

Arterial Sleeve Lobectomy for Lung Cancer Invading Chest Wall

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Received: 7 Oct 2021 ♦ **Accepted:** 17 Mar 2022 ♦ **Published:** 30 Apr 2023

Citation: Kielbowski K, Ostrowski P, Kubisa M, Pieróg J, Wójcik J, Kubisa B. Arterial sleeve lobectomy for lung cancer invading chest wall. *Folia Med (Plovdiv)* 2023;65(2):311-315. doi: 10.3897/folmed.65.e76253.

Abstract

Lung cancer is a leading cause of cancer-related deaths worldwide. Non-small cell lung cancer (NSCLC) is a predominant subtype and treatment may include immunotherapy, radiotherapy, chemotherapy, and surgery. Tumors of bigger size infiltrating large bronchi and vessels require more invasive resection such as pneumonectomy. To save lung parenchyma, sleeve lobectomy can be performed in certain patients.

We report the case of a patient with NSCLC infiltrating the chest wall who underwent arterial sleeve lobectomy with rib resection. Furthermore, we discuss other surgical treatment strategies.

A 58-year-old female patient was admitted to the hospital in 2020 with pain in her left posterolateral chest. Radiological imaging revealed a tumor (5.0×3.5×4.8 cm) in the top of the left lung, infiltrating pulmonary artery and ribs. Therefore, left upper sleeve lobectomy together with resection of rib blocks II to V was performed. The surgery was uncomplicated, but a few weeks postoperatively, the patient experienced repeated episodes of consciousness disturbances. Contrast CT revealed a cerebral malformation in the patient who died 3.5 months after surgery.

Sleeve lobectomy can be safely performed in patients with lung tumors infiltrating larger bronchi and vessels who would not tolerate pneumonectomy.

Keywords

lung cancer, NSCLC, sleeve lobectomy

INTRODUCTION

Lung cancer is the most common cause of cancer-related mortality with approximately 28% of men and 17% of women with cancer dying from the disease.^[1] The most common histological subtype is non-small cell lung cancer (NSCLC) with 85% of all cases while adenocarcinoma and squamous cell carcinoma are the two most often encountered subtypes of this neoplasm.^[2] It can arise in several different locations in the bronchial tree, generating highly variable signs and symptoms depending on its anatomical

location. Treatment options include radiation therapy, chemotherapy, immune therapy, and surgery. NSCLC should be resected radically, i.e., anatomically: segmentectomy, lobectomy, bilobectomy or pneumonectomy. Surgical management depends on the tumor size and localization. Smaller tumors located at the margin of an organ may require wedge resection or segmentectomy, while more invasive approaches, such as pneumonectomy, may be necessary in larger tumors placed centrally and infiltrating larger bronchi or vessels. In certain patients, an alternative treatment for pneumonectomy can be sleeve lobectomy (SL). In

this paper, we present a case of a patient with squamous cell carcinoma located in the left superior lobe and infiltrating surrounding structures. We describe the surgical approach used and discuss different treatment strategies.

CASE REPORT

In 2020, a 58-year-old Caucasian ex-smoker female with Hashimoto thyroiditis reported a pain in the left posterolateral part of the chest and was admitted to the Department of Thoracic Surgery and Transplantation of Pomeranian Medical University in Szczecin.

