Usefulness of Timed Up and Go test, Berg Balance Scale and Six Minute Walk Test as fall risk predictors in post stroke adults attending Rehabilitation Hospital Ragama

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Abstract: Stroke is a major risk factors for falls. However, there are no established practices being used to predict fall risk with Stroke patients in Sri Lankan stroke care settings. The purpose of this study is to determine the usefulness of Timed Up and Go test (TUG), Berg Balance Scale (BBS) and Six Minute Walk Test (6MWT) as fall risk predictors in post stroke individuals and to introduce cut off values to predict fall risk. 74 patients with first ever stroke during past year (mean age 56.5± 28.5, males 67.6%) recruited from the Physiotherapy Unit, Rehabilitation Hospital, Ragama; 17 (23%) had history of falls. History of falls was recorded from participants' interview. Each participant underwent TUG, BBS and 6MWT. Scores were compared with existing cut off values. Receiver Operating Characteristic (ROC) curves were constructed to describe sensitivity, specificity and predictive values. Optimum cut off values for fall risk prediction were determined. There is no significant difference in the baseline characteristics between the two groups. The cut off values for fall prediction of three tests were recognized as follows; TUG ≥ 23s, p = 0.044, AUC = 0.662; BBS <45, p = 0.001, AUC = 0.773; 6MWT <193 meters, p =0.020, AUC = 0.686. The BBS performed better than TUG and 6MWT in predicting fall risk in stroke individuals. We recommend the use of physical performance tests as TUG test, BBS and 6MWT to predict fall risk and to minimize risk of falling in stroke individuals in Sri Lanka.

KeyWords: Stroke, fall risk, Timed Up and Go Test, Berg Balance scale, six Minute walk Test

Introduction:

Stroke is the second leading cause of death worldwide among top ten leading causes. There were about 14 million first ever stroke victims in 2016. According to the WHO statistics approximately 6.2 million deaths occur due to stroke and also rated as third most common cause of disability of the adults globally. Stroke leads to functional disability of a stroke survivor and effect of stroke causes paralysis of the body. The stroke prevalence in Sri Lanka increased during the past decades with changes of demography**.** However improvements in the healthcare facilities may lead to increase in the number of survived stroke victims in Sri Lanka. Rheumatology and Rehabilitation Hospital Ragama is the main rehabilitation hospital in Sri Lanka for stroke rehabilitation. According to the Medical Statistics Unit of Rheumatology and Rehabilitation hospital, 402 post stroke survivors were admitted to the hospital in the year 2018. There were 339 males and 63 females. When considering the 2019 statistics, 108 post stroke individuals were admitted during the first five months. The disability of the wage earner may be a burden to the family and also to the community. In this sense, stroke is a burden not only globally but also in Sri Lanka, as it affects patient's abilities physically and psychologically

Post stroke individuals are more prone to fall as they present with impaired weight bearing to

paretic limb and increased muscle tone. Frequent falls may be a cause for increased length of hospital stay and it could increase health care costs. Stroke causes severe disability in post stroke survivors. This sudden onset disability is a life changing stressful incident for family members. In this context, caregiving for the post stroke survivor is a responsible and stressful task for the family caregivers and also this situation badly influence financially. Falls can be predicted as well as prevented. Falls can occur repeatedly if preventive measures are not taken Hence, prediction and prevention of falls should be a key component in stroke rehabilitation. The unexpected incidence of falls and fear of falling may have a negative impact on rehabilitation process and can lead to lack of socialization with depression. The consequences of accidental falls also may be a burden for family members and healthcare professionals. Unprovoked incidence of falls during the hospital stay has been identified as an adverse effect, which need special consideration. It will increase the healthcare cost if there is a fracture which can increase the length of stay. Therefore, it is important to identify which patient is having a risk of falling and provide with fall prevention interventions. This task can be achieved by assessing the patients using valid and reliable clinical tests which can be used easily. The fall risk prediction has been done in many countries using Timed Up and Go test, Berg balance scale and Six Minute Walk Test. Though there are previous studies, data from one country would not reflect the fall risk of another country. There may be differences in demographic factors between the countries. Considering the above factors, the importance of fall risk prediction and its value cannot be underestimated. Hence, this study aimed to investigate the contribution of TUG test, BBS and Six minute walk test within the context of fall risk prediction, quantifying fall risk in post stroke individuals and providing information to family members.

Methodology:

A cross sectional descriptive study was carried out from May 2019 to August 2019, at the Physiotherapy Department of Rehabilitation Hospital, Ragama. The appropriateness of the subjects was evaluated by the researcher according to their past medical records in the BHT or clinic book. 74 first ever post stroke adults (>18 years) were recruited to the present study. Demographic data collected using Participants' Data Collection Form and fall history was recorded. The enrolled participants were tested with three clinical tests. (1) Timed Up and Go test (TUG), (2) Berg Balance Scale (BBS) and (3) Six Minute Walk Test (6MWT). The TUG test was used to assess functional mobility and was performed according to the international guidelines. The cut off value for the TUG test was determined as ≥14s for fall risk prediction.

BBS which comprises of 14 components used to assess functional balance. Maximum score was 56/56 and <45 was suggested as cut point to predict fall risk. The 6MWT was used to assess walking capacity of post stroke individuals. The test was carried out according to American Thoracic Society guidelines and protocols (2002) and reference value for normal healthy adults was 510m. But this value cannot be justified for post stroke adults. Hence, we consider new cut value of 285m which was proposed by Dunn et al. in 2015 specifically for post stroke adults. The entitled subjects participated above three physical performance tests and individual scores were recorded.

