



## Incidence of Pneumonia among Stroke Patient in Zainoel Abidin Hospital Banda Aceh – A Descriptive Study

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### A B S T R A C T

Stroke is an acute and focal neurological deficit syndrome resulting from vascular injury (infarction, bleeding) in the central nervous system. Apart from that, stroke causes the second number of deaths in the world with the highest morbidity and the incidence increases in young and middle age (<55 y.o). In 2018, the prevalence of stroke in Aceh was 13.389 people. On the other hand, pneumonia is the most common non-neurological complication in the acute phase of stroke. In severe brain injury, it causes sympathetic overactivity which causes Systemic Inflammatory Response Syndrome (SIRS). The aim of the research is to provide a descriptive overview of the incidence of pneumonia in stroke patients including gender, onset, stroke classification, complications/comorbidities, use of antibiotics and length of treatment. Quantitative research type with a descriptive design with a cross-sectional study and purposive sampling approach. The population is medical records of stroke patients who experienced pneumonia during the treatment period for the period January-December 2023 and samples were taken in the Medical Records Room at RSUD dr. Zainoel Abidin Banda Aceh. This study showed that the dominant age of SAP was over 55 years and 60 cases of ischemic stroke (77.9%) and 17 cases (22.1%) of hemorrhagic stroke was male patient. The highest stroke onset is 1-7 days. The main comorbid factors were hypertension and diabetes mellitus. The use of antibiotics was 3rd generation cephalosporins. The incidence of pneumonia in stroke sufferers was influenced by age, gender and comorbid factors.

## INTRODUCTION

Stroke is the second leading cause of mortality in the world with the highest morbidity, and the incidence of stroke increases in young and middle age (<55 years) (Feigin et al., 2023). The 2022 Global Stroke Fact Sheet reveals that the risk of having a stroke has increased by 50% over the last 17 years and 1 in 4 people are at risk of having a stroke. An increase in Disability Adjusted Life Years (DALY) of 143% occurred in low and lower middle income countries (World Health Organization, 2022).

In Indonesia, the Center for Health Financing and Insurance by the Ministry of Health of the Republic of Indonesia reported that the number of stroke sufferers in Indonesia is 1.789.261 people in 2020 (Kementerian Kesehatan Republik Indonesia, 2020). Based on RISKESDAS Aceh 2018, the prevalence of stroke is 13.389 people (Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan, 2019). The number of patient with stroke admitted to RSUD dr. Zainoel Abidin during 2022 reached 1250 people, dominated by ischemic stroke with 965 cases and hemorrhagic stroke with 285 cases (Rinaldi, 2023)

Various factors that cause stroke which include undetected and uncontrolled hypertension, difficult to access health services, lack of attention to stroke prevention, air pollution, unhealthy lifestyles, smoking and obesity. Primary prevention of stroke and risk of cardiovascular disease is by focusing on early detection and adequate management of hypertension (Feigin et al., 2023).

Complications that arise in stroke patients often cause death (40-95%). Pneumonia is the most common non-neurological complication in the acute phase of stroke. In severe brain injury, it causes sympathetic overactivity which causes systemic inflammation (Systemic Inflammatory Response Syndrome). The release of catecholamines occurs which affects the integrity of the alveolar basement membrane which increases the hydrostatic pressure of the pulmonary capillaries and produces a transudate in the alveolar cavity called neurogenic pulmonary edema (NPE). This buildup of fluid in the lungs is a good medium for bacterial growth because it makes it easier for germs to colonize the lungs (Fatni Muhafidzah *et al.*, 2021)

Stroke-associated pneumonia (SAP) occurs quite often in 5-26% of stroke patients, thereby reducing quality of life. One of the factors that influences the incidence of SAP is the severity of the stroke. A study reported that 24 of 81 research subjects experienced SAP 29.6%. The highest prevalence of SAP is in men (58.3%) in the age group 65-74 years (41.7%) with risk factors for hypertension (87.5%), onset of stroke (Wandira *et al.*, 2018).

