

Krzysztof Głowacki

**Predyktory wystąpienia reakcji stowarzyszonych kończyny
górnej u pacjentów po udarze mózgu**

Predictors of associated reactions of upper limb in patients
after stroke

Rozprawa doktorska na stopień doktora
w dziedzinie nauk medycznych i nauk o zdrowiu
w dyscyplinie nauki o zdrowiu
przedkładana Radzie Dyscypliny Nauk o Zdrowiu
Warszawskiego Uniwersytetu Medycznego

Promotor: Prof. dr hab. n. med. i n. o zdr. Izabela Domitrz

Promotor pomocniczy: dr n. med. Jakub Stolarski

Warszawa, 2026

Streszczenie w języku angielskim

Introduction

Stroke is the leading cause of disability worldwide. Early physiotherapy is essential for maximizing post-stroke functional outcomes. Associated reactions (ARs) are a negative phenomenon that develops in the subacute phase after stroke and impairs patient functioning. ARs consist in an involuntary increase of muscle tone in the limbs or face on the affected side, occurring in response to exertion, pain, stress or loss of postural control. Predicting their occurrence during the Stroke Department stay can contribute to better physiotherapy planning.

Aims of the study

Primary aim: To identify predictive factors in the acute phase of stroke for the occurrence of ARs of the upper limb approximately three months after stroke onset.

Secondary aims: To assess the feasibility of using the modified Associated Reactions Rating Scale (ARRS) in clinical settings, and to evaluate the usefulness of the Trunk Control Test (TCT) and Trunk Impairment Scale (TIS) for trunk assessment in the acute stage of stroke.

Material and methods

Data were collected from 112 stroke survivors in a prospective cohort study. This study was conducted from November 2023 to January 2026 at the Neurological Department of Bielanski Hospital as well as in patients' home environments after hospital discharge. Initial assessment was conducted during patients' hospitalization at the Stroke Department. This assessment included: muscle tone and strength of the limbs (measured using items from the Scandinavian Stroke Scale), superficial and deep sensation impairment in the limbs, presence of hemineglect syndrome, trunk activity (measured using TCT, the modified TCT and TIS). In addition, the following data were collected from each participant: age, sex, more affected side, length of hospital stay, ability to follow verbal commands, type of stroke and receipt of reperfusion treatment. Approximately three months after stroke onset, a final assessment was conducted. It involved assessment of ARs occurrence with the modified ARRS.

Results

Of the 112 patients enrolled in the study, 69 completed the final assessment, while 43 were lost to follow-up. In the prediction of study completion, 15 factors significantly influencing completion rates were identified. Multivariate logistic regression revealed two independent predictors of study completion: the TCT score (per one point) and the presence of decreased muscle tone in the lower limb. The model demonstrated good calibration. These two predictors were further examined for associations with the remaining significant predictive factors.

Univariate logistic regression analyses identified 15 statistically significant predictors of associated reaction (AR) occurring approximately three months after stroke onset. Based on these variables, a final multivariate logistic regression model was developed. The independent predictors of AR were right-sided neurological deficit (associated with increased risk) and high muscle strength of the upper limb (associated with decreased risk). Patients with a right-sided neurological deficit and low upper limb muscle strength had the highest risk of AR (70.8%), whereas those with a left-sided deficit and high upper limb strength had the lowest risk (1%). The model showed good calibration with respect to the observed data. Both independent predictors were further analysed for associations with other univariate predictive factors.

Analysis of individual components of the TCT revealed that the ability to turn onto the less affected side and to sit up from both the directly and indirectly affected sides were significantly associated with a reduced risk of AR. The majority of patients with AR at the final assessment (13 out of 14) scored “1” on the modified ARRS

Conclusions

1. In patients in the acute phase of stroke, several factors were identified that predict the occurrence of AR approximately three months after stroke onset. Multivariate logistic regression analysis revealed two independent predictors:
 - a. Higher muscle strength of the upper limb in the acute phase of stroke was associated with a significantly lower risk of AR after three months.
 - b. Right-sided neurological deficit was associated with a substantially higher risk of AR compared with left-sided neurological deficit.

2. Higher Trunk Control Test scores and the presence of decreased muscle tone in the lower limb were independent predictors of study completion, indicating greater likelihood of retention in the final assessment.
3. Based on the findings of this study, a clinical management algorithm for patients in the acute and subacute phases of stroke has been proposed.
4. The modified ARRS appears to be a potentially useful tool for the clinical assessment of upper limb ARs. However, its ability to reliably grade the severity of AR requires further validation.
5. The Trunk Impairment Scale did not demonstrate clinical utility in predicting ARs occurrence three months after stroke onset. In contrast, higher scores on the Trunk Control Test, particularly the components involving turning onto the less affected side and the ability to sit up (from either side), were associated with a significantly reduced risk of the occurrence of ARs.