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Assessing the Impact of General Anesthesia and Bronchial Intubation in Conjunction with Thoracic Paravertebral Nerve Block on Cellular Immunity and Surgical Management in Tuberculous Pyothorax Patients

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Abstract: *Objective:* This study aims to investigate the impact of combining general anesthesia with bronchial intubation and thoracic paravertebral nerve block during surgery for patients with tuberculous pyothorax. *Methods:* Eighty patients diagnosed with tuberculous pyothorax, admitted to the hospital between January 2023 and September 2023, were randomly selected for this study. The patients were divided into control and study groups using a numerical table method. The control group underwent general anesthesia with bronchial intubation, while the study group received general anesthesia with bronchial intubation in conjunction with thoracic paravertebral nerve block. Subsequently, the patients were monitored to assess mean arterial pressure, heart rate variations, and adverse reactions to anesthesia. *Results:* The study group exhibited significantly lower mean arterial pressure and heart rate levels during the post-surgical incision, immediate end of surgery, and immediate extubation periods compared to the control group ($P < 0.05$). Furthermore, the Ricker and Ramsay scores in the study group were significantly lower than those in the control group ($P < 0.05$). *Conclusion:* The combined use of general anesthesia via bronchial intubation and thoracic paravertebral nerve block has been found to stabilize mean arterial pressure and heart rate while providing effective sedation for surgical treatment in patients with tuberculous septic thorax.

Keywords: General anesthesia and bronchial intubation; Thoracic paravertebral nerve block; Tuberculous pyothorax; Surgical treatment effect

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1. Introduction

Tuberculous empyema is a common form of tuberculosis, and surgical treatment is a conventional approach to eliminate the lesions. Since the surgical procedure involves multiple operations, appropriate anesthetic interventions are necessary to ensure the success of the surgery [1,2]. The onset of tuberculosis empyema is gradual, and patients typically exhibit symptoms such as low-grade fever and chest pain. As the disease

progresses, it can give rise to complications such as pleural fistula and scoliosis [3], significantly impacting the patient's quality of life. Pleural fiber stripping represents a common surgical approach for treating tuberculous empyema, effectively eliminating the pus cavity and fostering the restoration of thoracic elasticity and lung function. However, individuals with tuberculosis empyema often present with compromised cardiopulmonary function [4,5]. This type of surgery is primarily conducted through double-lumen bronchial intubation and single-lung ventilation, involving a high level of stimulation. Consequently, the demands for anesthesia management are elevated. General anesthesia via bronchial intubation is a traditional anesthetic method that can provide analgesia and sedation [6]. However, the dosage of analgesic drugs was high, resulting in a pronounced postoperative stress response and significant pain, along with an increased occurrence of postoperative complications and poor anesthesia effectiveness [7]. Recently, ultrasound techniques have been progressively incorporated into surgical anesthesia. Studies have demonstrated the efficacy of ultrasound-guided thoracic paravertebral nerve blocks. Studies conducted in recent years indicate that bronchial intubation under general anesthesia, combined with thoracic paravertebral nerve block, can improve sedation, reduce surgical stress reactions, prevent abnormal fluctuations in vital signs, and enhance safety [8].

2. General information and methodology

2.1. General information

Eighty cases of patients with tuberculous pyothorax, admitted to the hospital between January 2023 and September 2023, were randomly selected for this study. The patients were then divided into two groups: the control group and the study group, each comprising 40 cases. The numerical table method was used to divide the patients into two groups. The control group consisted of 27 males and 13 females, with ages ranging from 22 to 65 years old and an average age of 44.8 ± 3.34 years old. The study group consisted of 25 males and 15 females, with ages ranging from 23 to 66 years old and an average age of 42.4 ± 3.08 years old. No statistically significant differences were found in the comparison of data ($P > 0.05$).

Inclusion criteria included all patients who met the diagnostic criteria for tuberculous pyothorax [9], had complete data, and provided informed consent by voluntarily signing the consent form.

Exclusion criteria included patients with concurrent tuberculous meningitis, contraindications to surgery, and participants unable to cooperate with the study.

2.2. Methods

In the control group, general anesthesia with bronchial intubation was performed. This involved administering midazolam at a dose of 0.06 mg/kg, sufentanil at a dose of 0.5 μg/kg, cisatracurium at a dose of 0.2 mg/kg, and propofol at a dose of 1.5 mg/kg. For the induction of pre-surgical anesthesia, 5 mg/kg of propofol was administered. Tracheal intubation was performed using a visual laryngoscope to ensure a clear position of the bronchoscope, and the anesthesia machine was connected after accurately positioning the double-lumen bronchial tube. Respiratory control was established with a tidal volume of generally 8 mL/kg, a respiratory rate of 10 breaths per minute, and an end-tidal CO_2 ($PetCO_2$) of 35 mmHg.

In the study group, a combination of general anesthesia with bronchial intubation and thoracic paravertebral nerve block was administered, following the same procedure as the general anesthesia with bronchial intubation in the control group. After accurately locating the thoracolumbar vertebrae T3-T4 and T6-T7 using transvaginal ultrasound, routine disinfection was performed, and a towel was placed over the puncture site. Ultrasound guidance was used to assist with needle puncture, and ropivacaine was injected into the area at a concentration of 0.5% and a dosage of 15 mL [10].

