

# Post-covid myocarditis in athletes

(final)

By

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# Agenda

- **Introduction**
- **Types of sports**
- **Incidence of sudden cardiac death (SCD )in athletes**
- **Prominent viruses associated with inflammatory cardiomyopathy**
- **Clinical presentation**
- **Cardiac MRI (CMR)**
- **Incidence of post-covid 19 myocarditis in athletes**

# THE IMPACT OF COVID-19 ON SPORTING EVENTS AND THE IMPLICATIONS FOR SOCIAL DEVELOPMENT

- **COVID-19** might have forced us to stay home for longer than we thought, but that doesn't mean we can't be fit and active!
- The **Olympics and Paralympics**, for the first time in the history of the modern games, have been postponed
- **To safeguard** the health of athletes and others involved, most major sporting events at
  - international
  - regional
  - and - national levelshave been cancelled or postponed

**BUT**

- The **WHO recommends** 150 minutes of moderate intensity or 75 minutes of vigorous-intensity physical activity **per week**

# Types of sports

- **Elite sport** (sport at highest level of competition )
- **Recreational sport** (football, volleyball, etc ....)
- **Competitive sport** (like recreational but are much more time consuming e.g. games for fun)
- **Regular exercise** (30min, at least 3 days/wk, For the last 3 month of moderate intensity)
- **Physical activity:** Moderate: 3-6 METS      Vigorous: >6 METS

# COVID 19 and athletics

- Clinical symptoms were observed in 84% of subjects.
- The severity of COVID-19 was mild in 82% of athletes and moderate in 2% of cases.
- Athletes aged above 26 Ys and male were more likely to develop symptomatic COVID-19
- The severity of COVID-19 in elite athletes is predominantly mild and without complications
- Athletes can return to sport after two symptom-free weeks and additional heart screening is usually not required.

# Practical implications cardiovascular (CV) manifestations

- Determination of antibodies has been shown to be a useful indicator of a previous COVID-19 disease, and some symptoms can be used as predictors of antibody response.
- While COVID-19 can have significant (CV) manifestations, recent data demonstrate that a screening approach guided by
  - (1) severity of COVID-19 infection
  - (2) cardiovascular symptomsand allows the majority of athletes to safely return to play in a timely manner.

