



UC San Diego Guidelines for Evaluation of Divers during COVID-19 pandemic

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Background:

Coronavirus Disease 2019 (COVID-19) has become a global pandemic with SARS-CoV2 infecting millions of people and resulting in thousands of hospitalizations and deaths worldwide. Research examining the origins and structure of the virus, its pathogenesis, and the clinical features of its acute presentation is growing at a fast pace. However, as a nascent pandemic, the long-term sequelae to be expected in those who have survived the acute disease are largely unknown. SARS-CoV2 infection manifests primarily as atypical pneumonia, but in severe disease other complications are common, including cardiac and thromboembolic disease.

Scuba diving is a passion for many recreational divers, but, more importantly, it also represents a critical component of the commercial diving industry and scientific research. UCSD runs a diving medicine clinic that sees approximately 250 divers per year, most of whom are employed as commercial and scientific divers. As society begins to re-open after quarantines, many of these divers are presenting to our (and others') clinic requesting guidance and clearance on returning to dive after the pandemic.

COVID-19 and Diving:

We are presented with the challenge of performing fitness to dive evaluations in the context of a disease in which the natural history is currently unknown. In what we know of the pathophysiology of the disease, the pulmonary, cardiac, and thromboembolic/hypercoagulable disease seems to be relevant to divers. Potential long-term sequelae include decreased exercise tolerance, increased susceptibility to cardiac events such as heart failure, pulmonary edema, and arrhythmia, structural changes of the lung leading to increased risk for barotrauma, and increased risk of decompression sickness from underlying hypercoagulability.

Unfortunately, we do not have the luxury of waiting 6-12 months to evaluate our divers when there will likely be much better information to provide evidence-based guidelines. Thus, we have developed working guidelines based on the limited evidence of sequelae of COVID-19 available and our experiences with other diseases that share similar features, such as pneumonia and cardiomyopathy. We fully anticipate we will be able to revise these guidelines as more evidence becomes available. They are not meant to be prescriptive, but to share our experience with other institutions and organizations who are faced with similar challenges.

Our goal has been to categorize divers based on the history and severity of their illness and base their return to dive evaluation accordingly. As with any illness, ultimately the work up is left to the discretion of the evaluating physician. Our plan is to update them frequently as we gain more experience and more evidence becomes available. The following guidelines are referring to divers who are ***completely asymptomatic*** after their illness, including exercise tolerance (see below). Before using the guidelines below, a few terms warrant definition:

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Definitions of terms used in guidelines:

COVID-19-suspected Illness

We define a COVID-19-suspected illness as a diver who had symptoms consistent with COVID-19 with or without a positive PCR or antibody test, given that testing is currently unreliable and many were not tested. As more accurate antibody testing is developed and becomes widely available it will likely be useful in guiding these evaluations. We are currently using the CDC case definition (updated April 5, 2020) of COVID-19 for those patients who did not have PCR or antibody confirmed illness:

At least two of the following symptoms: fever (measured or subjective), chills, rigors, myalgia, headache, sore throat, new olfactory and taste disorder(s)

OR

at least one of the following symptoms: cough, shortness of breath, or difficulty breathing

OR

Severe respiratory illness with at least one of the following: Clinical or radiographic evidence of pneumonia, or Acute respiratory distress syndrome (ARDS)

AND

No alternative more likely diagnosis

Exercise Tolerance

This is likely the most important definition used in our guidelines and it is vital that physicians evaluate it carefully. It is our belief that a diver with significant cardiac or pulmonary pathophysiology would not have a normal exercise tolerance. However, the definition of the word normal is critical. First, the diver must have returned to his or her baseline level of exercise and tolerance. Even minor deviations from their baseline (“getting more winded,” longer recovery times, etc) warrants further testing and investigation. Second, the physician must be satisfied that the diver’s exercise regimen warrants an appropriate exertional test for diving. There are no universally agreed upon recommendations on an exercise tolerance level needed for all divers, but the ADCI guidelines for commercial divers require a minimum level of 10 METS. If the physician is not convinced that the diver’s self-reported exercise level meets appropriate criteria or concerned it would not reveal underlying cardiac or pulmonary disease, further testing is warranted.

