Infection Control & Hospital Epidemiology (2021), 1–3
doi:10.1017/ice.2021.398

Concise Communication

Hospital-acquired pneumonia is more frequent and lethal in stroke patients: A nationwide 4-year study

João C. Gonçalves-Pereira PhD[1,2,3], Flavio Marino MD[1], Paulo Mergulhão MD[3,4,5], Baltazar Nunes MD[6,7] and Filipe Froes PhD[3,8]

[1]Hospital Vila Franca de Xira, Vila Franca de Xira, Portugal, [2]Nova Medical School, Universidade Nova de Lisboa, Lisbon, Portugal, [3]Grupo de Infeção e Sépsis, Oporto, Portugal, [4]Hospital Lusíadas, Oporto, Portugal, [5]Faculdade de Medicina, Universidade do Porto, Oporto, Portugal, [6]Departamento de Epidemiologia, Instituto Nacional de Saúde Dr. Ricardo Jorge, Lisbon, Portugal, [7]Centro de Investigação em Saúde Pública, Escola Nacional de Saúde Pública, Universidade Nova de Lisboa, Lisbon, Portugal and [8]Chest Department, Hospital Pulido Valente, Centro Hospitalar Lisboa Norte, Lisbon, Portugal

Abstract

We report a higher incidence of hospital-acquired pneumonia (HAP) in patients admitted with stroke (odds ratio, 5.6; 95% CI, 5.4–5.8). Patients with HAP and stroke had an elevated risk of death (odds ratio, 1.2; 95% CI, 1.1–1.3). The incidence and mortality of HAP in stroke patients increased across all age groups.

(Received 29 June 2021; accepted 25 August 2021)

Stroke is often associated with significant mortality and morbidity, along with poor quality of life in survivors. Although medical advances have provided health benefits to an increasing number of patients, complications occurring during hospitalization, especially stroke-associated hospital-acquired pneumonia (SA-HAP), often jeopardize these gains.[1] These complications also foster neurologic deterioration and lead to poor functional outcomes and higher mortality. Several risk factors for SA-HAP have been described,[2] including stroke-induced immunosuppression and dysphagia.[3] These may co-occur with age, as well as immunosenescence and swallow dysfunction, to increase SA-HAP risk.

The epidemiology of SA-HAP is uncertain. This topic has been addressed in the literature but often in single-center studies that focus on patients admitted to stroke or intensive care units (ICUs), and general-ward patients are often underrepresented.[4] Calculation of the SA-HAP risk should include all stroke patients admitted to the hospital to realistically plan and assess the efficacy of prevention strategies.

In this study, we addressed the incidence of HAP in patients with and without stroke (both ischemic and hemorrhagic) at a national level. We included data collected during 4 complete consecutive years (2014–2017), accounting for possible seasonal variation, including all hospitals (both community and academic) of the Portuguese healthcare system.

Methods

The study protocol has been described elsewhere.[5] All adult hospital discharges between January 1, 2014, and December 31, 2017, were retrieved from the anonymized database of the Central Administration of the Health System of the Portuguese Ministry of Health. Patients with a hospital length of stay (LOS) of <48 hours were excluded. The codes used in this study are described in detail in Supplementary File A (online). All discharge codes had a complementary classification, indicating its presence or absence on admission. Consequently, HAP was defined as a pneumonia not present on admission.

All admissions were screened for the presence of stroke, either hemorrhagic or ischemic. The remaining patients comprised the control group. We identified all episodes of HAP in these 3 groups. A subanalysis was performed for age. Hospital length of stay, ICU admission, and hospital mortality were calculated for patients with and without HAP. Continuous variables were expressed as mean (± standard deviation) or median (interquartile range) according to data distribution. Odds ratios (ORs) with 95% confidence intervals (CIs) were computed. Differences between groups were evaluated using the χ^2 test for discrete variables and the Student *t* or Mann-Whitney test for continuous variables, as appropriate.