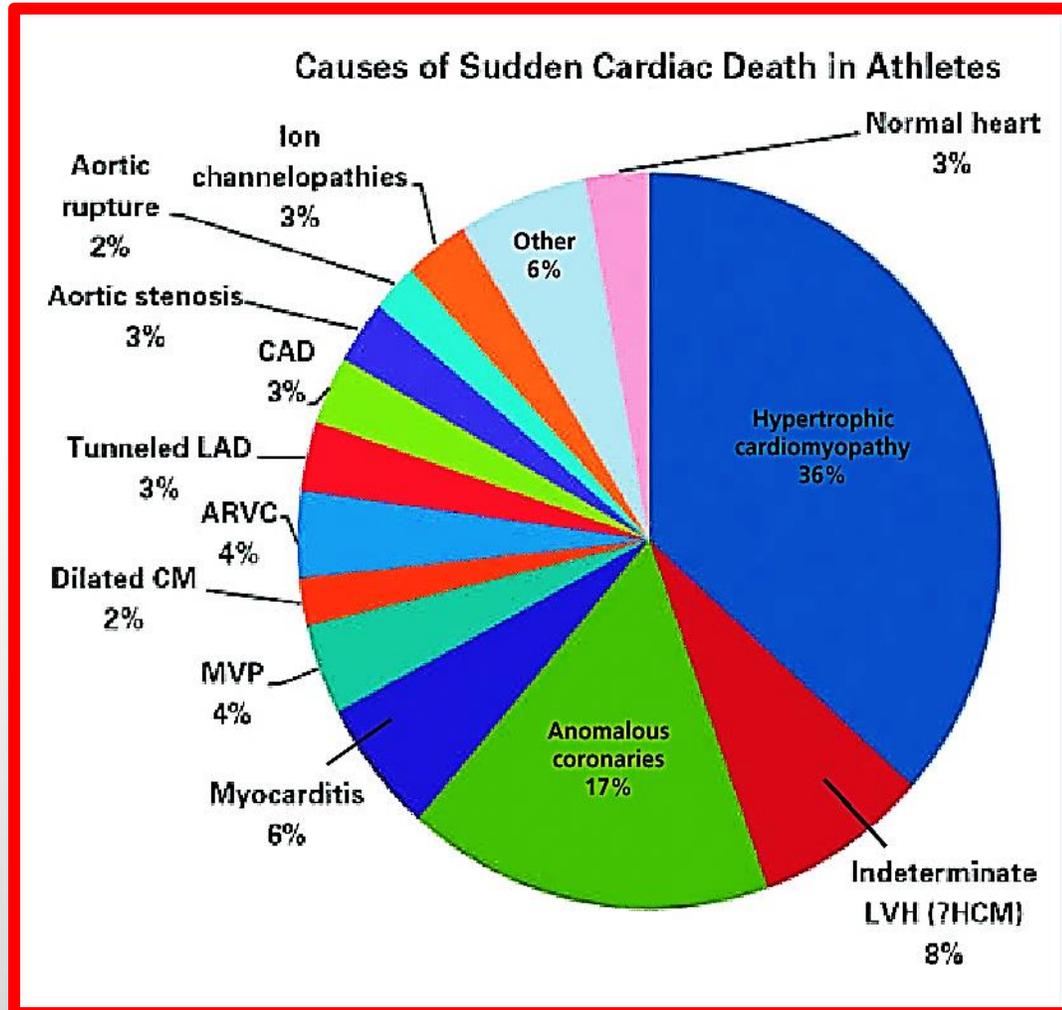
# Causes of SCD in athletes

# Incidence of SCD in athletes

- **The Sudden cardiac death (SCD) is the most frequent medical cause of sudden death in athletes**
- **A recent estimate of SCD incidence ranged from 1 in 40,000 to 1 in 80,000 athletes per year**
- **In Egypt , 2017 anecdotal estimates report between 1 and 5 million athletics in Egypt (Egypt's estimated 97 million population )**  
**and if we consider the percentage of SCD 1:40000**  
**i.e. about 2,425 deaths/year which is a relatively big percentage**

<https://en.m.wikipedia.org>>wiki >i

# Causes of SCD in athletes



## I. less than 35 y

1- Hypertrophic cardiomyopathy

36 %

2- Anomalous coronaries

3- Myocarditis

## II. In older athletes (>35y)

the most common cause is hidden **coronary artery disease!**

Pathophysiology of **COVID-19-related**  
myocarditis

# General knowledge about viral myocarditis

- Myocarditis is an inflammatory disease of the heart characterized by inflammatory infiltrates and myocardial injury without an ischemic cause.
- Pathophysiology of viral myocarditis is a combination of direct cell injury and T-lymphocyte-mediated cytotoxicity, which can be augmented by the cytokine storm syndrome

# Clinical presentation

- The initial presentation of myocarditis is often nonspecific, so a high index of suspicion is required by the clinician
- A viral prodrome (congestion, rhinorrhea, cough, and/or fever) may precede viral myocarditis.
- **associated with viral myocarditis** young athletes patients, without coronary artery disease (CAD) risk factors may present with
  - severe chest painand
  - ST-segment elevations on an (ECG),  
described as an “infarct-like” pattern

# SARS-CoV-2

- **target** :

- ACE2 which can be found on the ciliated columnar epithelial cells of the respiratory tract, type II pneumocytes, and cardiomyocytes

- **Process**

- 1) SARS-CoV-2 spike protein must first be cleaved at the S1/S2 and subsequently at the S2' sites to enable binding to ACE2.

