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RESEARCH ARTICLE

# Experience of Using Pneumonectomy and Pleuropneumonectomy in the Treatment of Patients with Multiple/Extensive Drug-Resistance Pulmonary Tuberculosis

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ABSTRACT

**Introduction.** Multi/extensive drug-resistant lung tuberculosis (MDR/EDR–TB) is a serious problem as in Ukraine as throughout the world. The number of patients with pulmonary MDR/EDR–TB is increasing year by year, which is due to the difficulties in early detection of this disease.

**The aim.** To analyze the results of pneumonectomy and pleuropneumonectomy in patients with pulmonary tuberculosis with multiple/extensive drug resistance (MDR/EDR–TB).

**Materials and methods.** The results of 118 own operations performed on patients with various forms of pulmonary tuberculosis with multiple/extensive drug resistance (MDR/EDR-TB) treated in our clinic during 2006-2022 were analyzed. Pneumonectomy (PE) was performed in 82 (69.5%) patients, pleuropneumonectomy (PPE) - in 36 (30.5%) patients. Minimally invasive video-assisted surgical procedures (VATS) were used in 5 (4%) patients whom VATS - pneumonectomy was performed: 3 (2.5%) on the right and 2 (1.5%) on the left.

**Research results.** Among the patients operated on by us surgery treatment was effective in 102 (86.4±3.2%) patients during the observation period of up to 6 years. Postoperative complications developed in 11 (9.3±2.7%) patients: 5 (4.2±1.9%) patients - pleural empyema with bronchial fistula, 2 (1.7±1.2%) patients - early postoperative empyema without bronchial fistula, 4 (3.4±1.7%) - patients with postoperative intrapleural bleeding. 9 (7.6±2.4%) patients were operated on again due to postoperative complications: thoracostomy application with open sanation - 1 patient (0.8±0.8%), staged thoracoplasties - 2 patients (1.7±1.2%), video thoracoscopic sanation of the pleural cavity - 2 patients (1.7±1.2%), removal of intrapleural hematoma – 4 (3.4±1.7%) patients. 5 (4.2±1.9%) patients died after surgery.

**Conclusions.** Pneumonectomy (PE) and pleuropneumonectomy (PPE) are effective methods of treatment for patients with pulmonary tuberculosis with multiple/extensive drug resistance (MDR/EDR-TB) against the background of complex antituberculosis therapy. According to the data of our clinic, the use of PE or PPE was effective in 86.4% of cases, progression of TB was observed in 9.3% of patients. Making a decision to perform PE or PPE is possible in conjunction with a phthisiologist only after conducting a spiral computed tomography (SCT), which allows detecting small destructive changes in the remaining lung. Performing PE or PPE is possible in the presence of dense foci or small dense tuberculomes in the contralateral lung without signs of destruction, occupying no more than one segment; in all other cases it is more appropriate to perform collapsosurgical interventions (primary thoracoplasty or resection with thoracoplasty). When conducting PE or PPE in patients with MDR/EDR-TB of the lungs, it is mandatory to use one of the methods of additional strengthening of the bronchial stump and prevention of pleural empyema.

**Keywords:** pulmonary tuberculosis with multiple/extensive drug resistance, surgical treatment, pneumonectomy, pleuropneumonectomy.

**Introduction.**

Approaches to the treatment of pulmonary tuberculosis (TB) have changed significantly in recent years. It is obvious that the epidemic cannot be overcome only by the use of anti-epidemic measures and specific chemotherapy. This is due to the modern features of the TB epidemic - a large number of polydestructive processes and the wide spread drug resistance of TB. In Ukraine the frequency of primary chemoresistance ranges from 7 to 20% of patients depending on the region and secondary resistance reaches 75%. In Ukraine MDR/EDR-TB is observed in 9% of newly diagnosed TB patients[2,12].

