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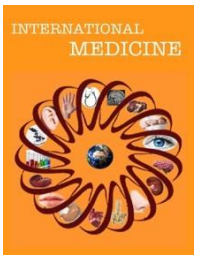

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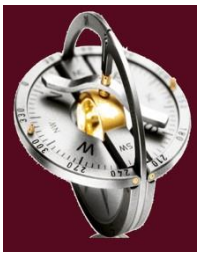

Original Research

From Struggle to Breathe: A Case Report on the Novel Stepwise Use of SEMS Followed by Silicone Y-Stent in Post-Tubercular Airway Stenosis

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Abstract

Background: Post-tubercular tracheobronchial stenosis (PTTBS) is a rare but disabling benign airway condition. Self-expanding metallic stents (SEMS) are traditionally used for malignant airway obstruction, and their temporary use in benign stenosis is uncommon but may help in selected complex cases. ***Case Presentation:*** A 30-year-old woman, cured of pulmonary tuberculosis in 2019, presented with chronic cough, exertional dyspnea, and recurrent LRTIs. HRCT and bronchoscopy showed bilateral bronchiectasis with multilevel fibrostenoticbenign airway stenosis, including a pinpoint left main bronchus. Repeated balloon dilatations yielded only short-lived relief. A staged approach was adopted: a customized SEMS Y-stent–typically used for malignant obstruction–was temporarily placed via rigid bronchoscopy to remodel the airway, followed three weeks later by its removal, repeat dilatations, and placement of a definitive customized silicone Y-stent. The patient achieved significant symptomatic improvement and maintained airway patency. ***Conclusion:*** Temporary SEMS, although conventionally reserved for malignant disease, can function effectively as a bridge to silicone stenting in complex benign PTTBS. A staged, customized, multidisciplinary strategy can safely restore durable airway patency in challenging benign airway stenosis.

Keywords: *PTTBS, benign airway stenosis, SEMS bridge stenting, silicone Y-stent, interventional pulmonology.*

Introduction

Post-tubercular tracheobronchial stenosis (PTTBS) is a debilitating benign airway sequela resulting from cicatricial fibrosis following endobronchial tuberculosis[1]. Given India's high tuberculosis burden, many young patients continue to experience delayed airway complications long after microbiological cure[2]. These individuals often present with dyspnoea, wheeze, and recurrent respiratory infections–symptoms frequently misdiagnosed as asthma or nonspecific post-TB sequelae, leading to delayed specialized evaluation[3,4].

At Universal Superspeciality Hospital, Surat, increasing referrals of young post-TB patients with severe multilevel stenosis underscore the growing recognition of complex benign airway disease and the need for centres with expertise in rigid bronchoscopy and fluoroscopy-guided interventions. Balloon dilatation alone often fails in such cases due to dense fibrostenosis and rapid recoil[5]. High-resolution CT is essential for defining the extent of disease[6], while bronchoscopy provides direct assessment and exclusion of other causes such as post-intubation stenosis or malignancy[7]. When stenosis is severe, advanced bronchoscopic modalities–including balloon dilatation, debridement, and airway stenting–become necessary to restore airway patency[8].

Self-expanding metallic stents (SEMS), although traditionally used for malignant central airway obstruction due to their strong radial force, are generally avoided in benign disease because of risks of mucosal ingrowth and difficulty in removal[9]. However, in carefully selected complex PTTBS, temporary SEMS use can provide rapid airway expansion and preparation for definitive stenting. Silicone stents, preferred for benign stenosis due to their removability and biocompatibility[10], can then be placed as part of a staged hybrid approach, combining the strengths of both stent types[11].

This report describes a challenging case of complex post-tubercular airway stenosis managed using the rare, unconventional strategy of temporary SEMS as a bridge to definitive silicone Y-stenting, demonstrating how customized staged airway reconstruction can restore durable airway patency in benign disease.

Self-expanding metallic stents (SEMS) have traditionally been used for malignant central airway obstruction due to their high radial force and tendency to embed within the mucosa. Their use in benign airway disease is generally avoided because of risks of granulation, mucosal ingrowth, and difficulty in removal[9].

