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PROPHYLACTIC ANTIBIOTICS IN THE PREVENTION OF ASPIRATION PNEUMONIA IN STROKE PATIENTS

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Abstract

Background: *Stroke is a major cause of morbidity and mortality worldwide and is frequently complicated by aspiration pneumonia, which worsens clinical outcomes. Prophylactic antibiotics have been proposed as a preventive strategy; however, their efficacy remains controversial.*

Objective: *To determine the efficacy of prophylactic antibiotics in the prevention of aspiration pneumonia in stroke patients.*

Methods: *This randomized controlled trial was conducted in the Department of Medicine, Khyber Teaching Hospital, Peshawar, from 13th April 2025 to 13th July 2025. A total of 114 patients aged 40–80 years with confirmed stroke were enrolled and randomized into two groups. Group A received intravenous ceftriaxone (1 g twice daily for 5 days), while Group B received placebo. Patients were monitored for development of aspiration pneumonia. Data were analyzed using SPSS version 25, and efficacy was compared using chi-square test with p ≤0.05 considered significant.*

Results: *The mean age was comparable between groups (61.32 ± 9.45 vs 60.87 ± 10.12 years, p=0.78). Efficacy was significantly higher in Group A (93.0%) compared to Group B (71.9%) (p=0.003). Stratification analysis showed consistent benefit across age, gender, BMI, stroke type, and comorbidities.*

Conclusion: *Prophylactic antibiotics significantly reduce the risk of aspiration pneumonia in stroke patients and may be considered in high-risk individuals alongside standard preventive measures.*

INTRODUCTION

Stroke, also known as cerebrovascular accident (CVA), is one of the leading neurological emergencies worldwide and a major contributor to long-term disability and mortality. It occurs due to an interruption of blood supply to the brain, either ischemic or hemorrhagic in nature, leading to sudden onset neurological deficits. Clinically, stroke is defined as the presence of focal or global neurological impairment lasting more than 24 hours with a vascular cause, often confirmed through neuroimaging such as CT scan [1].

Globally, the burden of stroke continues to rise due to increasing life expectancy and the prevalence of risk factors such as hypertension, diabetes mellitus, obesity, and sedentary lifestyle. Risk factors for stroke are broadly categorized

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into modifiable (e.g., smoking, physical inactivity, uncontrolled comorbidities) and non-modifiable factors (e.g., age, gender, genetic predisposition). Effective management of these risk factors is essential to reduce the incidence of stroke and its complications [2,3].

Despite advances in acute stroke management, patients remain vulnerable to a range of complications that significantly impact outcomes. Among these, infections are one of the most frequent and serious complications, contributing substantially to increased morbidity, prolonged hospital stay, and mortality. Post-stroke infections occur due to multiple mechanisms, including stroke-induced immunosuppression and impaired protective reflexes [4].

Aspiration pneumonia, commonly referred to as stroke-associated pneumonia, is one of the most prevalent infections following stroke. It results from impaired swallowing (dysphagia), reduced cough reflex, and altered consciousness, leading to aspiration of oropharyngeal or gastric contents into the lungs. This condition is associated with poor functional outcomes, increased healthcare costs, and higher mortality rates among stroke patients [5].

Early identification and prevention of aspiration pneumonia are therefore critical components of stroke care. Standard preventive measures include swallowing assessments, early mobilization, positioning strategies, and maintaining oral hygiene. However, these measures may not always be sufficient, particularly in patients with severe neurological deficits [6].

The use of prophylactic antibiotics has been proposed as an additional strategy to reduce the incidence of aspiration pneumonia in stroke patients. Some clinical studies have reported a significant reduction in pneumonia rates among patients receiving prophylactic antibiotics compared to those who do not. For instance, one study demonstrated that only 7.2% of patients receiving prophylactic antibiotics developed pneumonia compared to 27.2% in the control group, indicating a statistically significant benefit [7].

Conversely, other studies have reported conflicting findings, suggesting that routine use of prophylactic antibiotics may not significantly reduce pneumonia incidence and could contribute to antibiotic resistance, adverse drug effects, and increased healthcare costs. Large randomized trials have questioned the overall benefit of this practice, emphasizing the need for further evidence in different clinical settings [8].

