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BALANCE, GAIT AND LATEROPULSION DISORDERS IN THE ACUTE ISCHEMIC STROKE

Neurology

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ABSTRACT

Introduction: Stroke mortality rates has decreased to a considerable value over the past few decades owing to the improved medical facilities and technology. This has lead to more number of stroke survivors in the aging population. A strong predictor of independent living after stroke is maintaining body balance and it was showing strong correlation with the disability perceived at the time of patient's discharge from the stroke rehabilitation unit **Methodology:** All patients with acute ischemic stroke were taken for study. These initial assessments collected information about handedness, all motor deficits, postural instability and gait disorders, and disability affecting motor function. The second assessment was performed after one week of stroke at the discharge after daily physiotherapy and only focused on postural and gait disorders. Motor weakness was assessed by a standardized examination of muscle strength adapted for participants with central neurological disorders. Lateropulsion, gait and balance disorders were identified by specific protocols. **Results:** It was observed that the lesions of frontal lobe, thalamus, basal ganglia and internal capsule had significant assosciation with balance and gait abnormality post stroke while lesions of parietal lobe, temporal lobe and occipital lobe did not lead to any significant gait or balance deficits. Individuals with lateropulsion improves well on daily physiotherapy in both Lw/oP (r = -0.65) and for pushers (r = -0.61) to a significantly improved state(r= -0.5 for upright and r= -0.24 for pushers).**Conclusion:** Lateropulsion is a main factor in determining recovery of balance and gait in the subacute stage of stroke recovery. Special emphasis should be given to the impaired body orientation with respect to gravity in stroke rehabilitation stage and techniques to improve lateropulsion has to be stressed during physiotherapy for better recovery of balance and gait post stroke.

KEYWORDS

Lateropulsion, Stroke, Balance disorders

BACKGROUND & RATIONALE

Stroke mortality rates has decreased to a considerable value over the past few decades owing to the improved medical facilities and technology. This has lead to more number of stroke survivors in the aging population.[1] But atleast 60 % of the stroke survivors experience significant limitations in carrying out day today activities.[2] Sensory impairment, motor disabilities, perceptual and cognitive impairment are the major complications after stroke; among which motor impairment is the most important factor causing patient disability for daily activities.[2] The rehabilitation of patients with chronic stroke aims at improving functional mobility and balance.[3]

A strong predictor of independent living after stroke is maintaining body balance and it was showing strong correlation with the disability perceived at the time of patient's discharge from the stroke rehabilitation unit.[4,5] Assessment of the body balance is required to guide the physiotherapists in the selection of appropriate interventions in improving balance and gait and measurement of outcome post therapy.[6] 60% of stroke patients has been found to succumb fall at least once during the period of hospitalization and 73% patients has been found to develop fall in the first 6 months after stroke.[6] Multiple episodes of falling post stroke will increase the patient's fear to restart walking, thereby restricting physical activity, and increasing care giver dependency.[7] A fall after stroke has been found to enhance social dependence, leading to psychiatric disturbances like anxiety and depression, and prolongation of hospital stay after stroke.[8]

The theoretical model of control of balance includes two domains, comprising of body orientation in relation to gravity and body stabilization in relation to the base of support. This model helps in better understanding of the balance disorders and aid in balance rehabilitation.[8]

Balance during sitting in the acute stage post stroke has been found to have shorter hospital stays and acquirement of better functionality levels.[9] It is also considered as an important factor predicting walking ability so as to achieve a stable gait within 6 months post stroke.[9] Postural Assessment Scale for Stroke Patients (PASS) is a widely used scale to assess balance disorders in stroke and it evaluates patient's balance while lying, sitting and standing. The construct validity of PASS score has been studied with respect to the Barthel Index and it has showed a high correlation index.[9]

Lateropulsion is postural disorder in a patient with hemispheric stroke which is a strong resistance to postural correction to vertical upright.[10] Its Incidence ranges from 10% to 60% in patients with stroke.[10] Lateropulsion is measured by the Scale of Contraversive Pushing.[10] Patients with lateropulsion were found to have a delayed functional recovery, especially when right-sided brain lesions are present.[10-14]

OBJECTIVE

To identify the occurence of lateropulsion, disorders of balance and gait in the rehabilitation phase of acute ischemic stroke

Study Population: Patients with acute ischemic stroke who are admitted in the Neurology department of TVMCH
Study Design: Cross sectional study
Sampling Strategy: Patients with acute ischemic stroke who were admitted in the Neurology ward of TVMCH.
Sample Size: Patients admitted with acute ischemic stroke to Neurology department from August 2021 to December 2022

Methods

Inclusion Criteria

Patients who got first episode of stroke and age ≥ 18 to 80 years were included in the study.

