

Complete videothoroscopic *en-bloc* resection of lung cancer invading the diaphragm

Diyafragmayı invaze eden akciğer kanserinin tam videotorakoskopik en-bloc rezeksiyonu

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ABSTRACT

Locally advanced non-small cell lung cancer invading the diaphragm is an infrequent clinical presentation. A 74-year-old male patient was operated using video-assisted thoracoscopic surgery in our clinic for a tumor originating from the right lower lobe. A right lower lobectomy with diaphragmatic resection was performed to the tumor with a diameter of 3 cm that invaded the diaphragm, and the resulting defect was repaired primarily with video-assisted thoracoscopic surgery. The patient did not develop complications in the postoperative period and was discharged on Day 6. In conclusion, patients with non-small cell lung cancer invasive to the diaphragm can be even safely operated with the video-assisted thoracoscopic surgery.

Keywords: Diaphragm, invasion, non-small cell lung cancer, video-assisted thoracoscopic surgery.

Locally advanced non-small cell lung cancer (NSCLC) is defined as tumors larger than 4 cm, T3 or T4 tumors, and/or tumors with neoadjuvant therapy.^[1] Diaphragmatic involvement is extremely rare in NSCLC. In the literature, diaphragm invasion is reported in patients with locally advanced NSCLC at a rate of <0.5%.^[2] The video-assisted thoracoscopic surgery (VATS) method is superior in operable lung cancer treatment with less intraoperative trauma, reduced postoperative complications, and rapid recovery.^[3] Although locally advanced tumors were considered a contraindication for VATS in the initial years when it was first started to be performed,^[4] VATS can be successful in locally advanced diseases with increasing experience and developing experience currently.

ÖZ

Diyafragmayı invaze eden lokal ileri evre küçük hücreli dışı akciğer kanseri, nadir görülen bir klinik tablodur. Kliniğimizde 74 yaşındaki erkek hasta sağ alt lobtan köken alan bir tümör nedeniyle video yardımlı torakoskopik cerrahi kullanılarak ameliyat edildi. Diyafragmaya invaze olan 3 cm çaplı tümöre, torakoskopik olarak diyafragma rezeksiyonu ile birlikte sağ alt lobektomi uygulandı ve oluşan defekt yine video yardımlı torakoskopik cerrahi ile primer olarak onarıldı. Ameliyat sonrası dönemde komplikasyon gelişmeyen hasta 6. günde taburcu edildi. Sonuç olarak, diyafragmaya invaze küçük hücreli dışı akciğer kanseri hastaları dahi video yardımlı torakoskopik cerrahi yöntemi ile güvenle ameliyat edilebilir.

Anahtar sözcükler: Diyafragma, invazyon, küçük hücreli dışı akciğer kanseri, video yardımlı torakoskopik cerrahi.

In this article, we present a diaphragm-invaded NSCLC case operated using VATS due to its rarity.

CASE REPORT

A 74-year-old male patient was admitted to our hospital due to cough. On his medical examination, a tumor with a diameter of 4 cm was observed in the lower lobe of the right lung, closely adjacent to the diaphragm and mediastinum (Figure 1). The transthoracic fine-needle aspiration biopsy revealed a squamous cell carcinoma. On positron emission tomography (PET), the maximum standardized uptake value (SUV_{max}) of the mass was reported to be 9.4. Mediastinal pathological SUV was not observed on PET examination. The patient was evaluated in the oncology clinic initially. After considering the tumor

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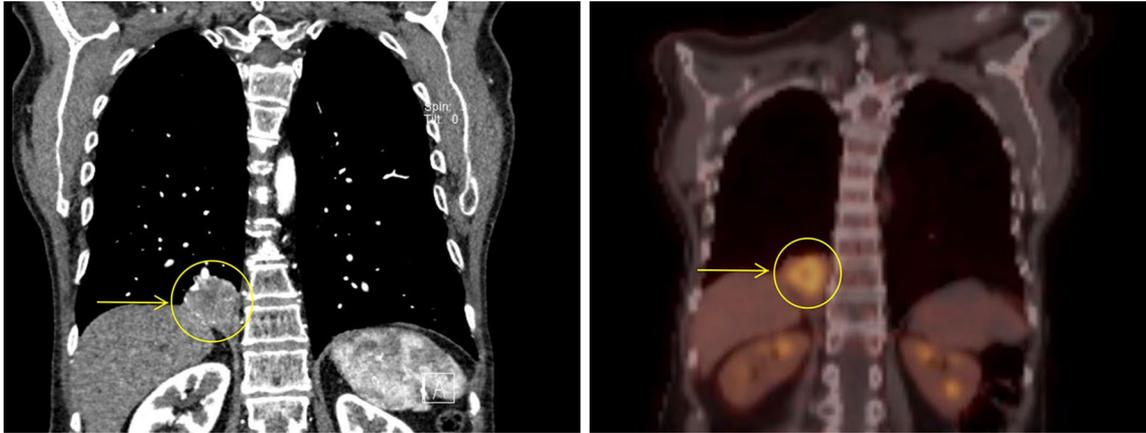


