DOI: 10.15825/1995-1191-2020-4-162-167

TREATMENT OF EXPIRATORY TRACHEAL STENOSIS IN COMBINATION WITH BRONCHIECTASIS IN A LUNG RECIPIENT (INITIAL REPORT IN THE RUSSIAN FEDERATION)

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Lung transplantation is the final treatment option for end-stage lung failure. In 2019, 63,530 lung transplants were performed worldwide [13]. Due to the variety of diseases causing patients to resort to lung transplant surgeries, there is a wide range of different complications and conditions that are subject to an individual clinical approach to determine treatment tactics. Each case is of great clinical interest due to the small amount of these operations and the complexity of postoperative rehabilitation, which requires a multidisciplinary approach [12]. We present a report on a surgical treatment of expiratory tracheal stenosis in combination with bronchiectasis in a lung recipient.

Keywords: lung transplantation, multidisciplinary approach, expiratory tracheal stenosis, bronchiectasis.

INTRODUCTION

Lung transplant recipients have an increased risk of developing infectious complications, particularly bronchiectasis, due to impaired blood supply to the bronchial tree and immunosuppressive drugs. The main factors in the development of the latter are local inflammatory processes in the bronchi and obstructive atelectasis. Progression of the inflammatory process is promoted by bronchial lumen obstruction. In view of the increase in inflammatory changes, the ciliated epithelium is rearranged towards replacement by stratified squamous epithelium, which in turn impairs mucociliary clearance processes. Microcirculation disorder leads to degeneration and dystrophic degeneration of smooth muscle fibers and the bronchial cartilaginous plate, followed by its replacement by connective tissue. Under these conditions, increased intrabronchial pressure, for example, when coughing, leads to stretching of the bronchial wall and promotes formation of bronchiectasis [11].

The incidence of expiratory stenosis is 0.4–21.0% [4]. To date, there is no generally accepted theory of the origin of expiratory tracheal stenosis, but it is often accompanied by chronic inflammatory processes in the lungs. It is not always possible to assert unequivocally which of the pathophysiological processes is primary. Difficulty coughing up phlegm exacerbates chronic inflammation, which in turn produces sputum, increases coughing, and stretches the tracheal walls. Thus, thinning and excessive mobility of the posterior wall of the trachea develop, leading to expiratory stenosis [1]. Conservative treatment of this condition is aimed at improving sputum discharge and prescribing anti-inflammatory drugs [5].

Attempts to find a surgical solution to the problem of expiratory tracheal stenosis have been made since the middle of the 20th century. R. Nissen in 1954 for the first time used a bone graft to strengthen the membranous wall of the trachea [7]. At the same time, H. Herzog suggested using the aponeurosis of the rectus abdominis muscle [2, 3]. The outcomes of surgical treatment of this category of patients are not always satisfactory, and, given that such operations are performed quite rarely, each case is of clinical interest [1]. Currently, synthetic materials such as polypropylene meshes [8, 9] or polytetrafluoroethylene sheets [10] are most often used for posterior tracheal wall plasty. Besides, these operations are usually performed using posterolateral thoracotomy [6].

There are few reports on video-assisted thoracoscopic surgery for expiratory tracheal stenosis. R. Machino et al. in 2020 demonstrated a clinical observation of thoracoscopic plication of the membranous tracheal wall with interrupted sutures in an elderly patient with crescent-shaped tracheobronchomalacia with a positive effect. The patient was discharged on day 126 after surgery [6].

Our observation presents the first experience in the Russian Federation on surgical treatment of expiratory tracheal stenosis in combination with bronchiectasis in the lung graft.

MATERIALS AND METHODS

Description of clinical observation

Patient P., male, 61 years old, since 2018 has been under observation at Shumakov National Medical Research Center of Transplantology and Artificial Organs with the following diagnosis: chronic obstructive pulmo-

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nary disease (COPD), pulmonary emphysema, extremely severe course, type 2 respiratory failure, mixed form. In August 2018, the patient was included in the waiting list for deceased donor lungs.