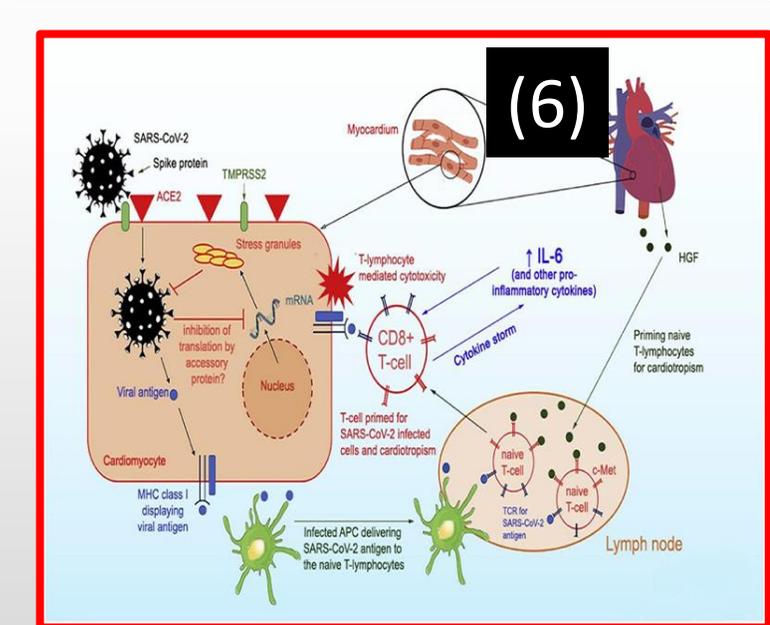
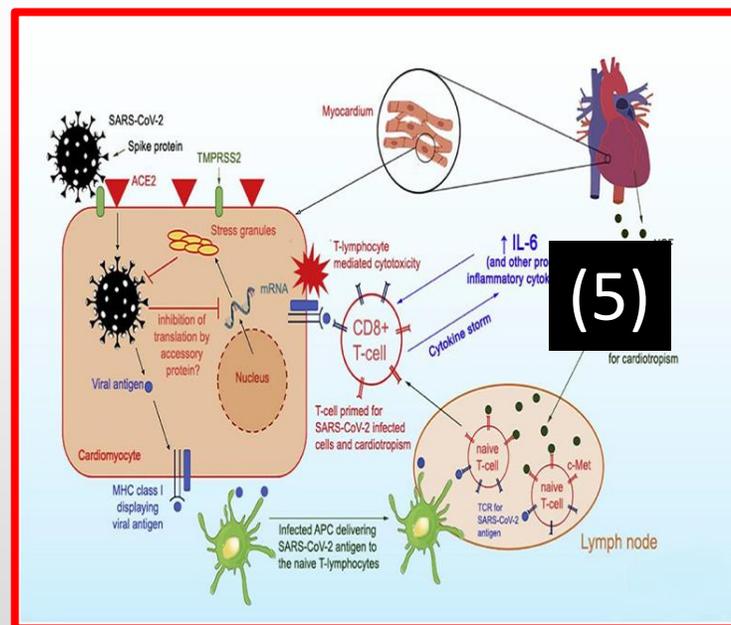
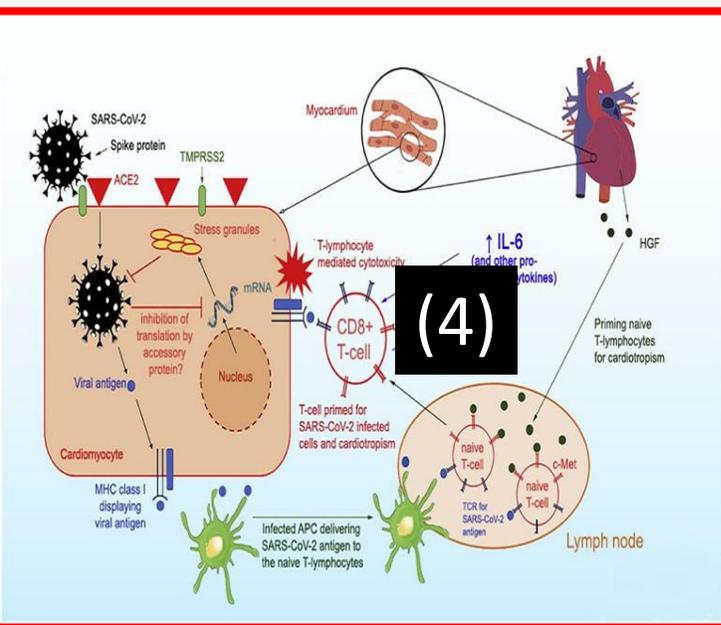
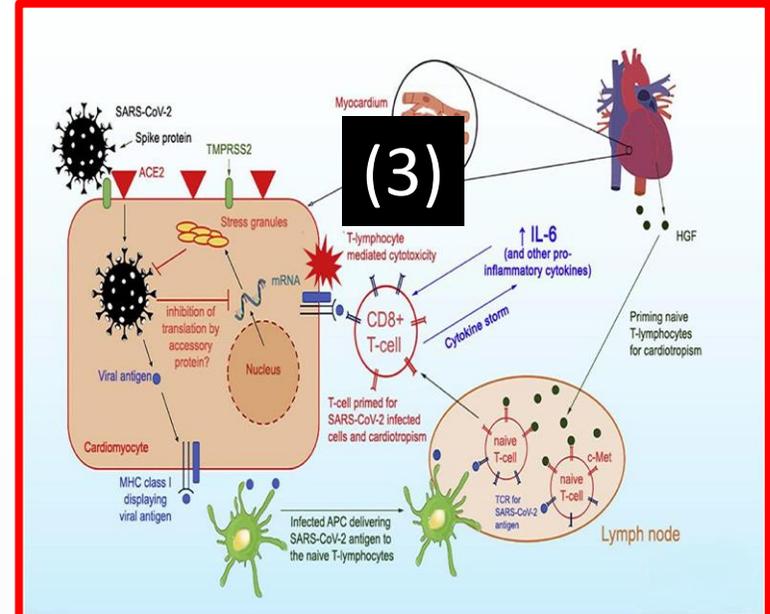
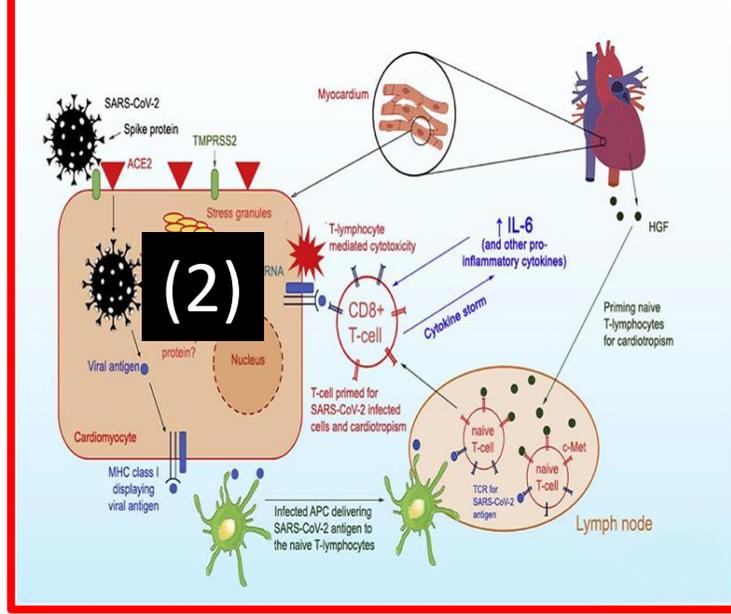