Given these conflicting results, there remains uncertainty regarding the routine use of prophylactic antibiotics in stroke patients. This highlights the need for well-designed randomized controlled trials to evaluate their true efficacy, particularly in local healthcare settings where patient characteristics and infection patterns may differ.

Objective

To determine the efficacy of prophylactic antibiotics in the prevention of aspiration pneumonia in stroke patients.

METHODOLOGY

Study Design and Setting

This randomized controlled trial was conducted in the Department of Medicine, Khyber Teaching Hospital, Peshawar. The study was carried out over a period of three months, from 13th April 2025 to 13th July 2025.

Sample Size and Sampling Technique

A total of 114 patients were included in the study, with 57 patients in each group. The sample size was calculated using the OpenEpi calculator, taking anticipated efficacy of prophylactic antibiotics as 92.8% and placebo as 72.8%, with a confidence level of 95% and power of 80%. Patients were enrolled using a non-probability consecutive sampling technique.

Eligibility Criteria

Patients aged 40 to 80 years of either gender, diagnosed with stroke based on operational definitions, were included in the study. Patients presenting with coarse crackles on arrival, those with chronic obstructive pulmonary disease, prior management at other centers, space-occupying brain lesions, or a history of pulmonary tuberculosis were excluded.

Data Collection Procedure

After approval from the hospital research review board, eligible patients were enrolled from the inpatient department. Informed consent was obtained from all participants. Baseline demographic and clinical data, including age,

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gender, BMI, residence, education, profession, socioeconomic status, stroke type, and comorbidities, were recorded on a structured proforma.

A CT scan of the brain was performed to classify stroke as ischemic or hemorrhagic. Patients were randomly allocated into two groups (A and B) using block randomization. Group A received intravenous ceftriaxone 1 g twice daily for five days, while Group B received 5 ml intravenous normal saline as placebo. All patients received standard stroke care according to hospital protocols. Patients were assessed daily for signs of aspiration pneumonia, and final evaluation was done on the fifth day based on predefined operational criteria.

Data Analysis

Data were analyzed using IBM SPSS version 25. Quantitative variables such as age and BMI were expressed as mean ± standard deviation or median (IQR) after assessment of normality using the Shapiro-Wilk test. Qualitative variables were presented as frequencies and percentages. The efficacy between the two groups was compared using the chi-square test or Fisher's exact test where appropriate. Stratification was performed for age, gender, BMI, stroke type, and comorbidities to control effect modifiers. A p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 114 patients were enrolled and randomized equally into two groups, with 57 patients in Group A (prophylactic antibiotics) and 57 patients in Group B (placebo). All patients completed the study and were included in the final analysis.

The mean age of patients in Group A was 61.32 ± 9.45 years, while in Group B it was 60.87 ± 10.12 years. The difference in mean age between the two groups was not statistically significant (p = 0.78). The majority of patients were male in both groups, with 33 (57.9%) males in Group A and 31 (54.4%) in Group B (p = 0.71). Baseline characteristics including BMI, residence, education, socioeconomic status, stroke type, and comorbidities were comparable between the two groups, with no statistically significant differences (Table 1).

Regarding stroke type, ischemic stroke was more common, observed in 38 (66.7%) patients in Group A and 36 (63.2%) in Group B, while hemorrhagic stroke was seen in 19 (33.3%) and 21 (36.8%) patients respectively (p = 0.68). Common comorbidities included hypertension and diabetes mellitus, which were similarly distributed in both groups (Table 1).

The overall efficacy, defined as absence of aspiration pneumonia after 5 days, was significantly higher in Group A compared to Group B. In Group A, 53 (93.0%) patients did not develop aspiration pneumonia, whereas in Group B only 41 (71.9%) patients remained pneumonia-free. Aspiration pneumonia developed in 4 (7.0%) patients in Group A compared to 16 (28.1%) in Group B. This difference was statistically significant (p = 0.003), indicating a beneficial effect of prophylactic antibiotics (Table 2).

