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Postoperative arrhythmias in geriatric lung cancer patients undergoing thoracoscopic surgery: an exploration of prevalence and influencing factors

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Abstract

Background Arrhythmias are a frequent complication in the postoperative period following surgical procedures. This study aims to investigate the incidence and contributing factors of arrhythmias in elderly patients with lung cancer who have undergone thoracoscopic surgery, thereby providing scientific evidence to support clinical treatment and nursing care.

Methods This retrospective cohort study included elderly patients diagnosed with lung cancer who underwent treatment at our hospital between June 1, 2022, and October 31, 2024. Patients were categorized into two groups based on the development of postoperative arrhythmias following thoracoscopic surgery: the arrhythmia group and the non-arrhythmia group. A comparative analysis of the clinical data was conducted between these two groups.

Results A total of 208 patients were enrolled, with an incidence of postoperative arrhythmias of 19.71% (41/208). Logistic regression analysis identified age ≥ 70 years (*OR* = 2.586, 95% *CI*: 1.805–3.221), hypertension (*OR* = 2.761, 95% *CI*: 2.103–3.588), history of smoking (*OR* = 2.070, 95% *CI*: 1.741–2.446), TNM stage II (*OR* = 3.181, 95% *CI*: 2.842–3.690), postoperative pulmonary infection (*OR* = 2.122, 95% *CI*: 1.836–2.690), and postoperative constipation (*OR* = 2.495, 95% *CI*: 1.988–3.072) as independent risk factors for postoperative arrhythmias (all $p < 0.05$).

Conclusion The incidence of postoperative arrhythmias in elderly patients with lung cancer following thoracoscopic surgery is relatively high. Targeted interventions addressing the identified risk factors are essential to mitigate the risk of postoperative arrhythmias.

Keywords Arrhythmias, Geriatric, Lung cancer, Surgery, Treatment, Care

Introduction

Lung cancer, ranking first globally in both incidence and mortality rates among malignant tumors, has become a focal point in the medical community for prevention and treatment (Kratzer et al. 2024). According to the global cancer statistics (Florez et al. 2024; Zhou et al. 2024), there were an estimated 19.974 million new cancer cases worldwide, with lung cancer accounting for approximately 2.481 million cases, representing a significant 12.4% of the total, reaffirming its position as the leading cancer globally. In China, the number of new lung cancer cases reached 1.061 million in 2022, translating to a rate of 75.1 per 100,000 people (Wu et al. 2021). Among the elderly population, the burden of lung cancer is particularly heavy, with the crude incidence rate of lung cancer in individuals aged 65 and above being approximately

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11 times higher than that in the working-age population (15–64 years) (Luo et al. 2021). Surgical treatment, a common therapeutic approach for lung cancer patients, involves the removal of the primary tumor and metastatic lymph nodes, alleviating tumor compression and effectively curbing disease progression (Mattioni et al. 2023). However, surgical procedures can stimulate the autonomic nervous system and impact respiratory and circulatory systems, predisposing patients to postoperative arrhythmias (Fukui et al. 2019; King et al. 2023). The occurrence of arrhythmias not only increases the risk of adverse events, prolongs hospital stays, and hinders patient recovery but may also lead to higher mortality rates (Iwata et al. 2016). Therefore, identifying measures to reduce the risk of postoperative arrhythmias is particularly crucial in elderly lung cancer patients. This is not only relevant to patient quality of life but also key to improving survival rates and reducing mortality.