2.3. Observation indicators

(1) Monitoring of vital signs: Vital signs for both patient groups were monitored at every stage of surgery, including before anesthesia induction, after surgical incision, immediately after surgery completion, post-extubation, and recording of the average arterial pressure and heart rate index. Clear and secure documentation is essential.

(2) Assessing anesthesia effects: The Ricker sedation agitation scale was used to evaluate patients' surgical agitation, with higher scores indicating more serious agitation. The Ramsay sedation score was employed to assess postoperative pain, with a score of 1 indicating irritability and restlessness, 2–4 indicating adequate sedation, and 5–6 indicating excessive sedation and poor awakening quality [13].

2.4. Statistical analyses

SPSS 23.0 was used to conduct the analysis, employing χ^2 and t-tests. Results are presented as [*n* (%)] and mean ± standard deviation (SD), with statistical significance set at $P < 0.05$. Any differences observed in the data are considered statistically significant.

3. Results

3.1. Comparison of vital signs monitoring indicators between the two groups

No statistically significant difference was observed in heart rate and mean arterial pressure indexes before anesthesia induction between the two groups ($P > 0.05$). However, **Tables 1** and **2** indicate that during surgical incision, immediately after surgery, and at extubation, the study group exhibited lower mean arterial pressure and heart rate values compared to the control group ($P < 0.05$).

Table 1. Comparison of mean arterial pressure between the two groups (mean ± SD, mmHg)

Groups	*n*	Before anesthesia induction	After surgical incision	Immediately after surgery completion	Post-extubation
Control group	40	81.24 ± 3.37	79.84 ± 7.52	89.54 ± 6.37	93.58 ± 7.52
Study group	40	81.37 ± 3.25	76.24 ± 5.11	52.67 ± 3.87	88.63 ± 6.37
t		0.1963	2.7998	34.9785	3.5516
P		0.8447	0.0062	0.0000	0.0006

Table 2. Comparison of heart rate between the two groups (mean ± SD, beats/min)

Groups	*n*	Before anesthesia induction	After surgical incision	Immediately after surgery completion	Post-extubation
Control group	40	70.24 ± 4.52	76.24 ± 4.28	79.85 ± 3.45	81.34 ± 5.28
Study group	40	70.33 ± 4.27	72.04 ± 3.52	74.36 ± 4.27	78.24 ± 4.39
t		0.1023	5.3592	7.0716	3.1923
P		0.9187	0.0000	0.0000	0.0019

3.2. Comparison of anesthetic effects between the two groups

Table 3 shows that the study group demonstrated significantly lower Ricker and Ramsay scores compared to the control group ($P < 0.05$).

Table 3. Comparison of Ricker and Ramsay scores between the two groups (mean ± SD)

Groups	*n*	Ricker score	Ramsay score
Control group	40	5.05 ± 0.37	3.58 ± 0.27
Study group	40	3.84 ± 0.41	2.91 ± 0.22
χ^2		15.4925	13.6028
P		0.9187	0.0000

4. Discussion

Surgery is a commonly employed approach for treating tuberculous pyothorax. Therefore, it is essential to investigate the practicality and efficacy of anesthesia schemes in improving clinical outcomes and patient prognoses [11]. Effective perioperative analgesia can alleviate the pain response induced by surgical trauma, promoting a smoother postoperative recovery. While the traditional thoracic epidural block technique demonstrates a favorable analgesic effect, its application is hindered by anatomical variations, resulting in high anesthesia technology requirements and noticeable operational challenges [12,13]. The thoracic paravertebral nerve block technique involves the injection of local anesthetic drugs around the spinal nerve roots on both sides of the thoracic spine, effectively producing a significant analgesic effect by interrupting the signal conduction pathway of paraspinal nerves. When performed under ultrasound guidance, this technique offers a high level of safety and success, thereby reducing the likelihood of puncture-related complications [14]. In the assessment of this experiment, it was found that the average arterial pressure and heart rate in the study group were lower than those in the control group ($P < 0.05$) during surgical incisions, surgery completion, and immediate extubation. The thoracic paraspinal nerve block method involves the injection of local anesthetic drugs into the thoracic paraspinal space. The lateral diffusion of the drug is controlled to ensure vertical diffusion, enabling quick nerve block action and reducing the individual's stress response. This method is designed to provide effective analgesia. Combining this technique with bronchial intubation during general anesthesia can mitigate the adverse effects of surgery on vital signs. In addition, the thoracic paravertebral nerve block primarily affects one side of the nerves and sympathetic nerves, thereby avoiding any impact on the hemodynamic index [15].

The Ricker and Ramsay scores for surgical anesthesia in the study group were lower than those in the control group ($P < 0.05$). This suggests that general anesthesia with bronchial intubation, combined with thoracic paravertebral nerve block, can extend the block plane, increase surgical analgesia, reduce patient agitation post-surgery, and control the dose of local anesthetic drugs to ensure the effectiveness of anesthesia.

In conclusion, the surgical treatment of patients with tuberculous pyothorax can stabilize mean arterial pressure and heart rate when general anesthetic with bronchial intubation is combined with a thoracic paravertebral nerve block. Additionally, this approach yields a high level of sedation.

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Disclosure statement

The authors declare no conflict of interest.

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