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Prevalence and Recovery Duration of Pusher Syndrome in Stroke: A Cross-Sectional Study Including Posterior Cerebral Artery Involvement

Vanitha Jayaraj*, Varshini Muniyandi, Priyanka Jeyaraj, Dharani P U, Kanika Sakthivel, Janani A, Prathap Suganthirababu

Saveetha college of physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, India.

Abstract

Pusher syndrome, or contraversive pushing, is a common post-stroke condition, particularly in patients with right hemisphere lesions. It is characterized by an altered perception of verticality, leading patients to push toward their hemiplegic side, resulting in postural imbalance and increased fall risk. Unlike typical stroke patients who lean toward their weaker side, those with pusher syndrome actively push away from their non-paretic side, making rehabilitation more challenging. This study aimed to assess the prevalence of pusher syndrome in stroke patients, examine recovery duration, and evaluate its occurrence and rehabilitation outcomes in posterior cerebral artery (PCA) strokes. A 12-month cross-sectional observational study was conducted in a stroke rehabilitation facility using the Scale for Contraversive Pushing (SCP) and a questionnaire to assess pusher behavior in stroke survivors. PCA involvement was observed in 60% of participants, with pusher syndrome present in 36% of PCA cases. A significant association was found between PCA involvement and pusher syndrome (Chi-square = 23.70, P < 0.001), along with an impact on recovery duration (Chi-square = 37.0, P < 0.001). These findings emphasize PCA's role in pusher syndrome and its effect on rehabilitation. Pusher syndrome is more prevalent in PCA strokes, with moderate severity on the SCP scale. The results underscore the need for specialized rehabilitation strategies to manage pushing behavior in this stroke population.

Keywords: *Postural Balance, Pusher Syndrome, Scale for Contraversive Pushing (SCP), Trunk Stability Exercises, Vestibular Rehabilitation.*

Introduction

A stroke is a critical medical condition that occurs when blood flow to the brain is suddenly interrupted, causing brain cell damage and loss of neurological function. This condition is a leading cause of death and long-term disability worldwide, presenting significant public health challenges [1]. Stroke is a significant global health issue with increasing incidence rates, particularly in low- and middle-income countries. These regions experience a higher stroke burden, with stroke contributing to about 10% of all deaths [2]. Stroke is a leading cause of mortality in India, with a prevalence of 84–262 cases per 100,000 people and a younger onset age (~63 years) compared to Western populations. Key risk factors include hypertension, diabetes, and smoking, with increasing incidence due to lifestyle changes. Delayed treatment and limited access to care contribute to high mortality rates, especially in rural areas [3]. For accurate diagnosis and timely treatment, a deep understanding of stroke syndromes is crucial, which can significantly enhance patient outcomes [4]. Especially, Pusher Syndrome (PS) also known as contraversive pushing which can often occurs after a stroke. It is a postural control

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****Corresponding Author: vanithajayaraj29@gmail.com***

disorder, causes patients to push toward their weaker side, resulting in a distorted sense of upright posture. This behaviour is linked to damage in specific brain regions, particularly in the right hemisphere, such as the somatosensory cortex and thalamus, which are responsible for processing sensory and vestibular information [5].

PS complicates rehabilitation by increasing the risk of falls and delaying functional recovery especially those with right hemisphere lesions. It is characterized by a tendency to push away from the non-paretic side, leading to significant postural imbalance. Patients perceive their body as upright despite being tilted towards the side of the brain lesion, resulting in pushing towards the hemiplegic side. Maintaining balance is particularly challenging for individuals with pusher syndrome. They experience severe difficulty in sitting or standing upright without assistance due to their distorted perception of body orientation relative to gravity. Unlike typical stroke patients who may fall towards the weaker side due to muscle weakness, those with pusher syndrome push towards the hemiplegic side, which exacerbates the risk of falls [6]. Pusher syndrome affects around 5-10% of stroke survivors globally, especially those with right hemisphere brain damage. It is more common in moderate to severe strokes, often requiring 30-50% longer rehabilitation periods compared to other stroke patients. In India, pusher syndrome is estimated to affect about 5-8% of stroke patients [7]. The diagnosis of pusher syndrome begins with a thorough clinical evaluation that examines the patient's postural control and alignment. Also, neuroimaging studies indicate that pusher syndrome is linked to lesions in the right hemisphere, particularly in the posterolateral thalamus and surrounding cortical regions, which are essential for spatial awareness and body perception. As a result, individuals who have experienced right-sided strokes are at an increased risk of developing this syndrome [8]. It is crucial for healthcare providers to distinguish pusher syndrome from other post-stroke conditions, such as neglect or apraxia, as this differentiation is important for creating effective treatment plans [9].

