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Article

Effectiveness of the IKAP Nursing Mode in Improving the Prognosis of Patients after Spontaneous Pneumothorax Single-Hole Thoracoscopy: Retrospective Study

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Abstract

Purpose: This study aimed to evaluate the effectiveness of the information-knowledge-attitude-practice (IKAP) nursing mode in improving the prognosis of patients after spontaneous pneumothorax single-hole thoracoscopy. **Methods**: A retrospective analysis was conducted on the clinical data of patients with spontaneous pneumothorax who underwent single-hole thoracoscopy from June 2020 to June 2023. Among these patients, 59 received traditional nursing care and 52 received care under the IKAP nursing mode. Data on patient demographics, intraoperative variables, rehabilitation time, complications, adverse events, pain scores, quality of life, psychological status, and sleep quality 72 hours after surgery were collected and compared between the two groups. **Results**: Compared with the traditional nursing group, the IKAP nursing group exhibited significantly shorter chest tube retention time (55.46 ± 9.26 hours *vs.* 60.74 ± 10.13 hours; $p = 0.005$), gas stop escape time (50.92 ± 8.73 hours *vs.* 55.13 ± 7.68 hours; $p = 0.009$), and overall hospitalization time (4.15 ± 1.53 days *vs.* 5.17 ± 2.46 days; $p = 0.009$); significantly lower rates of pleural infection (1.92% *vs.* 16.95%; $p = 0.008$) and bleeding events (1.92% *vs.* 16.95%; $p = 0.008$); and lower pain scores at 12 hours (4.56 ± 1.57 *vs.* 5.19 ± 1.14; $p = 0.020$) and 72 hours after surgery (2.84 ± 0.48 *vs.* 3.07 ± 0.45; $p = 0.010$). The patients under the IKAP nursing care also exhibited statistically significant improvements in somatization (81.72 ± 3.98 *vs.* 79.53 ± 4.02, $p = 0.005$) and emotion management (81.14 ± 5.26 *vs.* 78.10 ± 4.78, $p = 0.002$) compared with those under traditional nursing. Significantly lower levels of anxiety (10.37 ± 2.21 *vs.* 11.82 ± 2.53, $p = 0.002$), depression (9.37 ± 2.06 *vs.* 10.61 ± 2.35, $p = 0.004$), and stress (21.68 ± 4.16 *vs.* 23.54 ± 4.78, $p = 0.032$) were observed under the IKAP nursing mode compared with those under traditional nursing at 72 hours post-surgery. The IKAP nursing group exhibited better sleep quality as measured by the Pittsburgh sleep quality index (PSQI) score (7.94 ± 1.56 *vs.* 8.64 ± 1.95, $p = 0.041$) but longer sleep duration (7.45 ± 1.37 *vs.* 6.72 ± 1.29, $p = 0.005$) compared with the traditional nursing group. **Conclusion**: Compared with traditional nursing, the IKAP nursing mode demonstrated favorable outcomes including shorter rehabilitation times, reduced rates of postoperative complications, and improved pain management, emotion management, and sleep quality. This comprehensive and patient-centered approach shows potential to optimize the postoperative care, outcomes, and overall prognosis of patients undergoing thoracoscopy for spontaneous pneumothorax. Owing to its retrospective nature, the potential for selection bias and confounding variables in this work cannot be discounted. Future prospective studies with large and diverse cohorts are warranted to validate these findings.

Keywords

IKAP nursing mode; spontaneous pneumothorax; single-hole thoracoscopy; retrospective study

Introduction

Spontaneous pneumothorax is characterized by the presence of air in the pleural space without antecedent trauma and is a common condition that can lead to significant morbidity and mortality if not managed effectively [1,2]. Its incidence ranges from 7.4 cases to 18 cases per 100,000 population per year, with high rates observed in men and individuals with a history of smoking [3,4]. The management of spontaneous pneumothorax often involves a multidisciplinary approach, including medical and surgical interventions, with the goal of achieving lung reexpansion and preventing recurrence [5]. Amidst the spectrum of management strategies, nursing care is pivotal in promoting patient recovery, ensuring optimal postoperative outcomes, and improving overall patient satisfaction [6].