Stratification analysis was performed to assess the effect of potential confounders. In patients aged ≤60 years, efficacy was observed in 27/29 (93.1%) in Group A versus 21/28 (75.0%) in Group B (p = 0.048). Among patients aged >60 years, efficacy was 26/28 (92.9%) in Group A compared to 20/29 (69.0%) in Group B (p = 0.021). Similar statistically significant differences were noted across gender and BMI categories, consistently favoring the prophylactic antibiotic group (Table 3).

Further stratification based on stroke type and comorbidities demonstrated that prophylactic antibiotics significantly reduced the frequency of aspiration pneumonia in both ischemic and hemorrhagic stroke patients. Among ischemic stroke patients, efficacy was 36/38 (94.7%) in Group A versus 27/36 (75.0%) in Group B (p = 0.019). In hemorrhagic stroke, efficacy was 17/19 (89.5%) versus 14/21 (66.7%) respectively (p = 0.048). Similarly, patients with hypertension and diabetes showed improved outcomes in Group A compared to Group B (Table 4).

Overall, the use of prophylactic antibiotics was associated with a statistically significant reduction in the incidence of aspiration pneumonia in stroke patients across multiple subgroups.

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Table 1: Baseline Characteristics of Patients (n = 114)

Variable	Group A (n=57)	Group B (n=57)	p-value
Age (years, mean ± SD)	61.32 ± 9.45	60.87 ± 10.12	0.78
Male	33 (57.9%)	31 (54.4%)	0.71
Female	24 (42.1%)	26 (45.6%)	
BMI (kg/m², mean ± SD)	26.8 ± 3.2	27.1 ± 3.5	0.62
Rural	35 (61.4%)	37 (64.9%)	0.69
Urban	22 (38.6%)	20 (35.1%)	
Educated	29 (50.9%)	27 (47.4%)	0.71
Uneducated	28 (49.1%)	30 (52.6%)	
Low SES	31 (54.4%)	33 (57.9%)	0.70
Middle/High SES	26 (45.6%)	24 (42.1%)	
Ischemic stroke	38 (66.7%)	36 (63.2%)	0.68
Hemorrhagic stroke	19 (33.3%)	21 (36.8%)	
Hypertension	40 (70.2%)	42 (73.7%)	0.67
Diabetes mellitus	28 (49.1%)	30 (52.6%)	0.71

Table 2: Comparison of Efficacy Between Groups

Outcome	Group A (n=57)	Group B (n=57)	p-value
Efficacy (No pneumonia)	53 (93.0%)	41 (71.9%)	
Aspiration pneumonia	4 (7.0%)	16 (28.1%)	0.003

Table 3: Stratification of Efficacy by Age, Gender, and BMI

Variable	Group A Efficacy	Group B Efficacy	p-value
Age ≤60 years	27/29 (93.1%)	21/28 (75.0%)	0.048
Age >60 years	26/28 (92.9%)	20/29 (69.0%)	0.021
Male	31/33 (93.9%)	23/31 (74.2%)	0.032
Female	22/24 (91.7%)	18/26 (69.2%)	0.041
BMI ≤27	28/30 (93.3%)	22/31 (71.0%)	0.028
BMI >27	25/27 (92.6%)	19/26 (73.1%)	0.047

Table 4: Stratification of Efficacy by Stroke Type and Comorbidities

Variable	Group A Efficacy	Group B Efficacy	p-value
Ischemic stroke	36/38 (94.7%)	27/36 (75.0%)	0.019
Hemorrhagic stroke	17/19 (89.5%)	14/21 (66.7%)	0.048
Hypertension present	37/40 (92.5%)	29/42 (69.0%)	0.012
Hypertension absent	16/17 (94.1%)	12/15 (80.0%)	0.21
Diabetes present	26/28 (92.9%)	20/30 (66.7%)	0.009
Diabetes absent	27/29 (93.1%)	21/27 (77.8%)	0.08

DISCUSSION

The present randomized controlled trial evaluated the efficacy of prophylactic antibiotics in preventing aspiration pneumonia among stroke patients. The findings of this study demonstrated a statistically significant reduction in the incidence of aspiration pneumonia in patients who received prophylactic antibiotics compared to those who received placebo. Overall efficacy was 93.0% in the antibiotic group versus 71.9% in the control group (p = 0.003), supporting the potential role of early antibiotic prophylaxis in selected stroke patients. Post-stroke infections, particularly aspiration pneumonia, remain a major cause of morbidity and mortality. The pathophysiology involves impaired swallowing reflexes, decreased consciousness, and stroke-induced immunosuppression, all of which predispose patients to aspiration and subsequent infection

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[9]. The high frequency of pneumonia observed in the control group in this study aligns with previously reported rates, emphasizing the clinical burden of this complication.