GUIDELINES FOR DIVER EVALUATION

Category 0 Asymptomatic Diver without history of COVID-19 suspected illness

We recommend divers who have no history of COVID-19 suspected illness proceed with normal evaluations. Additionally, we would use these criteria in those who may have had a positive screening PCR or antibody test, *but without any history of illness or symptoms consistent with COVID-19.*

- a. Commercial Divers
 - Initial/annual exam per ADCI guidelines
 - Chest radiograph only if required per Q 3-year cycle
 - No additional testing required
- b. Scientific Divers AAUS/NOAA
 - Initial/recurrent exam per AAUS or NOAA guidelines
 - No additional testing required
- c. Recreational
 - Follow RSTC guidelines
 - No additional testing required

Category 1 Asymptomatic Diver who had a mild COVID-19-suspected illness

We define a mild illness as any patient who:

- Did not seek health care or received outpatient treatment only without evidence of hypoxemia.
- Did not require supplemental oxygen
- Imaging was normal or not required
- ***They have returned to their baseline exercise tolerance.***

Commercial Divers/Scientific Divers/Recreational

- Initial/annual exam per ADCI/AAUS/NOAA/RSTC guidelines
- Spirometry
- Chest radiograph (PA & Lateral)
- If chest radiograph is abnormal, obtain Chest CT scan
- If unknown (or unsatisfactory) exercise tolerance, perform exercise tolerance test with oxygen saturation

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Category 2 Asymptomatic Diver who had a moderate COVID-19-suspected illness

We define a moderate illness as any patient who:

- required supplemental oxygen or was hypoxic
- had abnormal chest imaging (chest radiograph or CT scan)
- admitted to the hospital but did NOT require assisted ventilation (BIPAP, CPAP, or ventilator) or ICU level of care.
- If admitted, had documentation of a normal cardiac work up including normal ECG and cardiac biomarkers e.g. troponin or CK-MB and BNP
- ***They have returned to their baseline exercise tolerance.***

Commercial Divers/Scientific Divers/Recreational

- Initial/annual exam per ADCI/AAUS/NOAA/RSTC guidelines
- Spirometry
- Chest radiograph (PA & Lateral) (if abnormal, obtain Chest CT)
- ECG
- Echocardiogram (if no work up was done inpatient. Can forgo if had negative work up)
- If unknown (or unsatisfactory) exercise tolerance, perform exercise tolerance test with oxygen saturation
- Investigation and management of any other complications or symptoms per provider and ADCI/AAUS/NOAA/RSTC guidelines

Category 3 Asymptomatic Diver who had a severe COVID-19-suspected illness

We define a severe illness as any patient who:

- Required mechanical or assisted (CPAP, BIPAP) ventilation, or ICU admission
- Cardiac involvement defined as abnormal ECG, abnormal echocardiogram, or elevated cardiac biomarkers; e.g. troponin or CK-MB and BNP (or absence of documented work up)
- Thromboembolic complications (such as PE, DVT, or other coagulopathy)
- ***They have returned to their baseline exercise tolerance.***

Commercial Divers/Scientific Divers/Recreational

- Initial/annual exam per ADCI/AAUS/NOAA/RSTC guidelines
- Spirometry
- Chest radiograph (PA & Lateral) (if abnormal, obtain Chest CT)
- ECG
- Repeat Cardiac troponin or CK-MB and BNP to ensure normalization
- Echocardiogram
- Exercise Echocardiogram with oxygen saturation
- Investigation and management of any other complications or symptoms per provider and ADCI/AAUS/NOAA/RSTC guidelines

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Symptomatic divers or those with abnormal test results

It is not currently our plan to allow divers who are symptomatic or have abnormal testing per the guidelines above to dive (though each will need to be evaluated on a case by case basis and exceptions are to be expected). However, we do not feel this necessarily represents a lifetime ban on diving as many of the sequelae which are currently disqualifying (such as abnormal CT scans) may resolve over the next 3-6 months and re-testing may be indicated. It is currently unknown whether or not potential sequelae of COVID-19 will become chronic and therefore re-evaluation will likely be indicated until more evidence becomes available.

Screening of diving employees prior to diving

We currently recommend following CDC guidelines for screening of an employee prior to diving and do not feel that measuring vital signs or oxygen saturation routinely before diving are warranted. Any diver should not dive if they currently have a fever, or have had any of the following symptoms in the last 14 days (cough, shortness of breath or difficulty breathing, fever, chills, muscle pain, or new loss of smell or taste).