Among the resistant forms of tuberculosis there are MDR-TB — EDR-TB with multiple drug resistance (previously the term MDR-TB was used): resistance to at least isoniazid and rifampicin and EDR-TB with extensive drug resistance (previously the term tuberculosis with extended drug resistance was used ( ER-TB)): resistance to any fluoroquinolone and at least one additional group A drug (bedaquiline and/or linezolid) in addition to multidrug resistance or rifampicin-resistant TB[11].

The results of many studies indicate that one of the main obstacles to the effective fight against tuberculosis is the drug resistance of MBT[4,12,18]. A number of factors contributed to the emergence and expansion of the spectrum of MBT drug resistance : inadequate chemotherapy regimens, treatment of tuberculosis without strict control over the patients' drug intake, interruptions in the supply of anti-tuberculosis drugs, interruptions in treatment due to the occurrence of adverse reactions caused by tuberculosis anti-tuberculosis drugs, defects of the immune system, low patients adherence to treatment. Treatment of patients with MDR-TB and EDR-TB is usually more complex, toxic and expensive, and less effective than treatment of other forms of tuberculosis. For the treatment of patients with MDR-TB and EDR-TB, new anti-tuberculosis drugs such as bedaquiline and delamanid are now used[13,18].

During the COVID-19 pandemic, most health care resources were directed to combating it. Anti-tuberculosis measures were secondary and curtailed. This led to a decrease in the statistical rate of incidence of all clinical forms of tuberculosis and mortality from it including multi-resistant and its relapses, as well as co-infection - tuberculosis/HIV/AIDS. The decrease in the statistical incidence rate of tuberculosis in Ukraine is also influenced by the consequences of the war in which our country has been living for almost 10 years (forced relocation of citizens abroad, the impossibility of conducting an analysis of the incidence in the temporarily occupied territories)[2].

In Ukraine from 1990 to 2001 phthisiosurgical activity decreased by 39.2%. Currently, a reverse trend is observed and taking into account the peculiarities of the TB epidemic in Ukraine one can expect that the role of surgical treatment of lung TB with irreversible morphological changes will grow[8,12].

Methods of surgery treatment of TB have also undergone a certain evolutionary development. The reason for this is the lower effectiveness of anti-tuberculosis therapy than in previous years due to the significant spread of drug resistance of MB, which requires more radical surgical interventions. One of the types of such operations is pneumonectomy (PE) and pleuropneumonectomy (PPE). These operations for TB have been carried out for about 70 years and the technique of their performance is constantly being improved. PE and PPE are one of the most radical and traumatic operations in phthisiosurgery. According to various authors, the frequency of performing PE and PPE in pulmonary TB ranges from 21.6 to 56.4% of cases. According to the data of our clinic the frequency of performing PE and PPE in MDR/EDR-TB of the lungs is 21.3%. Since 2008 in the surgical treatment of patients with MDR/EDR-TB in our clinic, minimally invasive video-assisted techniques of surgical interventions (VATS) have been used[8,9,17].

We conducted an analysis of our own operations results in order to determine the optimal indications for surgery, the peculiarities of intraoperative and postoperative tactics when performing PE and PPE in the treatment of MDR/EDR-TB of the lungs in modern conditions. PE and PPE were evaluated by us together for the reason that the choice of a specific type of operation often occurs intraoperatively depending on the degree of the pleura damage by a specific process.

**The aim.** To analyze the results of pneumonectomy and pleuropneumonectomy in patients with pulmonary tuberculosis with multiple/extensive drug resistance (MDR/EDR–TB).

**Materials and methods.**

The results of 118 own operations performed on patients with various forms of pulmonary tuberculosis with multiple/extensive drug resistance (MDR/EDR-TB) treated in our clinic during 2006-2022 were analyzed. There were 78 men (66.1%), 40 women (33.9%). The age range of patients was from 9 to 59 years (up to 30 years – 37 patients (31.4%), 31-40 years – 46 patients (39.0%), 41-50 years – 25 patients (21.2%) , 51-59 years old - 10 patients (8.5%)). Most patients