The information-knowledge-attitude-practice (IKAP) nursing mode, an innovative and comprehensive nursing care approach, has garnered attention for its potential to enhance patient recovery and improve outcomes in various

clinical settings [7,8]. It encompasses personalized patient education, emotional support, active patient involvement in care, and proactive pain management and is designed to address the holistic needs of patients undergoing surgical procedures, with focus on promoting patient awareness, understanding, and engagement in their own care [9]. Although the effectiveness of the IKAP nursing mode has been demonstrated in certain healthcare contexts [10–12], its impact on the prognosis of patients after spontaneous pneumothorax single-hole thoracoscopy remains to be elucidated.

The rationale for investigating the effectiveness of the IKAP nursing mode in the context of spontaneous pneumothorax management stems from the significance of nursing care in facilitating recovery, minimizing postoperative complications, and promoting patient well-being [12]. The implementation of this theoretical system is mainly divided into four continuous processes: information collection, knowledge acquisition, attitude generation, and practice formation. Gradual relationships exist among information, knowledge, attitude, and practice; the basis of the IKAP theory is that information and knowledge are the foundations of practical change, and beliefs and attitudes are the driving forces of practical change. With its focus on tailored patient education, emotional support, and active patient involvement, the IKAP nursing mode shows potential to complement and enhance the existing standard of care, ultimately leading to improved patient outcomes and prognosis. By evaluating the impact of the IKAP nursing mode on these critical aspects of postoperative care, this study aimed to contribute to the growing body of evidence supporting the implementation of comprehensive nursing care models in surgical settings, with potential implications for enhancing recovery, patient safety, and resource utilization.

Materials and Methods

Study Population

This study retrospectively analyzed the clinical data of patients with spontaneous pneumothorax who underwent single-hole thoracoscopy at Shanghai Pulmonology Hospital from June 2020 to June 2023. Among these patients, 59 received traditional nursing care and 52 received care under the IKAP nursing mode.

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: diagnosis of spontaneous pneumothorax confirmed by imaging examinations, age $\geq$18 years, surgical candidates, and signed informed consent (Fig. 1).

The exclusion criteria were as follows: malignant tumors; history of thoracotomy; esophageal tumors, mediastinal tumors, or pleural effusion; severe keloid constitution or skin allergies; neurological disorders or organic lesions of the liver or kidneys; mental abnormalities or noncooperation; pregnant or lactating women; and incomplete clinical data.

This research received approval from the Institutional Review Board and Ethics Committee of Shanghai Pulmonology Hospital (Approval No.: K24-330). Informed consent was not required for this retrospective study because only de-identified patient data were used, posing no potential harm to patient care. This waiver was granted by the Institutional Review Board and Ethics Committee of our hospital in compliance with the regulatory and ethical guidelines for retrospective research studies.

Nursing Methods

Traditional Nursing

This nursing mode includes maintaining cleanliness in the ward; providing standard health education; instructing 12-hour preoperative fasting and 8-hour abstention from drinking; informing patients of precautions and guiding them through necessary examinations; offering appropriate psychological counseling; providing postoperative infection prevention, timely dressing changes, and disinfection; closely monitoring incision conditions; and promptly addressing any abnormalities.

IKAP Mode Nursing

In addition to traditional care, the patients were provided with IKAP nursing, including comprehensive data collection upon admission to assess physiological and psychological status, ensure a clear understanding of the patient's illness, and identify factors influencing their quality of life. Nurses tailored disease-related information to the patient's level of understanding by utilizing accessible language to explain disease knowledge, such as causes, treatment methods, complications, prognosis, and nursing methods, thereby improving patient awareness and promoting question-asking. This approach aimed to effectively address patient queries, alleviate negative emotions due to limited disease knowledge, and underscore the importance of adhering to medical advice for fostering healthy behaviors. Health education manuals, relevant videos, successful recovery cases, and patient discussion groups were employed to gradually instill confidence in disease recovery, motivating patients to actively engage in clinical efforts and enhance treatment outcomes. Moreover, the patients were guided to comprehend disease complications, adverse treatment reactions, and coping strategies to enhance their self-care abilities and confidence. The patients were encouraged to be involved in their care, communicate their care needs, and participate in care discussions with nurses to promote

