

# COVID-19 Cardiac involvement

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## **47 year old teacher first seen 7/9/2020 with history of COVID 3/2020, hospitalized for 3 weeks and intubated for 10 days with pneumonia, She is on home O2, c/o chest pain, SOB and tachycardia on minimal activity**

### **CT scan 5/13/2020**

LUNGS, AIRWAYS: The trachea, mainstem bronchi and visualized segmental airways are patent.

- There is groundglass opacification in all areas of the lungs, mild and extensive.
- There is distortion of the lung parenchyma with fibrotic changes for example image 70 series 3 involving both upper lobes.
- This extensive scarring is seen throughout the upper lobes. There is less significant scarring in other areas of the lungs. There is mild traction bronchiectasis for example in the right middle lobe and the lower lobes particularly the right lower lobe posteriorly.
- Mild distal bronchiectasis present in the inferior lingula.
- There is no lung mass and there is no focal pneumonia currently.

### **Echo 7/10/2020**

Conclusion(s):

1. Left ventricle is normal in size with mildly to moderately reduced function. EF = 40-45%.
2. Mild left atrial enlargement.
3. Diffuse left ventricular hypokinesis.

### **CT Coronary Angiogram 9/3/2020**

1. Mild noncalcified coronary atherosclerosis without evidence of severe stenosis.
2. The calcium score is zero, representing <89th percentile adjusted for age, gender, and ethnicity.
3. Normal left ventricular size with 54% ejection fraction.
4. Mild scattered subsegmental atelectasis/scarring in the partially imaged lungs in this patient with prior diagnosis of COVID-19.
5. Small hiatal hernia

## 51 year old African American male with prior CAD and stent s/p admission for COVID pneumonia May 2020, noted to have frequent non-sustained polymorphic VT, negative troponin and newly reduced EF 45%.

Echo 5/7/19: Normal left and right ventricular size and systolic function. Regional wall motion abnormalities consistent with ischemic heart disease. basal and mid inferior walls are mildly hypokinetic Mild septal hypertrophy. No significant valvular disease.

Echo 5/30/20: Technically difficult study with poor endocardial border definition. Normal left ventricular size. Mild septal hypertrophy. Frequent ventricular ectopy limits evaluation of systolic function, however probably mildly reduced left ventricular systolic function. LVEF 45%. Regional wall motion abnormalities consistent with ischemic heart disease vs. myocarditis. Probably normal right ventricular size and systolic function. Mild mitral regurgitation. Recommend repeat LVEF evaluation with Definity contrast once ectopy has improved.

LHC 5/27/2020: **RCA** Proximal 60 - 70% Mid 50 - 60% Distal Moderate diffuse disease **Left Main** Mid Moderate diffuse disease **LAD** Proximal Mild diffuse disease Mid Mild diffuse disease Distal Moderate diffuse disease **LCx** Proximal Moderate diffuse disease Distal 50 - 60% Moderate size OM1 50 - 60% Patent Intervention site.

Cardiac MRI 7/29/20 : Normal LV size and global systolic function (LVEF=52%). Focal hypocontractility of the apical inferior wall. Normal RV and systolic function (RVEF=51%). Mild subepicardial edema in the basal inferior wall. Biventricular enhancement as above consistent with a non-ischemic inflammatory process. Given clinical scenario this most likely represent COVID acute/subacute myocarditis. A similar enhancement pattern may be seen also in sarcoidosis

## Cardiac Symptoms post COVID-19

- Chest pain and heaviness
  - Chest wall pain
  - GI source
  - Pericarditis
  - Myocarditis
  - Existing Coronary artery disease
  - Thromboembolic disease
  
- Palpitation and tachycardia
  - Dysautonomia and Postural Orthostatic Tachycardia Syndrome (POTS)
  - Arrhythmia related to pericardial, myocardial disease or pulmonary embolism
  
- Shortness of breath
  - Residual lung disease
  - Myocardial involvement
  - Pulmonary thromboembolic disease
  - Underlying lung and cardiac condition
  
- Exercise intolerance

## Cardiac disease post COVID 19

- Dysautonomia
  - Fluid intake
  - Salt intake
  - Proper sleep
  - Exercise and Rehabilitation
  - Compression stocking
  - Medication
  
- Myo-pericarditis
  - Rest
  - Anti-inflammatory- Role for steroids?
  - Treatment of LV dysfunction
  - Arrhythmia management
  
- Thromboembolic Disease

## COVID Cardiac involvement

- Autopsy studies by nature tested only mortally ill patients
- Cardiac Troponin and Pro-BNP are significantly elevated during the acute phase and on follow up
- Cardiac MRI study in 100 patient post COVID saw 78% involvement with 60% continued inflammation. Elevated troponin was present in 71% of these subjects at time of CMR
  - Needs validation
  - Mere cardiac involvement does not automate to clinical symptoms or long-term poor outcome
  - Still the high incidence is alarming

## Special considerations in athletes

- Symptoms analysis to understand the degree of severity of the acute illness
- Any residual symptoms
- Abnormal findings on examination, resting EKG and blood tests to assess any ongoing inflammation or myocardial injury
- Consider specialized testing including echocardiogram, 24-48 Hour Holter Monitor, Loop recorder, stress testing, CPET and CMR
- Treatment
  - 3-6 month of disqualification from sport
  - Ant-inflammatory medication?
  - Guideline optimal therapy for any left ventricular dysfunction or heart failure
  - Arrhythmia concern and management

