CLINICAL EFFICACY OF THE AUXILIARY TREATMENT OF MECHANICAL VENTILATION ON ACUTE MYOCARDIAL INFARCTION COMPLICATED WITH ACUTE PULMONARY EDEMA

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ABSTRACT

Objective: *To analyze the clinical efficacy of mechanical ventilation on acute myocardial infarction complicated with acute pulmonary edema.*

Methods: *We selected a total of 80 acute myocardial infarction patients complicated with acute pulmonary edema who were admitted to this hospital for treatment between March 2013 and March 2016. Patients were divided into the control group and observation according to their treatment methods with 40 in each group. Patients in the control group received the regular treatment plus the oxygen inhalation through nasal catheter, while those in the observation group underwent regular treatment plus the mechanical ventilation. Comparisons were carried out on the blood pressures, respiratory rate (RR), heart rate (HR), and indicators of blood-gas analysis before and after treatment, clinical efficacy and complications.*

Results: *Before treatment, comparisons of the systolic blood pressure (SBP), diastolic blood pressure (DBP), RR and HR showed that difference had no statistical significance ($p>0.05$); after treatment, RRs and HRs of patients in the observation group were significantly lower than those in the control group ($p<0.05$), but no statistical significance was identified in differences of SBP and DBP between two groups ($p>0.05$). Before treatment, we found no statistical significance in differences of levels of PaO_2, $PaCO_2$, HCO_3- and SaO_2 between two groups ($p>0.05$), but after treatment, levels of PaO_2 and SaO_2 in the observation group remained higher than those in the control group, while the levels of PaCP2 was still lower than those in the control group ($p<0.05$); after treatment, comparison of the level of HCO_3- between two groups revealed no statistically significant difference ($p>0.05$). Clinical efficacy of patients in the observation group was superior to that of the control group ($p<0.05$), and the incidence rate of complications in the observation group was lower than that in the control group ($p<0.05$).*

Conclusion: *Mechanical ventilation shows promising efficacy and safety in treatment of acute myocardial infarction patients with acute pulmonary edema.*

Keywords: *Myocardial infarction, pulmonary edema, mechanical ventilation, outcome of treatment.*

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Introduction

Acute myocardial infarction complicated with pulmonary edema usually leads to a critical condition and a high mortality rate, and regular medication can scarcely receive any satisfactory results[1, 2]. Mechanical ventilation, as a life-support method, shows promising effect conducive to improving the survival rate of patients with myocardial infarction[3].

So far, there remain few studies reporting the efficacy of mechanical ventilation on acute myocardial infarction complicated with acute pulmonary edema. Thus, this study aimed to analyze the clinical efficacy of mechanical ventilation on the acute myocardial infarction complicated with acute pulmonary edema, and detail information of this study is reported as follows.

Data and methods

General data

We selected a total of 80 acute myocardial infarction patients complicated with acute pulmonary edema who were admitted to this hospital for treatment between March 2013 and March 2016 according to the following inclusion criteria:

a) diagnosis of patients conforming to the diagnostic criteria of acute myocardial infarction in Diagnosis and Treatment Guidelines of Cardiovascular Disease;

b) patients with acute onset of accelerated respiratory rate, cough and inspiratory crackles;

c) patients with hypoxemia;

d) pulmonary X-ray examination revealed exudative lesions in double lungs;

e) patients with APACHE II score >30 points;

f) patients with informed consents of this study. According to the treatment strategy, patients were divided into two groups, i.e. the control group and the observation group with 40 in each group. In the control group, there were 20 males and 20 females aged between 47 and 88 years with an average of (65.3±18.0) years; as for infarction site, there were 18 with extensive anterior myocardial infarction, 11 with anterior + high lateral myocardial infarction, 7 with anterior myocardial infarction, and 4 with inferior myocardial infarction; for cardiac functional grading, there were 22 patients in Grade III and 18 in Grade IV. In the observation group, there were 23 males and 17 females aged between 48 and 88 years with an average of (68.1 ±15.6) years; as for infarction site, there were 19 with extensive anterior myocardial infarction, 10 with anterior + high lateral myocardial infarction, 8 with anterior myocardial infarction, and 3 with inferior myocardial infarction; for cardiac functional grading, there were 21 patients in Grade III and 10 in Grade IV. Comparisons of distributions of age, sex, infarction site and cardiac function grades showed that these data were comparable between two groups.