In September 2018, bilateral sequential lung transplantation from a deceased donor was carried out.

The donor was a 33-year-old man. Mechanical ventilation (MV) lasted for 1 day. Plain chest x-ray showed no focal or infiltrative changes. Arterial blood oxygenation index pO_2/FiO_2 was 252. Video-assisted bronchoscopy showed a moderate amount of mucous sputum. Cold preservation was carried out using Celsior solution (IGL, France) by anterograde and retrograde method.

Lung transplantation was performed according to the standard technique. The patient was extubated and transferred to spontaneous breathing after 24 hours. The patient stayed in the intensive care unit for 8 days. Drains from pleural cavities were removed on day 8. Immunosuppressive therapy included tacrolimus, methylprednisolone, and mycophenolate mofetil.

The early postoperative period on day 24 was complicated by the development of right lower lobe pneumonia; therefore, tacrolimus dosage was reduced for the patient. Based on the results of a bacteriological study of bronchoalveolar lavage, according to which the growth of Ps. aeruginosa was noted, multicomponent antibacterial therapy (polymyxin, meropenem, sodium colistimethate, ceftazidime) was started with a positive effect – normalization of inflammatory markers and resolution of the clinical and radiological picture of pneumonia.

Control transbronchial biopsy on day 30 revealed the presence of antibody-mediated acute low-intensity graft rejection for which 5 sessions of plasmapheresis and correction of immunosuppressive therapy were carried out. The control transbronchial biopsy of the graft after treatment showed no signs of rejection. The patient was discharged from the hospital in a stable condition on day 54 after transplantation.

On June 10, 2020, patient P. was re-hospitalized at Shumakov National Medical Research Center of Transplantology and Artificial Organs with complaints of severe cough with discharge of copious amounts of viscous purulent sputum. Saturation was 92%, there was a need for continuous oxygen insufflation through nasal cannulas with a 7 L/min flow. Multidetector chest CT scan revealed bronchiectasis of the lower and middle lobes of the right lung (Fig. 1).

Control video-assisted bronchoscopy revealed expiratory stenosis of the lower third of the membranous trachea, which significantly complicated sputum evacuation (Fig. 2).

A multicomponent antibiotic therapy selected according to the sensitivity of the bacterial flora, and multiple sanitation bronchoscopies with a short-term positive effect were administered at the transplant center. Noninvasive ventilation of the lungs was contraindicated in

