ХИРУРГИЯ

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THE ROLE OF SURGERY IN DIAGNOSTICS AND TREATMENT OF PULMONARY TUBERCULOSIS (REVIEW OF LITERATURE)

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In the recent years, the tactic of tuberculosis treatment has undergone significant changes due to increased incidence of MDR and XDR-TB. These forms of the disease can not be treated by the usual chemotherapy regimens. A similar trend is observed worldwide. Therefore, TB surgery has obviously experienced a kind of rebirth in many countries. This article summarizes the current views on the surgical treatment of pulmonary tuberculosis. Refs 33.

Keywords: pulmonary tuberculosis, thoracic surgery, lobectomy, tuberculoma, cavitary tuberculosis.

РОЛЬ ХИРУРГИИ В ДИАГНОСТИКЕ И ЛЕЧЕНИИ ТУБЕРКУЛЕЗА ЛЕГКИХ

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В последние годы тактика лечения туберкулеза претерпела значительные изменения в связи с увеличением количества пациентов с туберкулезом, вызванным микобактериями с множественной и широкой лекарственной устойчивостью. Аналогичная тенденция наблюдается во всех странах мира. Эти формы заболевания не поддаются стандартным схемам химиотерапии.В связи с этим, происходит пересмотр подходов к хирургическому методу в лечении туберкулеза легких. В данной статье приведены современные представления о хирургическом лечении туберкулеза легких.

Ключевые слова: легочный туберкулез, торакальная хирургия, лобэктомия, туберкулема.

Introduction

As reported in GLOBAL TUBERCULOSIS REPORT 2015, about 3.3% of all new cases and 20% of previously treated cases had MDR-TB. More than half of these patients were in India, China and the Russian Federation. Extensively drug-resistant TB (XDR-TB) has been reported by 105 countries. Approximately 9.7% of people with MDR-TB

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have XDR-TB [1]. Drug-resistant tuberculosis is closely related to the development of new antibiotics. Genetic resistance to an anti-TB drug occurs naturally, because of mutations. MDR-TB/XDR-TB is an artificial phenomenon that has appeared due to an improper TB treatment. DR-TB has emerged since isoniazid and rifampicin have been used in the 1970s. Increased use of fluoroquinolone in TB treatment in the 1990s stimulated the expansion of pre-XDR-TB/XDR-TB. Compared to drug-susceptible TB, MDR-TB and XDR-TB are more difficult to treat, followed with treatment success rates of 60–80% and 44–60% respectively [2].

Due to the failure of medical treatment, MDR-TB has become a major indication for surgery [3]. Despite the large number of publications on the role of surgery in the treatment of MDR/ XDR pulmonary tuberculosis, the questions of indications and best tactic remain open [4].

Indications for surgery

According to Russian National Clinical recommendations, all indications for surgery can be divided by time of surgery [5].

1. **Emergency**: profuse pulmonary bleeding, tense spontaneous pneumothorax
2. **Urgent**: acute progression of tuberculosis (caseous pneumonia), despite adequate anti-TB chemotherapy, repeated hemoptysis, which can not be stopped by other options
3. **Elective**: diagnostic, localized forms of TB with and without cavity, complications and sequelae.

The questions of emergency and urgent indications are not disputable due to the high risk of death. The main uncertainties relate to the elective surgery. Therefore these questions will be addressed in this article.

Diagnostic procedures

Indications for all diagnostic procedures can be divided into two main groups: solitary nodule in the lungs and mediastinal lymphadenopathy with or without lung dissemination.

Solitary nodule. Solitary pulmonary lesions are parenchymal lesions of less than 3 cm in diameter without atelectasis or adenopathy, surrounded by normal lung parenchyma. There are common incidental findings on computed tomography (CT) studies. These lesions may be classified as either solid or subsolid nodules (SSN), based on CT characteristics [6, 7]. Nowadays, we have many non-invasive or minimal invasive options for diagnosis of solitary nodules.

In one trial, all cases of solitary pulmonary nodules were diagnosed with 40.6% primary malignant, 35.1% benign (mostly tuberculosis) and 24.2% metastatic [8]. The first question which has to be resolved is the size of the nodule. The balance must be found if a lower threshold will lead to fewer lung cancers being missed but will increase the false-positive rate. Some trials have shown that the majority of the identified nodules are solid and ≤ 5 mm in diameter. But there is no direct evidence linking the nodule size threshold that is used to label the screen as positive to oncologic or patient-centered outcomes [9].