## Coronavirus Disease 2019 (COVID-19) and the Heart— Is Heart Failure the Next Chapter?

Clyde W. Yancy, MD, MSc; Gregg C. Fonarow, MD

**Multiple data sets now confirm** the increased risk for morbid and mortal complications due to coronavirus disease 2019 (COVID-19) in individuals with preexisting cardiovascular diseases including hypertension, coronary artery disease, and



heart failure.<sup>1,2</sup> These salient observations have strengthened preventive strategies and undoubtedly have resulted in lives saved. Although episodes of clinical myocarditis have been suspected and a few cases

Compared with controls including those with a similar profile of preexisting conditions, left ventricular ejection fraction was lower and volumes higher, as well as 32% manifesting late gadolinium enhancement and 22% with pericardial involvement. There are important residual questions about potential selection bias and generalizability and not all of the patients may have recovered, but the observations cannot be dismissed. Months after a COVID-19 diagnosis, the possibility exists of residual left ventricular dysfunction and ongoing inflammation, both of suf-

JAMA Cardiology | **Original Investigation**

## Outcomes of Cardiovascular Magnetic Resonance Imaging in Patients Recently Recovered From Coronavirus Disease 2019 (COVID-19)

Valentina O. Puntmann, MD, PhD; M. Ludovica Carerj, MD; Imke Wieters, MD; Masia Fahim; Christophe Arendt, MD; Jędrzej Hoffmann, MD; Anastasia Shchendrygina, MD, PhD; Felicitas Escher, MD; Mariuca Vasa-Nicotera, MD; Andreas M. Zeiher, MD; Maria Vehreschild, MD; Eike Nagel, MD

# Letters

## RESEARCH LETTER

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### Cardiovascular Magnetic Resonance Findings in Competitive Athletes Recovering From COVID-19 Infection

Myocarditis is a significant cause of sudden cardiac death in competitive athletes and can occur with normal ventricular function.<sup>1</sup> Recent studies have raised concerns of myocardial inflammation after recovery from coronavirus disease 2019 (COVID-19), even in asymptomatic or mildly symptomatic patients.<sup>2</sup> Our objective was to investigate the use of cardiac magnetic resonance (CMR) imaging in competitive athletes recovered from COVID-19 to detect myocardial inflammation that would identify high-risk athletes for return to competitive play.

**Methods |** We performed a comprehensive CMR examination including cine, T1 and T2 mapping, extracellular volume fraction, and late gadolinium enhancement (LGE), on a 1.5-T scanner (Magnetom Sola; Siemens Healthineers) using standardized protocols,<sup>3</sup> in all competitive athletes referred to the sports medicine clinic after testing positive for COVID-19 (reverse transcriptase-polymerase chain reaction) between June and August 2020. The Ohio State University institutional review board approved the study, and informed consent in writing was obtained from participating athletes. Cardiac magnetic resonance imaging was performed after recommended quarantine (11-53 days). Electrocardiogram, serum troponin I, and transthoracic echocardiogram were performed on day of CMR imaging.

RESEARCH

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# Prevalence and pattern of cardiovascular magnetic resonance late gadolinium enhancement in highly trained endurance athletes



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## Abstract

**Background:** Intensive endurance exercise may induce a broad spectrum of right ventricular (RV) adaptation/remodelling patterns. Late gadolinium enhancement (LGE) has also been described in cardiovascular magnetic resonance (CMR) of some endurance athletes and its clinical meaning remains controversial. Our aim was to characterize the features of contrast CMR and the observed patterns of the LGE distribution in a cohort of highly trained endurance athletes.

**Methods:** Ninety-three highly trained endurance athletes (> 12 h training/week at least during the last 5 years; 36 ± 6 years old; 53% male) and 72 age and gender-matched controls underwent a resting contrast CMR. In a subgroup of 28 athletes, T1 mapping was also performed.

**Results:** High endurance training load was associated with larger bi-ventricular and bi-atrial sizes and a slight reduction of biventricular ejection fraction, as compared to controls in both genders ( $p < 0.05$ ). Focal LGE was significantly more prevalent in athletes than in healthy subjects (37.6% vs 2.8%;  $p < 0.001$ ), with a typical pattern in the RV insertion points. In T1 mapping, those athletes who had focal LGE had higher extracellular volume (ECV) at the remote myocardium than those without ( $27 \pm 2.2\%$  vs  $25.2 \pm 2.1\%$ ;  $p < 0.05$ ).

**Conclusions:** Highly trained endurance athletes showed a ten-fold increase in the prevalence of focal LGE as compared to control subjects, always confined to the hinge points. Additionally, those athletes with focal LGE demonstrated globally higher myocardial ECV values. This matrix remodelling and potential presence of myocardial fibrosis may be another feature of the athlete's heart, of which the clinical and prognostic significance remains to be determined.

**Keywords:** Athletes, Fibrosis, Magnetic resonance imaging

# Center for Post-COVID Care at Mount Sinai Union Square



## **Experts from Every Specialty, Working for Your Care**

The long-term effects of COVID-19 are not clear yet. The virus can affect many different systems within the body—from the lungs to the heart to the kidneys. But by bringing in specialists who have been on the frontlines of the outbreak, you will have the most knowledgeable experts available. Your team and clinical staff may include disciplines such as:

- Primary Care
- Pulmonary Medicine
- Cardiology
- Infectious Diseases
- Nephrology
- Physiatry
- Physical and Occupational Therapy
- Radiology
- Neuropsychiatry
- Behavioral Health
- Social Workers
- Pharmacists