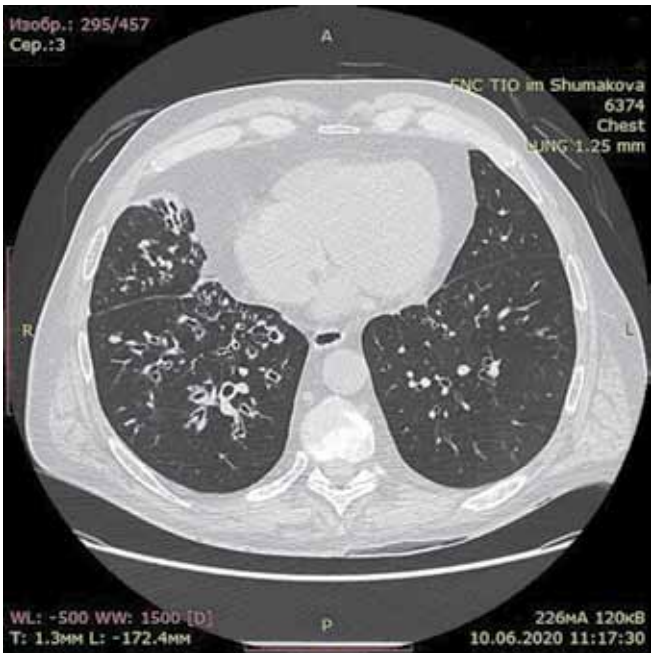

Fig. 1. CT before operation

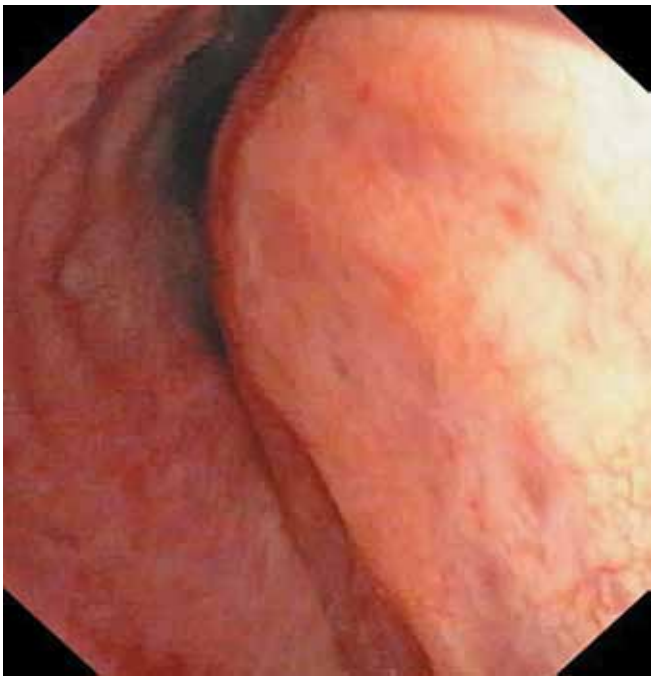

Fig. 2. Expiratory tracheal stenosis in the lower third

the patient due to the presence of bronchiectasis in the middle and lower lobes of the right lung and a large amount of hard-to-separate purulent sputum.

In order to eliminate the expiratory prolapse of the lower third of the trachea, the method developed by M.I. Perelman in 1987 was applied; it consists in phased sclerosis of the membranous trachea by injecting a glucose solution (40%) and the patient's plasma in a 1/1 ratio [14]. Injections were performed at 14-day intervals.

After two stages of endoscopic sclerotherapy, there were some positive dynamics – visual decrease in the

prolapse of the membranous part of the lower third of the trachea, decreased cough intensity, and improved sputum discharge. However, a few days later, the patient re-developed a clinical and laboratory picture of infectious process exacerbation and increased respiratory insufficiency. Bronchoscopy conducted showed a relapse of expiratory prolapse of the membranous wall of the trachea (Fig. 3).

