Balneo and PRM Research Journal
English Edition
ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Aphasia after acute ischemic stroke: epidemiology and impact on tertiary care resources

STAN Adina [1,2,3], STRILCIUC Stefan [1,2], GHERGHEL Nicoleta [3], COZMA Angela [4], CRISTIAN Alexander [3], ILUT Silvina [1,2,3], BLESNEAG Alina [1,2,3], VACARAS Vitalie [1,2,3], STANCA Delia [1,2,3], STAN Horatiu [1,3], MURESANU Dafin [1,2,3]

Editor: Constantin Munteanu, Romanian Association of Balneology, office@bioclima.ro
Reviewers: Silisteanu Sinziana Calina and Rotariu Mariana

Balneo and PRM Research Journal DOI: http://dx.doi.org/10.12680/balneo.2021.465 Vol.12, No.4 December 2021 p: 376–380

*Corresponding author: **STRILCIUC Stefan, E-mail:** stefan.strilciuc@ssnn.ro

1. Department of Neurosciences, "Iuliu Hatieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania.
2. RoNeuro Institute for Neurological Research and Diagnostic, Cluj-Napoca, Cluj, Romania.
3. Emergency County Hospital Cluj-Napoca, Neurology Department, Cluj-Napoca, Romania
4. Department 5 Internal Medicine, 4th Medical Clinic, "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania.

Abstract

Introduction. This study aimed to reveal the disease burden of aphasia after acute ischemic stroke (AIS) at the national level and investigate the impact of aphasia on tertiary care resources and patient outcomes. We aimed to investigate the length of stay (LOS) and discharge modified Rankin Scale (mRS) score in aphasic, acute ischemic stroke (AIS) patients in order to estimate aphasia-related disease burden at a national level.

Material and method. The local database from the Cluj-Napoca Emergency County Hospital (CNECH), the second largest stroke center in Romania was used to export demographics, baseline clinical and laboratory data, inpatient length of stay (LOS), NIH Stroke Scale (NIHSS), and discharge modified Rankin Scale (mRS) score data for all AIS patients admitted during March 2019.

Results and discussions. Of 92 patients included in the study, 30 (32.6 %) had aphasia on admission. In a marginally significant unadjusted hierarchical multiple regression model, individuals with aphasia had a LOS of 1.86 days longer than stroke survivors without aphasia. In an adjusted version of the model, the NIHSS score at baseline was a significant predictor for LOS. In addition, the presence of aphasia was associated with a 1.49 increase in the mean mRS score. Aphasia was a marginally significant predictor for increased LOS. Presence of aphasia was more likely to produce a poor functional outcome.

Conclusions. Considering an estimated impact of approximately EUR 3 million on direct medical expenditure annually, future policymaking efforts should improve prevention of stroke and improved access to post-stroke aphasia care in Romania.

Keywords: *aphasia; acute ischemic stroke; length of stay; disability, outcome,*

INTRODUCTION

In the context of ever-growing pressure on health system resources related to population aging, increase in morbidity and mortality due to non-communicable diseases, as well as the impact of the COVID-19 pandemic, culprits such as stroke, which have significant contributions to the global burden of disease have come into the spotlight of health economists seeking to find ways to increase value for money.

Data from 32 European countries showed that in 2017 the cost of stroke reached €60 billion, with direct medical costs accounting for almost half of this staggering figure. Health expenditure for stroke varies greatly between western and eastern European countries (1). Romania has one of the lowest proportions of Gross Domestic Product allocated to healthcare, historically at around half of the European Union average. As evidenced by the most recent cost of illness studies, access to proper stroke care infrastructure, staff, and supplies are limited accordingly (4).

Aphasia, or difficulty in producing or comprehending spoken or written language, is one of the most debilitating manifestations of AIS, affecting 21%-38% of all cases (2). Patients with post-stroke aphasia are shown to have increased mortality, long-term disability, and more complications than stroke survivors without aphasia (3). Despite anecdotal reports that access to care such as speech therapy for aphasia is notoriously low in Romania, few studies have reported insight on the epidemiology of aphasia at the national level and its impact on hospital resources. Moreover, data regarding the current cost and precise cost structure related to stroke are scarce (4). We hypothesize that inappropriate access to care for post-stroke aphasia may lead to substantial direct and indirect costs regardless of economic perspective.

In this article, we scanned our hospital's electronic records for relevant information in the context of aphasic AIS patients. Then, based on identified variables, we analyzed the length of stay (LOS) and discharged modified Rankin Scale (mRS) score for these patients to estimate aphasia-related disease burden at a national level.

