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Streamlining assessment and intervention in a falls clinic using the Timed Up and Go Test and Physiological Profile Assessments

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Abstract

Background: the Timed Up and Go Test (TUGT) has been recommended as a simple screening tool to identify those at risk of falling. However, subsequent detailed assessment is required to identify underlying falls risk factors to provide direction for optimal targeted intervention strategies.
Methods: 110 consecutive falls clinic patients underwent the TUGT, the Abbreviated Mental Test and the Physiological Profile Assessment (PPA), a validated tool for quantifying risk of falling based on a combination of physiological measures—contrast sensitivity, knee extension strength, proprioception, reaction time and postural sway. Regression analysis was used to determine how well the TUGT and presence of cognitive impairment could identify patients at high risk of falls as defined by the PPA.
Results: TUGT and cognitive status were found to be independent and significant predictors of PPA scores. These variables accounted for 21% of the variance in PPA scores (multiple $R = 0.47$, $P<0.001$). The standardised beta weights were 0.403 for TUGT and 0.236 for cognitive status. A receiver–operator curve (ROC) indicated that 15 seconds in the TUGT was the optimal cut-point for identifying those with a high risk of falling: 70% of the total sample.
Conclusions: the TUGT and a simple test of cognition can be used to streamline referrals in a high-risk population, allowing for more efficient use of available resources in clinical practice. A subsequent PPA provides quantification of risk and direction for tailored intervention.

Keywords: *aged, accidental falls, mobility, falls risk, cognitive impairment, elderly*

Introduction

There is now strong evidence that exercise and multidisciplinary interventions are effective in preventing falls in older people [1]. However, in health services with limited resources, it is still unclear how to effectively identify high-risk populations most likely to benefit from intervention programmes.

The AGS/BGS guideline [2] recommends the Timed Up and Go Test (TUGT) as a screening tool for identifying older people at increased risk of falls. The TUGT, derived from the original up and go test [3], is an indicator of 'basic mobility', and measures the time required for a person to rise from a chair, walk 3 m, return to the chair and sit down. The tool was originally validated on 60 day hospital patients, where it was found that a poor performance in this test was significantly correlated with slow gait speed, low Berg balance and Barthel Index scores [4].

Subsequently, three retrospective studies have examined the relationship between TUGT performance and falls in community-dwelling people. In a study of 15 subjects with a history of two or more falls in the previous 6 months and 15 non-fallers, Shumway-Cook *et al.* [5] found that a TUGT cut-point of 14 seconds significantly discriminated between the faller and non-faller groups. Using this criterion, 13/15 subjects from both groups were correctly classified, providing a sensitivity and specificity for identifying falls outcome of 87%. Rose *et al.* [6] used a similar classification of faller status (no falls versus two plus falls in the past year) in their study of 134 subjects. A considerably lower cut-point (10 seconds) was identified as optimal for discriminating between non-fallers and recurrent fallers. With this criterion the overall prediction rate was 80%: specificity 86% and sensitivity 71%. The third study comprised 157 subjects classified as either fallers (one plus fall in the past year) or non-fallers [7]. In this sample, the TUGT had very high sensitivity with 98% of the 109 fallers being correctly classified, but considerably lower sensitivity, with only 15% of the 48 non-fallers being correctly classified.

The above evidence for TUGT as a falls screening test is encouraging but could be described as still only preliminary due to the retrospective study designs. The findings are also likely to overestimate the predictive ability of the TUGT in a general community setting due to the selection of subjects with only marked risk of falling as fallers [5–7]. However, the TUGT warrants further examination and validation because of its simplicity and ease of administration.

Even if the TUGT has clinical utility as a falls risk screening tool, it cannot provide detailed information regarding the impairments in physiological domains that contribute to falls risk and therefore provides little in the way of information about how to target intervention strategies. In contrast, the Physiological Profile Assessment (PPA) is a tool which has been validated as a predictor of falls using data from over 2,000 community-dwelling older people [8–10]. The PPA provides objective data on the relative contribution of vision, proprioception, muscle strength, reaction time and postural stability to falls risk, and has the benefit of identifying likely interventions to reduce falls risk [8]. This is important, given that evidence suggests that targeted falls interventions strategies are more effective at reducing falls and fall-related injuries [1].

In this study we explore how the TUGT can be used in association with the PPA in a multidisciplinary falls clinic as a means of identifying high-risk patients and streamlining referrals for subsequent detailed physiotherapy assessment and intervention.