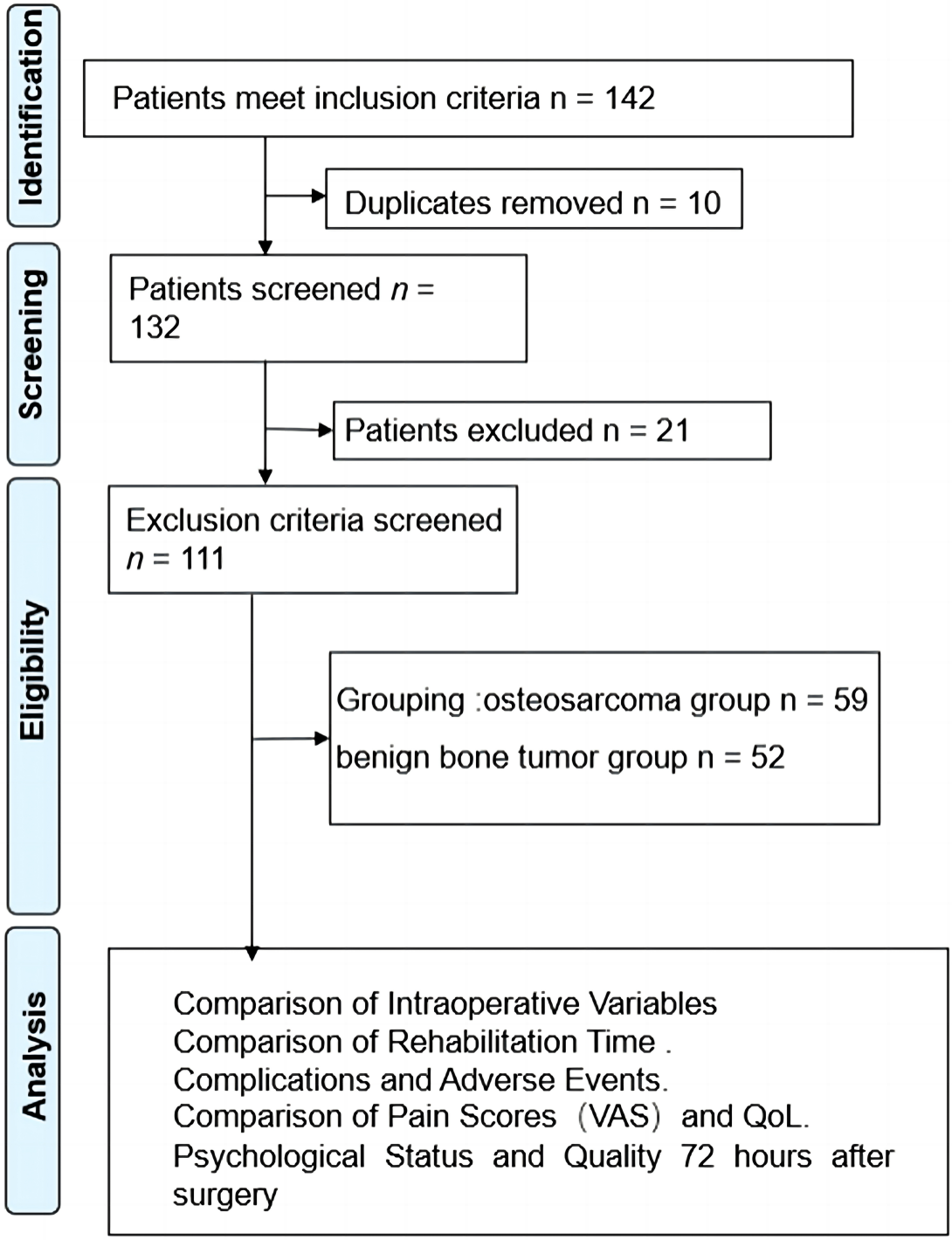

Fig. 1. Flow chart of patient selection. QoL, Quality of Life.

patient initiative and family involvement in care supervision. Finally, the patients were informed about scheduled follow-up visits and received telephone and home visits as per the IKAP nursing mode.

General Information

General data, including age, gender, body mass index (BMI), smoking history, hypertension, diabetes, hyperlipidemia, disease location, compressed area, oxygen saturation, arterial blood gas, and blood pressure, were collected from the medical records. In addition, data on surgical duration, intraoperative analgesic consumption, blood loss, chest tube retention time, gas stop escape time, hospitalization duration, and postoperative adverse events such as pleural infection, bleeding, wound complications, respiratory complications, and other complications were obtained from the medical record system.