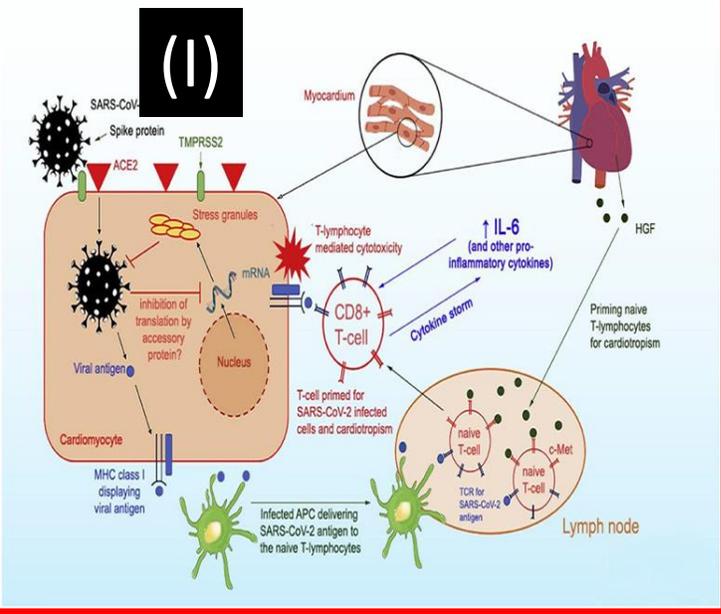
- 2) It gain entry into the target cells by binding its spike protein to the membrane protein angiotensin-converting enzyme 2 (ACE2).

