



Temporary Treatment of Complex Subglottic Stenosis by an On-Site Customized Stent

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Subglottic stenosis may be complex in shape, making challenging its treatment with standard commercially available stents. Personalized stents can lead to successful treatment; however they are not readily available due to the customization waiting time. We report the use of on-site customized temporary silicone stents for difficult benign subglottic stenosis in five patients unfit for surgery.

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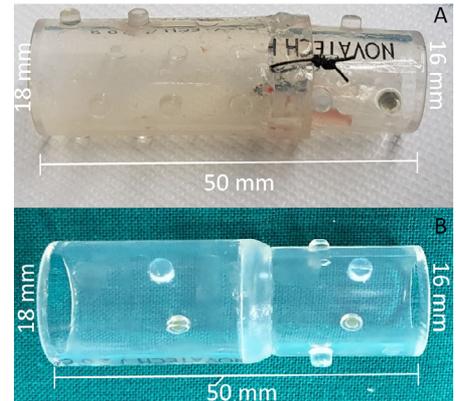
Keywords: Subglottic stenosis, On-site customized stent, Airway stent

INTRODUCTION

Complex subglottic stenosis is often difficult to treat with commercially available stents.^{1–3} We herein report the use of on-site customized stent as temporary bridge to industry custom stent for prompt treatment of life-threatening difficult subglottic stenosis.

TECHNIQUE

This procedure, summarized in Video 1 and Figure 1, was carried out in 5 nonoperable patients with benign subglottic stenosis due to tracheostomy ($n = 4$) and intubation ($n = 1$). In all cases, the stenoses had an hourglass-like shape and were unsuccessfully treated with standard cylinder silicone stent that anyway dislocated after a median time of 45 days. The severe respiratory distress due to recurrence of stenosis required urgent rigid bronchoscopy. The dislocated stent was removed and the stenosis was dilated with barrels of increasing diameter. Since the stenosis presented an hourglass shape, the commercially cylindrical available stent was deemed inappropriate. Thus, we customized on site a silicone stent fitting the shape of the stenosis. A smaller cylindrical stent (diameter: 16 mm; length: 25 mm) was telescoped into a 5 mm into a larger cylindrical stent (diameter: 18 mm; length: 30 mm). A 2–0 silk suture fixed the 2 bodies of the stent to obtain a unique stent with 2 different diameters. The stent was loaded into introducer, pushed over the stenosis and pulled upward to



Prototype stent vs custom made stent.

Central Message

On-site customized stent is a temporary treatment to industry custom stent for prompt treatment of difficult subglottic stenosis. It should be replaced in 2 months to prevent modification of airway.

correct position with forceps. No complications as dislocation, granulation, and mucus plugging related to on-site stent were seen. Our stent was replaced with industry custom hourglass-like stent (Novatech, France) (Fig. 2) after a median time of 40 days. The replacement was performed in the same session and no additional endoscopic procedures as dilation were performed between insertion of on-site made stent and industry custom made stent to prevent potential modifications of airway anatomy. In 4 cases, the industry custom stent was removed after a median time of 13 months, when the maturation of the tracheal framework was achieved (Table).

DISCUSSION

Although surgical resection should always be considered as the gold standard for benign subglottic stenosis,³ there are still patients not fit for surgery. Inoperable stenosis can be successfully treated with self-expanding coated metallic stent; however, any benign subglottic stenosis could present a complex shape difficult to treat with commercially available stents. A potential strategy could be cutting a commercial hourglass silicone stent at a desired length as reported by Vergnon et al.⁴ Initial dilation of the stenosis with subsequent insertion of a custom made stent could be unfeasible since

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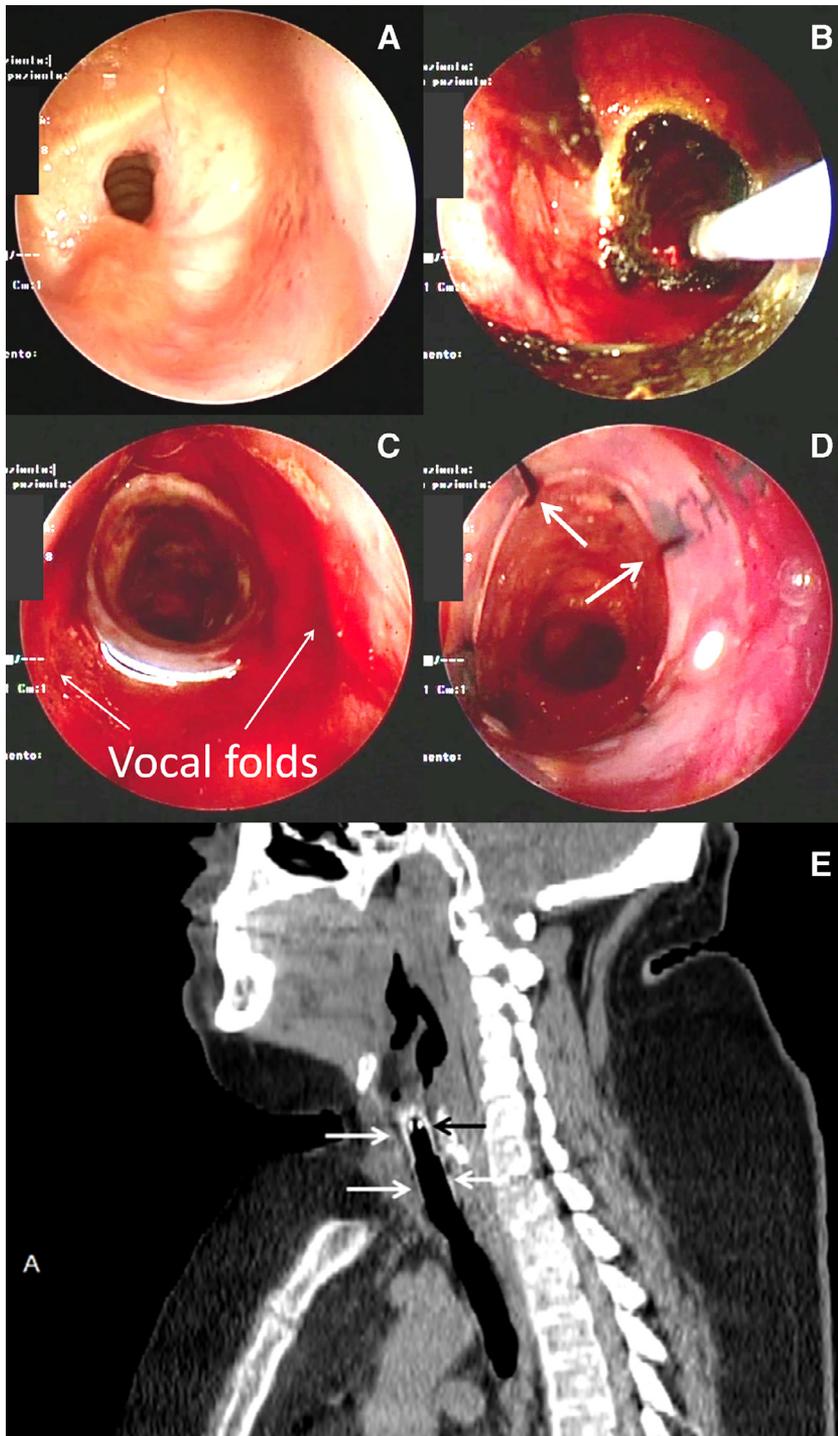