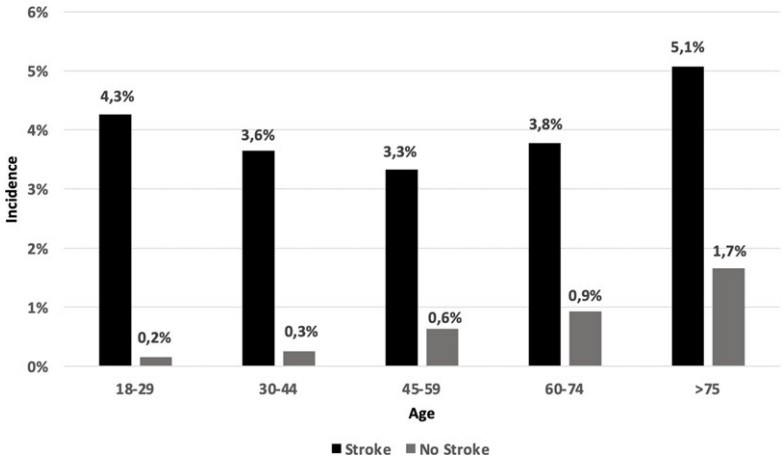
All calculations were performed using statistical software from the R Project for Statistical Computing (R Foundation for Statistical Computing, Vienna, Austria) and the Microsoft Excel spreadsheet (Microsoft, Redmond, WA). The study was approved by the central administration of the Portuguese National Health System. Because all individual patient information was protected and not accessible, and only aggregated data were available, the requirement for patient informed consent was waived.

Results

We screened 3,026,233 hospital admissions, including 96,038 episodes of stroke (15.8% hemorrhagic). We identified 28,632 episodes of HAP, a global incidence of 0.95%.[5] Stroke was strongly associated with HAP, corresponding to 15.0% of all HAP episodes

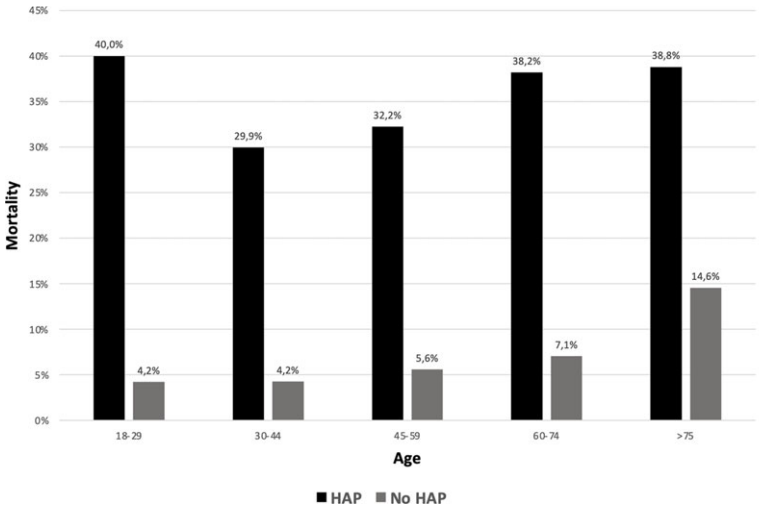
Author for correspondence: João C. Gonçalves-Pereira, E-mail: joao.goncalvespereira@hvfx.min-saude.pt

Cite this article: Gonçalves-Pereira JC, *et al.* (2021). Hospital-acquired pneumonia is more frequent and lethal in stroke patients: A nationwide 4-year study. *Infection Control & Hospital Epidemiology*, https://doi.org/10.1017/ice.2021.398



	OR	95% CI
18-29	30.7	18.7-50.5
30-44	16.1	13.0-20.0
45-59	6.0	5.3-6.7
60-74	4.7	4.4-5.0
>75	3.6	3.5-3.8
Tot	**5.6**	**5.4-5.8**

Fig. 1. Incidence of hospital-acquired pneumonia (HAP) according to the presence of stroke and age. Incidence of HAP in patients admitted with or without stroke. Age was the main determinant of HAP in the general population, but not in those with stroke. The odds ratio (with 95% CI) for the presence of HAP is provided for each age strata and for the whole population, according to the presence of stroke.



	OR	95% CI
18-29	15.0	5.4-41.9
30-44	6.9	4.7-10.3
45-59	5.5	4.5-6.7
60-74	8.1	7.2-9.2
>75	3.7	3.4-4.0
Tot	**4.8**	**4.5-5.2**

Fig. 2. Mortality of stroke patients according to age and the presence of hospital-acquired pneumonia (HAP). In patients admitted with stroke, mortality increased with HAP. The odds ratios (OR with 95% CI) for each age strata and for the whole stroke population are provided, according to the presence of HAP.

