

UDC: 616.831-005.1:616.24-002]-06
[https://doi.org/10.32345/USMYJ.1\(136\).2023.84-93](https://doi.org/10.32345/USMYJ.1(136).2023.84-93)

Received: January 12, 2023

Accepted: February 27, 2023

Stroke-associated pneumonia risk estimation in patients admitted to a comprehensive stroke unit at different phases after stroke

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Abstract: stroke is one of the leading causes of death and acquired disability among adults worldwide. Various complications frequently occur in patients with stroke and can significantly increase the risk for poor outcomes. Stroke-associated pneumonia, with the rate of up to 15%, is considered the most common serious medical complication in stroke patients. The aim of the study was to determine the independent predictors of the stroke-associated pneumonia in patients admitted to a comprehensive stroke unit at different time from stroke onset, as well as to develop a prognostic model for stroke-associated pneumonia risk estimation. Medical complications, including stroke-associated pneumonia, were documented in patients with clinical diagnosis of intraparenchymal cerebral stroke at admission and during their stay on the comprehensive stroke unit in 2010 to 2018. The workup at admission included assessment using the National Institutes of Health Stroke Scale and the modified Rankin scale. The diagnosis of stroke-associated pneumonia was made by specialists, in accordance with Centers for Disease Control recommendations. Qualitative variables are displayed as numbers and percentages, quantitative variables are displayed using the median (interquartile range). The method of logistic regression models was used to quantitatively assess the impact of characteristics on the PSP risk. The analysis was carried out using the package MedCalc v. 19.1. The study enrolled 539 patients, 309 (57.3%) men and 230 (42.7%) women. Median age of the patients was 66.0 years (57.9-75.1). Among the participants 101 (18.7%) were diagnosed with intracerebral hemorrhage, and 438 (81.3%) were diagnosed with ischemic stroke. Median initial National Institutes of Health Stroke Scale total score was 11 (6–18), median baseline modified Rankin scale score was 4 (3–5). Majority (64.1%) individuals were admitted within the first 30 days from onset, while 194 (35.9%) patients presented later. History of medical complications before the admission was present in 192 (35.6%) of the study participants, while during our in-hospital stay they occurred in 103 (19.1%) of the patients. The rate of new medical complications at the unit was significantly lower ($p < 0.001$) than prior to the admission. The diagnosis of stroke-associated pneumonia before the admission was established in 20 (3.7%), and during our in-patient treatment was made in 7 (1.3%) subjects ($p < 0.001$). Independent predictors of the stroke-associated pneumonia development were older age (odds ratio 1.11; 95% confidence interval 1.02-1.21, on average, for each additional year, $p = 0.02$) and history of stroke-associated pneumonia at admission (odds ratio 12.2; 95% confidence interval 2.0-72.4, $p = 0.006$). Excellent sensitivity (85.7%), good specificity (75.0%) and area under the operating characteristic curve of 0.86 (95% confidence interval 0.83 – 0.89) for the developed prognostic model

based on these of two variables, indicate their strong association with the risk of stroke-associated pneumonia during a comprehensive stroke unit stay. Therefore, stroke patients frequently develop medical complications at various stroke phases. The risk of stroke-associated pneumonia is higher in older patients and, especially, in those with stroke-associated pneumonia history. The lower rate of medical complications, in particular stroke-associated pneumonia, observed during in-hospital stay compared to the period prior to the admission may indicate the benefits of comprehensive stroke unit.

Keywords. [humans](#), [aged](#), [stroke](#), [pneumonia](#), [prognosis](#), [retrospective studies](#), [multivariate analysis](#), [severity of illness index](#).