Elderly patients are more susceptible to postoperative arrhythmias (Ganea et al. 2023). With advancing age, the heart undergoes degenerative changes in structure and function, including a reduction in the number of cardiomyocytes, increased myocardial fibrosis, and aging of the cardiac conduction system. These alterations can lead to changes in the electrophysiological properties of the heart, thereby increasing the risk of arrhythmias (Elsebaie et al. 2024). Moreover, the autonomic nervous system in elderly individuals tends to be dysregulated, characterized by increased sympathetic nerve activity and decreased vagal tone. This imbalance in autonomic function can disrupt the normal rhythm of the heart, predisposing it to arrhythmias (El-Sherbini et al. 2023). Current evidence regarding the incidence and risk factors of postoperative arrhythmias in lung cancer patients undergoing thoracoscopic surgery remains limited and inconclusive. To address this knowledge gap, this study systematically investigates the epidemiological characteristics and determinants of post-thoracoscopic arrhythmias in lung cancer patients, which may contribute to the development of evidence-based clinical strategies for perioperative management.

Methods

This study was a retrospective cohort design, which had been duly approved by the Ethics Committee of The First Affiliated Hospital of Fujian Medical University (approval number: 20240815). Prior to the commencement of the study, informed consent was obtained from all included patients.

Clinical trial number

This is not applicable.

In this study, we selected elderly patients with lung cancer who were treated at our hospital from June 1, 2022, to October 31, 2024, as the study population of our research. The inclusion criteria were patients pathologically diagnosed with primary lung cancer who underwent thoracoscopic surgery at our institution and those who were 65 years of age or older. The exclusion criteria encompassed patients with a history of atrial fibrillation, thyroid dysfunction, or other relevant medical histories; those who showed arrhythmias in preoperative electrocardiogram examinations or had recently used antiarrhythmic medications; patients with significant dysfunction of vital organs such as the heart, liver, or kidneys; and those who explicitly declined to participate in the study.

For patients pathologically diagnosed with primary lung cancer who underwent thoracoscopic surgery (VATS) in our study, a comprehensive preoperative assessment was conducted to ensure optimal surgical outcomes and patient safety. Detailed medical histories were taken, including smoking history, chronic alcohol consumption, and comorbidities such as hypertension, diabetes, heart disease, and lung disease. Whole lung CT scans were routinely performed to identify intrapulmonary small metastases, regional lymph node swelling, and anatomical variations of the pulmonary bronchovasculature. CT scans also helped in assessing the presence or absence of underlying lung diseases such as pulmonary emphysema, fibrosis, or interstitial lung disease. Patients with a history of smoking were advised to quit smoking for at least 1 week before surgery to reduce the risk of postoperative complications. For patients with comorbidities such as hypertension, diabetes, and heart disease, consultations with relevant departments were arranged to stabilize their conditions before surgery. Preoperative education was provided to patients, including information on the surgical procedure, expected recovery process, and postoperative care. Preoperative nebulization, expectorant and antispasmodic treatments, and active pulmonary exercises were conducted to optimize respiratory function. Based on the preoperative assessment, the surgical approach (single-port or multi-port VATS) was determined. The choice of approach depended on the patient's specific condition, tumor characteristics, and surgeon's expertise.

Patients were typically positioned in the lateral decubitus position, which facilitated rib separation and access to thoracic structures. General anesthesia was administered, and a double-lumen endotracheal tube was commonly used for airway management to achieve one-lung ventilation. The patient was then positioned on their side with their arm positioned overhead, and the operating table was sometimes flexed to facilitate surgical exposure. The standard VATS procedure typically involved making

3 to 4 small incisions arranged in a triangular configuration to allow for scope and instrument insertion. The camera was inserted through one of these incisions to create additional entry ports safely. The procedure progressed under the guidance of the video thoracoscope, and the specific steps varied based on the surgery being performed. For example, in lung resection, the surgeon used specially designed instruments inserted through the incisions to remove part of the lung and lymph nodes. After the surgery, one or two pleural drains connected to an underwater seal drain were usually placed, depending on the procedure. Patients were typically discharged from the hospital a few days after surgery and were advised to rest and gradually recover at home.

