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Decline in Functional Performance Predicts Later Increased Mobility Loss and Mortality in Peripheral Arterial Disease

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Objectives We hypothesized that a greater 2-year decline in office-based functional performance measures would be associated with greater mobility loss and mortality in people with peripheral arterial disease (PAD).

Background Associations of decline in functional performance with clinically important outcomes in patients with PAD are unknown.

Methods A total of 440 men and women with PAD completed the 6-min walk test and measures of walking velocity at baseline and annually for 2 years. Participants were categorized into tertiles according to their functional decline between baseline and 2-year follow-up and were followed annually after the functional change assessment. Cox proportional hazard models were used to assess relations between the 2-year change in functional performance with later mortality and mobility loss, with adjustments for age, sex, race, ankle brachial index, comorbidities, and other confounders.

Results A total of 102 participants (23.2%) died during a median follow-up of 44.5 months after functional change was assessed. Of 319 participants without baseline mobility disability, 60 (18.8%) developed mobility loss after functional change was assessed. Participants in the tertile with the greatest 6-min walk decline had the highest subsequent mobility loss (hazard ratio [HR]: 3.50; 95% confidence interval [CI]: 1.56 to 7.85; p = 0.002), all-cause mortality (HR: 2.16; 95% CI: 1.28 to 3.64; p = 0.004), and cardiovascular disease mortality (HR: 2.45; 95% CI: 1.08 to 5.54; p = 0.031), compared with those with the smallest 6-min walk decline. Greater declines in fastest-paced 4-m walking velocity were associated with higher mobility loss (p trend = 0.018), all-cause mortality (p trend = 0.01), and cardiovascular mortality (p trend = 0.004).

Conclusions Participants with PAD with declining functional performance are at increased risk for later mobility loss and mortality. (J Am Coll Cardiol 2011;57:962–70) © 2011 by the American College of Cardiology Foundation

Men and women with lower-extremity peripheral arterial disease (PAD) have greater functional impairment, faster functional decline, and higher all-cause and cardiovascular disease (CVD) mortality, compared with individuals without PAD (1–3). Previous studies have demonstrated that baseline performance on office-based functional measures predicts subsequent mobility loss and mortality in patients with PAD (4,5).

It is unknown whether greater declines in office-based functional performance measures predict increased subsequent mobility loss or mortality in PAD. Declining performance may indicate deteriorating health associated with increased risk of later outcomes. Among men and women with PAD, we studied associations between 2-year change in lower-extremity performance and subsequent mobility loss and mortality, after the functional change was assessed. Functional performance measures assessed included the 6-min walk test, walking velocity over 4 m at usual and fastest pace, and the short physical performance battery (SPPB). We hypothesized that participants with PAD with greater declines in these functional performance measures over a 2-year period would have higher subsequent rates of mobility loss, all-cause mortality, and CVD mortality,

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compared with participants with PAD with less decline. In secondary analyses, we assessed the relative value of baseline functional performance versus 2-year change in functional performance for predicting later mobility loss and mortality in participants with PAD.

Methods

Participant identification. The institutional review boards of Northwestern University and Catholic Health Partners Hospital approved the protocol. Participants gave written informed consent.

Participants were part of the WALCS (Walking and Leg Circulation Study) and WALCS II prospective, observational studies designed to identify clinical characteristics associated with functional decline and mortality in PAD (2–7). Participants with PAD were identified from among consecutive patients in 3 Chicago-area noninvasive vascular laboratories. Participants in the WALCS cohort were enrolled between 1998 and 2000 and returned annually for up to 8 follow-up visits. Newly identified participants with PAD were enrolled between 2002 and 2004 as part of the WALCS II cohort and returned annually for up to 4 follow-up visits. WALCS participants were age 55 years or older at enrollment (2,3). Newly identified WALCS II participants, enrolled 4 years after the WALCS cohort, were age 59 years and older at enrollment (6). Participants with PAD from the WALCS and WALCS II cohorts were included in this study if they attended a baseline visit and at least 2 annual follow-up visits and continued to be followed for later mortality and/or mobility loss.

