Biodegradable Stent Placement for Airway Kinking After Bronchoscopic Lung Volume Reduction Treatment

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Symptomatic airway kinking after bronchoscopic lung volume reduction with endobronchial valves is rare. Owing to the development of the desired lobar atelectasis, the position of the airways of the nontreated lobe changes, and that might lead to invalidating symptoms. We present a case of a patient with symptomatic airway kinking after treatment with endobronchial valves, who was successfully treated with a single placement of a biodegradable stent. Placement of a biodegradable stent can be considered for symptomatic patients with airway kinking.

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Bronchoscopic lung volume reduction with one-way valves is an important treatment option for selected patients with severe emphysema, hyperinflation, and absence of collateral ventilation.1 Because of the development of the desired atelectasis of the treated lobe after bronchoscopic lung volume reduction with valves, the position of the airways of the nontreated lobes changes. In very rare cases (0% to 6%), that might lead to symptomatic airway kinking,2,3 which has been described more often after surgical lobectomy and might lead to decreased pulmonary function and increased complaints of coughing, wheezing, and dyspnea.3,5 Here, we describe a case of a patient with airway kinking after treatment with endobronchial valves that resolved using successful placement of a biodegradable airway stent.

A 59-year-old woman with advanced emphysema and severe hyperinflation was found eligible for bronchoscopic lung volume reduction with endobronchial valves. Before treatment she had a forced expiratory volume in 1 second of 1.12 L (45% of predicted value), residual volume was 3.80 L (203% of predicted value), and residual volume to total lung capacity ratio was 56%. Computed tomography (CT) showed an upper lobe predominant heterogeneous centrilobular emphysema. The left upper lobe was defined as the treatment target lobe. Quantitative CT scan analysis showed a destruction score (percent voxel density less than –950 Hounsfield Units) of 42% for the left upper lobe and 18% for the left lower lobe, with a lobe volume, respectively, of 1642 mL and 1715 mL.

The bronchoscopic lung volume reduction treatment was performed under general anesthesia, absence of collateral flow in the target lobe was confirmed with a Chartis measurement, and four endobronchial valves were placed in the left upper lobe. The procedure was uncomplicated.

In the days after the valve treatment, the patient had a significant increase in coughing. Pharmacologic treatment with codeine and a course of prednisolone and amoxicillin did not have any effect on these symptoms. At 2-month follow-up, her complaints persisted and were experienced as invalidating.

Pulmonary function test showed a significant reduction in residual volume with 850 mL (~22.4% improvement from baseline); however, only a small increase in forced expiratory volume in 1 second (40 mL, +3.6% improvement from baseline) was observed. The CT scan showed complete atelectasis of the left upper lobe with airway kinking of the left lower lobe bronchus (Figure 1). Bronchoscopy was again performed and confirmed the left lower lobe airway kinking (Figures 2A, 2B), and a custom-made biodegradable polydioxanone stent (ELLA-CS, Hradec Králové, Czech Republic) with a diameter of 10 mm and a length of 15 mm was placed between the apex of the left lower lobe (LB6) and the basal segments (LB8, LB9, and LB10; Figure 2C). The procedure was performed under general anesthesia with endotracheal tube. The self-expandable custom-made stent was advanced over a guidewire to the correct position. After deployment under direct bronchoscopic visualization, in-stent balloon dilation was performed to secure the position of the stent.

Directly after stent placement, the patient’s complaints improved, and 1 day after stent placement the forced expiratory volume in 1 second improved significantly (~18% from baseline). At 6-month follow-up after endobronchial valve treatment (and 2 months after stent placement), she had consistent improvement with...
minor coughing complaints (chronic obstructive pulmonary disease assessment test improved from 27 to 15 points) and had an increased exercise capacity (6-minute walking distance improved from 350 m to 405 m). The CT scan showed sustained atelectasis of the left upper lobe, and the airway kinking of the left lower bronchus was no longer present (Figure 1C).

**COMMENT**

Symptomatic airway kinking after bronchoscopic lung volume reduction with endobronchial valves is rare. If a patient has significant coughing complaints or decreased oxygen saturation, despite the desired atelectasis of the treated lobe, CT evaluation and bronchoscopy are recommended. Valve removal may be necessary to undo the airway kinking, but stent placement may be an alternative and more attractive option to allow sustained lung volume reduction effect.

This is the first case published in which an airway stent had been placed for this specific indication. There are some case reports that describe metallic and silicone stent placement for kinking after surgical lobectomy in patients with lung cancer. However, metallic and silicone stents may lead to granulation tissue formation, microbial colonization, and repeated bronchoscopies. \(^3\)\(^,\)\(^6\) In this case, a biodegradable stent was used and may lead to less granulation tissue and biofilm formation. Furthermore, biodegradable stents may avoid the need for permanent stenting. After approximately 4 months, the stent is degraded. It is not always necessary to place a new stent once the stent has

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**FIGURE 1** (A) Coronal view of baseline computed tomography scan shows heterogeneous emphysema, with most destruction of upper lobes. Arrow indicates left lower lobe bronchus. (B) Follow-up computed tomography scan after treatment with endobronchial valves of left upper lobe, which is not visible owing to lung volume reduction. The left lower lobe bronchus has been displaced superiorly; there is kinking of airway (arrow) between superior segment (LB6) and inferior segments (LB8-10) of left lower lobe. (C) Airway stent (arrow) has been placed between LB6 (dashed arrow) and inferior segments; kinking between LB6 and LB8-10 is no longer visible.

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**FIGURE 2** (A) Endoscopic view of entrances to left upper lobe (LUL) and left lower lobe (LLL) before endobronchial valve treatment of LUL with normal anatomy. (B) Endoscopic view of entrances to LUL and LLL 2 months after endobronchial valve treatment of LUL, with visible airway kinking of LLL bronchus and endobronchial valve visible in lingular segment (LB4/LB5) of LUL. (C) Endoscopic view of entrances to LUL and LLL 149 days after endobronchial valve treatment of LUL, with endobronchial valve visible in lingular segment (LB4/LB5), and biodegradable stent in situ in LLL bronchus. (LB6, apical segment of left lower lobe.)
In this case, the effect persisted at 8 months of follow-up after stent placement and no revision bronchoscopy was needed, even though the stent was fully degraded at this time. Unfortunately, we have no longer follow-up available because the patient died of a SARS-CoV-2 infection.

In conclusion, placement of a biodegradable airway stent can be considered for symptomatic patients with airway kinking after bronchoscopic lung volume reduction treatment with endobronchial valves. It may also be an option for patients with airway kinking after surgical lobectomy.

REFERENCES