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CASE PRESENTATION

1. Patient Information and Demographics

A 30-year-old woman, homemaker, with a past history of pulmonary tuberculosis treated in 2019 with a complete 9-month AKT regimen and confirmed microbiological cure. She was a nonsmoker with no comorbidities such as diabetes, cardiac disease, or immunosuppression.

2. Presenting Complaints and History of Illness

Since completing TB treatment, she developed persistent productive cough, gradually progressive exertional dyspnoea, and recurrent lower respiratory tract infections requiring repeated antibiotics. Exercise tolerance declined, and she reported occasional wheezing but denied hemoptysis, significant weight loss, or orthopnoea.

3. Obstetric, Gynaecologic, and Additional History

She was postpartum during her initial TB episode. Menstrual cycles were regular without obstetric complications. She had no systemic illnesses, no history of airway trauma, and no prior intubation.

4. Clinical Examination

She was afebrile with mild exertional respiratory distress. Vital signs were stable except for a mildly elevated respiratory rate. Chest auscultation revealed bilateral coarse crepitations, intermittent expiratory wheeze, and markedly reduced air entry over the left lung fields. Cardiovascular and abdominal examinations were normal.

5. Initial Investigations

Laboratory testing showed mild anaemia with normal renal and liver function. HRCT chest demonstrated bilateral bronchiectasis with multilevel tracheobronchial stenosis, most pronounced at the left main bronchus. Bronchoscopy confirmed multiple complex fibrotic stenoses with a pinpoint left main bronchus opening.

6. Initial Management – Balloon Dilatation

Multiple bronchoscopic balloon dilatations were performed at stenotic segments, each providing only transient benefit with rapid recoil. Given the multilevel, rigid nature of stenosis, balloon dilatation alone was deemed inadequate.

7. Decision-Making and Staged Intervention Strategy

After detailed counselling about risks, benefits, and alternatives, a staged approach was chosen:
- **Stage 1** – temporary SEMS Y-stent placement for airway expansion and remodeling.
- **Stage 2** – definitive customized silicone Y-stent placement for long-term stabilization.

8. Step 1: SEMS Y-stent Placement (Airway Preparation Phase)

Stent Planning: A 6 × 3 cm SEMS Y-stent was customized by trimming the right limb to 1 cm to avoid right upper lobe obstruction.

Procedure: Flexible bronchoscopy with C-arm guidance failed due to acute LMB angulation, so rigid bronchoscopy was used for deployment. The stent was positioned across the carina with good bilateral main bronchial coverage.

Outcome: Immediate bronchoscopy confirmed excellent airway opening. The patient experienced rapid symptomatic improvement and remained stable for 2-3 weeks, allowing airway remodeling.

9. Step 2: Silicone Y-stent Placement (Definitive Phase)

Pre-procedure: On follow-up admission, symptoms remained improved. Bronchoscopy showed patent but fibrotic airways.
Procedure: Bronchial washings were taken. The SEMS was removed with minimal mucosal trauma. Serial balloon dilatations were performed before and after removal. A customized silicone Y-stent was measured, prepared, and deployed using rigid bronchoscopy under C-arm guidance.

Outcome: Final inspection confirmed excellent stent seating and restored airway patency. The patient showed sustained improvement in dyspnoea and infection frequency and was discharged with advice on physiotherapy, airway hygiene, and follow-up monitoring.

Table 1. Summary of Case Details and Interventional Timeline

Parameter	Brief Details
Patient Demographics	30-year-old female, homemaker
Past History	Pulmonary TB (2019), completed 9-month AKT, cured
Presenting Symptoms	Chronic cough, exertional dyspnoea, recurrent LRTIs
Key Examination Findings	Mild respiratory distress; bilateral crepitations; ↓ air entry (left)
Initial Investigations	Mild anaemia; normal RFT/LFT; HRCT: bilateral bronchiectasis + multilevel stenosis; bronchoscopy: pinpoint LMB
Initial Management	Multiple balloon dilatations → only temporary improvement
Decision Strategy	Staged plan: temporary SEMS Y-stent → definitive silicone Y-stent
Stage 1: SEMS Y-stent	Customized 6×3 cm SEMS (right limb trimmed); deployed via rigid bronchoscopy
Outcome After SEMS	Excellent airway opening; symptom relief for 2-3 weeks
Stage 2: Silicone Y-stent	SEMS removal → repeat dilatations → customized silicone Y-stent placed under rigid bronchoscopy + C-arm
Final Outcome	Widely patent airway; sustained symptom relief; improved exercise tolerance
Follow-up Advice	Physiotherapy, airway hygiene, surveillance for granulation/migration

