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Reply to 'Heart failure with preserved ejection fraction and COVID-19: which comes first, the chicken or the egg?'

We thank Baratto *et al.* for their interesting and thought-provoking letter. Since SARS-CoV-2 particles have been found in cardiac tissue accompanied by tissue inflammation,[1] understanding the relation between COVID-19 and cardiac dysfunction is of utmost importance. This has spiked research in the past year in many different directions.[2–5]

While both cohorts from Caravita *et al.*[6] and Hadzibegovic *et al.*[7] suffered from COVID-19 disease, their major difference was that the patients from Caravita *et al.*[6] were all treated in an intensive care unit with mechanical ventilation, while the patients from Hadzibegovic *et al.*[7] were patients from a regular ward without any additional circulatory or respiratory support – making them somewhat complicated to compare. Especially those patients in the intensive care unit have a variety of possible causes for left ventricular (LV) systolic and diastolic dysfunction or changes in pulmonary pressure despite possible viral-directed mechanisms. These include indirect damage through cytokine storm and the interaction of many factors such as continuous mechanical airway ventilation with possible lung compression and injury, decompensation, volume overload, and catecholamine treatment.[8]

Studies with long-term cardiovascular follow-ups of COVID-19 patients are needed to better understand whether cardiovascular problems seen in the acute phase of COVID-19 patients also persist in the remission phase. Especially, whether diastolic dysfunction, that is seen in the acute phase of COVID-19 infection, will also persist in remission is important to investigate, because those patients would be at increased risk for developing heart failure with preserved ejection fraction (HFpEF) in the so-called post-COVID-19 phase. Surely, the HFA-PEFF[9] and H_2FPEF[10] scores were not developed for unstable patients cared for in an intensive care setting. Here the reasons for changes in LV diastolic and right ventricular function, as well as changes in pulmonary pressure are very variable, multi-factorial and do not represent the classical HFpEF syndrome. The scores estimate the likelihood for the classical diagnosis of HFpEF and a HFpEF-like syndrome, respectively, under stable conditions. In this context, HFpEF-like syndromes include a bundle of different cardiac aetiologies, including genetic and storage diseases as well as e.g. several myocardial inflammatory diseases, including viral myocarditis. We could show in our study for the first time that these scores are able to detect a HFpEF-like phenotype under COVID-19 conditions. It is of great interest to further assess these patients in their long-term follow-up to identify their risk of developing chronic HFpEF and to evaluate whether the HFA-PEFF and H_2FPEF scores are sufficient for monitoring these patients. This is important since it is known that a subgroup of patients after viral or lymphocytic myocarditis can develop a HFpEF syndrome.[11] Additionally, COVID-19 patients in remission frequently report fatigue, tiredness, dyspnoea, and dizziness which has been termed 'long COVID'[12] – symptoms that are also frequently seen in HFpEF.[13–15]

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Markus S. Anker[1,2,3]* and Carsten Tschöpe[2,3,4,5]

[1]Department of Cardiology Charité, Universitätsmedizin Berlin, Campus Benjamin-Franklin, Berlin, Germany; [2]Berlin Institute of Health Center for Regenerative Therapies (BCRT), Berlin, Germany; [3]German Centre for Cardiovascular Research (DZHK), partner site Berlin, Berlin, Germany; [4]Department of Internal Medicine and Cardiology, Charité - Universitätsmedizin Berlin, Campus Virchow Klinikum, Berlin, Germany; and [5]Berlin Institute of Health (BIH) at Charite (BIH), Universitätsmedizin Berlin, Berlin, Germany
*Email: markus.anker@charite.de

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