



Original Article

Diagnostic Accuracy of Adult-Assisting Hand Assessment in People with Chronic Stroke Who Had Pain

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ABSTRACT

Background: Pain in patients with stroke is one of the essential factors that can influence upper-limb performance, and it is better to divide these people into separate groups. The Adult-Assisting Hand Assessment (Ad-AHA) is a tool that recently is being used in upper-limb performance evaluation among patients with stroke. The present study aimed to evaluate the diagnostic accuracy of the Ad-AHA among patients with chronic stroke who had pain to discriminate between the high upper-limb performance group and the low upper-limb performance group.

Methods: In this cross-sectional study, 51 patients (mean age±SD = 69.33±8.73) with chronic stroke who had pain participated and were divided into two groups of high (group 1) and low (group 2) upper-limb performance measured by the Action Reach Arm Test. The best cutoff point between groups, sensitivity, and specificity by receiver operating characteristic (ROC) for Ad-AHA was calculated.

Results: A significant difference in the total score of Ad-AHA between the high and low upper-limb performance groups was seen ($P<0.001$). The best cutoff point for the total score of Ad-AHA between stroke patients with high and low performance in the upper-limb who had pain was 47 (sensitivity=95.45, specificity=89.21).

Conclusion: The results of this study show that the Ad-AHA has high sensitivity and specificity to discriminate between stroke patients with high and low performance in upper-limb performance who had pain.

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Introduction

Stroke is one of the major causes of disability in adulthood that can reduce the independence of individuals in daily routine activities [1]. According to previous studies, about 70% of patients with stroke experience a disability in upper-limb performance, and only a portion of them will return to their previous level of function. Inability to perform activities that require proper performance of both sides, like dressing and eating, can significantly influence these patients' satisfaction and quality of life [2-4]. Thus,

one of the main scopes of rehabilitation in patients with stroke is the improvement of movement and training in compensating strategies to increase satisfaction among these people during their activities [5].

Pain in patients with stroke, mainly when it is chronic (when more than six months have passed), can be a major factor in causing limitation in daily activities. Pain in stroke patients can result from increased muscle tone, restriction in range of motion, dislocation, instability of joints, and muscle spasms that can considerably influence the self-reported level of pain among these patients. On the other hand, these patients may experience central pain because of the interruption that has come up in their central nervous systems, which can be the cause of increased muscle tone, spasms, and tension in muscles

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that will disrupt and reduce performance of stroke patients' daily and personal activities [6-9]. Thus, in addition to muscle assessments, tone and range of motion and level of performance of patients in performing daily activities considering the pain can be essential to better planning for increasing patient performance. These patients are better assessed in a particular group.

Various tools have been developed for assessing upper-limb performance. One of them is the Ad-AHA, a semi-structured questionnaire that can accurately survey upper-limb performance on both sides based on observation. In the Ad-AHA, patients should perform some bimanual activities (wrapping a present, making a sandwich), which monitors bimanual activities. Their performance is scored based on observation of a person's performance from completely not doing the exercise (1) to completing it (4) [10].

Recently, the psychometric properties of the tool have been surveyed among the stroke population. The acceptable results for assessing upper limb performance among patients with chronic stroke have been reported, but its diagnostic accuracy has not yet been investigated [11, 12]. Thus, the objective of the current study is to evaluate the diagnostic accuracy of Ad-AHA in patients with chronic stroke who had pain to discriminate between groups with high and low performance in upper limbs.

Methods

Participants

In this cross-sectional study, 51 patients with chronic stroke who had pain participated. This study was conducted from June 2020 to August 2021, and participants were selected using the convenience non-probability sampling method. Mean age \pm SD of the participants was 69.33 \pm 8.73 years.

Study inclusion criteria comprised confirmation of stroke based on WHO standards, diagnostic validity with MRI by neurologists [13], six months after stroke, non-existence of significant cognitive problem (Mini-Mental Status Examination with a score greater than 21) [14], ability to communicate, and ability to comprehend orders in Persian. Individuals who had other neurological problems such as MS, Parkinson, or orthopedic issues that influenced upper limb performance were excluded from the study.

