

Post-stroke Movement Disorders: The Clinical, Neuroanatomic, and Demographic Portrait of 284 Published Cases

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Purpose: Abnormal movements are a relatively uncommon complication of strokes. Besides the known correlation between stroke location and certain movement disorders, there remain uncertainties about the collective effects of age and stroke mechanism on phenomenology, onset latency, and outcome of abnormal movements. *Materials and Methods:* We systematically reviewed all published cases and case series with adequate clinical-imaging correlations. A total of 284 cases were analyzed to evaluate the distribution of different movement disorders and their association with important cofactors. *Results:* Posterolateral thalamus was the most common region affected (22.5%) and dystonia the most commonly reported movement disorder (23.2%). The most common disorders were parkinsonism (17.4%) and chorea (17.4%) after ischemic strokes and dystonia (45.5%) and tremor (19.7%) after hemorrhagic strokes. Strokes in the caudate and putamen were complicated by dystonia in one third of the cases; strokes in the globus pallidus were followed by parkinsonism in nearly 40%. Chorea was the earliest poststroke movement disorder, appearing within hours, whereas dystonia and tremor manifested several months after stroke. Hemorrhagic strokes were responsible for most delayed-onset movement disorders (>6 months) and were particularly overrepresented among younger individuals affected by dystonia. *Conclusions:* This evidence-mapping portrait of poststroke movement disorders will require validation or correction based on a prospective epidemiologic study. We hypothesize that selective network

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Received March 2, 2018; revision received April 7, 2018; accepted April 23, 2018.

Financial disclosure: Dr. Dwivedi is supported by the NIH (1R01HL125016-01) as a Co-Investigator and (R21 AI118228) as a Collaborator. He has also been serving as a statistician in 4 CPRIT grants (PP110156, PP140211, PP150031, and PP130083), Coldwell (Co-Investigator), MSA Coalition (Collaborator), and as a principal investigator in a TTUHSC ELP mini seed grant. Dr. Dwivedi is a director of Biostatistics and Epidemiology Consulting Laboratory at the TTUHSC ELP. Dr. Espay has received grant support from the NIH, Great Lakes Neurotechnologies, and the Michael J. Fox Foundation; personal compensation as a consultant/scientific advisory board member for Abbvie, TEVA, Impax, Acadia, Acorda, Cynapsus/Sunovion, Lundbeck, and US WorldMeds; publishing royalties from Lippincott Williams & Wilkins, Cambridge University Press, and Springer; and honoraria from Abbvie, UCB, US WorldMeds, Lundbeck, Acadia, the American Academy of Neurology, and the Movement Disorders Society.

Conflict of interest: Drs. Suri, Rodriguez-Porcel, Donohue, and Lovera, and Ms. Jesse declare that they have no conflict of interest to disclose. Author contributions: **Case Series Project:** Conception: R.S., F.R.P., L.L., and A.J.E.; Organization: R.S. and A.J.E.; Execution: R.S., F.R.P., E.J., and K.D. **Statistical Analysis:** A.D. **Manuscript:** Writing of the First Draft: R.S. and F.R.P.; Review and Critique: E.J., K.D., L.L., A.D., and A.J.E.

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1052-3057/\$ - see front matter

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<https://doi.org/10.1016/j.jstrokecerebrovasdis.2018.04.028>

vulnerability and resilience may explain the differences observed in movement phenomenology and outcomes after stroke. **Key Words:** Movement disorders—stroke—ischemic stroke—hemorrhage—dystonia.

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Introduction

Poststroke movement disorders (PSMDs) represent up to 22% of all secondary movement disorders. However, PSMDs are only observed in 1%–4% of all strokes.^{1,2} Despite the fact that the basal ganglia, thalamus, and cerebellum are commonly affected, the vast majority of strokes in these regions do not complicate their course with a movement disorder.^{1,3} This remains an intriguing phenomenon, considering the role of these structures in the pathophysiology of idiopathic and degenerative movement disorders. Furthermore, while selected movement disorders may emerge after lesions in distinct parts of the brain, the topographical specificity for many movements may be poor, and there remains uncertainty about the effects of age and stroke type on phenomenology, onset latency, and outcome of abnormal movements. The reasons for these discrepancies remain unclear.

In this study, we sought to elucidate the role of type of stroke (ischemic versus hemorrhagic), location, and age on the phenomenology, latency to onset, and outcome of PSMDs based on a review of published cases.

Methods

We conducted a systematic review of the literature to identify cases of PSMDs reported between 1986 and 2016. We performed a PubMed search with the following terms: (stroke or infarct or hemorrhage or ischemia) AND (movement disorders or hyperkinetic or dystonia or myoclonus or chorea or Parkinson's or parkinsonism or tremor or restless legs syndrome or periodic limb movements or stereotypy or akathisia or alien hand syndrome or tics). Search results, titles, and abstracts were reviewed to include case reports and case series pertinent to our research objectives. Among the identified articles, we included in the review those that contained (1) well-documented patients with movement disorders developing after a stroke; (2) characterization of the stroke type (e.g., ischemic, hemorrhagic) and location; (3) report of the latency between the stroke and onset of the movement disorder; and (4) patients who did not present alternative causes for the emergence of the movement disorder (e.g., metabolic abnormalities, medications). Additional articles were identified by screening secondary research articles (reviews, commentaries, and letters) yielded by the initial PubMed search. We excluded articles with incomplete characterization of the movement disorder or the imaging data regarding localization. Subjects from criteria-meeting articles were included in a database, which included

demographics (e.g., age and gender), type and location of stroke, reported movement disorder, latency to onset and, if available, outcome (e.g., improvement or persistence).

Statistical Analysis

A total of 74 articles yielding 284 patients were found suitable for the analysis.^{4–75} Because the majority of the articles were case reports, each subject from each study was considered to be a unit of analysis, and thus no weight was assigned to any studies. Type of stroke (ischemic versus hemorrhagic), average age, gender distribution, type and location of movement disorders, latency period between stroke and movement disorder, and outcomes were extracted from each report. All data were described using frequencies and proportions. All data were compared according to type of stroke, gender, and age groups using Fisher's exact tests. Comparison of latency period according to different factors was assessed using chi-square test. All the statistical analyses were carried out using STATA 13 (StataCorp, College Station, TX).

Results

General Features of PSMD

Of a total of 323 qualifying cases, 39 were excluded due to insufficient data. In total, 284 cases fulfilled our research criteria and were used for analyses. Reported PSMDs were more common in men (58%), with a mean age at presentation of 62 years (range 18–93). Ischemic strokes preceded more than three quarters of PSMDs. Posterolateral thalamus (23%) was the region most frequently affected, followed by the putamen (19%) and caudate (14%). Dystonia was the most common PSMD (23%), followed by chorea (16%) and myoclonus (15%) (Table 1).

Basic Demographics and PSMD

In patients between 50 and 70 years (51.4%), the posterolateral thalamus was the most common location (29%), while myoclonus and dystonia were the most common PSMD (27% and 24%, respectively). In those younger than age 50, the putamen and caudate (28% and 19%, respectively) were the most common locations, and dystonia the most common PSMD (40%). In those older than 70 years, the putamen was most frequently affected (25%) and chorea the most common PSMD (24%) (Supplementary Table S1). Women showed greater putaminal involvement than men (26% versus 14.0%) but similar frequency of

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