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Impact of coronary artery disease on outcomes of video-assisted thoracoscopic surgery for non-small cell lung cancer: A retrospective analysis

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ABSTRACT

Introduction: Coronary artery disease (CAD) is a prevalent comorbidity among patients undergoing lung cancer surgery, posing significant perioperative challenges. Video-assisted thoracoscopic surgery (VATS) has gained prominence for its minimally invasive approach and reduced morbidity compared to open thoracotomy. This study investigates the outcomes of VATS in patients with non-small cell lung cancer (NSCLC) and concomitant CAD.

Materials and Methods: This retrospective study analyzed 42 patients with NSCLC who underwent VATS anatomical resections at Kartal Kosuyolu High Specialization Education & Research Hospital from April 2020 to August 2024. Patients were divided into two groups: the study group included those with a history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), while the control group comprised patients without such histories. All patients underwent preoperative cardiac evaluations and tailored antithrombotic management. Outcomes were assessed in terms of perioperative complications, postoperative recovery, and pathological findings.

Results: The study group (n=20) and control group (n=22) were comparable in terms of demographics and tumor characteristics. The mean operative time was 312 minutes for the study group and 330 minutes for the control group. Drain removal time and hospital stay were slightly longer in the study group. Postoperative cardiovascular complications were minimal, with no significant differences between groups. Pathological evaluation revealed similar tumor histology and staging, predominantly adenocarcinoma in both groups. VATS demonstrated low conversion rates and acceptable outcomes, even in high-risk patients with CAD.

Conclusion: VATS is a feasible and safe surgical option for NSCLC patients with concomitant CAD. With appropriate preoperative evaluations and individualized management, perioperative risks can be minimized, enabling effective surgical treatment for this complex patient population.

Keywords: Coronary artery disease, non-small cell lung cancer, perioperative outcomes, video-assisted thoracoscopic surgery

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Introduction

Lung cancer remains the leading cause of cancer-related mortality worldwide, representing a major global health challenge.[1-3] In Türkiye, the burden of lung cancer is similarly substantial, contributing to a significant number of cancer-related deaths annually.[4] According to the National Comprehensive Cancer Network (NCCN) Guidelines, surgical intervention is the cornerstone of treatment for stage 1 and stage 2 lung cancer and may also be indicated for certain subgroups of patients with stage 3 disease.[2,3] While open thoracotomy has long been the standard surgical approach, the past three decades have seen a growing shift toward minimally invasive techniques, driven by advances in surgical technology and the pursuit of improved patient outcomes.[1,5]

Video-assisted thoracoscopic surgery (VATS) has emerged as a prominent minimally invasive approach for the management of lung cancer.[6] Compared to open thoracotomy, VATS is associated with several advantages, including reduced perioperative complications, shorter hospital stays, and lower surgical morbidity. These benefits are particularly pronounced in high-risk patients, such as those with significant comorbidities, who were previously considered unsuitable for surgery. Despite these advantages, the role of VATS remains a subject of debate, with some studies reporting comparable outcomes between VATS and open thoracotomy. Nevertheless, the global adoption of VATS has steadily increased, with notable variability in its utilization across countries and healthcare institutions.[6] In Türkiye, the technique has gained traction, reflecting broader international trends in minimally invasive thoracic surgery.[7]

Coronary artery disease (CAD) is a common comorbidity in patients undergoing lung cancer surgery, posing unique challenges for perioperative management.[8] Large-scale institutional databases estimate the prevalence of CAD in resectable lung cancer patients to be between 7% and 16%. Furthermore, the risk of major adverse cardiac events (MACE) following anatomic lung resection is approximately 3%. Studies from Japan and other cohorts have highlighted the intersection of lung cancer and cardiovascular disease, reporting that up to 26.5% of lung cancer patients have concomitant coronary heart disease, with perioperative cardiovascular event risks as high as 4.2%. These findings underscore the importance of optimizing surgical strategies and perioperative care to mitigate cardiovascular risks while ensuring effective oncologic outcomes.[8]

In this study, we aimed to investigate the perioperative and postoperative outcomes of lung cancer patients undergoing video-assisted thoracoscopic surgery (VATS) with coexisting CAD, focusing on the incidence of MACE and the feasibility of VATS in this high-risk population.