Figure 1. Post-Balloon Dilatation of Carina and Main Bronchi
Bronchoscopic image demonstrating airway calibre improvement after multiple rounds of balloon dilatation performed prior to silicone Y-stent deployment. The left main bronchus (LMB), carina, and right lower lobe bronchus (RLLB) are labelled for clarity.

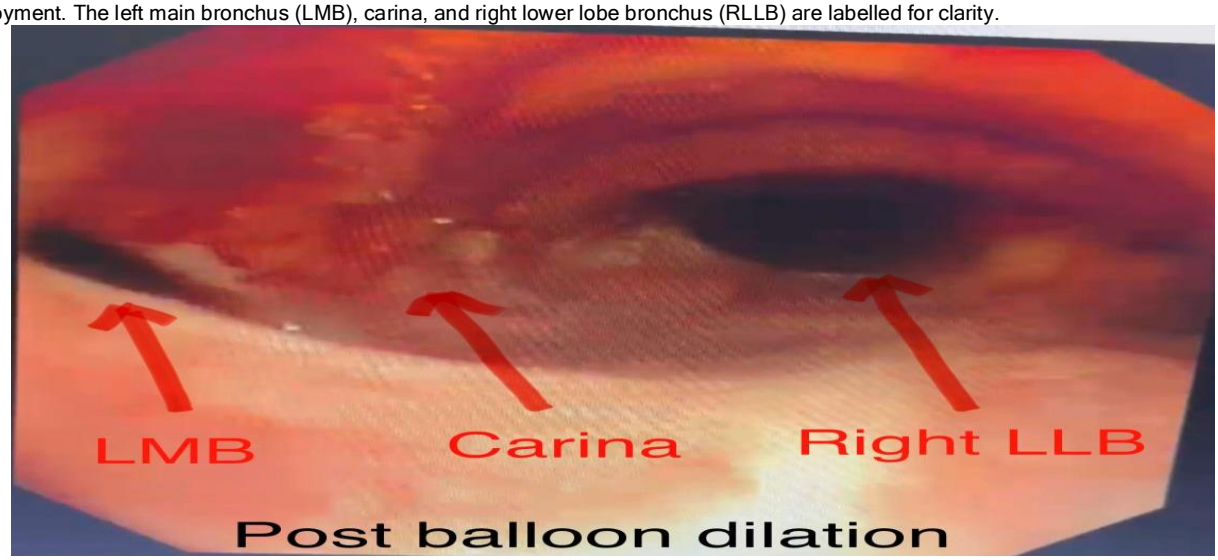


Figure 2. Carina with SEMS Y-Stent in Situ (Initial Airway Preparation Phase)
Bronchoscopic view showing the carina with the self-expanding metallic Y-stent (SEMS) placed during the first stage of intervention. The stent is visible across the trachea and extending into the main bronchi, maintaining airway patency before definitive silicone stenting.