PET-scan can be used in the cases when the mean SUV max value of nodules was 3.49 ± 3.03, 7.69 ± 4.08 and 3.19 ± 3.13 in benign, malignant and metastatic groups respectively. The mean SUV max value of malignant nodules was significantly higher than other

two groups but there was no statistically significant difference between the SUV max values of benign and metastatic nodules.

That is why, if PET-CT is used in diagnosis of SPN, the possibility of false positive and false negative results should be taken into account [8].

Morphological verification is the most common diagnostic problem for all imaging techniques. Transthoracic needle aspiration of these lesions can be done when nodules are located in the peripheral parts of the lung. This procedure is well established, with a sensitivity rate of 74–96%, but with a high risk of pneumothorax, ranging between 15% and 44%. Transbronchial forceps biopsy (TBB) under fluoroscopy is the standard approach to obtain tissue samples. The sensitivity of lesions between 2.5 cm and 4.0 cm is described at 62%, being under 40% for lesions smaller than 2.5 cm [7].

The high probability of malignancy is suspected if the size of the lesion is more than 8 mm. Those patients should be chosen for a surgical resection of a solitary nodule. Other diagnostic procedures have to be applied when patients are unsuitable for a surgical approach.

Mediastinal lymphadenopathy. Lymphadenopathy is the abnormality of node size, density of mediastinal lymph nodes [10]. Frequent causes of lymphadenopathy are inflammatory and neoplastic conditions, as well as several infections. Among all benign etiologies, the most common infection associated with thoracic lymphadenopathy is TB [11]. Lymphadenopathy is the main feature of primary TB. It is observed in 40% of adult cases and 90–95% of pediatric cases. Unilateral compromise is usually presented, and hilar lymph nodes are most often affected. On CT, the most suggestive aspect of primary TB consists of enlarged lymph nodes–generally >2 cm in diameter– with hypodense centers secondary to caseous necrosis, as well as a peripheral denser area that increases after the administration of contrast, representing a rim of granulomatous inflammatory tissue [12].

A variety of techniques for diagnosis of mediastinal lymphadenopathy is available: endoscopic techniques, radiological methods, nuclear medicine techniques and surgical procedures. CT-scan is the first option for diagnostic mediastinal abnormalities. In the evaluation of mediastinal lymph nodes, the clinical significance of CT is less convincing since CT mainly relies on size parameters. Short-axis diameter of 10–15 mm were suggested to define abnormal lymph nodes [13, 14]. However, 44% of metastatic lymph nodes were <10 mm in diameter, and of 139 patients with no metastatic lymph node involvement as much as 77% had at least one lymph node that was >10 mm in diameter [15].

Use of PET and integrated PET-CT can improve the sensitivity of CT for detecting mediastinal lymph node metastases up to 76% [16]. But there is no actual data proving a high efficacy of PET for diagnosis of tuberculosis. So, morphological verification in cases of mediastinal lymphadenopathy is crucial for diagnostic purposes. The two most usable techniques for verification of diagnosis of mediastinal lymphadenopathy are the endobronchial and the transesophageal ultrasound-guided biopsies. Many trials demonstrated the 88% sensitivity of transesophageal endosonography (32 studies, 2,680 patients) and 92% of EBUS for mediastinal lymphadenopathy (14 studies, 1,658 patients with low morbidity 0–2.3% and 0–1.2%, respectively [17].

Standard cervical mediastinoscopy, video-assisted mediastinoscopy (VAM) and video-assisted thoracoscopic surgery (VATS) are the minimally-invasive surgical methods for sampling of mediastinal lymph nodes. VAM allows better visualization and has a bet-

ter diagnostic yield than standard mediastinoscopy, but with the almost equal sensitivity (95 vs. 92.2%) [18]. VATS is generally limited to the evaluation of one side of the mediastinum.

Indications for treatment of localized forms of TB with and without cavity

The elimination of the source of Mycobacterium of tuberculosis is the main idea of surgery in cases of tuberculosis. In this regard, in cases of persisting of MBT in sputum, despite chemotherapy according to drug susceptibility test, surgical treatment can be regarded as a logical continuation of the efforts aimed to cure the patient.

Another point, cavitation is the most typical manifestation of tuberculosis (40–80%). The lesion liquefies and perforates into the bronchus, necrotic material is coughed out and air enters to form the cavity. Surgery for MDR-TB can be qualified as a "neoadjuvant" procedure for removing necrotic and devitalized tissues from the lungs.

A TB cavity contains a large population of tuberclous bacilli, which damages local lung tissue resulting in caseous necrosis [19].