In the past, the patient had undergone two mastectomies (left-sided in 1999, right-sided in 2017) with bilateral breast reconstruction. Moreover, she was treated with post operational radio-, chemo- and hormone therapy. Physical examination and laboratory findings were within normal ranges. As part of the oncological follow-up, the patient underwent a chest computed tomography (CT). The examination found a tumor (5.0×3.5×4.8 cm) located at the top of the left lung and infiltrating the surrounding structures. According to the results of 18F-fluorodeoxyglucose positron emission tomography (PET), the lesion showed features of metabolic malignancy with standardized uptake value (SUV) of 11.1 (Fig. 1). Bronchoscopy examination revealed that the opening of the bronchus of S3 of the left lung was obstructed in 99% and openings of bronchi of S4 and S5 were obstructed in 90%. Additionally, in the left superior lobar bronchus, white granulation tissue was noticed. Furthermore, the spirometry test was performed: forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) were measured at 89%. Ultrasonography did not show any significant abnormalities. The decision was made to perform a left upper sleeve lobectomy (SL) to extinct the neoplasm. Before the surgery, the patient was placed in the right lateral decubitus position to gain better access to the pleural cavity. A posterolateral thoracotomy was performed under general anesthesia with one-lung ventilation. A skin incision was made underneath the left 5th rib which has shown a tumor directly extended in the upper lobe infiltrating the 2nd, 3rd, and 4th rib, and the hilum of superior lobe. Moreover, the neoplastic infiltration was present on the vagus nerve right next to the aortic arch and on the superior part of the pulmonary artery (A1+2 and A3). The decision was made to resect the superior lobe with the 5th segment. The tumor was dissected from the chest wall. Afterwards, the posterolateral infiltrated shafts of the ribs were isolated, and the rib block 2nd to 5th was removed. Then the pulmonary ligament was dissected in the same way as the superior pulmonary vein, which had earlier been isolated and ligated. Using staplers, the oblique fissure was reconstructed anteriorly and posteriorly along with the 6th segment. Bronchus was isolated up to the upper lobe and then dissected with the use of staplers. Heparin in the dose of 3000 IU was administered. Afterwards, pulmonary angioplasty was performed. The vascular clamps were placed on the pulmonary artery medially and laterally to the infiltrated tis-

sue. The infiltrated vessel was removed in the length of 3 cm. Intraoperative histopathological examination determined a negative surgical margin of 5 mm on both sides of the excised fragment. The pulmonary artery was anastomosed end-to-end with continuous suture (Prolene 5-0). The clamps were removed from the artery resulting in restoration of circulation in the inferior lobe. Thereafter, 30 mg of protamine sulfate was administered. Lymph nodes from groups 5, 7, 9, and 11 were harvested for examination. One pleural drainage was applied. Before closing the chest, it was decided to place metal clips on the margins where earlier the neoplasm was located. It was useful for further radiological assessment. The periosteum of the 5th rib was stitched with a strict surgical suture. Due to the small range and advantageous localization of ribs resection, the risk of developing the flail chest was defined as minor. Therefore, it was not decided to use an additional form of surgical dressing. The incision was closed in layers. Shortly after the surgery, the patient was successfully extubated and moved to a postoperative room. The surgical intervention went without any complications. Subsequent histopathological investigation confirmed squamous cell carcinoma of the lung and lack of lymph nodes metastasis. As a result, T3N0M0-IIB stage was assigned. During the postoperative procedure, two units of packed red blood cells were administered. During the drainage, air leakage into the pleural cavity took place, which subsided after 9 days. After 14 days, the patient was discharged. Despite her good, stable general condition after the surgery, the patient experienced an episode of consciousness disturbance accompanied by a feeling of breathlessness during hospitalization. Similar episodes were repeated later as well, and the subsequent CT scan of the head with contrast revealed a cerebral malformation. Unfortunately, the patient died suddenly while sleeping 3.5 months after surgery.

DISCUSSION

Surgical treatment is the gold standard in early stages of NSCLC. The aim of surgical treatment is to completely remove tumorous tissues with adequate margin. Excision is considered when there is a high risk that a lesion is malignant or when the tumor presents features of metabolic malignancy in PET.^[3] Bronchial sleeve lobectomy is a technically complex procedure. It is performed in selected group of patients when the tumor infiltrates larger airway passage (main bronchus). It involves removal of pulmonary tissue and tumor, together with infiltrated region of bronchus. Afterwards, bronchoplasty is performed (Fig. 2). Arterial sleeve lobectomy, which was carried out in the presented case, is another type of sleeve resection which involves angioplasty and is performed when lesion infiltrates pulmonary artery (Fig. 3). Sleeve resections offer preservation of pulmonary tissue, beneficial in patients who cannot tolerate pneumonectomy. Recent advances in minimally invasive surgery allow for video-assisted or even robotic-assisted sleeve resections.^[4,5] Nevertheless, there is a limited num-

