- Even if clinical presentation is dominated by cardiac manifestations and there is no fever, COVID-19 should be in differential.

**Cardiogenic Shock**
- Myocardial dysfunction may be caused by direct injury by virus or secondary to cytokine storm.
- ECMO provides circulatory (VA) and respiratory support (VV). Low flows on VA ECMO may be sufficient.
- Stabilization and recovery of profound cardiac dysfunction related to COVID-19 is possible with temporary mechanical circulatory support.
- ECMO requires high resource utilization and should be used judiciously during the COVID-19 pandemic.

**Decompensated Heart Failure**
- Preexisting cardiac conditions (congestive heart failure, atrial fibrillation, hypertension) may be exacerbated by COVID-19.
- Invasive hemodynamic monitoring may be beneficial in select cases to manage both cardiac and respiratory failure.
- The use of QT-prolonging agents (azithromycin, hydroxychloroquine) should be closely monitored in patients with underlying cardiomyopathies.

**COVID-19 Associated Cardiovascular Disease**

**Heart Transplant Recipient**
- Heart transplant recipients exhibit similar symptoms of COVID-19 infection as non-transplant population.
- Consider holding anti-metabolite (mycophenolate mofetil or azathioprine) in patients requiring hospitalization for COVID-19 infection.
- COVID-19 pandemic imposes challenging decisions for heart transplant programs, including maintaining safety of heart failure patients on waitlist and safety of post-transplant patients.
MYOCARDIAL INJURY IN COVID-19

Fried et al. Circulation 2020

Relative/absolute ischemia

Inciardi et al. JAMA Cardiol 2020

Myocarditis
CARDIOVASCULAR DISEASE IN COVID-19

CARDIAC COMPLICATIONS OF IN COVID-19

- RV Overload secondary to ARDS (RV injury/failure)
- Acute Myocarditis (heart failure, arrhythmia, sudden death)
- Acute Myocardial Infarction (heart failure, sudden death)
- Sepsis (inadequate output/heart failure)
FIBROSIS - SCAR - INFILTRATION: PATTERNS OF LATE GADOLINIUM ENHANCEMENT

CMR OF MYOCARDIAL INJURY

Ischemic vs non-ischemic

Non-ischemic etiology


Cummings et al. Radiographics 2009
# Lake Louise Criteria

## CMR of Acute Myocarditis: Lake Louise Criteria

<table>
<thead>
<tr>
<th>Main Criteria</th>
<th>CMR Image Examples</th>
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</thead>
<tbody>
<tr>
<td><strong>Myocardial Edema</strong>&lt;br&gt;(T2-mapping or T2W images)</td>
<td><img src="image1.png" alt="Regional or global increase of native T2" /> or <img src="image2.png" alt="Regional or global increase of T2 signal intensity" /></td>
</tr>
<tr>
<td><strong>Non-ischemic Myocardial Injury</strong>&lt;br&gt;(Abnormal T1, ECV, or LGE)</td>
<td><img src="image3.png" alt="Regional or global increase of native T1" /> or <img src="image4.png" alt="Regional or global increase of ECV" /> or <img src="image5.png" alt="Regional LGE signal increase" /></td>
</tr>
<tr>
<td><strong>Pericarditis</strong>&lt;br&gt;(Effusion in cine images or abnormal LGE, T2, or T1)</td>
<td><img src="image6.png" alt="Pericardial effusion" /></td>
</tr>
<tr>
<td><strong>Systolic LV Dysfunction</strong>&lt;br&gt;(Regional or global wall motion abnormality)</td>
<td><img src="image7.png" alt="Regional or global hypokinesis" /></td>
</tr>
</tbody>
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Ferreira et al. J Am Coll Cardiol 2018
CMR SAFETY ASPECTS IN COVID-19

- Virus is transmitted through contact with endothelium (mouth, nose, eyes)
- Transmission through droplets and contaminated surfaces
- Longer distance (>1m) aerosol transmission possible, but less likely
SAFETY RULES FOR MRI IN COVID-19

A diagnostic MRI is not an aerosol-generating procedure, but in a pandemic, all patients should be considered carriers.

Healthcare staff needs optimal protection.

⇒ efficient personal protective equipment:

Mask (N95/FFP2), face shield, impermeable gown, gloves
SAFETY RULES FOR MRI IN COVID-19

Personal protective equipment (PPE):
- Mask, gown, gloves

- Urgent cases only
- Mask, gown, gloves for patients
- Focused, native CMR protocols, where possible
- Careful surface cleaning after the scan
- Additional measures in critical and intubated patients:
  - extended cleaning protocol
Suggested Role of Cardiac MRI

Patient with suspected COVID-19

Clinical Features of Acute Myocardial Injury (check daily)
(chest pain, unexplained shortness of breath, arrhythmia, ST elevation)

- absent
- mild
- present

TnT

TnT (↑/↑)

Cardiac MRI

- normal
- Acute MI
- Myocarditis

Echo FU

- stable
- Function ↓

Other Treatment
(Consult Cardiology/Int Med)

Thrombolysis/PCI
(Consult Interventional Team)

CHF Treatment
(Consult HF Team)