were operated on for chronic forms of tuberculosis - 109 (92.4%). The duration of the disease before the operation was from 10 months to 6 years. 69 (58.5%) right-sided surgeries were performed, 49 (41.5%) left-sided ones. Pneumonectomy (PE) was performed in 82 (69.5%) patients, pleuropneumonectomy (PPE) - in 36 (30.5%) patients. Minimally invasive video-assisted surgical procedures (VATS) were used in 5 (4%) patients whom VATS - pneumonectomy was performed: 3 (2.5%) on the right and 2 (1.5%) on the left. It should also be noted that the Children's Phthisiosurgery Center functions on the basis of our department, during its existence 2 (1.5%) PE were performed on children with MDR/EDR-TB, 1of them was VATS – pneumonectomy. The youngest patient was 9 years old[8,9].

The main indications for PE are the presence of irreversible destructive changes in the lungs which cannot be eliminated with the use of conservative antituberculosis therapy and it is a source of intoxication and further progression of the disease. At the same time taking into account the traumatic nature of the operation, PE is indicated when the use of more economical resections is impossible. According to the literature indications for PE in TB of the lungs are also a malignant tumor in the operated lung due to TB and pneumothorax against the background of widespread fibrous-cavernous TB of the lung without pleural empyema[5,9].

The main risks when performing PE and PPE are the possibility of exacerbation of TB in a single lung in the postoperative period, as well as the development of a bronchial fistula with subsequent occurrence of pleural empyema[1,3]. Therefore, in our opinion, it is necessary to have an objective assessment of the parenchyma condition of the contralateral lung before using PE and/or PPE. An absolute condition for performing PE is the absence of inflammatory changes in the main bronchus during FBS (Table No. 1).

**Table No. 1** Conditions for execution of PE and PPE

| |
|---|
| absence of inflammatory changes in the mucous membrane of the main bronchus at a distance of at least two rings from the zone of the planned resection; |
| absence of destructive changes in the contralateral lung, confirmed by CT scan of the OCC |
| sufficient functional reserves (LVL more than 50% before the operation); |
| absence of somatic pathology in a state of decompensation. |

We would like to emphasize separately that the performance of PE and PPE is only possible after conducting a spiral computed tomography (SCT), which allows detecting small destructive changes in the remaining lung. It is possible to perform PE in the presence of dense foci or small dense tuberculomas in the contralateral lung without signs of destruction, occupying no more than one segment. In all other cases, it is more appropriate to perform collapsosurgical interventions (primary thoracoplasty or resection with thoracoplasty).

The main problem faced by thoracic surgeons after PE is a bronchial fistula of the bronchus stump (BS) which leads to empyema of the pleura and is the main cause of mortality in this category of patients[1,3,10]. At the core of the problem is poor blood supply to the cartilaginous rings of the BS, which is further worsened due to the separation of the bronchus from the root tissue, the passing of sutures through the mucous membrane and lumen of the bronchus. It is also important the traumatic nature of the surgical intervention, the constant presence of an infectious factor in the area of the bronchial stump, the effect of increased pressure on the stump from the middle in the postoperative period (as a result of coughing up sputum) which collectively reduce the reparative processes in the bronchial stump. Therefore, we believe that when performing PP or PPE it is mandatory to use one of the methods of additional strengthening of the bronchial stump and prevention of pleural empyema.

An important point is the sparing selection of the main bronchus along the perimeter with maximum preservation of the surrounding tissue in order to preserve the blood supply and innervation of the BS not only from the vessels and nerves located in the wall of the bronchus but also from the vascular and nervous tissue located in the adventitia of the bronchus and in surrounding tissue. Devices with tantalum staples are used for stitching the bronchus. It should be noted that recently we have been using disposable suture devices with a green cassette to stitch the bronchus. Sometimes, if necessary, the stump of the bronchus (SB) is additionally strengthened with knotted sutures according to Suit with the use of absorbable suture material and sprinkled with tienam or meronem powder. One of the biopolymers ("Tahocomb" or "Surzhisel-fibrillar") covers the SB. Pleurization of the SB is performed by creating a duplication of the pleural sheets or using a flap of pericardial adipose tissue (PAT) on the vascular pedicle. The choice of the method of strengthening the SB remains up to the surgeon

and depends on the specific clinical situation and the availability of additional materials[7].

