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Clinical effect of antibiotic combined with fiber bronchoscope perfusion in treatment of pneumonia after severe cerebral hemorrhage

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To explore the curative effect of antibiotic combined with mucosolvan perfusion under fiber bronchoscope in treatment of pneumonia after severe cerebral hemorrhage. The clinical data of 120 patients with pneumonia after severe cerebral hemorrhage admitted to our hospital from January 2017 to December 2019 were collected. All patients were divided into the lavage group and perfusion group by random number method, with 60 patients in each group. Patients in the lavage group received antibiotics combined with mucosolvan lavage therapy under fiber bronchoscope, while patients in the perfusion group received antibiotics combined with mucosolvan perfusion therapy under fiber bronchoscope. Clinical pulmonary infection score (CPIS), arterial blood gas index, clinical symptom improvement, and hospitalization costs were compared between the two groups before and after treatment. CPIS scores were improved after treatment in both groups ($P < .05$), and CPIS scores of patients in the perfusion group were lower than those in the lavage group at 3, 5, and 7 days after treatment ($P < .05$). The blood oxygen saturation and partial arterial oxygen pressure of the perfusion group were all higher than those of the lavage group ($P < .05$), while the partial carbon dioxide pressure was lower than that of the lavage group ($P < .05$). In the perfusion group, the duration of cough, adequacy of fever, disappearance of rhonchus in the lungs, and the length of hospital stay were less than those in the lavage group ($P < .05$). The hospitalization costs of perfusion group were lower than that of lavage group ($P < .05$). The combination of antibiotics and mucosolvan infusion therapy under fiber bronchoscope can effectively improve the clinical efficacy, reduce the hospitalization cost, and improve the prognosis of patients with pneumonia after severe cerebral hemorrhage.

Abbreviations: CPIS = clinical pulmonary infection score, $PaCO_2$ = partial carbon dioxide pressure, PaO_2 = partial arterial oxygen pressure, SaO_2 = blood oxygen saturation.

Keywords: antibiotics, CPIS score, fiber bronchoscopy, mucosolvan, pneumonia, severe cerebral hemorrhage

1. Introduction

Patients with severe cerebral hemorrhage have dramatic decrease of immunity, increased intracranial pressure, severe cerebral edema, and are prone to ischemia and hypoxia in the brain. In addition, patients are in a coma, with severe disturbance of consciousness, and are prone to pulmonary infection and other complications.[1] Fiber bronchoscopy can effectively enter the nasal cavity, oral cavity, and other parts, and it can be operated under the doctor's direct vision. It is widely used in the diagnosis and treatment of respiratory system, and the addition of antibiotics can effectively control pulmonary infection and improve the bactericidal effect. Rizik et al[2] believed that fiber bronchoscope and bronchoalveolar lavage could determine the cause of pulmonary infection, effectively dredge the bronchus, and act as a safe diagnostic tool for evaluating pulmonary performance. Studies have shown that fiber bronchoscope lavage can relieve respiratory symptoms in patients, but has little effect on the control of pulmonary rales and fever.[3] Based on this, this study analyzed the clinical efficacy of antibiotics combined with mucosolvan perfusion and lavage in patients with severe cerebral hemorrhage after pneumonia.

2. Methods

2.1. Patients

The written informed consents were obtained from all the subjects and this study was approved by the Ethics Committee of Linyi Jinluo Hospital (no. AF/SC-08/02.0). Clinical data of 120 patients with pneumonia after severe cerebral hemorrhage admitted to our hospital from January 2017 to December 2019 were collected, and the patients were divided into a lavage group and a perfusion group by random number method, with 60 patients in each group. There were 37 males and 23 females in the lavage group; and they were 45 to 75 years old, with an average age of (62.34 ± 6.21). There were 35 males and 25 females in the perfusion group; and they were 45 to 74 years old, with an average age of (62.78 ± 6.19). The gender and age

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Table 1

CPIS scoring criteria.