The data analyses were performed using program SPSS version 22.0 and both univariate and bivariate analyzing methods were used. To find the association between categorical variables Chi-square test was used. Independent sample t-test was used for analysis of numeric data. The p value < 0.05 was considered as significant value. A receiver operating characteristic curves (ROC) analysis

and areas under the curves (AUC) were used to determine the cut off points of TUG, BBS and 6MWT. (0.5< AUC≤ 0.7 = less accurate, 0.7<AUC≤ 0.9 = moderately accurate, 0.9<AUC ≤1.0 = very accurate, AUC = 1 perfectly accurate). Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine, University of Kelaniya. Administrative authorization was obtained from the Deputy Director and the Rheumatology and Rehabilitation Consultants of Rehabilitation Hospital, Ragama.

Results and Discussion:

This study population comprised of 74 post stroke individuals (mean age 56.5± 28.5, males 67.6%) and 17 (23%) had history of falls. There is no significant difference in baseline characteristics for instance age, gender, duration of stroke, type, use of orthses and use of assistive device.

Association between physical performance tests and fall history

TUG test

Table 1: *Results of the Timed Up and Go test in relation to fall history*

Characteristic	Fallers	Non fallers	p-value	Total
BBS < 45	15 (88.2%)	27 (47.4 %)		42 (56.8%)
BBS > 45	02 (11.8%)	30 (52.6 %)		32 (43.2%)
Mean BBS± SD	37.59 ± 6.2	44.37± 6.88	0.001	

Note: TUG- Timed Up and Go test, SD- Standard Deviation , TUG test duration of ≥ 14s indicate high fall risk (G. Andersson et al., 2006; Jalayondeja et al., 2014)

Receiver operating characteristic curve (ROC) analysis of TUG test

In accordance with Receiver Operating Curve Analysis (ROC) for the TUG test introduced cut off value was 23 seconds (77% sensitivity, 50% specificity). Area Under the Curve (AUC) of all measured TUG values was 0.662, provide less accurate prediction. (p = 0.044)

BBS

Table 2: *Results of the Berg Balance Scale in relation to fall history*

Characteristic	Fallers	Non fallers	p-value	Total
	16(94.1%)	49(86%)		TUG
≥ 14 seconds				65 (87.8%)
TUG ≤ 14 seconds	01 (5.9%)	08 (14%)		09 (12.2%)
Mean TUG±SD	35.92±19.72	25.86±12.55	0.061	28.17±14.97

Receiver operating characteristic curve (ROC) analysis of BBS

According to Receiver Operating Curve Analysis (ROC) for the BBS cut off value was 45 (88% sensitivity, 50% specificity). Area Under the Curve (AUC) of all measured BBS values was 0.773 provide moderately accurate prediction. (p = 0.001)

6MWT

Receiver operating characteristic curve (ROC) analysis of 6MWT

ROC curve analysis for 6MWT indicated a cut off value of 193metres (76% sensitivity, 50% specificity) and the Area Under the Curve (AUC) for all measured 6MWT distances was 0.686 provide less accurate prediction. (p = 0.020)

Table 3: *Results of the Six Minute Walk test in relation to fall history*

Characteristic	Fallers	Non fallers	p-value	Total
6MWT > 285m	Mean 6MWT±S	19(33.3 %)		21(28.4%)
6MWT < 285m	15(88.2%)	38(66.7 %)		53(71.6%)
Mean 6MWT± S	144.62±12 1.42	216.37± 123.77	0.0 39	

The aim of the present study was to determine the usefulness of assessment of mobility, functional balance and endurance among the post stroke individuals. We have investigated whether there is fall predictive ability in physical performance tests. In present study TUG test did not have significant association with fall history. Though TUG test has been widely used in clinical settings, literature reveals that TUG has to be used along with other clinical tests to make future fall prediction. In the current study we used cut off value of 45 for BBS as stated by previous literature. We could correctly identify 15 of the 17 previous Fallers' while incorrectly identifying 27 of the 57 non Fallers' Hence, BBS might be useful to identify potential fallers than non Fallers'. Present study confirms that there is a statistical significance of BBS with fall history. ROC curve for the BBS shows moderate predictive ability to discriminate Fallers' and non Fallers'. We conducted 6MWT to assess walking capacity of our study population. During the 6MWT subjects were allowed to use their assistive devices and orthoses. But, there is no significant association between history of falls and utility of assistive devices and orthoses. Nevertheless, there may be an association between walking distance and gait speed. The orthoses and assistive devices were used to minimize gait deviations in post stroke individuals As expected, the mean value for the entire participants was 199.89m which was significantly lower than the cut off. Furthermore, there is a mean difference between Fallers' and non Fallers' in the current study. Even though non Fallers' had a relatively better walking capacity, mean value reduced than existing cut off value. In the current study, new fall predictive cut off value is 193m which is relatively equal to mean value of 6MWT. There is a statistical significance between 6MWT and history of falls ($p < 0.05$). We can enhance utility of physical performance tests such as TUG and BBS in our clinical settings as fall risk prediction measures within first week following primary strokes. Among the three tests only the BBS performed better in predicting fall risk. Though there is a less predictive ability 6MWT is significantly associate with fall history. Similarly, the TUG test can be used in conjunction with other clinical tests.

Conclusion:

The BBS and 6MWT were significantly associated with falls. BBS was better than 6MWT and TUG test in predicting fall risk. We recommend the use of physical performance tests, ideally the BBS, to identify those at a higher risk of falling among those individuals recovering from a stroke in Sri Lanka.

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