

Title: Lung metastasis after pneumonectomy. Is there a place for surgery?

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Running title: Lung metastasis after pneumonectomy.

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Key Clinical Message: Resection of the contraletal lung after primary total pneumonectomy is a real surgical procedure that can be performed for patients with secondary lung disease.

Introduction: Synovial sarcoma of the lungs is an extremely rare pathology that is not common in the daily clinical practice of thoracic and oncological surgeons. According to the world literature, it occurs only in 0.5% of cases among all primary lung tumors [1]. At the same time, global statistics, which collected data from 170,000 patients with primary malignant lung tumors, showed that approximately 50% of patients in the future would have lung metastases, which can be treated [2]. In this case, data on the survival of patients after re-resection of the lungs for lung metastases of synovial sarcoma show the average duration of recurrence-free disease up to 25 months [3]. And the level of 5-year survival in patients after lung resection for metastatic synovial sarcoma is up to 42.9% [4]. Which indicates aggressive biological behavior of this type of tumor, but the possibility of surgical treatment with radical resection of metastatic tumors can be quite effective and prognostically satisfactory. At the same time performance of repeated wedge resections of a lung usually do not cause big technical difficulties for the surgeon. According to the literature, the main intraoperative findings may be pleural adhesions, which can sometimes lead to open the pericardium and intrapericardial dividing of blood vessels [5]. In the modern literature it is very rare to find reports of clinical cases of contralateral lung resection after pneumonectomy for malignant lung tumors. Because most patients in this category either have a metastatic disease that precludes surgical treatment, or have a fairly low pulmonary reserve, the amount of parenchyma remaining after surgery is insufficient for adequate oxygenation of the patient, so such surgery may be associated with a high risk of severe respiratory failure and pulmonary complications [6]. To date, there are no unified guidelines to address which patient can be selected for re-surgical treatment. Assessment of pulmonary reserves, echocardiography and oxygenation status can be effective predictors for lung resection in patients who have undergone total pneumonectomy. There is no research in the world literature on the selection and treatment of patients who have undergone total pneumonectomy and require re-resection of the lung. Therefore,

we propose to consider the clinical case of treatment for the patient with a tumor in right lung after left pneumonectomy.

Case report: The 52-year-old patient in 2016 was admitted to the O.O. Shalimov's National Institute of Surgery and Transplantology with complaints of shortness of breathes during light exercise and chest pain. At the same time CT scan showed that left hemithorax is occupied by an inhomogeneous tumor size of 17.5x20x26 cm, which pushes the mediastinum to the right, no signs of metastases (Fig.1, 2).

Cardiac ultrasound showed that the pulmonary artery pressure was normal at 28 mmHg, and the fraction of left ventricular ejection 73%. Examination of arterial blood gases: pO₂ - 76.1 mmHg, pCO₂ - 32.6 mmHg, venous blood pO₂ - 40.8 mmHg, pCO₂ - 40.1 mmHg. No changes in the general and biochemical analysis of blood were revealed.

Preoperative studies of pulmonary function showed obstructive changes. Forced expiratory volume 1 - 0.94 liters. (32.4%), maximum vital volume - 1.58 liters (45.4%), forced lung volume 1.58 liters (42%). At such indicators of pulmonary function performance of the left pneumonectomy looked doubtful, because of high risks of development of postoperative respiratory failure. But we supposed that after CT modeling, the parenchyma that will be removed is not functional, due to total atelectasis of the left lung. Moreover, the removal of a large tumor mass and returning of the mediastinal organs to a more physiological location could improve cardiopulmonary function in the future.

So, taking into account all the above, we decided to perform pneumonectomy. Thus, during hospitalization, transpericardial left total pneumonectomy was performed as planned. Given the big volume of tumor mass and compression of the mediastinal organs, the approach was chosen by Clamshell, which includes bilateral thoracotomy with sternotomy in the 5th intercostal space. Intraoperative images (Fig. 3-5).

