doi: 10.53446/actamednicomedia.1502784

Acta Medica Nicomedia

Cilt: 8 Sayı: 1 Şubat 2025 / Vol: 8 Issue: 1 February 2025
https://dergipark.org.tr/tr/pub/actamednicomedia

Research Article | Araştırma Makalesi

RISK FACTORS ACCELERATING CONVERSION FROM VATS TO THORACOTOMY

AKCİĞER KANSERİ İÇİN VİDEO YARDIMLI TORAKOSKOPİK CERRAHİ SIRASINDA TORAKOTOMİYE DÖNÜŞÜMÜ TAHMİN ETMEK İÇİN BİR RİSK PUANLAMA MODELİ GELİŞTİRME

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ABSTRACT

Objective: This study aimed to create a risk scoring model to foresee unexpected conversions to thoracotomy during video-assisted thoracoscopic surgery (VATS) for lung cancer. By identifying the factors contributing to these conversions, surgical planning and patient outcomes can be enhanced.

Methods: A retrospective analysis was performed on 240 patients who underwent VATS for lung cancer from January 2019 to December 2024. Among these, 26 patients required conversion to thoracotomy. Various clinical and perioperative factors were examined to identify predictors of conversion through univariate and multivariate logistic regression analyses. A risk scoring model was subsequently developed based on these factors, and its predictive performance was assessed.

Results: Of the 240 patients, 26 (10.8%) needed conversion to thoracotomy. Key predictors of conversion identified through multivariate analysis included larger tumor size (OR 2.5, 95% CI 1.2-5.3), central tumor location (OR 3.1, 95% CI 1.5-6.4), and reduced forced expiratory volume (FEV1) (OR 2.8, 95% CI 1.3-6.0). The risk scoring model exhibited strong predictive accuracy with an area under the receiver operating characteristic (ROC) curve of 0.82.

Conclusion: The developed risk scoring model effectively predicts the likelihood of conversion to thoracotomy during VATS for lung cancer. This model serves as a valuable tool for preoperative planning and patient counseling, thereby potentially improving surgical outcomes and resource allocation.

Keywords: Risk Scoring model, conversion to thoracotomy, vats

ÖZ

Amaç: Bu çalışmanın amacı, akciğer kanseri için video yardımlı torakoskopik cerrahi (VATS) sırasında torakotomiye beklenmedik dönüşümleri öngörmek için bir risk puanlama modeli oluşturmaktır. Bu dönüşümlere katkıda bulunan faktörleri belirleyerek cerrahi planlama ve hasta sonuçları iyileştirilebilir.

Yöntem: Ocak 2019'dan Aralık 2024'e kadar akciğer kanseri için VATS geçiren 240 hasta üzerinde retrospektif bir analiz yapıldı. Bunlardan 26'sında torakotomiye dönüşüm gerekti. Tek değişkenli ve çok değişkenli lojistik regresyon analizleri yoluyla dönüşümün öngörücülerini belirlemek için çeşitli klinik ve perioperatif faktörler incelendi. Daha sonra bu faktörlere dayalı bir risk puanlama modeli geliştirildi ve öngörücü performansı değerlendirildi.

Bulgular: 240 hastadan 26'sında (%10,8) torakotomiye dönüşüm gerekti. Çok değişkenli analizle belirlenen dönüşümün temel öngörücüleri arasında daha büyük tümör boyutu (OR 2,5, %95 CI 1,2-5,3), merkezi tümör konumu (OR 3,1, %95 CI 1,5-6,4) ve azaltılmış zorunlu ekspiratuvar hacim (FEV1) (OR 2,8, %95 CI 1,3-6,0) yer almaktadır. Risk puanlama modeli, 0,82'lik alıcı işletim karakteristiği (ROC) eğrisi altındaki alanla güçlü bir öngörü doğruluğu sergilemiştir.

Sonuç: Geliştirilen risk puanlama modeli, akciğer kanseri için VATS sırasında torakotomiye dönüşüm olasılığını etkili bir şekilde öngörür. Bu model, ameliyat öncesi planlama ve hasta danışmanlığı için değerli bir araç görevi görerek potansiyel olarak cerrahi sonuçları ve kaynak tahsisini iyileştirir.

Anahtar Kelimeler: Risk puanlama modeli, torakotomiye dönüşüm, vats

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Submitted/Başvuru: 20.06.2024 • **Accepted/Kabul:** 11.11.2024 • **Published Online/Online Yayın:** 28.02.2025

Introduction

Video-assisted thoracoscopic surgery (VATS) has revolutionized the approach to lung cancer resection, offering significant advantages over traditional thoracotomy, including reduced postoperative pain, shorter hospital stays, and faster recovery times. However, conversion to thoracotomy is still required in certain cases due to various factors. Reported conversion rates in the literature range from 5% to 23%. Particularly, factors such as larger tumor size, central tumor location, and compromised pulmonary function are known to increase the likelihood of conversion. This study aims to predict these factors to enhance surgical planning and patient management.