Patients were categorized into two groups based on the occurrence of postoperative arrhythmias: the Arrhythmia Group and the No Arrhythmia Group. The diagnostic criteria for arrhythmia were as follows: the presence of any arrhythmia lasting 3 min or longer within the first week postoperatively, including atrial fibrillation, ventricular premature contractions, and sinus tachycardia. We collected the following data from the medical records and nursing records, including age, gender, body mass index (BMI), history of heart disease, hypertension, diabetes, history of smoking, types of lung cancer, tumor node metastasis (TNM) staging, tumor size, number of lymph node metastases, postoperative pulmonary infection, and postoperative constipation. In our study of lung cancer patients undergoing thoracoscopic surgery, stage II was defined according to the TNM classification system, which takes into account tumor size and the presence of regional lymph node involvement. Specifically, stage II generally included tumors that had invaded deeper tissues but had not yet metastasized to distant sites. Lymph node metastasis, which refers to the spread of cancer cells to the lymph nodes, was a critical factor in cancer staging and prognosis, as it indicated the extent of disease spread within the body.

In this study, data analysis was performed using SPSS software version 26.0. Categorical data were expressed as relative frequencies, and group comparisons were conducted using the chi-squared test. For ordinal data, the Mann–Whitney *U*-test was employed to compare groups. Continuous data, which were found to be normally distributed following the Shapiro–Wilk test of normality, were presented as means ± standard deviations, and group comparisons were made using the independent samples *t*-test. We did not apply a correction for multiple comparisons. The analyses were primarily exploratory in nature; therefore, the significant findings should be interpreted with caution. The relationship between the occurrence of arrhythmias and individual patient characteristics was assessed using Spearman's correlation analysis. A multivariable logistic regression analysis was utilized to investigate the factors associated with the occurrence of postoperative arrhythmias in lung cancer patients undergoing thoracoscopic surgery. A *p*-value of less than 0.05 was considered to indicate statistically significant differences between groups.

Results

In this study, a total of 208 lung cancer patients were enrolled, with an incidence of postoperative arrhythmias in elderly patients undergoing thoracoscopic surgery for lung cancer recorded at 19.71% (41 out of 208). Arrhythmias predominantly occurred within the first 3 days postoperatively, with atrial fibrillation accounting for 29 cases, ventricular premature contractions for 8 cases, and tachycardia for 4 cases. As depicted in Table 1, significant differences were observed between patients with and without arrhythmias in terms of age, hypertension, smoking history, TNM staging, postoperative pulmonary infection, and postoperative constipation (all $p < 0.05$).

As shown in Table 2, Spearman correlation analysis indicated that age ($r = 0.601$), hypertension ($r = 0.522$), smoking history ($r = 0.587$), TNM staging ($r = 0.564$), postoperative pulmonary infection ($r = 0.617$), and postoperative constipation ($r = 0.592$) were associated with the occurrence of postoperative arrhythmia in geriatric patients with lung cancer undergoing thoracoscopic surgery (all $p < 0.05$).

Table 3 presents the variable assignments used in the multivariate logistic regression analysis, which was performed to identify the determinants of postoperative arrhythmia in elderly patients with lung cancer who underwent thoracoscopic surgery. The purpose of this analysis was to identify significant factors associated with the development of arrhythmias following the surgical procedure. As indicated in Table 4, a logistic regression analysis was performed to identify the influencing factors of postoperative arrhythmia in elderly patients with lung cancer who had undergone thoracoscopic surgery. The analysis revealed that several factors were significantly associated with the occurrence of postoperative arrhythmia. Specifically, patients aged 70 years or older (*OR* = 2.586, 95% *CI*: 1.805–3.221), those with a history of hypertension (*OR* = 2.761, 95% *CI*: 2.103–3.588), and those with a history of smoking (*OR* = 2.070, 95% *CI*: 1.741–2.446) were at a higher risk of developing postoperative arrhythmia. Additionally, patients with TNM staging II (*OR* = 3.181, 95% *CI*: 2.842–3.690), those who experienced postoperative pulmonary infection (*OR* = 2.122, 95% *CI*: 1.836–2.690), and those who suffered from postoperative constipation (*OR* = 2.495, 95% *CI*: 1.988–3.072) were also identified as having a