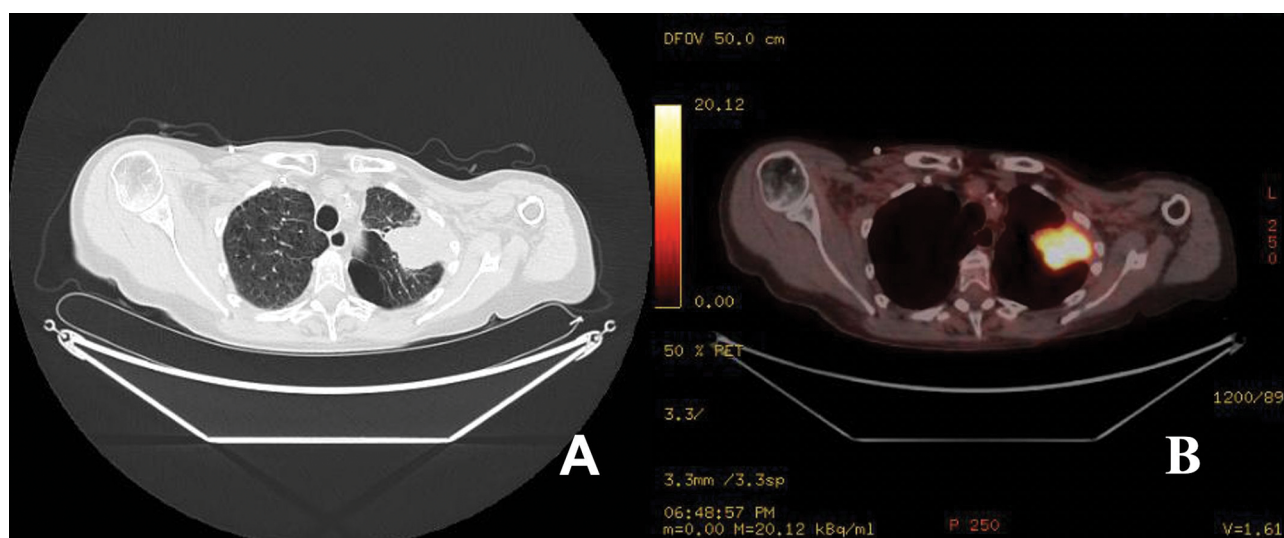


Figure 1. A. Computer tomography of the patient preoperatively (25.09.2020). Large tumor visible in the left lung; **B.** Positron emission tomography, lesion with signs of metabolic malignancy in the left lung.

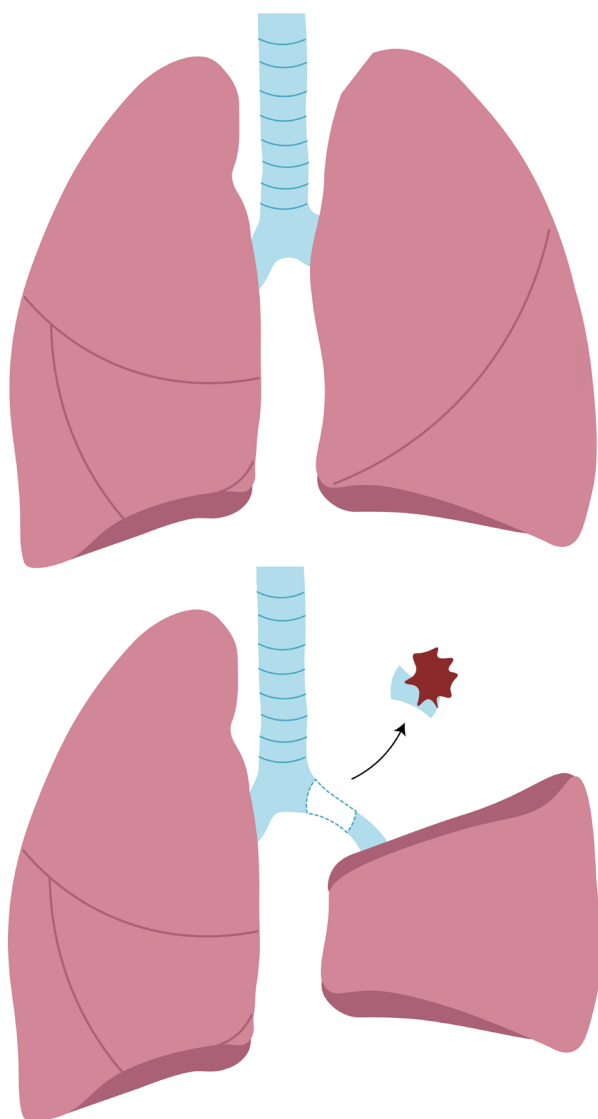


Figure 2. Scheme presenting typical bronchial sleeve lobectomy.