Violation of the biomechanics of breathing due to decrease in respiratory volume can lead to respiratory and purulent-infectious complications in the postoperative period. For the prevention of endobronchial patency disorders and respiratory complications we performed remedial FBS, mucolytic therapy, inhalations and adequate analgesia of the patient.

In order to prevent thromboembolic complications, early activation of patients and low-molecular-weight heparins are used.

The presence of an empty pleural cavity (PC) after surgery requires the use of adequate antibiotic therapy and antibiotic prophylaxis. Antibiotic prophylaxis was started by us during induction anesthesia and was carried out intraoperatively. The PC was filled through a microirrigator installed intraoperatively in the suprascapular area. Air aspiration and antibiotic solution were administered daily, the level of leukocytes in the exudate and the quality of the cells were monitored daily. The optimal time for filling out the PC is 3-5 days. Later, after removal of the microirrigator, control pleural punctures were performed with antibiotic administration.

In 4 (3.4±1.7%) patients, when PE or PPE was performed, we observed significant resorption of exudate from PC in the postoperative period which led to overstretching of the remained lung and required daily additional administration of an antibiotic solution intrapleurally for 14-17 days. In two cases (1.7±1.2%), the opposite phenomenon was observed - increased production of exudate, which required additional exudate evacuation from the PC. 8 (6.8±2.3%) patients had early fragmentation of PC, formation of intrapleural pockets with different levels of leukocytes in the exudate. In such cases, we replaced PC exudate with an antibiotic solution through successive pleural punctures in different parts of the hemothorax. In 1 (0.8±0.8%) patient, this procedure was ineffective and on the 17th day after surgery, video thoracoscopic sanation of the PC was performed with monocavity closure and exudate replacement with an antibiotic solution. In all cases the overall result of the treatment was positive.

Taking into consideration the traumatic nature of the operation, it is necessary to prevent stress ulcers and complications from the gastrointestinal tract. We use preoperative and postoperative administration of omeprazole or pantoprazole in a daily dose of 40 mg.

Parametric and non-parametric statistics methods were used in data analysis. The choice of methods depended on whether the studied numerical series corresponded to a normal distribution. The check was performed using a special function NORMSAMP_1 developed for the Excel program. In our research, we used methods of descriptive statistics. To estimate how much the sample arithmetic mean differed from the general mean, the mean squared deviation was calculated.

**Research results.**

In our study patients with the following forms of MDR/EDR-TB of the lungs were operated on (Table No. 2).

**Table No. 2** Forms of MDR/EDR-TB of the lungs in operated patients

| Clinical form of the disease | Number of patients | % |
|---|---|---|
| Fibro-cavernous MDR/EDR-TB of lungs | 66 | 55,9 |
| Multiple tuberculomas with disintegration and bacterial secretion | 13 | 11,0 |
| Relapse of MDR/EDR-TB after surgical treatment ("final" PE) | 22 | 18,6 |
| Pulmonary bleeding or recurrent hemoptysis in widespread destructive MDR/EDR-TB of one lung | 8 | 6,8 |
| Combination of malignant lung tumor and MDR/EDR-TB | 1 | 0,9 |
| Caseous pneumonia | 5 | 4,2 |
| Post-tuberculosis cirrhosis of the lung with bacterial excretion or complicated by hemoptysis | 3 | 2,5 |
| **Total:** | **118** | **100** |

Among the patients operated on by us surgery treatment was effective in 102 (86.4±3.2%) patients during the observation period of up to 6 years. Postoperative complications developed in 11 (9.3±2.7%) patients: 5 (4.2±1.9%) patients - pleural empyema with bronchial fistula, 2 (1.7±1.2%) patients - early postoperative empyema without bronchial fistula, 4 (3.4±1.7%) - patients with postoperative intrapleural bleeding. 9 (7.6±2.4%) patients were operated on again due to postoperative complications: thoracostomy application with open sanation - 1 patient (0.8±0.8%), staged thoracoplasties - 2 patients

(1.7±1.2%), video thoracoscopic sanation of the pleural cavity - 2 patients (1.7±1.2%), removal of intrapleural hematoma – 4 (3.4±1.7%) patients. In the early postoperative period, 14 (11.9±3.0%) patients had a reflex dry cough, which was relieved by taking codterpin.