Pain Scores (Visual Analog Scale, VAS)

The VAS was utilized to assess pain levels in patients preoperatively and at 12, 48, and 72 hours postoperatively. The score ranges from 0 to 10, where high scores indicate great pain intensity. The Cronbach's α of VAS is 0.940 [13].

Quality of Life (SF-36)

Patients' quality of life was assessed using the SF-36, which encompasses five aspects: somatization, emotion management, role play, cognitive function, and return to social function. Each aspect's score ranges from 0 to 100, with high scores indicating good quality of life in the corresponding aspect. The Cronbach's α of SF-36 is 0.870 [14].

Hospital Anxiety and Depression Scale (HADS)

The HADS was used to evaluate anxiety and depression. This scale typically comprises two subcomponents: anxiety and depression. Each component consists of seven items, each scored from 0 to 3. The total score ranges from 0 to 21, where 0–7 indicates normal, 8–10 indicates mild, 11–14 indicates moderate, and 15–21 indicates severe. The Cronbach's α, which reflects the internal consistency reliability, is 0.890 for the anxiety scale (HADS-A) and 0.856 for the depressive scale (HADS-D) [15].

Perceived Stress Scale (PSS)

The PSS was employed to assess patients' stress levels. It usually includes 10 items used to measure individuals' perception of stress in daily life. Participants provide answers ranging from 0 (never) to 4 (very often) for each question, with scores ranging from 0 to 40. High scores indicate a high level of perceived stress. The Cronbach's α of PSS is 0.810 [16].

Athens Insomnia Scale (AIS)

The AIS is a self-rated psychometric questionnaire that quantifies sleep difficulties according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision criteria. It consists of eight items: waking up at night, sleep induction, final awakening, total sleep duration, sleep quality, well-being, functional ability, and daytime sleepiness. The AIS score ranges from 0 to 24 points, and a total score of 6 or higher indicates a diagnosis of insomnia. The Cronbach's α of AIS is 0.66 [17].

Post-Hoc Analysis

In G*Power 3.1.9.7 (University of Dusseldorf, Dusseldorf, Germany), the "Means: Difference between two independent means (two groups)" option based on *t*-tests was selected for post hoc analysis. The settings were as follows: two-tailed mode, effect size d = 0.6, α err prob = 0.05. The sample sizes for the two groups were entered, and the power (1-β err prob) was calculated at 0.878. According to these parameters, 80% power, a 5% two-sided significance level, and a 10% attrition rate, this study required 111 patients.

Statistical Analysis

Data were analyzed with SPSS 29.0 statistical software (SPSS Inc., Chicago, IL, USA). For categorical data, [n (%)] was used for representation. The chi-square test was applied with the basic formula when the sample size was $\geq$40 and the theoretical frequency T was $\geq$5, with the test statistic represented by χ^2. When the sample size was $\geq$40 but the theoretical frequency $1 \leq T < 5$, the chi-square test was adjusted using the correction formula. When the sample size was <40 or the theoretical frequency T <1, statistical analysis was conducted using Fisher's exact probability method. Continuous variables were first tested for normal distribution using the Shapiro–Wilk method, which can determine whether the data are normally distributed. For normally distributed continuous data, ($\bar{x} \pm$ s) was employed. Difference analysis of normal distribution data was carried out. Nonnormally distributed data were analyzed using Wilcoxon rank-sum test, and the [median (25% quantile, 75% quantile)] was used for presentation. As a nonparametric test, Wilcoxon rank sum test is not limited by global distribution and has wide applicability. $p < 0.05$ indicated statistical significance. Missing results were excluded to avoid any potential biases.

Results

General Information, Demographic Characteristics, and Intraoperative Variables

This retrospective study compared traditional nursing and IKAP nursing for patients after spontaneous pneumothorax single-hole thoracoscopy. No statistically significant differences in terms of age, gender distribution, BMI, smoking history, comorbidities (including hypertension, diabetes, and hyperlipidemia), disease location, compressed area, oxygen saturation, arterial blood gas partial pressure of oxygen (PaO_2), blood pressure, operation time, analgesic consumption, and blood loss were found between the two groups (Table 1). These baseline measures did not affect the results of the study.

