Archives of Gerontology and Geriatrics 59 (2014) 554–561

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

The relationship between physical performance and cardiac function in an elderly Russian cohort

Pulod Tadjibaev [a], Elena Frolova [a], Natalia Gurina [a], Jan Degryse [b,c], Bert Vaes [b,c,*]

[a] Department of Family Medicine, The North-Western State Medical University named after I.I. Mechnikov, St. Petersburg, Russian Federation
[b] Institute of Health and Society, Université catholique de Louvain (UCL), Brussels, Belgium
[c] Department of Public Health and Primary Care, Katholieke Universiteit Leuven (KUL), Leuven, Belgium

ARTICLE INFO

Article history:
Received 22 May 2013
Received in revised form 1 August 2014
Accepted 4 August 2014
Available online 12 August 2014

Keywords:
Cardiac dysfunction
Physical performance
Mortality

ABSTRACT

This study aims to determine the cardiac dysfunction prevalence, to investigate the relationship between the Short Physical Performance Battery (SPPB) test and structural and functional echocardiographic parameters and to determine whether SPPB scores and cardiac dysfunction are independent mortality predictors in an elderly Russian population. A random sample of 284 community-dwelling adults aged 65 and older were selected from a population-based register and divided into two age groups (65–74 and ≥75). The SPPB test, echocardiography and all-cause mortality were measured. The prevalence of cardiac dysfunction was 12% in the 65–74 group and 23% in the ≥75 group. The multivariate models could explain 15% and 23% of the SPPB score total variance for the 65–74 and ≥75 age groups, respectively. In the younger age group, the mean follow-up time was 2.6 ± 0.46 years, and the adjusted hazard ratio (HR) for risk of mortality from cardiac dysfunction was 4.9. In the older age group, the mean follow-up time was 2.4 ± 0.61 years, and both cardiac dysfunction and poor physical performance were found to be independent predictors of mortality (adjusted HR = 3.4 and adjusted HR = 4.2, respectively). The cardiac dysfunction prevalence in this elderly Russian population was found to be comparable to, or even lower than, reported prevalences for Western countries. Furthermore, the observed correlations between echocardiographic abnormalities and SPPB scores were limited. Cardiac dysfunction was shown to be a strong mortality predictor in both age groups, and poor physical performance was identified as an independent mortality predictor in the oldest subjects.

1. Introduction

The health-care and social-security programs of industrialized countries across the world are confronted with the problem of aging populations. In 2010, people over the age of 65 accounted for 16% of the total population of the European Union, and this proportion is projected to rise to 28% by 2050 (Population projections, http://epp.eurostat.ec.europa.eu). Similarly, in 2010, 40.2 million people in the United States of America (13% of the population) were over the age of 65, and this number is projected to rise to 88.5 million (20% of the population) by 2050 (Projected future growth, http://www.aoa.gov). Unavoidably, this so-called 'gray epidemic' will lead to higher burdens of chronic disease, functional decline and disability for these industrialized nations.

Russia is currently facing an important demographic transition. Over the next 15 years, the population will continue to age and is expected to shrink by 12% due to high mortality and a low birth rate (Anos-Casero, Ulatov, & Emelyanova, 2007). In particular, the cardiovascular disease (CVD) death rate in Russia, which mainly affects middle-aged men, is among the world's highest (829 per 100,000 people) (Population by age groups, http://www.gks.ru.2010). However, these demographic changes have also resulted in a growing population of CVD survivors. Considering that the proportion of people over the age of 65 in Russia is projected to rise from 14% in 2005 to 26% by 2050 (Pirozhkov, Safarova, & Shcherbov, 2007), the high burden of CVD in this population is of great concern. The Crystal study showed that 85% of people aged 65–74 had at least one cardiovascular (CV) morbidity and that 50% had two or more; for people over the age of 75, these numbers rose to 89% and 54%, respectively (Gurina, Frolova, & Degryse, 2011).

The 'cardiovascular continuum' created by Braunwald and Dzau describes the progression from risk factors to asymptomatic cardiac dysfunction and eventually to symptomatic heart failure

* Corresponding author at: Clos Chapelle-aux-Champs, 30 bte 30.15, 1200, Woluwe-Saint-Lambert (UCL-Brussels), Belgium. Tel.: +32 2 7643460; fax: +32 2 7643470.
E-mail address: Bert.Vaes@uclouvain.be (B. Vaes).

http://dx.doi.org/10.1016/j.archger.2014.08.003
0167-4943/

and death (Dzau & Braunwald, 1991). With respect to populations with a high burden of CV morbidity, one might also expect to see prevalent and frequent instances of cardiac dysfunction and heart failure. However, until now, data on the prevalence and incidence of cardiac dysfunction and heart failure in the older Russian population have been extremely scarce.

A high burden of CV morbidity could also lead greater numbers of people with impaired physical abilities. The Short Physical Performance Battery (SPPB) is a reliable indicator of adverse outcomes, including mortality and the development of new disabilities (Guralnik et al., 1994). However, the relationship between SPPB scores and indicators of cardiac dysfunction has not been extensively studied in older populations (Vaes et al., 2012).

Therefore, this substudy of the Crystal Study was carried out to (1) estimate the prevalence of cardiac dysfunction in the aging Russian population, (2) investigate the relationship between the SPPB and both structural and functional echocardiographic parameters and (3) determine whether the SPPB and cardiac dysfunction are independent predictors of mortality.