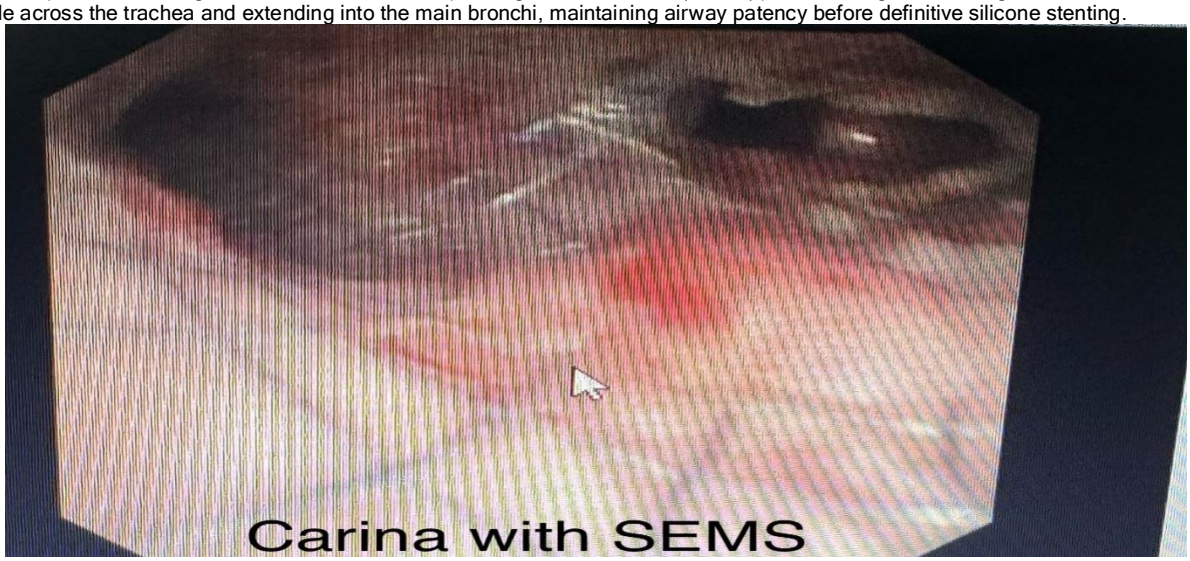
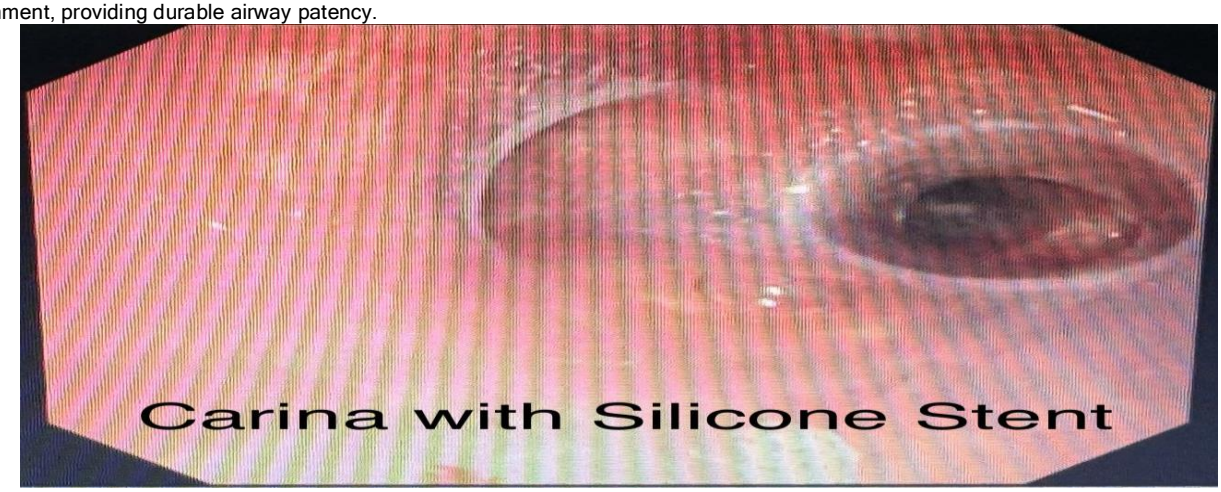


Figure 3. Carina After Removal of SEMS Y-Stent
Bronchoscopic evaluation following careful removal of the SEMS. The underlying stenotic segments and mucosa are visualized, showing residual narrowing but improved luminal shape following the initial stent-mediated airway remodeling.

Figure 4. Carina with Customized Silicone Y-Stent (Definitive Stenting Phase)
Final bronchoscopic inspection following deployment of the customized silicone Y-stent via rigid bronchoscopy. The stent sits well with optimal alignment, providing durable airway patency.