Materials and Methods

This retrospective study included 42 patients diagnosed with non-small cell lung cancer (NSCLC) who underwent consecutive VATS anatomic resections at the Department of Chest Surgery, Kartal Kosuyolu High Specialization Education & Research Hospital, between April 2020 and August 2024. Ethical approval was obtained from the local ethics committee (No: 2024/19/955), and the study was conducted in accordance with the principles of the Helsinki Declaration. Written informed consent was obtained from all participants, and patient privacy was strictly maintained.

Patients were categorized into two groups based on their cardiovascular history. The study group comprised patients with a history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) for acute coronary syndrome. The control group consisted of patients without such a history. Only patients with a confirmed diagnosis of NSCLC were included; those with other diagnoses were excluded.

Preoperative Assessment and Management

All patients underwent a comprehensive preoperative cardiac evaluation, including resting electrocardiogram (ECG) and ultrasound echocardiography (ECHO). The management of antithrombotic agents was guided by cardiologists. Antiplatelet agents were discontinued seven days before surgery, while warfarin therapy was stopped five to seven days prior and replaced with bridging therapy using unfractionated heparin (UFH). UFH was resumed postoperatively as soon as hemostasis was confirmed.

Surgical Procedure

VATS was performed under single-lung intubation anesthesia with the patient positioned in the lateral decubitus position (Fig. 1). The surgical team, including the primary surgeon and assistant, was positioned anterior to the patient, while the camera operator was placed posteriorly.

Thoracic access was achieved using a 10 mm thoracoport inserted at the seventh intercostal space along the midclavicular line, and a 30 mm utility incision made at the

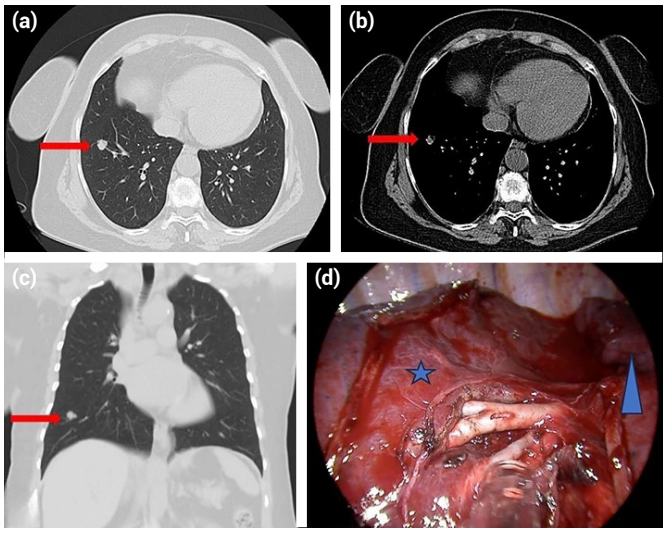

Figure 1. Thoracic computed tomography; right lung lower lobe fissure neighbor anteriorly lobulated parenchymal nodule with 12.5 mm diameter (arrow) **(a)** In sections in the parenchymal window **(b)** In sections in the mediastinal window **(c)** In sections in the coronary section parenchymal window **(d)** Surgical image, lower lobe (star) upper lobe (triangle).

fourth intercostal space along the preaxillary line. A 10 mm, 30-degree thoracoscope was used for visualization.

Adhesions were carefully separated using sharp dissection or energy devices, depending on their density. Anatomical resection involved sequential ligation and division of the artery, vein, and bronchus of the affected lobe using sharp and blunt dissection techniques. Conversion to thoracotomy was performed in cases of significant bleeding, dense adhesions preventing safe dissection, or inability to achieve an R0 resection via VATS.

Postoperative Care

Patients were closely monitored in the surgical intensive care unit for the first postoperative night. Vital signs, drainage output, chest X-rays, and laboratory parameters were assessed on the first postoperative day before transferring the patients to the thoracic surgery ward.

Statistical Analysis

Data were analyzed to compare the study and control groups across various demographic, clinical, and surgical parameters. Categorical variables were analyzed using Chi-square tests, with Fisher's exact test employed for comparisons where cell counts were less than five. Continuous variables were compared using the Mann-Whitney U test due to the non-normal distribution of the data. Statistical significance was defined as $p<0.05$ for all analyses.

Results

A total of 42 patients with NSCLC were included in the analysis, comprising 20 individuals in the study group and 22 in the control group. The study group consisted of patients with a history of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG), while the control group included those without such a history.

