Research

EFFECT OF REPEATED APPLICATION OF LOW-INTENSITY PULSED ELECTROMAGNETIC FIELDS (PEMF) ON GAIT SPEED IN OLDER ADULTS WITH A HISTORY OF FALLS

To the Editor: Falls in older adults are a major healthcare issue worldwide, being associated with significant mortality, disability, costs and reduction of quality of life.[1,2] In the last 2 decades, several tools have been developed to improve clinician's ability to predict falls and to identify individuals at high risk of falling.[3,4] Gait speed has been demonstrated to be a particularly useful tool.[3,4]

A spectrum of rehabilitative and physical interventions have been shown to improve gait speed and gait parameters in older adults, potentially reducing fall risk.[5] Low-intensity pulsed electromagnetic fields (PEMFs) have been used successfully for fracture healing and bone-implant osteointegration and are being investigated in the management of inflammation and other conditions.[6,7] In an exploratory randomized placebo-controlled trial, a single 10-minute PEMF exposition was found to improve gait parameters in older adults.[7]

To further clarify the beneficial effects of PEMF over the long term, the effect of repeated PEMF exposure on self-selected gait speed was retrospectively assessed in a population of older adults at risk of falls consecutively treated in an outpatient clinic.

METHODS

From the population of subjects treated from February 2012 to January 2013, 266 community-living older adults (91% female, mean age 77.1 ± 5.6) without cognitive impairment (age-adjusted Mini-Mental State Examination score >27)[8] who had fallen at least once in the previous year and were not using drugs for vertigo were selected.

Subjects were assessed at baseline, just before the intervention, and immediately after. Gait characteristics were evaluated using a portable walkway system, which automates the acquisition, analysis, and reporting of objective parameters of gait as the subject walks the walkway with embedded sensors.[3] Self-selected gait speed (cm/s) was considered for the present analysis.

After the baseline assessment, low-intensity pulsed electromagnetic fields, transmitted using a low-power laser (wave length 500–700 nm), low-energy infrared pulsed light (wave length 700–1,050 nm), and transcutaneous electrical nerve stimulation (maximum amplitude 200 V) were administered according to specific characteristics of wave length and shape (TEPS–Triple Energy Postural Stabilization), through six skin electrodes connected to the subject. A detailed description of the procedure has been reported elsewhere.[7] The treatment lasted approximately 10 minutes and was repeated every 2 months for 1 year.

Gait analysis was performed before and after every intervention, and at each visit, subjects were interviewed about falls, clinical events, and new drugs.

Data on self-selected gait speed were described as means ± standard deviations and were compared before and after the treatment for each exposure to PEMF. Categorical data were analyzed using the Fischer exact test, and continuous variables were compared using the dependent-samples *t*-test (paired *t*-test) or the nonparametric asymptotic Wilcoxon signed rank test. Statistical inferences were made on the basis of a two-sided significance level of $P < .05$. All analyses were performed in R version 3.0.1 for Windows (R Foundation for Statistical Computing, www.r-project.org).

RESULTS

Subjects underwent six treatments over 1 year. Gait speed increased significantly after each treatment with respect to baseline as follows: first treatment, from 73.9 ± 31.5 cm/s to 81.3 ± 31.1 cm/s ($P < .001$); second treatment, from 80.2 ± 32.9 cm/s to 88.4 ± 29.8 cm/s ($P < .001$); third treatment, from 77.8 ± 28.3 cm/s to 86.1 ± 30.5 cm/s ($P < .001$); fourth treatment, from 84.4 ± 24.7 cm/s to 90.6 ± 26.4 cm/s ($P < .001$); fifth treatment, from 91.5 ± 23.8 cm/s to 98.4 ± 25.5 cm/s ($P < .001$); sixth treatment, from 94.1 ± 25.5 cm/s to 102.7 ± 25.9 cm/s ($P < .001$). After 1 year, subjects with a baseline gait speed less than 80 cm/s had a mean percentage increase (60.1%) significantly greater than that of those with a baseline value greater than 80 cm/s (8.1%) ($P < .001$).

No subjects reported any falls during the year, and no adverse events were reported.

CONCLUSIONS

These results suggest that continuous exposure to PEMF improves self-selected gait speed in older adults at risk of falling. Although encouraging, these data need to be confirmed in large-scale randomized placebo-controlled trials lasting at least 1 year.