(OR, 5.6; 95% CI, 5.4–5.8). Interestingly, the incidence of SA-HAP was elevated in all age groups, ranging between 3.3% and 5.1%, in contrast to the control group (Fig. 1). Stroke was related to age and, consequently, 64.6% of SA-HAP episodes occurred in patients aged >75 years. Mortality of patients with HAP was higher in patients with stroke (OR, 1.2; 95% CI, 1.1–1.3). A relationship between age and mortality was evident in the control group (an increase from 20.3% in patients <60 years to 35.9% in the older ones) but less straightforward in patients with SA-HAP (31.9% and 38.6%, respectively). The mortality risk imposed by SA-HAP decreased with age, from an OR of 15.0 (95% CI, 5.4–41.9) in younger patients to an OR of 3.7 (95% CI, 3.4–4.0) in the elderly population, possibly related to the increasing weight of other risk factors (Fig 2).

The SA-HAP risk was higher in patients with hemorrhagic stroke, 7.6% (vs 3.9% in ischemic stroke; $P < .01$), although patients with hemorrhagic stroke were younger: 69.9 (±14.8) versus 74.9 (±12.8) ($P < .001$). Moreover, in patients with SA-HAP, ICU admission and hospital LOS, respectively, were also longer in hemorrhagic stroke: 10.3% versus 4.0% ($P < .001$) and 29 (95% CI, 17–47) versus 22 (95% CI, 13–38) ($P < .001$).

Discussion

We have presented the results of a national-level study assessing the incidence, health-resource utilization, and mortality of HAP in stroke patients. Stroke was associated with 5.6 times higher incidence of HAP, higher hospital mortality (OR, 1.2 ; 95% CI, 1.1–1.3), longer hospital LOS, and greater need for ICU admission. The incidence and mortality rates of SA-HAP were elevated across all age groups (Fig. 2) compared to the control group. Similar results were reported in another multicenter study, in a less severely ill population, part of a health improvement initiative, a SA-HAP incidence of 5.7% associated with a 5-fold increase in the mortality risk.[6] Age and stroke severity were the main risk factors for SA-HAP,[6] and dysphagia screening did not improve outcomes. This finding contrasted sharply with a single-center, before-and-after study in which a drop in SA-HAP from 6.5% to 2.8% was noted.[7] This difference emphasizes the importance of proper training to improve infection prevention.

Risk factors for SA-HAP seem to be related to stroke severity, state of consciousness and physical dependency.[10] The relationship of age and SA-HAP incidence is more controversial, and no clear association was detected in our study (Fig 1).

A lower incidence of SA-HAP is frequently reported in stroke units, although admission criteria are seldomly random, and selection bias should not be ignored.[8] In fact, a study involving 9,238 older stroke patients reported a higher incidence of SA-HAP, 11.7%, again leading to higher mortality (OR, 5.9; 95% CI, 5.0–6.9), longer LOS, and worse functional outcome.[9] Although prevention and treatment are the priorities in HAP, infection is frequently the final common pathway for several, ultimately fatal, diseases.

This study had several limitations. Only Portuguese hospitals were included. The investigation relied on a discharge diagnosis codification system and was retrospective in design. The nature of the database did not allow us to identify the time of the SA-HAP diagnosis, stroke severity, the presence of repeated strokes, or the presence of an ultimately fatal disease. All of these factors can influence prognosis. Finally, potential underreporting of HAP cannot be discarded, and the study design did not allow identification of causality, only association.

The study also has several strengths. To our knowledge, it was the first SA-HAP incidence study conducted at a national level, including both large and small community hospitals as well as teaching hospitals. Furthermore, we included data from 4 complete consecutive years, accounting for a potential seasonal variation. A large database allowed the discrimination between hemorrhagic and ischemic stroke, we were able to address the different age groups, which strengthened our conclusions. Finally, we excluded community-acquired pneumonia, which occurs along with the acute stroke episode but before hospital admission and is not prone to a prevention strategy.

In conclusion, SA-HAP often complicates the treatment of stroke patients and is associated with longer hospital stay, ICU admission, and increased mortality. Unlike patients with no stroke, these associations were detected across all age groups.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2021.398

Acknowledgments.

