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Case Report

Thoracoscopic Bronchovascular (Double) Sleeve Lobectomy to Correct Intraoperative Vascular Injury: A Case Report

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Abstract

Double sleeve lobectomy, involving both bronchial and vascular reconstruction, is a complex but lung-sparing alternative to pneumonectomy for centrally located tumors. While traditionally performed via thoracotomy, its application through video-assisted thoracoscopic surgery (VATS) remains limited. We report the first known case of a double sleeve lobectomy in Türkiye performed via a VATS approach in a 58-year-old female with a centrally located left upper lobe pleomorphic carcinoma involving both the pulmonary artery and bronchus. This case demonstrates the technical feasibility of VATS double-sleeve lobectomy when performed by experienced surgeons and shows that a mistake made during pulmonary artery division does not necessarily result in pneumonectomy.

Keywords: Bronchovascular reconstruction, double sleeve lobectomy, lung carcinoma, surgical error, VATS

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Double sleeve lobectomy is a valuable lung-preserving procedure in patients with centrally located non-small cell lung cancer (NSCLC) involving both the bronchus and pulmonary artery.[1] Compared to pneumonectomy, it offers the advantage of preserving lung function and reducing postoperative morbidity and mortality.[2,3] Traditionally performed via thoracotomy, the procedure remains technically demanding, which has limited its broader adoption in the era of minimally invasive surgery. With increasing experience in video-assisted thoracoscopic surgery (VATS), there has been a growing interest in extending its application to more complex cases. Nevertheless, double sleeve lobectomy via VATS remains a rarely reported procedure, mostly limited to case reports or small series due to its technical complexity and steep learning curve.[2,4,5]

Dr. Diego Gonzalez-Rivas pioneered the use of uniportal VATS for double sleeve resections, demonstrating its feasibility in selected cases and encouraging thoracic surgeons to push the boundaries of minimally invasive approaches.[2,6] Furthermore, multicenter experiences, such as the report by Huang et al.[5] and the small series by Mei et al.,[7] have provided preliminary evidence supporting the safety and effectiveness of VATS in such complex reconstructions. Despite these advances, there is still limited literature on the intraoperative management of unexpected vascular complications during VATS and the use of vascular sleeve anastomosis as a salvage strategy.

To the best of our knowledge, we present the first bronchovascular (double) sleeve lobectomy performed using the VATS approach in Türkiye. This case not only illustrates the feasibility of performing a double sleeve lobectomy via

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VATS but also highlights the role of vascular reconstruction in avoiding pneumonectomy following an intraoperative pulmonary artery injury.

Case Report

A 58-year-old male non-smoker patient presented with a complaint of persistent cough. A chest X-ray revealed an opacity in the left upper zone, prompting further evaluation with thoracic computed tomography, which demonstrated a 6cm mass in the left upper lobe involving both the left upper lobe bronchus and the pulmonary artery. The patient had no significant comorbidities. Positron emission computed tomography (PET-CT) confirmed a centrally located 6.4cm mass with complete collapse of the left upper lobe and a standardized uptake value (SUVmax)=18. Fiberoptic bronchoscopy (FOB) revealed a mass completely obstructing the left upper lobe bronchus, and a histopathological diagnosis of pleomorphic carcinoma was established through a bronchoscopic biopsy obtained from this mass (Fig. 1). Mediastinal staging was performed using EBUS, and as the pathological results were negative, surgical resection via a VATS approach was planned. Written informed consent was obtained from the patient.

Surgical Technique

Under general anesthesia with selective intubation, FOB confirmed complete obstruction of the left upper lobe bronchus. The patient was positioned in the right lateral decubitus position. A 3cm utility incision was made at the anteromedial axillary line in the 5th intercostal space without rib spreading. A soft tissue wound retractor (Alexis) was used for exposure. No pleural adhesions were observed. The fissure was complete, and the tumor did not involve the lower lobe. Based on radiological imaging, invasion of the pulmonary artery by the tumor was suspected. Therefore, the main pulmonary artery was first dissected, mobilized, and encircled with a vessel loop to provide proximal control in the event of vascular injury during dissection. At this stage, no vascular clamping was performed. Aortopulmonary window and hilar lymph nodes were dissected. The superior pulmonary vein was divided using an endoscopic stapler. Subsequently, the basal pulmonary artery was approached through the fissure, and the anterior fissure was stapled.

