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Case Report

Closure of TB pulmonary cavern using endobronchial valve placement

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Abstract

Introduction: Enhancing the efficacy of treatment for Multi-Drug Resistant (MDR) and Extensively Drug Resistant (XDR) Tuberculosis has prompted exploration into adjunctive therapies, such as Endobronchial Valve Placement (EVP) in addition to pharmacological interventions. Materials and Methods: EVP was performed utilizing a combination of rigid and flexible bronchoscopes to address airway hemorrhage and facilitate closure of TB cavities. The procedure involved the deployment of large valves (12 mm and 17 mm), necessitating the utilization of a rigid bronchoscope. Results: Sputum conversion was confirmed through culture analysis after one month, and chest CT scans revealed complete closure of the tuberculous cavity five months post the EVP procedure. Conclusion: We posit that when used in conjunction with anti-TB chemotherapy, this method holds promise for shortening treatment duration and improving overall efficacy.

Keywords: EVP, XDR and MDR TB, Endobronchial Valves

INTRODUCTION

The World Health Organization (WHO) reported an estimated 10.6million cases of tuberculosis in 2021. Despite a gradual decline in TB incidence over the years there was a concerning 3.6% increase noted in 2021. The estimated total number of deaths attributed to TB reached 1 400 000, with approximately 450 000 cases classified as Multi-Drug Resistant/Rifampicin-Resistant Tuberculosis (MDR/RR-TB). Furthermore, the global treatment success rate for MDR/RR-TB patients remained disappointingly low.

TB remains a significant public health concern in Georgia, with 1645 cases reported in 2021, including 146 cases of MDR-TB and XDR-TB.

Despite the widespread introduction of new anti-TB drugs, resistance to these medications has been observed in *Mycobacterium tuberculosis*. To enhance the effectiveness of complex therapy and manage complications, alongside medical and surgical intervention, the less invasive endoscopic method, EVP, is being considered. This procedure involves the temporary occlusion of the bronchial lumen by endobronchial valves (Figs 4–7).

In 2020, EVP was incorporated into the National TB Management Guideline and refeived funding through the state program as an additional treatment component.

CASE REPORT

The patient, a 31-year-old male, previously underwent an incomplete course of anti-TB chemotherapy (Pyrazinamide (Z) + Capreomycin (Cm) + Levofloxacin (Lfx) + Prothionamide (Pto) + Para-Amino Salicylic acid (PAS) for MDR-TB (Sensitivity: Isoniazid (H), Rifampicin (R), Ethambutol; Resistance: Ofloxacin (Ofx), Kanamycin (Km), Capreomycin (Cm), PAS), and was subsequently lost to follow-up. In seven years, the patient was re-enrolled in anti-TB treatment under the national program after testing positive for MDR-TB via sputum smear (SS). The prescribed anti-TB regimen included Bedaquiline (Bdq) + Linezolid (Lzd) + Levofloxacin (Lfx) + Clofazimine (Cfe) + Cycloserine (Cs). In 1 months' time, despite receiving directly observed treatment, the patient experienced persistent hemoptysis. A chest CT scan revealed an oval-shaped, cavitary lesion with thick, irregular walls and a nonhomogeneous fluid level in the lower lobe of the left lung (S10), with a maximum axial diameter of 49–39 mm. (Fig. 1). additionally, small centrilobular nodules were observed surrounding the lesion. The National MDR-TB clinical council decided to incorporate EVP as an adjunctive treatment alongside anti-TB chemotherapy.

EVP was conducted over a span of 4 days. Under general anesthesia, the first endobronchial valve (12 mm) was selectively