2. Materials and Methods

2.1. Study population

A retrospective analysis of data regarding all patients with AIS admitted in the first 24 hours after onset to a primary acute stroke center from CNECH during March 2019 was performed. Data extracted from our local registry included demographic variables, baseline clinical and laboratory variables, LOS, NIHSS, discharge mRS scores, and discharge location. Only patients with index symptomatic AIS in the middle cerebral artery (MCA) territory and a pre-stroke mRS score of 0 or 1 were included. NIHSS and mRS were performed by trained neurologists during standard clinical care.

2.2. Exposure and outcome definitions

The NIHSS was performed for each patient on admission (5). Aphasia was defined as having a score of 1 or greater on admission NIHSS question 9. Aphasia type was classified according to Boston Classification System by speech-language pathologists using standardized tests. (6). Outcomes of interest included LOS and mRS scores at discharge. Poor functional outcome was defined as a mRS score of 3 or above at discharge (7).

2.3. Statistical analysis

Frequencies means and standard deviations were used for the descriptive analysis. Two hierarchical multiple regression analyses were conducted with LOS and mRS scores as dependent variables. In the first step, an unadjusted model was tested, with aphasia as a single predictor. Age and NIHSS scores were added as predictors in the second step to adjust for their effects. Assumptions of the multiple regression analysis were also tested to ensure the reliability of the analysis. Analyses were run in SPSS (IBM, Armonk, NY, USA).

3. Results

3.1. Assumptions' check

Collinearity analysis showed no multicollinearity in the data, as proved by Variance Inflation Factor (VIF) scores below ten and tolerance scores above 0.2. VIF values were as follows: unadjusted models: VIF= 1, tolerance = 1; adjusted models: VIF scores of 1.34, 1.07, 1.39; tolerance scores of 0.74, 0.93, 0.71. Analysis of Durbin-Watson statistic for the model with LOS was 2.23, for the model with mRS score was 2.22, therefore showing that the values of the residuals are independent. The standardized residuals versus standardized predicted values plot indicated no signs of funneling, suggesting that the homoscedasticity assumption is met. The P-P plot suggests that the assumption of normality of the residuals was met—inspection of the Cook's distance values no compelling cases (all values lower than 1).

3.2. Main analysis

The descriptive statistics of all variables are shown in Tables 1 and 2. Separate values are provided for patients with and without aphasia. Hierarchical regression analysis in the model with LOS as dependent variable indicated in the unadjusted model that aphasia was a marginally significant predictor (F (1, 90) = 3.79, p =0.055), accounting for 0.040 % of the variance in LOS.

Table 1. Baseline demographic information for patients with and without aphasia.

	Aphasia (N= 30)	No aphasia (N= 62)
Variable	Frequency (percent)	Frequency (percent)
Female sex	20 (66.7)	30 (48.4)
Thrombolysis	7 (23.3)	7 (11.3)
Medical history		
Atrial fibrillation	15 (50)	11 (17.7)
Symptomatic Carotid stenosis	1 (3.3)	6 (9.7)
Smoking	5 (16.7)	12 (19.4)
Dyslipidemia	24 (80)	52 (83.9)
Hypertension	24 (80)	52 (83.9)
Aphasia type		
Broca	9 (30)	
Mixed transcortical	12 (40)	
Global	7 (23.3)	
Anomic	2 (6.7)	
Discharge deposition		
Home	20 (66.7)	57 (91.9)
Another department/center	4 (13.3)	2 (3.2)
Deceased	4 (13.3)	1 (1.6)
Senior care centre	2 (6.7)	2 (3.2)

Table 2. Demographic and outcome information for patients with and without aphasia

	Aphasia (N= 30)	No aphasia (N= 62)
Variable	Mean (Standard Deviation) Minimum - Maximum	Mean (Standard Deviation) Minimum - Maximum
Age (years)	74.86 (11.51) 41 - 97	70.83 (10.82) 40 - 88
LOS (days)	9.76 (5.51) 0 - 25	7.90 (3.58) 0 - 19
NIHSS score	13.70 (8.74) 1 - 30	5.80 (4.94) 1 - 25
Discharge mRS score	3.26 (2.03) 0 - 6	1.77 (1.62) 0 - 6

As shown by regression coefficients in Table 3-unadjusted model, having aphasia marginally increased the mean LOS by 1.86 days. Adjusting for the effects of age and NIHSS score resulted in an overall significant model (F (3, 88) = 4.53, p=0.005) and explained an

additional 0.134% of the variance in LOS. Examination of individual predictors indicated NIHSS score to be the only significant predictor in the model. Effects of aphasia and age were not significant. As shown by regression coefficients in Table 3 - adjusted model, the predicted LOS for a patient without aphasia, of mean age and mean NIHSS score was 11.30 days. A one-unit increase in the NIHSS score predicted a 0.20 day increase of this mean LOS.

