Original Article
Nursing postoperative lung cancer patients using continuous positive airway pressure treatment

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Abstract: Objective: This study aimed to investigate the nursing of postoperative lung cancer patients treated with continuous positive airway pressure (CPAP). Methods: A total of 64 lung cancer patients in our hospital were recruited as the study cohort and randomly divided into a CPAP group and a control group. The patients in the CPAP group (n=30) were administered CPAP, while those in the control group (n=34) were given routine low flow oxygen inhalation, a respiratory stimulant, a bronchodilator, antibiotics, antitussives, anti-inflammatories (glucocorticoids), an apophlegmatisant (ambroxol), basic nutritional support, correcting acidosis, etc. Results: The patients in the CPAP group showed a more significant improvement in their blood gas analysis, and they also had better airway patency and secretion cleaning effects compared with those in the control group. One month after the treatment, the patients in the CPAP group had significantly less inappetence, weight loss, electrolyte disturbance, dyspnea, and pulmonary encephalopathy than the patients in the control group. One week after the treatment, the patients in the CPAP group had higher maximum ventilatory volumes (MVV), higher maximum mid-expiratory flows (MMF), higher forced expiratory volumes in 1s/forced vital capacity (FEV1/FVC), higher peak expiratory flows (PEF), and higher total lung capacity (TLC) than the patients in the control group. Conclusion: CPAP can significantly improve postoperative dyspnea in lung cancer patients.

Keywords: CPAP, non-invasive ventilator, lung cancer

Introduction
Lung cancer is a common malignant tumor, which is mainly treated surgically, mostly unilateral lobectomy, accompanied by radiotherapy and chemotherapy [1]. From a microscopic point of view, lung cancer patients have increasing alveolar elastic resistance, which impedes their breathing. Consequently, their alveoli gradually undergo atrophy or form bullae over time [2]. In particular, elderly patients with other underlying diseases may encounter the major problem of surgical tolerance when they also have lung cancer [3]. Due to lung tissue loss after surgery, there is also the problem of respiratory failure, which is a postoperative complication of lung cancer surgery [4]. Therefore, the postoperative care for lung cancer patients is extremely important, and previous efforts may be wasted if it is done carelessly [5]. Clinically, we usually provide symptomatic treatment for postoperative lung cancer patients, including low-flow oxygen inhalation, respiratory stimulants, bronchodilators, antibiotics, antitussives, anti-inflammatories (glucocorticoids), apophlegmatisant (ambroxol) [6], basic nutritional support, correcting acidosis, etc. [7].

Among the abovementioned methods, oxygen inhalation is the first option [8]. Ventilators are of two types: invasive and non-invasive. The former has a variety of complications, including airway injury, bleeding, hemolysis, secondary infections, neurological complications, limb necrosis, gas embolism, patients’ intolerance, aspiration, etc., while the latter is more commonly used and is also more widely accepted by patients [9]. Therefore, this study mainly discusses the nursing of and the matters needing attention in postoperative lung cancer patients treated with continuous positive airway pres-
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**Table 1.** Comparison of the patients’ general clinical data between the two groups (x ± s)/n (%)

<table>
<thead>
<tr>
<th>General clinical data</th>
<th>CPAP group (n=30)</th>
<th>Control group (n=34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Female</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Average age (years)</td>
<td>79.55 ± 5</td>
<td>74.93 ± 6</td>
</tr>
<tr>
<td>Smoking history (years)</td>
<td>9.55 ± 2.36</td>
<td>8.27 ± 2.11</td>
</tr>
<tr>
<td>COPD course (years)</td>
<td>10.35 ± 3.15</td>
<td>11.25 ± 4.21</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Squamous carcinoma</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Adenosquamous carcinoma</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Small-cell carcinoma</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

**Figure 1.** Comparison of the PaCO₂ and PaO₂ between the two groups before and at 2, 4, 6, 8, 10, 12, 14, and 16 hours after treatment. The PaCO₂ levels decreased gradually in the CPAP and control groups, but it decreased more faster and greater in the CPAP group than in the control group (P<0.05, A); The PaO₂ levels increased gradually in both groups, but the PaO₂ levels in the CPAP group increased faster and finally increased more than they did in the control group (P<0.05, B).