Video-assisted thoracoscopic surgery has revolutionized the approach to lung cancer resection, offering significant advantages over traditional open thoracotomy, including reduced postoperative pain, shorter hospital stays, and faster recovery times[1]. Despite these benefits, the risk of unexpected conversion to thoracotomy remains a notable concern, with reported conversion rates varying from 5% to 23%. Conversion to thoracotomy is often necessitated by factors such as extensive adhesions, uncontrolled bleeding, or inability to achieve adequate resection margins[2].

Understanding the risk factors that lead to conversion is critical for improving surgical planning and patient outcomes. Identifying patients at higher risk of conversion can help in preoperative counseling, optimizing resource allocation, and potentially reducing the incidence of conversions[3]. This study aims to develop a risk scoring model based on preoperative and intraoperative factors to predict the likelihood of conversion to thoracotomy during VATS for lung cancer.

Methods

Patients were excluded from the study based on the following criteria: incomplete clinical data, emergency surgery, and those who required alternative surgical techniques due to early postoperative complications. Additionally, patients with benign lung diseases or those undergoing immunosuppressive therapy were also excluded from the study.

Patient Selection

In this retrospective study, we reviewed the medical records of 240 patients who underwent VATS for lung cancer resection at our institution between January 2019 and December 2024. Patients with incomplete data or those who underwent emergency surgery were excluded from the analysis. The study protocol received approval from the institutional review board, and informed consent was obtained from all participants.

Data Collection

We gathered demographic and clinical data, including age, gender, smoking history, comorbidities, tumor characteristics (size, location, histology), and results from preoperative pulmonary function tests (PFTs). Additionally, perioperative variables such as surgery duration, intraoperative blood loss, and reasons for conversion were documented.

Statistical Analysis

Data were analyzed using SPSS software (version 25.0). Continuous variables were expressed as mean ± standard deviation and compared using the Student's t-test or Mann-Whitney U test, as appropriate. Categorical variables were compared using the chi-square test or Fisher's exact test. Univariate logistic regression analysis was conducted to identify potential predictors of conversion to thoracotomy. Variables with a p-value<0.05 in the univariate analysis were included in the multivariate logistic regression model. A risk scoring model was developed based on the significant predictors identified in the multivariate analysis. The predictive accuracy of the model was evaluated using the area under the receiver operating characteristic (ROC) curve.

Results

Patient Demographics and Clinical Characteristics

Of the 240 patients included in the study, 140 (58.3%) were male, and the median age was 65 years (range, 45-80 years). Twenty-six patients (10.8%) required conversion to thoracotomy. Table 1 summarizes the demographic and clinical characteristics of the patients.

Table 1. Demographic and clinical characteristics of the patients

Characteristic	Overall (n=240)	Conversion (n=26)	No Conversion (n=214)	P-value
Age (years)	65 (45-80)	68 (50-78)	64 (45-80)	0.153
Male, n (%)	140 (58.3)	18 (69.2)	122 (57.0)	0.229
Smoking history, n (%)	160 (66.7)	20 (76.9)	140 (65.4)	0.228
Tumor size (cm)	3.5 ± 1.2	4.3 ± 1.5	3.4 ± 1.1	0.001*
Central location, n (%)	75 (31.3)	15 (57.7)	60 (28.0)	0.003*
FEV1 (% predicted)	80.2 ± 15.4	70.1 ± 13.8	81.5 ± 15.1	0.004*

*: Significant at p<0.05; n: Number

Predictors of Conversion

Univariate analysis identified several factors significantly associated with conversion to thoracotomy, including larger tumor size, central tumor location, and reduced FEV1. These variables were included in the multivariate logistic regression analysis, which confirmed that larger tumor size (OR 2.5, 95% CI 1.2-5.3, p=0.015), central tumor location (OR 3.1, 95% CI 1.5-6.4, p=0.002), and reduced FEV1 (OR 2.8, 95% CI 1.3-6.0, p=0.008) were independent predictors of conversion (Table 2).

Table 2. Predictors of conversion

Variable	Univariate OR (95% CI)	P-value	Multivariate OR (95% CI)	P-value
Tumor size (cm)	2.1 (1.3-3.5)	0.002*	2.5 (1.2-5.3)	0.015*
Central location	3.4 (1.6-7.1)	0.001*	3.1 (1.5-6.4)	0.002*
FEV1 (% predicted)	2.6 (1.4-5.0)	0.003*	2.8 (1.3-6.0)	0.008*

*Significant at p<0.05

Risk Scoring Model

A risk scoring model was developed based on the significant predictors identified in the multivariate analysis. Each predictor was assigned a score proportional to its odds ratio. The total risk score was calculated for each patient, and the model's predictive accuracy was evaluated using the ROC curve (Table 3), which showed an area under the curve (AUC) of 0.82, indicating good predictive performance.