Hierarchical regression analysis in the model with mRS score as dependent variable indicated in the unadjusted model that aphasia was a significant predictor ($F(1, 90) = 14.43$, $p = <.001$), accounting for 0.138 % of the variance in mRS scores. As shown by regression coefficients in Table 4 - unadjusted model, having aphasia increased the mean mRS score by 1.49 points compared to the mean scores of 1.77 for patients without aphasia. Adjusting for the effects of age and NIHSS score resulted in an overall significant model ($F(3, 88) = 41.68$, $p<0.001$) and explained an additional 0.587% of the variance in mRS scores. Examination of individual predictors indicated significant effects for age and NIHSS score. As shown by regression coefficients in Table 4 - adjusted model, the predicted mRS score for a patient without aphasia, of mean age and mean NIHSS score was -1.26. A one unit increase in the NIHSS score predicted a 0.18 point increase of this means mRS score.

Table 3 Regression coefficients for the length of stay (LOS) model

Unadjusted model					
	B	SE	β	t	P
Constant	7.90	0.547		14.46	<.001
Aphasia	1.86	0.957	0.201	1.94	.055
Adjusted model					
	B	SE	β	t	P
Constant	11.301	2.847		3.97	<.001
Aphasia	0.537	1.065	0.058	0.50	.615
Age	-0.064	0.040	-0.165	-1.60	.113
~~N~~NIHSS	0.201	0.069	0.340	2.90	.005

Table 4. Regression coefficients for modified Rankin Scale (mRS) model

Unadjusted model					
	B	SE	β	t	p
Constant	1.774	0.224		7.91	<.001
Aphasia	1.492	0.393	0.372	3.80	<.001
Adjusted model					
	B	SE	β	t	p
Constant	-1.260	0.851		-1.48	.143
Aphasia	-0.066	0.319	-0.017	-0.208	.836
Age	0.028	0.012	0.164	2.31	.023
NIHSS	0.183	0.021	0.716	8.85	<.001

4. Discussion

This study evaluated all available information on post-AIS aphasic patients in the Romanian patient pathway. Our main results show that aphasia is associated with prolonged LOS during acute stroke admission and a higher mRS score at discharge. These findings are in accordance with recent studies highlighting the underrecognized effect of communication impairment on stroke patients' outcomes (2,3). However, as opposed to our study, extensive international literature indicates aphasia is a significant predictor for prolonged LOS even after adjusting for NIHSS score and other variables, such as inpatient complications. We assert that contrasts between these observations could be explained either by our sample not being representative of the Romanian population (which could be the case given the limited timeframe for data collection) or by essential differences in care standards between countries. Neurorehabilitation procedures are generally not initiated in Romania's initial post-AIS inpatient admission. Therefore the decision to discharge patients might not incorporate their recovery potential (17). An alternative explanation would be that the sample size for various independent variables is too low to be used in the regressive model.

Over the last few years, studies have shown that aphasic patients have more disability at discharge (defined as a mRS score of 3-6) than non-aphasics (8). These findings remain even after accounting for NIHSS scores and inpatient complications. In contrast, patients with hemiparesis are not at higher odds of having a discharge mRS of 3-6 after adjusting for the same parameters (2). Furthermore, aphasia at baseline was also associated with a poorer mRS at three months in a retrospective analysis on 8904 stroke patients (9). These data align with our results that show that aphasia increases the mean mRS score at discharge by 1.49 points.

In the present study, aphasic and non-aphasic patients had a mean LOS of 9.76 and 7.9 days, respectively, lower than the previously reported mean for other countries (11) but similar to that obtained in another Romanian regional study (4). We found that the presence of aphasia marginally prolongs LOS by 1.86 days, as compared to non-aphasic patients. However, when controlling for age and NIHSS score, the effect of aphasia alone was no longer significant. This observation does not necessarily imply that aphasia no longer has an impact, as the NIHSS score includes a measure of aphasia, which we could not separate from the total score due to limitations in data collection. In a retrospective analysis on 1847 stroke patients, after adjusting for NIHSS score and inpatient complications, a 1.22 day increase in LOS was reported in aphasics (2). In addition, in a retrospectively examined cohort of 3200 stroke patients, the LOS was 8.6 days in aphasic patients compared to 7.2 days in non-aphasic ones (3).