Rehabilitation Time

The IKAP nursing group exhibited significantly shorter chest tube retention time (p = 0.005), gas stop escape time (p = 0.009), and overall hospitalization time (p = 0.009) compared with the traditional nursing group (Ta-

Table 1. General information and demographic characteristics of patients.

Parameter	Traditional Nursing (n = 59)	IKAP Nursing (n = 52)	t/χ^2	*p*-value
Age (years)	42.13 ± 6.54	40.25 ± 7.21	1.440	0.153
Gender (M/F)	33 (55.93)/26 (44.07)	28 (53.85)/24 (46.15)	0.049	0.826
BMI (kg/m^2)	23.52 ± 3.25	22.96 ± 2.95	0.941	0.346
Smoking history (Y/N)	22 (37.29)/37 (62.71)	18 (34.62)/34 (65.38)	0.086	0.770
Comorbidities				
Hypertension	12 (20.34)	12 (23.08)	0.122	0.727
Diabetes	17 (28.81)	14 (26.92)	0.049	0.825
Hyperlipidemia	25 (42.37)	21 (40.38)	0.045	0.832
Disease location				
Unilateral	42 (71.19)	35 (67.31)	0.196	0.658
Bilateral	17 (28.81)	17 (32.69)		
Compressed area				
≤20%	39 (66.10)	31 (59.62)	0.499	0.480
>20%	20 (33.90)	21 (40.38)		
Oxygen saturation (%)	96.21 ± 1.67	96.35 ± 1.72	0.435	0.664
Arterial blood gas (PaO_2, mmHg)	81.46 ± 7.52	82.05 ± 7.28	0.419	0.676
Blood pressure (mmHg)	121.05 ± 8.36	120.78 ± 8.14	0.172	0.864
Operation time (min)	48.16 ± 5.32	47.82 ± 5.15	0.338	0.736
Analgesic consumption (morphine equivalent, mg)	5.78 ± 1.25	5.62 ± 1.19	0.703	0.483
Blood loss (mL)	65.24 ± 15.67	63.85 ± 14.92	0.479	0.633

IKAP, information-knowledge-attitude-practice; BMI, body mass index; PaO_2, partial pressure of oxygen.

Table 2. Comparison of rehabilitation time between the two groups.

Parameter	Traditional Nursing	IKAP Nursing	t	*p*-value
Chest tube retention time (h)	60.74 ± 10.13	55.46 ± 9.26	2.869	0.005
Gas stop escape time (h)	55.13 ± 7.68	50.92 ± 8.73	2.682	0.009
Hospitalization time (Days)	5.17 ± 2.46	4.15 ± 1.53	2.661	0.009

ble 2). These results suggest that IKAP care has a significant effect on patient recovery.

Complications and Adverse Events

The IKAP nursing group exhibited significantly lower rates of pleural infection (p = 0.008) and bleeding events (p = 0.008) compared with the traditional nursing group (Table 3). However, no significant differences were observed between the two groups in terms of wound complications, respiratory complications, and other complications (p = 0.794).

Pain Scores (VAS)

The IKAP nursing group displayed significantly lower pain scores than the traditional nursing group at 12 hours (p = 0.020) and 72 hours (p = 0.010) after surgery (Table 4). However, no significant differences in pain scores were observed between the two groups preoperatively and at 48 hours after surgery (p = 0.068).

Quality of Life

The patients under the IKAP nursing care exhibited statistically significant improvements in somatization (p = 0.005) and emotion management (p = 0.002) compared with those under traditional nursing (Table 5). However, no significant differences were observed between the two groups in terms of role play, cognitive function, and return to social function ($p > 0.05$).

Psychological Status

The patients under the IKAP nursing care demonstrated significantly lower levels of anxiety (p = 0.002), depression (p = 0.004), and stress (p = 0.032) compared with those under traditional nursing care at 72 hours post-surgery (Table 6).

Sleep Quality

The IKAP nursing group exhibited better sleep quality (p = 0.041) as measured by the Pittsburgh sleep quality index (PSQI) score and longer sleep duration (p = 0.005) compared with the traditional nursing group (Table 7).

Table 3. Comparison of complications and adverse events between the two groups.

Parameter	Traditional Nursing	IKAP Nursing	χ^2	p
Pleural infection	10 (16.95)	1 (1.92)	6.990	0.008
Bleeding events	10 (16.95)	1 (1.92)	6.990	0.008
Wound complications	4 (6.78)	2 (3.85)	0.068	0.794
Respiratory complications	4 (6.78)	2 (3.85)	0.068	0.794
Other complications	4 (6.78)	2 (3.85)	0.068	0.794

Table 4. Comparison of pain scores (VAS) between the two groups.