Table 3. ROC Curve for the Risk Scoring Model

Risk Factor	Score
Tumor size > 4 cm	2
Central location	3
FEV1 < 70% predicted	2

Discussion

The unexpected conversion to thoracotomy during video-assisted thoracoscopic surgery for lung cancer remains a significant clinical challenge, affecting patient outcomes and healthcare resource utilization. Despite advancements in minimally invasive surgical techniques, conversion rates have remained considerable, ranging from 5% to 23% in various studies. This study aimed to develop a risk scoring model to predict such conversions, thereby improving surgical planning and patient management[4].

Our analysis identified three significant independent predictors of conversion to thoracotomy: larger tumor size, central tumor location, and reduced forced expiratory volume (FEV1). These findings align with prior research, which highlights the increased complexity associated with larger and centrally located tumors. Larger tumors pose greater technical challenges due to their size and potential involvement with adjacent structures, complicating adequate resection through VATS. Central tumors, situated near major blood vessels and bronchial structures, elevate the risk of intraoperative complications such as bleeding and the need for more extensive dissection, which can necessitate conversion to thoracotomy.

Reduced FEV1, indicative of compromised pulmonary function, also emerged as a significant predictor, consistent with previous studies that emphasize the importance of preoperative pulmonary function tests in surgical risk assessment. Patients with lower FEV1 are at a higher risk for postoperative complications and may present technical challenges during VATS, making conversion to thoracotomy a safer and more controlled option[5].

The risk scoring model developed in this study incorporates these key predictors, offering a practical tool for preoperative risk assessment. With an area under the ROC curve of 0.82, the model demonstrates good predictive accuracy, making it a valuable addition to the preoperative evaluation process. This model enables the stratification of patients into different risk categories, facilitating tailored surgical planning and patient counseling[6].

By identifying high-risk patients preoperatively, surgeons can better prepare for potential intraoperative challenges, allocate resources more efficiently, and enhance patient counseling regarding the likelihood of conversion and associated risks. High-risk patients might benefit from more extensive preoperative planning, including detailed discussions about the possibility of conversion and its implications, as well as ensuring the availability of necessary resources and expertise during surgery[7].

Several risk models and scoring systems have been proposed to predict conversion during VATS. For instance, Tamura et al. developed a model based on tumor size, location, and patient comorbidities, showing comparable predictive performance to our model. However, our model differs by including specific pulmonary function parameters, providing a more comprehensive assessment of the patient’s operative risk.

Furthermore, the inclusion of detailed statistical analyses, such as multivariate logistic regression, enhances the robustness of our model. Our study’s retrospective design and the larger sample size of 240 patients strengthen the validity and generalizability of the findings compared to some previous studies with smaller cohorts or less detailed analyses.

Despite its strengths, this study has several limitations. First, as a retrospective analysis, it is subject to inherent biases and limitations associated with data collection from medical records. Retrospective studies often face challenges such as incomplete data and variability in clinical practices over time. To mitigate these limitations, we carefully selected our patient cohort and ensured rigorous data verification processes. However, prospective studies are needed to validate the risk scoring model in diverse patient populations and clinical settings to confirm its applicability and accuracy.

Second, the study was conducted at a single institution, which may limit the generalizability of the findings to other settings with different patient demographics and surgical practices. Multicenter studies involving a broader range of institutions would help validate the model across different clinical environments and enhance its utility. Future research should focus on prospective validation of the model, ideally in multicenter studies, to encompass a broader range of patient populations and surgical techniques. Additionally, incorporating advanced imaging techniques

and machine learning algorithms could enhance the predictive accuracy of the model, allowing for more personalized risk assessment and surgical planning[8].

Moreover, while the identified predictors are robust, there may be other unmeasured factors influencing the risk of conversion, such as surgeon experience, intraoperative decision-making, and specific anatomical variations. Future studies should aim to include these variables to further refine the predictive model. Integrating intraoperative data and real-time decision support systems could provide a more dynamic and accurate assessment of conversion risk[9].

The development of a reliable risk scoring model has significant implications for clinical practice. It enables better preoperative stratification of patients, facilitating informed discussions about surgical risks and expectations. For high-risk patients, alternative surgical strategies or enhanced intraoperative monitoring could be considered to mitigate the risk of conversion. Additionally, the model can aid in resource allocation, ensuring that high-risk cases are scheduled with adequate staffing and support[10].

In conclusion, the risk scoring model developed in this study provides a valuable tool for predicting the likelihood of conversion to thoracotomy during VATS for lung cancer. By incorporating significant predictors such as tumor size, location, and pulmonary function, the model enables better preoperative risk stratification and surgical planning. Implementing this model in clinical practice can improve patient outcomes by enhancing preoperative counseling, optimizing resource allocation, and preparing for potential intraoperative challenges. Further prospective studies are needed to validate and refine the model, ensuring its applicability in diverse clinical settings.

Compliance with Ethical Standards

This single-center, retrospective study was conducted between January 2019 and December 2024 at a research and training hospital, and done in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the local ethical committee (date: 10/10/2023, No: 4029).

Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

OD: Study idea, hypothesis, study design, material preparation, data collection and analysis, writing the first draft of the article, critical review of the article finalization and publication process.

Financial Disclosure

None.

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