Beyond ischemia evaluation: The potential for assessing and addressing physical inactivity in the cardiac stress laboratory

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Exercise has been shown to have beneficial effects in a wide range of disease states including cardiovascular disease, pulmonary disease,¹ and cancer.² Large prospective studies have illustrated the mortality benefit associated with exercise and physical activity, with even small amounts of exercise conferring mortality benefits.^{3–5} A recent study has shown that the benefit of exercise is at least that conferred by drug interventions.⁶ Furthermore, exercise has a favorable side effect profile compared to the most effective medical therapies.

Despite these benefits, levels of occupational related physical activity and leisure time physical activity remain suboptimal in the US.^{7–9} The BRFSS reported that in 2010, 25% adults in the US do not engage in any leisure time activity.¹⁰ Furthermore, only 50% of US adults meet the recommended amount of leisure time activity.⁹ In regards to occupational related physical activity, Church et al found that the number of jobs requiring moderate physical activity decreased from 48% to 20% between 1960–2008, along with a concomitant increase in jobs that require light physical activity or are categorized as sedentary jobs.⁸ There was also a decrease in time spent on household management between 1965–2010 resulting in a decrease in energy expenditure during household duties.⁷ Taken together, the US has become a more sedentary society in which the requirements for

occupational energy expenditure has decreased and the levels of leisure time activity have not increased enough to offset this trend. In an era of increasing healthcare costs, physical inactivity is thought to be responsible for 12.2% of the global burden of myocardial infarction and to account for between 1.5% and 3.0% of total healthcare expenditures in the US.⁹ Thus, the challenge remains in how to efficiently identify, assess, and motivate patients to increase their physical activity. An important step would be to identify a point of contact with patients where physical fitness could be assessed and addressed with proven methods of intervention.

In the current issue of the *Journal of Nuclear Cardiology*[®], Poulin et al evaluate the prognostic value of patients ability to perform exercise during stress testing.¹¹ This study included 1,511 patients who were prospectively enrolled at a single center. Patients were divided according to stress modality into three groups: (1) exercise by the Bruce protocol, (2) low level exercise plus adenosine, and (3) and adenosine only. More than three quarters of patients enrolled in this study underwent exercise testing, with 10% and 13% of the patients undergoing adenosine plus exercise and adenosine only protocols, respectively. In the overall cohort, 89% of single-photon emission computed tomography (SPECT) images were normal. The authors used the social security death index (SSDI) to ascertain patients' status as alive or dead. In patients who were deceased, the cause of death was ascertained using their death certificates. Causes of death were categorized as cardiac, non-cardiac, or unsure.

Poulin et al report a gradient of risk associated with the inability to exercise, with the highest event rates (all-cause mortality and cardiovascular events) associated with patients undergoing an adenosine only protocol, an intermediate event rate associated with the adenosine plus exercise protocol, and the lowest event rate associated with those patients able to perform the Bruce protocol.¹¹ In addition, the current study found a higher

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non-cardiac death rate associated with the inability to exercise. On multivariate analysis, patients undergoing an adenosine only protocol were at a significantly higher risk for cardiac and non-cardiac death compared to those patients undergoing the Bruce protocol. However, while there was a trend for lower risk in the adenosine-exercise patients this was not statistically significant. This is likely due to the small number of patients in the adenosine-exercise and adenosine only groups.

Poulin et al findings have expanded upon and are consistent with previous studies.^{11–15} Two recent studies have evaluated the risk of patients undergoing pharmacologic stress with normal SPECT myocardial perfusion images (MPI) studies. Supariwala et al followed 5,762 patients with normal SPECT studies for a mean follow-up of 8 years.¹⁵ The authors reported an annualized event rate 3 times higher among patients undergoing pharmacologic stress test vs. exercise stress test (3.6% per year vs 1.2% per year, $P < .0001$). In a second study, Rozanski et al studied a propensity-matched cohort of 6,069 patients, followed for a mean of 10.2 years.¹⁴ The authors report an annualized event rate of 3.9% per year among patients undergoing pharmacologic stress and an event rate of 1.6% per year among exercising patients. Interestingly, the mortality rate was similar among patients who exercised <3 minutes and those undergoing pharmacologic stress, illustrating the high-risk associated with poor exercise capacity. Nair et al reported a large study of 19,367 patients who underwent three stress protocols, exercise only, exercise plus adenosine, and adenosine only.¹³ The authors found a gradient of risk associated with the inability to perform exercise, with the highest risk of cardiac death and myocardial infarction associated with adenosine only patients, an intermediate risk associated with exercise plus adenosine, and the lowest risk in patients undergoing exercise only stress. Furthermore, Nair et al found this relationship between exercise ability and cardiac risk exists among patients with normal SPECT images and those with abnormal SPECT images.

It is clear based on previous studies as well as the current study by Poulin et al,¹¹ that the inability to exercise at the time of referral to the stress laboratory identifies patients at high risk for cardiac and non-cardiac death. Thus, the stress laboratory is an excellent point of contact to assess their risk based on their exercise ability. Traditionally, exercise capacity has been an important factor in evaluating patients cardiovascular risk. However, the evaluation of exercise capacity has been in the context of the risk for cardiovascular events and the need for further medical management or revascularization procedures. Based on data such as the current study, perhaps the stress laboratory is an opportune time for a meaningful evaluation and intervention regarding

exercise, particularly in light of a study that highlighted the reduction in mortality among previously sedentary middle-aged men who started exercising.¹⁶ An important first step would be to take a thorough exercise history and detail the reasons patients are unable to perform exercise. Patients may be unable to exercise for a wide variety of reasons including orthopedic, vascular, poor physical conditioning, and unfamiliarity with the treadmill. Based on this assessment proper recommendations or referrals could be made, such as a tailored exercise program or referral to a physical therapist, as deemed appropriate. In addition, the stress report issued to the referring physician could reflect the need to address the issue of exercise as a risk factor itself. This could prompt an evaluation to a specialist in exercise physiology to address the needs of the patients poor exercise performance or the inability to exercise.

Future directions for research could include prospective studies which perform a detailed assessment as to why patients are unable to exercise and need undergo pharmacologic stress testing. Detailing reasons patients undergo pharmacologic stress testing in favor of exercise will allow investigators to determine which sub groups are at highest risk for poor outcomes and to determine the most efficient way to evaluate and intervene on each patient group.

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