Association of COVID-19 and Sudden Cardiac Arrest: COVID-19 and Cardiovascular Health Impact on Youth Athlete Return to Play

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Background

- COVID-19 infection ranges from asymptomatic to severely symptomatic cases and death.
- COVID-19 infection has significant effects on cardiovascular health.
- COVID-19 is particularly serious for those with underlying pre-existing conditions.
  - ✓ Diabetes, kidney disease/failure
  - ✓ Cardiac conditions (hypertension, cardiomyopathy, coronary artery disease, arrhythmias)
- *A sudden cardiac arrest (SCA) occurs when the heart stops suddenly without warning and immediately loses electrical function. It is a major public health concern responsible for over 380,000 deaths per year.*

Research Questions

- **Is there an association between COVID-19 and sudden cardiac arrest?**
- **How does COVID-19 infection impact young athletes?**
- **What are the return to play guidelines for safe exercise after COVID?**

COVID-19 and Cardiovascular Health

- COVID infection is more severe and less well tolerated in the presence of pre-existing heart conditions.
- COVID-19 can present with acute cardiovascular effects such as **shock, heart failure, and arrhythmias (atrial fibrillation, ventricular tachycardia, and ventricular fibrillation).**[1]
- COVID-19 infection causes **myocarditis** with inflammation of the heart in up to 27.8% in a report from China.[2]
  - ✓ Myocarditis appears 10-15 days following onset of symptoms and can cause heart damage and **sudden cardiac arrest** (SCA).[3]
- Other cardiovascular effects include **vascular inflammation with venous thromboembolism and coagulopathies (clots, pulmonary emboli).**[4]
- COVID-19 infection can lead to respiratory failure stressing the heart, including **pneumonia, ventilator dependence,** as well the need of an **ECMO** machine (heart-lung).
- COVID-19 infection can lead to secondary bacterial infections.

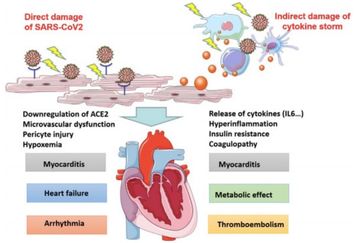

Figure 1. Direct (disfunction at cellular level) and indirect (immune system response) effects of COVID-19 infection on the heart.

Risk Factors and Outcomes

- Several **risk factors** contribute to adverse outcomes from COVID-19 infection:
  - ✓ Underlying state of health (cancer, chronic kidney disease, diabetes, obesity, etc.)
  - ✓ Lack of access to routine quality care (having a primary care doctor that is visited regularly)
  - ✓ Absence of preventive care
  - ✓ Age, race/ethnicity, gender
  - ✓ Other social determinants of health (SDOH) such as education, socioeconomic status/income, and neighborhood
  - ✓ Case fatality higher by race/ethnicity: Pacific Islanders, Latinos, Indigenous and Black Americans; Gender: men; SDOH: Education: lower education levels, lower income, and living in crowded and/or urban areas
  - ✓ Delay in seeking care for symptoms with delayed diagnoses
  - ✓ Lack of access or hesitancy to visit medical providers with high COVID prevalence in the community
  - ✓ **Those with pre-existing cardiac conditions or cardiac involvement from COVID have more severe outcomes.**
- **Mortality (survival after acute infection)**
  - 1.7% case-fatality ratio in the United States (as reported by Johns Hopkins)[5]
- **Morbidity**
  - Pneumonia and residual lung disease
  - Hypercoagulability (clots: deep venous thrombosis and pulmonary emboli/PE)
  - Mental confusion
  - Exercise intolerance and chronic fatigue
  - **Long-haul or long COVID**: persistent symptoms after recovering from acute COVID-19. This includes fatigue, muscle weakness, trouble sleeping, anxiety, memory issues, and depression 6 months post recovery.[6]
  - Patients with severe illness in the hospital had increased risk of residual lung impairment.[7]

COVID-19 and Sudden Cardiac Arrest

- Studies show an increase in out of hospital cardiac arrest (OHCA) during the pandemic.
- A study performed in Italy found a strong correlation between out-of-hospital cardiac arrests in 2019 and 2020 and incidence of COVID-19 cases in the region.[8]
- US studies show an increase in sudden cardiac arrests (88.5 ± 64.1 vs. 69.7 ± 49.8 per million residents; P < 0.01), especially in communities more severely affected by the virus.[9]
- ✓ The Houston Fire Department reported a **45% increase** in sudden cardiac death.[10]
- ✓ In Philadelphia, **1.3% of patients admitted for COVID had a sudden cardiac arrest, all of whom were in intensive care**.[11]

COVID-19 Impact on CPR

- **Cardiopulmonary resuscitation** (CPR) and use of an **automated external defibrillator** (AED) increases chances of survival after a SCA.
- Philadelphia is a city with low bystander CPR pre-pandemic, around 20%.
- There is a **"culture of fear"** associated with the pandemic, with bystanders less willing to perform CPR because of fear of contracting COVID.[12]
- This can be combatted through education about safe CPR and AED use.
- Due to overstretched resources, normal responses for SCA may not be readily available during the pandemic, increasing the risk of SCD.