Patients signed a consent form before participating, and the ethics committee of IUMS approved the study (IR. IUMS.REC.1399.302).

Procedure

A trained occupational therapist (H.H.) assessed stroke patients. Demographic characteristics of patients, such as age, gender, time of stroke, affected side, and type of stroke (ischemic or hemorrhagic) were primarily recorded. Then, the patients' upper extremity performance was evaluated by Ad-AHA and ARAT. Moreover, pain in participants' upper limbs was checked with yes/no questions. In the assessment process, tests were random, and the participants were given time to rest. The two groups were separated by ARAT total score. Patients with a score higher than 32

comprised the high-performance group, and patients with a score of zero or less than or equal to 32 comprised the upper limb low-performance group [15].

Instruments

Adult-Assisting Hand Assessment (Ad-AHA): Lena Krmlinde-Sundhlohm developed the Ad-AHA test in 2017 to assess the influence on dysfunctional upper limb with bilateral performance in stroke patients. To perform measurements, patients were asked to attempt two daily activities (wrapping sandwiches and presents) that require both hands to do them. The assessor observed the individual's upper limb performance in these two activities and scored each of 19 items on a 5-point Likert-type scale (4=effective, 3=somewhat effective, 2=ineffective, 1=does not do). The minimum score in this tool is 19, and the top score is 76. The demanded time for the process and its instructions is 20 minutes [10, 11].

Action Reach Arm Test (ARAT): Van der Lee designed and developed this test in 2001 to assess upper limb performance among stroke patients. This tool includes 19 motion items that assess daily activities, coordination, hand skills, and upper limb performance (in these four groups, pinch, grip, grasp, and gross arm movements). Activities are scored based on observation using a four-point scoring scale (could not perform any part of the test=0, partially performed the test=1, performed the test with great difficulty or for a longer time=2, performed the test normally=3). The least score in this test is 0, and the maximum score is 57. In addition, the first step of this assessment, the toughest step in each item, is implemented. If the patient does it correctly during the performance, they will be given the maximum score, and further steps are not needed; However, in non-performance of the stage, each item's second step, which is the easiest step, will be implemented. If the patient is unable to do it, the score will be 0, and if they do it correctly, the next two steps must be implemented by the patients. The reasonable time for implementation of the test is 5-15 minutes [16].

Statistical Approach

Statistical analysis was done using Med Calc, SPSS for Windows (Version 13, and Statistical (Version 13.0.6). The significance level of $P < 0.05$ was considered in all statistical analyses in this study. The frequency, mean, SD, and range of demographic features and Ad-AHA domains were calculated for both groups. The Kolmogorov-Smirnov test was performed to evaluate the normal distribution of data. How accurately stroke patients with pain were classified by Ad-AHA as high and low upper-limb performance [Sensitivity $\left(\frac{\text{true positive}}{(\text{true positive} + \text{false negative}) \times 100} \right)$ and Specificity $\left(\frac{\text{true negative}}{(\text{true negative} + \text{false positive}) \times 100} \right)$] was calculated. Negative predictive value (NPV) and positive predictive value (PPV) were calculated by the following formulae, respectively: true negative/ (true negative+false negative) and true positive/ (true positive+false positive). The negative likelihood ratio (NLR) and positive likelihood ratio (PLR) were calculated as (1-sensitivity)/ specificity and sensitivity/ (1-specificity) [17].

Results

Description Data

In the current study, 51 chronic stroke patients who had pain (23 men, 28 women) with a mean±SD age of 69.33±8.73 years participated. The mean time (±SD) from stroke onset was 16.92±13.70 months. Based on ARAT test data, 29 participants (14 men, 15 women) were in the group with high performance in the upper limb, and 22 participants (9 men, 13 women) were in the group with low performance in the upper limb. In the upper limb high-performance group, 19 participants' right side had the affected limb. Twenty participants had ischemic stroke type. Among 22 participants with low upper limb performance, 15 participants' right side had the affected limb, and the type of stroke in 14 participants was ischemic. The scores in the Ad-AHA test ranged from 25 to 74 (Table 1).