Introduction

Cerebral stroke (CS) remains one of the leading causes of death and acquired disability among adults worldwide (Feigin et al., 2022; Tsao et al., 2022). According to 2019 global estimates, there were about 12.2 million CS, almost 6.6 million people died from CS (11.6% of the total number of deaths), and more than 143 million years of healthy life were lost due to premature death or acquired disability after CS (GBD 2019 Stroke Collaborators, 2021). Moreover, the burden of CS is projected to grow, and in 2050s the number of CS and deaths due to CS is expected to reach 30 million and 12 million respectively, while the number of CS survivors is going to exceed 200 million (Brainin et al., 2020). As of 2019, Ukraine was included in the group of countries with a very high CS incidence and mortality (Kim et al., 2020). Therefore, there is an urgent need to identify key elements of the chain of care for patients with CS that can be improved with maximum benefits both for individual patients and their families as well as communities and whole countries (Pandian & Sebastian, 2021).

Various complications that frequently occur in patients with CS can significantly increase the duration of stay, the cost of treatment, and the risk for poor outcomes (Janus-Laszuk et al., 2017; Kumar et al., 2010; Verma, 2019). More than 20 years ago, it was shown that 25% to 50% of deaths after CS are related complications (Weimar et al., 2002). The most frequent type of complications in patients with CS are medical complications, such as respiratory and urinary tract infections, fluid / electrolyte and metabolic disturbances, cardiac disorders, venous thromboembolism, urinary and fecal incontinence, pressure sores and major bleeding, as well as trauma from falls and pain syndromes (Elkind et al.,

2020; Ingeman et al., 2011; Kitisomprayoonkul et al., 2010; Kumar et al., 2010). Due attention to the prevention and treatment of complications is an important component of high-quality care for patients with CS (Kumar et al., 2010; Teasell et al., 2020). Stroke-associated pneumonia (SAP), with the rate of up to 15%, is considered the most common serious medical complication in patients with CS (Badve et al., 2019; Kishore et al., 2015; Westendorp et al., 2011). Previous studies have shown that SAP is associated with worse neurological and functional recovery and more than triples the risk of death (Armstrong & Mosher, 2011; Ingeman et al., 2011; Yuan et al., 2021). Despite the fact that reducing the risk of SAP could have a significant impact on CS outcome, effective medical (in particular, with antimicrobial agents) prevention of SAP has not yet been developed, and the risk factors of SAP in different periods of the disease have not been sufficiently studied (Grossmann et al., 2021; Liu et al., 2016; Zheng et al., 2017).

Aim

The aim of the study was to determine the predictors of the development of SAP in patients with CS during inpatient treatment in a comprehensive stroke unit (CSU) in different CS phases, as well as to build an appropriate prognostic model that allows for SAP risk estimation.

Material and methods

1. Study setting and selection criteria.

This retrospective observational study was conducted in the Stroke Center (SC) – a general university hospital department. The structure and processes in the SC correspond to CSU principles: evidence-based care is provided by a multidisciplinary team in compliance with established medical care standards; full primary and, if necessary, extended work-up (neuroimaging using

multidetector spiral computer or 1.5T magnetic resonance imaging of the brain, visualization of extracranial and intracranial arteries using computer tomographic or magnetic resonance angiography, transthoracic echocardiography, 12-lead ECG, Holter heart rate monitoring for 24–72 hours, and a set of conventional laboratory tests) with the determination of the CS type and most likely etiological subtype is performed in every case; early comprehensive secondary prevention; a high volume of rehabilitation care during the entire stay. A complete neurological examination using a set of stroke assessment scales was performed upon admission. All patients were seen by a cardiologist and, if necessary, by other medical specialists. Laboratory tests were performed in a certified hospital laboratory.

The study inclusion criteria were a clinical diagnosis of intraparenchymal CS verified by neuroimaging, at least 3 days of inpatient treatment in the SC between February 2010 and September 2018, results of auxiliary investigations, internal medicine specialist or pulmonologist consultation, and the main stroke assessment scales scores available. Patients with subarachnoid hemorrhage or extremely severe comorbidity that significantly affected the course and outcome (e.g., advanced malignant neoplasm, end-stage renal failure, hematological diseases, unfused bone fractures, severe malnutrition, sepsis), as well as patients after revascularization procedures (systemic thrombolytic therapy and/or mechanical thrombectomy for ischemic CS), surgical interventions (e.g., removal of intracerebral hematoma) and patients requiring mechanical ventilation were excluded from the study.

