Original Research Article

Synergistic effect of continuous care and cephalosporin antimicrobials in managing pulmonary infections in acute stroke patients: A comprehensive study

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Abstract

Purpose: To investigate potential benefits of continuous nursing combined with cephalosporin antibiotics in patients with acute cerebral infarction complicated by pulmonary infection.
Methods: A total of 106 patients diagnosed with acute cerebral infarction complicated by pulmonary infection were selected for this study, and admitted to The Second Affiliated Hospital of Hainan Medical University, Haikou, China from June 2020 to June 2022. Patients were randomly divided into a control group (which received conventional care and cephalosporin antibiotics, n =53), and a study group managed with sustained nursing and cephalosporin antibiotics (n = 53). The study compared various clinical parameters between two groups before and after intervention, including time of symptom relief for fever, cough, and wet rales, as well as the National Institutes of Health Stroke Scale (NIHSS), Fugl-Meyer Assessment (FMA), Barthel Index (BI), Self-Perceived Burden Scale (SPBS), Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), Acute Physiology and Chronic Health Evaluation II (APACHE II) score, and severity of pulmonary infection which was assessed by CURB 65 score.
Results: Compared with control group, study group had a significantly shorter clinical symptom relief time after intervention (p < 0.05). After intervention, NIHSS, SPBS, SAS, SDS, APACHE II, and CURB 65 scores in study group were significantly lower, whereas FMA and BI scores were significantly higher before intervention (p < 0.05).
Conclusion: Administration of nursing care and cephalosporin antibiotics reduces the time required for symptom relief, and improves neurological function in patients with acute cerebral infarction and pulmonary infections.

Keywords: Acute cerebral infarction, Pulmonary infection, Sustained nursing, Cephalosporin antibiotics

INTRODUCTION

Incidence of acute stroke in China has been progressively increasing over time, with a simultaneous reduction in the age of onset, rendering it as one of the principal fatal ailments in China [1]. Pulmonary infections are common complications following acute stroke, primarily caused by aspiration of secretions (such as saliva and food) from the oropharynx into

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bronchial and pulmonary tissues. Prolonged bed rest can lead to reduced respiratory function and capacity, as well as accumulation of sputum, resulting in difficulties in expectoration and subsequent aspiration pneumonia [1]. Patients who develop pulmonary infections after a stroke often experience rapid disease progression, leading to loss of consciousness and, in severe cases, pulmonary congestion, significantly affecting prognosis.

Cephalosporin antibiotics are widely used in clinical practice due to their potent antibacterial activity against various gram-positive, gram-negative, and anaerobic bacteria. However, identifying underlying cause of pulmonary infections in acute stroke patients is challenging, often resulting in recurrent lung infections. Therefore, continuous nursing care is essential to extend duration of clinical care and provide comprehensive rehabilitation guidance, effectively minimizing impact of pulmonary infections on patients' condition. As a result, this study aims to investigate clinical utility of continuous nursing care combined with cephalosporin antibiotics in managing acute stroke patients with concurrent pulmonary infections.

METHODS

Patients' general information

A prospective study was conducted on 106 patients with acute stroke and concurrent pulmonary infection admitted to The Second Affiliated Hospital of Hainan Medical University, Haikou, China between June 2020 and June 2022. Patients were randomly and equally assigned to a control group (n = 53) and a study group (n = 53).

Inclusion criteria

Patients diagnosed with acute stroke by imaging for first time; patients meeting the diagnostic criteria for pulmonary infection according to Diagnosis of Stroke-Associated Pneumonia published by the Stroke Pneumonia Consensus Group in 2015, with positive sputum culture [2]; conscious patients who could undergo simple scale evaluation; and patients who signed informed consent forms.

Exclusion criteria

Patients with pulmonary infection or other infectious diseases prior to stroke; sputum culture showing lung fungal infection; patients with malignant tumors, autoimmune diseases, severe liver or kidney dysfunction or moderate to severe anemia, patients who received anti-infection treatment before admission, and withdrew from study midway.

