Functional Status and Outcome After Coronary Artery Bypass Grafting*

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Physical activity and fitness strongly predict mortality in healthy adults of all ages and in individuals with cardiovascular disease and other health conditions (1). Physical fitness can be assessed by maximal or submaximal exercise testing or approximated by history taking or formal questionnaires that query the ability to perform activities of various intensities. Assessment of the ability to perform activities that require more than 4 metabolic equivalents is recommended pre-operatively for risk stratification in individuals in need of noncardiac surgery (2). Formal cardiopulmonary exercise testing, especially the determination of anaerobic threshold, has been advocated for pre-operative functional assessment (3). Others have suggested that the 6-min walk test can be used when cardiopulmonary exercise testing is not available (4). Functional status is not currently included as a risk marker in the Society of Thoracic Surgeons Risk Calculator for cardiovascular surgery (5).

Current guidelines for the management of patients with stable coronary heart disease (CHD) emphasize accurate risk assessment for determining optimal treatment strategies and go on to suggest that the absolute mortality benefit of coronary artery bypass grafting (CABG) is greatest among those at highest risk on the basis of an analysis of the CABG Trialists Collaboration (6,7). In contrast, the more recent STICH (Surgical Treatment for Ischemic Heart Failure) trial, which randomized individuals with left ventricular ejection fraction below 35% and coronary anatomy suitable for CABG (a high-risk group) to either intensive medical therapy plus CABG or intensive medical therapy alone, could not demonstrate a significant benefit of CABG on total mortality over 56 months of follow-up, independent of the presence or absence of viable myocardium or ischemia (8,9). Both CABG and medical therapy are thus considered Class IIa, Level of Evidence: B options for such individuals in the current heart failure guidelines (10).

The prognostic value of cardiopulmonary exercise testing, the 6-min walk test, and other assessments of functional capacity among individuals with left ventricular dysfunction (LVD) is well documented (11–13), but it is not known whether functional capacity assessment can identify patients with LVD and CHD who are likely to benefit from surgical revascularization. In this issue of JACC: Heart Failure, Stewart et al. (14) report an exploratory analysis of the STICH trial database designed to determine whether baseline functional capacity was related to mortality in this cohort and whether baseline functional status influenced the balance of risks and benefits of CABG on a background of intensive medical therapy.

Functional status was assessed at baseline by 6-min walk testing and by selected questions from the Kansas City Cardiomyopathy Questionnaire, in which patients were asked to rank their degree of limitation by dyspnea or fatigue for 6 types of activities that ranged in intensity from low (showering or bathing) to high (hurrying or jogging). In the overall cohort, both 6-min walk (dichotomized by walking distance below or above 300 m) and the Physical Activity Score (dichotomized at >55 vs. a lower score) were associated with subsequent mortality, but only the Physical Activity Score remained statistically significant after multivariate adjustment. However, both assessments were associated with response to surgical therapy: Higher-functioning patients by either measure had improved survival after CABG compared with medical therapy alone, whereas those with lower functional

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status did not, and higher performance on the 2 measures combined was an even better predictor of outcome in the surgical compared with the medical group. Although early post-operative risk within 60 days of surgery was evident in all subgroups, this early risk was more pronounced in the subgroups with lower functional status. In addition, those with better functional status benefited to a greater degree from CABG between 61 days and 2 years after surgery, as well as long-term beyond 2 years. Although adherence to evidence-based pharmacological measures was high in STICH (9), it is not known what proportion of patients participated in cardiac rehabilitation after CABG or whether such participation altered the relationship between baseline functional capacity and prognosis.

This interesting study raises several important questions about our current practices of caring for patients with chronic CHD. First, it suggests that there is considerable heterogeneity in prognosis among patients with LVD and CHD amenable to CABG and that benefit from surgical revascularization is not uniform. We, as clinicians, thus have to get better at determining which of our patients are and are not likely to achieve a mortality benefit from CABG. Second, this post-hoc study demonstrates that there is a strong association between objectively determined functional capacity or subjectively assessed ability to perform certain activities and subsequent mortality in such patients. This finding is consistent with a large body of literature that shows a powerful relationship between functional capacity measures and prognosis independent of other demographic and clinical characteristics. Physical activity level and functional capacity are not routinely assessed during clinic encounters. This and many other studies before suggest that we should make physical activity/functional capacity assessment a “vital sign” during office visits. Third, if functional capacity relates to outcome after CABG in this selected population of patients with LVD and it relates to perioperative risk in noncardiac surgery, is it not plausible that it would also relate to outcome after CABG in less-selected populations or non-CABG cardiovascular surgery? This question should be explored systematically, and if the answer is affirmative, functional capacity assessment should be incorporated into pre-operative risk assessment for cardiovascular surgery.

Is poor functional capacity a risk marker, or is it causally related to outcome after surgery? The current study is clearly not designed to answer this question, but my assumption is that the answer is “both.” Age, psychosocial factors, comorbidities, and genetic factors contribute to innate physical fitness, affect our ability and motivation to participate in regular physical activity, and affect our ability to respond with an increase in physical fitness in response to this physical activity. These same factors are also directly related to future mortality and thus potentially confound any relationship between functional capacity and outcome. However, a causal relationship between poor functional capacity and mortality after CABG is plausible: Patients with poor functional capacity may not have the reserve to appropriately respond to perioperative and post-operative hemodynamic and metabolic demands, and they may have limited ability to participate in early mobilization and post-operative rehabilitation and thus increase their risk of post-operative complications and long-term poor health. HF ACTION (Heart Failure: A Controlled Trial Investigating Outcomes of Exercise Training) showed that functional capacity among individuals with impaired left ventricular function is amenable to change and that exercise training is safe and improves prognosis (15). This raises an intriguing question: Could such exercise training be used in individuals with LVD before elective CABG to improve functional status, improve prognosis overall, and result in better outcomes after the surgical intervention? Cardiac rehabilitation is already a Class I intervention in people with systolic heart failure or stable angina, after myocardial infarction, and for patients after percutaneous or surgical revascularization and other cardiovascular surgical procedures. Future studies should explore whether exercise training before CABG (“pre-habilitation”) can improve post-surgical mortality in deconditioned CHD patients with and without LVD.

**REFERENCES**