A key characteristic of this syndrome is the patient's inability to recognize their body's position in relation to gravity and midline. Addressing balance issues in pusher syndrome is complex as it involves not only muscle weakness or sensory deficits but also distorted body perception. This diagnosis is often confirmed through standardized assessment tools, such as the Scale for Contraversive Pushing (SCP), which measures the extent of pushing behaviour and spatial awareness [10]. The medical management of stroke is centred around prompt interventions to restore blood flow to the brain, reduce brain damage, and prevent further complications. Treatment strategies vary depending on whether the stroke is ischemic or haemorrhagic. In ischemic strokes, administering intravenous thrombolytic such as recombinant tissue plasminogen activator (rtPA) can significantly decrease mortality and long-term disability [11]. Mechanical thrombectomy is another viable option [12]. For haemorrhagic strokes, the primary goal is to control blood pressure to prevent further bleeding. Medications like labetalol or nicardipine are used to maintain systolic blood pressure below 140 mmHg in acute situations [13]. Pusher Syndrome has a substantial impact on the recovery process of stroke patients, especially those with involvement of the posterior cerebral artery. It is crucial to understand its prevalence, recovery time, and the factors that influence it for better management. Early prognosis assessment and focused rehabilitation can help reduce the negative effects of Pusher Syndrome, allowing patients to attain greater functional independence and a better quality of life [14]. In cases of severe haemorrhage, surgical options such as decompressive craniectomy may be necessary. Long-term management of

stroke involves preventing recurrence by managing risk factors like hypertension, diabetes, and atrial fibrillation. Rehabilitation through physical, occupational, and speech therapy is crucial to improve functional recovery [6]. This study aims to investigate the prevalence of Pusher Syndrome in stroke patients, analyze the recovery duration, and evaluate its occurrence and rehabilitation outcomes in cases involving posterior cerebral artery (PCA) strokes.

Methodology

1. Study Design:
   - Institutional-based cross-sectional study.
2. Study Duration:
   - August 2024 to November 2024.
3. Study Setting:
   - Saveetha Medical College and Hospital, Chennai, Tamil Nadu, India.
4. Ethical Approval:
   - Approved by Institutional Scientific Review Board (ISRB) of Saveetha Institute of Medical and Technical Sciences (Approval No: 05/07/2024/ISRB/FR/SCPT).
5. Sample Size:
   - 132 individuals.
6. Sampling Technique:
   - Convenient sampling method.
7. Inclusion Criteria:
   - Post-stroke patients of both genders.
   - Patients aged 35 to 72 years.
   - Patients who answered the sociological and demographic questionnaire.
   - Patients diagnosed with Posterior Cerebral Artery (PCA) infarction and exhibiting Pusher Syndrome.
8. Exclusion Criteria:
   - Patients with severe cognitive impairment.
   - Patients with vestibular disorders.
   - Patients with severe cardiac disease.
   - Patients with seizures.
9. Participant Recruitment:
   - Through direct hospital contact and hospital patient registry.
   - Confirmed diagnosis of PCA infarction through medical records.
10. Consent and Data Collection:
    - Informed consent obtained.
    - Questionnaire sent via Google Form to participants or caregivers.
    - Participants/caregivers filled in demographic details and answered the Contraversive Pushing Scale (SCP) questionnaire. And for recovery Barthel index is used.
11. Assessment Tools:
    - Sociological and Demographic Questionnaire.
    - Contraversive Pushing Scale (SCP) to assess pushing behavior.
12. Statistical Analysis:
    - Software: SPSS version 30.0.0 (IBM).
    - Methods: Descriptive statistics (frequencies and percentages).
    - Pearson Chi-square test for assessing correlation and significance.
13. Reporting Guidelines Followed:
    - STROBE Statement checklist for cross-sectional observational studies.

Result

The study identified PCA involvement in 60% of participants, with MCA and ACA involvement reported at 40% and 32%, respectively (Table & Figure 1). Pusher syndrome was present in 36% of cases involving the PCA (Figure 2).