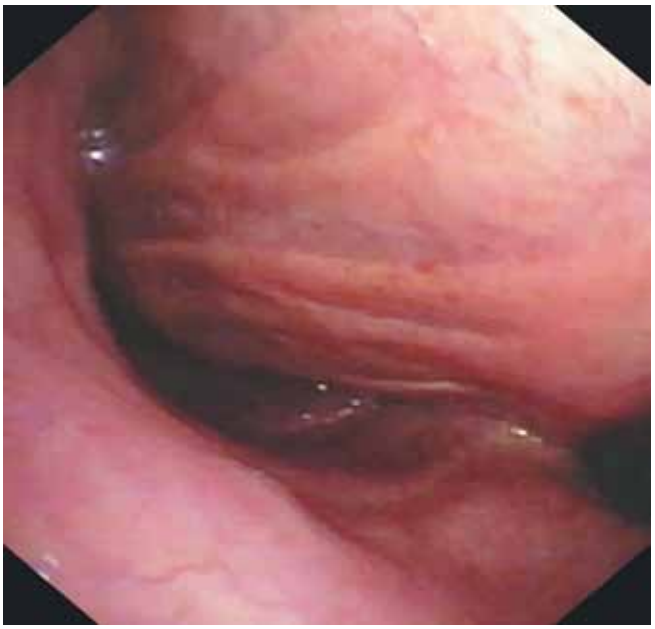

Fig. 3. Recurrence of expiratory prolapse of the membranous wall of the trachea

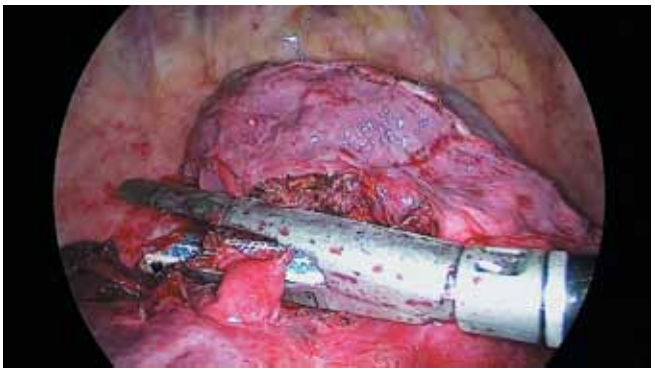

Fig. 4. Transection of basal part of the right pulmonary artery with a linear cutter

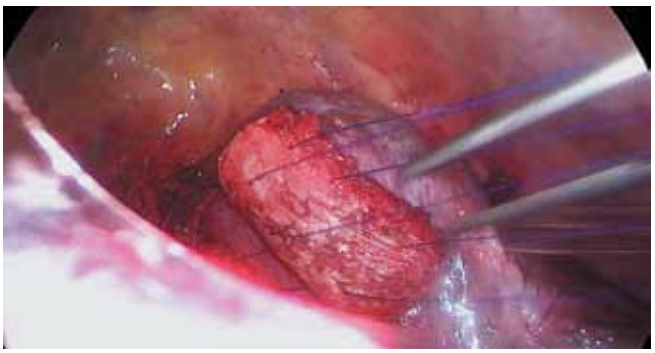

Fig. 5. Suturing the bone allograft to the posterior wall of the trachea

Given the increasing respiratory insufficiency and presence of a persistent infectious process, we decided to perform a surgical operation for vital indications. The purpose was to eliminate the focus of chronic infection and strengthen the membranous wall of the trachea.

On July 30, 2020, video-assisted thoracoscopic lower bilobectomy on the right side was performed with simultaneous plasty of the lower third of the membranous wall of the trachea with bone allograft (Fig. 4, 5, 6).

Course of operation

The patient position was on the left side. Separate intubation with a double-lumen orotracheal tube. An optics was inserted into the 7th intercostal space along the mid-axillary line, and a minithoracotomy (3 cm) was performed in the 5th intercostal space between the anterior and mid-axillary lines. Thoracoscopic inferior bilobectomy on the right side was performed as the first step, after the lung had been isolated from the adhesions using an ultrasonic harmonic scalpel (Fig. 4).

During the surgical access in the 5th intercostal space, a 4 cm long section of the 5th rib was resected to form a bone allograft, cut lengthwise, and a bone plate was formed; its edges were rounded. Suture holes were formed in the resulting bone plate.

In order to prevent damage to the endotracheal tube cuff, the trachea was reintubated using a single-lumen tube under endoscopic guidance. The trachea was mobilized in the middle and lower thirds, taken on a holder. The bone allograft was sutured to the membranous part of the trachea in its lower third with separate interrupted sutures (Prolen 4/0) (Fig. 5).

Multiple bronchiectasis in the lung tissue was found in the macropreparation cut (Fig. 6).

The early postoperative period was complicated by prolonged alveolar insufficiency, which required an artificial pneumoperitoneum (5 sessions of 600 mL each). Drainage was removed on day 5. Control bronchoscopy found no prolapse of the membranous trachea (Fig. 7). Multidetector chest CT scan found that the upper lobe of the right lung completely filled the right hemithorax. The patient subjectively noted significant improvement in his condition. Oxygen demand was reduced to 1–2 L/min. After 7 days, the patient stopped oxygen therapy, arterial blood saturation by atmospheric air was 91%. The patient was discharged in a stable condition on day 21 after the operation. Control CT after 2.5 months showed that the operated right lung was fully expanded, and there were no additional focal-infiltrative changes (Fig. 8). A comparative analysis of objective indicators over time is presented in Table.

