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Original article

Predicting falls with the cognitive timed up-and-go dual task in frail older patients

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ABSTRACT

Background: The cognitive timed up-and-go dual task (CogTUG) has been proposed to improve the performance of the timed up-and-go (TUG) test for predicting falls in older patients and as a screening tool for early detection of frailty. We aimed to determine whether the CogTUG score is associated with a history of falls in frail older outpatients with gait disorders.
Methods: This retrospective study involved outpatients >75 years old with or without previous falls who were admitted from 2012 to 2014 to a geriatric day hospital for gait disorders. Patients took the TUG and CogTUG tests on the day of comprehensive geriatric assessment.
Results: Among the 161 patients included (157 analyzed; mean age 84.4 ± 6.2 years; 72% women), 84 (53.5%) had fallen in the previous year: 105 (66.9%) were considered pre-frail and 52 (33.1%) frail. As compared with non-fallers, fallers had lower Tinetti balance scores ($P = 0.0004$) and handgrip strength ($P = 0.03$), more lost weight ($P = 0.04$), and they took longer to perform the TUG test ($P = 0.04$). Fallers and non-fallers did not differ in time taken to perform the CogTUG test (30.7 ± 11.2 vs. 28.5 ± 10.2 s, $P = 0.20$). History of falls was associated with only weight loss (odds ratio 3.43; 95% CI 1.13–11.30, $P = 0.03$) and handgrip strength (0.88; 0.78–0.97, $P = 0.02$) on multivariate analysis.
Conclusion: Unlike TUG scores, the CogTUG score was not associated a history of falls in frail older outpatients with gait disorders. Our results underline that weight loss and low muscle strength are related to falls.

1. Introduction

Falls are a major health problem in older people. More than 30% of people older than 65 and 50% older than 80 fall at least once a year [1]. Falls are the most common cause of injury in old age and lead to distress, pain, fractures, loss of confidence and loss of independence [1,2].

The cause of falling can be multifactorial, but gait disorders are often the main cause in older people [1]. Several walking and balance tests have been proposed to assess the risk of falls, but their predictive validity in older people is still controversial [3–5]. Among these tests, the timed up-and-go (TUG) test is often routinely used [5–8].

The relationship between gait and cognitive function has been well established in healthy older people and those with cognitive impairment [9–11]. Executive and attentional functions are essential for normal walking [12,13]. A decrease in gait speed while talking was proposed to indicate mild cognitive impairment [11,13]. Dual-task paradigms were then proposed for predicting falls in older people, but showed conflicting results [14]. Although very mild impairment in attention and executive functions are independently associated with risk of postural instability and falls [12–14], the added value of dual-balance tasks for assessing fall intervention remains controversial [15].

Frailty [16] is associated with a high risk of falls. Low gait speed is one of the criteria proposed in the Fried et al. definition of frailty [17], and the TUG score was suggested to be a proxy for frailty in older people [18]. An added dual task could improve the validity of the TUG score as a screening tool for detecting pre-frailty [19]. A recent review [20] recommended adding a cognitive task to improve the sensitivity and specificity of the frailty risk.

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We hypothesized that the TUG score associated with a cognitive dual task (CogTUG) score could differentiate older frail people who would fall and not fall better than the TUG score alone. We designed this retrospective study to determine whether the CogTUG score was associated with a history of falls in frail older hospital outpatients with gait disorders.

2. Methods

2.1. Population

This study took place in a geriatric day hospital specializing in evaluating gait disorders and falls (Bretonneau Hospital, Paris). We retrospectively included all patients >75 years old who were admitted from January 2012 to January 2014 for gait or balance disorders with or without a history of falls. We did not include patients who could not perform walk tests or presented an acute disease; major visual loss; serious neurological, articulation or motor handicap; or falls related to loss of consciousness. The data were declared to the French National Computing and Freedom Commission (CNIL) (No. 1858079).

2.2. Comprehensive geriatric assessment

All patients underwent a comprehensive geriatric assessment [21] including number of comorbidities, number of drugs taken per day, activities of daily living (score 0–6), instrumental activities of daily living (score 0–4), mini-mental state examination (MMSE) (score 0–30), albumin level and the first part of the Tinetti scale (balance section, score 0–16) [1,3].

Frailty indicators were operationalized as closely as possible to the phenotypic definition of Fried et al. [17]. Only 3 criteria were used: (1) weight loss (yes/no), (2) gait speed < 1 m/s as measured in a 10-m walk at preferred velocity [22], and (3) low handgrip strength. The handgrip strength of the dominant hand was measured by using a hydraulic dynamometer (Sissel, Sweden). Handgrip strength was considered low at <30 kg for men and <20 kg for women [23]. Patients were considered pre-frail with 1 or 2 of these criteria and frail with 3.