Dissection was continued to encircle and divide the apicoanterior branch of the pulmonary artery. However, due to traction from the atelectatic upper lobe and excessive rotation during dissection, the basal segmental artery was mistakenly stapled instead of the apicoanterior branch (Fig. 2). This error was detected during further dissection of the pulmonary artery in the fissure. To avoid performing a pneumonectomy, a vascular sleeve anastomosis was planned. The inferior pulmonary ligament was released to reduce tension and facilitate mobilization of the lower lobe. Following systemic heparinization (5,000IU), the remaining upper lobe branch

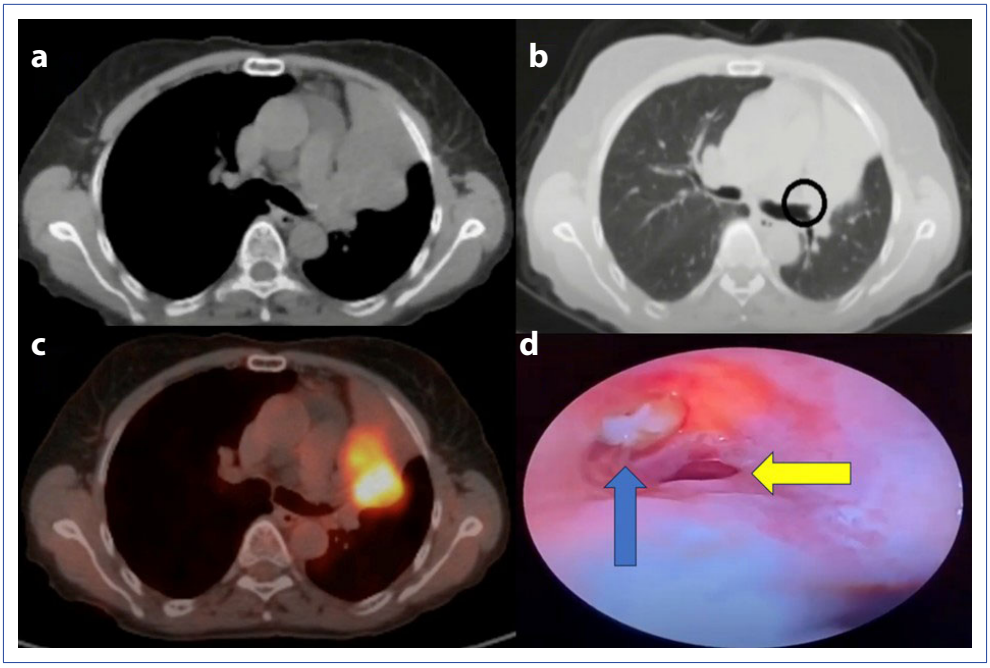

Figure 1. Radiological and bronchoscopic findings. **a.** The mass is close to the pulmonary artery, **b.** Atelectasis due to complete obstruction of the left main bronchus by the mass, **c.** High SUVmax retention of the mass in PET-CT, **d.** Image of the mass from the left main bronchus entrance with fiber optic bronchoscopy. Blue: left upper lobe bronchus Yellow: left lower lobe bronchus.