Table 1 The characteristics of included geriatric patients with lung cancer undergoing thoracoscopic surgery ($n=208$)

Variables	Postoperative arrhythmias group ($n=41$)	No postoperative arrhythmias group ($n=167$)	*P*
Age (years)	72.28 ± 6.69	68.05 ± 6.34	0.024
Male/female	26/15	98/69	0.115
BMI (kg/m^2)	22.84 ± 1.20	23.09 ± 1.15	0.093
History of heart disease			0.201
Yes	7 (17.07%)	29 (17.37%)	
No	34 (82.93%)	138 (82.63%)	
Hypertension			0.019
Yes	21 (51.22%)	129 (77.25%)	
No	20 (48.78%)	38 (22.75%)	
Diabetes			0.134
Yes	9 (21.95%)	35 (20.96%)	
No	32 (78.05%)	132 (789.04%)	
History of smoking			0.012
Yes	20 (48.78%)	41 (24.55%)	
No	21 (51.22%)	126 (75.45%)	
Types of lung cancer			0.208
Squamous cell carcinoma	19 (46.34%)	77 (46.11%)	
Adenocarcinoma	22 (53.66%)	90 (53.89%)	
TNM staging			0.008
Stage I	8 (19.51%)	78 (46.71%)	
Stage II	33 (80.49%)	89 (53.29%)	
Tumor size (cm)			0.069
≥ 3	28(68.29%)	93 (55.69%)	
< 3	13 (46.43%)	74 (44.31%)	
Number of lymph node metastases			0.101
≥ 3	10 (24.39%)	29 (15.57%)	
< 3	31 (75.61%)	138 (82.63%)	
Postoperative pulmonary infection			0.002
Yes	9 (21.95%)	10 (5.99%)	
No	32 (78.05%)	157 (94.01%)	
Postoperative constipation			0.005
Yes	16 (39.02%)	33 (19.76%)	
No	25 (60.98%)	134 (80.24%)	

BMI Body mass index, *TNM* Staging, tumor, node, and metastasis staging

significantly higher likelihood of postoperative arrhythmia. All these factors were statistically significant (all $p<0.05$).

Discussion

The etiology of postoperative arrhythmias in lung cancer patients remains to be fully elucidated. Given this, there is a compelling need to delve deeper into the factors associated with the development of postoperative arrhythmias in lung cancer patients following thoracoscopic surgery (Yim and Krahn 2024). This investigation is crucial for the development of targeted preventative strategies aimed at mitigating the adverse health impacts of these risk factors. Our study indicates that the risk of postoperative arrhythmias in lung cancer patients who have undergone thoracoscopic surgery is relatively high, with atrial fibrillation being the most prevalent form. Notably, the incidence of arrhythmias is particularly high during the first three postoperative days, a finding that aligns with existing literature on the subject. The significance of this observation lies in its potential to inform clinical practice. By identifying the early postoperative period as a critical window for arrhythmia development, healthcare providers can focus their monitoring and intervention efforts accordingly. This targeted approach may enhance the early detection and management of

Table 2 Correlation analysis on the postoperative arrhythmia and characteristics of geriatric patients with lung cancer undergoing thoracoscopic surgery

Variables	*r*	*P*
Age	0.601	0.015
Gender	0.225	0.124
BMI	0.149	0.081
History of heart disease	0.121	0.099
Hypertension	0.522	0.019
Diabetes	0.131	0.125
History of smoking	0.587	0.011
Types of lung cancer	0.131	0.147
TNM staging	0.564	0.008
Tumor size (cm)	0.180	0.114
Number of lymph node metastases	0.113	0.079
Postoperative pulmonary infection	0.617	0.023
Postoperative constipation	0.592	0.010

BMI Body mass index, *TNM* Staging, tumor, node, and metastasis staging

Table 3 The variable assignments utilized in the multivariate logistic regression analysis to assess the influencing factors of postoperative arrhythmia in elderly patients with lung cancer who have undergone thoracoscopic surgery