Methods

Subjects

The sample comprised 110 consecutive patients (27 men and 83 women) aged 63–95 years (mean = 79.3, SD = 7.2) who attended the falls clinic at King's College Hospital, London. Patients were referred to this clinic from the emergency department at the hospital and by local general practitioners usually, but not exclusively, following one or more falls in the preceding 6–8 weeks.

Assessments

Following a comprehensive medical assessment [11] including an Abbreviated Mental Test (AMT) [12], patients underwent an assessment of mobility and falls risk. The TUGT was assessed in the standard manner: patients were asked to rise from a 46-cm-high chair, walk forward 3 m at their usual walking pace, turn 180°, walk back to the chair and sit down. It was emphasised to participants that they undertake the test at their 'usual walking pace'.

Falls risk was determined using the PPA [8], which includes five validated measures of physiological function. Visual contrast sensitivity was assessed using the Melbourne Edge Test [13]. Proprioception was measured using a lower limb-matching task. Errors were recorded in degrees using a protractor inscribed on a vertical clear acrylic sheet (60 × 60 × 1 cm) placed between the legs. Quadriceps strength was measured isometrically in the dominant leg, with the angles of the hip and knee at 90° with patients seated [8]. The best of three trials was recorded in kilograms. Simple reaction time was measured in milliseconds using a light as the stimulus and a finger-press as the response. Postural sway area was measured in square millimetres using a sway meter measuring displacements of the body at the level of the waist [8]. Testing was performed with patients standing on a foam rubber mat with eyes open (40 × 40 × 7.5 thick). In multivariate models, weighted contributions from these five variables provide a falls risk score that can predict those at risk of falling with 75% accuracy in community settings [8].

Based on a PPA falls risk score of 2 (indicating a marked risk of falls in community-dwelling older people) [8], patients were divided into two groups: patients with a 'high' falls risk (HFR group) and patients with a 'low' falls risk (LFR group). A score of <8 on the AMT was used to define those people with a cognitive deficit.

Statistical analysis

TUGT had a right-skewed distribution (skewness = 1.25) that could be normalised with a log transformation, so logs of this variable were used in all analyses. The association between PPA falls risk scores, individual physiological domain scores, TUGT times and cognitive impairment were initially examined using Pearson correlations and grouped t-tests. Multiple regression analysis was then used with PPA falls risk score as the dependent variable, and TUGT times and cognitive impairment as the independent variables. Standardised beta weights for these two independent variables included in the regression equation are presented. These provide an indication of the relative importance of the variables in explaining variance in PPA scores. Finally a receiver–operator curve (ROC) was inspected to determine an optimal cut-point in TUGT times for discriminating between the LFR and HFR groups. P values of <0.05 in the univariate and multivariate analyses were considered statistically significant. The data were analysed using SPSS for Windows [14].

Results

TUGT scores ranged between 9.6 and 60 seconds. The mean TUGT time was 25.3 seconds (SD = 14.8) and the median was 19.6 seconds (IQR = 14.0–30.8). Forty-eight patients (43.6%) were classified as having a high risk of falls based on PPA scores >2. The mean PPA falls risk score for the total sample was 1.9 (SD = 1.3, range = –1.24 to 4.79). Twenty-eight patients (25%) scored <8 on the AMT, indicating cognitive impairment. Table 1 shows the demographic characteristics, median TUGT times, mean PPA scores and proportion of patients with cognitive impairment in the LFR and HFR groups and the total sample.

Log TUGT times were significantly correlated with PPA falls risk scores (r = 0.39, P<0.0001). This association is shown in Figure 1. Log TUGT times were also significantly correlated with the physiological domains of knee extension strength (r = –0.19, P<0.05), proprioception (r = 0.26, P<0.005), contrast sensitivity (r = –0.30, P<0.005) and postural sway (r = 0.31, P<0.001). The association between log TUGT times and reaction time approached statistical significance (r = 0.18, P = 0.06).

Table 1. Demographic characteristics, TUGT times, PPA scores and prevalence of cognitive impairment for the low- and high-risk faller groups and total sample

	Low falls risk (LFR) (n = 62)	High falls risk (HFR) (n = 48)	Total sample (n = 110)
Age in years: mean (SD)	78.4 (7.3)	80.3 (7.1)	79.3 (7.2)
Women: n (%)	46 (74.2%)	36 (75.0%)	82 (74.5%)
Cognitive impairment: n (%)	12 (19.4%)	16 (33.3%)	28 (25%)
TUGT in seconds: median (IQR)[a] **	17.9 (14.0–24.0)	25.1 (16.3–40.3)	19.6 (14.0–30.8)
PPA score: mean (SD)***	1.01 (0.78)	3.05 (0.75)	1.90 (1.27)
Contrast sensitivity: mean (SD)***	21.8 (2.5)	17.7 (4.0)	20.0 (3.8)
Proprioception in degrees error: mean (SD)*	1. 9 (1.3)	2.6 (1.9)	2.2 (1.6)
Knee extension strength (kg): mean (SD)*	20.8 (9.5)	16.9 (6. 6)	19.1 (8.5)
Reaction times milliseconds: mean (SD)***	249 (33)	325 (61)	282 (60)
Postural sway area in mm: mean (SD)***	1684 (971)	3184 (1789)	2338 (1570)