Demographics and Clinical Characteristics

The study group had 18 males (90%), and the control group included 16 males (72.7%), yielding an overall male prevalence of 80.9%. The mean age was 66.5 years (range: 57–82) in the study group and 65 years (range: 50–83) in the control group, with an overall mean of 66 years. Smoking was reported by 14 participants (70%) in the study group and 14 (63.6%) in the control group, resulting in an overall smoking prevalence of 66.6% (Table 1).

Comorbidities varied between groups: hypertension was present in 40% of the study group and 31.8% of the control group, chronic obstructive pulmonary disease (COPD) in 10% and 13.6%, and diabetes mellitus (DM) in 45% and 13.6%, respectively. Overall, DM was the most prevalent comorbidity, affecting 28.5% of participants (Table 1).

Operative and Postoperative Data

The VATS approach was used for 75% of the study group and 72.7% of the control group, while hybrid VATS was employed for the remaining participants. Lobectomy was the predominant surgical technique, performed in 80% of the study group and 86.3% of the control group. The mean operative time was 312 minutes (range: 150–630) for the study group and 330 minutes (range: 190–440) for the control group.

Postoperative recovery metrics showed a mean drain removal time of 5 days (range: 1–54) in the study group and 3.5 days (range: 1–25) in the control group. The average hospital stay was 6 days (range: 3–52) for the study group and 5 days (range: 1–14) for the control group (Table 1).

Pathological Findings and Staging

In the study group, 85% of participants had N0 lymph node status, 5% had N1, and 10% had N2. Similarly, in the control group, 86.3% had N0, 9% had N1, and 4.5% had N2 status. Adenocarcinoma was the most common tumor

Table 1. Demographic, clinical, postoperative and histopathological data of patients who treatment with video-assisted thoracoscopic surgery (VATS)

Parameter	Total (n=42)	Study group (n=20)	Control group (n=22)
Gender (male), N (%)	34 (80.9)	18 (90)	16 (72.7)
Age (years; mean)	66 (50-83)	66.5 (57-82)	65 (50-83)
Smoker, N (%)	28 (66.6)	14 (70)	14 (63.6)
Comorbidity, N (%)			
HT	15 (35.7)	8 (40)	7 (31.8)
COPD	5 (11.9)	2 (10)	3 (13.6)
DM	12 (28.5)	9 (45)	3 (13.6)
PCI, N (%)	18 (42.8)	18 (90)	0 (0)
CABG, N (%)	4 (9.5)	4 (20)	0 (0)
Antithrombotic agents, N (%)			
None	16 (38)	1 (5)	15 (68.1)
One	19 (45)	13 (65)	6 (27.2)
Two	7 (16.6)	6 (30)	1 (4.5)
Resection type, N (%)			
Segmentegtomy	7 (16.6)	4 (20)	3 (13.6)
Lobectomy	35 (83.3)	16 (80)	19 (86.3)
Side of resection, N (%)			
R	20 (47.6)	8 (40)	12 (54.5)
L	22 (52.3)	12 (60)	10 (45.5)
Perative approach, N (%)			
VATS	31 (73.8)	15 (75)	16 (72.7)
Hybrid VATS	11 (26.1)	5 (25)	6 (27.2)
Operative time (min)	322.5 (150-630)	312 (150-630)	330 (190-440)
Drain removing time (days)	4 (1-54)	5 (1-54)	3.5 (1-25)
Length of stay in hospital (days)	6 (1-52)	6 (3-52)	5 (1-14)
Tumour size (mm, median)	25 (10-65)	24.5 (10-65)	25.5 (10-50)
Tumor subtype, N (%)			
Adenocarcinoma	26 (61.9)	14 (70)	12 (54.5)
Squamous carcinoma	13 (30.9)	3 (15)	10 (45.4)
Carcinoid	2 (4.76)	2 (10)	0 (0)
Sarcomatoid carcinoma	1 (2.38)	1 (5)	0 (0)
The extent of the tumor (T), N (%)			
T1a	3 (7.14)	2 (10)	1 (4.5)
T1b	15 (35.7)	7 (35)	8 (36.3)
T1c	14 (33.3)	5 (25)	9 (40.9)
T2a	4 (9.5)	2 (10)	2 (9)
T2b	2 (4.76)	-	2 (9)
T3	4 (9.5)	4 (20)	-
The extent of spread to the lymph nodes (N), N (%)			
N0	36 (85.7)	17 (85)	19 (86.3)
N1	3 (7.14)	1 (5)	2 (9)
N2	3 (7.14)	2 (10)	1 (4.5)

COPD: Chronic obstructive pulmonary disease; DM: Diabetes mellitus; HT: Hypertension; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass grafting; VATS: Video-assisted thoracoscopic surgery.

histology in both groups, observed in 70% of the study group and 54.5% of the control group. Squamous carcinoma was present in 15% of the study group and 45.4% of the control group, with carcinoid and sarcomatoid carcinoma exclusively in the study group (Table 1).

