Observational Study

A randomized study on the effect of sequential acupoint stimulation on pulmonary function of patients with spontaneous pneumothorax during VATS perioperative period

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Abstract

This study aims to explore the effect of sequential acupoint stimulation on the postoperative pulmonary function of patients with spontaneous pneumothorax who underwent video-assisted thoracoscopic surgery (VATS).

Using a random number table, the patients were randomly divided into 2 groups: routine nursing group and sequential acupoint stimulation group. Patients in the routine nursing group received standard nursing care of thoracic surgery, while patients in the acupoint group received sequential acupoint stimulation on Shenshu (BL23), Gaohuang (BL43), Feishu (BL13), and Tiantu (CV22). Then, the maximal ventilatory volume (MVV), oxygen saturation (SpO_2), postoperative drainage volume, postoperative drainage time, postoperative hospitalization days, and procalcitonin (PCT) were observed on the first, third, fifth and 30th day after VATS operation.

On the fifth day after spontaneous pneumothorax was treated with VATS, MVV, and SpO_2 of the sequential acupoint stimulation group were significantly higher than those of the routine nursing group ($P < .05$). On both the third day and fifth day after VATS, PCT of the sequential acupoint stimulation group was significantly lower than that of the routine nursing group ($P < .01$). Furthermore, the difference in postoperative drainage volume between the 2 groups was not statistically significant ($P > .05$), while chest tube drainage time ($P < .01$) and postoperative hospitalization days ($P < .05$) of the sequential acupoint stimulation group were significantly lower than those of the routine nursing group.

In spontaneous pneumothorax patients who underwent VATS, sequential acupoint stimulation nursing was significantly more effective than routine postoperative nursing in promoting postoperative recovery of lung function, alleviating inflammatory response and shortening hospitalization days.

Abbreviations: MVV = maximal ventilatory volume, PCT = Procalcitonin, SP = Spontaneous pneumothorax, SpO_2 = oxygen saturation, VATS = video-assisted thoracoscopic surgery.

Keywords: MVV, PCT, sequential acupoint stimulation nursing, spontaneous pneumothorax, video-assisted thoracic surgery

1. Introduction

Spontaneous pneumothorax (SP) refers to the visceral pleura ruptures or bulla near the surface of the lung ruptures in the absence of trauma or human factors, in which air goes into the pleural cavity and causes the pathological state of pleural pneumatosis. According to differences in its causes, SP can be divided into 2 types: primary and secondary types. Some patients with mild symptoms can be cured by conservative treatment. However, approximately 20% of patients still need to be operated due to the persistence of the disease.[1] Video-assisted thoracoscopic surgery (VATS) is the most commonly used surgical method for the treatment of SP.[2,3] Thoracic surgery would inevitably cause injury to the tissues and organs in the thoracic cavity. In addition, patients lack guidance for preoperative breathing training, postoperative respiratory dysfunction, pulmonary infection and other complications that can easily occur, which can affect the effect of the operation,[4,5] and accordingly have bad effects on the lung function of patients. Traditional perioperative nursing measures, such as respiratory tract management, disease observation, and assisting sputum excretion, have made great progress in the postoperative recovery of SP patients.[6] However, these cannot meet the concept of rapid postoperative recovery. It has been pointed out in traditional Chinese medicine that acupoints are the sites of the body where the qi from the meridians and viscera is infused to the body surface, thereby stimulating certain acupoints that can regulate the viscera, qi and blood through the meridians and collaterals, and accordingly activate the resistance to disease in the body.[7–9] According to this theory, the investigators summarized that the Tiantu (CV22) acupoint, Xinshu (BL15) acupoint, Feishu (BL13), asthma (pant) acupoint, Gaohuang (BL43), Pishu (BL20) acupoint, and Shenshu (BL23) acupoint are the acupoints that have good clinical effects in the recovery of pulmonary