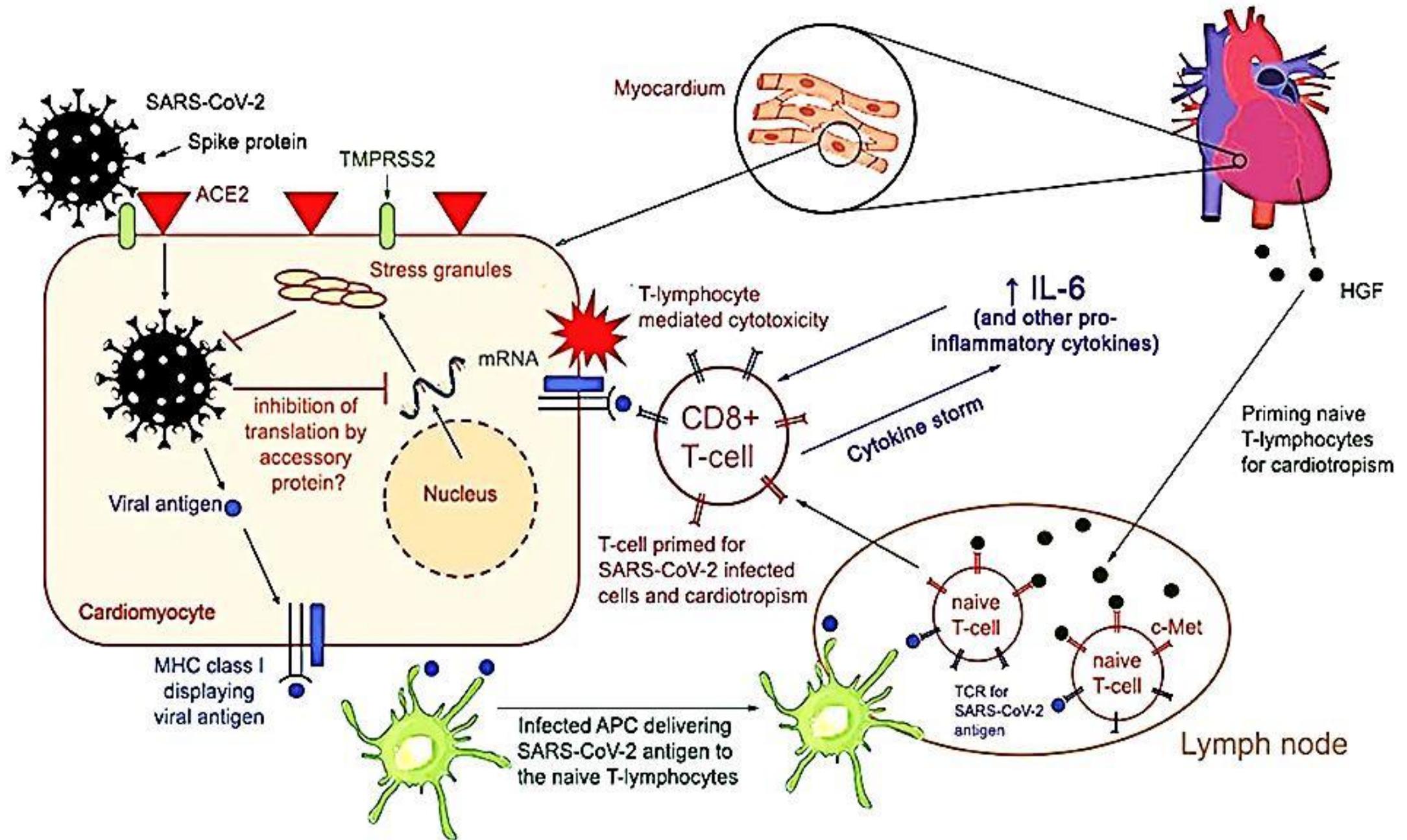
- 3) Intracellular it impair stress granule formation via its accessory protein.