2. Materials and methods

2.1. Study population

The Crystal Study is a prospective cohort study of community-dwelling individuals aged 65 and older living in the Kolpino district of St. Petersburg, Russia. The study design and the characteristics of the population have been described in detail previously (Gurina et al., 2011). In brief, of the 10,986 eligible subjects aged 65 and older, random samples were selected from the 65–74 ($n = 462$) and the ≥ 75 ($n = 452$) age groups; the participation rates were 66% ($n = 305$) and 68% ($n = 306$), respectively. All data were collected between March 2009 and July 2010. All participants were tracked for mortality until the census date of July 1, 2012. This study was approved by the local ethics committee of the North-Western State Medical University named for I. I. Mechnikov, and informed consent was obtained from all the respondents.

2.2. Clinical characteristics

Dyspnea symptoms were registered based on the Medical Research Council (MRC) dyspnea scale (Fletcher, 1960). Details concerning past and current medical problems were collected based on medical histories and/or medical records. Non-cardiovascular morbidities were defined as any of the following: obstructive pulmonary disease, asthma, Parkinson's disease, cancer, osteoarthritis, rheumatoid arthritis and renal disorders. Cardiovascular morbidities – with the exception of specific cardiac diagnoses – were defined as any of the following: peripheral artery disease, stroke, diabetes mellitus and arterial hypertension. Incidences of incontinence, vision decline and hearing decline were also systematically recorded. Values representing the total number of morbidities per patient (range 0–13) were used in the analyses.

The Short Physical Performance Battery (SPPB) consists of timed measures of the following activities: quickly walking, rising from a chair, putting on and taking off a cardigan and maintaining balance in a tandem stand (Guralnik et al., 1994). The activities were timed by specially trained clinical research assistants who were blinded to the echocardiograph results of the participants. Categories were created for each set of performance measures to allow for analysis of data from participants who were unable to perform a given task. For the walking, chair-stand and cardigan tests, those who could not complete the task were assigned a score of 0. Those who completed the task were assigned a score between 1 and 4 based on the gender- and age-specific quartiles they fell in, with a score of 4 corresponding to the fastest times. For the tandem-stand balance test, a score of 0 was assigned to those who were either unable to perform the test or who could only maintain the tandem stand for less than 3 s. Those who could maintain a tandem stand for longer than 3 s but less than 10 s were assigned a score of 1; those who could maintain a tandem stand for 10 s or more were assigned a score of 2. A summary performance scale (ranging from 0 to 14) was created by summing the scores from the individual tests. 'Poor physical performance' was defined as belonging to the lowest gender- and age-stratum-specific tertile of the total score.

2.3. Echocardiography

The echocardiograms were performed in randomly selected patients of the entire cohort by a single cardiologist (blinded to all other test results) using a commercially available portable system (M5; Mindray, Shenzhen, China). Participants who were not able to travel to the research center were examined in their homes. All participants were examined in the left lateral decubitus position. Complete examinations – consisting of standard parasternal short-axis, long-axis, apical and subcostal 2-dimensional views – were performed according to the recommendations of the American Society of Echocardiography and the European Society of Echocardiography (Lang et al., 2005). The images were saved on an external hard drive, and a random sample of 30 echocardiograms was re-evaluated for quality by two independent experts. The intra-class coefficient (ICC), as an index of inter-rater reliability, was measured for the left ventricle (LV) ejection fraction and the E/A (early transmitral inflow wave peak velocity/atrial transmitral inflow wave peak velocity).

LV function was assessed using the Simpson biplane method (Lang et al., 2005). Left atrial (LA) volume was measured using the biplane area-length formula (Lang et al., 2005).

The mitral, aortic and tricuspid valves were evaluated using color Doppler echocardiography after optimizing the gain settings and determining the Nyquist limit of the imaging system. Standard, continuous and pulsed-wave Doppler recordings were acquired. Stenotic and regurgitant valve diseases were evaluated using the semiquantitative and quantitative methods recommended by the American Society of Echocardiography (Quinones, Otto, Stoddard, Waggoner, & Zoghbi, 2002; Zoghbi et al., 2003). Clinically relevant valvular heart disease (VHD) was defined as a mitral stenosis of any severity, severe aortic stenosis (aortic valve area <1 cm^2), severe mitral regurgitation or severe aortic regurgitation.

Diastolic parameters were measured in subjects lacking mitral stenosis, severe mitral regurgitation and atrial fibrillation (Fig. 1). Diastolic function was assessed using mitral-flow velocities obtained from the pulsed Doppler recordings (Nagueh et al., 2009). Diastolic dysfunctions were defined using the ASA-EAE guidelines (Nagueh et al., 2009).

Echocardiographic abnormalities were defined using previously published cut-off values (Dickstein et al., 2008; Lang et al., 2005; Nagueh et al., 2009; Vaes et al., 2012). Cardiac dysfunction was defined as one or more of the following conditions: systolic dysfunction (LVEF $\leq$ 50%), VHD or isolated moderate/severe diastolic dysfunction (Fig. 1).

2.4. Statistical analysis

Continuous data are presented as mean values with the standard deviation (SD) or as median values with the interquartile range (IQR). Categorical data are presented as numbers and frequencies. Differences between subjects with and without echocardiography and differences between subjects with poor and normal performance were calculated separately for each age