Assessment of Frailty in Older Adults with Cardiovascular Diseases in a Rehabilitation Program: A Retrospective Study

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Abstract

Introduction: Frailty syndrome is a multifactorial phenomenon that increases vulnerability in older adults, compromising their functional capacity. Frailty is associated with cardiovascular diseases (CVD) and can be mitigated through appropriate interventions.

Objectives: Thus, the study aims to evaluate the vulnerability index associated with cardiovascular diseases and the performance in functional tests applied to participants in the

cardiovascular rehabilitation program.

Methods: This is a descriptive, retrospective study based on data from 10 patient records aged ≥60 years who participated in a cardiovascular rehabilitation program at the Federal University of Uberlândia. The tests analyzed included the 1-Minute Sit-to-Stand Test (STS), Timed Up and Go (TUG), and 6-Minute Step Test (6MWT), along with the Clinical Frailty Scale (CFS).

Results: The tests showed improvements in functional indices after rehabilitation, with significant increases in performance in the STS and 6MWT. However, the mean functional capacity, as assessed by the CFS, did not show significant improvement.

Conclusion: Cardiovascular rehabilitation proved effective in improving some functional parameters in frail older adults but did not impact the overall mean functional capacity. Future studies with longer intervention periods may provide clearer insights into these findings.

Keywords: Frailty, Cardiovascular Diseases, Cardiovascular Rehabilitation, Functional Tests, Older Adults.

Introduction

Frailty syndrome is multisystemic in nature and is associated with increased vulnerability in the elderly, thereby leading to a reduction in gait, functional decline, sarcopenia, exhaustion, and self-reported fatigue, all of which, in turn, compromise the individual's ability to perform daily activities (MARTIN et al., 2008).

Given the relevance of frailty in cardiovascular medicine, it is crucial to recognize that various disease processes can contribute to physical impairments, ultimately exacerbating cardiovascular conditions. Frailty, with its multifactorial origins, encompasses several domains, including physical, cognitive, nutritional, and psychosocial aspects, highlighting the need for a multidisciplinary approach (Ljaz et al 2022).

Moreover, frailty is a modifiable process; if identified early and depending on the interventions and assessment tools used, a patient may transition from being frail to non-frail over time, thereby demonstrating that frailty can indeed be reversed (GIL et al., 2006).

As age advances, there is an increased prevalence of chronic non-communicable

diseases, including cardiovascular diseases (FRISOLI et al., 2018). These are strongly associated with frailty syndrome, forming a bidirectional relationship—frailer patients tend to experience greater cardiovascular complications, while cardiovascular disease can, in turn, lead to an increase in frailty (GIL et al., 2006).

Furthermore, restricted mobility has been a key component in the assessment of frailty (PORTEGIJS et al., 2016). Given that muscle mass and strength are critical determinants, there are significant associations between functional tests and the evaluation of vulnerability, thereby highlighting the considerable impact of exercise in improving these metrics.

In order to assess the relationship between frailty and cardiovascular diseases in older adults, this study intends to evaluate their performance in specific functional tests during a cardiovascular rehabilitation program.

Objectives

The study aims to analyze the relationship between frailty and cardiovascular diseases in older adults, focusing on the impact of frailty on their health outcomes. It also seeks to evaluate the performance of these individuals in functional tests administered during a cardiovascular rehabilitation program. By investigating these aspects, the research will provide insights into how frailty influences both disease progression and recovery. Understanding these dynamics is essential for developing tailored rehabilitation strategies to improve patient outcomes.

Methods

This is a descriptive, retrospective study involving the analysis of medical records of older adults (≥60 years) who participated in the outpatient cardiovascular rehabilitation program at the Federal University of Uberlândia from April 2022 to August 2023. Records of 10 patients were included for the STS and TUG tests, and 8 patients for the 6MWT.

Functional Tests Assessed:

1. *1-Minute Sit-to-Stand Test (STS):* Assesses flexibility, balance, and motor coordination. Patients repeatedly sit down and stand up from a standard chair for 1 minute. Heart rate, blood pressure, and oxygen saturation are monitored before and after the test.

2. *Timed Up and Go (TUG):* Assesses dynamic balance. The patient stands up from a chair, walks 3 meters, navigates around a cone, and returns. The total time is recorded, with longer times indicating a higher risk of falls.

3. *6-Minute Step Test (6MWT):* The patient ascends and descends a 20 cm step as quickly as possible for 6 minutes. Peak oxygen consumption (VO2peak) is estimated.

Inclusion criteria: Medical records were included for retrospective analysis of elderly patients, aged over 60, regardless of gender, who were able to perform the tests and had cardiovascular disease, having completed the outpatient rehabilitation program between April 2021 and April 2023.