Without the stress granules, the virus is allowed to replicate and damage the cell.

# SARS-CoV-2 cont.

- Naïve T lymphocytes can be ready for viral antigens
- T lymphocytes migrate to the cardiomyocytes and cause myocardial inflammation through cell-mediated cytotoxicity
- Pro inflammatory cytokines are released into the circulation,
- T-lymphocyte activation is augmented and releases more cytokines
- This results in a positive feedback loop of immune activation and myocardial damage





# Clinical presentation

- The initial presentation of myocarditis is often nonspecific, so a high index of suspicion is required by the clinician
- A viral prodrome (congestion, rhinorrhea, cough, and/or fever) may precede viral myocarditis.
- Young patients, particularly athletes, without coronary artery disease (CAD) risk factors may present with
  - severe chest painand
  - ST-segment elevations on an (ECG),  
described as an “infarct-like” pattern  
**associated with viral myocarditis**

- Alternatively, patients may report various degrees of exertional dyspnea, atypical chest pain, palpitations, and/or generalized fatigue.

In extreme cases, previously healthy patients may present with decompensated heart failure or cardiogenic shock.

- The most morbid presentation is one of a patient with life-threatening arrhythmia or SCD, as a result of the nonischemic ventricular scarring induced by myocarditis, which is a nidus for re-entrant circuits

# Biomarkers

- If viral myocarditis is suspected, clinicians should obtain markers of myocardial injury, including
  - elevated troponin (I or T) and - creatinine kinase.
- Elevated brain natriuretic peptide (**BNP**) may indicate ventricular dilation or strain from myocardial injury
- In athletes,  
alternative etiologies of cardiomyopathy should be excluded, such as ---
  - substances (i.e., cocaine)
  - metabolic derangements (thyroid) with urine toxicology, and serum thyroid stimulating hormone (TSH) -

# ECG

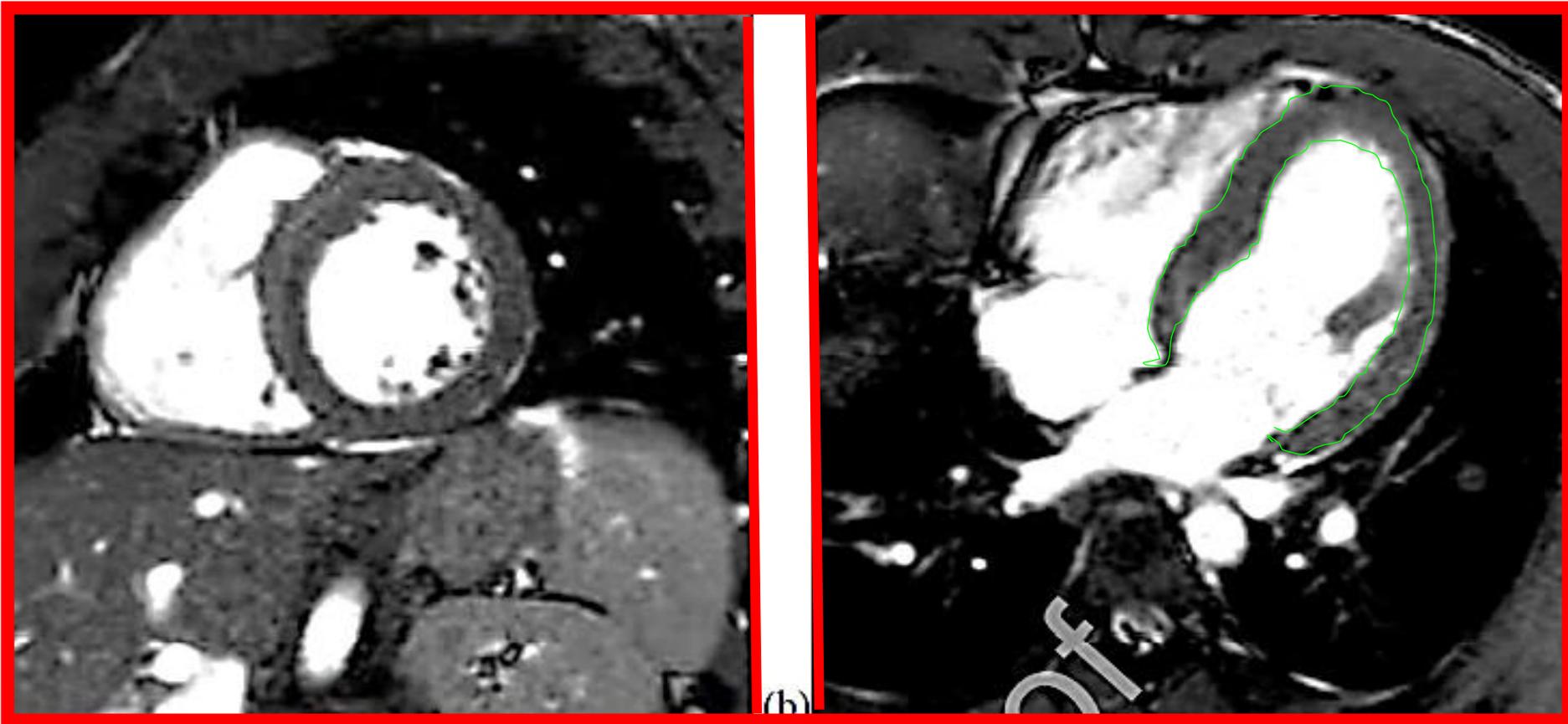
- ✓ In myocarditis, a 12-lead ECG may demonstrate :
- ✓ diffuse ST-segment elevations, T-wave inversions, low-voltage QRS complexes, or even q-waves.
- ✓ Myocardial inflammation may induce intraventricular conduction delay, AV-block, supraventricular tachycardia (SVT) and ventricular tachycardia (VT).
- ✓ If inflammation extends to the pericardium, the ECG may also demonstrate PR-interval depressions.

