Advances in Geriatrics

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Assessing and Improving Mobility in Older Adults

Established in 1988, the VA Ann Arbor Geriatric Research, Education and Clinical Center (GRECC) aims to expand knowledge of aging and health systems through research, apply this knowledge in clinical activities at the Ann Arbor VA Medical Center (VAMC), Ann Arbor, MI and transmit it to health professionals throughout VISN 11. Research in both the basic science and clinical domains focuses on aging, syndromes affecting geriatric patients, and neuroscience; additional domains involve health services and rehabilitation.

One particular avenue of rehabilitation research, mobility assessment and improvement in older adults, has brought the Ann Arbor GRECC into a close partnership with the University of Michigan (UM) Mobility Research Center (MRC). Maximizing mobility—and, in particular, optimizing the abilities to walk and to avoid falls—are critical goals for enhancing the quality of life of aging veterans.[1]

THE MRC: AN OVERVIEW

The mission of the MRC, which is located a few blocks from the Ann Arbor GRECC and the UM north campus, is to assess and enhance mobility and physical activity in older adults. Researchers, staff, and trainees from the Ann Arbor GRECC are closely involved in MRC studies, often assuming leadership roles, and many of these studies recruit veteran participants from the VA Ann Arbor Healthcare System's patient population.

The physical space of the MRC is divided into several areas, including: (1) a gait laboratory with an adjustable force plate pit, an overhead safety harness system, an instrumented gait mat, and an optoelectronic camera system for kinematic and kinetic measurements; (2) a 60-ft walkway for walking tests, such as the six-minute walk; (3) dedicated areas for treadmill-based peak oxygen uptake (VO_2) tests and muscle strength measurements (isokinetic dynamometry); (4) a separate room for private medical history interviews and physical examinations; and (5) a common area with rails for group exercise activities.

The MRC leverages expertise from a range of disciplines, such as geriatrics, biomechanics, exercise physiology, kinesiology, nursing, physical and occupational therapy, and neuropsychology. Additionally, the MRC has developed into a training center for undergraduate, graduate, and junior faculty members. GRECC-affiliated trainees include medical students and residents, geriatrics fellows (including VA special fellows in aging), and junior faculty members.

MRC projects receive funding support from a variety of sources, including the VA Office of Research and Development (R&D), especially the VA Rehabilitation R&D (RR&D) program; the National Institute on Aging (NIA); and such organizations as the Hartford Foundation and the American Diabetes Association. This support has included a number of research career development awards for MRC investigators.

HIGHLIGHTS OF MRC-GRECC RESEARCH

The MRC began investigating how older adults rise from a chair or a bed, as well as how they rise from the floor, through studies largely funded by the VA's RR&D Merit Review Program. Subsequent, controlled interventions demonstrated that task-specific training (that is, training on submovements of the task), either with or without a resistance component, improved the ability of mobility-impaired older

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The VHA's Geriatric Research, Education and Clinical Centers (GRECCs) are designed for the advancement and integration of research, education, and clinical achievements in geriatrics and gerontology throughout the VA health care system. Each GRECC focuses on particular aspects of the care of aging veterans and is at the forefront of geriatric research and clinical care. For more information on the GRECC program, visit the web site (http://www1.va.gov/grecc/). This column, which is contributed monthly by GRECC staff members, is coordinated and edited by Kenneth Shay, DDS, MS, director of geriatric programs for the VA Office of Geriatrics and Extended Care, VA Central Office, Washington, DC.

adults to rise from the aforementioned positions (Table).[2–4] This theme of task-specific mobility assessment and intervention is carried through in a number of studies.

The MRC's efforts in postural control and fall risk reduction are highly relevant for aging veterans. Postural control projects have included the development of two new assessments: (1) the maximal step length (MSL) test, a measure of volitional stepping in various directions, and (2) trunk reposition errors (TREs), a measure of trunk position sense.