Therefore, researchers were interested in examining the description of the incidence of pneumonia in stroke sufferers at RSUD dr. Zainoel Abidin Banda Aceh. The aim of this study is to provide an overview of the incidence of pneumonia in stroke sufferers and information on demographic data regarding gender, onset, stroke classification, complications/comorbidities, use of antibiotics and length of treatment.

## METHOD

The research uses a quantitative type of research with a descriptive design with a cross-sectional study approach. The population in this study were all stroke patients diagnosed by a neurologist who were hospitalized at RSUD dr. Zainoel Abidin Banda Aceh. The research sample was medical records in the Medical Records Room at RSUD dr. Zainoel Abidin Banda Aceh and the research was conducted March-April 2024. The study inclusion criteria were acute stroke patients, both ischemic and bleeding, confirmed by a CT scan of the head without contrast, adult patients aged over 18 years and during treatment for a stroke accompanied by pneumonia.

We used purposive sampling to determine the sample size, which is more related to the research objectives, population characteristics, diversity of information required, and the researcher's abilities. The data needed is demographic data regarding gender, onset, stroke classification,

complications/comorbidities, use of antibiotics and length of treatment. The population of this study were all patients registered as stroke patients who experienced pneumonia during treatment at RSUD dr. Zainoel Abidin Banda Aceh from January-December 2023. The research sample is all populations that meet the inclusion criteria for conducting research.

## RESULT

The results of the research that was carried out showed that there were 77 stroke cases with pneumonia that met the inclusion criteria with characteristics based on age and gender. The characteristics of stroke patients based on age are presented in Table 1. The characteristics of stroke patients who experienced predominant pneumonia at age >65 years were 29 patients (37.7%), 28 patients aged 56-65 years (36.4%), age 46-55 years amounted to 16 patients (20.8%), aged 17-25 years amounted to 2 patients (2.6%) and aged 36-45 years amounted to 2 people (2.6%).

Table 1. Characteristics of stroke patients with pneumonia based on age

Age (years)	Freq (n)	Percentage (%)
17-25	2	2.6%
26-35	0	0%
36-45	2	2.6%
46-55	16	20.8%
56-65	28	36.4%
>65	29	37.7%
Total	77	100%

Characteristics of stroke patients based on gender are presented in Table 2. It was found that the characteristics of stroke patients were predominantly male with a total of 49 patients (63.6%) compared to female gender with a total of 28 patients (36.4%).

Table 2. Patient characteristics by gender

Gender	Freq (n)	Percentage (%)
Male	49	63.6 %
Female	28	36.4%
Total	77	100%

From the research results based on Table 3, it was found that men were more at risk of experiencing ischemic stroke in 39 cases (79.6%) compared to women in 21 cases (75%). Hemorrhagic stroke has a low risk in women with 7 cases (25%) and men with 10 cases (20.4%).

Table 3. Gender characteristics with stroke incidence

Gender	Freq (n)	Stroke classification	
		Hemorrhagic	Ischemic
Male	49	10 (20.4%)	39 (79.6%)
Female	28	7 (25%)	21 (75%)
Total	77	17	60

Data characteristics based on age and stroke incidence showed that the highest data distribution was at ages >65 years with the highest cases of ischemic stroke being 23 cases (79.3%) and hemorrhagic 6 cases

(20.7%), followed by those aged 56-65 years with hemorrhagic 5 cases (17.9%) and ischemic 23 cases (82.1%). Age 46-55 years 4 cases (25%) hemorrhagic and 12 cases (75%) ischemic, followed by ages 36-45 years and 17-25 years 2 cases each.