# Echocardiogram

- **In the acute phase** of viral infection, myocardial inflammation may be characterized by
  - impaired ventricular function
  - abnormal ventricular dimensions (i.e., dilation or increased myocardial wall thickness),and/or - pericardial effusion.
- **TTE** can be useful in evaluating for myocarditis as well as excluding alternative etiologies of cardiomyopathy, such as valvular pathology or other structural heart disease.

# Cardiac magnetic resonance imaging (CMR) in athletes

- In the early days, CMR as a detector for post-covid myocarditis in professional athletes was questionable ,
- Recently, (CMR) is often used in athletes to **image cardiac anatomy and function** and is increasingly requested in the context of screening for pathology that can cause sudden cardiac death (SCD).



Cut-off value for diastolic wall-to-volume ratio of less than  $0.15 \text{ mm} \times \text{m}^2 \times \text{ml}^{-1}$ , athletes' hearts could be differentiated from all forms of pathological cardiac hypertrophy with 99% specificity

athlete's heart

HCM

ARVC

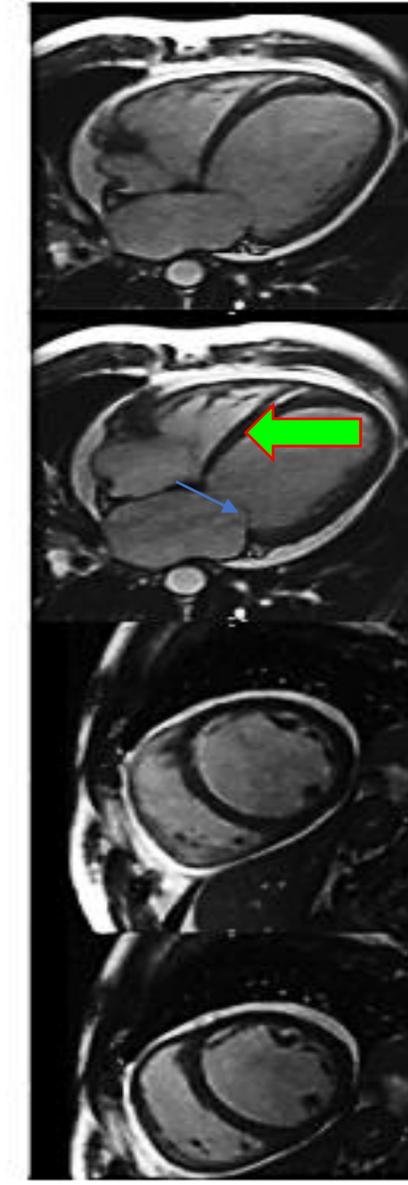
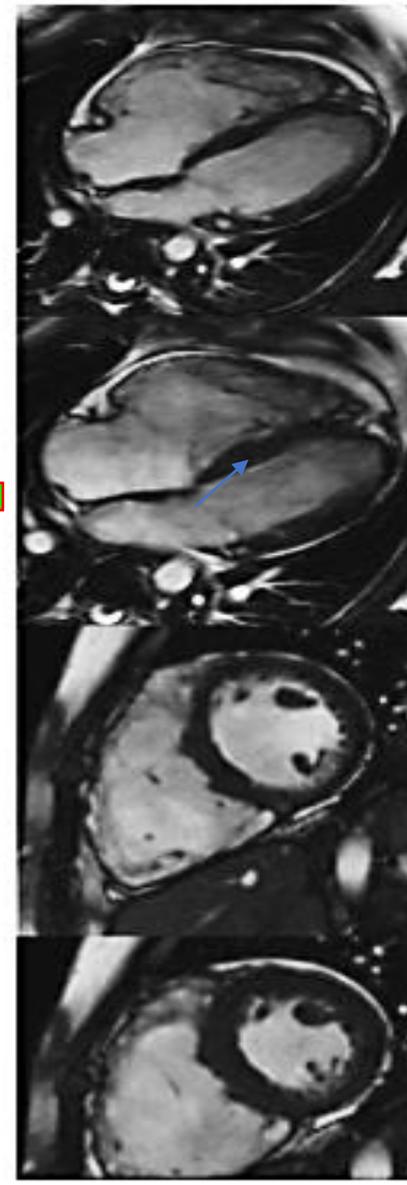
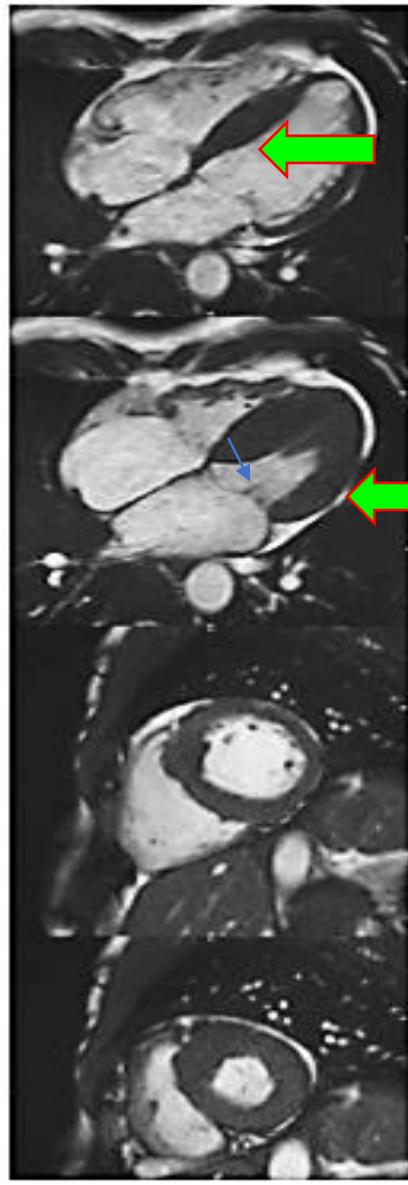
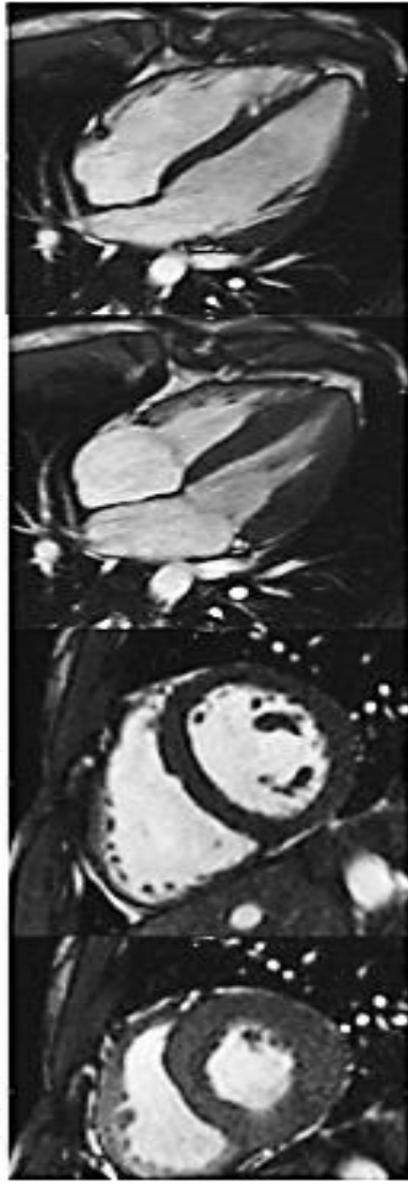
DCM

4C-D

4C-S

SA-D

SA-S



# Recent trials



ELSEVIER

JACC: Cardiovascular Imaging  
Volume 13, Issue 12, December 2020, Pages 2635-2652



State-of-the-Art Review

## Screening of Potential Cardiac Involvement in Competitive Athletes Recovering From COVID-19: An Expert Consensus Statement

Dermot Phelan MD, PhD <sup>a</sup>  , Jonathan H. Kim MD, MSc <sup>b</sup>, Michael D. Elliott MD <sup>a</sup>, Meagan M. Wasfy MD <sup>c</sup>, Paul Cremer MD <sup>d</sup>, Amer M. Johri MD, MSc <sup>e</sup>, Michael S. Emery MD, MS <sup>d</sup>, Partho P. Sengupta MD <sup>f</sup>, Sanjay Sharma BSc, MD <sup>g</sup>, Matthew W. Martinez MD <sup>h</sup>, Andre La Gerche MBBS, PhD <sup>i</sup>

# Incidence of post-covid 19 myocarditis in athletes

- In September 2020, Rajpal et al. published the first major study regarding COVID myocarditis in athletes from The Ohio State University.
- **Twenty-six** athletes who had PCR-confirmed COVID infection, underwent CMR, TTE, ECG, and troponin measurements following recommended quarantine (11–53 days).
- The published **results** indicate that
  - **four** of these athletes (**about 15%**) fulfilled 2018 LLC for **myocarditis**
  - **two** out of those four reporting mild dyspnea,
- while - **eight** others had evidence of **pericarditis** as well .