Factors	Variables	Assignment
Postoperative arrhythmia	Y	Yes = 1, no = 2
Age	X_1	≥ 70 = 1, < 70 = 2
Hypertension	X_2	Yes = 1, no = 2
History of smoking	X_3	Yes = 1, no = 2
TNM staging	X_4	Stage II = 1, stage I = 2
Postoperative pulmonary infection	X_5	Yes = 1, no = 2
Postoperative constipation	X_6	Yes = 1, no = 2

TNM Staging, tumor, node, and metastasis staging

Table 4 Logistic regression analysis on the influencing factors of postoperative arrhythmia in elderly patients with lung cancer who have undergone thoracoscopic surgery

Variables	*OR*	95% *CI*	*P*
Age ≥ 70 years	2.586	1.805 ~ 3.221	0.012
Hypertension	2.761	2.103 ~ 3.588	0.037
History of smoking	2.070	1.741 ~ 2.446	0.034
TNM staging II	3.181	2.842 ~ 3.690	0.005
Postoperative pulmonary infection	2.122	1.836 ~ 2.690	0.014
Postoperative constipation	2.495	1.988 ~ 3.072	0.010

TNM Staging, tumor, node, and metastasis staging, *OR* Odds ratio, *CI* Confidence interval

arrhythmias, thereby potentially improving patient outcomes.

With advancing age, the atrial myocardial tissue may undergo varying degrees of dilation, leading to atrial structural remodeling. This anatomical alteration predisposes the atria to arrhythmias under pathological stimuli such as inflammation, hypoxia, and trauma (Liu et al. 2024; Suero et al. 2024). Furthermore, the functional capacity of the myocardium or conduction system in elderly individuals tends to deteriorate progressively, notably with a reduction in the number of sinoatrial node pacemaker cells, which may be reduced to approximately 10% by the age of 75 (Jiang et al. 2023a). Coupled with increased blood viscosity and decreased pulmonary capacity, these factors synergistically heighten the susceptibility of elderly patients to arrhythmias (Kashiwagi et al. 2023). Moreover, advanced age is often associated with diminished cardiopulmonary reserve and compensatory abilities, as well as attenuated cardiovascular stress response, rendering them relatively intolerant to surgical trauma and anesthesia (Tohidinezhad et al. 2022). Consequently, the increase in age is correlated with postoperative conduction system dysfunction, thereby elevating the risk of inducing arrhythmias (Benker et al. 2022). These insights underscore the critical importance of preventative measures and early intervention for postoperative arrhythmias in elderly lung cancer patients, aiming to enhance their prognosis and quality of life.

Hypertension is a critical factor influencing the development of postoperative arrhythmias. Research indicates that as blood pressure levels increase in patients, there is an augmentation of the body's stress response, a decline in vascular elasticity, and an increase in cardiac pump resistance. These alterations, under the provocations of surgery and anesthesia, predispose individuals to conduction bundle dysfunction in the myocardium, thereby precipitating arrhythmias (Semeraro et al. 2021; O'Brien et al. 2024). Furthermore, sustained elevation of blood pressure in hypertensive patients leads to an increase in neuroendocrine hormones, which in turn causes left ventricular hypertrophy (Tong et al. 2021). Studies (Xue et al. 2022; Lu et al. 2014) have shown that approximately 28% of hypertensive patients with left ventricular hypertrophy experience tachycardia postoperatively. Consequently, the proactive management and control of blood pressure before surgery are of significant importance in preventing the onset of postoperative arrhythmias. These findings underscore the importance of hypertension management and control as a pivotal step in reducing the risk of postoperative arrhythmias in the treatment process of elderly lung cancer patients.