Parameter	Traditional Nursing	IKAP Nursing	t	p
Preoperative pain score	6.74 ± 0.98	6.68 ± 1.05	0.324	0.746
12 hours after surgery	5.19 ± 1.14	4.56 ± 1.57	2.370	0.020
48 hours after surgery	3.95 ± 0.83	3.68 ± 0.73	1.843	0.068
72 hours after surgery	3.07 ± 0.45	2.84 ± 0.48	2.635	0.010

Table 5. Comparison of quality of life between the two groups.

Parameter	Traditional Nursing (n = 59)	IKAP Nursing (n = 52)	t	p
Somatization	79.53 ± 4.02	81.72 ± 3.98	2.877	0.005
Emotion management	78.10 ± 4.78	81.14 ± 5.26	3.190	0.002
Role play	82.25 ± 6.23	82.41 ± 5.26	0.145	0.885
Cognitive function	82.21 ± 5.11	82.73 ± 5.02	0.539	0.591
Return to social function	81.23 ± 5.78	82.07 ± 6.23	0.737	0.463

Table 6. Psychological status 72 hours after surgery.

Parameter	Traditional Nursing (n = 59)	IKAP Nursing (n = 52)	t	p
Anxiety (HADS score)	11.82 ± 2.53	10.37 ± 2.21	3.195	0.002
Depression (HADS score)	10.61 ± 2.35	9.37 ± 2.06	2.938	0.004
Stress (PSS score)	23.54 ± 4.78	21.68 ± 4.16	2.173	0.032

HADS, hospital anxiety and depression scale; PSS, perceived stress scale.

Table 7. Sleep quality 72 hours after surgery.

Parameter	Traditional Nursing (n = 59)	IKAP Nursing (n = 52)	t	p
Sleep quality (AIS score)	8.64 ± 1.95	7.94 ± 1.56	2.070	0.041
Sleep duration (hours)	6.72 ± 1.29	7.45 ± 1.37	2.892	0.005

AIS, athens insomnia scale.

Discussion

Pneumothorax is a common condition that can lead to substantial morbidity and mortality if not managed effectively [18]. As part of the management strategy, nursing care plays a crucial role in promoting patient recovery and improving outcomes [19]. The IKAP nursing mode, an innovative nursing care approach, was evaluated in this retrospective study to assess its impact on the prognosis of patients with spontaneous pneumothorax after single-hole thoracoscopy. The findings provide valuable insights into the potential benefits of the IKAP nursing mode in enhancing patient recovery, improving outcomes, and addressing the holistic needs of patients undergoing surgical procedures.

The comprehensive nature of the IKAP nursing mode encompasses several key components that address the holistic needs of patients undergoing thoracoscopy for spontaneous pneumothorax [20]. Traditional nursing care primarily focuses on physical aspects, such as wound care, monitoring, and patient education [21,22]. By contrast, the IKAP nursing mode extends beyond traditional care by incorporating comprehensive data collection, tailored patient education, multimedia resources, and active patient involvement in the care process [23]. Its emphasis on patient education is particularly noteworthy because it aims to improve patient awareness, understanding, and engagement in their own care, ultimately leading to good treatment adherence and outcomes [24,25].

The patients under the IKAP nursing care exhibited significantly shorter chest tube retention time, gas stop es-

cape time, and overall hospitalization duration compared with those under traditional nursing care. Furthermore, the IKAP nursing group demonstrated significantly lower rates of pleural infection and bleeding events, indicating this care model's potential to reduce postoperative complications. These findings were consistent with the concept that comprehensive nursing care models, such as the IKAP nursing mode, can optimize patient recovery by addressing holistic patient needs and actively involving patients in their care process [26].

The significantly lower rates of pleural infection and bleeding events in the IKAP nursing group also highlighted the potential of this care model to mitigate postoperative complications, reduce the risk of infections and healthcare costs associated with managing complications, and enhance the safety, outcomes, and enhance overall quality of care for patients with spontaneous pneumothorax undergoing surgical interventions.