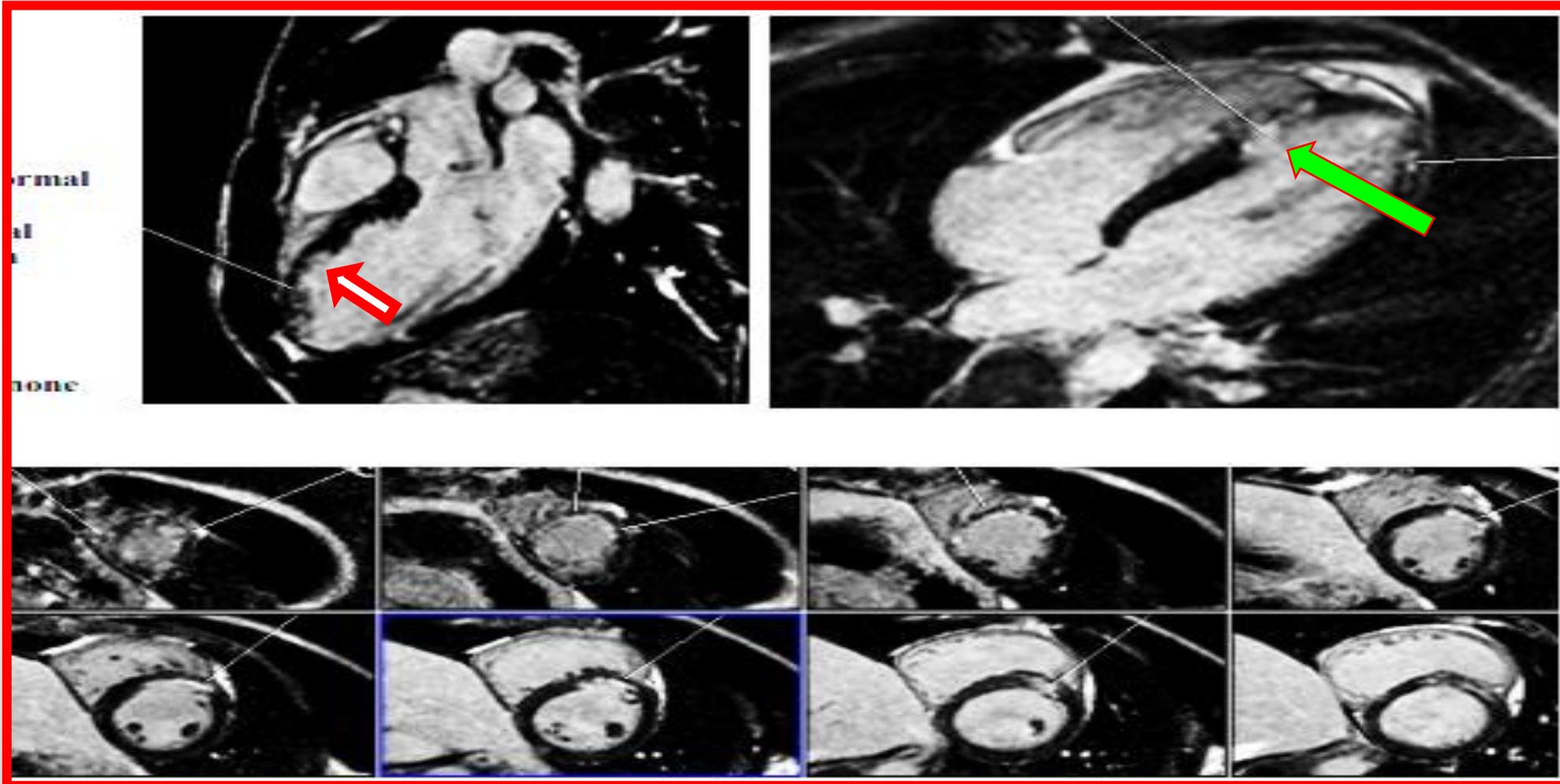
# CONT. Incidence of post-covid 19 myocarditis in athletes

- In March 2021, Martinez et al.
  - evaluated 789 professional North American league athletes following COVID infection,
  - ultimately finding that just five (0.6%) of the 789 had CMR evidence of myocarditis/pericarditis.
- April 2021 ,Moulson et al. released their findings in that
  - among 3,018 athletes who tested positive for COVID,
  - 21 (0.7%) found to have cardiac involvement

we are running MD thesis  
role of CMR in detection of cardiac changes  
post COVID in athletes

- we investigated 106 athletics
  - All of them suffered documented COVID 19 All of them returned back to their sports
  - We did all the investigations which are recommended in such cases
  - In CMR we found scar in the myocardium in 7 athletes
  - this scar:
    - 1) not related to severity of the symptoms
    - 2) Not related to the type of sport
    - 3) Only related to bouts of palpitation after the end of exercise
- Holter monitoring showed no abnormal beats  
Study will continue till we complete 200 athletics

# One of our case of post-covid myocarditis in athlete



# conclusion

- Attacks of COVID 19 in athletics is not uncommon
- 82% has mild symptoms
- Sudden cardiac death is one of complications
- We were in need of big studies to discover the cause of CSD of those patients
- CMR was proved to detect the cardiac anatomy and function of those patients with high sensitivity and specificity and may be of help in declaration of cause of SCD in those patients

Thank you