Table 4. Age characteristics with stroke incidence

Age (years)	Freq (n)	Stroke classification	
		Hemorrhagic	Ischemic
17-25	2	1 (50%)	1 (50%)
26-35	0	0 (0%)	0 (0%)
36-45	2	1 (50%)	1 (50%)
46-55	16	4 (25%)	12 (75%)
56-65	28	5 (17.9%)	23 (82.1%)
> 65	29	6 (20.7%)	23 (79.3%)
Total	77	17	60

The onset of a stroke is the beginning of an attack of brain function disorders. In this study, the onset of patients admitted to the emergency room or health facility was the highest, namely, 1-7 days, 37 cases (82.2%) were ischemic, and 8 cases (17.8%) were hemorrhagic, followed by <1 day, 15 cases (62.5%) ischemic and 9 cases hemorrhagic and >7 days as many as 8 cases (100%) ischemic.

Table 5. Stroke onset

Stroke onset	Freq(n)	Stroke classification	
		Hemorrhagic	Hemorrhagic
< 1 days	24	9 (37.5%)	15 (62.5%)
1-7 days	45	8 (17.8%)	37 (82.2%)
> 7 days	8	0 (0%)	8 (100%)
Total	77		

The length of stay for stroke sufferers varied greatly so that researchers grouped them into 3, namely, the highest was 8-14 days with 34 cases (44.2%), then 1-7 days with 25 cases (32.5%) and >18 days with 23.33 %.

Table 6. Characteristics of length of stay in hospital

Length of stay	Freq (n)	Percentage (%)
1-7 days	25	32.5 %
8-14 days	34	44.2 %
>14 days	18	23.3%
Total	77	100%

The use of antibiotics in stroke patient with pneumonia can be given with one or in combination approach. In this study, the highest type of antibiotic being used was ceftriaxone in 54 cases (70.1%), then levofloxacin in 22 cases (28.6%), meropenem in 8 cases (10.4%) and other types of antibiotics (ceftazidime, cefotaxime, cefixime, cefepime and azithromycin) in 6 cases (7.8%).

Table 7. Use of antibiotics in stroke sufferers with pneumonia during treatment

Antibiotic	Yes	No	Total
Ceftriaxone	54 (70.1%)	23 (29.9%)	77 (100%)
Meropenem	8 (10.4%)	69 (89.6%)	77 (100%)
Levofloxacin	22 (28.6%)	55 (71.4%)	77 (100%)
Others	6 (7.8%)	71 (92.2%)	77 (100%)

Total	90 (29.2)	218 (70.8%)	308 (100%)
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There are various comorbid factors that increase the occurrence of stroke in patients, one of the highest is hypertension, accounting for 40 cases (71.4%) of ischemic stroke, 16 cases (28.6%) of hemorrhagic stroke. Then diabetes mellitus was 18 cases (100%) of ischemic stroke, others (chronic kidney disease, Parkinson's disease, dyslipidemia, congestive heart failure, pulmonary TB) were 14 cases (93.3%) of ischemic stroke and 1 case (6, 7%) hemorrhagic stroke, coronary arterial disease (history of PCI/percutaneous coronary intervention or no PCI) in 8 cases (100%) and history of previous stroke in 4 cases (57.1%) hemorrhagic stroke and 3 cases (42.9%) ischemic stroke.

However, the limitations of this study are that it uses medical record data, there is some data that is not listed, such as history of smoking, alcohol consumption, history of diabetes mellitus (DM), glucose levels are not included at the time of acute onset of stroke, CHF is not differentiated according to functional class I-IV and CKD. stages are not differentiated based on GFR (glomerular filtration rate) calculations.

**Table 8. Characteristics of comorbidities with stroke incidence**

Comorbid	Evaluation	Stroke classification		Total
		Hemorrhagic	Hemorrhagic	
Diabetes mellitus	Yes	0 (0%)	18 (100%)	18
	No	17 (28.8%)	42 (71.2%)	59
Hypertension	Yes	16 (28.6%)	40 (71.4%)	56
	No	1 (4.8%)	20 (95.2%)	21
Coronary arterial disease	Yes	0 (0%)	8 (100%)	8
	No	17 (24.6%)	52 (75.4%)	69
History of stroke	Yes	4 (57.1%)	3 (42.9%)	7
	No	13 (18.6%)	57 (81.4%)	70
others	Yes	1 (6.7%)	14 (93.3%)	15
	No	16 (25.8%)	46 (74.2%)	62

Stroke patients with pneumonia during the treatment period experienced improvement in 48 cases (73.8%) of ischemic stroke and 17 cases (26.2%) of hemorrhagic stroke and died in 12 cases (100%) of ischemic stroke.