Exclusion criteria: Participants under the age of 60, those who did not complete the cardiovascular rehabilitation program, or those unable to perform the functional test were excluded.

Statistical Analysis: Friedman test was used for statistical analysis, with $p < 0.05$ considered significant.

Results

In this study, 15 older adults aged between 60 and 80 years participated, with a mean age of 70 years. The analysis considered individual classification criteria such as cardiovascular disease (CVD), hypertension, dyslipidemia, and diabetes. The frequencies of cardiovascular diseases (CVD) were detailed, including various conditions such as coronary artery disease (CAD), multi-vessel disease/heart failure with reduced ejection fraction (HFrEF), single-vessel coronary artery disease, heart failure, myocardial infarction (MI), ischemic heart disease without ST-segment elevation (NSTEMI), among others. Dyslipidemia was present in 60% of the participants, while 53.3% had hypertension, and 40% had diabetes. Statistical analysis of individuals aged 60 years and older revealed significant improvements in participants who underwent cardiovascular rehabilitation (RC) in the physical therapy outpatient clinic. Notably, the post-rehabilitation Clinical Frailty Scale (CFS Post-RC) scores were better than pre-rehabilitation (CFS Pre-RC), indicating an improvement in frailty.

The results of the three tests were analyzed based on medical records of participants in the cardiovascular rehabilitation outpatient clinic. For the STS and TUG tests, ten patients were

evaluated (5 men and 5 women, aged 60-80 years, mean age 69.2±7.46). Results obtained were as follows: CFS Pre-RC was 4.9±0.87 (slightly/moderately frail) and Post-RC was 3.6±1.50 (vulnerable/fair) (p<0.001); STS Pre-RC was 20±4.13 and STS Post-RC was 24±7.36 (p<0.001); TUG Pre-RC was 11.23±4.00 and Post-RC was 10.30±2.66 (p>0.999).

The estimated mean VO2peak based on TUG performance Pre-RC was 13.21±3.39 and Post-RC was 14.25±3.34 (p=0.555). There was a strong positive correlation between CFS and TUG Post-RC (rs=0.667) and a strong negative correlation between CFS and VO2peak Pre-RC (rs=-0.719). In the 6MWT, eight patients were evaluated (4 men and 4 women, aged 60-80 years, mean age 65.8±6.94).

The number of steps in the 6MWT Pre-RC was 74.50±30.47 and Post-RC was 95.80±40.19 (p<0.001); VO2peak predicted by 6MWT performance was 17.60±2.96 ml/kg/min Pre-RC and 19.30±3.79 ml/kg/min Post-RC (p<0.001); CFS Pre-RC was 5.00±0.91 (slightly/moderately frail) and Post-RC was 3.60±1.69 (vulnerable/fair) (p<0.001). Participant data are presented in Table 2. There was a strong and significant correlation between CFS and 6MWT Pre-RC, with a Spearman's rho of -0.817; no correlation was observed between 6MWT and CFS Post-intervention.

Table 1: Data on the individual performance of patients evaluated by performance in TUG and STS.

	Age	Gender	Before RCV				After RCV			
			CFS	STS	TUG	VO$_{2peak}$	CFS	STS	TUG	VO$_2$ peak
Patient 1	61	F	4	19	7,09	16,36	1	24	7,82	15,82
Patient 2	64	F	5	14	12,3	12,06	4	15	8,45	14,91
Patient 3	71	F	5	18	10	12,18	3	22	9,59	11,84
Patient 4	70	F	4	16	10,7	12,11	3	16	11,2	11,24
Patient 5	75	F	6	24	11	12,01	5	26	12,6	10,18
Patient 6	69	M	5	25	10,2	17,05	4	40	12,6	17,44
Patient 7	80	M	6	16	8,43	9,11	6	17	7,9	12,39
Patient 8	62	M	4	26	17	16,83	2	26	12,8	17,95
Patient 9	60	M	4	22	15,4	16,82	3	25	14,2	19,63
Patient 10	80	M	6	20	10,2	7,61	5	29	8,62	11,11

TUG: VO2 peak = 33,553 + (−0,149*age) + (−0,738*TUG) + (−2,870*gender); with a value of 0 being assigned to males and 1 to females.

Table 2: Data on the individual performance of the patients evaluated by the 6MWT.