Financial support. This work was supported by a research grant from Merck, Sharp, and Dohme, a division of Merck (IIS no. 58769) under the Investigator Studies Program.

The content of this publication reflects only the view of the authors; the sponsor had no role in the analyses or interpretation of the data. The authors assume full responsibility for the accuracy and completeness of the results presented as well as for the study conclusions.

Conflicts of interest. Dr Gonçalves-Pereira reports an unrestricted research grant from Merck, Sharp, and Dohme for this study and personal fees from Merck Sharp and Dohme and Biomerieux for lectures at medical events outside the submitted work during the past 36 months. He is currently the nonpaid president of the Portuguese Infection and Sepsis Group (Grupo de Infecção e Sepsis, www.gis.pt). This group has received financial support during the past 36 months from the following sources: Merck, Sharp, and Dohme; Pfizer; BioMérieux in support of a medical education initiative regarding the use of antibiotics; Astellas, Accelerate Diagnostics; Maquet; Baxter; Gilead; Pfizer; and Merck, Sharp, and Dohme in support of the Infection and Sepsis International Symposium organization. Dr Mergulhão reports personal fees for lectures at medical events from Merck, Sharp, and Dohme; Pfizer; BioMérieux; and Accelerate Diagnostics. He also reports nonfinancial support from Merck, Sharp, and Dohme for attending a medical meeting outside of the submitted work during the past 36 months. Dr Froes reports an unrestricted research grant from Merck, Sharp, and Dohme for this study as well as personal fees for lectures at medical events from Pfizer; Merck, Sharp, and Dohme; Gilead; Novartis; Bial; Sanofi; AstraZeneca; Tecnifar; Glaxo Smith Kline; Bayer; Lilly; Roche; and Boehringer Ingelheim outside the submitted work. During the past 36 months, he has received nonfinancial support from Merck, Sharp, and Dohme; Pfizer; Gilead; and Sanofi for attending medical meetings as well as personal fees for serving on advisory boards for Merck, Sharp, and Dohme and Sanofi.

References

1. Hannawi Y, Hannawi B, Rao CPV, Suarez JI, Bershad EM. Stroke-associated pneumonia: major advances and obstacles. *Cerebrovasc Dis* 2013;35:430–443.
2. Ji R, Shen H, Pan Y, *et al.* Novel risk score to predict pneumonia after acute ischemic stroke. *Stroke* 2013;44:1303–1309.
3. Lord AS, Lewis A, Czeisler B, *et al.* Majority of 30-day readmissions after intracerebral hemorrhage are related to infections. *Stroke* 2016;47:1768–1771.
4. Hilker R, Poetter C, Findeisen N, *et al.* Nosocomial pneumonia after acute stroke: implications for neurological intensive care medicine. *Stroke* 2003;34:975–981.
5. Gonçalves-Pereira J, Mergulhão P, Nunes B, Froes F. Incidence and impact of hospital-acquired pneumonia: a Portuguese nationwide 4-year study. *J Hosp Infect* 2021;112:1–5.
6. Masrur S, Smith EE, Saver JL, *et al.* Dysphagia screening and hospital-acquired pneumonia in patients with acute ischemic stroke: findings from get with the guidelines—stroke. *J Stroke Cerebrovasc Dis* 2013;22:301–309.
7. Lee Titsworth W, Abram J, Fullerton A, *et al.* Prospective quality initiative to maximize dysphagia screening reduces hospital-acquired pneumonia prevalence in patients with stroke. *Stroke* 2013;44:3154–3160.
8. Chapman C, Cadilhac DA, Morgan P, *et al.* Chest infection within 30 days of acute stroke, associated factors, survival and the benefits of stroke unit care: analysis using linked data from the Australian Stroke Clinical Registry. *Int J Stroke* 2020;15:390–398.
9. Teh WH, Smith CJ, Barlas RS, *et al.* Impact of stroke-associated pneumonia on mortality, length of hospitalization, and functional outcome. *Acta Neurol Scand* 2018;138:293–300.
10. Brogan E, Langdon C, Brookes K, Budgeon C, Blacker D. Can't swallow, can't transfer, can't toilet: factors predicting infections in the first week post stroke. *J Clin Neurosci* 2015;22:92–97.