**Table 9. Outcomes of stroke patients with pneumonia during the treatment period**

Outcome	Hemorrhagic Stroke	Ischemic Stroke	Total
Fixed	17 (26,2%)	48 (73,8%)	65
Dead	0 (0%)	12 (100%)	12
Total			77 (100%)

## DISCUSSION

Stroke associated pneumonia (SAP) is often caused by aspiration, due to a weak swallowing reflex. Insertion of an endotracheal tube (ETT) to avoid aspiration occurs, but there is still a risk of aspiration. The use of ETT blocks the body's defense mechanisms such as coughing and increases the risk of ventilator associated pneumonia. Coughing is an important defense mechanism to protect against aspiration and pneumonia. Weakening of the cough reflex and swallowing disorders will develop into

aspiration pneumonia. The combination of weakened swallowing and cough reflexes appears to be an important marker of increased risk of pneumonia in patients with post-stroke dysphagia (Grossmann et al., 2021)

Our research obtained data on stroke patients who experienced predominant pneumonia aged over 55 years. This is in accordance with study conducted by Novi et al, the characteristics of stroke patients with pneumonia compared to stroke patients without pneumonia, namely that pneumonia patients tend to occur in the age group 45–59 years with an average age of  $59 + 13.53$ . This is in accordance with prospective study in India reporting a younger average age for stroke with nosocomial pneumonia, namely  $55.1 + 16.2$  years. These results are different from the post-stroke pneumonia (PSP) prediction model score cohort study in Germany which stated that old age  $>65$  years was a predictor factor for the occurrence of pneumonia. Old age (especially  $>65$  years) is a risk factor for pneumonia in stroke because this is related to decreased protective reflexes such as coughing and swallowing (Fatni Muhafidzah et al., 2021).

Amanda et al's study showed that factors that increase the occurrence of pneumonia in older age are related to immunity and the risk of aspiration in the elderly. Decreased consciousness and the severity of the stroke are at risk of developing pneumonia. Patients who experience decreased consciousness are associated with decreased cough reflex, impaired esophageal sphincter, and swallowing function, thereby increasing the risk of aspiration. In addition, the large size of the infarct causes immunosuppression so that patients are more susceptible to infection (Azzahra et al., 2021).

From table 3 it is known that the type of stroke was ischemic in 60 cases (77.9%) and 17 cases (22.1%) were hemorrhagic stroke. This is similar to research conducted by Artanti et al which stated that stroke patients had a higher rate of ischemic stroke (72.60%) than hemorrhagic stroke (27.39%) (Artanti *et al.*, 2020). A study conducted by Husen Abdu also obtained similar results, which stated that ischemic stroke was 65.4% higher than hemorrhagic stroke 34.6% (Abdu et al., 2021). However, this is different from a study conducted by Derrel V. Barahama which showed that there were more hemorrhagic stroke patients than ischemic stroke sufferers (Barahmana et al., 2019).

Based on gender, the prevalence of ischemic stroke and hemorrhagic stroke is higher in men compared to women. Hemorrhagic stroke was 10 cases in men, 7 cases in women and ischemic stroke 39 cases in men and 21 cases in women. This finding is not consistent in several other studies, but men are very significant in experiencing ischemic stroke (Abdu et al., 2021).