Index	Entry	Score (points)
Body temperature (°C)	36.5–38	4
	38–38.9	1
	≥39 or ≤36	2
White blood cell count ($\times 10^9$/L)	4–11	4
	12–17	1
	<4 or >17	2
Secretions	No phlegm or occasional phlegm	0
	Often, non-purulent phlegm	1
	Often, purulent phlegm	2
Oxygenation index (mm Hg)	>240 or ARDS	0
	≤240 and no evidence of ARDS	2
X-ray infiltration	No	0
	Patchy	1
	Fused lamellar	2
Airway aspirate culture	No pathogenic bacteria grew	0
	In the presence of pathogenic bacteria growth	1
	The same bacteria were cultured twice	2

CPIS = clinical pulmonary infection score.

differences between the two groups of patients were comparable ($P > .05$). No patients died during the treatment in this study.

2.2. Inclusion and exclusion criteria

Inclusion criteria: All patients met the diagnostic criteria for pneumonia after severe cerebral hemorrhage,[4] including increased dyspnea, dry and wet rhonchus in the lungs, and body temperature over 38℃, and lung CT indicated irregular patchy high-density images in the lower part of both lungs; all patients met the criteria for bronchoscopy, including airway obstruction and persistent and recurrent pneumonia; patients or their family members agreed to the treatment in this study and participated voluntarily. *Exclusion criteria*: Patients with immunodeficiency and severe dysfunction of heart, liver, or kidney organs; patients allergic to antibiotics.

2.3. Treatments

Preoperative instructions were given to the patients and their families about procedures and risks of the operation. All patients fasted for 2 hours before surgery, and the operators followed the aseptic operation. Two groups of patients with preoperative supine or half a lie, both with propofol (1.5 mg/kg, maintain the quantity 6–8 μg/kg/h) compound vein anesthesia combined lidocaine (2–4 mL) in the bronchial mucosa surface anesthesia, carrying out intraoperative vital signs monitoring, and maintaining patients' blood oxygen saturation of no less than 95%. When the blood oxygen saturation dropped to 85% and the heart rate exceeded 120 beats/min, the operation was suspended and the ventilator was used to assist breathing. When the oxygen saturation of blood rose to 95% and the heart rate dropped to 100 beats/min, the operation was performed for no more than 20 minutes each time.

Patients in the lavage group were treated with antibiotics combined with mucosolvan lavage under fiber bronchoscope. According to the patient's airway, XZ-5 fiberoptic bronchoscope (Shanghai Yiguang Instrument Co., Ltd.) was used to reach bronchus through nasal cavity and epiglottis to observe the lesion site. Segmental lavage of normal saline at 37℃ was applied to the lesion site, and 0.5 to 1 mL/kg of normal saline was injected each time with 30 mg of mucosolvan injection plus 80 mg of tinidazole for repeated lavage. 5 to 10 mL diluted sensitive antibiotics were injected into each lesion site, and the airway fluid was sucked clean and then the bronchoscope was withdrawn. Patients in the perfusion group were treated with antibiotic combined with mucosolvan infusion under fiber bronchoscope. The use of fiber bronchoscope lavage was the same as that of the lavage group. After the secretions were sucked out, 0.2 g isoniazid + 0.4 g amikacin were applied to each lesion site.

All patients were fasted for 2 hours after surgery, and the operation was immediately stopped if abnormal vital signs appeared during the operation. According to the patient's clinical symptoms and physical condition, the treatment frequency was controlled within 1 to 3 times per week.

2.4. Testing index

1. Clinical pulmonary infection score (CPIS) was used for scoring on 3, 5, and 7 days after treatment, respectively. CPIS score[5] was shown in Table 1. The lower the CPIS score is, the more severe the pneumonia infection is.
2. Blood gas analyzer (Roche Group, Model: Omin-C) was used to detect blood gas analysis index such as fasting arterial oxygen saturation (SaO_2), arterial partial pressure of oxygen (PaO_2), and arterial partial pressure of carbon dioxide ($PaCO_2$) in the morning of 7 days before and after treatment.
3. The improvement of clinical symptoms, length of stay, and cost of stay were observed. The clinical symptoms included cough, fever, and vanishing time of rhonchus in the lungs, etc.

2.5. Statistical analysis

The data were processed by statistical software SPSS22.0 (International Business Machines, corp., Armonk, NY); enumeration data were represented by cases n and (%); measurement data were represented by ($\bar{x} \pm s$), and chi-square (χ^2) and t were used for test, respectively. $P < .05$ was considered statistically significant.