Vaccination Impact on the Heart

- Vaccinations can mitigate this pandemic by preventing severe illness and death.[13]
- There are reported cases of myocarditis and pericarditis following mRNA vaccinations (Pfizer/BioNTech and Moderna) several days (3-10) after vaccination, primarily after the second dose more often in males ≥ 16 years.[14]
- All patients responded to medications and treatments and recovered quickly.
- **Vaccination is still recommended because the risk of cardiac complications of COVID-19 far outweighs the risk from vaccination.**

Return to Play

- SCD is known to occur in athletes, raising the concern of whether COVID infection, known to affect the heart, could increase the risk of SCA in athletes.
- SCA is responsible for 75% of young athlete deaths in high schools.
  - ✓ 1 in 80,000 high school athletes and 1 in 50,000 college athletes have a SCA/D per year
  - ✓ Higher incidence of SCA in male and black athletes
  - ✓ Highest risks in male basketball and football players
- Exercising with myocarditis could trigger abnormal heart rhythms and lead to SCA.
- Athletes should allow the heart inflammation to heal as to prevent further stressing the heart and triggering abnormal rhythms and SCA.
- **There are current return to play guidelines from the American Medical Society for Sports Medicine (AMSSM) and an expert consensus statement from JACC: Cardiovascular Imaging:**[15]
  - ✓ Begin with a focused medical history and examination using a targeted approach depending on whether the athlete is symptomatic or asymptomatic.
  - ✓ Cardiovascular testing may not be necessary for asymptomatic or mildly symptomatic athletes.
  - ✓ Graduated return to play protocol recommended (see Figure 2)
- **Recommendations and considerations for return to play (Figure 3):**
  - ✓ Comparison with previous ECGs if available: Look for changes in ST segments and T waves.
  - ✓ Assess for subclinical myocardial injury using blood tests (high sensitivity troponin)
  - ✓ TTE (transthoracic echocardiography) imaging for athletes with acute symptoms.
  - ✓ CMR (cardiac magnetic resonance) imaging as a next step in identifying pericardial enhancement or myocarditis
- Health practitioners should consider the potential health care and societal costs and risks of testing and avoid what is unnecessary including:[16]
  - ✓ Financial costs
  - ✓ Strain on healthcare systems with limited resources in areas with high COVID-19 infection rates
  - ✓ Access to testing
  - ✓ Harm to athletes due to extensive use of imaging
- Note that there should not be a one-size-fits-all approach, but one chosen depending on athletic discipline, setting, and available resources.

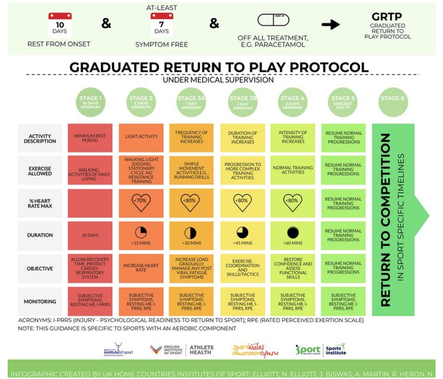

Figure 2. Graduated return to play protocol.

Conclusion and Future Considerations

- The association of COVID-19 infection with sudden cardiac arrest is a serious risk of the virus.
- This is a cause for concern for health practitioners and cardiologists.
- Measures that are normally taken to prevent a sudden cardiac death from a sudden arrest, such as proper CPR training and AED access, should continue, and take greater precedence during this pandemic.
- This includes increased scrutiny when clearing young athletes for return to play.
- There should be a greater focus on prevention and the importance of vaccination to control and mitigate the spread of COVID-19.
- Other mitigation factors, such as masking and social distancing, when possible, should be considered.
- Return to play guidelines can be used for all athletes.
- Following the conclusion of the Olympics, researchers should investigate COVID infection rates and vaccinations during the games and develop improved recommendations for athletic participation.
- Researchers should also carefully evaluate new data regarding booster shots and how new variants affect recommendations.

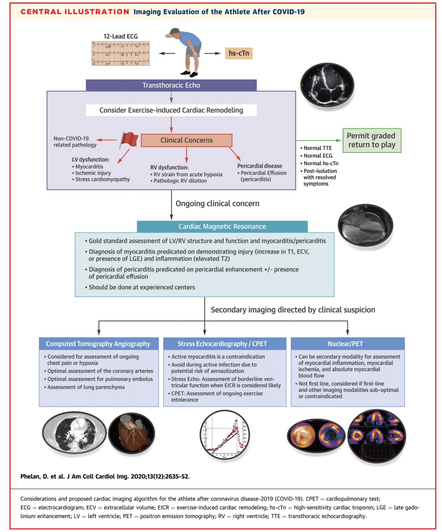

Figure 3. Imaging evaluation.

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Images
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Text
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