The effect of Acapella trainer on respiratory function of patients after thoracoscopic lung cancer surgery

Xinxin Lu | Yan Qiang

Department of Critical Care Medicine, Jiangsu Cancer Hospital, Jiangsu Institute of Cancer Research, Nanjing Medical University Affiliated Cancer Hospital, Nanjing, China

Correspondence
Yan Qiang, Department of Critical Care Medicine, Jiangsu Cancer Hospital, Jiangsu Institute of Cancer Research, Nanjing Medical University Affiliated Cancer Hospital, Nanjing, China.
Email: 1149895732@qq.com

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Abstract
Objective: To investigate the effect of Acapella training on respiratory function in patients undergoing video-assisted thoracic surgery (VATS).

Methods: A total of 60 patients undergoing VATS surgery for lung cancer in the department of thoracic Surgery of our hospital from August 2018 to February 2019 were selected as study subjects, and were divided into observation group (n = 30) and control group (n = 30) according to the random number table method. The control group received routine pulmonary rehabilitation exercise after surgery, and the patients in the observation group received postoperative respiratory function exercise with Acapella therapeutic apparatus on the basis of the control group. Respiratory function, including forced vital capacity (FVC), forced expiratory capacity in the first second (FEV1), peak expiratory flow (PEF), and length of hospital stay, were observed and compared between the two groups before and after using Acapella trainer.

Results: There was no significant difference in FEV1, FVC, and PEF between the two groups before treatment with Acapella (P >.05), the difference between the above indicators after treatment and before treatment was statistically significant (P <.05); After Acapella treatment, FEV1, FVC, and PEF were significantly different between the two groups (P = .04, P = .047, P = .047). The postoperative hospital stay in the experimental group was shorter than that in the control group, and the difference was statistically significant (P = .028).

Conclusion: Acapella trainer can improve patients’ respiratory function and shorten postoperative hospital stay.

KEYWORDS
Acapella, lung cancer, respiratory function, thoracoscopy

1 | INTRODUCTION

Lung cancer ranks the first in malignant tumor incidence and cause of death. The treatment methods of lung cancer include surgery, immunotherapy, and targeted therapy. At present, there are thoracoscopic surgery and open surgery. With the improvement of surgical instruments and surgical techniques, thoracoscopic surgery has become the main surgical method. Video-assisted thoracic surgery (VATS) provides a new method and means for the diagnosis and treatment of chest diseases, which has the advantages of less trauma and faster...
recovery, and is increasingly widely used in clinical practice. However, postoperative complications such as pulmonary infection and atelectasis often occur. Postoperative sputum retention and weakened respiratory muscle strength are the major contributing factors to the high incidence of postoperative respiratory complications in patients with lung cancer. There is no doubt that rapid and effective clearance of respiratory secretions and scientific and correct respiratory training have positive effects on the prevention of pulmonary complications after lung cancer surgery. Acapella is a new type of vibration positive pressure expiratory device, which has the effect of promoting sputum excretion and opening the airway, and has certain curative effect in the treatment of senile chronic obstructive pulmonary disease. In this study, Acapella trainer was used to train the respiratory function of patients, and good results were achieved. It is reported as follows:

2 METHODS

A total of 60 lung cancer surgery patients admitted to the department of thoracic surgery of our hospital from August 2018 to February 2019 were selected. Inclusion criteria: (1) Patients aged 18 to 80 years; (2) Patients with lung cancer who have undergone preoperation of pneumonectomy; (3) Preoperative airway protection ability such as cough and sputum; (4) No positive expiratory pressure (PEP) contraindications; (5) Informed consent to this study and voluntary participation in this study. Exclusion criteria: (1) Combined with other site trauma or surgery; (2) Patients who have undergone pneumonectomy beforehand; (3) Poor coordination or in a coma; (4) Complicated with upper gastrointestinal bleeding; (5) Severe hypoxemia or acidosis. Criteria for shedding in this study and voluntary participation in this study. Exclusion criteria: (1) Combined with other site trauma or surgery; (2) Patients who have undergone pneumonectomy beforehand; (3) Poor coordination or in a coma; (4) Complicated with upper gastrointestinal bleeding; (5) Severe hypoxemia or acidosis. Criteria for shedding in this study and voluntary participation in this study.

2.1 Control group

Routine nursing: (1) preoperative preparation for surgery. The day before the operation, the nurse instructed the patients to learn the methods of deep breathing and effective expectoration, and carried out health education. (2) On the day of operation, perform operative cooperation; (3) After the operation, the patient’s condition was observed well. The responsible nurse provided oral care, turning over, oxygen inhalation, and atomization inhalation according to the patient’s condition. Meanwhile, routine pulmonary rehabilitation exercises such as stair climbing, pursed lip breathing, balloon blowing, and effective cough training were also performed. During the training, oxygen saturation instrument was used to monitor the patient’s vital signs in real time, and the frequency was maintained at twice a day.

