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Original research article

Is the Clock Drawing Test useful in the screening assessment of aged patients with chronic heart failure?

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ABSTRACT

Purpose: Cognitive impairment is one of the most common geriatric deficits in old patients with heart failure (HF), but there has been a lack of study on the utility of the Clock Drawing Test (CDT) when used with this group of patients. The aim of the study was to assess the usefulness of the CDT in the geriatric assessment of aged outpatients with chronic HF.
Patients and methods: A cross-sectional analysis of the results of the comprehensive geriatric assessment (CGA), including the CDT, of 92 aged outpatients with heart failure was conducted.
Results: We found a high prevalence of five examined geriatric problems. The majority of the patients presented signs of cognitive deterioration of different patterns and severity on the Clock Drawing Test. All the CDT scoring systems correlated significantly with the Mini-Mental Test Examination results.
Conclusions: It seems reasonable to perform the routine CGA with the CDT examination in all aged heart failure patients.

1. Introduction

Populations worldwide are ageing. It is said that by 2050 the percentage of aged people in communities will reach up to 16% [1]. Advanced age, in terms of both successful ageing as well as senescence, is associated with an inevitable accumulation of some deficits and diseases [2]. Chronic heart failure (HF) is one of the most frequent cardiovascular chronic conditions in the old adults [3]. In older adults with multimorbidity, HF is often found to be an index condition that determines patients' short and long-term prognosis [4].

The crucial question seems to be how to optimize symptom and drug management, and thus reduce social and economical burden in aged heart failure patients.

An important problem is cognitive impairment (CI). The risk for CI and exposure to or occurrence of cardiovascular risk factors increases with age [3,5]. According to the 'heart failure-cognition' paradigm, the association between HF and acute and chronic cognition deterioration is evident and well-proven [3,6]. Cognitive problems accompanying heart failure encompass the progressive chronic cognitive deterioration corresponding to the mild cognitive impairment of different modalities (multi-domain, amnestic, and non amnestic) and dementia, as well as an acute onset delirium. The most plausible mechanisms include reduced ejection fraction and hemodynamic abnormalities resulting in a decreased cardiac output with cerebral hypoxia, impairment of brain autoregulation and microemboli, all in all, altogether with small vessel disease leading to ischemic brain damage and cognitive dysfunction [7,8]. It has been shown that patients with HF and CI are at a higher risk for drug errors, unnecessary doctors' appointments and hospital admissions, higher rates of re-hospitalization, greater need for home-care, institutionalization or long-term care, and risk of death. What is more, they tend not only to not adhere to the drug regimens prescribed to them or follow the diet and lifestyle modification, but also neglect initial symptoms and signs of heart failure decompensation [7].

Furthermore, it is widely known that if older adults suffer from geriatric deficits and disabilities, it in unison negatively affects their self-care independence, mood and well-being, and the quality of life [2]. As current medicine research has made it possible to treat symptoms of the patients with cognitive deficits corresponding diagnosis of dementia pharmacologically and non-pharmacologically, it is of great importance to screen for and treat dementia as soon as possible [9]. A large selection of cognitive screening tests is available [6,10,11]. From the clinicians' point of view, an optimal tool has to be an easy-to-use, simple to perform and analyze, and time-efficient instrument [11]. The Clock Drawing Test (CDT) is a cognitive screening tool that is used to detect deterioration of the visuoconstructive and visuospatial skills.

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Nevertheless, it has been proven that the process of correct clock drawing and clock setting require not only intact space perception and constructional skills, but also auditory comprehension, numerical knowledge, semantic memory, abstract thinking, concentration and frustration tolerance, and accurate executive functioning [12–14].Recognizing the CDT clinical utility and its neuropsychological modalities, we decided to check the applicability of the Clock Drawing Test in the geriatric screening assessment of aged patients with chronic heart failure, with a particular emphasis on functional deficits and executive function deterioration due to cognitive impairment. The aim of the analysis was to evaluate the usefulness of the Clock Drawing Test as a first-line screening tool for distinction between aged heart failure patients with and without the most common geriatric problems, i.e. mood disorders, executive function impairment, malnutrition, falls, and functional impairment. An additional aim was to analyze the frequency of occurrence of those five geriatric problems in the heart failure outpatients population of older adults. We hypothesized that aged patients with HF who revealed any abnormalities on the CDT examination, would be at greater risk for geriatric problems, including executive function impairment and functional dependence.

2. Patients and methods

The results are part of a prospective observational, multicomponent study on functional and cognitive performance of aged patients with chronic heart failure.

The subjects were recruited from the patients of the outpatient clinic of the tertiary-care teaching hospital.

Inclusion criteria:

- age $\geq$60 years,
- presence of stable chronic heart failure at the time of examination,
- Mini
- Mental State Examination (MMSE) result $\geq$ 20 points,
- informed consent.