In 11 (9.3±2.7%) patients in the postoperative period, the progression of TB in a single lung was noted. In 1 (0.8±0.8%) patient, the exacerbation developed against the background of pregnancy, in 7 (5.9±2.2%) due to improper administration of antituberculosis therapy in the postoperative period. One of these patients was operated on for pulmonary bleeding at the time of the first detected TB after 2 months from the beginning of taking anti-tuberculosis therapy.

5 (4.2±1.9%) patients died after surgery: 1 (0.8±0.8%) patient died of profuse erosive intrapleural bleeding from the aorta affected by a specific process (tubaaortitis) after thoracostomy for pleural empyema with bronchial fistula after PPE. 1 patient (0.8±0.8%) underwent thoracoplasty for pleural empyema with bronchial fistula after PE. The operation was ineffective, the patient died 14 months after thoracoplasty from progression of TB. 2 (1.7±1.2%) patients died from progression of TB in the only one lung more than 12 months later after surgery. 1 (0.8±0.8%) patient died on the operating table as a result of reflex cardiac arrest during ligation of the pulmonary artery. An autopsy revealed a malignant hemangiopericytoma with invasion of the pulmonary artery wall and destructive TB of the lungs, although the tumor was not detected on the computed tomography with contrast before the operation.

The evaluation of the overall effectiveness of the treatment was calculated as the ratio of the number of cases of postoperative mortality and relapse of tuberculosis to the total number of performed operations.

$$x = \frac{N - (nm + nr)}{\mathrm{N}}$$

X – overall effectiveness;
N – total number of operations;
Nm – total number of postoperative mortality;
Nr – total number of disease recurrence.

**Discussion.**

Other scientists also presented their results of surgical treatment of patients with pulmonary tuberculosis Korpusenko I.V., Savenkov Y.F. (Dnipro) submit the results of surgical treatment of patients with destructive pulmonary tuberculosis. The main group consisted of 129 patients who underwent mini-invasive surgical treatment methods using mini-accesses under the control of video thoracoscopy. The comparison group included 130 patients operated on from standard approaches using generally accepted techniques. The frequency of multiresistant MBT strains in the main group was 42.2±2.1% and 57.5±3.8% in the comparison group. 18 patients underwent lung/pleuropulmonectomy using mini-accesses under the control of video thoracoscopy (VAT), 19 patients had lung/pleuropulmonectomy performed from standard approaches using generally accepted methods. Postoperative complications after lung/pleuropulmonectomy were observed in 6 (33.3%) / 9 (47.4%) patients, 1 (5.6%) / 2 (10.5%) patients died, according to the groups. Treatment was effective in 16 (88.8±2.5%) / 14 (73.6±1.9%) patients with destructive pulmonary tuberculosis who underwent lung/pleuropulmonectomy, respectively[6].

Paula Duarte D'Ambrosio et al. (Brazil) presented the results of 56 pneumonectomies performed in two medical centers for infectious lung diseases over the past 10 years. The average age of patients was 44 years, women predominated (55%). Left-sided pulmonectomy was performed in 29 cases (51%). Most often, patients were operated on for pulmonary tuberculosis (51.8%). The overall frequency of complications was 28.6%. Most often it was empyema (19.2%). To eliminate this complication 36.3% of patients needed thoracostomy, 27.3% needed thoracoscopy, and 36.3% of patients underwent thoracoplasty. Fistula of the bronchial stump was observed in 10.7% of cases. After surgery 4 patients died (7.1%). The cause of death was massive postoperative bleeding (1 case) and sepsis (3 cases)[15].