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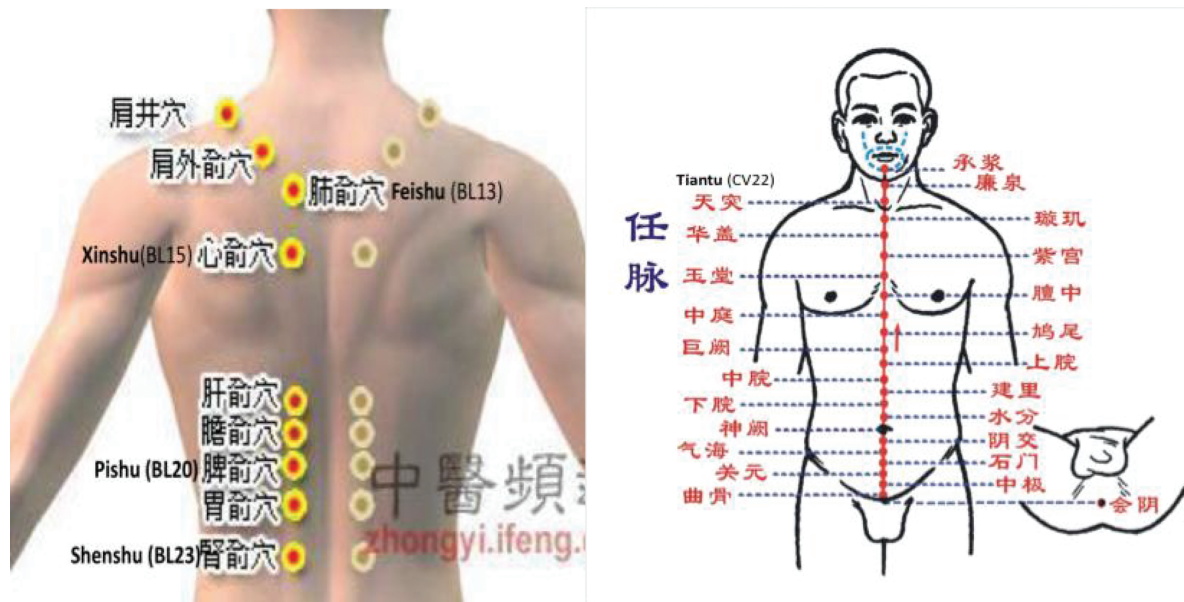
Figure 1. The acupoint diagram. The acupoints, Shenshu (BL23), Gaohuang (BL43), Feishu (BL13) and Tiantu (CV22), were marked in the figure.

function after thoracic surgery,[10–13] and accordingly proposed the sequential acupoint stimulation method, which is a new perioperative nursing program. The effect of this method on the perioperative recovery of pulmonary function of SP patients is reported as follows.

2. Materials and methods

This study was conducted in accordance with the Declaration of Helsinki. This study was conducted with approval from the Institutional Review Board and Ethics Committee of Tianjin Fifth Central Hospital. Written informed consent was obtained from all participants.

2.1. General information
2.1.1. Subjects. From January 2012 to June 2016, 398 SP patients treated by VATS in the Department of Thoracic surgery of our hospital were enrolled in our study. The sample size was calculated based on previous data of MVV and SpO$_2$ of the 2 nursing methods after VAST, and with the following the parameters: $\alpha = 0.05$, $1 - \beta = 0$, $\Delta = 0.2$, ratio of patient number of the 2 groups were set as 1:1. The calculated sample size of each group was 43 and 70, respectively, based on previous data of MVV or S$_P$O$_2$. Therefore, the 398 patients were enough for our study.

The patients were all native Chinese people. We used SPSS 16.0 software to randomize the patients. First, each patient was given a number within the range of 1 to 398 and the numbers were typed into SPSS. Next, the "Random number generators" function was chosen, then the "Rv.Uniform" function was used to compute the random numbers for each patient. At last, we used "Select cases" to randomly assign the patients into 2 groups, which were the conventional nursing group and the sequential acupoint stimulation group.

2.1.2. Observation indexes. The major observation indexes included the maximal ventilatory volume (MVV), oxygen saturation (SpO$_2$), postoperative drainage volume, postoperative drainage time, postoperative hospitalization days and procalcitonin (PCT).

2.1.3. Statistical analysis. Data were processed using the SPSS 16.0 software, and statistically analyzed using t-test. All results were expressed as mean ± standard deviation ($x \pm$ SD). $P < .05$ was considered statistically significant.