Figure 1. Prototype stent vs custom made stent.

during the waiting time for manufacturing (about 1–2 months), the stenosis could rapidly recur with critical reduction of airway patency and/or progressive change in shape and size. A 3D-printed personalized airway stent is an exciting strategy to obtain quickly a personalized airway stent. However, the lack of authorization by the European Commission of suitable materials for manufacturing airway stents

remains the main limitation. The on-site customization of airway stents is not a new idea. It consists in the modification of stent length. Breen and Dutau⁵ reported a more complex on-site customization as the defenestration of stent to enable ventilation of lobes that would otherwise become obstructed by the sides of the silicone stent. However so far, no author reported using 2 different size stents to create an hourglass-



Figure 2. Subglottic stenosis (A); resection and dilation of stenosis with laser (B); proximal end of the prototype stent (C); 2 parts of the prototype stent fixed with stitches (D); chest computed tomography scan showed the proper position of the stent, and the relation between the stent and the stenotic area (arrows).

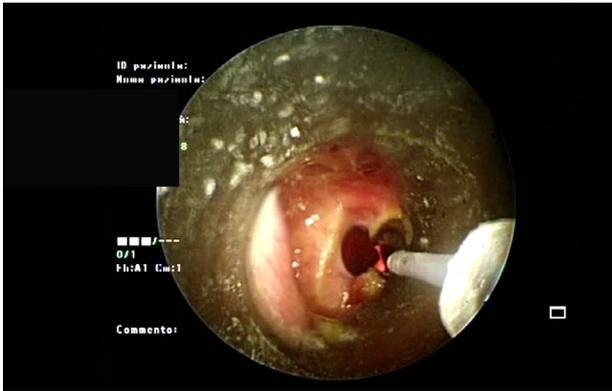
shaped stent. Our strategy allowed to readily obtain a personalized stent that was more effective than standard cylindrical stents to treat a challenging and life-threatening situation as hourglass subglottic stenosis. The insertion of on-site custom stent preserved airway patency and prepared the airway for a wider custom stent. In fact, our stent was used as proof by the industry to create a new type of stent not yet produced. However, it remained a temporary treatment and should be replaced with industry custom stent within 2 months to prevent potential modifications of airway anatomy. Technically, deployment and removal did not present any problem. The recommendation is to grasp with forceps the 2 parts of the stent to avoid rupture during the pulling out maneuvers. Despite in the Dutau's series,⁵ the use of the on-site-modified stent did not increase the complication rates, it certainly remains a temporary treatment. In our specific series, telescoping a smaller stent into a larger one and anchoring the 2 parts to obtain a unique stent changed the inner area and reduced the elasticity and radial force of the stent with potential risk of plugging and/or dislocation. These defects were corrected in the new custom made stent that had a smoother internal surface and a unique body.

Table. Study Population

Pts	Sex	Age	Cause of Stenosis	Characteristics of Stenosis (mm)			Characteristics of Customized Stent (mm)			Duration of On-Site Stent (d)	Complications
				Size	Length	Distance From Vocal Folds	Proximal End	Distal End	Length		
1	M	27	Tracheostomy	6	25	15	16	18	50	40	None
2	M	47	Tracheostomy	6	20	15	16	18	50	50	None
3	F	43	Tracheostomy	8	20	20	14	16	50	50	None
4	M	61	Intubation	7	25	15	16	18	50	40	None
5	M	53	Tracheostomy	6	30	15	16	18	50	40	None
Median	–	47		6	25	15	16	18	50	40	

SUPPLEMENTARY MATERIAL

The following is the supplementary data to this article:



Video 1. Video edited the subglottic stenosis treated with insertion of on-site customized stent.

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