ber of case reports about VATS double sleeve lobectomies (vascular and bronchial) in the literature.^[6] In presented case, due to chest wall invasion, stage of lung cancer was classified as T3, while lack of metastases to lymph nodes or other organs as T3N0M0 – IIB NSCLC. It is considered that chest wall invasion develops in less than 10%. Chest wall resection is usually performed while margins include 1 cm in all directions or 1 intact rib from both sides of tumor.^[7] Vascular sleeve lobectomy together with removal of rib blocks is not frequently reported. It is still questionable whether video-assisted thoracoscopic surgery is an appropriate approach in lung cancer invading chest wall. Typical resection of tumor infiltrating ribs may be associated with long hospitalization and painful postoperative period while mini-invasive procedures ensure less invasive alterations in chest ribcage and chest muscles, improving patient's postoperative quality of life. However, such procedures are performed in centers with extensive experience in minimally invasive thoracic surgeries.^[8] In certain patients, chest wall reconstruction may be performed. Upper ribs have adequate coverage from pectoral muscle while resection of lower ribs may require application of net or prosthesis.^[9] Chest wall resection and potential reconstruction are associated with some complications, of which infections and seromas are often encountered.^[10] Different strategies of postoperative care have been proposed in the literature, including adjuvant and neoadjuvant chemotherapy, as well as radiotherapy. The 5-year survival rate for T3N0 lung cancer invading chest wall varies between 40% and 50%. In this patient, lung cancer developed 3 years after surgical removal of second breast cancer. Therefore, NSCLC in this patient can be considered as metachronous malignancy. According to a study by Donin et al. lung cancer is the most common second primary malignancy (SPM) in cancer survivors (18% of all SPMs).^[11] However, lung cancer as SPM after breast cancer is not very common.^[12] According to a