Smoking is recognized as a risk factor for cardiovascular diseases, exerting a multifaceted impact on human

health. Nicotine, a key component of tobacco, has significant deleterious effects on the cardiovascular system. It is capable of altering endothelial function, triggering adhesion cascade reactions, and promoting vascular inflammation, thereby accelerating the progression of atherosclerosis and hypertension (Chandy et al. 2024; Shi et al. 2024). Moreover, nicotine may directly induce coronary artery spasm and localized ischemia, increasing the risk of coronary artery disease and myocardial infarction (Ishida et al. 2024; Wilcox et al. 2024). Smoking not only diminishes the body's cardiopulmonary function and compensatory capabilities but also makes the myocardial conduction system more susceptible to functional abnormalities under the stress of surgery and anesthesia, leading to arrhythmias (Cho et al. 2024; Gaalema et al. 2024). Studies (Chen et al. 2024; Wang et al. 2013) have revealed that patients with a high smoking index tend to produce more sputum postoperatively, encounter difficulties in expectoration, potentially leading to postoperative pulmonary infections or atelectasis, and thereby increase the risk of arrhythmic complications. The established guideline typically advises patients to cease smoking approximately 1 month before surgery to mitigate the risk of postoperative complications, including pulmonary infections. In our study, the requirement for at least 1 week of smoking cessation was determined based on the practical considerations relevant to our patient population and the specific context of thoracoscopic surgery for lung cancer. Although we acknowledge that a longer period of smoking cessation is generally more advantageous, we also recognize that adhering to a 1-month cessation period can be particularly challenging for some patients, especially those with advanced disease who require prompt surgical intervention. We concur that this shorter duration of smoking cessation might potentially contribute to an increased incidence of pulmonary infections. Moreover, the pulmonary damage resulting from long-term smoking creates a microenvironment that may facilitate tumor cell invasion, thereby potentially influencing the clinical staging progression in patients with lung cancer (Zhao et al. 2019; Li et al. 2024). Therefore, strict preoperative smoking cessation and enhanced postoperative respiratory tract management are essential components in the treatment of elderly patients with lung cancer.

In the management of lung cancer, the TNM staging system serves as a critical tool for assessing tumor aggressiveness and prognosis. Empirical evidence suggests that as the TNM stage increases, so does the invasiveness of the tumor, along with a more pronounced infiltration into surrounding tissues (Jiang et al. 2023b). This alteration in biological behavior may subject lung cancer patients to a heightened risk of postoperative complications. Specifically, patients with advanced-stage lung cancer often present with larger tumor volumes, which can exert more extensive compression on adjacent pulmonary tissue, nerves, and blood vessels (Mao et al. 2023). During thoracoscopic surgery, the complete resection of the tumor and lymph node dissection may necessitate the removal of a greater amount of tissue, thereby increasing the risk of nerve and vascular damage during the procedure (Wang et al. 2023). This, in turn, may trigger more intense stress and inflammatory responses, which can not only impair postoperative recovery but also elevate the likelihood of cardiovascular complications such as arrhythmias. In light of these considerations, a comprehensive preoperative assessment is particularly crucial for lung cancer patients with higher TNM stages undergoing thoracoscopic surgery. This assessment should encompass a meticulous evaluation of the patient's cardiovascular status to determine the need for prophylactic antiarrhythmic medication. TNM stage II signifies a more advanced stage of cancer, which is often associated with increased systemic inflammation and heightened cardiovascular stress. These factors may collectively predispose patients to arrhythmias in the postoperative period. Additionally, depending on the individual patient's condition, neoadjuvant chemotherapy may be considered prior to surgery to reduce tumor volume, thereby potentially decreasing the extent of tissue resection and lymph node dissection required during the surgical procedure (Liang and He 2022). This approach may mitigate surgical trauma and the risk of associated complications.