Optimal time for surgery. The timing for surgery is crucial for postoperative mortality, morbidity, and chances for cure. Still there is no consensus related to the duration of preoperative chemotherapy. The 2 month period from the beginning of chemotherapy is recommended in some studies as an optimal time before the operation [4]. Some authors advocate to postpone surgery for at least 3 months after the start of a new regime [19, 20]. We suggest that optimal time for surgery in such cases is the period between 6 and 8 months after start of treatment according to the drug susceptibility test [21].

All types of thoracic procedures can be done in cases of localized forms of TB: wedge resections, anatomical resections: segmentectomy, lobectomy\bilobectomy (VATS or Robotic lobectomy) and pneumonectomy.

Wedge resections. Some authors published the favorable results of wedge resections in cases of tuberculosis [22]. However, we suggest that this type of surgery can be performed only in a limited number of patients with tuberculosis without cavity, due to high risk of postoperative disease recurrence [24].

Segmentectomy. This type of operations constitutes approximately 35% of all resections in cases of tuberculosis [24]. The main indication for segmental resections is tuberculosis without cavity. In patients with cavities, this procedure can be done if the lesion is located in 1 to 2 segments, with no harm for adjacent lung zones. If the mortality after segmentectomy is less than 1%, the rate of full recovery from TB is as high as 95–97%. The average early postoperative period lasts 7–10 days [25].

(bi) Lobectomy. The presence of cavities located in the boundaries of 1 or 2 lobes is an indication for lobectomy and bilobectomy. This type of procedure is most frequently done in cases with MDR/XDR tuberculosis, in some centers representing more than 40% of all resections [21].

Most of the literature shows good results of this operation with a low complication rate. The mortality after lobectomy is 2–3%. In case of an uneventful postoperative course, hospital stay should be 2–3 weeks. Sputum conversion is achieved in more than 90% of patients [4, 19, 25].

VATS and robotic lobectomy. In the recent period, we can see the continuing expansion of a minimal invasive approach in thoracic surgery. The same situation concerns the

surgery of MDR/XDR tuberculosis. Some papers showed the optimal indications for VATS approach [26, 27, 28].

Our clinic has the first worldwide experience in performing robotic surgery for MDR pulmonary tuberculosis in a series of eight patients. Indications for this approach were the same as for traditional surgery, but previous pleural effusion or lung resection on the side of the planned operation have been considered as contraindications. In the early postoperative period, sputum conversion rate was 100% [29].

Pneumonectomy. The presence of cavities located in more than six segments is an indication for pneumonectomy. In these patients, reinforcement of the suturing line of the bronchial stump is recommended in all cases. Extrapleural freeing of the lung is advised in case of severe pleuropulmonary adhesions in order to prevent tears of the lung tissue and opening of the cavities leading to massive contamination of the pleural space. Some procedures of bronchial stump coverage should be performed. Flaps from mediastinal pleura, muscles or omental pedicle wrap can be used to protect the bronchus.

Pneumonectomy represents 15.3%–40% of all lung resections for tuberculosis. Pneumonectomy and pleuropneumonectomy are characterized by high efficacy in early postoperative period (95%) with mortality rate of 3,5% [19, 25, 30].

The most efficient surgical method in the treatment of tuberculosis is the pulmonary resection. However, lung resection is not always feasible due to the extensive lung damage. Palliative interventions could be done in this case, such as endobronchial valves and thoracoplasty.

Endobronchial valves. Endobronchial valves can be employed for pulmonary cavity management. This method is based on the creation of hypoventilation and athelectasis of the affected part of the lung, thus preserving the drainage function of the blocked bronchus and the cavity. Routinely, endobronchial valves can be used alone or in combination with thoracoplasty, but in cases of MDR or XDR, a combination of these methods is favorable. This approach improves the immediate efficacy of thoracoplasty. Maximal duration of follow-up is 2 years after the valve placement [21, 31, 32].

Extrapleural thoracoplasty. A single cavity in the upper lobe observed for up to 12 months with a diameter of 4 cm localized at least 3 cm deep from the surface of the lungs and having a thin wall is an indication for thoracoplasty when pulmonary resection cannot be performed. The postoperative period usually is uncomplicated in more than 70% of cases and the rate of conversion of smears is from 40% to 57% [21, 33].

Surgery can achieve the biological and the anatomical eradication of the disease, especially in cases of MDR-TB and medical failure lesions. Proper patient selection and the timing of the operation are crucial to avoid relapses, provide definitive cure and prevent the spread of the disease in the community.

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