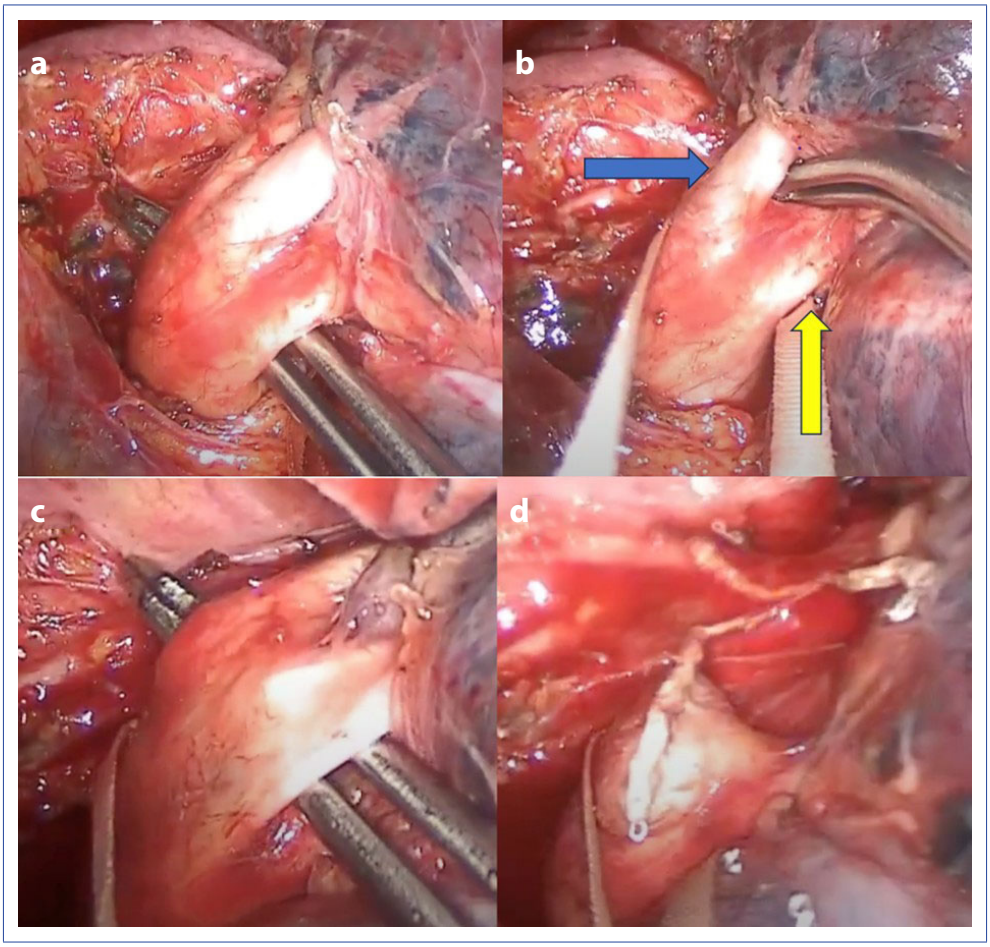

Figure 2. Relationship of the tumor with the pulmonary artery. **a.** Left main pulmonary artery, **b.** Blue: basal segment artery Yellow: apicoanterior branch, **c.** Rotation of basal segment artery confused with apicoanterior branch, **d.** Stump of basal segment artery mistakenly stapled.

(posterior branch) of the pulmonary artery at the fissure level was temporarily clamped with a hem-o-lok clip and divided. Then, the last branch (apicoanterior branch) at the level of the main pulmonary artery was temporarily divided by stapling (Fig. 3). At this point, the upper lobe was completely separated from all arterial and venous connections. The main bronchus and the lower lobe bronchus were then dissected and encircled. The main bronchus was divided proximally to the upper lobe bronchus, and the lower lobe bronchus was divided at the secondary carina. The left upper lobe was removed en bloc using an endobag. Frozen section analysis confirmed negative bronchial margins. A bronchial sleeve anastomosis was performed using continuous 3-0 nonabsorbable polypropylene sutures. Subcarinal and paraesophageal lymph nodes were also removed. No air leakage was detected during the intraoperative leak test.

Given the technical challenges anticipated during vascular anastomosis through a single port, especially due to the placement of a Satinsky clamp via the utility incision, a second camera port was added at the 7th intercostal space in the posterior axillary line, converting the procedure to a biportal VATS approach. The pericardium was opened, and the main pulmonary artery was controlled intrapericardially to gain more distance before anastomosis, and a large thoracoscopic Satinsky clamp (D'Amico Clamp, Scanlan International, Inc.) was used for clamping. This Satinsky clamp was positioned at the lower part of the wound and directed through the utility incision. The superior segmental and basal arteries of the lower lobe were separately controlled with double vessel loops. The previously applied hem-o-lok was cut and removed. The apicoanterior artery, which had been temporarily stapled, was reopened with scissors to prepare the vascular edges for sleeve anastomosis. The pulmonary artery anastomosis was then performed using a continuous 4-0 double-needle polypropylene suture. Prior to knot tying, air was evacuated by partially releasing the Satinsky clamp. After ensuring that bleeding and leak-free flow were achieved, the distal and proximal parts of the pulmonary artery were slowly opened (Fig. 4). The bronchial and vascular anastomoses were wrapped with oxidized regenerated cellulose.