Discussion

Post-tubercular tracheobronchial stenosis (PTTBS) remains one of the most complex benign airway disorders, characterized by dense cicatricial fibrosis and multilevel luminal narrowing. While airway stenting is well established in malignant obstruction, its use in benign disease–especially self-expanding metallic stents (SEMS)–is generally avoided due to long-term risks such as granulation, mucosal ingrowth, and difficulty in removal [12]. However, in highly selected cases with near-complete or rigid stenosis, temporary SEMS placement can serve as a strategic bridge to facilitate later silicone stenting. This case exemplifies such rare, judicious use of SEMS in benign disease.

Balloon dilatation is typically considered the initial intervention for benign airway stenosis, yet recurrence is extremely common in long-segment or circumferential fibrostenosis due to rapid elastic recoil [13]. In these situations, a staged strategy–temporary SEMS to remodel the airway followed by definitive silicone stent placement–has been increasingly recognized as an effective hybrid approach. This method leverages the high radial force of SEMS for short-term airway expansion while avoiding their long-term complications by removing them after adequate lumen gain [14].

Silicone Y-stents remain the preferred long-term option in benign central airway obstruction because of their removability, favourable tissue compatibility, and lower granulation rates. Comparative studies consistently show better durable outcomes with silicone stents, especially when customized and deployed via rigid bronchoscopy for accurate positioning [15-17]. In our patient, SEMS created the necessary luminal space for safe silicone Y-stent insertion, demonstrating how hybrid stenting can overcome anatomical challenges in severe PTTBS.
Management of multilevel post-TB stenosis requires meticulous pre-procedural planning, accurate CT-based measurements, staged dilatations, and technical precision in stent customization. Multidisciplinary expertise–including interventional pulmonology, anesthesiology, radiology, and trained bronchoscopic support–is essential for optimal outcomes [18]. The excellent symptomatic improvement and sustained airway patency observed in this case align with global evidence that staged airway interventions performed at high-expertise centers can restore functional capacity and improve quality of life in benign central airway obstruction [19].

Conclusion

This case underscores the effectiveness of a staged, personalized interventional strategy in managing complex post-tubercular tracheobronchial stenosis, a benign but debilitating airway condition. Notably, the temporary deployment of a self-expanding metallic Y-stent (SEMS)–typically reserved for malignant airway obstruction–acted as a critical bridging tool, allowing controlled expansion of a severely rigid benign stenosis. This facilitated the safe placement of a definitive customized silicone Y-stent, achieving sustained airway patency and significant symptom improvement. The experience highlights that in severe benign post-TB airway disease with dense fibrosis, distorted anatomy, and multilevel involvement, a structured stepwise approach combining unconventional temporary SEMS use with long-term silicone stenting can safely restore airway calibre when balloon dilatation alone fails. With detailed assessment, customization, and coordinated multidisciplinary expertise, even highly complex benign airway obstructions can be successfully rehabilitated.

Limitations

As a single-patient case report, the findings cannot be generalized to all benign airway stenosis cases, particularly given the rare and unconventional temporary use of SEMS–typically indicated for malignant airway obstruction–in a benign post-TB setting. The relatively short follow-up restricts assessment of late silicone stent complications such as granulation, migration, or infection. Furthermore, the specialized resources and technical expertise required–rigid bronchoscopy, fluoroscopic guidance, and customized stent modification–may not be available in all centres, limiting wider applicability of this approach.

Recommendations

For complex post-tubercular tracheobronchial stenosis, a staged, individualized management plan is recommended–particularly in cases where direct silicone stent placement is not feasible due to severe narrowing. Temporary SEMS use, although traditionally limited to malignant obstruction, may serve as an effective bridge for airway remodeling in carefully selected benign cases. Precise customization of stent dimensions and deployment via rigid bronchoscopy are essential to ensure anatomical accuracy and reduce complications. Post-procedure care should include structured bronchoscopic follow-up to monitor stent position, secretion clearance, and early granulation. At a systems level, early screening and timely referral for post-TB airway disease in high-burden regions, supported by a multidisciplinary interventional team, are key to optimizing outcomes when employing innovative off-label SEMS use in benign disease.

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