Exclusion Criteria

Patients with recurrent stroke, who had hemodynamic instability and acute complications of stroke, patients with haemorrhagic stroke, patients with vestibular complaints, sensory impairment were excluded from the study.

METHODOLOGY

All patients with acute ischemic stroke were taken for study. These initial assessments collected information about handedness, all motor deficits, postural instability and gait disorders, and disability affecting motor function. The second assessment was performed after one week of stroke at the discharge after daily physiotherapy and only focused on postural and gait disorders. Motor weakness was assessed by a standardized examination of muscle strength adapted for participants with central neurological disorders.

Lateropulsion, gait and balance disorders were identified by specific protocols. Postural Assessment Scale for Stroke (PASS), was used to assess balance disorders at the subacute stage after stroke.[11] The total PASS score has a range from 0 to 36, and when score ≥ 28, the patient was observed to stand independently.[9,11] Modified Fugl-Meyer Assessment (mFMA),was used to identify gait disorders post

stroke.[8] Only motor components of mFMA was considered in our studied and was scored out of 100.[8] The motor assessment scoring was used quantify voluntary limb movements of the patient. It included the upper extremity(score 0–66) and the lower extremity (score 0–34), with a total motor score of 100.[12] The scale of contraversive pushing(SCP) assessed the pusher syndrome in balancing with the total score which range from 0 to 6.[7,8] Primary outcomes of the study were balance and gait disorders post stroke, was quantified by the Postural Assessment Scale for Stroke (PASS), the modified Fugl-Meyer Gait Assessment (mFMA), and lateropulsion was assessed with the Scale for Contraversive Pushing (SCP) at admission and at discharge. Global disability was calculated by using the modified Rankin Scale (mRS).

CT and MRI Imaging was done and the features were correlated with clinical findings.

Recovery after stroke was assessed by modified rankin scale(mRS) .

Statistics

Analyses was performed with SPSS 25.0 software for Windows. Initial SCP scores at admission and their role in predicting the ability to stand independently (PASS ≥ 28) or walk independently (mFMA ≥ 5) at discharge and at 30 days after discharge were studied. Relationship between the side of stroke and it's relationship to the balance and gait disorders were also studied. The relationship of affected balance and gait was analyzed by linear regression. The results of the linear regression analysis were presented using 95% confidence intervals. Upright, lateropulsion without pushing, and pusher groups were compared by the Mann-Whitney U-test. Univariate analysis was done to identify the relationship between recovery post stroke to gait and balance disorders. Data was represented with median and inter quartile range.

For all tests, p value of less than or equal to 0.05 was considered statistically significant.

RESULTS

The total number of study subjects was 282, out of which there were 200 males and 82 females. 231 patients(81.9%) were hypertensives, 155 patients(55 % were) diabetic and hyperlipidemic. Alcoholism was the major modifyable behavioral risk factor (65.6%) followed by smoking (54.3%). Majority of the strokes were ischemic (70.8 %). 176(62.4%) had right hemispheric strokes while 106(37.5%) had left hemispheric strokes.