2. Set of collected and analyzed variables.

The predetermined set of variables for each of the patients was entered into a special database. These included age, sex, CS type and subtype, baseline National Institutes of Health Stroke Scale (NIHSS) total score, and modified Rankin Scale (mRS) severity of disability after SCU admission. According to the pathophysiological type, all patients were divided into two groups: ischemic SC and intracerebral hemorrhage. Patients with ischemic CS, according to the developed algorithm, were divided into four

main etiological subtypes: atherosclerotic (AT), cardioembolic (CE), lacunar (LA) and other (OT) (Flomin et al., 2022). In all patients, at SC admission, based on history and medical records, medical complications, such as SAP, which occurred between estimated CS onset and SC admission, were registered. If patients developed medical complications, including SAP, during their stay in the SC, these were documented as new complications. Considering the fact that there is no “gold standard” or universally recognized diagnostic criteria for SAP yet, the diagnosis of SAP was established by a pulmonologist or a internal medicine specialist based on clinical manifestations and the results of investigations (e.g., chest X-ray or multidetector spiral computer tomography), in accordance with the recommendations of the Centers for Disease Control and Prevention (Horan et al., 2008). According to the NIHSS total score, all cases were divided into mild (0-5), moderate (6-13), severe (14-20) and very severe (more than 20) CS (Zhuo et al., 2021). CS phases, depending on the time elapsed from the estimated CS onset to SC admission, were classified as hyperacute (0-24 hours), acute (1-7 days), early subacute (8 to 90 days), late subacute (91 to 180 days) and chronic (after 180 days) (Bernhardt et al., 2017).

3. Statistical analysis.

Qualitative variables are expressed through frequency and percentages. Quantitative variables are displayed using median and interquartile range (IQR). The chi-square test was used to compare qualitative features. The threshold for statistical significance was set at $p=0.05$. The method of constructing and analyzing logistic regression models was used to quantitatively assess the influence of variables on the risk of SAP development. The prognostic quality of the models was evaluated by its sensitivity (proportion of correctly predicted cases of SAP) and specificity (proportion of correctly predicted “non-cases”, i.e., absence of SAP diagnosis) (Petrie, 2009). The corresponding 95% confidence interval (95% CI) was calculated for these values. Adequacy of the models was assessed by the method of construction and analysis of operating characteristic curves (ROC – Receiver Operating Characteris-

tic curve analysis), while the area under the ROC curve (AUC – Area under the ROC curve) and its 95% CI were calculated. The model is considered adequate when the AUC value differs statistically from 0.5 (Gurianov et al., 2018). The influence of variables was assessed by the value of the odds ratio (OR), for which 95% CI was calculated (Petrie, 2009). To select the minimum set of variables independently associated with SAP in multivariable analysis, the method of stepwise rejection/addition was used. The optimal decision threshold for the model was determined by achieving maximum sensitivity and specificity according to the Youden index (Gurianov et al., 2018). Statistical analysis of the research results was performed using the MedCalc® Statistical Software package version 19.6.4 (MedCalc Software Ltd, Ostend, Belgium, 2021).

Results

The study enrolled 539 patients, including 309 (57.3%) men and 230 (42.7%) women. The age of patients varied from 20.4 to 95.6 years (median 66.0 years, IQR 57.9 - 75.1). In the study sample, 101 (18.7%) patients were diagnosed with intracerebral hemorrhage, and 438 (81.3%) subjects were diagnosed with ischemic CS. Among the latter, 177 (40.4%) participants were assigned to AT, 200 (45.7%) to CE, 30 (6.9%) to LA, and remaining 32 (7.0%) to OT ischemic CS subtype. Among the enrolled patients, 109 (20.2%) were admitted in the hyperacute phase, 113 (21.0%) in the acute phase, 199 (36.9%) in the early subacute phase, 36 (6.7%) in the late subacute phase, and 82 (15.2%) – in the chronic CS phase. In total, 345 (64.1%) individuals from the study sample were admitted to the SC within the first 30 days from the CS onset, while 194 (35.9%) patients were admitted later. The total baseline NIHSS score varied from 1 to 39 points (median 11 points, IQR 6 to 18). Among the studied patients, 119 (22.1%) had mild CS, 218 (40.5%) had moderate CS, 114 (21.2%) had severe CS, and 88 (16.3%) had very severe CS. According to the initial mRS assessment, 45 (8.3%) patients had a score of 0-1, 58 (10.8%) had a score of 2, 65 (12.1%) had a score of 3, 136 (25.2%) had a score of 4, and the majority of 235 (43.6%) patients had a score of 5. The median mRS score in the study sample was 4 (IQR 3-5).