A retrospective study conducted by Amanda et al showed that ischemic strokes predominantly occur in men. The female hormone estrogen functions to protect the brain and blood vessels. Estrogen can increase blood flow by reducing blood vessel reactivity, while testosterone has the opposite effect. In addition, genes on the Y chromosome are involved in increasing blood pressure and hypertension in men. Ischemic lesions mostly occur in the parietal lobe in strokes with pneumonia and lesions in the basal

ganglia in strokes without pneumonia. The middle cerebral artery (MCA) is the artery that causes the most strokes and is the main determinant of stroke associated infection (Azzahra et al., 2021).

In this study, people aged >65 years showed a highest cases of ischemic stroke. In contrast to Novi et al's research, SAP tends to occur more frequently in hemorrhagic stroke types (56.67%), occurring due to decreased consciousness due to increased intracranial pressure (ICP) thus increasing the inflammatory response, nerve tissue damage and immunosuppression (Fatni Muhafidzah et al., 2021). A study conducted in the United Kingdom of 854 SAP patients with an average age of 83 years (77.5-88.5) were male and most experienced ischemic stroke (85.1%) (Tinker et al., 2021).

This gender difference is influenced by cardiovascular diseases such as hypertension, men being taller than women of the same age as well as smoking habits and alcohol consumption. In research conducted by Abdu et al, hypertension is the highest risk factor for hemorrhagic stroke and ischemic stroke, this is in accordance with various population and hospital-based studies that report (Abdu et al., 2021).

Older patients suffer more from hospital onset stroke which is influenced by a history of previous illnesses such as CHF and atrial fibrillation. Arterial disease is the basic etiology of cardiovascular disease that is often identified. In this study, the prevalence of diabetes and hypertension was the same as in previous studies (Fluck et al., 2022).

In this study, the highest onset of stroke was 1-7 days, with 37 cases (82.2%) of ischemic stroke and 8 cases (17.8%) of hemorrhagic stroke. The risk of stroke associated pneumonia (SAP) is increased where stroke onset < 48 hours is associated with a more severe degree of stroke. Lesion location in the left hemisphere was associated with higher NIHSS values and greater severity. Onset > 48 hours indicates a long patient stay in hospital, thereby increasing the risk of hospital-acquired pneumonia (Wandira, 2018). Research conducted by Marry et al found that 20% of stroke cases had no known onset. Patients whose stroke onset is unknown tend to fall into the category of severe strokes which often occur in old age, are female and live alone (Søyland et al., 2022).

In this study, the highest length of stay for stroke sufferers with pneumonia was 8-14 days in 34 cases (44.2%). Length of stay greatly influences exposure to nosocomial infections in the hospital. This is in accordance with research at Hasan Sadikin Hospital in Bandung, the highest death rate in SAP was respiratory failure (84.62%) which occurred due to the use of ventilators and limited space in the intensive care unit (ICU). The length of stay in stroke patients with pneumonia was greater with LOS (Length of Stay) <7 days (36.67%), with a median value of 10 days (2–22), close to the median value in a prospective study in Denmark, namely 11 days (Fatni Muhafidzah et al., 2021).

In contrast to a study conducted by Jeroen et al, most pneumonia was diagnosed on the third day of the stroke and 20% of patients experienced post-stroke pneumonia. Pneumonia occurs earlier and more

frequently in patients with severe stroke and the pathophysiology of post-stroke pneumonia: aspiration and immunodepression (de Jonge et al., 2022).

The length of stay for Community Onset Stroke (COS) is significantly shorter as taken from the median value (19 days in 1995-2001 vs 7 days, P value <0.001), in contrast to In Hospital Stroke (IHS) (21 days in 1995-2001 vs 17 days in 2009-2015, P value = 0.688). Since 1995, there has been an increase in the number of COS patients being discharged home with care or to sheltered accommodation and fewer to residential care (Emmett et al., 2019).