Figure 1. Thoracic computed tomography and positron emission tomography-computed tomography images of the tumor before the neoadjuvant treatment. The tumor originated from right lower lobe had a maximum standardized uptake value of 9.4 with no lymph node involvement. The yellow arrow indicates the tumor.

as invaded to mediastinum and diaphragm, the patient underwent two cycles of gemcitabine + cisplatin neoadjuvant chemotherapy. Afterward, the patient was referred to our clinic to be evaluated for surgery.

On PET examination taken after neoadjuvant treatment, there was no lymph node involvement, and a decrease in the metabolic activity of the tumor

was reported ($SUV_{max} = 3.4$). No metastasis was observed on cranial magnetic resonance imaging. In the respiratory function test, the forced expiratory volume in 1 sec (FEV1) value was 2.0 L (91%). In the preoperative examinations, although there was no lymph node involvement on PET, the tumor was T4N0M0 (Stage IIIA) according to clinical Tumor,

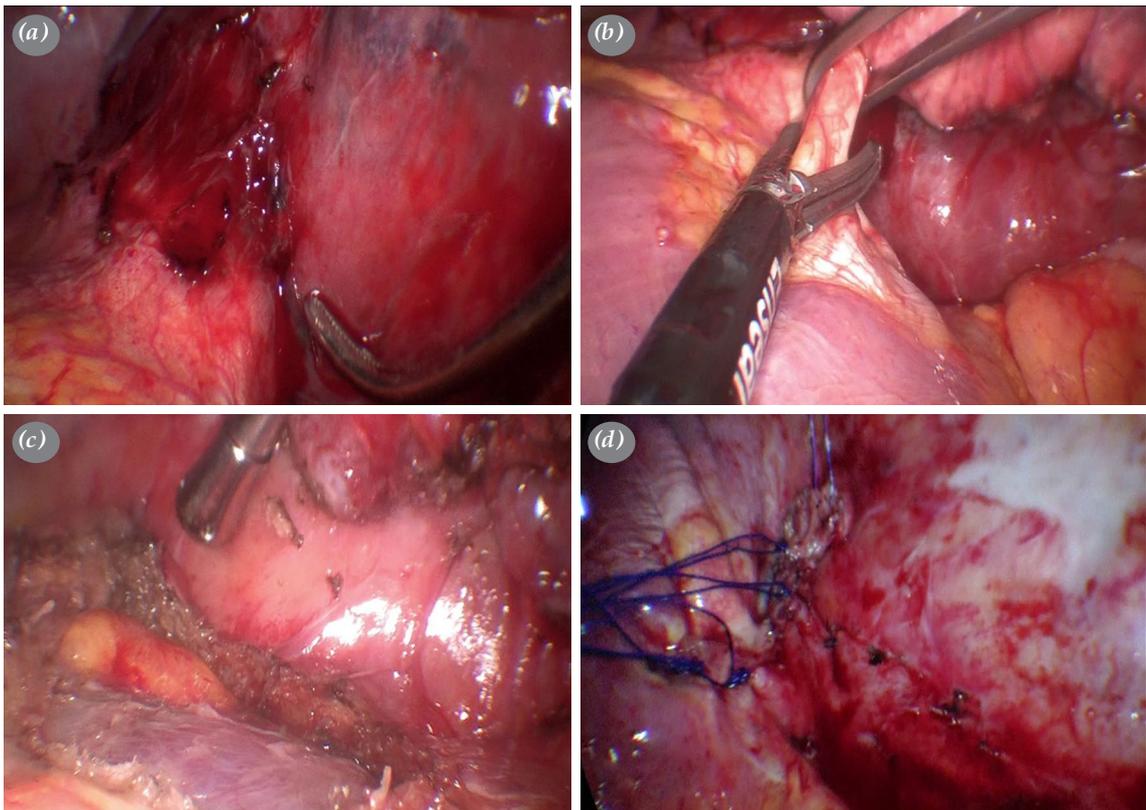


Figure 2. Operational view of the tumor. (a) The tumor invading the diaphragm. (b) *En bloc* resection of tumor with the diaphragm. (c) Resulting defect on the diaphragm. (d) The view of the diaphragm repaired with primary suturing.

Node, Metastasis (cTNM) staging system, and mediastinal staging was performed with endobronchial ultrasound (EBUS) biopsy. The lymph node stations of 4R, 4L, and 7 were biopsied. The patient, who was evaluated as N0 according to the EBUS, was operated on Day 21 after neoadjuvant therapy.