The frequency of medical complications at admission and during the SC stay

Among the study participants, 192 (35.6%) had documented medical complications that occurred between the estimated stroke onset and the SC admission. Over the period of the SC stay, 103 (19.1%) patients developed new medical complications. While the most frequent type of medical complications registered in the SC was urinary tract infection, the serious medical complications were SAP and venous thromboembolism. The rate of medical complications that occurred prior to the SC admission was statistically significantly ($p < 0.001$) higher than during the stay in the SC. Similarly, SAP rate before the admission was significantly ($p < 0.001$) higher than SAP rate during the SC stay: prior to the SC admission diagnosis of SAP was made in 20 (3.7%) patients while it was diagnosed only in 7 (1.3%) SC in-patients.

Determination of new SAP predictors the prognostic model

In order to determine the predictors of SAP that occurred during the patient's inpatient treatment in the SC, an analysis of the selected patients' variables (CS type and subtype age, sex, time delay from the CS onset to the SC admission, initial NIHSS and mRS scores as well as the medical complications known at admission) was performed. The results of the univariate analysis are shown in Table 1.

The univariate analysis have identified three factors that are statistically significantly associated with the increased risk of SAP development: older age of the patient (OR 1.11; 95% CI 1.02–1.20 on average for each additional year, $p = 0.014$), diagnosis of SAP before the SC admission (OR 11.4; 95% CI 1.1–63.0, $p < 0.001$), and more severe CS at the SC admission (OR 1.13; 95% CI 1.03–1.23, on average, for each additional point of the NIHSS total score, $p = 0.007$). No statistically significant relationships with the risk of SAP were found for other variables.

To identify independent predictors of SAP during the SC stay, a multivariate analysis was conducted. The results of multivariate analysis are shown in Table 2.

As shown in Table 2, only two variables were found to be independent predictors of a new SAP in CS patients during their stay at the SC: old-

Table 1. Influence of selected variables on the new SAP risk: univariate analysis results

Variable		The model coefficient value, $b \pm m$	Level of significance, $p \ddagger$	OR (95% CI)
Age		0.10±0.04	0.014	1.11 (1.02–1.20)
Sex	Female	Reference		
	Male	-0.01±0.77	0.992	–
SAP diagnosis prior to the SC admission	No	Reference		
	Yes	2.43±0.87	<0.001	11.4 (2.1–63.0)
Baseline mRS score		1.53±0.94	0.103	–
Baseline total NIHSS score		0.12±0.04	0.007	1.13 (1.03–1.23)
CS type and subtype	AT	Reference		
	LA	-18.4±10000	0.999	–
	OT	-18.4±9800	0.999	–
	ICH	-0.12±1.23	0.920	–
	CE	0.58±0.87	0.506	–
Time from the CS onset to the SC admission	0-24 hours	Reference		
	1-7 days	-1.68±1.10	0.127	–
	8-30 days	-1.77±1.10	0.109	–
	31+ days	-20.8±6600	0.999	–

\ddagger Differences of the model coefficient from 0. ICH – intracerebral hemorrhage.

er age (OR 1.11; 95% CI 1.02-1.21, on average, for each additional year, $p=0.02$) and, predominantly, the history of SAP at admission (OR 12.2; 95% CI 2.0-72.4, $p=0.006$). Therefore, in contrast to the univariate analysis, the multivariate analysis did not confirm the influence of more severe baseline neurological deficit on the SAP risk. The ROC of the prognostic model is shown in Figure 1.