Two studies demonstrated that the MSL test was strongly associated with the risk of falling and with other tests of balance and disability.[5,6] In another, NIH-funded, randomized trial comparing dynamic balance and stepping training to tai chi, the MSL test was used as one of the key indicators of improvement.[7] Ten weeks of the combined balance and step training resulted in significantly greater improvements in functional mobility (as measured by the timed up and go test, as well as the MSL) than did 10 weeks of tai chi.[7] The major clinical implication of this study is that balance training for fall avoidance may need to be focused specifically on rapid, dynamic body (and stepping) responses.

On the other hand, the slower dynamic training of tai chi may allow for the inclusion of participants who have been previously excluded from mobility-related research studies, such as patients with cognitive impairment. Accordingly, a trial of tai chi training in older adults with Alzheimer disease (AD) is underway, using the AD participants' caregivers to assist in providing the training. The tai chi in AD program is part of a clinical demonstration project for the Ann Arbor GRECC, and will begin with a VA cohort using recently awarded VISN 11 funding.

TREs are good indicators of balance impairment,[8] especially when used in patients who have peripheral neuropathy (PN) secondary to impaired glucose tolerance (IGT).[9] These errors are the basis of a newly funded VA RR&D study, which is being conducted in collaboration with the Baltimore VAMC, Baltimore, MD to reduce impairment in IGT-related PN.

MRC research is also working toward advancing our understanding of the influence of cognitive impairment on walking and stepping performance. Using a walkway embedded with a neuropsychological task of visual processing, the Trails A and B tests, MRC investigators have observed significant performance deficits in older adults—particularly those with executive function deficits—compared with younger adults.[10,11] These tests may simulate older adults' ability to negotiate walking hazards in their environment and to deal with fall risk.

Projects in the MRC gait laboratory have focused on the biomechanical requirements underlying the MSL and other tests of stepping,[12–14] as well as those underlying stooping, crouching, and kneeling.[15] Findings point toward decrements in hip and knee function, altered postural adjustments, and decreased control of the torso and momentum as sources of age-related alterations in the performance of stepping and bending activities. These studies were conducted in collaboration with the UM Biomechanics Research Laboratory.

Table. Clinical implications of Mobility Research Center studies[2–11,16,17]

- Interventions to improve functional mobility (such as rising from a chair, a bed, or the floor) should be task-specific (i.e., involving submovements of the task).[2–4]
- Interventions to reduce fall risk also can be task-specific, involving dynamic balance and stepping training.[7]
- Quantifiable tests of stepping and trunk stability may provide additional information regarding overall postural control and fall risk.[5–9]
- Tests of cognitive demand embedded into walking tasks may indicate the extent to which cognitive impairment may affect risk of falling while walking.[10,11]
- Walking tests at submaximal aerobic load may be good indicators of functional mobility in older adults, particularly when used with analyses of oxygen uptake kinetics.[16]
- Self-reported fatigue may be an important contributor to physical activity, particularly in those reporting pain with activity.[17]

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A new area of research, which is being funded by the VA's Clinical Science R&D and RR&D programs and conducted in collaboration with the Minneapolis GRECC, Minneapolis, MN, involves the assessment of aerobic function and the use of aerobic training to improve functional mobility and physical activity. Measures of VO_2 kinetics prior to and after a submaximal exercise load appear to predict functional mobility as well as peak VO_2 measurement during a maximally graded treadmill, especially in mobility-impaired older adults (Figure).[16] These types of measurements are particularly useful in patients with congestive heart failure (CHF), whose VO_2 during a submaximal task, such as the six-minute walk, approaches their levels measured during a maximal treadmill test. These findings have served as the basis for randomized, clinical trials of functional circuit training in older adults with CHF and with type 2 diabetes mellitus that are being led by research scientists from the Ann Arbor GRECC. Given the high prevalence of type 2 diabetes and CHF in the older veteran population, Ann Arbor VA Health Services R&D Quality Enhancement Research Initiative databases were used to boost recruitment of veteran participants for these studies.