As the operative method, right-side VATS was performed using three ports. A utility incision was made where the fifth intercostal space intersected with the midaxillary line. The camera port was placed at the junction of the seventh intercostal space and the anterior axillary line. Finally, an assistance port was placed in the area where the posterior axillary line intersected with the eighth intercostal space. The tumor was observed to be in the lower lobe of the right lung as tightly adhered to the diaphragm. The adhesions were partially removed, but the tumor was thought to invade an area on the diaphragm (Figure 2a). Then, a diaphragm area of 3 cm in diameter was resected with the energy device in full-thickness (Figure 2b, 2c). Afterward, a standard right lower lobectomy was performed. The inferior pulmonary vein and the arterial branches of the lower lobe were dissected and cut using endoscopic staplers. The fissure was completed with endoscopic staplers and an energy device. Following the removal of the specimen from the thorax, the systemic mediastinal lymph node dissection was performed. The lymph node stations of 2R, 4R, 7, 8, 9, and 11 were dissected. The resulting diaphragm defect was primarily repaired with separated suturing using non-absorbable monofilament polypropylene sutures (Figure 2d). Since the defect was in a diameter of 3 cm, any reconstructive material was not used. The operation lasted 180 min, and blood loss was approximately 200 cc. The postoperative period



Figure 3. The chest radiograph of patient at the postoperative third month.

was uneventful. The chest tube was removed on the postoperative fifth day, and the patient was discharged on the sixth day. The patient's histopathology report revealed that the tumor 3 cm in diameter invaded the diaphragm superficially but not in full-depth, with N0 status. There were fibrosis and necrosis zones within the tumor. The diagnosis was confirmed as a squamous cell carcinoma, and the immunohistochemical staining result was CK5/6 (+), TTF1 (-), and P63 (+). Since the patient had a T4N0M0 tumor (Stage IIIA), the patient was referred to the oncology department in the postoperative period and received adjuvant therapy. The patient's disease-free follow-up still continues in the ninth postoperative month.

DISCUSSION

Video-assisted thoracoscopic surgery is a safe and feasible method, providing successful postoperative results even in locally advanced tumors. Fan et al.^[1] operated 64 locally advanced NSCLC patients with uniportal VATS and compared them with the same number of open method patients. They achieved better perioperative results in the uniportal VATS group compared to the thoracotomy patients. Fang et al.^[5] also compared the VATS method and thoracotomy in patients with locally advanced squamous cell carcinoma who received neoadjuvant therapy. As a result of their study, they reported that those who were operated with VATS showed faster recovery, as well as oncological and survival results similar to the thoracotomy method. However, cases with diaphragm invasion operated by VATS are not frequently reported in the literature. Although videothoracoscopic procedures performed for benign reasons such as diaphragm plication were previously reported as case reports, only one case of diaphragm-invasive lung cancer was treated using VATS in the English literature.^[6] Akar and Gonzalez-Rivas^[6] operated an NSCLC case originating from the lower lobe of the left lung and invading the diaphragm with uniportal VATS. They resected the diaphragm in full-thickness with the energy device and repaired the defect primarily with continuous suturing using non-absorbable sutures. However, no data on operation time, postoperative period, and survival were presented. In our case, the right lower lobe tumor was invasive to the diaphragm, and the diaphragm was resected using an energy device similarly. The diaphragm was resected first to mobilize the lower lobe, enabling easier anatomical resection. To prevent peritoneal tissue injuries, we cut the diaphragm by hanging it up so that we could see under it. We repaired the diaphragm with separated sutures instead of continuous suturing.

The main factors affecting survival in NSCLC cases with diaphragm invasion are N status and invasion depth.^[2] In the study performed by Galetta *et al.*,^[2] the five-year survival of N0 patients with invasion to the diaphragm was 43%. In the aforementioned study, cases showing full-depth diaphragm invasion did not survive five years, but five-year survival in superficial invasions was 50%. In the study of Yokoi *et al.*,^[7] five-year survival in N0 status was 28.3% in diaphragm-invasive NSCLC cases, while this rate was 18.1% in N1-2 patients. In the same study, five-year survival in full-depth invasion was 14.3% and 33% in superficial invasions.^[7] Our case had an N0 tumor, and the diaphragm invasion was superficial. Disease-free follow-up continues in the ninth postoperative month.

In conclusion, the video-assisted thoracoscopic surgery method can be used safely in locally advanced non-small cell lung cancer patients with diaphragm invasion. The merits of video-assisted thoracoscopic surgery allow the continuity of the treatment by rapidly overcoming the operative trauma. The surgeon's correct surgical planning in line with his/her experience is the most critical issue in such cases.

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Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Conception and design of the study: A.A, K.C.C.; Literature review: A.A., H.M.; Writing the article: A.A.; Control/Supervision: K.C.C., N.Y.

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