Table 1 : Baseline Characterstics Of The Study Subjects (n=282)

Age mean+-SD (Range)	68+-12(48-80)
Sex Males n(%) Females n (%)	 200(70.9) 82(29.1)
Baseline NIHSS Score , Median(IQR)	11.3, 12 (4)
Systemic risk factors Hypertension n(%) Diabetes n(%) Hypercholesterolemia n(%)	 231(81.9) 155(55) 155(55)
Behavioural risk factors Smoking n (%) Alcoholism n(%)	 153(54.3) 185(65.6)
Territory of stroke Middle cerebral artery territory Anterior cerebral artery territory Posterior cerebral artery territory	 199(70.8) 73(25.8) 10(3.5%)
Side of stroke Right hemisphere Left hemisphere	 196(69.5%) 106(30.4%)
Median mFMA(IQR)	72 (9)
Median mRS (IQR)	2 (0.78)

Table 2 : At Admission And At Discharge Variables Of Balance And Gait For Stroke Patients As A Function Of Lateropulsion

	Total (n=282) (range)	Up-right (n= 172)	Pus-her (n= 58)	Lw/OP (n= 52)	Lw/OP Ver-sus Up-right	Up-right Ver-sus Pus-her	Upright Versus Lw/OP	Pusher Versus Lw/OP
At Admission								
Latero-pulsion (SCP)	1 (0-1.6)	1 (0-1.2)	1.5 (0-0)	0.5 (0-1)	r= -0.65 p<0.05	r= -0.75 p<0.05	r= -0.53 p<0.05	r= -0.61 p<0.001
Balance (PASS)	24 (18-26)	22 (23-25)	18 (16-24)	22 (18-26)	r=-0.62 p<0.001	r= -0.56 p<0.05	r= -0.45 p<0.001	r= -0.72 p<0.05
Gait (mFMA)	62 (52-66)	61 (59-65)	58 (56-66)	66 (58-64)	r=-0.79 p<0.001	r= -0.59 p<0.001	r= -0.87 p<0.001	r= -0.66 p<0.001
mRS	2.4 (1-3)	1.5 (1-3)	1 (0-1.5)	0.5 (0-1)	r=-0.77 p<0.05	r= -0.54 p<0.001	r= -0.59 p<0.05	r= -0.52 p<0.001
At Discharge								
Latero-pulsion (SCP)	3.17 (0.9-3.5)	2 (1-3.5)	1.9(1.6-2.4)	0 (0-0)	r= -0.55 p<0.05	r= -0.56 p<0.001	r= -0.35 p<0.001	r= -0.24 p<0.05
Balance (PASS)	28 (13-34)	22 (21-34)	24 (20-30)	28 (22-32)	r= -0.58 p<0.05	r= -0.45 p<0.001	r= -0.42 p<0.05	r= -0.32 p<0.001
Gait (mFMA)	73 (69-84)	70 (68-78)	74 (70-84)	76 (69-84)	r= -0.54 p<0.05	r= -0.53 p<0.001	r= -0.26 p<0.05	r= -0.28 p<0.001
mRS	1 (0-3)	0.5 (0.5-1)	0.9 (0.5 -1.4)	0 (0-0)	r= -0.49 p<0.05	r= -0.42 p<0.001	r= -0.32 p<0.001	r= -0.24 p<0.001

Data are represented as median (Q1–Q3). SCP = Scale for Contraversive Pushing. Lw/oP=lateropulsion without pusher syndrome. Pusher = lateropulsion with pusher syndrome. PASS = Postural Assessment Scale for Stroke. mFMA gait scale = modified Fugl-Meyer Assessment gait scale. mRS = Modified Rankin scale. r = effect size of the Mann-Whitney U test

Table 2 shows that individuals with lateropulsion improves well on daily physiotherapy in both Lw/oP (r = -0.65) and for pushers (r = -0.61) to a significantly improved state(r= -0.5 for upright and r= -0.24 for pushers). At one week post discharge, balance (r = -0.58) and gait (r = -0.54) abilities were showing an improving trend compared to the examination at admission.

Upright patients were found to have better gait and balance abilities at discharge than patients with lateropulsion and patients with Lw/oP was found to have better balance and gait capacities than pushers.

Table 3: Brain Imaging Comparisons Of Lesion Localizations For Patients Without And With |psilateral Pushing

Region involved	Pushers(N=58)	Without pushing(N=224)	p value
Frontal lobe	18(31%)	96(42.8%)	0.02
Parietal lobe	4(6.8%)	58(25.9%)	0.07
Temporal lobe	5(8.6%)	24(10.7%)	0.06
Occipital lobe	9(15.5%)	8(3.5%)	0.06
Thalamus	11(18.93%)	14(6.2%)	0.03
Basal ganglia	6(10.3%)	12(5.3%)	0.007
Internal capsule	15(25.8%)	34(15.1%)	0.05

Table 3 shows that on studying brain imaging in the stroke affected patients, it was observed that the lesions of frontal lobe, thalamus, basal ganglia and internal capsule had significant assosciation with balance and gait abnormality post stroke while lesions of parietal lobe, temporal lobe and occipital lobe did not lead to any significant gait or balance deficits.