2.2. Research methods

For patients in the sequential acupoint stimulation group, in the early postoperative period, nurses in the Department of Thoracic Surgery helped these patients to arrange the sputum excretion and instructed these patients to carry out breathing exercises according to the above-mentioned program: according to the location of the acupoints marked by the thoracic surgery doctors, in the order of dorsal-chest and bottom-up, and along a line 5 cm apart from the spine, the Shenshu (BL23) acupoint was first stimulated, which was heavily hit by empty palms, thereby allowing air in the empty palm to impact the acupoints. The Gaohuang (BL43) and Feishu acupoints (BL13) were the key. Next, the Tiantu (CV22) acupoint was pressed with the index finger 5 times, and 20 actions were completed in each round. Then, lung function was detected 30 minutes later, and blood SpO$_2$ and PCT were detected at the same time. Patients in the control group received routine nursing care of thoracic surgery.

The Acupoint diagram was seen in Figure 1.[14] The process of the study is depicted in Figure 2.

3. Results

3.1. General information of the patients

The sequential acupoint stimulation group, comprised of 148 male patients and 52 female patients, the age of these patients ranged within 18–57 years old, with an average age of 24.35 years old; conventional nursing group, comprised of 152 male patients and 46 female patients, the age of these patients ranged within 16–61 years old, with an average age of 25.23 years old. The gender composition and average age did not differ significantly between the 2 groups ($P > .05$).
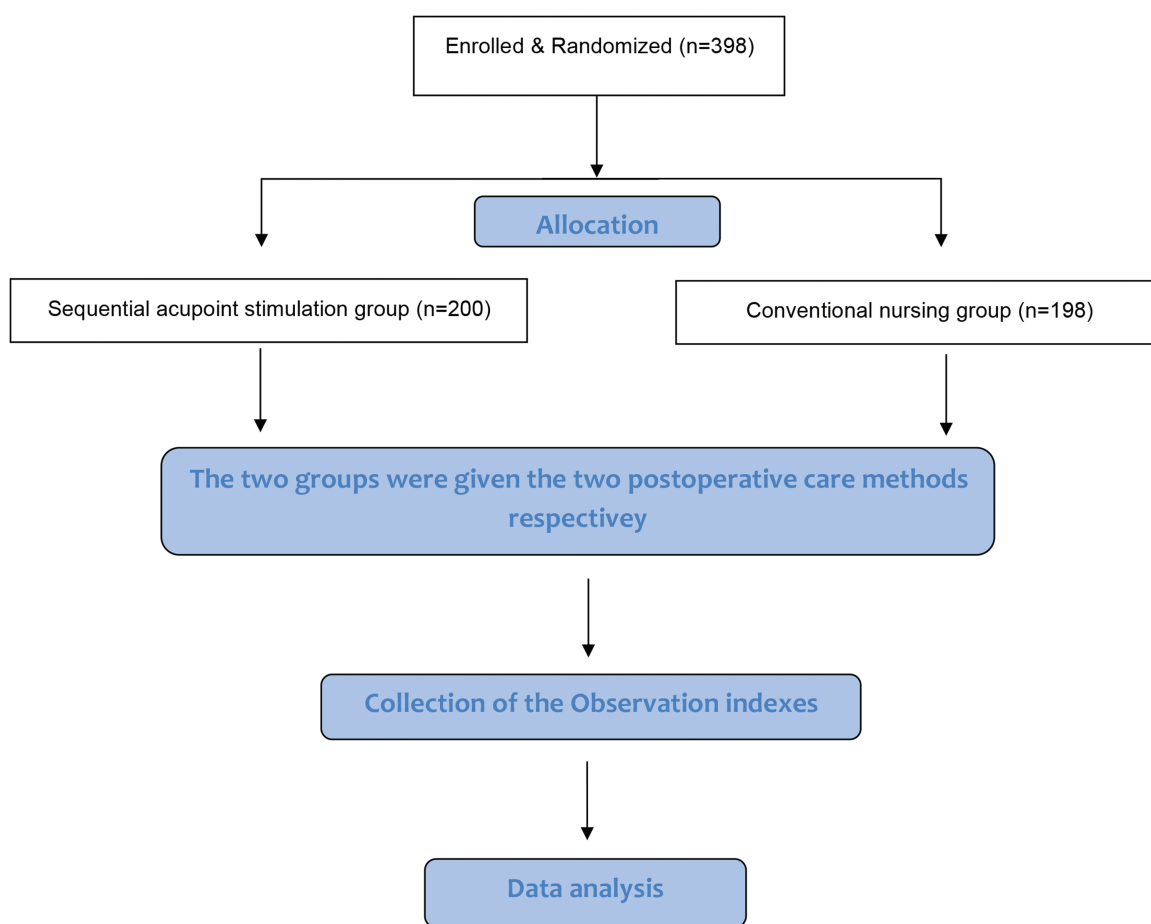
Figure 2. Flow chart of the study. Subjects were first randomized, and then the 2 groups received the 2 different postoperative care methods respectively, and the data were collected. At last, the data were analyzed.