Anvar Riskiyev et al. (Uzbekistan) reports the results of surgical treatment in Uzbekistan, which is performed as an adjunct to medical treatment in 10–12% of pulmonary tuberculosis (TB) patients. The study included 101 tuberculosis patients who underwent surgical interventions in the Republican Specialized Scientific and Practical Medical Center of Phthisia and Pulmonology of Uzbekistan (RSSPMCPPU) from January to May 2017. The average age was 36 years, 51% were men, 71% lived in rural areas. The main indications for presurgical intervention were tuberculomas (40%), fibrocavernous or cavernous tuberculosis (23%) and massive hemoptysis (20%). The most frequent surgical interventions were: segmentectomy (41%), lobectomy or bilobectomy (19%), combined resection (17%), lung/pleuropulmonectomy - 15 (14.9%). Postoperative complications occurred in 10 patients (9%). According to the histological examination after surgical intervention, tuberculosis

was confirmed in 81 (80%) patients. Lung cancer (n = 6), echinococcosis (n = 5), post-tuberculous fibrosis (n = 5), non-tuberculous pleurisy (n = 2), hamartoma (n = 1) and pneumonia (n = 1) were diagnosed in another 20 patients after surgery. The majority of patients (94%) who underwent surgery were considered successfully cured. 2 (2.0%) patients died[14].

Yablonskii Piotr K. et al. inform that among lung resections for TB, pneumonectomy and pleuropneumonectomy constitute up to 12% to 15%. Pneumonectomy is indicated in patients with totally destroyed lung by TB[20].

Dmitry Giller et al. The results of surgical treatment of 65 (80 operations) children (average age 14.8 years) with cavernous TB (I group) and 116 patients (average age 15.6 years) with fibro-cavernous TB (II group) were analyzed. 27 (41.5%) patients in the I-group had MDR/EDR-TB and 69 (59.5%) in the II-group. Pulmonectomy was performed in 4 (6.2%) patients of the I group and 12 (10.3%) of the II group. Pleuropulmonectomy was performed in 4 (3.4%) patients of the II group. In group I after 80 operations long-term underexpansion of the lung after combined resections was observed in two (2.5%) cases. In group II postoperative complications after 160 operations were observed in eight (5.0%) cases (significant difference r 0.05). There were no fatal cases. Effectiveness at the time of discharge from surgery (stopping of bacteriization and elimination of decay cavities in the lungs) was 100% in groups I and II respectively. One year later, according to Lazerson's criteria, the efficiency in the I group was 100%, in the II group - 97.4%. It has been proven that operations in patients with cavernous tuberculosis which are performed after 10 up to 12 months of conservative treatment have a lower risk of postoperative complications and relapses of cavernous tuberculosis than operations in patients with fibrous cavernous tuberculosis after 22 or more months of treatment[16].

Sayir F. et al. presents the results of surgical treatment of 32 patients who underwent pulmonectomy. The average age was $31.7 \pm 10.8$ years. All patients had a constant cough, 25 had sputum discharge, 18 had hemoptysis, and 11 had chest pain. The main primary diseases included non-specific bronchiectasis in 20 (62.5%), tuberculosis in 9 (28.1%), left lung hypoplasia accompanied by Bochdalek hernia in 2 (6.2%), aspiration of a foreign body stuck in the left main bronchus, in 1 (3.1%) patient. The average duration of surgery was $220.6 \pm 40.2$ min, and the average perioperative bleeding was $450.9 \pm 225.7$ ml. Postoperative complications occurred in 14.2% of patients, most commonly including atelectasis associated with secretion stasis and wound infection. The average postoperative hospital stay was $11.8 \pm 2.8$ days and the average follow-up period was $35.5 \pm 28.3$ months. Significant clinical improvement was observed in 81.2% of patients after surgery[19].

