Effect of sputum suction in three different positions on oxygenation index and SPO2 recovery in elderly patients after cardiac surgery

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Abstract: Objective: to explore the effect of sputum aspiration in three different positions on oxygenation index and SPO2 recovery in elderly patients after cardiac surgery methods: 60 elderly patients who needed sputum aspiration after cardiac surgery were randomly divided into group I (n = 20), group II (n = 20) and group III (n = 20). The patients in group I were in the supine position for sputum aspiration, while those in group II were in the lateral decubitus position. In group III, the head of the bed was raised by 15°–30° during sputum aspiration, and the patients were in the position of lying on the side and with their heads tilted back later. The negative pressure of-35 kPa ~-40 kPa was used for sputum aspiration for three days, during which the changes of oxygenation index and SPO2 recovery in each group were observed. Results After sputum aspiration in the three postures, the oxygenation was improved, and the oxygenation index was increased to different extents. In group III (15°–30° posture), the oxygenation index was increased more after sputum aspiration, which indicated that the oxygenation was more adequate. As the oxygen supply was affected to different extents during sputum aspiration, the recovery of SPO2 from the three kinds of sputum aspiration was affected. However, in group III, the recovery time of SPO2 was the shortest, which was significantly shorter than that in group I and group II, and there was a very significant difference between the groups ($P < 0.01$). Conclusion: The oxygenation index and SPO2 recovery of elderly patients after cardiac surgery are obviously affected by the position of sputum suction. To take the position of raising the head of the bed by 15°–30° during sputum suction, taking the lateral decubitus and tilting the head back is better for the patients, which has a positive significance in reducing the complications of sputum suction and the adverse consequences.

1. Introduction

Routine sputum aspiration requires temporary interruption of ventilator treatment for patients undergoing mechanical ventilation assisted breathing, and hypoxia is the most likely to occur. The mild ones show increased heart rate, while the severe ones show decreased blood pressure or arrhythmia. For patients with pre-existing pulmonary hypertension, pulmonary vascular crisis may occur, resulting in cardiac arrest, which directly endangers the life of patients. There are reports that patients undergoing open heart surgery may die suddenly from sputum aspiration after surgery [1–2]. In clinical work, it has been found that SPO2 (percutaneous oxygen saturation) will be significantly decreased in elderly patients after routine sputum aspiration after cardiac surgery, and it will take a long time to recover.

In order to prevent hypoxemia and heart rate changes caused by sputum aspiration and reduce the risk to the minimum, 60 patients who underwent mechanical assisted breathing after open heart surgery in our hospital from January 2019 to December 2020 were compared between groups using the method of inter-group control and the changes of heart rate were recorded to observe the effects of three different sputum aspiration methods on blood oxygen and heart rate of patients after cardiac surgery, in order to find a safer and more effective method for clinical application.

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2. Materials and methods

2.1. General information

A total of 60 patients were treated with ventilator-assisted ventilation in ICU after open heart surgery under cardiopulmonary bypass. There were 45 males and 15 females, and they were aged from 50 to 75 years old, with the average age of (59±2.6) years old. Among them, there were 14 cases of mitral stenosis, 20 cases of mitral stenosis and insufficiency, 18 years of mitral stenosis and tricuspid insufficiency, and 12 cases of aortic stenosis and insufficiency. They were divided into three groups on average. The lung function measured before surgery was about the same, and they were sent to ICU for mechanical ventilation immediately after surgery. T-test showed no significant differences in general information between the three groups (P> 0.05), indicating that they were comparable.

2.2. Method

After admission, all cases included in the study were given routine measures such as thrombolysis, anti-infection, phlegm reduction, and nutritional support treatment, and scheduled back clapping to promote sputum discharge. Sputum was suctioned under negative pressure of-35 kPa ~-40 kPa. Before the start of sputum suction check instrument without damage, and connect the negative pressure device, adjust the negative pressure parameters, after connecting pipe try to suck normal saline, etc., the equipment debugging is completed. The sputum suction tube was inserted into the oropharynx by the right hand, and the insertion process was kept gentle and slow, so that the left hand relaxed the pressing at the folded part at the end of the catheter after reaching the pharynx. After the secretion at the oropharynx was sucked out, the sputum suction tube was replaced by this operation. The left hand continued to press the fold at the end of the new replacement catheter. When the patient was in the inspiratory phase, the insertion catheter was conveniently inserted into the trachea, about 13cm. Afterwards, the left hand released the press at the fold of the catheter to start sputum suction. During the sputum suction, the catheter was rotated left and right and the catheter was gradually lifted from bottom to top. After the sputum was sucked completely, the sputum suction tube and other related equipment were removed.

All the sputum suction operations were performed by the researchers in the research group, and all of them were familiar with the sputum suction methods in three different positions involved in this study. The sputum aspiration procedures of patients in three groups were the same, but they adopted different sputum aspiration positions, which were as follows: Group I: In the supine position; Group II: lateral decubitus positioning; In Group III, the head of the bed was firstly raised by 15°–30°, and the patient lay on his/her side and kept his/her head tilted back later.

2.3. Evaluation standard of sputum suction effect index

Before and after the implementation of each oxygen supply method (basic value), the reducing amplitude of SPO2 (reducing amplitude after sputum suction); The stable value of SPO2 after sputum aspiration (stable value after sputum aspiration); The time for SPO2 to return to the basic level before sputum aspiration (recovery time) and the time for SPO2 to reach a stable value after sputum aspiration (time to reach a stable value) after sputum aspiration were recorded.