Requirement for comparative study

In the control group (n = 53), there were 32 males and 21 females, aged 40 to 71 years with a mean age of 55.72 ± 7.91 years, and the duration of illness was 16 to 36 days with a mean of 25.13 ± 4.50 days. There were 10 cases of hemorrhagic stroke and 43 cases of ischemic stroke, with 7 cases of hypertension, 9 cases of diabetes, and 6 cases of hyperlipidemia. The ratio of patients with high school education or above to those with high school education or below (including high school) was 30 : 23. In study group (n = 53), there were 33 males and 20 females, aged 42 to 70 years with a mean age of 56.15 ± 7.13 years, and duration of illness was 13 to 33 days with a mean of 24.94 ± 4.49 days. There were 12 cases of hemorrhagic stroke and 41 cases of ischemic stroke, with 10 cases of hypertension, 7 cases of diabetes, and 7 cases of hyperlipidemia. The ratio of patients with high school education or above to those with high school education or below (including high school) was 29 : 24. There were no statistically significant difference in baseline data between the two groups ($p > 0.05$). This met the requirements for comparative studies. Study was approved by the ethics committee of The Second Affiliated Hospital of Hainan Medical University (approval no. 2020LL-20200518J-004HN) and complied with the guidelines of the Helsinki Declaration.

Interventions and drug administration

The study used intravenous cefoperazone sodium injections (Pfizer Pharmaceuticals, approval no. H21021895) at a dose of 0.5 g for both control and study groups. Medication was prepared by mixing 2.0 g of the drug with 100 mL of 0.9 % saline and administered via intravenous infusion every 12 h. Control group received basic care such as closely monitoring changes in the patient's condition, reporting any abnormalities to doctor, and providing diet and respiratory care, as well as oral and skin care according to the patient's actual condition. The study group received continuous care, including the following interventions.

Psychological intervention

In order to mitigate impact of stroke and subsequent pulmonary infections on patients' psychological well-being, a comprehensive

psychological intervention protocol was implemented. This protocol involved actively engaging in compassionate and supportive communication with patients, offering psychological counseling sessions, and assisting patients in relaxation techniques to better cope with fear, anxiety, and depression.

Health education

Patients and their families were able to learn about the disease, precautions, treatment and care process through use of health manuals or health seminars.

Dietary guidance

A systematic approach was employed to guide dietary intake in patients with swallowing dysfunction. Measures included ensuring oral hygiene through mouth rinsing and expectoration prior to meals, maintaining a semi-reclining position during feeding, consumption of semi-liquid food, or nasogastric tube feeding as required. Attention was given to adhering to standardized operating procedures when administering enteral nutrition. Post-meal care involved maintaining oral hygiene, prompt removal of saliva and subglottic secretions, and ensuring effective sputum drainage.

Rehabilitation nursing and discharge guidance

Nurses were responsible for providing comprehensive rehabilitation knowledge to both patients and their families prior to discharge. This involved distributing health manuals and establishing a "patient WeChat communication group." The group served as a platform to address any questions or concerns on a weekly basis, while also conducting follow-up phone calls every three months to monitor patient's psychological, physical, and social well-being.

Evaluation of parameters/indices

Clinical symptoms

Time to clinical relief of symptoms, such as fever, cough, and wet lung sounds, was recorded in study and control groups. Prior to and following intervention, the National Institutes of Health Stroke Scale (NIHSS) [3] was used to assess the two patient groups. The NIHSS has a highest possible total score of 42, and lower scores indicate better neurological recovery. Cronbach α value was 0.875. Additionally, Fugl-Meyer assessment (FMA) [4] was used to evaluate limb motor function. The FMA has a highest possible

total score of 100, with 66 points for upper limbs and 34 points for lower limbs. Lower scores indicate poorer motor function, and Cronbach α value was 0.861. Finally, Barthel index (BI) [5] was used to assess functional ability. The BI has a highest possible total score of 100, and higher scores indicate better ability. The Cronbach α value was 0.793.

Prior to and following intervention, Self-perceived burden scale (SPBS) [6] was used to evaluate self-perceived burden in study and control groups. The SPBS has a highest possible total score of 50, and higher scores indicate a heavier self-perceived burden. The Cronbach α value was 0.804. Furthermore, Self-Rating Anxiety Scale (SAS) [7] and the Self-Rating Depression Scale (SDS) [7] was utilized to evaluate anxiety and depression, respectively. The SAS and SDS have a highest possible total score of 80, and higher scores indicate more severe anxiety and depression, respectively. The Cronbach α values were 0.853 and 0.850, respectively.