The model has AUC=0.86 (95% CI 0.83 – 0.89), which indicates a strong connection of the identified independent predictors with the SAP risk during the SC stay. The developed model with sensitivity of 85.7% and specificity of 75.0% has high accuracy. If its external validity

is confirmed, it can be used in clinical practice to estimate the SAP risk.

Discussion

Therefore, in this retrospective observational study with a rather large cohort of in-patients with CS (N=539), who were thoroughly assessed upon admission to CSU at different CS phases and throughout their stay, the frequency of medical complications, in particular SAP, was determined, and independent predictors of a SAP development were identified. In general, the study sample was characterized by a high frequency of medical complications: more than a third (35.6%) of patients were diagnosed with medical complications prior to the SC admission, and almost

Table 2. Features of the model for predicting the risk of SAP during treatment in the SC

Variable		The model coefficient value, $b \pm m$	Level of significance, $p \ddagger$	OR (95% CI)
Age		0.10±0.04	0.02	1.11 (1.02–1.21)
SAP diagnosis prior to the SC admission	No	Reference		
	Yes	2.50±0.91	0.006	12.2 (2.0–72.4)

\ddagger Differences of the model coefficient from 0.

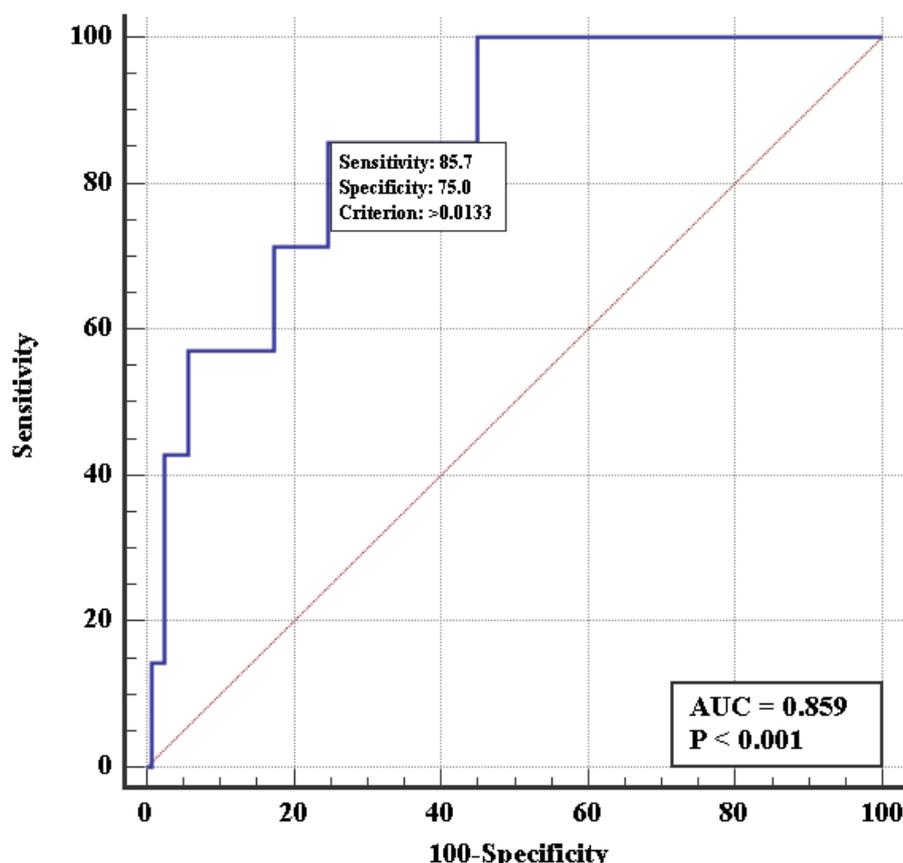


Figure 1. ROC of the prognostic model for assessing the risk of SAP during the SC stay.

one in five (19.1%) patients developed new medical complications during their stay at the SC. Our findings are in line with the results of other studies carried out over the last decades, which demonstrated that high overall frequency of complications in CS patients varied from 24% to 95%, and that some patients had two or more complications (Bustamante et al., 2017; Janus-Laszuk et al., 2017; Kitisomprayoonkul et al., 2010). The high rate of complications points out the importance of a multidisciplinary approach to CS care, including stroke physicians and other specialists as well as trained nurses, physical therapists and speech and language therapists. It also emphasizes the need for attention to the prevention, early diagnosis, and treatment of complications from the very admission and throughout the in-hospital stay of patients with CS.

