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## Editorial

## Cardiac Rehabilitation: You Can't Have "Too Much of a Good Thing"

DANIEL E. FORMAN, MD,<sup>1,2</sup> AND LINDA R. PETERSON, MD<sup>1,2</sup>

PA; and Saint Louis, Missouri

- *As You Like It, Act 4, Scene 1*

You can't have *too much of a good thing*. As cardiologists, we often wish that our patients would do more "good things" to enhance their health, including integration of more exercise, healthful lifestyle choices, and medication adherence into their daily routines. Although the related usefulness of cardiac rehabilitation (CR) in patients with cardiovascular disease is well-established, the study by Uithoven et al. reinforces the premise that more CR sessions are better for our patients who have undergone cardiac transplantation. In their study of 140 patients after transplantation, the authors found that those who attended  $\geq 23$  CR sessions fared better than those who attended  $< 23$  sessions. The patients who attended more sessions had a remarkable 60% fewer major adverse cardiac events (MACE), which were defined as the composite of strokes, heart failure hospital admissions, ST-elevation or non-ST elevation myocardial infarctions, hospitalizations for acute rejection, or death from any cause. Moreover, the advantage for patients who attended  $\geq 23$  CR sessions persisted even after adjusting for multiple covariates, including a robust measure of physical fitness before transplantation,  $VO_{2peak}$ . Indeed, the difference in MACE-free survival between the 2 groups seems to persist over a 10-year follow-up. Based on their data, the authors estimate that after heart transplantation, patients reap a  $\sim 4\%$  improvement in MACE-free survival *for every session* that they attend.

Importantly, in the current study, the authors used MACE-free survival as the primary end point. An earlier study of the effectiveness of CR among heart transplant recipients showed a similar association between the number of sessions and survival, but did not evaluate MACE.<sup>2</sup> It is also significant that the current study included rehospitalization in the definition of MACE. As the authors note, the readmission rate within the first year following heart transplantation is very high—64% in 1 study.<sup>3</sup> Achieving an adequate "dose" of CR seems likely to help avoid rehospitalization, and seems to be especially valuable given the high readmission rate in this population.

Nonetheless, caution should be taken in the interpretation of the results of this study. Association is not causation. The question arises—were the patients who completed  $< 23$  sessions sicker than the subjects who completed  $\geq 23$  sessions? It is not clear from the data presented how many patients did not complete  $\geq 23$  sessions because they were hospitalized or had another "event." The authors did attempt to account for several clinical variables including fitness level by adjusting for  $VO_{2peak}$  before transplantation in the multivariable analyses. In these analyses, the number of CR sessions, whether analyzed as a dichotomous variable ( $\geq 23$  or  $< 23$  sessions) or as a continuous variable (increasing number of CR sessions), remained as the only independent predictor of event-free survival.

Overall, Uithoven et al.<sup>1</sup> provide compelling support for the importance of CR for the transplant population, but their analysis does little to explain the factors that may impede the patient's ability to attend CR sessions. *The rub* that deters our patients from not only getting to CR,<sup>4</sup> but also from getting enough CR sessions, is likely multifactorial. In a previous study from the Mayo Clinic, patients were required to stay near the tertiary center where they had the heart transplant for 90 days, and most patients in that study were enrolled in CR within 2 weeks, which would help patients to complete  $> 23$  sessions.<sup>2</sup> However, this also points out the general need for CR care teams to facilitate completion of remaining CR sessions at another center if/when patients leave one CR center for whatever reason (eg, patients going to Florida for the winter).

From the <sup>1</sup>Department of Medicine, Divisions of Geriatrics and Cardiology, University of Pittsburgh, PA and <sup>2</sup>Division of Cardiology, Washington University School of Medicine, Saint Louis, Missouri.

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Reprint requests: Linda R. Peterson, MD, FAHA, FACC, FASE, Washington University School of Medicine, Campus box 8086; 660 S. Euclid Ave. Saint Louis, Missouri 63110. Fax: 314-362-9982. E-mail:

[lpeterso@wustl.edu](mailto:lpeterso@wustl.edu)

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The authors of the current study also raise the important question: How many patients would complete more sessions of CR if they knew that each session would yield a ~4% improvement in MACE-free survival? Improving adherence to CR, however, will likely require a more personalized approach that does not put the onus on the patient alone. A more effective strategy will likely be for the provider to give each patient this information *and* to collaborate with them to discover their specific impediments to attending CR, break down barriers to participation, and discuss options for improving attendance. Creative approaches to make CR more achievable may also include innovative models for motivating patients and for providing CR care.

Innovative models of home-based CR, possibly enriched by telemedicine, could be particularly helpful to expand and extend participation in CR to maximize its MACE-reducing benefits. Many patients lack the resources and access to attend site-based CR facilities. This is especially true for transplant recipients, many of whom travel to tertiary centers for their transplant surgery and who may start CR at that center, but then go back home before their CR sessions are complete. There are also many patients who

live closer to site-based facilities but who do not drive, or who fear coronavirus disease-2019, or who have other reasons for not attending an on-site CR program. Based on the data from Uithoven et al. and others, it is high time that we, together with our patients, test new approaches to improving participation and continuation in CR, because when it comes to CR, you can't have too much of a good thing.

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