Subjective and objective physical activity are becoming key outcome parameters in MRC studies and are particularly relevant for VA initiatives, such as the Managing Overweight and/or Obesity for Veterans Everywhere (MOVE!) program. Of particular interest is the model developed by Ann Arbor GRECC research scientists on the relationship between actigraph-measured physical activity and self-reported pain in osteoarthritis of the leg, which is likely mediated by self-reported fatigue.[17] A newly funded VA RR&D initiative will expand the study of fatigue and its relationship to physical activity. GRECC faculty also led

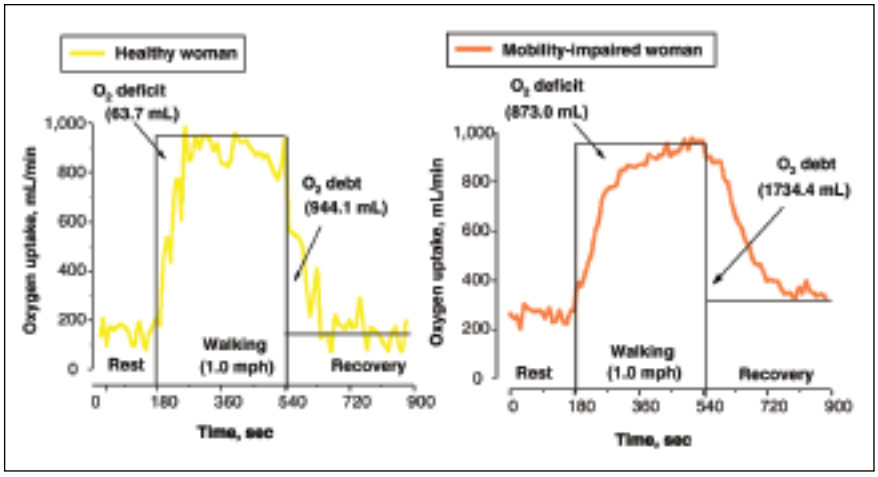

Figure. Oxygen kinetics in a healthy older woman (left) and a mobility-impaired older woman (right) in response to a bout of submaximal exercise (walking on a treadmill for 6 min at 1 mph). With age and increasing disability, the kinetics for oxygen uptake are delayed and the time constant related to deficit increases. In the impaired older adult, the oxygen deficit at the onset of exercise is greater and results in a longer time constant. As a result of this increase in oxygen deficit, the impaired older adult incurs an increase in oxygen debt during recovery, also with a longer time constant. Figure reprinted from: Alexander NB, Dengel DR, Olson RJ, Krajewski KM. Oxygen-uptake (VO2) kinetics and functional mobility performance in impaired older adults. *J Gerontol A Biol Sci Med Sci*. 2003;58(8):734–739.[16] Copyright © 2003 The Gerontological Society of America. Reproduced by permission of the publisher.

a bath transfer study, in which older adults bathing independently exhibited unsafe utilization of their bathing environment and objective difficulties in transfer performance.[18]

The MRC has long been involved in muscle strength testing, particularly in the leg—and, most recently, in the hip.[19] Interest in studying ways to augment standard resistance training has led to studies of leg power training. A leg press training device has been developed, with ongoing randomized, controlled studies comparing lengthening (eccentric) contraction training to shortening (concentric) contraction training in older adults.

IN SUMMARY

The MRC provides a unique environment for educating GRECC and other VA trainees in research on mobility in older adults. This environment is enriched with projects that are relevant for the aging veteran, as evidenced by the long history of VA Merit Review grant support as well as participation of the veterans themselves in the projects. Innovative assessments and interventions developed at the MRC hold promise to be translated into quality of life enhancements for aging veterans. Moreover, the experience gained by Ann Arbor GRECC clinicians and researchers in working with the MRC have helped to make this VA institution a major resource for mobility assessment and improvement nationwide. ●

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