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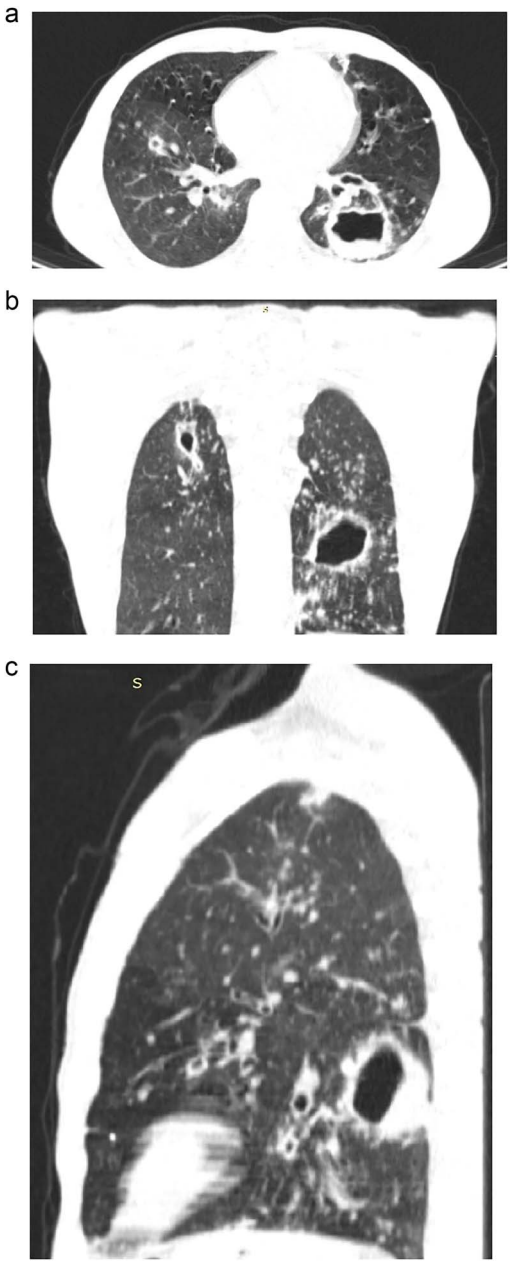

Figure 1. CT scan in axial, coronal, and sagittal section before EVP.

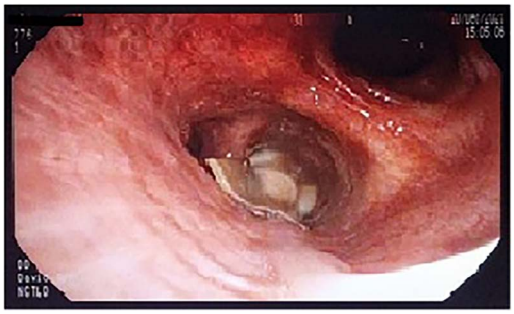

Figure 2. Inserted Endobronchial Valve in the Left Lower Lobe Bronchus.

inserted into the left posterior segmental bronchus (LB10), while the second valve (17 mm) was directly inserted into the lumen of the left lower bronchus (Fig. 2).

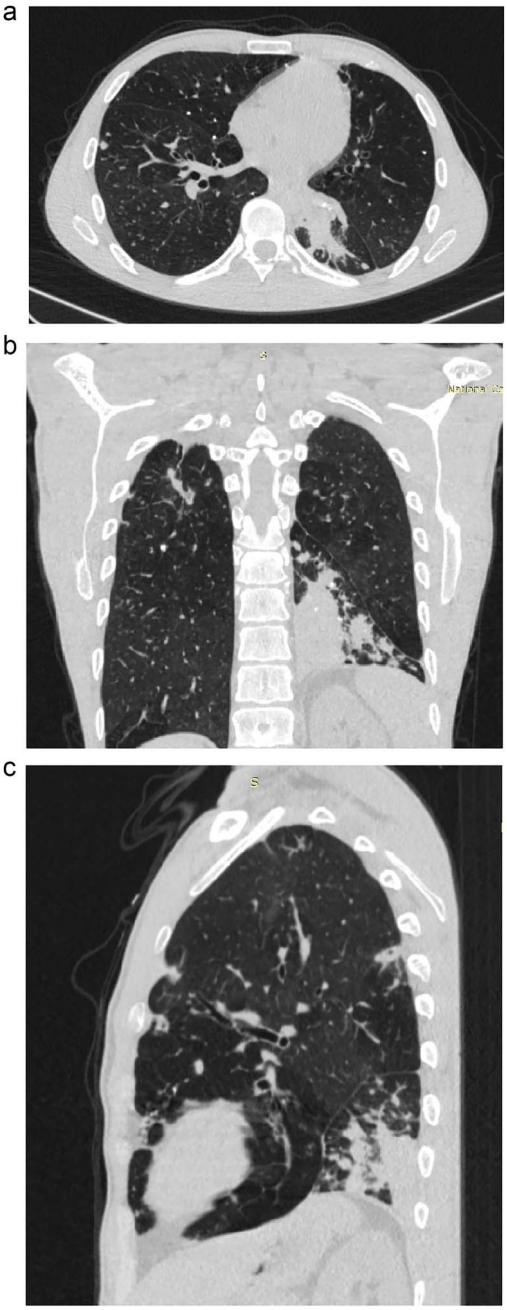

Figure 3. CT scan in axial, coronal, and sagittal sections after EVP.