Prior to and following intervention, the Acute Physiology and Chronic Health Evaluation II (APACHE II) [8] and the CURB-65 score [9] was used to assess patients' illness in study and control groups. The APACHE II has a highest possible total score of 71, and higher scores indicate more severe illness. The Cronbach α value was 0.794. The CURB-65 score has a highest possible total score of 5, and higher scores indicate more severe lung infection. The Cronbach α value was 0.776.

Statistical analysis

Data analysis was performed using SPSS 22.0 statistical software (IBM, Armonk, NY, USA). For count data, number of cases was presented, and chi-square test was used for analysis. Metric data that followed a normal distribution, was presented as the mean ± standard deviation (mean ± SD), and independent t-test was used for intergroup differences, while paired t-test was used for intragroup differences before and after intervention. For metric data that did not follow a normal distribution, the median (P25, P7) was presented, and Mann-Whitney U test was used for analysis. $P < 0.05$ was considered statistically significant.

RESULTS

Clinical symptom relief time

Clinical symptoms such as fever, expectoration and moist rales in study group were relieved for a

shorter time after intervention ($p < 0.05$) compared to control group (Table 1).

Post intervention NIHSS, FMA and BI scores

After intervention, NIHSS scores of study and control groups were significantly lower and FMA and BI scores were significantly higher, and NIHSS scores of study group were significantly lower and FMA and BI scores were significantly higher ($p < 0.05$) (Table 2).

Post intervention SPBS, SAS and SDS scores

As shown in Table 3, after drug intervention, the scores for SPBS, SAS and SDS in study group and the control group were lower than those before intervention, and the scores in SPBS,

SAS and SDS in study group were lower ($p < 0.05$).

Post intervention APACHE II and CURB 65 scores

After intervention, APACHE II and CURB 65 scores in study and control groups were significantly lower than before intervention, but APACHE II and CURB 65 scores in the study group were also significantly lower ($p < 0.05$).

DISCUSSION

Stroke is a neurological disorder that, if left untreated, can lead to various complications. Prompt and effective treatment of these complications is crucial to preventing deterioration of patient's condition and potential fatality.

Table 1: Comparison of clinical symptom relief time between study and control groups (M ($P_{25}P_{75}$), day; n=53)

Group	Pyrexia	Expectoration	Lung moist rales
Study group	3 (3,4)	7 (6,8)	7 (6,8)
Control group	4 (4,4)	8 (7,9)	8 (8,9)
T	6.318	5.154	5.689
P-value	< 0.001	< 0.001	< 0.001

Table 2: Comparison of NIHSS, FMA and BI scores between the two groups (n=53)

Group	NIHSS		FMA		BI	
	Pre-intervention	*Post intervention*	*Pre-intervention*	*Post intervention*	*Pre-intervention*	*Post intervention*
Study	13.11± 64	4.67±0.68*	32.04±5.02	75.26±10.42*	50.51±7.31	87.15±10.89*
Control	12.39± 51	6.39±0.91*	31.72±4.97	55.17±7.91*	51.63±7.45	70.27±8.78*
T	1.439	11.023	0.330	11.180	0.781	8.785
P-value	0.153	< 0.001	0.742	< 0.001	0.437	<0.001

Note: *Before intervention, $p < 0.05$

Table 3: Comparison of SPBS, SAS and SDS scores between the two groups (n=53)

Group	SPBS		SAS		SDS	
	Pre intervention	*Post intervention*	*Pre intervention*	*Post intervention*	*Pre intervention*	*Post intervention*
Study	39.01±5.88	12.09±2.51*	59.42±8.43	15.62±2.95*	61.33±8.67	17.62±3.20*
Control	38.59±5.82	24.53±4.07*	58.93±8.37	32.58±5.07*	62.01±8.75	32.93±5.12*
T	0.370	18.940	0.300	21.049	0.402	18.460
P-value	0.712	< 0.001	0.765	< 0.001	0.689	< 0.001

Note: *Comparison with pre-intervention period, with $p < 0.05$ considered statistically significant

Table 4: Comparison of APACHE II and CURB 65 scores between the two groups (n = 53)