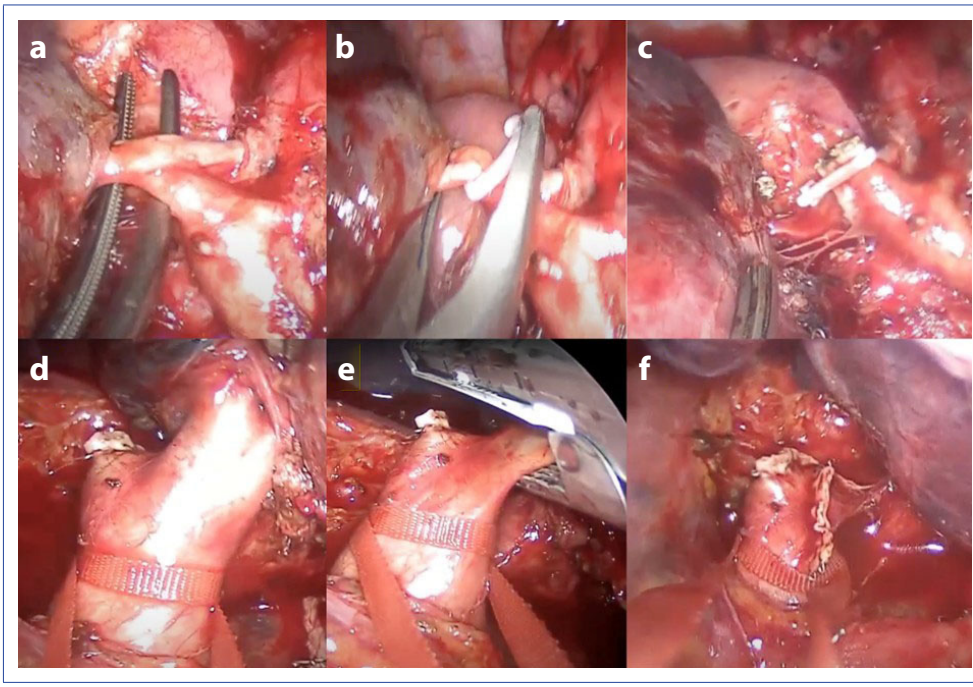

Figure 3. Preparation of arterial stumps before vascular sleeve anastomosis. **a.** Posterior segment artery at the level of the fissure, **b.** Temporary hem-o-lok clipping of the posterior segment artery, **c.** Posterior segment artery stump, **d, e.** Temporary division of the apicoanterior artery branch with a stapler, **f.** Stump of the apicoanterior artery branch.