Pathology report: Synovial sarcoma. As a result, the patient was diagnosed with synovial sarcoma of the left lung T2bN0M0 stage III. (TNM Classification 7th Edition)

In the postoperative period, the patient received 3 courses of chemotherapy (endoxan, doxorubicin, vincristine, dacarbazine). There was no respiratory failure and pulmonary hypertension in the postoperative period.

Follow up CT scans of the abdomen, chest, and pelvis with IV contrast were performed every 6 months.

Five years after the initial surgery, the patient began to complain of intermittent pain in the upper right half of the chest. CT scan revealed tumor 150x80x100 mm in the upper right lung lobe, which is involved the costal pleura.

CT signs of 3-D formation of the right lung (Fig. 6, 7).

Based on which the diagnosis was made: Synovial sarcoma of the left lung T2bN0M0 stage III (after surgery and chemotherapy (2016)) prolongatio morbi mts of the right lung.

To determine the possibility of surgical treatment of the patient, a full list of necessary studies was performed, including: respiratory function, echocardiography, electrocardiogram, arterial and venous blood gas exchange, clinical and biochemical blood tests.

Preoperative studies of pulmonary function showed minor obstructive changes. Pulmonary reserve was better even compared to preoperative parameters before primary pneumonectomy: forced expiratory volume 1 - 1.66 liters. (64%), maximum vital volume - 4.45 liters (119%), forced lung volume 3.12 liters. (87%).

Cardiac ultrasound showed that pulmonary artery pressure was 34 mmHg, and the left ventricular ejection fraction 58%. Examination of arterial blood gases: pO₂ - 101 mmHg, pCO₂ - 31.0 mmHg, venous blood pO₂ - 40.1 mmHg, pCO₂ - 39.8 mmHg. No changes in the general and biochemical analysis of blood were revealed.

Based on this assessment, we considered that the patient would be able to undergo right lobectomy or wedge resection of the right upper lobe. Thus, right

thoracotomy in 3-rd intercostal space and wedge resection of the right upper lobe with tumor was performed (Fig. 8-9).

The postoperative period was uneventful. Examination of arterial blood gases: pO₂ - 207 mmHg, pCO₂ - 33 mmHg, venous blood pO₂ - 40.4 mmHg, pCO₂ - 33.5 mmHg.

Pathology report: In the material of recurrence - monophasic synovial sarcoma.

On the 8th postoperative day, the patient was discharged from the hospital in satisfactory condition.

Discussion: Due to the fact that surgical treatment of isolated metastatic tumor of synovial sarcoma is mainly a guarantee of longer life expectancy, wedge lung resection or lobectomy is a justified surgical procedure. However, according to some authors, this decision may be controversial in patients who have already undergone total pneumonectomy [6]. And most of the reports and articles available in the modern literature are not full-fledged studies, but only reports of clinical cases and do not have a large sample of patients, the decision to perform surgery will be based only on personal experience and understanding of a multidisciplinary team [7,8].

Therefore, we believe that mainly in complex cases of the need for surgical treatment of metastatic lung disease in patients who have undergone pneumonectomy is the right choice of the patient to undergo surgery. Because the high risk of postoperative complications can dramatically worsen the overall condition and quality of life of patients and even lead to death. Although to date there is no unified protocol and criteria for selecting patients, we believe that the main predictors of postoperative cardiopulmonary complications are pulmonary function with the number of lung parenchyma to be lost, echocardiography, pulmonary artery pressure, left ventricular ejection fraction and blood gas exchange rates. In our case, both before and after primary surgery and after secondary resection of the left lung, all of the above indicators remained at a fairly

good level, which allowed to ensure a good postoperative quality of life for the patient and allowed to achieve satisfactory result of treatment.

In our opinion resection of the contraletal lung after primary total pneumonectomy is a real surgical procedure that can be performed for patients with secondary lung disease. The main indicators of the development of postoperative respiratory and heart failure are pulmonary function, echocardiography and blood gas exchange.

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