A fall was defined as the person unintentionally coming to rest on the ground. History of falls over the previous year was recorded by use of a standardized questionnaire [1,6].

2.3. TUG and CogTUG

Patients were first asked to stand from a seated position, walk 3 m at their usual pace, turn around, walk back to the chair, and sit down (the TUG test). Walking aids were allowed. After a recovery phase, patients were asked to perform the same exercise while performing a cognitive dual task (continuously subtracting 2, starting from 100; the CogTUG test) [24,25]. Both tests were timed in seconds. We also calculated the difference between the time to perform the CogTUG and TUG tests (CogTUG − TUG = ΔTUG).

2.4. Statistical analysis

Quantitative data are reported as mean ± SD and categorical data as frequency (%). Missing values were studied, but we did not impute missing values. The differences between groups (fallers and non-fallers) were examined by independent Student *t* test for continuous variables and chi-square test for categorical variables. The validity conditions of these tests were checked. Logistic regression analysis was used to model the factors associated with a history of falls. The covariables were selected by their clinical relevance, their association with falls on bivariate analysis at a 20% threshold and a correlation matrix. Regression diagnosis was used to assess the conduct of the convergence process and check the robustness of the model. Data were analyzed by using R v3.1.1 (http://www.r-project.org). All tests were two-tailed, and $P < 0.05$ was considered statistically significant.

3. Results

We included 161 patients. We excluded the 4 patients who were neither frail nor pre-frail or had incomplete data, so the analysis included 157 patients (mean age 84.2 ± 6.2; 72% women). The sample characteristics and test results are in the Table. The patients walked slowly (0.62 ± 0.30 m/s) and had low handgrip

Table 1
Characteristics and test results of older patients with and without a history of falls.

	Total (*n* = 157)	Falls (*n* = 84)	No falls (*n* = 73)	*P* value*
Age (years)	84.4 ± 6.2	85.3 ± 6.2	83.3 ± 6.1	0.05
Female, no. (%)	113 (72.0)	62 (69.8)	51 (73.8)	0.58
No. of comorbidities	4.8 ± 2.1	5.1 ± 2.3	4.6 ± 1.8	0.18
No. of drugs per day	6.2 ± 3.6	6.0 ± 3.4	6.4 ± 4.0	0.53
Activities of daily living (0–6)	5.3 ± 1.1	5.3 ± 1.0	5.2 ± 1.5	0.49
Instrumental activities of daily living (0–4)	2.7 ± 1.2	2.7 ± 1.1	2.7 ± 1.2	0.82
Mini-mental state examination score (0–30)	23.9 ± 4.3	24.2 ± 4.3	23.5 ± 4.3	0.38
Weight (kg)	63.0 ± 14.5	62.0 ± 13.4	64.2 ± 15.6	0.33
Weight loss: no. of patients (%)	53 (33.8%)	35 (43.7%)	18 (27.2%)	0.04
Albumin level (g/l)	37.5 ± 5.1	36.6 ± 5.4	38.7 ± 4.3	0.04
Handgrip strength (kg)	17.6 ± 7.3	16.4 ± 6.8	18.9 ± 7.6	0.03
Men	25.2 ± 7.4	23.4 ± 7.4	27.04 ± 7.2	0.10
Women	14.6 ± 4.5	14.0 ± 4.5	15.45 ± 4.5	0.08
Gait speed (m/s)	0.61 ± 0.24	0.60 ± 0.2	0.61 ± 0.3	0.84
Tinetti balance score/16	12.3 ± 2.3	11.8 ± 2.3	13.0 ± 2.1	0.0004
TUG (s)	22.2 ± 8.8	23.5 ± 9.9	20.8 ± 7.2	0.04
CogTUG (s)	29.7 ± 10.8	30.7 ± 11.2	28.5 ± 10.2	0.20
ΔTUG (s)	7.47 ± 5.51	7.20 ± 5.48	7.78 ± 5.57	0.51
Frailty status, no. (%)				
Pre-frail	105 (66.9)	50 (59.5)	55 (75.3)	
Frail	52 (33.1)	34 (40.5)	18 (24.6)	0.035

Data are mean ± SD unless indicated.
* $P < 0.05$ by Student *t* test or chi-square test.
TUG, timed up-and-go task; CogTug, cognitive timed up-and-go dual task.