2.4. Statistical method

The data of each group is expressed by $\bar{x} \pm s$, and the analysis of variance is used for comparison between groups. P< 0. 05 was the difference with statistical significance.

3. Result

After sputum aspiration in the three positions, the oxygenation was improved and the oxygenation index was increased to different extents. In group III (15°–30° position), the oxygenation index was increased more after sputum aspiration, indicating that oxygenation was

more adequate. As the oxygen supply was affected to different degrees during sputum aspiration, the recovery of the three kinds of sputum aspiration SPO2 were all affected. However, in group III, the recovery time of SPO2 was the shortest, significantly shorter than that of group I and group II. There was a very significant difference between the groups ($P < 0.01$, see Table 1).

Table 1 Effects of different postures on SPO2, recovery time and oxygenation index ($\bar{x} \pm s$)

Group □	Recovery time(min)	Oxygenation index(AI)		
		Before sputum suction	After sputum suction,	Δ AI
Group I	2.36±0.27**	233.62±0.02	247.63±0.11◆	13.24±0.04◆
Group II	2.07±0.38	234.07±0.07	245.75±0.06**▼▼	15.69±0.05**▼▼
Group III	1.25±0.31▼▼	235.09±0.01	265.31±0.05	27.58±0.06

Note: "* *" means that group I is compared with group II, $p < 0.01$; "◆〞 means that the comparison between group I and group III is $p < 0.05$; "▼ ▼" means that the comparison between group II and group III is $p < 0.01$.

4. Discussion

The respiratory state of most patients undergoing cardiopulmonary bypass is unstable after cardiac surgery, especially the increase in lung secretion after cardiopulmonary bypass. In addition, because the artificial respiration machine may lead to lung infection, the sputum volume of patients will be greatly increased. To clean the respiratory tract by sputum suction is an important measure to improve lung ventilation and maintain cardiac function [3–4]. Even patients who maintain spontaneous breathing disturb their respiratory function due to sputum aspiration, which leads to hypoxia in patients with decreased arterial partial pressure of oxygen and increased heart rate. Particularly in critical patients, the more obvious effect of sputum aspiration on respiratory function is more appropriate to cause myocardial hypoxia, arrhythmia and even cardiac arrest. [5] It has been reported that patients undergoing open heart surgery may die suddenly due to sputum aspiration in the trachea after the surgery. Therefore, continuous oxygen inhalation during sputum aspiration is of great significance for the stability of patients after cardiac surgery, in that it can effectively prevent the hypoxemia induced by sputum aspiration and the changes of heart rate.

This study showed that sputum aspiration in three different positions could significantly increase SPO2 before and after sputum aspiration ($P < 0.01$ and $P<0.001$), thus increasing the oxygen reserve before sputum aspiration and quickly compensating for the hypoxia state during sputum aspiration, thus significantly reducing the amplitude of SPO2 decline and recovery time after sputum aspiration compared with the conventional method (all $P<0.001$), and effectively preventing hypoxemia caused by sputum aspiration. In this study, the optimal sputum aspiration position was to raise the bed head by 15°–30° as adopted in Group III, and the patient lay on his/her side while keeping his/her head tilted back. The lower tongue root of the body tilted to one side under the influence of gravity, which was conducive to opening the throat and facilitating the insertion of sputum aspiration tube. Moreover, the stimulation to the pharynx and trachea was correspondingly reduced, which was conducive to the complete aspiration of sputum [6–7]. This position could not be achieved in either the supine or lateral position. It was conducive to the short-term recovery and long-term efficacy of the patient. Correct and effective sputum aspiration can clear the secretions in the respiratory tract, improve ventilation, and ensure the adequate oxygen supply of patients, which is beneficial to the continuity of mechanical courage and the maintenance of good oxygenation.

Literature [8] has revealed that a controlled high pressure, mechanical ventilation with long inspiratory time and controlled lung expansion ventilation could not cause barotrauma, make alveolar with different compliance fully and uniformly expand, and significantly improve oxygenation. The maximum value was reached 10min after SI application, and the effect could be maintained for more than 4h without offline. It can also avoid the formation of shearing force due to the repeated opening and closing of alveolar space, thus reducing the lung injury caused by

mechanical ventilation. The results of this study showed that SPO2 could be significantly increased by using a single controlled lung expansion combined with increasing inhaled oxygen concentration before and after sputum aspiration, that is, firstly elevating the head of the bed by 15°–30° and lying on the side of the patient's head while keeping the head tilted back. In a state of no hypoxia, the anxiety and other emotions of the patient would naturally decrease, and the heart rate would be relatively stable, which played a great role in the stability of the patient's condition. The self-control blood gas result and heart rate change record clinically applied to 60 patient after cardiac surgery show that compared with other common sputum suction methods, that SPO2 can be remarkably improve, the arrhythmia can be reduced, and the heart rate is relatively stable, thereby effectively preventing the hypoxemia and the heart function change induced by sputum suction, greatly improving the safety of sputum suction operation, and being suitable for critical patients with abundant phlegm and thick and difficult to suck out.

5. Conclusions

In brief, the head of the bed was elevated 15° to 30 °, with the patient lying laterally and keeping the head flat at a later time is a better suctioning body position, which can help to improve the degree of tolerance of suctioning after cardiac surgery in advanced age patients, and can maintain the plateau of vital signs during the process, and can quickly improve the hypoxemia of patients after the operation, which has a positive effect on reducing suctioning complications and reducing the occurrence of adverse outcomes, and is worth promoting the suctioning operation body position.

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