3. Results

3.1. Comparison of CPIS improvement between the two groups

CPIS score improved after treatment in both groups ($P < .05$). CPIS scores of patients in the perfusion group on 3, 5, and 7 days after treatment were all lower than those of patients in the lavage group, and the data between the two groups were statistically significant ($P < 0.05$), as shown in Table 2.

3.2. Comparison of blood gas index improvement between the two groups

The blood gas indexes of both groups were improved 7 days after treatment ($P < .05$). SaO_2 and PaO_2 of perfusion group were higher than that of perfusion group ($P < .05$); the $PaCO_2$ was lower than that of the irrigation group, and the difference between the two groups was statistically significant ($P < .05$). As shown in Table 3.

3.3. Comparison of clinical index of patients in two groups

In the perfusion group, the duration of cough, hot course, disappearance of rhonchus in the lungs, and the length of hospital stay were less than those in the lavage group ($P < .05$). The hospitalization cost of the perfusion group was lower than that of the lavage group, and the difference between the two groups was statistically significant ($P < .05$). As shown in Table 4.

Table 2

CPIS improvement of patients in two groups [n (%)].

Group	n	Before treatment	3 d after treatment	5 d after treatment	7 d after treatment
Lavage group	60	8.85 ± 1.42	6.92 ± 1.35*	5.82 ± 1.29*	4.89 ± 1.35*
Perfusion group	60	8.62 ± 1.31	6.13 ± 1.32*	5.11 ± 1.32*	3.82 ± 0.86*
χ^2	/	0.922	3.241	2.980	5.178
P	/	.358	.002	.004	.000

CPIS = clinical pulmonary infection score.
Compared with patients in this group before treatment, *$P < .05$.

Table 3

Comparison of blood gas index improvement between the two groups ($\bar{x} \pm s$).

		SaO_2 (%)		$PaCO_2$ (mm Hg)		PaO_2 (mm Hg)	
Group	n	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Lavage group	60	85.74 ± 8.37	90.36 ± 10.32*	65.23 ± 8.24	48.15 ± 9.51*	52.98 ± 9.02	69.71 ± 8.15*
Perfusion group	60	85.64 ± 10.55	96.12 ± 11.07*	66.03 ± 8.51	40.27 ± 7.25*	53.70 ± 8.38	76.28 ± 9.27*
t		0.058	2.948	0.523	5.104	0.453	4.123
P		.954	.004	.602	.000	.651	.000

$PaCO_2$ = partial carbon dioxide pressure, PaO_2 = partial arterial oxygen pressure, SaO_2 = blood oxygen saturation.
Compared with the group before treatment, *$P < .05$.

Table 4

Comparison of clinical index of patients in two groups ($\bar{x} \pm s$).

Group	n	Vanishing time of cough (d)	Adequacy of fever (d)	Vanishing time of lung rales (d)	Length of hospital stay (d)	Hospitalization cost (yuan)
Lavage group	60	8.42 ± 3.13	12.24 ± 5.21	10.43 ± 3.21	13.43 ± 1.32	4.24 ± 1.32
Perfusion group	60	6.43 ± 3.24	8.35 ± 2.42	7.21 ± 1.84	10.07 ± 2.46	5.31 ± 1.72
t	/	3.433	5.245	6.741	13.223	3.823
P	/	.001	.000	.000	.000	.000

4. Discussion

Severe cerebral hemorrhage has high mortality and disability rate, while most patients have pulmonary complications due to long-term bedridden or mechanical ventilation. Studies have shown that the complications of pneumonia after severe cerebral hemorrhage will not only prolong the length of hospitalization and increase the cost of hospitalization, but also affect the recovery of patients and even endanger the lives of patients.[6] Antibiotic drugs are often used in clinical treatment, but the effect is limited. In recent years, with the continuous improvement of medical technology, fiber bronchoscopy therapy can effectively improve the treatment effect, and combined with antibiotics can accelerate the improvement of patients' symptoms.[7] However, the effect of fiber bronchoscopy lavage therapy is different from that of fiber bronchoscopy perfusion therapy.