3.2. After VATS was performed to treat SP, the effect of the sequential acupoint stimulation nursing and routine nursing on the pulmonary function of patients were observed and compared.

On the first, third, fifth and 30th day after the day when VATS operation was performed and different nursing methods were used to assist patients in sputum excretion, the MVV in patients was measured using a MSA99 pulmonary function detector. In addition, the SpO_2 in patients was determined using an oximeter. The patients were instructed to return to the hospital for reexamination of pulmonary function on the 30th day after the operation (Table 1). The results revealed that on the fifth day after

VATS treatment for SP, the difference in levels of MVV and SPO_2 between the sequential acupoint stimulation group and routine nursing group were statistically significant ($P < .05$).

3.3. After VATS was performed to treat SP, the clinical indexes of patients in the sequential acupoint stimulation group and routine nursing group were observed.

After VATS was performed to treat SP, different nursing methods were used to assist patients in the sputum excretion and guide patients in training for respiratory function. Differences in chest tube drainage time and the postoperative length of hospital stay between the routine nursing group and sequential

Table 1

The influence of different nursing methods after VAST on the lung function.

Postoperative days	Routine nursing		The sequential acupoint stimulation nursing	
	MVV (%)	S_PO_2 (%)	MVV (%)	S_PO_2 (%)
1	41.12±4.41	92.78±3.11	40.37±4.17	92.07±3.31
3	43.23±4.12	93.03±3.67	43.89±4.67	93.87±3.33
5	56.77±5.11	94.79±3.42	59.78±5.23[*]	96.52±3.76[*]
30	86.92±8.24	97.01±3.89	85.67±7.88	97.56±3.65

Number of patients for the Routine nursing group and the Sequential acupoint stimulation nursing were 198 and 200, respectively.

Data were expressed as mean ± standard deviation (x ± SD) and analyzed using t-test.

[*] $P < .05$.

Table 2

Comparison of clinical indexes between different nursing methods after VATS.

	Routine nursing	The sequential acupoint stimulation nursing	*t* value	P value
Postoperative drainage volume, ml	266.75±175.12	259.96±176.62	0.3851	>0.05
Postoperative drainage time, d	3.69±0.68	3.03±1.10**	7.2075	<0.01
Postoperative length of hospital stay, d	6.48±1.29	5.29±1.39*	8.8504	<0.05

Number of patients for the routine nursing group and the sequential acupoint stimulation nursing were 198 and 200, respectively.
Data were expressed as mean ± standard deviation ($x \pm$ SD) and analyzed using *t*-test.
* $P < .05$.
** $P < .01$.

acupoint stimulation group were statistically significant ($P < .05$, Table 2).

3.4. After VATS was performed to treat SP, the PCT value of patients in the sequential acupoint stimulation group and routine nursing group were compared.

On the first, third, fifth and 30th day after the VATS operation, 2 mL of peripheral venous blood was withdrawn from each patient, and the level of PCT was determined using enzyme-linked immunosorbent assay (ELISA, Table 3). The results revealed that after VATS treatment for SP, the reduction in PCT level in the sequential acupoint stimulation group was more significant. On the third day and the fifth day post VATS operation, the difference in PCT level was statistically significant, when compared with the routine nursing group ($P < .001$).