2.2 Observation group

Besides giving more than conventional nursing care and rehabilitation exercise in patients with preoperative namely to Acapella training instrument (Acapella Smith, by the United States Medical ASD company) the use of training, the responsibility of nurses to patients before operation and mission using Acapella training instrument reason, work principle and use method, daily to the patient and the situation of the effective cough in detail, the succession to guide and urged patients postoperative effectively use Acapella training apparatus. The detailed method is as follows: (1) Adjust the frequency and set the frequency and resistance of Acapella device to the minimum value; (2) Hold the bite with the mouth, to ensure the sealing of the device, if necessary, can be added with a nose clip; (3) Instruct the patient to relax the diaphragmatic muscle breathing, ensure that the inhaled air volume is slightly larger than the normal tidal volume, hold it for 2 to 3 seconds after inhalation, promote the establishment of positive airway pressure, open collateral ventilation, and thus induce collapsed alveolus to reopen and form PEP; Instruct the patient to ventilate to the residual function with the device, gradually adjust the frequency dial, and adjust the inspiratory/expiratory ratio to 1:3 to 1:4, lasting 10 to 20 breaths; Remove the breathing device to ensure that the patient has 2 to 3 effective coughs; The training method should be used 3 to 4 times a day, each time lasting 15 to 20 minutes. After the patient gradually ADAPTS to the device, the initial resistance can be adjusted to 4 to 5 gear.

| Group          | Case (n) | Gender | Age  | BMI  | Operation time (hour) |
|----------------|----------|--------|------|------|-----------------------|
| Control group  | 30       | Man    | 4    | 59.3 ± 1.92 | 22.28 ± 2.21 | 2.44 ± 0.54 |
|                |          | Woman  | 16   |      |                       |            |
| Observation group | 30     | Man    | 7    | 60.4 ± 1.64 | 22.87 ± 2.40 | 2.47 ± 0.38 |
|                |          | Woman  | 13   |      |                       |            |

Table 1 General information of patients

| Statistic | χ² = 0.601 | t = 2.030 | t = 0.985 | t = −0.293 |
|-----------|------------|-----------|-----------|------------|
| P         | .438       | .174      | .329      | .77        |
2.3 | Observation indicators

The respiratory function and postoperative hospital stay of the two groups were compared before and 30 days after operation. Respiratory function was determined according to the lung function indicators before and after intervention, including FVC, FEV1, and PEF.

2.4 | Statistical analysis

The SPSS 22.0 software was used for statistical analysis. Measurement data such as respiratory function and postoperative hospital stay were represented by (x ± s), and comparison between groups was performed by T test. The difference was statistically significant (P <.05).

3 | RESULT

There were no statistically significant differences in lung function FVC, FEV1 and PEF between the two groups at admission (P <.05). The differences in the above indicators were statistically significant between the two groups at 30 days after surgery and at admission (P <.05). The differences of FEV1, FVC, and PEF between the two groups after Acapella treatment were statistically significant (P = .04, P = .047, P = .047), as shown in Table 2.

4 | DISCUSSION

Thoracoscopic surgery has the advantages of fewer complications, less trauma and faster recovery, such as less chest muscle injury, no rib distraction, preservation of thoracic integrity, and no injury to intercostal nerves and muscles. Compared with traditional Thoracic surgery, thoracoscopic minimally invasive surgery significantly reduces the trauma. However, postoperative patients may also experience massive retention of airway secretions due to incision pain and difficulty in deep breathing, thus affecting respiratory function and causing pulmonary related complications. Therefore, it is of great significance to improve postoperative respiratory function to reduce complications and improve prognosis of patients.

The purpose of respiratory training therapy is to establish a correct breathing pattern, increase diaphragm activity, improve alveolar ventilation, reduce energy consumption during breathing, improve postoperative respiratory motor function, and shorten hospitalization time of lung cancer patients. Acapella trainer, as a positive pressure vibration sputum drainage device, can effectively help patients to solve the airway obstruction and facilitate the reconstruction of normal breathing pattern.

In this study, 60 patients with thoracoscopic lung cancer received respiratory function training with Acapella trainer in our hospital, and the results showed that the patients who received Acapella trainer scored higher in various indicators of respiratory function and had a shorter hospital stay than those who received routine care. This indicates that the use of Acapella trainers after thoracoscopic lung cancer surgery can improve patients' respiratory function, shorten the length of hospital stay, and reduce medical costs.

In summary, Acapella trainer can improve the respiratory function of patients after thoracoscopic lung cancer surgery. However, this study is a single-center randomized controlled trial, which has some deficiencies. The selected sample size is small, the observation time is short, and the long-term impact of the patients is not observed, which can be verified by multi-center large sample study later.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

Xinxin Lu performed the experiment and wrote the manuscript; Yan Qiang designed the experiment and modified the manuscript.

ETHICS STATEMENT

The study was approved by the Jiangsu Cancer Hospital Ethics Committee and all patients gave written informed consent.

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| TABLE 2 | Comparison of respiratory function and length of hospital stay between the two groups |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Group           | n   | FVC   | FEV1  | PEF   | FVC   | FEV1  | PEF   | Hospital stay |
| Observation group | 30  | 2.79 ± 0.64 | 2.69 ± 0.71 | 5.06 ± 1.40 | 3.06 ± 0.64 | 3.06 ± 0.72 | 5.46 ± 1.39 | 12.07 ± 3.48 |
| Control group   | 30  | 2.64 ± 0.53 | 2.59 ± 0.68 | 4.57 ± 1.50 | 2.75 ± 0.53 | 2.69 ± 0.69 | 4.71 ± 1.48 | 15.37 ± 7.16 |
| t               | 1.03 | 0.56  | 1.32  | 2.06 | 2.02  | 2.03  | .04   | .028          |
| P               | .31  | .58   | .19   | .04  | .047  | .047  | .028   |               |
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