Materials and methods

**General materials**

Sixty-four lung cancer patients admitted to our hospital from February 2019 to August 2020 were recruited as the study cohort and randomly divided into the CPAP group and the control group. The patients in the CPAP group (n=30) were administered CPAP, and the patients in the control group (n=34) were given routine low flow oxygen inhalation, respiratory stimulants, bronchodilators, antibiotics, antitussives, anti-inflammatories (glucocorticoids), apophlegmatisants (ambroxol), basic nutritional support, correcting acidosis, etc. This study was approved by the Ethics Committee of the First People’s Hospital of Wenling.

Inclusion criteria: (1) patients who were diagnosed with lung cancer through pathology; (2) patients from whom an informed consent form was obtained; (3) patients who did not undergo radiotherapy or chemotherapy because they could not tolerate the side effects; and (4) patients over 70 years old.

Exclusion criteria: (1) patients who were emotionally unstable and unable to cooperate with the treatment; (2) patients with cardiovascular dysfunction, acute cerebrovascular events or a history of mental illness; (3) patients with respiratory obstruction or facial deformities who were unable to inhale oxygen effectively or wear a mask; and (4) patients with severe liver or renal insufficiency.

**Methods**

The patients in the control group received routine low-flow oxygen inhalation, respiratory stimulants, bronchodilators, antibiotics, antitussives, anti-inflammatories (glucocorticoids), apophlegmatisants (ambroxol), basic nutritional support, correcting acidosis, etc.

In addition to the treatments administered in the control group, the patients in the CPAP group were given CPAP with a nasal mask or face mask. The vital signs of all patients were closely monitored throughout the process, and the respiratory parameters of CPAP were adjusted promptly if any problems occurred.

**Statistical analysis**

SPSS software was used for the statistical analysis. The measurement data were expressed as the mean ± standard deviation (X ± SD). One-way analyses of variance (ANOVA) were used to analyze the differences between
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groups (≥ 3 groups), and t-tests were used for the comparisons between two groups. \( P < 0.05 \) was considered statistically significant.

**Results**

**Comparison of the general clinical indices between the two groups**

There were no significant differences in terms of the general clinical indices of the patients including gender, average age, smoking history, or COPD history between the two groups (\( P > 0.05 \), Table 1).

**Comparison of the improvement in the blood gas analyses between the two groups**

The \( \text{PaCO}_2 \) levels decreased gradually in the CPAP and control groups; however, they decreased faster and greater in the CPAP group (\( P < 0.05 \)). In addition, the \( \text{PaO}_2 \) levels increased gradually in both groups, but the CPAP group showed a faster and greater increase of \( \text{PaO}_2 \) than the control group (\( P < 0.05 \), Figure 1).

**Comparison of the airway patency and secretion cleaning effects between the two groups**

Figure 2A-C refers to the number of patients presenting marked effective, effective, and ineffective outcomes in each group, respectively. Both groups showed a growing number of patients with a marked effect, while the CPAP group had a faster and greater increase than the control group (\( P < 0.05 \)). The effective number in the two groups fluctuated with time, and there was no significant upward or downward trend, but the vertical coordinate height in the CPAP group was generally higher than it was in the control group (\( P < 0.05 \)). The number of ineffective outcome patients decreased gradually in both groups, but the CPAP group showed a greater speed and extent of the decrease (\( P < 0.05 \), Figure 2).