4. Discussion

SP is one of the most common diseases in clinical practice, and is also the most common emergency in thoracic surgery.[15] Surgical treatment remains one of the main treatment methods. In the present study, in addition to strictly mastering basic nursing skills and paying attention to individualized nursing and treatment, the investigators took the unique theories and concepts of traditional Chinese medicine into account, and adopted the self-created nursing method for pulmonary function recovery during the perioperative period. That is, the sequential acupoint stimulation method was used to help the patient recover their pulmonary function after the operation. The results of the present study revealed that the following: In the present study, on the first and third day after operation, damage to pulmonary function was the most serious. However, since different nursing methods were used for sputum excretion after the operation, on the fifth day after the operation, in terms of the MVV and SpO$_2$ levels in patients, the differences between the sequential acupoint

stimulation group and routine nursing group were statistically significant. The result suggests that the sequential acupoint stimulation method is superior to the routine nursing method. The pulmonary function of patients was re-examined on the 30th day after the operation. At this time point, the differences in the levels of MVV and SPO2 between the 2 groups were not statistically significant. The results of the present study were consistent with the results reported in previous literatures.[16] Due to similar surgical procedures, that is, VATS, was used to treat SP, the difference in postoperative drainage volume between the sequential acupoint stimulation group and routine nursing group was not statistically significant. However, patients in the sequential acupoint stimulation group adopted the nursing method of tapping the corresponding acupuncture points to discharge sputum, in order to promote the excretion of inflammation. Therefore, the placement time of the drainage tube was shortened. Hence, the difference in postoperative drainage time between the sequential acupoint stimulation group and routine nursing group was statistically significant. In addition, since the thoracic drainage tube was removed from these patients, they could be discharged from the hospital after recruitment maneuver, as suggested by the chest x-ray examination and the discontinuation of antibiotics. Thus, the postoperative length of hospital stay of patients was greatly shortened. Hence, the difference in discharge time between the sequential acupoint stimulation group and the routine nursing group was statistically significant. During the surgery, trauma to the patient was inevitable, and the inflammatory response of the body was also inevitable. PCT is an acute inflammatory reaction protein and marker, which has a dual role in the occurrence and development of inflammatory reaction and in stimulating the production of inflammatory mediators.[17,18] When the body is infected, it can be vigorously produced, and has an early diagnostic role for many infectious diseases. Due to its high specificity and sensitivity,[19] it is mainly used for the early evaluation of postoperative inflammatory complications. In the

Table 3

Comparison of PCT between different nursing methods after VAST ($\bar{x} \pm s$, ng/mL).

Groups	Postoperative days of nursing, d			
	1	3	5	30
Routine nursing	0.409±0.061	0.369±0.045	0.139±0.020	0.041±0.006
The sequential acupoint stimulation nursing	0.415±0.062	0.277±0.041**	0.042±0.008**	0.040±0.008
T	0.9731	21.3235	63.4081	4.1349
p	>0.05	<0.01	<0.01	>0.05

Number of patients for the routine nursing group and the sequential acupoint stimulation nursing were 198 and 200, respectively.
Data were expressed as mean ± standard deviation ($x \pm$ SD) and analyzed using *t*-test.
** $P < .01$.

present study, on the first day after VATS treatment for SP, the PCT level was approximately 10 times of that of the normal level. This may have been induced by the surgical trauma or inflammatory reaction of the wound sites. However, since different modes of nursing were applied after the operation, sequential acupoint stimulation nursing could promote the excretion of inflammation. On the third day and fifth day post-operation, the reduction in PCT level in patients in the sequential acupoint stimulation group was more significant. The difference in PCT level was statistically significant, when compared with the routine nursing group.

We did not do follow-ups after 30 days of the operation, therefore we did not know whether the sequential acupoint stimulation could prevent the recurrence of spontaneous pneumothorax. In our future studies, we will follow-up these patients, and more results may be obtained. The treatment of meridian acupuncture points is a method that has been handed down from thousands of traditional Chinese medicine, The meridians and acupoints were not actually dissected. But the independent approach to treatment outside Western medicine has been proven to be effective for thousands of years, Lack of basic research data that Western medicine can understand, It is a traditional of Chinese Medicine clinical experience. Size of power used is Patients can tolerate it, there is no uniform strength standard. This is the limitation and shortcoming of the study.

In conclusion, results from the current study revealed that in spontaneous pneumothorax patients who underwent VATS, sequential acupoint stimulation nursing was significantly more effective than routine postoperative nursing in promoting postoperative recovery of lung function, alleviating inflammatory response and shortening hospitalization days. Therefore, sequential acupoint stimulation is a potential effective method for patients with pneumothorax and undergo VATS.

Acknowledgments

Author contributions

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