Comparison revealed no significant difference in age and time from stroke onset between participants with high upper limb function and those with low upper limb function. Nonetheless, in mental condition and ARAT total score, there were substantial differences between patients with high performance and low-performance patients

(Table 2). The Ad-AHA total score mean (±SD) in high upper limb performance patients was 61.65±10.32 and in the low-performance group was 37.54±7.10 (Table 2).

Diagnostic Accuracy

The best cut off point in determination between stroke patients with pain in the high and low upper limb performance groups was equal/lower than 47. The sensitivity and specificity values were 95.45 and 89.21, respectively (Table 3, Figure 1). The results acquired from ROC indicated that with an Ad-AHA score ≤47, 84% of chronic stroke patients with pain who had low performance were classified accurately in this group.

Discussion

The Ad-AHA is an assessment tool that has recently been adopted for use with chronic stroke patients. It was designed primarily for children affected by hemiplegia cerebral palsy. Various studies then found the utilization ability of tests among the chronic stroke population. This assessment can evaluate upper limb function among the stroke population without considering the affected side. In addition to psychometric properties

Table 1: General and clinical characteristics of participants

Variable	High function group (n=29)	Low function group (n=22)	T	D _r	P _v
Age (year)	70.79±6.93	67.40±10.35	1.38	49	0.173
Stroke onset (month)	16.89±14.11	16.95±13.99	-0.01	49	0.988
Cognitive status (MMSE)	26.44±2.27	24.04±1.78	4.08	49	0.001
ARAT	49.51±7.14	20.31±8.97	12.94	49	0.001
Ad-AHA	61.65±10.32	37.54±7.10	9.38	49	0.001

MMSE: Min-Mental State Examination, ARAT: Action Research Arm Test, Ad-AHA: Adult- Assisting Hand Assessment

Table 2: Ad-AHA score in people with stroke who had pain with regards to upper extremity function

Ad-AHA score	High function group (n=29)	Low function group (n=22)
25-30	0	3
30-35	0	3
35-40	1	8
40-45	1	3
45-50	4	5
50-55	2	0
55-60	0	0
60-65	5	0
65-70	9	0
70-74	7	0
Total	29	22
Mean±SD	61.65±10.32	37.54±7.10

Ad-AHA; Adult- Assisting Hand Assessment

Table 3: Sensitivity (%), Specificity (%), Positive Likelihood Ratio (PLR), Negative Likelihood Ratio (NLR), Positive Predictive Value (PPV) and Negative Predictive Value (NPV) for Ad-AHA cut-off score in people with Stroke who had Pain

Cut-off score	Sensitivity	Specificity	PLR	NLR	PPV	NPV
≤41	68.18	93.10	9.89	0.34	88.2	79.4
≤43	72.73	93.10	10.55	0.29	88.9	81.8
≤44	77.27	93.10	11.20	0.24	89.5	84.4
≤45	81.82	93.10	11.86	0.20	90.0	87.1
≤46	90.91	89.66	8.79	0.10	87.0	92.9
≤47	95.45	89.21	6.92	0.05	84.0	96.2
≤48	95.45	82.76	5.54	0.05	80.8	96.0
≤49	95.45	79.31	4.61	0.05	77.8	95.8
≤50	100.00	79.31	4.83	0.00	78.6	100.0
≤52	100.00	72.41	3.62	0.00	73.3	100.0

PLR: positive likelihood ratio, NLR: Negative Likelihood Ratio, PPV: Positive Predictive Value, NPV; Negative Predictive Value

