Cardiopulmonary exercise testing in COVID-19 patients at 3 months follow-up

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Background: Long-term effects of Coronavirus Disease of 2019 (COVID-19) and their sustainability are of the utmost relevance. For the chronic phase, the main concerns are the development of pulmonary interstitial disease and/or lingering cardiovascular involvement. How to intercept, assess, and treat these patients with long-term consequences of COVID-19 remains uncertain.

Purpose: We aimed to determine: 1) functional capacity of COVID-19 survivors by cardiopulmonary exercise testing (CPET); 2) those characteristics associated with CPET performance; 3) safety and tolerability of CPET.

Methods: We prospectively enrolled consecutive patients with laboratory-confirmed COVID-19 discharged alive at a single hospital in northern Italy. At 3-month from hospital discharge, complete clinical evaluation, transthoracic echocardiography, cardiopulmonary exercise testing (CPET), pulmonary function test (PFT), and dominant leg extension (DLE) maximal strength evaluation were performed.

Results: From 225 patients discharged from March to November 2020 we excluded 12 incomplete/missing cases, and 13 unable to perform CPET leading to a final population of 200 patients. At PFT all median parameters were within normality range.

Median percent-predicted peak oxygen uptake (%pVO2) was 88% (78.3–103.1). Ninety-nine (49.5%) patients had %pVO2 below, whereas 101 (50.5%) above the 85% predicted value (indicating normality).

Sixteen (16.2%) patients had respiratory, 28 (28.9%) cardiac, 21 (21.2%) mixed-cardiopulmonary, and 34 (34.3%) non-cardiopulmonary limitation of exercise. One-hundred sixty (80.0%) patients complain at least one symptom, without relationship with peakVO2.

Multivariate linear regression analysis showed percent-predicted forced expiratory volume in one-second (β=5.29, p=0.023), percent-predicted diffusing capacity of lungs for carbon monoxide (β=6.31, p=0.001), and DLE maximal strength (β=14.09, p=0.008) independently associated with peakVO2.

At sensitivity analysis, the results of previous multivariate linear regression analysis were also similar among sub-groups of patients with no previous significant disease in anamnesis (cardiovascular disease except for arterial hypertension, respiratory disease, kidney disease, or cancer) and of those with a length of hospital stay ≤7 days.

None major event was reported during/after CPET, whereas only two cases (1.0%) had a mild symptomatic hypotension post exercise. None of the involved health professionals developed COVID-19.

Conclusions: CPET after COVID-19 is safe and about 1/3rd of COVID-19 survivors show functional capacity limitation mainly explained by muscular impairment, calling for future research to identify patients at higher risk of long-term effects that may benefit from careful surveillance and targeted rehabilitation.

Types of mainly CPET limitation

Peak VO2 per leg extension strength