Majority of the study subjects could maintain an upright posture post stroke after 30 days of discharge although they could not maintain it for longer duration. Lateropulsion was found to be frequent after right hemisphere stroke (at admission 68%; at day 30 after discharge 20%). Among all residual neurological deficits post stroke, lateropulsion was found to have the most detrimental effect on balance and gait. 228 (80.8%) patients had moderate to severe motor disability post stroke (mRS score >2). In this study, 172 patients (60.9%) were found to be

upright, when examined in two situations: 146 (84.8%) maintained upright posture while sitting and standing and 26 (15.1%) showed body tilt while sitting and/or on attempt to stand, without any tendency to fall down. The remaining 110 patients (39%) were identified to have lack of orientation with respect to gravity in erect posture; among these study subjects, 52 patients(18.4%) showed lateropulsion without pushing and 58(20.5%) were pushers.

On analysing the handedness with respect to balance disorders post stroke, it was found that all the patients with lateropulsion were right-handed, which proves that body orientation of self with respect to gravity is a measure of lateralized motor brain function. Lateropulsion was less common in subjects with left hemisphere strokes (12%) which indicated the strong role of right-hemisphere for the orientation in upright posture. On studying the relationship between gait and balance disorders post stroke, it was found that balance score calculated with PASS and gait score calculated with mFMA were showing a high degree of correlation ($r = 0.92$, p value <0.05).

DISCUSSION

There have been a wide range of studies from the Western world that studies the balance and gait disorders post stroke. [15-20] But studies that focus upon lateropulsion as a predicting factor of gait recovery is rare, especially in an Asian subset of population.

Gravity has a destabilizing effect on body and to over come it the person should have good postural control and balance. Impaired body orientation -with respect to gravity is defined as lateropulsion.[8] Here in this study we studied the balance, gait and lateropulsion disorders in the acute stage of stroke. We identified that lateropulsion is the major factor affecting balance and gait in the acute stage post stroke.

In our patient series of 282 subjects, majority of left hemisphere strokes (101 out of 106 LHS) remained the upright posture while patients with right hemisphere strokes had significant difficulty in maintaining balance and posture. 52 patients with lateropulsion without pushing and 51 patients with lateropulsion during pushing belonged to the category of right hemisphere strokes, thereby proving the role of uprightness as a lateralised brain function of right hemisphere. This finding is in conjunction with other scientific studies from the Western world which studied the type of strokes and the assosciated balance disorders.

Lateropulsion was identified to play a major role in the gait and balance disorders during the subacute stage of stroke. Lateropulsion is a key determinant of balance and gait disorders at the subacute phase after stroke. Our results stress on the importance of physiotherapy and rehabilitation strategies to improve motor function post stroke and that lateropulsion can be considered as a rehabilitation target.

Site of brain lesions have a role in maintaining balance post stroke. Pedersen et al. described brain lesions and their effect on balance.[14]He found a frequent involvement of internal capsule lesion in the stroke imbalance. Greater involvement of the subcortical areas in gait disorders support the hypothesis that lesions in these areas are required for pushing as reported by Karnath. However in our study we did not study the cognitive impairments post stroke and thus could not comment about the relationship between cognition and balance. This is a major limitation in our study.

CONCLUSION

Lateropulsion is a main factor in determining recovery of balance and gait in the subacute stage of stroke recovery. Special emphasis should be given to the impaired body orientation with respect to gravity in stroke rehabilitation stage and techniques to improve lateropulsion has to be stressed during physiotherapy for better recovery of balance and gait post stroke. Frontal lobe, its subcortical structures, thalamus, internal capsule and basal ganglia lesions were found to cause significant gait and balance involvement after stroke.

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