	Age	Gender	Before RCV				After RCV				Predicted values	
			CFS	6MWT	VO$_2$	Abillity CR	CFS	6MWT	VO$_2$	Ability CR	6MWT	VO$_2$
Patient 1	61	F	4	90	18,3	Regular	1	132	21,4	Good	109,95	20,25
Patient 2	64	F	5	43	14,4	Low	4	55	15,3	Low	106,8	16,43
Patient 3	70	F	4	48	14,2	Low	3	52	14,5	Low	100,5	16,2
Patient 4	69	M	5	52	16,6	Lower	4	89	19,4	Low	136,55	16,6
Patient 5	80	M	6	44	14,9	Lower	6	51	15,4	Lower	125	14,9
Patient 6	62	M	4	102	20,9	Low	2	106	21,4	Regular	143,9	21,05
Patient 7	60	M	4	103	21,3	Regular	3	152	25	Regular	146	21,33
Patient 8	60	F	3	114	20,2	Low	1	129	21,7	Low	111	22,15

CR: cardiorespiratory; VO2 expressed in ml/kg/min; F: female; M: male. Fitness for men between 60-80 years old and VO2 <17 very low, 17-21 low, 22-25 regular, 26-31 good and for women between 60-80 years old and VO2 <13 lower, 13-16 low, 17-19 regular, 10-22 good. 6MWT predicted: {209 - (1.05 x age [years]) =men {174 – (1.05x age [years]) women =}. Predicted VO2 peak number for men {=19.6 + (0.075 x 6MWT) - (0.10 x Age)} and for women {= 19.6 + (0.075 x 6MWT) - (0.10 x Age) – 2}.

Discussion

The results of this study underscore the association between frailty and reduced functional capacity in older adults with cardiovascular diseases (CVD). The increasing prevalence of chronic diseases and frailty among the elderly has been well-documented, particularly in the context of the accelerated aging population observed in Brazil. According to IBGE (2022), the number of individuals aged 60 and older has significantly risen, highlighting the need for effective strategies to manage the health of this population.

Frailty syndrome, characterized by reduced physiological reserve and increased vulnerability to stressors, is closely related to sarcopenia, which is the progressive and generalized loss of muscle mass and strength. Previous studies, such as those by Pícoli et al. (2011), have shown that sarcopenia significantly contributes to increased frailty in older adults. This aligns with our findings that functional decline, as assessed through the STS, TUG, and 6MWT tests, is directly associated with the degree of frailty measured by the CFS.

In this context, other studies have indicated that the epigenetic regulation of the gene encoding ASC, an adaptor protein involved in pro-inflammatory signaling, plays a significant role. It has been observed that exercise increases methylation and reduces the expression of

ASC in the peripheral blood of older individuals and patients with heart failure. ASC methylation was correlated with decreased plasma levels of IL-1β and improved performance in 6-minute walk tests among heart failure patients (Hastings et al., 2023)

The European Working Group on Sarcopenia in Older People (EWGSOP) defines sarcopenia as a syndrome negatively impacting muscle contraction, strength, balance, and coordination—factors crucial for elderly autonomy. This group also highlights that sarcopenia is associated with an increased risk of falls and mortality, aspects evidenced by the TUG results, where longer times indicate a higher fall risk and decreased functional capacity. Furthermore, frailty in individuals with chronic heart failure is significantly correlated with an approximately 1.5 times higher likelihood of death and the need for hospitalization. (Yang et al., 2018)

The STS test, which assesses the ability to sit and stand repeatedly within one minute, proved effective in identifying frailty levels. Patients who performed more repetitions in this test tended to show lower degrees of frailty, as measured by the CFS. This finding aligns with the literature indicating the STS test as a sensitive indicator of muscle strength and functional capacity in older adults (Araújo et., 1999).

Furthermore, the 6MWT, which measures the number of steps ascended and descended within six minutes, demonstrated significant improvement following cardiovascular rehabilitation, with an increase in the number of steps and peak VO2, suggesting an enhancement in functional capacity. The observed correlation between 6MWT results and CFS reinforces the utility of this test in evaluating frailty and functional capacity in older adults with CVD.

Lastly, the bidirectional relationship between CVD and frailty should be emphasized. Frail individuals are at higher risk of cardiovascular complications, while the presence of CVD can exacerbate frailty. Cardiovascular rehabilitation, therefore, plays a crucial role in mitigating these effects and improving the quality of life in the elderly.

These results suggest that frailty should be a key factor in planning cardiovascular rehabilitation interventions, aiming not only to improve functional capacity but also to reduce the degree of frailty. Rehabilitation, by improving functional parameters and VO2, may help mitigate the adverse effects of frailty and contribute to greater autonomy and quality of life in older adults.

Conclusions

The cardiovascular rehabilitation program demonstrated effectiveness in improving specific functional parameters. However, there was no significant change in the overall mean functional capacity of participants, as measured by the CFS. Future research should explore the efficacy of more extended interventions to better understand their impact on frailty and functional outcomes.

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