In table 7, the highest use of antibiotics was ceftriaxone with 54 cases (70.1%), then levofloxacin with 22 cases (28.6%), meropenem with 8 cases (10.4%) and other types of antibiotics (ceftazidime, cefotaxime, cefixime and azithromycin) in 6 cases (7.8%). Antibiotics can be given alone or in combination. The most frequently given antibiotic combination is ceftriaxone and levofloxacin. Nosocomial infections such as pneumonia and urinary tract infections require antibiotic therapy within 7 days of hospital admission (Fluck et al., 2022).

SAP occurs frequently and is a serious complication, but there is no standard recommendation for antibiotic use. A survey study in Germany in 2010 and included a standardized questionnaire for 83 stroke units, the study showed that in empiric monotherapy (58%) and combination therapy (42%). The antibiotics used, namely, 3rd generation cephalosporins and (acyl-)aminopenicillin/beta-lactamase inhibitors are the most used drugs (46%-60%). Prophylactic antibiotic treatment was used by a small proportion of stroke units (5%) (Grossmann et al., 2021). This is in accordance with the data in table 7, namely the use of 3rd generation cephalosporin antibiotics, the highest of which are ceftriaxone, ceftazidime, cefotaxime, and cefixime for gram-positive bacteria.

The most common etiology of CAP is *S. pneumoniae* and HAP is identified most often in patients complicated by stroke with pneumonia, namely *S. aureus*, *Enterobacteriaceae* and *P. aeruginosa*. The choice of antibiotics used is broad spectrum, depending on the doctor and the standard standards used for Community-Acquired Pneumonia (CAP), Hospital Acquired Pneumonia (HAP) or aspiration pneumonia. Antibiotics used for SAP vary in spectrum of antimicrobial activity, and patterns of antibacterial resistance are important considerations in empiric therapy (Kishore et al., 2019).

**Table 10. Specialist guidelines for HAP/VAP (Kishore et al., 2019)**

European Respiratory Society, European Society of Intensive Care Medicine, European Society for Clinical Microbiology and Infectious Diseases, Asociación Latinoamericana del Tórax on management of HAP in adults	Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of HAP in Adults
<p>Low-risk patients ( without septic shock, with no other risk factors for MDR pathogens and those who are not in hospitals with a high background rate of resistant pathogens and with low risk of mortality)</p> <p>Narrow-spectrum antibiotics (ertapenem, ceftriaxone, cefotaxime, moxifloxacin or levofloxacin) in patients with suspected low risk of resistance and early-onset HAP/VAP</p> <p>High-risk patients (in patients with suspected early-onset HAP/VAP who are in septic shock, in patients who are in hospitals with a high background rate of resistant pathogens present in local microbiological data and in patients with other (non-clas-sic) risk factors for MDR pathogens)</p> <p>Broad-spectrum empiric antibiotic therapy targeting <i>Pseudomonas aeruginosa</i> and extended-spectrum <math>\beta</math>-lactamase producing organisms</p>	<p>Not at high risk of mortality and no factors increasing likelihood of MRSA</p> <p>Piperacillin + Tazobactam or Cefepime <b>OR</b> Levofloxacin <b>OR</b> Imipenem/ Meropenem</p> <p>Not at high risk of mortality but with factors increasing likelihood of MRSA</p> <p>One of the following:</p> <p>Piperacillin + Tazobactam <b>OR</b> Cefepime <b>OR</b> Levofloxacin <b>OR</b> Imipenem/ Meropenem <b>OR</b> Aztreonam <b>PLUS</b></p> <p>Vancomycin <b>OR</b> Linezolid</p> <p>High risk of mortality or receipt of intravenous antibiotics during the prior 90 days</p> <p>Two of the following (avoid 2 <math>\beta</math>-Lactams)</p> <p>Piperacillin + Tazobactam <b>OR</b> Cefepime <b>OR</b> Levofloxacin <b>OR</b> Imipenem/ Meropenem <b>OR</b> Aztreonam <b>OR</b> Amikacin/Gentamicin/Tobramycin</p> <p><b>PLUS</b></p> <p>Vancomycin <b>OR</b> Linezolid</p>

HAP: hospital acquired pneumonia; VAP: ventilator associated pneumonia; MDR: multiple-drug resistant; MRSA: methicillin-resistant *Staphylococcus aureus*.