Exclusion criteria:

- neoplastic diseases,
- diagnosis of dementia.

The presented analysis was based on the cross-sectional medical data of 92 patients at the age of 60 years and older with stable chronic heart failure at the time of examination. HF-related symptoms were classified by the New York Heart Association (NYHA) Functional Classification from I to III [15]. The study was performed according to the Helsinki Declaration with the approval of the Ethics Committee. Written consents were obtained from all examined patients.

2.1. Study procedures- the elements of the comprehensive geriatric assessment

All the subjects had a comprehensive geriatric assessment (CGA) performed. It included the screening assessment for cognitive impairment, mood disorders, functional deficits and disabilities, malnutrition and falls.Cognitive functions were screened with the use of the Mini-Mental State Examination and the Clock Drawing Test [16,12]. MMSE is a screening tool commonly used for the routine assessment of cognitive functions in the elderly, invented and introduced by Folstein et al. in 1975. The questionnaire consists of 10 domains with the items testing the subject's temporal and spatial orientation, attention and calculation, working memory and registration, visuospatial and language functions, and the ability to follow a simple 3-stage command. It is scored from 0 to 30 points maximum, with the lowest scores being indicative of cognitive impairment [16]. In the presented analysis we included the subjects who achieved $\geq$ 20 MMSE points. If the subject was rated below 27 MMSE points in accordance with the National Institute for Health and Care Excellence (NICE) 2011 guidelines, cognitive impairment was suspected [9]. None of the analyzed subjects had a previous diagnosis of dementia nor had been treated with acetylcholinesterase inhibitors nor/and mementine nor had taken any neuroleptic drugs.The Clock Drawing Test is a well-known cognitive screening instrument which focuses on the assessment of visuoconstructive and visuospatial skills [12]. In our study, the subjects were first given the pre-drawn circle 14 cm in diameter and asked to "place the numbers on the circle to make it look like a clock" (Sheet 1). When they did their best, the subjects were given the next two pre-drawn clock faces and were asked to set the specific time (3:00 and 11:10 o'clock, respectively Sheet 2 and 3). They were not allowed to look at a watch or another clock for help. There was no time limit for the tasks.The modified Sunderland et al., Shulman et al., Goodglass and Kaplan, and Watson et al. criteria were employed in the analysis [17,12,18–20]. The completed sheets were rated independently by the three geriatricians involved in the study. In the case of discordant results between the raters, a consensus approach was implemented. As we were finally presented with three different CDT- sheets for evaluation, i.e. the pre-drawn circle with the numbers being put on by the subject, and the two pre-drawn clock faces with 3:00 and 11:10 o'clock being denoted, we decided to evaluate it as two tasks. It means that in both the modified Sunderland et al. and modified Shulman et al. scales, the subjects were given two scores. The points were given for drawing the clock face in a pre-drawn circle (Sheet 1) and then putting the clock hands in the pre-drawn clock faces, considered separately for 3:00 o'clock (Sheet 1 + 2) and 11:10 o'clock (Sheet 1 + 3). Goodglass and Kaplan, and Watson et al. scoring systems were then employed. The Goodglass and Kaplan method was used only for the evaluation of the position and length of the clock hands (Sheet 2 and 3), and the Watson et al. method was used only for the assessment of the proper clock face representation (Sheet 1). All the used original CDT error classifications were presented in Table A.1 (Supplementary material). Abnormal results were as follows: $\leq$8 points for the Sunderland et al. scoring system, $\leq$ 3 points for the modified Shulman et al., $\leq$ 2 points for the Goodglass and Kaplan, and $\geq$ 1 point for the Watson et al. scoring system.

Mood was screened with the Geriatric Depression Scale (GDS) [21]. The GDS questionnaire, which was introduced for older adults by Yesavage et al. in 1983, comprises of 30 "yes" or "no" questions about the subject's mood over the last week before the examination [21]. Mood disorders were suspected if the subject reached 11 out of 30 points maximum or was treated with antidepressant drugs.

Functional performance was assessed with the Activities of Daily Living Scale (ADL, Katz scale) and the Instrumental Activities of Daily Living Scale (IADL, Lawton scale) [22,23].The Activities of Daily Living Scale is a short screening instrument, invented by Katz et al. in 1970, assessing subject's independence in six basic activities of every-day life such as: dressing, toileting, transferring, eating, bathing, incontinence [22]. Functional disability was suspected if the subject was scored at $\leq$ 4 out of maximum 6 points in ADL scale.

The Instrumental Activities of Daily Living Scale was set by Lawton et al. in 1969 for evaluation of subject's independence in eight items such as: ability to use the telephone, shopping, food preparation, housekeeping, laundry, mode of transportation, responsibility for own medication, ability to manage their finances