We showed that, according to the results of univariate analysis, the risk of new SAP during inpatient treatment is higher in older people, patients with more severe CS, and especially in

the case of a SAP history. However, in the multivariate analysis, only the older age and an SAP history retained their prognostic value as independent predictors of a new SAP development. The unfavorable prognostic role of SAP that developed in the earlier CS phases is probably related to the persistence of risk factors, such as dysphagia and/or immunosuppression, which increase the risk of pneumonia (Armstrong & Mosher, 2011; Grossmann et al., 2021). The prognostic model for assessing the risk of SAP proved adequate and was characterized by excellent (85.7%) sensitivity and good (75.0%) specificity. Therefore, in patients who have both independent predictors of a new SAP (i.e., older age and an SAP history) careful monitoring of

body temperature and blood oxygen saturation, as well as chest radiography immediately upon admission and in case of deterioration may make sense regardless of the CS phase. In addition, in such patients, special preventive measures may be used in order to reduce the risk of SAP, including endoscopic examination of the function of swallowing to rule out “silent” aspiration, education on safer food consistency and intake, correct positioning in bed and during meals, early and sufficient mobilization by Nurses and Physical Therapists, breathing exercises and good nutritional support (Armstrong & Mosher, 2011; Grossmann et al., 2021; Tinker et al., 2021). Future studies should aim at identifying more SAP modifiable risk factors.

The fact that the frequency of any medical complications and, in particular, SAP, that occurred during the stay in the SC operating according to the principles of CSU, was significantly lower than those documented from CS onset to the SC admission, in our opinion, indicates the advantages of

CSU as a model inpatient care regardless of the CS phase. In CS, the outcome, in addition to the CS type and subtype, the size and localization of the lesion and comorbidity, depends on medical and neurological complications, the time delay from the onset to hospitalization, medical interventions, the processes of the medical care, hospital resources, and the availability of rehabilitation (Harvey, 2015). The results of a meta-analysis have shown that a stay in a CSU, where treatment in the acute period of stroke is combined with early comprehensive secondary prevention, skilled nursing care and persistent interdisciplinary rehabilitation, is associated with a reduction in mortality and disability (Chan et al, 2013; Langhorne & Ramachandra, 2020). The benefits of Stroke Units, among other factors, result from successful prevention, early detection and correct treatment of complications (Govan et al., 2007; Janus-Laszuk et al., 2017). Our findings corroborate other studies that emphasize the importance of risk assessment, prevention, early diagnosis, and treatment of medical complications, such as SAP, in all hospitalized patients at any phase of CS.

Conclusions

1. Documented in one in three patients at the CSU admission and in one in five patients during the CSU stay, medical complications are common in patients in all CS phases.
2. As older age and an SAP history are independent predictors of a new SAP development during CSU stay, presence of both

these factors at admission flags up the increased SAP risk.

3. The lower frequency of medical complications, in particular SAP, diagnosed during the CSU stay compared with documented at admission, indicates the advantages of CSU care.

Acknowledgments

The authors are grateful to A/Professor Vitaliy Gurianov, PhD for the assistance with data analyses and model development.

Financing

The authors received no funding for this research.

Conflict of interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Consent to publication

All involved patients agreed on their data analysis and publication of this manuscript.