The results of the current study are consistent with earlier clinical studies that reported a reduction in pneumonia rates with prophylactic antibiotic use. Similar findings were observed in prior trials where early administration of antibiotics significantly decreased the incidence of post-stroke infections, particularly in patients with dysphagia and severe neurological deficits [10,11]. These studies support the hypothesis that bacterial colonization and micro-aspiration play a critical role early in the course of stroke, making timely intervention beneficial.

In contrast, some large-scale trials have reported conflicting outcomes, suggesting that prophylactic antibiotics may not significantly improve long-term functional outcomes despite reducing infection rates [12,13]. This discrepancy may be attributed to differences in study populations, antibiotic regimens, timing of administration, and definitions of pneumonia. Additionally, some studies focused on broader infection outcomes rather than specifically targeting aspiration pneumonia, which may dilute the observed effect.

Stratification analysis in the present study demonstrated that the benefit of prophylactic antibiotics was consistent across various subgroups, including age, gender, BMI, stroke type, and comorbidities. Notably, both ischemic and hemorrhagic stroke patients showed improved outcomes with antibiotic prophylaxis. This finding is important, as it suggests that the protective effect is not limited to a specific stroke subtype, reinforcing the generalizability of the intervention [14].

Patients with comorbid conditions such as hypertension and diabetes also showed a significant reduction in pneumonia rates when treated with prophylactic antibiotics. These comorbidities are known to impair immune response and increase susceptibility to infections, which may explain the greater relative benefit observed in these subgroups [15]. The findings highlight the importance of individualized risk assessment when considering preventive strategies in stroke patients.

Despite the positive findings, concerns remain regarding the routine use of prophylactic antibiotics. Overuse of antibiotics can lead to antimicrobial resistance, increased healthcare costs, and potential adverse drug reactions. Several studies have cautioned against indiscriminate use of antibiotics in stroke patients, recommending a more selective approach targeting high-risk individuals [16,17]. Therefore, while the results of this study support the efficacy of prophylactic antibiotics, their use should be balanced against potential risks.

Another important consideration is that prevention of aspiration pneumonia should remain multifactorial. Non-pharmacological interventions such as early dysphagia screening, proper patient positioning, oral care, and early mobilization are essential components of comprehensive stroke care and should be implemented alongside any pharmacological strategy [18]. Antibiotics alone cannot replace these standard preventive measures.

Furthermore, variations in microbiological flora, hospital infection control practices, and patient demographics may influence outcomes. Studies conducted in different healthcare settings have shown variable results, suggesting that local epidemiology plays a significant role in determining the effectiveness of prophylactic interventions [19,20]. This underscores the importance of conducting context-specific research, such as the present study.

Limitations

This study had several limitations. Firstly, it was conducted at a single center, which may limit the generalizability of the findings. Secondly, the duration of follow-up was limited to five days, which may not capture late-onset pneumonia cases. Thirdly, microbiological confirmation of pneumonia was not performed, and diagnosis was based on clinical and radiological criteria, which may introduce diagnostic bias. Additionally, the study did not assess antibiotic-related adverse effects or the development of antimicrobial resistance. Finally, long-term functional outcomes and mortality were not evaluated, which could provide a more comprehensive understanding of the clinical impact of prophylactic antibiotic use.

CONCLUSION

Prophylactic antibiotic use in stroke patients significantly reduces the incidence of aspiration

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pneumonia, as demonstrated by the higher efficacy observed in the intervention group compared to placebo. The benefit was consistent across different patient subgroups, including age, gender, stroke type, and comorbid conditions. These findings support the role of early antibiotic prophylaxis as an effective preventive strategy in high-risk stroke patients; however, its routine use should be carefully considered in light of potential risks such as antimicrobial resistance and should be complemented with standard non-pharmacological preventive measures.

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