Table

Comparative analysis of objective indicators

RF indicators (% of the norm)	Preoperative	Postoperative	After 1 month	After 2.5 months
FEV_1 (% of the norm)	22	23	25	30
FVC (% of the norm)	36	37	45	46
Tiffno's index (%)	47	62	55	65
sO_2 in atm. air (%)	85	88	92	92
sO_2 in oxygen (%)/Vflow (L/min)	92/10	94/7	98/2	98/2

Fig. 6. Gross specimen of multiple bronchiectasis in the lung tissue

Fig. 7. Bronchoscopy after surgery

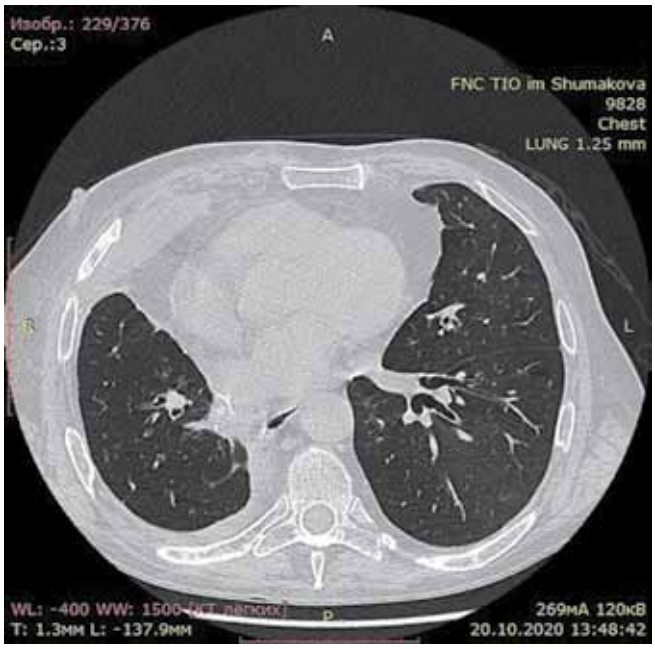

Fig. 8. Multispiral CT scan 2.5 months after surgery

DISCUSSION

Bronchiectasis in lung recipients is a serious issue due to the high risk of developing severe infectious complications against the background of immunosuppressive therapy. A combination of bronchiectasis and expiratory tracheal stenosis, causing impaired ventilation function, leads to rapid progression of respiratory insufficiency and significant deterioration in the patient's condition.

Surgical treatment of patients who have undergone bilateral lung transplantation is associated with a number of difficulties (pronounced adhesions in the pleural cavity, "altered anatomy", frequent exacerbations of chronic infections amidst immunosuppression, in some cases low functional reserves, difficulties in predicting the functional status in the early postoperative period). However, surgery is the only treatment that can significantly improve the quality of life of the patients.

In this clinical case, surgical treatment was the only treatment due to the ineffectiveness of conservative therapy. The increase in pulmonary function (PV) indicators was due to elimination of expiratory tracheal stenosis. Improved blood oxygenation was due to cessation of blood shunting through poorly ventilated as a result of bronchiectasis) lobes of the lung.

CONCLUSION

This clinical case indicates the need for a comprehensive multidisciplinary approach to the treatment of post-lung transplant complications, depending on the specific case. Video-assisted thoracoscopic surgical access, in

the absence of total adhesion, is the method of choice when performing surgical interventions in patients with low functional status. This is due to low trauma and, as a consequence, increased rehabilitation potential of the patient. Plasty of the membranous wall of the trachea in the presence of expiratory stenosis is an effective method of surgical treatment if other methods of correction are ineffective and/or impossible.

The authors declare no conflict of interest.

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The article was submitted to the journal on 23.10.2020