Pulmonary infection is a well-recognized risk factor for arrhythmias, with underlying mechanisms that involve multiple physiological pathways. Infection can lead to a reduction in the pulmonary capillary bed and an increase in intrapulmonary pressure, which in turn augments the cardiac load and may precipitate myocardial ischemia. Under ischemic conditions, the release of catecholamines from myocardial tissue is increased. This heightened release alters the automaticity and conduction properties of the myocardium, thereby elevating the risk of arrhythmias (Gong et al. 2022). Furthermore, the occurrence of postoperative constipation is associated with multiple factors, including the use of anesthetic drugs, surgical trauma, and the slowdown of intestinal motility due to prolonged bed res (Shen and Li 2021). Studies (Xiao et al. 2019; Zhang et al. 2022) have indicated that excessive straining and breath-holding during defecation can significantly increase right atrial pressure, which is one of the primary causes of arrhythmia development. Arrhythmias in constipated patients frequently manifest within 3 h following defecation, underscoring the necessity for vigilant monitoring and timely intervention in constipated patients during postoperative care.

The implementation of effective measures to facilitate defecation and to prevent excessive straining and breath-holding is of significant importance in reducing the incidence of postoperative arrhythmias. Therefore, the optimization of postoperative respiratory tract management and the prevention and effective control of constipation emerge as critical strategies in mitigating the risk of arrhythmias.

In examining the factors influencing the development of postoperative arrhythmias in elderly lung cancer patients following thoracoscopic surgery, our study acknowledges several limitations that may impact the interpretation and generalizability of the findings. Firstly, the study employed a single-center, retrospective design, which may be susceptible to selection and information biases during data collection and analysis, thus not fully elucidating the specific mechanisms by which various factors contribute to the occurrence of arrhythmias. Secondly, as our study is retrospective in nature, we were unable to collect the specific data required to calculate the Charlson Comorbidity Index (CCI) for each patient. Given the limitations of our dataset, incorporating the CCI was not feasible in this instance. We will include the CCI in future prospective studies where we have more control over data collection. Finally, the limited sample size may not capture the influence of all relevant factors, constraining the representativeness and universality of the study's outcomes. Consequently, future research should consider a multicenter, large-sample design to enhance the statistical power and generalizability of the results, thereby more precisely identifying the risk factors associated with postoperative arrhythmias following thoracoscopic surgery.

Conclusion

In summary, this study has identified that the incidence of postoperative arrhythmias in elderly patients who undergo thoracoscopic surgery for lung cancer is 19.71%. The factors influencing postoperative arrhythmias in this cohort include age of 70 years or older, hypertension, a history of smoking, TNM stage II disease, postoperative pulmonary infection, and postoperative constipation. Based on these findings, postoperative arrhythmias following thoracoscopic lung cancer resection in elderly patients are subject to a multitude of influencing factors. Clinical practice can benefit from these insights by implementing targeted interventions. Preoperatively, it is crucial to actively enhance cardiopulmonary function and control blood pressure. Postoperatively, management should be intensified, with a focus on electrocardiographic monitoring, promoting expectoration and nebulization, and facilitating bowel movements. These measures aim to minimize the occurrence of postoperative pulmonary infections and constipation, thereby reducing the risk of postoperative arrhythmias. This approach underscores the importance of a comprehensive, multifaceted strategy to manage the complex interplay of factors contributing to arrhythmic events in elderly lung cancer patients following thoracoscopic procedures.

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Authors' contributions
X C, Y W designed research; X C, Y W, X Z conducted research; X C, Y W, X Z analyzed data; X C, Y W wrote the first draft of manuscript; Y W had primary responsibility for final content. All authors read and approved the final manuscript. All authors contributed to the conception or design of the study or to the acquisition, analysis, or interpretation of the data. All authors drafted the manuscript, or critically revised the manuscript, and gave final approval of the version that was submitted for publication. All authors agree to be accountable for all aspects of the work, ensuring integrity and accuracy.

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Data availability
The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
In this study, all methods were performed in accordance with the relevant guidelines and regulations. The study has been reviewed and approved by the Ethics Committee of The First Affiliated Hospital of Fujian Medical University (Approval Number: 20240815). Written informed consent had been obtained from all the included patients.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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