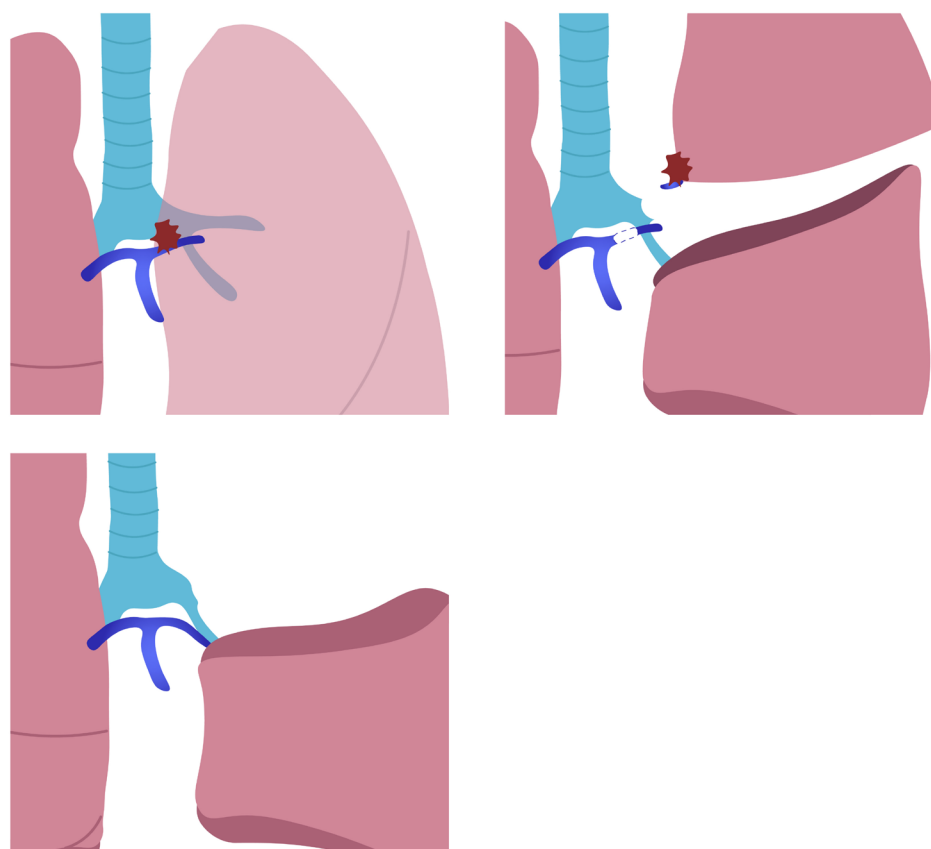


Figure 3. Scheme presenting arterial sleeve lobectomy.

large study performed by Gao et al., who compared different postoperative strategies, adjuvant chemo- or chemoradiotherapy improved overall survival compared to surgery alone.^[13] Another study carried out by Brown et al. did not prove that adjuvant chemotherapy increases overall survival in patients with T3 lung cancer infiltrating chest wall.^[14] Sleeve lobectomy is an alternative procedure for pneumonectomy in patients with larger lung tumors invading larger airway passages or vessels. Therefore, there are several studies that compare these two techniques. According to a recent large study examining the outcomes of the two afore-mentioned approaches, SL offers increased overall survival in 1-, 3-, and 5-year survival rates (90.8%, 69.1%, 61% vs. 86.2%, 53.8%, 44.7%).^[15] Similar results were observed in previous studies as well.^[16,17]

CONCLUSIONS

Sleeve lobectomy is an accepted treatment for patients with T3N0 NSCLC, especially in patients that cannot tolerate pneumonectomy. This case is an example of thorough surgical resection with negative oncological margin using SL with chest wall resection. The death of this patient is considered as unrelated to underlying disease or treatment.

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Артериальная рукавная лобэктомия при раке лёгкого, проникающем в грудную стенку

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Дата получения: 7 октября 2021 ♦ **Дата приемки:** 17 марта 2022 ♦ **Дата публикации:** 30 апреля 2023

Образец цитирования: Kielbowski K, Ostrowski P, Kubisa M, Pieróg J, Wójcik J, Kubisa B. Arterial sleeve lobectomy for lung cancer invading chest wall. *Folia Med (Plovdiv)* 2023;65(2):311–315. doi: 10.3897/folmed.65.e76253.

Резюме

Рак лёгких является ведущей причиной смертности от рака во всем мире. Немелкоклеточный рак лёгкого (NSCLC) является преобладающим подтипом, и лечение может включать иммунотерапию, лучевую терапию, химиотерапию и хирургическое вмешательство. Опухоли больших размеров, инфильтрирующие крупные бронхи и сосуды, требуют более инвазивной резекции, такой как пневмонэктомия. Для сохранения паренхимы лёгкого у некоторых пациентов может быть выполнена рукавная лобэктомия.

Мы сообщаем о случае пациента с NSCLC, инфильтрирующим грудную стенку, которому была выполнена лобэктомия артериального рукава с резекцией ребра. Кроме того, мы обсуждаем другие стратегии хирургического лечения.

Больная 58 лет поступила в клинику в 2020 г. с жалобами на боли в левой заднебоковой части грудной клетки. Рентгенологически выявлена опухоль (5.0×3.5×4.8 см) в верхушке левого лёгкого, инфильтрирующая лёгочную артерию и ребра. Поэтому была выполнена лобэктомия левой верхней части рукава вместе с резекцией рёбер II–V. Операция прошла без осложнений, но через несколько недель после операции у больной повторились эпизоды нарушения сознания. Контрастная КТ выявила мальформацию головного мозга у больной, которая умерла через 3.5 месяца после операции.

Рукавную лобэктомию можно безопасно выполнять у пациентов с опухолями лёгких, инфильтрирующими более крупные бронхи и сосуды, которые не переносят пневмонэктомию.

Ключевые слова

рак лёгкого, NSCLC, рукавная лобэктомия