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REFERENCES

1. Verghese J, Holtzer R, Lipton RB et al. Quantitative gait markers and incident fall risk in older adults. J Gerontol A Biol Sci Med Sci 2009;64A:896–901.
2. Studenski S, Perera S, Patel K et al. Gait speed and survival in older adults. JAMA 2011;305:50–58.
3. Shore WS, deLateur BJ, Kuhlemeier KV et al. A comparison of gait assessment methods: Tinetti and GAITRite electronic walkway. J Am Geriatr Soc 2005;53:2044–2045.
4. van Uden CJ, Besser MP. Test-retest reliability of temporal and spatial gait characteristics measured with an instrumented walkway system (GAITRite). BMC Musculoskelet Disord 2004;5:13.
5. El-Khoury F, Cassou B, Charles MA et al. The effect of fall prevention exercise programmes on fall induced injuries in community dwelling older adults: Systematic review and meta-analysis of randomised controlled trials. BMJ 2013;347:6234.
6. Guo L, Kubat NJ, Isenberg RA. Pulsed radio frequency energy (PRFE) use in human medical applications. Electromagn Biol Med 2011;30:21–45.
7. Giusti A, Giovale M, Ponte M et al. Short-term effect of low-intensity, pulsed, electromagnetic fields on gait characteristics in older adults with low bone mineral density: A pilot randomized-controlled trial. Geriatr Gerontol Int 2013;13:393–397.
8. Folstein MF, Folstein SE, McHugh PR. 'Mini-mental state'. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–198.

ASSOCIATION BETWEEN HEARING IMPAIRMENT AND FRAILTY IN OLDER ADULTS

To the Editor: Frailty is characterized by low physiological reserve and vulnerability to stressors and has been defined in epidemiological studies as being present when three or more of the following criteria are met: unintentional weight loss, slow walking speed, weakness, exhaustion, and low physical activity.[1] Frailty is independently associated with falls, disability, hospitalization, cognitive impairment, and death.[1,2] Whether hearing impairment, which is independently associated with physical and cognitive decline, is also associated with frailty is unknown. An exploratory cross-sectional study was conducted to investigate the association between self-reported hearing impairment and frailty.

METHODS

Data were analyzed from 2,109 individuals aged 70 and older in the 1999 to 2002 cycles of the National Health and Nutrition Examination Survey (NHANES), a nationally representative cross-sectional study that is representative of the noninstitutionalized, civilian U.S. population.

Hearing impairment was measured according to self-report, and individuals were classified as having good to a little trouble hearing versus a lot of trouble hearing. Frailty was defined according to a previous study that investigated frailty in NHANES using the following criteria: 5% or greater unintentional weight loss in the last year or body mass index less than 18.5 kg/m^2, 20-foot gait speed in the lowest sex-adjusted quintile, self-reported weakness (some or much difficulty lifting or carrying an object as heavy as 10 pounds or unable to do), self-reported exhaustion (some or much difficulty walking from one room to another or unable to do), and self-reported low physical activity (participant report of being less active than individuals of the same age).[3] Participants with three or more criteria were classified as frail, those with one or two criteria were classified as prefrail, and those with no criteria were classified as not frail. Individuals were classified in analyses as being not frail versus prefrail or frail. Trained technicians evaluated gait speed while participants completed a 20-foot usual-pace walk.

Differences in demographic and general health characteristics according to hearing status were analyzed using chi-square tests. The association between self-reported hearing impairment and frailty was examined using stepwise logistic regression models adjusted for demographic factors, cardiovascular risk factors, health status, and hearing aid use. Effect modification by sex was explored in stratified analyses Table 1.

Sample weights we used to account for the complex sampling design according to National Center for Health Statistics guidelines. Analyses were performed using Stata (StataCorp, College Station, TX), and statistical significance was defined as two-sided $P < .05$.

RESULTS

Demographic characteristics differed according to hearing status, with individuals with greater hearing impairment more likely to be older, male, Caucasian, and frail. The association between self-reported hearing impairment and frailty was analyzed using stepwise logistic regression. Self-reported hearing impairment was associated with frailty in a fully adjusted model (odds ratio (OR) = 1.68, 95% confidence interval (CI) = 1.00–2.82). When stratified according to sex, hearing was significantly associated with frailty in women (OR = 3.79, 95% CI = 1.69–8.51) but not men (OR = 0.85, 95% CI = 0.44–1.66). Hearing aid use was not significantly associated with frailty in men (OR = 0.82,