Group	APACHE II (min)		CURB {M($P_{25}P_{75}$), scores}	
	Pre intervention	*Post intervention*	*Pre intervention*	*Post intervention*
Study	20.18±3.52	10.15±2.27*	3 (2, 3)	1 (1, 2)*
Control	19.83±3.48	15.37±2.92*	3 (2, 3)	2 (2, 2)*
T	0.515	10.275	1.657	6.940
P-value	0.608	< 0.001	0.098	< 0.001

*$P < 0.05$ represents comparison with before intervention

Among the complications commonly observed in bedridden stroke patients, pulmonary infection is the most prevalent, characterized by symptoms such as fever, coughing, sputum production, and dyspnea [10-12]. Pulmonary infection is a leading cause of mortality in patients, often associated with impaired consciousness, dysphagia, and aspiration during meals. Empirical antibacterial treatment is typically initiated while awaiting results of microbiological examinations, which help to determine appropriate antibiotics for causative pathogen of the pulmonary infection [13]. Cephalosporins are commonly prescribed antibacterial agents in clinical practice, effective against numerous gram-positive, gram-negative, and anaerobic bacteria [14]. Despite symptomatic relief achieved through drug therapy, secondary infections may occur in the absence of an identified infectious cause. Therefore, effective nursing care during this period is critical.

Conventional nursing care primarily focuses on symptom management, potentially resulting in inadequate care. Continuous nursing care, characterized by its prolonged and comprehensive nature, is widely employed in long-term care of bedridden patients. In this research, study group demonstrated significantly shorter time to clinical symptom relief, compared to control group. Also, study exhibited lower NIHSS scores and higher FMA and BI scores than control group, consistent with findings reported by Colla *et al* [15]. These results suggest that continuous nursing care for stroke patients with concurrent pulmonary infection effectively reduces time required for symptom relief, improves neurological deficits, and enhances daily activities. This may be attributed to comprehensive guidance provided by continuous nursing care, including respiratory function exercises and limb movement exercises. Such interventions do not only help improve pulmonary infection symptoms, but also mitigates impact of infection on stroke, facilitating patient recovery and prognosis.

Stroke patients often experience sudden loss of work and daily life abilities, leading to anxiety, depression, and increased burden on their families [16,17]. Development of concurrent lung infections further exacerbates negative emotions. Therefore, in addition to medication, adjunctive nursing interventions are crucial in managing patient emotions. In this research, study group demonstrated significant improvements in SPBS, SAS, and SDS scores following intervention, consistent with findings reported by Li *et al* [18]. These results indicate that application of continuous nursing care to acute stroke patients with concurrent lung infections effectively reduces anxiety and depression, alleviates perceived burden, and enhances patient confidence in disease recovery.

Psychological interventions within continuous nursing care may improve patients' disease awareness, provide a sense of being valued by healthcare professionals, and regularly address their psychological status, thus enhancing patients' willingness to actively participate in treatment. Furthermore, after intervention, study group exhibited significant improvements in APACHE II and CURB-65 scores which are important indicators for evaluating patients' physiological health and pneumonia severity [19].

This suggests that continuous nursing care for acute stroke patients with concurrent lung infections significantly improves patients' physical status and controls progression of infection. Comprehensive nursing approach within continuous nursing care, which encompasses psychological interventions, dietary guidance, rehabilitation guidance, health education, and discharge planning, not only enhances patients' psychological well-being and treatment compliance, but also promotes relief from infection and stroke-related conditions.

Limitations of this study

The limitations of this study include the small sample size and lack of a control group receiving only nursing care without antibiotics. Also, the study did not consider potential confounding factors such as comorbidities or previous medication history. Furthermore, the study only focused on short-term outcomes and did not assess long-term effects of the intervention. Further research with larger sample sizes and longer follow-up periods is needed to validate these findings.

CONCLUSION

Continuous nursing care, in conjunction with cephalosporin antibiotics, effectively reduces time required to alleviate clinical symptoms in acute stroke patients with concurrent lung infections. It also improves neurological functional deficits, enhances daily life abilities, and effectively relieves negative emotions.

DECLARATIONS

Acknowledgements

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them. Lanqing Wu and Lirong Chen contributed equally to this work.

