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ORIGINAL ARTICLE

Incidence and Associations of Hemiplegic Shoulder Pain Poststroke: Prospective Population-Based Study

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Abstract

Objective: To provide an epidemiological perspective of the clinical profile, frequency, and determinants of poststroke hemiplegic shoulder pain.

Design: A prospective population-based study of an inception cohort of participants with a 12-month follow-up period.

Setting: General community and hospital within a geographically defined metropolitan region.

Participants: Multiple ascertainment techniques were used to identify 318 confirmed stroke events in 301 individuals. Among adults with stroke, data on shoulder pain were available for 198 (83% of the survivors) at baseline and for 156 and 148 at 4 and 12 months, respectively.

Interventions: Not applicable.

Main Outcome Measures: Subjective reports of onset, severity, and aggravating factors for pain and 3 passive range-of-motion measures were collected at baseline and at 4- and 12-month follow-up.

Results: A total of 10% of the participants reported shoulder pain at baseline, whereas 21% reported pain at each follow-up assessment. Overall, 29% of all assessed participants reported shoulder pain during 12-month follow-up, with the median pain score (visual analog scale score = 40) highest at 4 months and more often associated with movement at later time points. Objective passive range-of-motion tests elicited higher frequencies of pain than did self-report and predicted later subjective shoulder pain (crude relative risk of 3.22 [95% confidence interval, 1.01−10.27]).

Conclusions: The frequency of poststroke shoulder pain is almost 30%. Peak onset and severity of hemiplegic shoulder pain in this study was at 4 months, outside of rehabilitation admission time frames. Systematic use of objective assessment tools may aid in early identification and management of stroke survivors at risk of this common complication of stroke.

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Hemiplegic shoulder pain has been described as 1 of the 4 most common medical complications after stroke,[1] with others being depression, falls, and urinary tract infections.[1] Earlier studies have reported the frequency of shoulder pain after stroke to be as high at 65% to 70%.[2-4] A more recent prospective Swedish study of 416 consecutive patients with stroke reported that almost a third of stroke survivors developed shoulder pain, most of whom reported moderate to severe pain.[5] Contributions to pain development are often multifactorial; biomechanical factors are significant[6] and may occur in isolation or in addition to changes in tone[7] or neuropathic mechanisms.[8] Hemiplegic shoulder pain is associated with a reduction in functional use of the arm,[9] interference with rehabilitation,[9] increased length of stay,[9] and higher rates of depression.[10] Complexities in etiology and subsequent diagnosis

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mean that treatment of shoulder pain is difficult, and reviews have found little evidence to guide clinicians on effective prophylactic and treatment options.[11] Understanding the pattern of presentation and establishing tools to support early identification of those likely to develop pain would assist clinicians and patients.

The primary objective of this study was to determine the frequency, characteristics over time, and determinants of hemiplegic shoulder pain in a defined metropolitan population of South Australia. The secondary objective was to evaluate the predictive use of 3 standardized passive objective measures of shoulder range as screening tools for the development of shoulder pain. Objective assessment is necessary in conjunction with subjective questioning because self-report alone has been shown to be a poor predictor of examination findings,[6] and accurate clinical assessment and diagnosis is vital in establishing targeted management plans. A case-control study suggested that a simple set of clinical assessments (3 passive range-of-motion tests) conferred a 98% probability of predicting early hemiplegic shoulder pain at rest.[12] The generalizability of this finding is limited because of its small sample with multiple exclusion criteria (thalamic infarcts, upper limb sensory deficit, previous shoulder injury, complex regional pain syndrome, and dysphasia). We evaluated this same set of assessments in all participants in a stroke incidence study, on the basis of the principles of complete ascertainment,[13] to test their application as a predictor of the development of hemiplegic shoulder pain.

Methods

Overview

The Adelaide Stroke Incidence Study (ASCEND) was a prospective population-based stroke incidence study conducted in a defined region of the western suburbs of Adelaide, South Australia, with a census-projected population of more than 148,000. During the period from July 15, 2009, to July 15, 2010, multiple ascertainment methods were used to identify all occurrences of stroke. Ethics approval was obtained from every tertiary hospital in Adelaide and the University of Adelaide, and all participants provided consent before enrollment in the study. The detailed methodology has been previously described,[14] including specific information regarding the study population and ascertainment techniques.

After informed consent, participants were assessed at baseline, at 4 months, and at 12 months. All data were collected as part of the larger ASCEND trial and entered into a custom-designed online database. The data set specific to this study was extracted via an automated database query and checked against the raw database manually. Only data that were truly prospective were included for analyses, because retrospective report of subjective pain measures was not deemed reliable and retrospective case note data would not include the objective tests.

List of abbreviations:

ASCEND	**Adelaide Stroke Incidence Study**
CI	**confidence interval**
NIHSS	**National Institute of Health Stroke Scale**
VAS	**visual analog scale**

Definitions

Stroke was defined as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function lasting more than 24 hours (unless interrupted by surgery or death) with no apparent cause other than of vascular origin."[15(p105)] Hemiplegic shoulder pain was defined as any subjective complaint of pain in the contralesional or affected hemiplegic shoulder after stroke. Hemiplegic shoulder pain encompasses all etiologies, and we did not exclude patients on the basis of premorbid shoulder pathology. Pain was measured using a visual analog scale (VAS) (score range, 0−100), with severity classified into mild (10−30) and moderate to severe (40−100) in line with previous publications.[16,17] Upper limb motor function was determined using question 5 from the National Institute of Health Stroke Scale (NIHSS)—motor arm score of 3 or above was classified as "no motor function" (score 3 = no effort against gravity; score 4 = no movement), and reduced motor function was score 1 to 2 (score 1 = drift; score 2 = limited effort against gravity).

Demographic data: Subjective and objective assessments

The subset of data of interest in the study included record of demographic data and baseline and follow-up subjective and objective measures pertaining specifically to shoulder pain.

Demographic and clinical characteristics were recorded to characterize the subsets within the study population and to explore any associations with the risk of development of shoulder pain. Data included age, sex, significant medical history, stroke subtype and etiology, affected hemisphere, and motor arm component of the NIHSS.

Subjective information included history of shoulder pain before stroke and presence of shoulder pain on the affected side. If pain was reported, further questions regarding time of onset, severity of pain, and aggravating factors were asked. Patients were asked whether pain was worse at rest, on movement (active or passive), or at night. Pain severity was scored using a vertical VAS. Each participant who provided consent was assessed by a trained study nurse.

A rehabilitation physician taught all data collectors a standardized approach to objective tests, and a video support package was made and provided for ongoing reference.

Objective measures of the participants' affected upper limb included the following: (1) the modified Neer test (forced passive forward flexion), with the participant tested in a seated position; (2) passive hand-behind-neck test (passive abduction, external rotation), with the participant tested in a seated position; and (3) passive external rotation as compared with the unaffected limb. Passive external rotation was measured with the patient in a seated position. Range was measured using a goniometer.

Any pain on the modified Neer test or the passive hand-behind-neck test was scored as a positive result. Affected limb passive external rotation range that differed by $<10^{\circ}$ as compared to unaffected limb, was deemed a positive finding for limitation of range of movement.

Statistical analysis

Baseline demographic characteristics of participants with and without shoulder pain were compared using the Wilcoxon *U* rank-sum test for continuous variables and the chi-square test for