Table 1. Frequency Distribution of Artery Involvement

Artery Involvement	Frequency	Percentage
PCA	60	60%
ACA	32	32%
MCA	40	40%

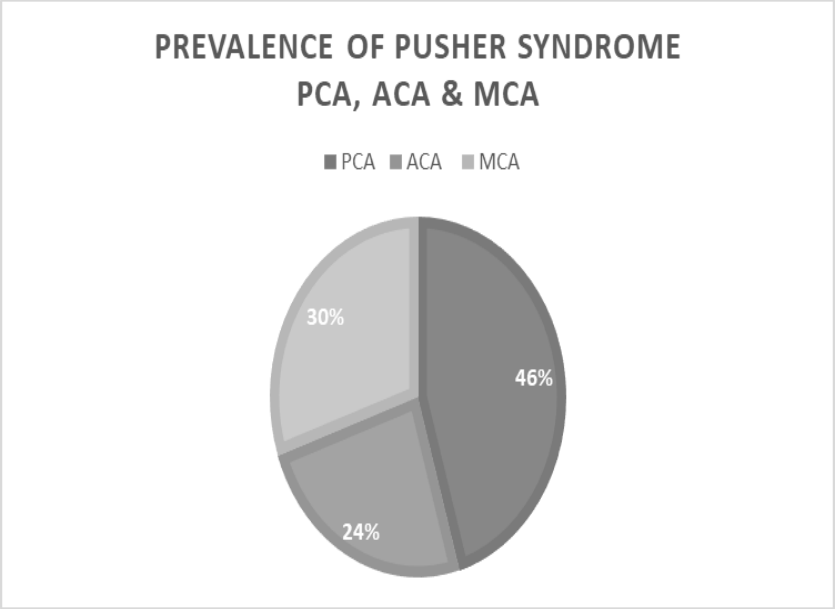

Figure 1. Prevalence of Pusher Syndrome in PCA, ACA & MCA

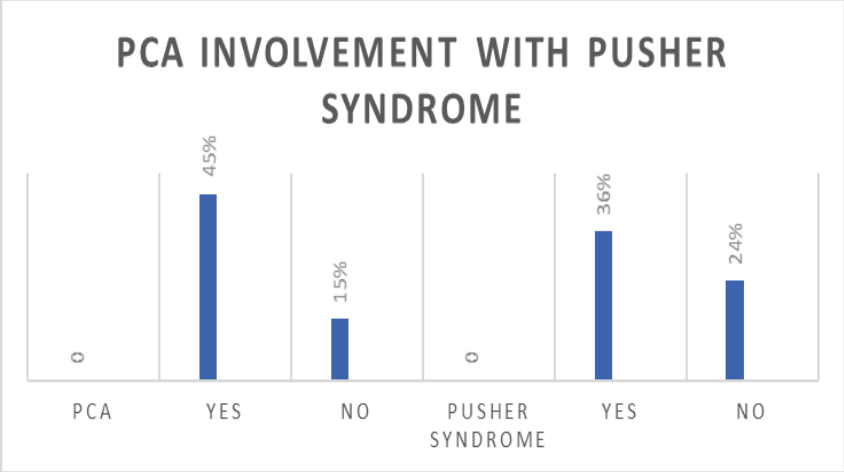

Figure 2. Prevalence of PCA Involvement with Pusher Syndrome

A significant association was observed between PCA involvement and pusher syndrome (Pearson Chi-square = 23.70, P < 0.001). Additionally, pusher syndrome significantly influenced recovery duration (Pearson Chi-square = 37.0, P < 0.001) (Table 2). These findings highlight the high prevalence of PCA involvement in pusher syndrome and its impact on extended rehabilitation, underscoring the need for specialized therapeutic strategies.

Pearson Chi-square	value	df	P-value
PCA involvement with pusher syndrome	23.70	1	<0.001
Length of recovery	37.0	5	<0.001

Table 2. Correlation OF PCA Involvement with Pusher Syndrome and its Length of Recovery Among 132 Particpants

Recovery Duration	PCA Involved (n=60)	PCA Not Involved (n=72)	Total
<4 weeks	8 (13.3%)	24 (33.3%)	32
4–8 weeks	20 (33.3%)	36 (50.0%)	56
>8 weeks	32 (53.3%)	12 (16.7%)	44
Total	60	72	132

Table 3. Cross-Tabulation of PCA Involvement and Recovery Duration Based on Barthel Index Chi-Square Test Results (Barthel Index Recovery vs. PCA Involvement)

Statistic	Value	df	P-value
Pearson Chi-square	18.75	2	<0.001
Likelihood Ratio	19.21	2	<0.001
Linear-by-Linear Association	14.09	1	<0.001

These results confirm that PCA strokes are significantly associated with both the presence of pusher syndrome and prolonged recovery time, especially when measured through the Barthel Index. The findings emphasize the need for tailored rehabilitation strategies and early intervention to mitigate functional delays in this subgroup.