**Table 11. Empirical therapy for CAP and aspiration pneumonia in previously healthy individuals without *S. aureus* resistance and before pathogen isolation and resistance testing) (Kishore et al., 2019)**

European Respiratory Society and European Society for Clinical Microbiology and Infectious Diseases on management of hospitalised CAP in adults	Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of hospitalised CAP in Adults
<p><u>Inpatients, non-ICU treatment</u></p> <p>Aminopenicillin <math>\pm</math> macrolide <b>OR</b></p> <p>Aminopenicillin/ <math>\beta</math>-lactamase inhibitor <math>\pm</math> macrolide <b>OR</b></p> <p>Non-antipseudomonal cephalosporin <b>OR</b></p> <p>Cefotaxime or Ceftriaxone <math>\pm</math> macrolide <b>OR</b> Levofloxacin <b>OR</b></p> <p>Moxifloxacin <b>OR</b></p> <p>penicillin G <math>\pm</math> macrolide</p> <p><b>Aspiration pneumonia</b></p> <p>oral or parenteral <math>\beta</math>-lactam/ <math>\beta</math>-lactamase inhibitor <b>OR</b></p> <p>Clindamycin <b>OR</b></p> <p>parenteral cephalosporin + oral Metronidazole <b>OR</b></p> <p>Moxifloxacin</p>	<p><u>Inpatients, non-ICU treatment</u></p> <p>Respiratory fluoroquinolone <b>OR</b> <math>\beta</math>-lactam plus macrolide</p> <p><b>Risk factors for <i>Pseudomonas aeruginosa</i></b></p> <p>An anti-pneumococcal, antipseudomonal <math>\beta</math>-lactam (Piperacillin, Tazobactam, Cefepime, Imipenem, or Meropenem) + either Ciprofloxacin or Levofloxacin <b>OR</b></p> <p>The above <math>\beta</math>-lactam + aminoglycoside and Azithromycin <b>OR</b></p> <p>The above <math>\beta</math>-lactam + an aminoglycoside and an anti-pneumococcal fluoroquinolone (for penicillin-allergic patients, substitute Aztreonam for above <math>\beta</math>-lactam)</p>

CAP: community acquired pneumonia; ICU: intensive-care unit.

Pneumonia exacerbates the ischemic cascade by increasing T Helper 1 antigens in the central nervous system (CNS). In addition, pneumonia is associated with hypoxia and the occurrence of an ischemic stroke cascade which stimulates toxicity and oxidative damage resulting in damage to neurons, glia and endothelial cells (Azzahra et al., 2021).

In this study, deaths from ischemic stroke reached 12 cases (100%) compared to 0 cases (0%) from hemorrhagic stroke. Research conducted in Ethiopia where the death rate for ischemic stroke was twice as high as for hemorrhagic stroke. These results are inconsistent with other literature where patients with

hemorrhagic stroke have a higher mortality rate. Several studies report a worse prognosis in patients with hypertension (Abdu et al., 2021).

## CONCLUSION

The incidence of pneumonia in stroke sufferers is caused by aspiration, weakened cough reflex and immunodepression. The most common etiology of CAP is *S. pneumoniae* and HAP is *S. aureus*, Enterobacteriaceae and *P. aeruginosa*. Based on the results of this study, it can be concluded that the dominant age of SAP is over 55 years and male gender accounts for 60 cases (77.9%) of ischemic stroke and 17 cases (22.1%) of hemorrhagic stroke. The highest stroke onset was 1-7 days, with 37 cases (82.2%) of ischemic stroke and 8 cases (17.8%) of hemorrhagic stroke. The main comorbid factors are hypertension and diabetes mellitus. The use of antibiotics for SAP is broad spectrum (3rd generation cephalosporins).

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