A total of 120 patients with pneumonia complications after severe cerebral hemorrhage were included in this study, and were divided into two groups: the lavage group and the perfusion group. The results showed a significant improvement in CPIS scores in both groups compared to pretreatment ($P < .05$), suggesting that fiber bronchoscopy can effectively improve the efficacy of pneumonia patients, which is consistent with the results of Khorvash et al.[8] CPIS is a comprehensive score for the diagnosis of pulmonary infection in terms of imaging, clinical situation, and microorganisms, which is of great significance for the treatment effect and prognosis of patients. and the diagnosis based only on clinical experience may lack objectivity. As a quantitative index, CPIS can be effectively used to evaluate the efficacy and prognosis, and has a certain role in guiding the medication.[9,10] In this study, CPIS scores of patients in the perfusion group on 3, 5, and 7 days after treatment were all lower than those in the lavage group ($P < .05$), suggesting that fiber bronchoscopy might be more effective than perfusion therapy, and could effectively alleviate the pulmonary lesions of patients. Kim et al[11] pointed out that the therapeutic effect of fiber bronchoscopy in the treatment of patients with pneumonia and atelectasis was worthy of affirmation. In patients with severe cerebral hemorrhage, massive secretions and phlegm might block the airway due to varying degrees of consciousness disorder, leading to hypoxemia, hypercapnia, and even acute respiratory failure.[12] The results of this study showed that both groups had improved blood gas indicators after the treatment ($P < .05$), SaO_2 and PaO_2 of the perfusion group were higher than that of the lavage group ($P < .05$), and partial pressure of $PaCO_2$ of the perfusion group was lower than that of the perfusion group ($P < .05$). Compared with the lavage group, the perfusion group could effectively administer drugs to the lesion site, in order to completely remove the inflammatory secretion and bloody exudate. Meanwhile, the combination of normal saline, mucosolvan, and antibiotics can effectively stimulate the cough and sputum excretion in patients, and keep the small airway open, thus improving the blood gas index[13,14] of patients.

At the same time, the use of antibiotics combined with fiber bronchoscopy combined with mucosolvan perfusion therapy could effectively improve the prognosis and outcomes of patients with severe cerebral hemorrhage. In this study, the perfusion group could effectively shorten the length of hospital stay of patients and the duration of antibiotic use, thus reducing intensive care units fine care and drug costs, and reducing

the hospitalization costs of patients. The results of this study showed that the duration of cough, hot course, disappearance of rhonchus in the lungs, and length of stay of the perfusion group were less than that of the lavage group ($P < .05$). The hospitalization cost of the perfusion group was lower than that of the lavage group ($P < .05$). It suggested that fiber bronchoscopy lavage therapy could effectively improve the respiratory symptoms of patients, but had limited effect on the clinical symptoms and body temperature. The result might be due to the rapid progression of patients with severe cerebral hemorrhage, and the severe decline in their own resistance, leading to the rapid invasion of pathogenic bacteria to other epithelial cells and a large number of proliferation.[15] Therefore, suction of secretions and airway clearance cannot effectively pose threat to the pathogen population. The associated pathogenic bacteria can persist in host cells and escape lavage, resulting in a long-term fever.[16,17] While the body temperature of patients in the perfusion group decreased to normal, indicating that the direct injection of antibiotic drugs in the lesion site by fiber bronchoscopy perfusion therapy can play a direct bactericidal and bacteriostatic role, promote the absorption of lesions, and relieve the clinical symptoms of the patients. Okachi et al[18] showed that fiber bronchoscopy perfusion therapy had no obvious complications and toxic and side effects, and was relatively safe. The results of this study suggested that fiber bronchoscopy perfusion therapy was helpful for patients with pneumonia complications after severe cerebral hemorrhage.

There were also some limitations in this study. This study had a small sample size, limited clinical study time, and no statistics on adverse reactions of patients, which would have a certain impact on the study results. The use of antibiotics of the two groups was different. Future studies with large sample randomized controls and long-term follow-up of patients after discharge are needed to obtain more accurate conclusion.

To sum up, antibiotic combined with mucosolvan perfusion under fiber bronchoscope can significantly improve the blood gas index of patients, relieve the symptoms of pulmonary infection, and thus indirectly reduce the length of hospital stay and hospitalization costs, which is conducive to the guarantee of postoperative quality of life of patients.

Author contributions

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