Tumor staging revealed that in the study group, 10% of participants had T1a tumors, 35% had T1b, 25% had T1c, 10% had T2a, and 20% had T3 tumors. In the control group, 4.5% had T1a, 36.3% had T1b, 40.9% had T1c, 9% had T2a, and 9% had T2b tumors (Table 1).

Discussion

This study evaluated the perioperative and postoperative outcomes of patients with NSCLC undergoing VATS, with a particular focus on those with concomitant CAD. Our findings emphasize the unique challenges and complexities associated with managing this high-risk population while also underscoring the potential for safe and effective surgical interventions when appropriate precautions are taken.

Comparison with Existing Literature

The prevalence of CAD in our cohort (7%–16%) aligns with recent reports, which identify CAD as a common comorbidity among lung cancer patients undergoing resection.[9-12] CAD remains a significant determinant of perioperative risk, as also highlighted by Sandri et al.[9], who reported that CAD increases the likelihood of MACE during the postoperative period. However, consistent with findings by Li et al.[13], our study demonstrated that with thorough preoperative preparation and carefully managed perioperative protocols, VATS lobectomy can be safely performed in this challenging population. The relatively low incidence of postoperative cardiovascular events in our cohort supports the view that proactive and individualized perioperative management is key to mitigating risks.

As Maeda et al.[14] emphasized, robust preoperative cardiac evaluations are critical, particularly in patients with a history of cardiovascular interventions. Our study adopted a similar approach, incorporating resting ECG, echocardiography, and consultation with cardiologists to guide antithrombotic management. The use of tailored bridging protocols ensured both cardiovascular stability and surgical safety, likely contributing to the favorable outcomes observed in our study.

Surgical Outcomes and Technique

Our findings reaffirm the advantages of VATS over open thoracotomy, in line with the results of Laursen et al.[6], who highlighted reduced operative times, shorter hospital stays, and fewer complications with minimally invasive approaches. Importantly, this benefit extends to high-risk populations, as noted by Serna-Gallegos et al.[15], who demonstrated the safety of VATS even in patients with extensive surgical histories. The low conversion rate to thoracotomy in our study further supports the feasibility of VATS in complex cases, provided that the procedure is conducted by an experienced surgical team adept at managing intraoperative challenges, such as dense adhesions or unexpected bleeding.

Impact of CAD on Outcomes

CAD was associated with a slightly longer hospital stay and a higher prevalence of certain complications in our study. However, these findings are consistent with Kirk et al.[8], who emphasized that meticulous patient selection and perioperative care can significantly reduce complications in patients with CAD. Notably, our study demonstrated comparable N0 staging and similar histological profiles between the study and control groups, suggesting that the presence of CAD does not adversely impact tumor resectability or oncological outcomes. This finding underscores the importance of not excluding CAD patients from surgical consideration solely based on cardiovascular risk, as outcomes can remain favorable with adequate preparation.

Strengths and Limitations

This study provides valuable insights into the integration of VATS for NSCLC patients with CAD, contributing to the growing evidence of its safety and efficacy in high-risk populations. The inclusion of preoperative cardiac optimization protocols and the comprehensive analysis of perioperative outcomes strengthen the relevance of our findings. However, the single-center, retrospective design limits generalizability, and the relatively small sample size may not capture the full spectrum of potential outcomes. Future research should focus on larger, multicenter cohorts and prospective designs to validate these findings further and to develop standardized perioperative pathways for this unique patient population.

Conclusion

This study highlights the feasibility and safety of VATS in NSCLC patients with concomitant CAD. Despite the increased perioperative challenges, careful preoperative evaluation and individualized management strategies can minimize risks and improve outcomes. These findings emphasize the need for multidisciplinary collaboration and tailored perioperative protocols in high-risk patient populations.

Disclosures

Ethichs Committee Approval: The study protocol was approved by the Ethical Committee of Clinical Research of Kartal Kosuyolu High Specialization Education & Research Hospital (No: 2024/19/955). This study was conducted according to the Helsinki principles, patients signed informed consent for participation, and nothing invasive of patients' privacy was done.

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