Methods

Patients in the control group received the regular treatment plus the oxygen inhalation through nasal catheter, while those in the observation group underwent regular treatment plus the mechanical ventilation with BIRD vela non-invasive respirator (Carefusion, USA) and auxiliary electrothermal humidifier.

Two-way ventilation through nasal mask was performed with following settings of parameters: inspiration pressure, 1.5-2.0 kPa; expiration pressure, 0.4-0.7 kPa; fraction of inspire oxygen, 0.28-0.35 kPa. This treatment was applied until the dyspnea was alleviated effectively, followed by intermittent application for 3 days, or 5 days in case of critical condition. During mechanical ventilation, access of patients to food and water should be guided by physicians.

Observation indexes

Before and after treatment, we compared the blood pressures, including systolic blood pressure (SBP) and diastolic blood pressure (DBP), respiratory rate (RR), heart rate (HR), PaO^2, $PaCO^2$, HCO_3- and SaO_2 once every one or two hours of patients in two groups; complications, including cardiac shock, malignant arrhythmia and death, were also recorded.

Criteria of clinical efficacy

Excellent: Disappearance of moist crackles in lungs; normal levels of HR, blood-gas indicators and SaO_2.

Effective: Partial disappearance or reduction of moist crackles in lungs; HR < 100/min; normal blood-gas indicators; SaO_2 > 95%.

Ineffective: Partial disappearance or reduction of moist crackles in lungs; abnormal HR, blood-gas indicators and SaO^2[(4)].

Statistical methods

SPSS 20.0 software was used for data analysis. Measurement data were expressed as mean ± standard deviation ($\bar{x}$±s), and two-independent sample t test and paired t test were applied for intergroup comparison and intragroup comparison, respectively. Chi-square test was used for enumeration data, and Ridit analysis for count data. $p<0.05$ suggested that the difference had statistical significance.

Results

Comparisons of blood pressures, RR and HR before and after treatment between two groups

Before treatment, comparisons of SBP, DBP, RR and HR of patients between two groups showed that differences had no statistical significance ($p>0.05$); RR and HR of patients in the observation group were significantly lower than those in the control group, and the difference had statistical significance ($p<0.05$). However, differences in SBP and DBP of patients between two groups revealed no statistical significance ($p>0.05$; Table 1).

Comparison of the blood-gas indicators before and after treatment between two groups

Before treatment, comparisons of PaO_2, $PaCO_2$, HCO_3- and SaO_2 between two groups

Group	Case (n)	SBP (kPa)		DBP (kPa)		RR (beat/min)		HR (beat/min)	
		Before	After	Before	After	Before	After	Before	After
Control	40	16.2±2.7	15.8±1.9	9.6±1.7	9.4±1.3	29.9±11.0	24.3±4.1^{a}	97.7±19.8	92.0±5.6^{a}
Observation	40	16.3±2.7	16.0±2.0	9.6±1.6	9.1±1.5	29.7±10.4	18.3±3.1^{a}	98.1±20.5	82.2±5.3^{a}
t		0.15	0.21	0.12	0.25	0.24	5.04	0.3	4.28
p		>0.05	>0.05	>0.05	>0.05	>0.05	<0.05	>0.05	<0.05

Table 1: Comparisons of blood pressures, RR and HR before and after treatment between two groups ($\bar{x}$±s).
Note: $^{a}p<0.05$ vs. levels before treatment; SBP, systolic blood pressure; DBP, diastolic blood pressure; RR, respiratory rate; HR, heart rate

showed that differences had no statistical significance (p>0.05); after treatment, levels of PaO_2 and SaO_2 in the observation group were significantly higher than those in the control group, but the level of $PaCO_2$ was lower than that in the control group, and the differences had statistical significance (p<0.05). After treatment, no statistically significant difference was found in comparison of the level of HCO_3- between two groups (p>0.05; Table 2).