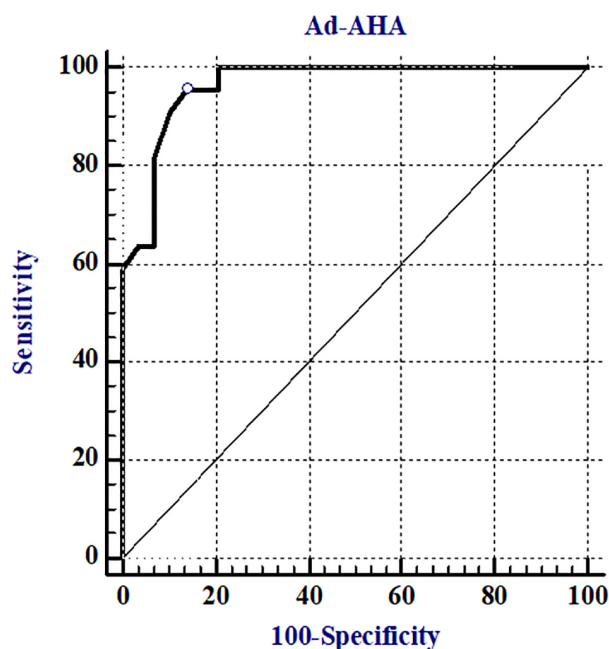


Figure 1: Receiver Operating Characteristic (ROC) curve for Adult-Assisting Hand Assessment (Ad-AHA) score in people with chronic stroke who had pain

that have been surveyed in various societies, calculating the discriminative point in determining upper limb performance among the chronic stroke population with pain is a considerable part of this study.

Chronic stroke individuals have stated that causes such as increased tone in muscles, motion striction, disability in joints (especially shoulders), and muscles spasm due to the illness had created pain for them [6, 8]. The consideration of pain and its management can be a significant factor in the effectiveness of rehabilitation protocol development for progress in upper limb function among chronic stroke patients. The results of previous studies in this context indicate that pain is important and must be assessed as an independent factor in this group of patients [6, 18, 19].

The current results indicated that the best discriminative Ad-AHA cut off score between high and low upper limb function of stroke patients with pain was equal to or lower than 47.

This result was found by description domain that was determined for sensitivity and characteristic (high, $\geq 90\%$; moderately high, $\geq 80\%$ - $<90\%$; moderate, $\geq 70\%$ - $\leq 80\%$; moderately low, $\geq 60\%$ - $<70\%$; and low, $<60\%$). The sensitivity range and specificity for the cut-off point were 94.45 and 89.21, respectively, showing high sensitivity and specificity for determination between the high- and low-upper-limb-function groups. On the other hand, patients with pain that score equal to or lower than 47 in the Ad-AHA test have a lower performance in upper limb function [17].

According to the results of this study, PPV=82, NPV=96.2, NLR=0.05, and PLR=6.92 are indicated for this cut-off point that is interpreted in the following sentences. PPV has shown that 84% of chronic stroke patients with pain and a positive score (Ad-AHA score more than 47) were correctly categorized in the high upper limb function group. NPV indicated that 96.2%

of chronic stroke patients with pain and negative scores (Ad-AHA score less than 47) were correctly categorized in the low upper limb function group.

According to the study results, the Ad-AHA total average score among chronic stroke patients with pain divided into two high and low upper limb groups by the ARAT tool had a significant statistical difference. This result shows that the two instruments have an equal ability to evaluate upper limb function among chronic stroke patients. The performance nature of ARAT was one of the leading reasons for its selection for grouping patients for Ad-AHA diagnostic accuracy determination [16].

Previous studies have not concentrated on Ad-AHA diagnostic accuracy; thus, the current study was first to focus on Ad-AHA diagnostic accuracy to determine high and low upper limb function. One of the limitations of this study was the inability to compare the results with previous results, as no previous results exist. Another restriction in this study was the sampling of available participants which can influence generalization of the results. If pain assessment was implemented in the upper limb only, more compelling data may be obtained, suggesting future studies in this field.

Conclusion

The study results indicated that Ad-AHA has excellent ability in determining upper limb function among chronic stroke patients with pain. The appropriate cut-off point for the determination of low and high upper limb function was 47. High sensitivity and high specificity were found that showed Ad-AHA can be used with other tools in upper limb performance among chronic stroke patients in studies and clinical environments.

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Conflict of Interest: None declared.

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