**Comparison of the symptoms after 1 month between the two groups**

After 1 month, the number of patients with inappetence, weight loss, electrolyte disturbance, dyspnea, and pulmonary encephalopathy in the CPAP group was significantly less than it was in the control group, and the differ-
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Inappetence | Experimental group | Control group
--- | --- | ---
Loss of weight
Electrolyte disturbance
Breathing difficulties
Pulmonary encephalopathy

Figure 3. Comparison of the symptoms between the two groups after 1 month. After 1 month, there were fewer patients in the CPAP group who experienced symptoms of inappetence, weight loss, electrolyte disturbance, dyspnea, or pulmonary encephalopathy compared to the patients in the control group, and the difference was statistically significant ($P<0.05$).

Comparison of maximum ventilatory volumes (MVV), maximum mid-expiratory flows (MMF), forced expiratory volume ins 1s/forced vital capacity (FEV1/FVC), peak expiratory flows (PEF) and total lung capacities (TLC) at 1 week after the treatment between the two groups

There were no significant differences in the MVV, MMF, FEV1/FVC, PEF or TLC levels before the oxygen inhalation between the two groups ($P>0.05$). However, at 1 week after the treatment, the patients in the CPAP group had significantly higher MVV, MMF, FEV1/FVC, PEF and TLC than those in the control group ($P<0.05$, Figure 4).

Discussion

Lung cancer is a common malignant tumor, and smoking is the main culprit [10]. At present, surgery is still the main treatment method for lung cancer patients, accompanied by radiotherapy and chemotherapy [11]. Thoracotomy was commonly used in the past, but now it has been less and less utilized in clinical practice because of its multiple complications and great trauma. Instead, thoroscopic lobectomy has attracted more attention [12]. However, with any type of surgery, there is a risk of damage to the respiratory muscles, making the normal alveoli with a small amount lose even more [13]. Therefore, patients may also have a lot of complications, such as severe trauma, patients intolerance, late extubation, etc. [16]. Hopefully, the emergence of non-invasive ventilators is of great significance, as they make up for the disadvantages of invasive ventilators [17]. Moreover, non-invasive ventilators are also easy to learn due to their simple and convenient operating modes, thus contributing to their more and more frequent application in various clinical respiratory diseases such as chronic bronchitis, COPD, lung cancer, lung transplantation, etc. [18, 19].

In this study, CPAP (a non-invasive respiratory aid device) was used in lung cancer patients after surgery to treat postoperative respiratory insufficiency, alveolar atrophy, and even respiratory failure [20]. The results proved that patients treated with CPAP had a better improvement of their blood gas analyses, airway patency, and secretion cleaning effects. After 1 month, the number of patients with inappetence, weight loss, electrolyte disturbance, dyspnea, and pulmonary encephalopathy in the CPAP group was significantly less than it was in the control group. At 1 week after treatment, the MVV, MMF, FEV1/FVC, PEF and TLC in the CPAP group were significantly higher than they were in the control group. There are various connections among these indicators, with consistent logic and a correlated direction. The indices of blood gas analysis (namely $\text{PaCO}_2$ and $\text{PaO}_2$), MVV, MMF, FEV1/FVC, PEF and TLC all directly reflect that CPAP can better...
The effect of continuous positive airway pressure improve the postoperative respiratory ventilation of lung cancer patients, that is to say, CPAP can facilitate the patients breathing more smoothly [21]. Therefore, more patients in the CPAP group did show marked effective and effective outcomes in the CPAP group when we evaluated the effectiveness of CPAP, that is, more patients were more efficient and had better airway patency. As a result, the CPAP group had fewer patients with inappetence, weight loss, electrolyte disturbance, dyspnea and pulmonary encephalopathy than the control group after 1 month.

However, the non-invasive ventilator also has shortcomings. For example, it is prone to air leakage, and the patients’ airway secretions cannot be completely drained due to the simplicity of the device. These issues have not yet been resolved [22-24].

This study demonstrated the huge benefits of non-invasive ventilator CPAPs for postoperative lung cancer patients, but there are still many limitations, such as the small sample size, the limited geographical location, no separate comparison of the invasive ventilator and the non-invasive ventilator, etc. The application of CPAP in postoperative lung cancer patients remains to be further explored [25].

Disclosure of conflict of interest

None.

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