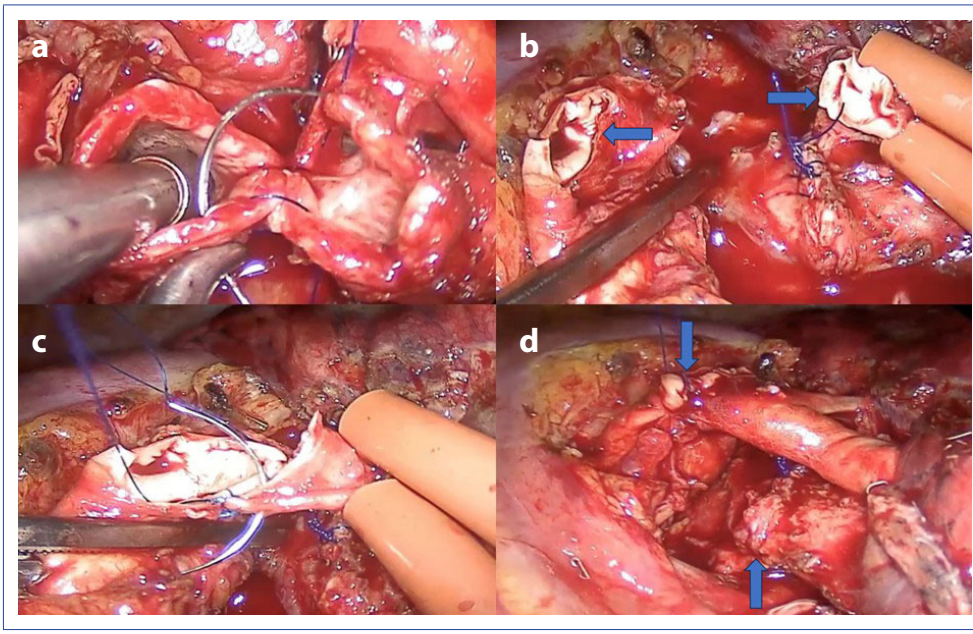

Figure 4. Bronchovascular sleeve anastomosis. **a.** Bronchial sleeve anastomosis, **b.** Stumps before pulmonary artery sleeve anastomosis, **c.** Vascular sleeve anastomosis, **d.** Image of bronchovascular sleeve anastomosis.

A single chest drain was inserted. The total operative time was 270 minutes, and the estimated intraoperative blood loss was 250 mL. The chest drain was removed on postoperative day 3, and the patient was discharged on day 4.

Final histopathology revealed a 6 cm pleomorphic carcinoma (squamous cell carcinoma with spindle cell components), staged as IIB (pT3N0M0). Resection margins were negative, and no lymph node metastasis was detected.

The patient completed six cycles of adjuvant chemotherapy, and no recurrence or metastasis was observed at the 15-month follow-up.

Discussion

To our knowledge, there are no prior reports in the literature of a vascular injury during VATS being successfully managed intraoperatively with pulmonary artery sleeve anastomosis as a corrective measure. In cases of perioperative vascular injury, the standard approach has generally been thoracotomy. However, this case is significant in demonstrating that VATS may also be a feasible alternative, thereby contributing valuable insight to existing surgical practice. This makes our case not only unique in terms of intraoperative decision-making and complication management but also the first reported VATS double sleeve lobectomy in Türkiye. We believe it provides valuable insights into the feasibility of complex thoracoscopic reconstructions.

Sleeve resections allow preservation of lung parenchyma and help avoid pneumonectomy, thereby reducing the risk of postoperative complications and improving functional outcomes.[3] Despite the increasing adoption of video-assisted thoracoscopic surgery (VATS) for major lung resections, double sleeve lobectomies requiring both bronchial and vascular reconstruction remain predominantly performed via open thoracotomy due to their complexity.[1] However, as experience with VATS bronchial sleeve resections grows, there is a shift toward expanding its indications even for more complex procedures.[4] For more complex surgeries such as double-sleeve resections, experience with VATS has largely remained limited to case reports due to both technical difficulty and restricted indications.[5] Dr. Diego Gonzalez-Rivas reported the feasibility of uniportal VATS double-sleeve resections by pioneering several such cases through a single incision.[2] In our case, we initiated the procedure via a uniportal approach. However, due to concerns about technical difficulty related to the use of a Satinsky clamp during vascular reconstruction, we opted to add a second camera port for better visualization and maneuverability.

Various techniques for proximal and distal control of the pulmonary artery during sleeve anastomosis have been described. Dr. Gonzalez-Rivas and colleagues have developed a vascular tourniquet method, allowing control without additional instrumentation, thereby maintaining the advantages of the uniportal approach.[6] We also have experience with isolated vascular anastomosis via VATS. In our opinion, the use of a Satinsky clamp provides a safer method for proximal control of the main pulmonary artery.

Mei et al.[7] reported a series of seven VATS double sleeve lobectomies performed via a multiport approach between 2012 and 2016, with an average operative time of 318 minutes and a mean intraoperative blood loss of 200mL. Their mean length of hospital stay was 15.5 days. Our operative time and blood loss were consistent with these findings, although our patient's recovery was notably faster.

Conclusion

VATS double sleeve lobectomy, while technically demanding, is a viable and safe alternative to open surgery in appropriately selected patients. Importantly, vascular sleeve anastomosis can be utilized not only as a planned reconstructive step but also as an intraoperative salvage technique to avoid pneumonectomy in the event of incorrect vascular stapling. This approach preserves lung function and accelerates recovery when performed by experienced minimally invasive thoracic surgeons.

Disclosures

Ethics Committee Approval: This is a single case report, and therefore ethics committee approval was not required in accordance with institutional policies.

Informed Consent: Written informed consent was obtained from the patient.

Conflict of Interest: The authors declare that there is no conflict of interest.

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