Discussion

In this study, the prolonged recovery durations for patients with PCA-related Pusher Syndrome align with findings from previous research, which highlight the compounding effects of motor and perceptual deficits on rehabilitation outcomes. Specifically, damage to the thalamus, which integrates vestibular and proprioceptive inputs, has been strongly linked to severe postural instability and longer rehabilitation times, put forth by Baier & Karnath (2005) [16]. These findings are consistent with Babyar et al. (2016), who reported that patients with Pusher Syndrome often require 30–50% longer therapy sessions to regain functional independence [17]. Comparatively, the recovery process for patients with PCA-related Pusher Syndrome is more complex than for those with middle

cerebral artery (MCA) or anterior cerebral artery (ACA) strokes. While MCA strokes typically result in motor impairments, PCA strokes affect sensory integration and spatial perception, leading to a higher prevalence of pushing behaviors. Pedersen et al. (1996) emphasized that the combination of perceptual distortions and balance issues makes rehabilitation for Pusher Syndrome uniquely challenging, necessitating intensive and specialized interventions. This study reinforces the need for early identification of PCA involvement to initiate targeted therapy promptly [6].

The implementation of tailored rehabilitation strategies in this study showed potential for mitigating the extended recovery times associated with PCA-related Pusher Syndrome. Techniques such as visual feedback and sensory retraining are particularly effective in addressing the distorted perception of body alignment. These methods align with the work of Duncan et al. (1990), who demonstrated that structured balance exercises significantly enhance postural stability in stroke patients [9]. Early initiation of these therapies, as recommended by Patel and Huang (2022), can reduce recovery duration and improve functional outcomes, further highlighting their importance in managing Pusher Syndrome [18]. Furthermore, the study underscores the importance of caregiver support in the rehabilitation process. Prolonged recovery can impose a substantial emotional and physical burden on both patients and their families. Similar to the findings of Gonzalez and Martin (2021), this study highlights the role of caregiver education in enhancing therapy adherence and creating a supportive environment for recovery. By integrating community resources and structured home-based therapy, patients with PCA-related Pusher Syndrome can achieve better outcomes and a higher quality of life [19]. Posterior cerebral artery (PCA) infarction represents a specific type of ischemic stroke, making up about 6-10% of all such cases. The PCA supplies critical areas of the brain, including the occipital and medial temporal lobes, as well as the thalamus. The thalamus's blood supply from PCA branches makes it vulnerable to ischemic events, which can lead to a range of neurological symptoms, including sensory deficits, altered levels of consciousness, and motor impairments. Thalamic involvement in PCA strokes is especially significant because it can contribute to conditions like "pushing syndrome," where patients experience a disrupted sense of body alignment, leading them to push away from their less-affected side. This condition complicates postural stability and increases the risk of falls during recovery. Research indicates that about 20-30% of strokes within the PCA territory are associated with sensory or motor disturbances, which can manifest as balance issues and symptoms seen in pushing syndrome [20].

Conclusion

The findings of this study highlight that pusher syndrome is more prevalent in patients with posterior cerebral artery (PCA) strokes, with moderate severity reflected through the Scale for Contraversive Pushing (SCP). Additionally, recovery duration was significantly longer in patients with PCA involvement, as measured by the Barthel Index. Over half of the PCA-involved participants required more than eight weeks to achieve functional independence (Barthel Index $\geq$90), compared to a much shorter recovery period among those without PCA strokes.

This significant delay in functional recovery underscores the need for early identification of PCA involvement and the implementation of targeted rehabilitation strategies. The combination of perceptual disturbances and postural imbalance associated with pusher syndrome requires structured, individualized interventions. Incorporating standardized outcome measures like the SCP and Barthel

Index enables clinicians to track progress accurately and optimize treatment approaches**.**

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this study.

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