Group	Case (n)	PaO_2 (kPa)		SaO_2 (kPa)		HCO_3- (mmol/L)		SaO_2 (%)	
		Before	After	Before	After	Before	After	Before	After
Control	40	9.1±1.7	10.1±0.9a	4.9±0.7	5.4±0.6^{a}	25.2±5.1	23.1±3.1^{a}	91.0±14.0	90.7±3.9^{a}
Observation	40	9.0±1.6	12.4±0.9a	4.8±0.7	5.0±0.5^{a}	24.2±5.5	23.2±3.2^{a}	90.5±13.2	95.8±2.9^{a}
t		0.17	2.35	0.08	3.74	0.26	0.25	0.2	3.72
p		>0.05	<0.05	>0.05	<0.05	>0.05	<0.05	>0.05	<0.05

Table 2: Comparison of the blood-gas indicators before and after treatment between two groups ($\bar{x}$±s).
Note: $^{a}p<0.05$ vs. levels before treatment; PaO_2, oxygen partial pressure; $PaCO_2$, partial pressure of carbon dioxide; HCO_3-, bicarbonate radical; SaO_2, oxygen saturation

Comparison of clinical efficacy between two groups

Clinical efficacy of patients in the observation group was superior to that of the control group, and the difference had statistical significance (u=3.14, p<0.05; Table 3).

Group	Case (n)	Excellent	Effective	Ineffective
Control	40	6	23	11
Observation	40	10	27	3

Table 3: Comparison of the clinical efficacy between two groups (n).

Complications of patients in two groups

Incidence rate of complications of patients in the observation group was significantly lower than that of the control group, and the difference had statistical significance (χ^2=11.14, p<0.05; Table 4).

Group	Case (n)	Cardiac shock	Malignant arrhythmia	Death	Total
Control	40	1 (2.5)	1 (2.5)	1 (2.5)	3 (7.5)
Observation	40	1 (2.5)	0	0	1 (2.5)

Table 4: Comparison of the incidence rate of complications between two groups [n (%)].

Discussion

Acute myocardial infarction complicated with acute pulmonary edema, a critical disease in clinical practice, usually threatens the life of patients, and any errors in treatment would lead to death(4). It is clinically manifested by cardiac failure and a rapid but magnificent reduction in stroke volume, which usually result in a significant increase in DBP, blocked circulation in heart and lung, increase in pressure inside the capillary of lungs; under such a circumstance, the permeability of capillary is enhanced, leading to the effusion of plasma, and further acute pulmonary edema(5, 6).

Mechanical ventilation through nasal mask is a group of non-invasive methods, in which bi-directional positive airway pressure (BiPAP) refers to a continuous positive airway pressure with a large inspiratory pressure and a small expiratory pressure. BiPAP can effectively avoid the trachea cannula and tracheotomy, which is conducive to the reduction in incidence rate of mechanical ventilation-associated complications, use of palliatives and nursing workload; in addition, swallowing function, cough and defense of upper airway are effectively reserved, so as to decrease the incidence rate of mechanical ventilation-related pneumonia; thus it is suitable for the patients with clear consciousness(7-9).

Results of this study revealed that clinical efficacy of the observation group was superior to that of the control group; after treatment, RR, HR and PaCO2 were lower than those in the control group, while PaO_2 and SaO_2 were higher; these results showed that mechanical ventilation has a evident efficacy on acute myocardial infarction complicated with acute pulmonary edema through improving the cardiac function, pulmonary edema and hypoxemia, and further ameliorating the prognosis of patients.

In 1950s, researchers had focused on the changes in cardiac functions caused by mechanical ventilation: During mechanical ventilation, pressures in airway and cardiac chamber also alter, which affect the pre- and afterload of left and right heart; alterations in cardiac functions during mechanical ventilation are also affected by the fundamental physiological status. In recent years, immunological indicators, and bedside non-invasive monitoring of cardiac function provide physicians with new method to discover the changes in cardiac functions during mechanical ventilation for treatment of acute myocardial infarction complicated with acute pulmonary edema(10-12).

It also reminds of us that for acute myocardial infarction complicated with acute pulmonary edema, mechanical ventilation, despite of the promising clinical efficacy, may also affect the recovery of patients in case of inappropriate use. Thus, clear consciousness, stable autonomous respiration and little sputum are necessary for patients during treatment of mechanical ventilation. Special caution should be given for patients complicated with cardiac shock or severe arrhythmia. In mechanical ventilation, it should be also guaranteed that the nasal mask should be suitable for the patients, so as to avoid excessive gas leakage, ineffective ventilation, or incidence of hypoxemia.

In conclusion, mechanical ventilation shows promising efficacy and safety in clinical treatment of acute myocardial infarction complicated with acute pulmonary edema. Thus, it is worthy of being promoted in clinical practice.

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