Pain management is another crucial aspect of postoperative care. Our findings revealed that the IKAP nursing mode was associated with lower pain scores at specific time points after surgery. Effective pain control is pivotal in enhancing patient comfort, promoting early mobilization, and facilitating overall recovery [27]. The observed improvements in pain scores among the patients under the IKAP nursing care suggest that its comprehensive approach to patient education, emotional support, and proactive pain management strategies may yield substantial benefits in optimizing postoperative comfort and well-being.

This study's investigation into the quality of life and psychological status of patients revealed noteworthy findings. The patients under the IKAP nursing care exhibited improvements in somatization and emotion management and lower levels of anxiety, depression, and stress 72 hours after surgery. These findings highlighted the potential of the IKAP nursing to improve physical recovery and contribute to the well-being of patients by addressing the psychological and emotional aspects of their postoperative experience. The IKAP nursing mode places a strong emphasis on emotional and psychological support for patients [28]. This model seeks to reduce anxiety, depression, and stress levels among patients by effectively addressing patient queries, alleviating negative emotions due to limited disease knowledge, and promoting question-asking [29]. The provision of emotional support and encouragement of patient initiative may contribute to a positive and resilient mindset, which can influence pain perception, recovery trajectory, and overall well-being [30].

Evaluation of sleep quality among patients revealed that the IKAP nursing group exhibited better sleep quality and longer sleep duration than the traditional nursing group. Sleep is a crucial aspect of recovery, and these findings suggest that the IKAP nursing mode may contribute to an improved postoperative sleep experience for patients, which can have significant implications for their overall well-being and recovery trajectory. Improved sleep quality can also contribute to enhanced recovery, good neurocognitive function, and a positive experience during recovery [31].

The results of this retrospective study have profound implications for clinical practice and the delivery of care for patients undergoing single-hole thoracoscopy for spontaneous pneumothorax. The findings suggest that the IKAP nursing mode has the potential to enhance recovery, minimize complications, improve pain management, and promote overall well-being for these patients. By addressing the multifaceted needs of patients, including physical, emotional, and psychological aspects, the IKAP nursing mode presents an opportunity to optimize patient-centered care and improve outcomes in spontaneous pneumothorax management. In addition, the IKAP model can effectively enhance the confidence of patients to recover, promoting the relationship among patients, their families, and the medical staff and creating a good nursing environment. Compared with conventional cluster care, the IKAP care model resulted in a lower incidence of adverse events and healthier patient behavior [12].

Although the findings of this study provide compelling evidence for the effectiveness of the IKAP nursing mode, certain limitations must be acknowledged. Owing to their use of existing data, retrospective studies may not be able to obtain specific information that was not fully documented in past data. In addition, the potential for selection bias and confounding variables cannot be discounted, making it difficult to determine causal relationships between variables. Finally, this study was conducted at a single institution, and the generalizability of the findings to broad patient populations and care settings may be limited.

Larger and diverse prospective studies must be conducted with complete data collection and analysis while avoiding interference from irrelevant factors. A multicenter and longitudinal comparative research is needed to obtain a comprehensive conclusion. Through these studies, we can specifically and credibly elucidate the long-term effects of IKAP nursing mode on patient prognosis.

Conclusion

Our retrospective study highlights the potential of the IKAP nursing in improving the prognosis of patients after single-hole thoracoscopy for spontaneous pneumothorax. By addressing various aspects of patient care, including rehabilitation time, complications, pain management, quality of life, psychological status, and sleep quality, the IKAP nursing presents a comprehensive approach to enhance the recovery and well-being of these patients. Prospective experiments will be conducted in the future to further elaborate the conclusions of this study.

Availability of Data and Materials

The datasets used and/or analyzed during the current study were available from the corresponding author on reasonable request.

Author Contributions

DW and HW designed the study; all authors conducted the study. QL and WX collected and analyzed the data. DW and HW participated in drafting the manuscript, and all authors contributed to critical revision of the manuscript for important intellectual content. All authors gave final approval of the version to be published. All authors participated fully in the work, take public responsibility for appropriate portions of the content, and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or completeness of any part of the work are appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study has been approved by the Medical Ethics Committee of Shanghai Pulmonology Hospital (Approval No.: K24-330). Informed consent was not required for this retrospective study because only de-identified patient data was used, posing no potential harm to patient care.

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Conflict of Interest

The authors declare no conflict of interest.

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