Several possible explanations account for a longer LOS in these patients. One is that a failure to communicate and understand commands can impair physical therapy, thus prolonging motor recovery (10,12). Moreover, aphasics have been shown to develop more complications (such as sepsis, pneumonia, neurological worsening, and myocardial infarction) than non-aphasics (2). This finding could result from difficulty expressing complaints and symptoms worsening or properly following instructions (2). Another pertinent explanation is that these patients sometimes have problems finding a suitable rehabilitation placement either because they do not necessarily have associated motor deficits or cannot perform occupational therapies (3,10).

Considering that acute LOS is responsible for more than 65% of the total inpatient costs, prediction of this outcome variable is essential for the precise planning of the health care system resources. The LOS-associated costs account for acute hospital beds, intensive use of neuroimaging, medication, and paramedical resources (13). Unfortunately, data regarding the costs of stroke care in Romania are limited. However, a recent analysis showed that the average cost per stroke inpatient care episode summed up to EUR 995 in 2017, while the mean LOS was 9.9 days (14). Thus, we estimated that the average cost for a one-day hospital stay for stroke was about EUR 100 in our country in 2017. Assuming a 30% aphasia rate among 55.000 new ischemic stroke cases annually (15) and considering a 1.86 day LOS prolongation, we concluded that aphasia adds EUR 3 million annually to the care of these patients in Romania.

Compared to a recent study that estimated that aphasia adds a cost of about EUR 1.77 billion annually in the US (2), the financial burden seems to be minimal in our country. In truth, with an annual expenditure of only EUR 7.15 per capita and a total allocation of EUR 140 million in 2017 for stroke, Romania was at the bottom among European countries and far away from the American expenditure for stroke (14). Consequently, aphasia's financial burden is considerable and represents a challenge for the limited local healthcare system budget.

We acknowledge several limitations to this study, including a small patient sample and a larger group of non-aphasics as compared to aphasics. This could account for aphasia not being a predictor for longer LOS in the adjusted model instead of similar research (2). Second, only the total NIHSS score was available for analysis, so we could not evaluate which individual NIHSS sub-components apart from aphasia correlate with LOS. Moreover, as the scope of the study was limited and focused on aphasia, no regression models were run with additional comorbidities as predictors of LOS. In addition, previous studies have found that aphasic patients have more inpatient complications than non-aphasics and that a significant part of the relationship between aphasia and LOS is explained by these complications (2). However, due to lack of homogeneity in data reporting, we could not adjust for inpatient complications when assessing LOS. As a consequence, the overall impact of aphasia could be overestimated in the present research. Aphasia outcome at 3 months is related with to the initial severity of language disorder, infarct's size and location and with to a range of patient-related indices like educational level (16). However, such variables were not analysed in our study, since the main objective was to asses short-term outcomes in these patients. The strengths of the present study lie in the novelty of the data, being the first in Romania to address the financial burden of stroke-related aphasia. Future research could focus on how different types of aphasia impact acute stroke outcomes. In addition, upcoming studies could investigate whether those outcomes are influenced by receiving aphasia therapy during hospitalization.

5. Conclusions

Overall, our study showed that aphasia in stroke patients is associated with increased disability at discharge and prolonged LOS, which significantly add to the burden of the health care system in Romania. These findings suggest that better management of communication disorders during acute stroke hospitalization is needed. Likewise, the results of this study can be used as a baseline for measuring cost-effectiveness of new or improved stroke care strategies. Access to information regarding stroke care is scanty and limited to medical records and focused registries with low sample sizes. Romania must make important strives to improve the quality of healthcare information systems to allow appropriate appraisal of standards of care for stroke patients.

Author Contributions: Conceptualization: STAN Adina, STRILCIUC Stefan, STAN Horatiu, MURESANU Dafin ; validation: STAN Adina, STRILCIUC Stefan, GHERGHEL Nicoleta, ILUT Silvina, BLESNEAG Alina, VACARAS Vitalie, STANCA Delia, STAN Horatiu, MURESANU Dafin; formal analysis, STAN Adina, STRILCIUC Stefan, COZMA Angela , CRISTIAN Alexander; investigation: STAN Adina, GHERGHEL Nicoleta, ILUT Silvina, BLESNEAG Alina, VACARAS Vitalie, STANCA Delia; writing—original draft preparation: STAN Adina, STRILCIUC Stefan, GHERGHEL Nicoleta, ILUT Silvina, BLESNEAG Alina, VACARAS Vitalie, STANCA Delia, STAN Horatiu, MURESANU Dafin supervision: STAN Adina, STRILCIUC Stefan, STAN Horatiu, MURESANU Dafin writing—review and editing: STAN Adina, STRILCIUC Stefan, GHERGHEL Nicoleta,

ILUT Silvina, BLESNEAG Alina, VACARAS Vitalie, STANCA Delia, STAN Horatiu, MURESANU Dafin, project administration: STAN Adina. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest and Ethics: The authors declare no conflict of interest. Institutional Review Board Statement: Ethical review and approval were waived for this study, due to the anonymized and aggregated nature of patient data used for a retrospective analysis.