The primary objective of the procedure was to halt ongoing airway bleeding and facilitate closure of the TB cavity. Closure of the TB cavity was defined as sputum culture conversion and corresponding changes observed on CT scan images (Fig. 3). A negative culture result was obtained from the sample collected on the 32nd day post-EVP procedure, and all subsequent cultures remained negative. Four months after the procedure, the patient underwent a chest CT scan, which revealed complete closure of the tuberculous cavity.

Following an assessment of the patient's clinical, laboratory, and radiologic data, the National MDR-TB clinical council opted to transition the patient from a 24-moth regimen to a shorter, 9-month oral regimen.

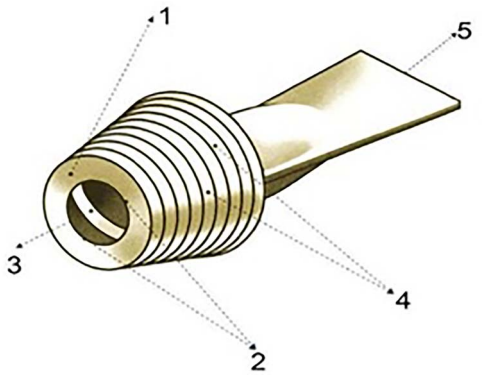

Figure 4. Endobronchial Valve [1]Hollow cylinder; [2]Internal valve opening; [3]The bridge that holds the valve; [4]Radial petals that allow fixation of the valve inside of the bronchus; [5]Collapsible petal-like valve. A. V. Levin, E. A. Tseimakh, P. E. Zimonin. The Use of Valvular Bronchial Blocking in Complicated Lung Tuberculosis. Guidelines for Doctors 2nd publication. 2008.

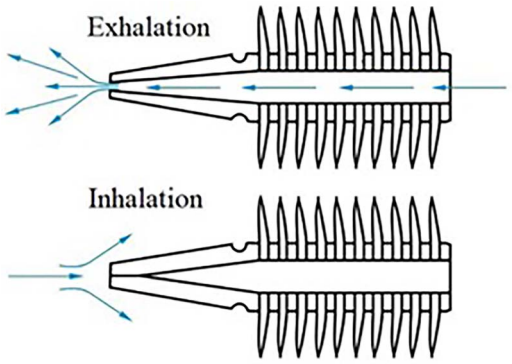

Figure 5. Endobronchial Valve.: Principle of operation. A. V. Levin, E. A. Tseimakh, P. E. Zimonin. The Use of Valvular Bronchial Blocking in Complicated Lung Tuberculosis. Guidelines for Doctors 2nd publication. 2008.

Figure 6. Endobronchial Valve is installed on the head of the flexible bronchoscope.

DISCUSSION

EVP achieves therapeutic hypoventilation (atelectasis) within the damaged lung area while preserving the drainage function of the affected bronchus through valve insertion into its lumen. This creates a collapsing effect, effectively sealing cavities in the lung tissue. Consequently, an unfavorable anaerobic environment is established for *M. tuberculosis*, inhibiting its spread withing the lung parenchyma. Moreover, this process promotes scar formation, aiding in tissue healing and containment of the infection.

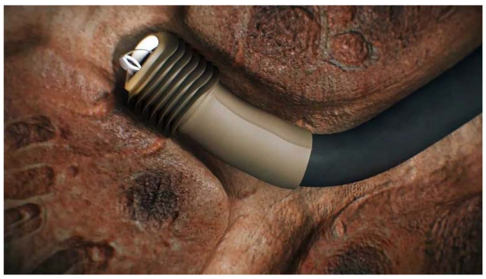

Figure 7. Fixation of the Endobronchial Valve in the blocked bronchus. A. V. Levin, E. A. Tseimakh, P. E. Zimonin. The Use of Valvular Bronchial Blocking in Complicated Lung Tuberculosis. Guidelines for Doctors 2nd publication. 2008.

Additionally, the localized effects of EVP complement systemic pharmacological interventions by potentially enhancing the efficacy of new anti-TB drugs.

CONCLUSION

EVP has demonstrated effectiveness as an adjunctive method in managing cases of MDR tuberculosis. We successfully achieved our primary objectives of halting lung bleeding, closing the cavity, and achieving sputum conversion. While further evidence is wassanted we anticipate that EVP will play a pivotal role in managing complex cases of MDR/XDR tuberculosis when employed alongside therapeutic treatment.

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