Seung-Kyu Park, Jin-Hee Kim, Hyungseok Kang et al. present the following. This was a prospective case study set in the National Masan Tuberculosis Hospital in Masan, Republic of Korea. From February 1998 to May 2004, 19 patients with well-localized, cavitary pulmonary MDR-TB or XDR-TB were enrolled and followed prospectively through April 2007. After radical surgical resection, patients were treated with anti-tuberculous therapy consisting of isoniazid (H), rifampin (R), ethambutol (E), pyrazinamide (Z), and streptomycin (S) (3HREZS/3HRES/6HRE). All recovered isolates of Mycobacterium tuberculosis were resistant to isoniazid and rifampin, and to a mean of 4.7 anti-tuberculous drugs (range 2–8 drugs). Seventeen patients had MDR-TB and two had XDR-TB. Surgical procedures included: lobectomy (14 patients), lobectomy plus segmentectomy or wedge resection (four patients), and pneumonectomy (one patient). The median time to postoperative sputum smear and culture conversion was 2 days (range 1–23 days). Fifteen (78.9%) subjects, including both with XDR-TB, had durable cures (mean follow-up period 53.2 months). One patient failed to convert her sputum and was successfully switched to second-line therapy. Another patient developed active disease again 68 months after cure, likely due to re-infection with a new M. tuberculosis strain. Two patients were lost to follow-up after hospital discharge. The authors believe that resectional lung surgery combined with isoniazid- and rifampin-based anti-tuberculous chemotherapy can be an effective treatment strategy for patients with well-localized, cavitary pulmonary MDR-TB and XDR-TB[21].

When analyzing the results of surgical treatment of patients with MDR/EDR-TB of the lungs, two main factors affecting the treatment outcome should be distinguished. The first factor is surgical. It includes all the methods described above, the use of which affects mainly the early results of treatment. This factor has the greatest influence on indicators of postoperative mortality and postoperative complications. The second factor is therapeutic. MDR/EDR-TB of the lungs is an infectious disease and without the use of adequate chemotherapy in the postoperative period and adherence to treatment, satisfactory long-term results cannot be achieved. This factor has the greatest influence on the rate of relapses

of MDR/EDR-TB of the lungs in the postoperative period. Therefore, the successful treatment of MDR/EDR-TB of the lungs depends on the mutual understanding between the phthisiologist and the thoracic surgeon, as well as on the commitment to the treatment of the patient himself.

It should be noted that during lung operations for TB the activation of a specific process always occurs to one degree or another. But these complications are the worst when PE or PPE is performed, since the exacerbation of MDR/EDR-TB of the lungs occurs in a single lung. In our clinic all patients must be managed together with a phthisiologist. Antimycobacterial conservative polychemotherapy is carried out in accordance with current regulatory documents on the treatment of patients with MDR/EDR-TB of the lungs[12,13]. In our study all patients in the preoperative and postoperative period were consulted by phthisiologists of the NIFP to optimize and individualize the regimen of taking antituberculosis drugs. All patients in the postoperative period received at least 5 antituberculosis drugs based on the data of the MBT drug sensitivity test with the use of first- and second-line drugs, new drugs (bedaquiline, delamanid) and broad-spectrum antibiotics active in relation to MBT. Further correction of the regimen of polychemotherapy was carried out after receiving the data of the MBT drug sensitivity test obtained during the inoculation of the material taken from the resection material during the operation.

**Conclusions.**

1. Pneumonectomy (PE) and pleuropneumonectomy (PPE) are effective methods of treatment for patients with pulmonary tuberculosis with multiple/extensive drug resistance (MDR/EDR-TB) against the background of complex antituberculosis therapy.
2. According to the data of our clinic, the use of PE or PPE was effective in 86.4% of cases, progression of TB was observed in 9.3% of patients.
3. Making a decision to perform PE or PPE is possible in conjunction with a phthisiologist only after conducting a spiral computed tomography (SCT), which allows detecting small destructive changes in the remaining lung.
4. Performing PE or PPE is possible in the presence of dense foci or small dense tuberculomes in the contralateral lung without signs of destruction, occupying no more than one segment; in all other cases it is more appropriate to perform collapsosurgical interventions (primary thoracoplasty or resection with thoracoplasty).
5. When conducting PE or PPE in patients with MDR/EDR-TB of the lungs, it is mandatory to use one of the methods of additional strengthening of the bronchial stump and prevention of pleural empyema.

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