Comparison of LFR and HFR groups: P values for differences between the two groups *P<0.05; **P<0.001; ***P<0.0001.
[a]Median and inter-quartile range presented due to skewed distribution.

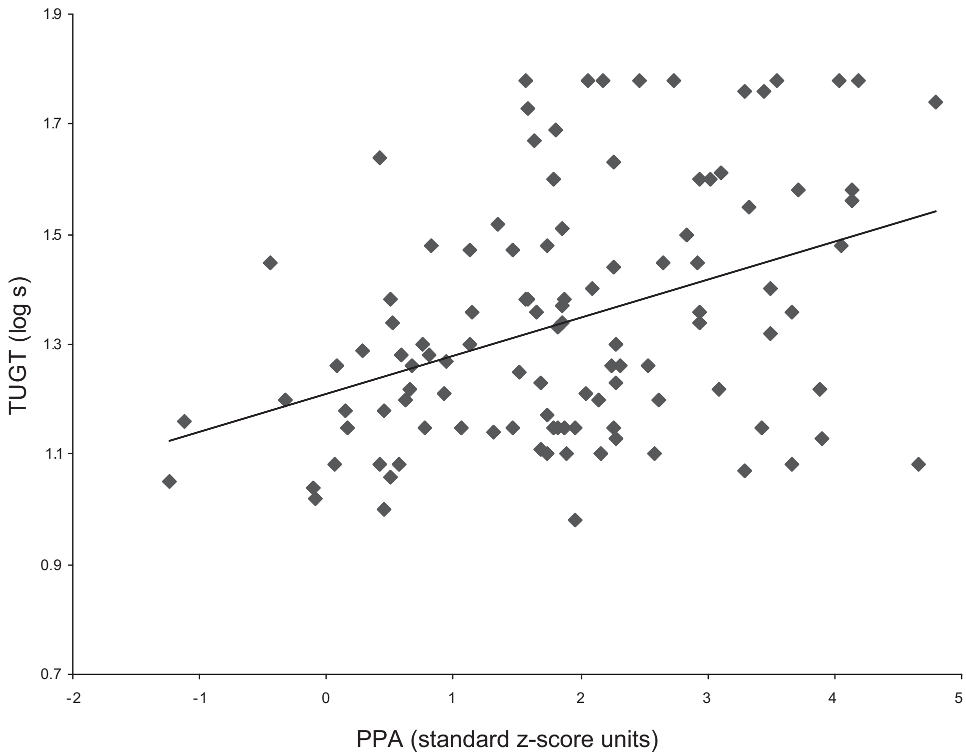

Figure 1. Association between log TUGT times and PPA falls risk scores.

There was no significant difference in TUGT times between those with and without cognitive impairment: 24.2 seconds (SD = 14) and 25.7 seconds (SD = 15), respectively (P = 0.60). In contrast, PPA falls risk scores were significantly higher in those with cognitive impairment compared with those without cognitive impairment: 2.37 (SD = 1.3) and 1.74 (SD = 1.2), respectively (P<0.05). This higher falls risk score was almost entirely due to those with cognitive impairment having increased reaction times of 306 milliseconds (SD = 72), compared with 274 milliseconds (SD = 54) in the unimpaired (P<0.05).

Multiple linear regression analysis revealed that both increased TUGT and presence of cognitive impairment were significant and independent predictors of high PPA falls risk scores. The beta weights for TUGT and cognitive impairment were 0.403 and 0.236, respectively. The two-variable model explained 21% of the variance in PPA falls risk scores (multiple R = 0.46, P<0.001).

The ROC curve reflected the moderate correlation with no single point that had clear advantages in maximising both sensitivity and specificity. A cut-point of 15 seconds was chosen as this provided maximal sensitivity and acceptable specificity in the identification of the HFR group: 81% sensitivity and 39% specificity. Using this criterion, 77 of the 110 patients (70%) who underwent a TUGT would be identified for further detailed assessment using the PPA.