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A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of article

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Оцінювання ризику інсульт-асоційованої пневмонії у пацієнтів, які перебували на лікуванні в інтегрованому інсультному блоці у різних періодах захворювання

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Анотація: інсульт є однією з головних причин смерті та набутої інвалідності серед дорослих у всьому світі. У пацієнтів з інсультом часто виникають різні ускладнення, які можуть значно підвищити ризик поганих результатів лікування. Пневмонія, що пов'язана з інсультом, має частоту до 15% і вважається найпоширенішим серйозним медичним ускладненням у пацієнтів з інсультом. Метою дослідження було визначення провісників інсульт-асоційованої пневмонії у пацієнтів з інсультом, які перебували на стаціонарному лікуванні в інтегрованому інсультному блоці у різних періодах захворювання, а також побудова прогностичної моделі для оцінювання ризику розвитку інсульт-асоційованої пневмонії. У пацієнтів, які у 2010–2018 рр. перебували на стаціонарному лікуванні в інтегрованому інсультному блоці з приводу інтрапаренхіматозного мозкового інсульту у різні періоди захворювання (від найгострішого до віддаленого), реєстрували соматичні ускладнення, зокрема інсульт-асоційовану пневмонію, як до госпіталізації, так і впродовж перебування. Після госпіталізації було проведено обстеження, що включало оцінку за допомогою Шкали інсульту Національних інститутів здоров'я та модифікованої шкали Ренкіна. Діагноз інсульт-асоційованої пневмонії встановлювали лікарі-спеціалісти, відповідно до рекомендацій Центрів з контролю захворювань. Якісні змінні відображені як число та проценти, кількісні змінні як медіана (міжквартильний інтервал). Для кількісної оцінки впливу ознак на ризик інсульт-асоційованої пневмонії був використаний метод моделей логістичної регресії. Аналіз проводився за допомогою пакету MedCalc v. 19.1. У дослідження були включені 539 пацієнтів, 309 (57,3%) чоловіків та 230 (42,7%) жінок. Медіана віку пацієнтів 66,0 років (57,9–75,1 років). У 438 (81,3%) учасників дослідження діагностовано ішеміч-

ний інсульт, у 101 (18,7%) внутрішньомозковий крововилив. Більшість (64,1%) пацієнтів були госпіталізовані впродовж перших 30 днів від початку захворювання, проте 194 (35,6%) особи поступили пізніше. Медіана початкової загальної оцінки за Шкалою інсульту Національних інститутів здоров'я становила 11 балів (6–18 балів), за модифікованою шкалою Ренкіна – 4 бали (3–5 балів). Соматичні ускладнення в анамнезі захворювання мали місце у 192 (35,6%) пацієнтів, а протягом перебування вони виникли у 103 (19,1%) учасників дослідження. Частота нових соматичних ускладнень у нашому стаціонарі була значуще ($p < 0,001$) нижчою, ніж у період до госпіталізації. Діагноз інсульт-асоційованої пневмонії до госпіталізації був встановлений у 20 (3,7%), а під час стаціонарного лікування – у 7 (1,3%) учасників дослідження ($p < 0,001$). Незалежними провісниками розвитку інсульт-асоційованої пневмонії були старший вік пацієнта (відношення шансів 1,11; 95% довірчий інтервал 1,02-1,21, в середньому, на кожен додатковий рік, $p = 0,02$) та інсульт-асоційована пневмонія в анамнезі (відношення шансів 12,2; 95% довірчий інтервал 2,0-72,4, $p = 0,006$). Відмінна чутливість (85,7%), добра специфічність (75,0%) та площа під кривою операційних характеристик 0,86 (95% довірчий інтервал 0,83–0,89) для прогностичної моделі, що була побудована на основі цих двох чинників, свідчить про їх сильний зв'язок з ризиком розвитку інсульт-асоційованої пневмонії у період перебування в інтегрованому інсультному блоці. Отже у пацієнтів з інсультом у різних періодах захворювання часто виникають соматичні ускладнення. Ризик інсульт-асоційованої пневмонії є вищим у пацієнтів старшого віку й, особливо, у разі інсульт-асоційованої пневмонії в анамнезі захворювання. Нижча частота соматичних ускладнень, зокрема інсульт-асоційованої пневмонії, під час стаціонарного лікування у порівнянні з періодом до госпіталізації є свідченням переваг інтегрованого інсультного блоку.

Ключові слова. Люди, вік, інсульт, пневмонія, прогноз, ретроспективні дослідження, багатофакторний аналіз, індекс тяжкості хвороби.



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