All participants had an ankle brachial index (ABI) <0.90 at their baseline visit (2–7). Exclusion criteria have been previously reported (6,7). Briefly, nursing home residents, wheelchair-bound individuals, and lower-extremity amputees were excluded. Potential participants with dementia, non-English speakers, and those with recent major surgery were excluded. Participants who underwent lower-extremity revascularization during the first 2 years of the study, when change in functional performance was evaluated, were excluded from all analyses. Participants who underwent lower-extremity revascularization after the assessment of functional change were excluded from analyses of mobility loss.

ABI measurement. A handheld Doppler probe (Nicolet Vascular Pocket Dop II, Nicolet Biomedical Inc, Golden, Colorado) was used to obtain systolic pressures in the right and left brachial, dorsalis pedis, and posterior tibial arteries (2–7). Each pressure was measured twice. The ABI was calculated by dividing the mean of the dorsalis pedis and posterior tibial pressures in each leg by the mean of the 4 brachial pressures (8). Average brachial pressures in the arm with the highest pressure were used when one brachial pressure was higher than the opposite brachial pressure in both measurement sets and the 2 brachial pressures differed by 10 mm Hg or more in at least 1 measurement set because subclavian stenosis was possible in such cases (9). Zero values (n = 17) for the dorsalis pedis or posterior tibial vessels were excluded from the ABI calculation. The lowest leg ABI was used in analyses.

Abbreviations and Acronyms

ABI = ankle brachial index
BMI = body mass index
CVD = cardiovascular disease
PAD = peripheral arterial disease
SPPB = short physical performance battery

Change in functional performance. All participants underwent baseline measures of functional performance and returned annually for 2 years for assessment of change in functional performance. Change in functional performance between baseline and the 2-year follow-up was studied for its association with subsequent mobility loss and mortality, occurring after the 2-year change in functional performance assessment was assessed.

6-MIN WALK. Following a standardized protocol (10,11), participants walked up and down a 100-foot hallway for 6 minutes after instructions to cover as much distance as possible. The intraclass correlation coefficient for test-retest reliability of the 6-min walk was 0.90 ($p < 0.001$) in our laboratory among 156 participants with PAD who completed the tests approximately 1 to 2 weeks apart (12).

4-M WALKING VELOCITY. Walking velocity was measured with a 4-m walk performed at "usual" and "fastest" pace (2–4,7). For the "usual"-paced walk, participants were instructed to walk at their usual pace, "as if going down the street to the store." Each walk was performed twice. The faster walk in each pair was used in analyses (2–4,7,13,14).

REPEATED CHAIR RISES. Participants sat in a straight-backed chair with arms folded across their chest and stood 5 times consecutively as quickly as possible. Time to complete 5 chair rises was measured (13,14).

STANDING BALANCE. Participants were asked to hold 3 increasingly difficult standing positions for 10 s each: standing with feet together side by side and parallel (side-by-side stand), standing with feet parallel with the toes of one foot adjacent to and touching the heel of the opposite foot (semitandem stand), and standing with one foot directly in front of the other (tandem stand) (13,14).

SPPB. The SPPB combines data from the usual-paced 4-m walking velocity, time to rise from a seated position 5 times, and standing balance. Individuals receive a zero score for each task they are unable to complete. Scores of 1 to 4 are assigned for remaining tasks, based upon quartiles of performance for more than 6,000 participants in the EPESE (Established Populations for the Epidemiologic Study of the Elderly) cohort (13,14). Scores are summed to obtain the SPPB, ranging from 0 to 12.

Mobility measures. At baseline and subsequent follow-up visits, participants were asked whether they were able to walk one-quarter mile and whether they could climb up and down 1 flight of stairs, selecting 1 of the following 3