Discussion

The study findings indicate that the TUGT and a simple test of cognition are significant and independent predictors of PPA falls risk score in a falls clinic population. When combined in a multiple regression model, these variables explained 21% of the variance in PPA falls risk scores, with TUGT performance providing the greater contribution to the prediction of patients with high falls risk.

Only 11% of the patients could complete the TUGT in less than 12 seconds, a suggested upper limit for normal mobility [15]. The slower TUGT times indicate that the patients attending the falls clinic have high levels of impaired mobility, and accordingly are more likely to benefit from exercise interventions [1, 15]. The high-risk nature of the group was also confirmed by a mean falls risk score of 1.9, a score approximating a marked risk of falls in older community-dwelling people [7]. Fifteen seconds was found to be the optimal cut-point for discriminating between patients with low and high falls risk in this population. The cut-point identified 81% of those with a marked risk of falls (>2) and 39% of those with a low or moderate risk of falls (<2). This criterion is also similar to that found in one retrospective study evaluating the ability of the TUGT to identify older people with a history of multiple falls [4], but considerably lower than the suggested criteria for functional dependency (>20 seconds) [3].

Patients with cognitive impairment did not differ significantly from the cognitively intact when undertaking the TUGT but had significantly higher PPA falls risk scores. This may reflect reduced awareness of risk and subsequent lack of adaptive behaviour. Alternatively, the TUGT is not primarily affected by slow reaction time, which in itself is an independent risk factor for falls that is highly prevalent in cognitively impaired people. This group may be particularly at risk of falling when required to make quick adaptive responses. These findings may partially explain why cognitive impairment is in itself a risk factor for falls. Well-designed multifactorial interventions [16, 17] in cognitively impaired populations, which have included interventions aimed at improving postural stability through strength and balance training, have failed to demonstrate any benefits in terms of falls reduction. Thus exercise interventions in cognitively impaired people remains of questionable efficacy. However, in the absence of an evidence base to guide practice in this high-risk population, the authors do undertake the PPA in this group, particularly as it can identify modifiable risk factors such as visual impairment from a refractive error or cataracts. If the individual has deficits in strength and balance and can cooperate with the components of the test, then supervised group-based strength and balance training is also feasible.

As expected, the correlation between TUGT times and the PPA scores was only moderate, and reflects the fact that the PPA falls risk score is derived from more measures than would be expected to predict performance in a simple mobility test undertaken under optimal conditions (i.e. with good lighting and on a firm, level walking surface) that does not require a quick response to maintain balance [18]. It is possible that as most of the patients attending the clinic had suffered falls, resultant injuries may have adversely affected both the TUGT and PPA scores, and this may have increased the correlation between the two assessments. This effect is likely to be small as no patients had an acute injury at the time of testing. However, it cannot be ruled out that other factors such as varying levels of motivation may have influenced performance in the TUGT and the PPA strength and reaction time tests.

Using the PPA to measure physiological domains related to falls risk can both quantify risk and provide direction for tailored intervention. Strength and balance training should be prescribed for those with impairments in knee extension strength, reaction time and/or postural sway. Individualised strength and balance training programmes have demonstrable efficacy in terms of falls reduction [19, 20]. Intervention for those with impaired vision should include an accurate diagnosis and appropriate management plan such as correction of a refractive error with prescription spectacles, cataract surgery, and limiting the use of multifocal and bifocal spectacles [21]. For those with marked proprioceptive loss, investigation of peripheral neuropathy would be indicated. Advice and information regarding how reduced lower limb proprioception can impair balance, particularly when walking on uneven or compliant surfaces, should be offered. Proprioception can be maximised by wearing shoes with low heels and firm rubber soles, and using a walking stick or cane to supplement sensory input [22, 23].

It is acknowledged that this approach to streamlining referrals must be seen in the context of a broader medical and multidisciplinary management of older people at increased risk of falls. In the absence of a good clinical history and examination, additional risk factors for falls including syncope can be overlooked. The TUGT and PPA should not function in isolation of a comprehensive service, but when used appropriately the TUGT in association with the PPA provides a practical, evidence-based approach for screening, quantifying falls risk and providing direction for tailored intervention in this setting. In doing so, it allows for more efficient use of available resources in an everyday service context.

Key points

- TUGT and a simple test of cognition were significant and independent predictors of PPA falls risk score.
- TUGT times in the falls clinic population were slower than the suggested normal.
- Those with cognitive impairment were not significantly slower in the TUGT but had significantly higher PPA falls risk scores.
- A TUGT cut-point of 15 seconds had optimal sensitivity and specificity to identify patients with marked PPA falls risk scores.
- Measuring the TUGT as a screen to prompt assessment using the PPA is one way of making efficient use of available resources in a falls service.

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