Informed Consent Statement: Not applicable.

References

1. Luengo-Fernandez R, Violato M, Candio P, Leal J. Economic burden of stroke across Europe: A population-based cost analysis. Eur Stroke J. 2020 Mar;5(1):17-25.
2. Boehme AK, Martin-Schild S, Marshall RS, Lazar RM. Effect of Aphasia on acute stroke outcomes. Neurology. 2016 Nov 29;87(22):2348-2354.
3. Ellis C, Simpson AN, Bonilha H, Mauldin PD, Simpson KN. The one-year attributable cost of poststroke Aphasia. Stroke. 2012 May;43(5):1429-31.
4. Strilciuc S, Grad DA, Mixich V, Stan A, Buzoianu AD, Vladescu C, Vintan MA. Societal Cost of Ischemic Stroke in Romania: Results from a Retrospective County-Level Study. Brain Sci. 2021 May 24;11(6):689.
5. Brott T, Adams HP Jr, Olinger CP, Marler JR, Barsan WG, Biller J, Spilker J, Holleran R, Eberle R, Hertzberg V, et al. Measurements of acute cerebral infarction: a clinical examination scale. Stroke. 1989 Jul;20(7):864-70.
6. Kertesz A, Assessment of Aphasia, in: T. Incagnoli, G. Goldstein, C.J. Golden (Eds.), Clinical Application of Neuropsychological Test Batteries, Springer US, Boston, MA, 1986: pp. 329–360.
7. Banks JL, Marotta CA. Outcomes validity and reliability of the modified Rankin scale: implications for stroke clinical trials: a literature review and synthesis. Stroke. 2007 Mar;38(3):1091-6.
8. Flowers HL, Silver FL, Fang J, Rochon E, Martino R. The incidence, co-occurrence, and predictors of dysphagia, dysarthria, and Aphasia after first-ever acute ischemic stroke. J Commun Disord. 2013 May-Jun;46(3):238-48.
9. Ali M, Lyden P, Brady M; VISTA Collaboration. Aphasia and Dysarthria in Acute Stroke: Recovery and Functional Outcome. Int J Stroke. 2015 Apr;10(3):400-406.
10. Dickey L, Kagan A, Lindsay MP, Fang J, Rowland A, Black S. Incidence and profile of inpatient stroke-induced Aphasia in Ontario, Canada. Arch Phys Med Rehabil. 2010 Feb;91(2):196-202
11. Appelros P. Prediction of length of stay for stroke patients. Acta Neurol Scand. 2007 Jul;116(1):15-9.
12. Galski T, Bruno RL, Zorowitz R, Walker J. Predicting length of stay, functional outcome, and aftercare in the rehabilitation of stroke patients. The dominant role of higher-order cognition. Stroke. 1993 Dec;24(12):1794-800
13. Ng YS, Tan KH, Chen C, Senolos GC, Chew E, Koh GC. Predictors of Acute, Rehabilitation and Total Length of Stay in Acute Stroke: A Prospective Cohort Study. Ann Acad Med Singap. 2016 Sep;45(9):394-403.
14. Lorenzovici L, Székely A, Csanádi M, Gaál P. Cost Assessment of Inpatient Care Episodes of Stroke in Romania. Front Public Health. 2020 Dec 4;8:605919.
15. Uivarosan D, Bungau S, Tit DM, Moisa C, Fratila O, Rus M, Bratu OG, Diaconu CC, Pantis C. Financial Burden of Stroke Reflected in a Pilot Center for the Implementation of Thrombolysis. Medicina (Kaunas). 2020 Jan 28;56(2):54.
16. Plowman E, Hentz B, Ellis C Jr. Post-stroke aphasia prognosis: a review of patient-related and stroke-related factors. J Eval Clin Pract. 2012 Jun;18(3):689-94.
17. Radu RA, Terecoasa E, Casaru B, Enache I, Ghita C, Tiu C. Access to post - stroke physical rehabilitation after acute reperfusion therapy– the neglected link in ischemic stroke management: a retrospective cohort study. Balneo and PRM Research Journal. 2021;12(1):46–52.