RESEARCH LETTER

Cardiovascular Outcomes in Collegiate Athletes After SARS-CoV-2 Infection: 1-Year Follow-Up From the Outcomes Registry for Cardiac Conditions in Athletes

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Recent large-scale prospective studies document prevalence estimates of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) cardiac involvement of 0.5% to 3.0% in young competitive athletes after SARS-CoV-2 infection.¹⁻³ This study was designed to examine cardiovascular outcomes among collegiate athletes after SARS-CoV-2 infection with intermediate term (>1 year) follow-up.

This prospective, observational, cohort study included collegiate athlete data submitted to ORCCA (Outcomes Registry for Cardiac Conditions in Athletes) from September 1, 2020, to November 1, 2021. A detailed description has been published.¹ Athletes were included if they had confirmed SARS-CoV-2 infection and follow-up for cardiovascular outcomes was available. Follow-up was requested from participating institutions periodically throughout the study period. Adverse cardiovascular events were defined as new clinically significant arrhythmias, clinical heart failure, or sudden cardiac arrest or death. Follow-up time was defined as the date of symptom onset or date of positive SARS-CoV-2 test if asymptomatic to the date of last clinical outcomes update from each institution. SARS-CoV-2 myocardial and myopericardial involvement were defined per previous definitions.¹ Continuous variables are presented as mean (SD) or median

(interquartile range) as specified. Statistical analyses were performed using R: A Language and Environment for Statistical Computing (2021; R Core Team). All study aspects were approved by the Massachusetts General Brigham Institutional Review Board (protocol 2020P002667) and the need for informed consent was waived. Data from the corresponding author are available on reasonable request.

A total of 3675 athletes (age 20±1 years, 33% female, 64% White, 27% Black), representing 45 colleges/universities and 27 unique sporting disciplines, met inclusion criteria for this study (Figure). Cardiovascular testing (ECG, troponin, transthoracic echocardiogram [TTE], or cardiac magnetic resonance imaging [CMR]) was performed in 3564/3675 (97.0%) athletes. Definite or probable SARS-CoV-2 myocardial or myopericardial involvement was diagnosed in 21/3675 (0.6%) athletes (10/21 definite myocardial, 2/21 definite myopericardial, 9/21 probable myopericardial). All athletes with cardiac involvement were restricted from sport after diagnosis and all were successfully cleared to return to sport after exercise restriction (median, 86 days [interguartile range, 33, 90]). One athlete decided not to return to sport despite medical clearance. The remaining athletes successfully returned without complication. Repeat cardiac imaging was performed in 15/21 (71%) athletes before return to

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tA list of members of the ORCCA (Outcomes Registry for Cardiac Conditions in Athletes) study group is provided in the Supplemental Material.

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| Nonstandard Abbreviations and Acronyms | |
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| CMR ORCCA | cardiac magnetic resonance imaging Outcomes Registry for Cardiac Condi- tions in Athletes |
| TTE | transthoracic echocardiogram |

play (TTE+CMR, 6 athletes; TTE only, 5 athletes; CMR only, 4 athletes). In the athletes undergoing repeat CMR before their return from sport restriction (median, 86 days [interguartile range, 33, 90]), 7/10 (70%) had complete resolution of initial CMR abnormalities, 1/10 (10%) had partial resolution (resolution of T2 abnormality with persistent late gadolinium enhancement), and 2/10 (20%) had persistent CMR abnormalities (persistent T2 and persistent T1/T2/late gadolinium enhancement abnormalities). After a median follow-up of 1.12 years (interquartile range, 1.06, 1.22), there were 2 (0.05%) adverse cardiovascular events, both in athletes without SARS-CoV-2 cardiac involvement. One athlete had successfully resuscitated sudden cardiac arrest attributed to preexisting genetic structural heart disease unrelated to SARS-CoV-2 infection (initial infection >3 months before sudden cardiac arrest). The other athlete developed new onset atrial fibrillation occurring <2 weeks after SARS-CoV-2 infection

with normal serial TTEs and no evidence of SARS-CoV-2 cardiac involvement on CMR. This athlete was managed with electric cardioversion with no recurrence to date.

This study examined intermediate duration cardiovascular outcomes among young competitive athletes after SARS-CoV-2 infection. The prevalence of definite or probable SARS-CoV-2 cardiac involvement was low (0.6%), consistent with previous results.¹⁻³ All athletes with SARS-CoV-2 cardiac involvement were cleared to return to sport after initial exercise restriction, consistent with contemporary management guidelines.⁴ We observed a single adverse cardiovascular outcome possibly related to SARS-CoV-2 infection (atrial fibrillation) but no incident life-threatening arrhythmias, heart failure, or sudden cardiac arrest related to SARS-CoV-2 infection.

Concern for adverse cardiac effects of SARS-CoV-2 infection resulted in return-to-play recommendations with variable cardiac testing requirements. Several large registries clarifying the prevalence of SARS-CoV-2 cardiac involvement in young competitive athletes have since been published.^{1–3} Our data fill an important knowledge gap and suggest that the risk of clinically relevant adverse cardio-vascular outcomes through >1 year of follow-up is low. This includes athletes with uncomplicated SARS-CoV-2 who returned to sport after recommended quarantine and athletes with clinically diagnosed cardiac involvement who underwent more extended, guideline-recommended



Figure. Cardiovascular outcomes from ORCCA.

*All athletes with definite or probable cardiac involvement were initially restricted from exercise and successfully returned to sport. *Followup unavailable because 10 athletes were cut from or quit the team. IQR indicates interquartile range; ORCCA, Outcomes Registry for Cardiac Conditions in Athletes; and SCA, sudden cardiac arrest.

exercise restriction before return to sport.⁴ In aggregate, these findings support that cardiac events after SARS-CoV-2 infection are low among athletes with a normal workup and those with cardiac imaging abnormalities suggestive of SARS-CoV-2 cardiac involvement who were temporarily restricted from exercise. Therefore, we recommend that CMR be performed only in athletes with a clinical syndrome consistent with myocarditis and ≥ 1 abnormal cardiovascular test (eg, ECG, troponin, TTE, ventricular arrhythmias on monitor or stress test) or in athletes with symptoms concerning for myocarditis on return to exercise,⁵ and athletes with confirmed SARS-CoV-2 infection should undergo exercise restriction per current guidelines.⁴ Despite these reassuring results, ongoing clinical surveillance of this population will be crucial to clarify the long-term cardiovascular implications of SARS-CoV-2 infection.

ARTICLE INFORMATION

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Disclosures

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Supplemental Material

Members of the ORCCA (Outcomes Registry for Cardiac Conditions in Athletes) Study Group

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