REFERENCES

1. Wastfelt M, Cao Y, Strom JO. Predictors of post-stroke fever and infections: a systematic review and meta-analysis. BMC Neurol 2018; 18(1): 49.
2. Smith CJ, Kishore AK, Vail A, Chamorro A, Garau J, Hopkins SJ, Di Napoli M, Kalra L, Langhorne P, Montaner J, et al. Diagnosis of stroke-associated pneumonia: Recommendations from the pneumonia in stroke consensus group. Stroke 2015; 46(8): 2335-2340.
3. Brott T, Adams HJ, 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; 20(7): 864-870.
4. Fugl-Meyer AR, Jaasko L, Leyman I, Olsson S, Steglind S. The post-stroke hemiplegic patient. 1. a method for evaluation of physical performance. Scand J Rehabil Med 1975; 7(1): 13-31.
5. Mahoney FI, Barthel DW. Functional evaluation: The Barthel index. Md State Med J 1965; 14: 61-65.
6. Cousineau N, McDowell I, Hotz S, Hebert P. Measuring chronic patients' feelings of being a burden to their caregivers: development and preliminary validation of a scale. Med Care 2003; 41(1): 110-118.
7. Dunstan DA, Scott N, Todd AK. Screening for anxiety and depression: reassessing the utility of the Zung scales. BMC Psychiatry 2017; 17(1): 329.
8. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: A severity of disease classification system. Crit Care Med 1985; 13(10): 818-829.
9. Lim WS, van der Eerden MM, Laing R, Boersma WG, Karalus N, Town GI, Lewis SA, Macfarlane JT. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. Thorax 2003; 58(5): 377-382.
10. Liu T, Wu L, Yang X, Chen Y, Du X, Luo X, Zhou J, Sui Y, Zhu W. Influence of nutritional status on prognosis of stroke patients with dysphagia. Altern Ther Health M 2022; 28(7): 26-33.
11. Lin X, Yu C, Ding H, Ma X, Guo F, Chen D, Fan Y. The study of serum C-reactive protein, serum cystatin C, and carbohydrate antigen 125 in patients with acute ischemic stroke. Cell Mol Biol 2022; 68(5): 89-95.
12. Beaudry L, Rochette A, Fortin S. Use of adapted dance to intensify subacute rehabilitation post-stroke: A qualitative study on the participation experience and active participation time. Altern Ther Health M 2022; 28(7): 40-51.
13. Lin S, Wang Q, Wang F, Shi H. Effects of aerosolized inhalation of N-acetylcysteine combined with high flow nasal cannulae oxygen therapy on inflammation, oxidative stress, and cognitive function in patients with severe pulmonary infection complicated with respiratory failure. Trop J Pharm Res 2022; 21(11):2467-2472 doi: 10.4314/tjpr.v21i11.28
14. Jordan E, Voide C, Petignat PA, Gobin N. Cephalosporins in clinical practice. Rev Med Suisse 2020; 16(710): 1906-1911.
15. Colla CH, Lewis VA, Stachowski C, Usadi B, Gottlieb DJ, Bynum J. Changes in use of post-acute care associated with accountable care organizations in hip fracture, stroke, and pneumonia hospitalized cohorts. Med Care 2019; 57(6): 444-452.
16. Huang Q, Chen Z, Yao J. Efficacy of co-administration of oxiracetam and butylphthalide in the treatment of elderly patients with hypertensive intracerebral hemorrhage, and its effect on NIHSS and ADL scores. Trop J Pharm Res 2022; 21(6):1279-1285 doi: 10.4314/tjpr.v21i6.21
17. Yang T, Cheng R, Zhang J, Tian L, Sun P, Ye X. Effect of acupuncture treatment on post-stroke depression by using diamond-like ultra-thin nano-coating technology. Cell Mol Biol 2022; 68(3): 122-130.

18. Li A, Liu Y. Reminiscence therapy serves as an optional nursing care strategy in attenuating cognitive impairment, anxiety, and depression in acute ischemic stroke patients. Irish J Med Sci 2022; 191(2): 877-884.

19. Liu Y, Lu P, Peng L, Chen J, Hu C. High-sensitivity troponin I is an indicator of poor prognosis in patients with severe COVID-19 related pneumonia. Int J Gen Med 2022; 15: 7113-7121.