Case Report

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Bedside Techniques: Horseshoe Cartilage Ring-Preserving Tracheostomy for Preventing Stomal Site Stenosis

Kembu Nakamoto, MD, PhD[1*], Toshiyuki Fujii, MD, PhD[1], Mika Kajiyama, MD[1], and Yuko Kawamura, MD[2]

[1]Division of General Thoracic Surgery Shunan Memorial Hospital, Kudamatsu, 744-0033 Yamaguchi, Japan.

[2]Division of Neurology, Shunan Memorial Hospital, Kudamatsu, 744-0033 Yamaguchi, Japan.

[*]Correspondence:
Kembu Nakamot, MD; Shunan Memorial Hospital, 1-10-1 Ikunoya-minami, Kudamatsu, 744-0033 Yamaguchi, Japan, Tel: +81833-45-3330, Fax: +81833-45-3331.

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Introduction

Post-tracheostomy cuff site stenosis (CSS) can be resolved using a soft cuff cannula [1], but there is no established treatment for stomal site stenosis (SSS), including subglottic stenosis (SGS), which can arise as a complication of tracheostomy [2,3]. To prevent SSS, we commonly use a tracheostomy procedure in which the framework of the horseshoe cartilage rings is preserved, as the trachea is opened transversely at the inter-cartilage ligament. This procedure is quite simple and involves a cannula being smoothly inserted using a percutaneous tracheostomy kit (PCT kit). As the number of tracheostomy procedures required has increased due to COVID-19-related pneumonia, a standard tracheostomy procedure should be re-established.

Operative procedure (Figure 1).

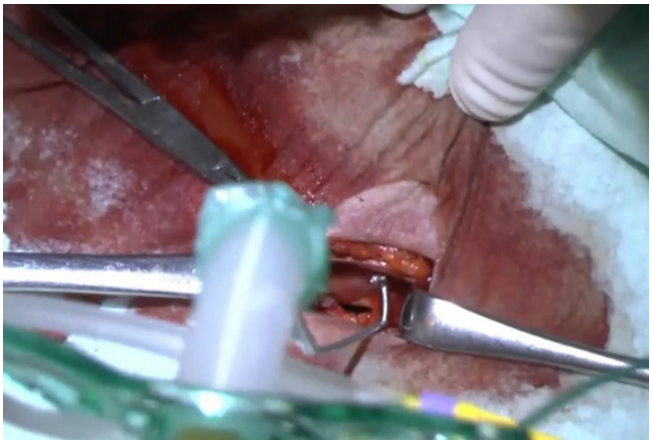

Figure 1: Cannulation through a transversely dissected stoma. Guiding stylet and J-wire loaded onto the cannula was inserting into the tracheal lumen. (Top was cranial side).

Individual patient consent was obtained.

Patient: A 76 y.o. male under respirator support with orotracheal intubation.

The skin was sterilized with electrolyzed saline spray, a superior disinfectant among current sterilizers, after the locations of the 3rd and 4th rings had been determined with the tip of the surgeon's nail to prevent a high tracheostomy, which can cause SGS [2,4]. The cricoid cartilage was used as a landmark for determining the optimal location for the stoma. A skin incision was made in the dermis, and the subcutaneous tissue was dissected at the median line with scissors. The subcutaneous layer was raised anteriorly with retractors, and the sheaths of the sternohyoid and sternothyroid muscles were exposed and dissected with scissors in the median avascular region. The thyroid isthmus, which had been exposed, was retracted cranially, and the tracheal sheath was dissected to expose the cartilage rings. Five ml of 1% Xylocaine was injected into the tracheal lumen through the 3rd/4th inter-cartilage ligament to suppress the cough reflex during cannulation. Mosquito forceps were passed through the needle hole, and the inter-cartilage ligament was dissected transversely. A stylet with a guiding wire was loaded onto the tracheal cannula, and the PCT kit (Neo Perk®, Covidien Japan, and Tokyo) was pushed into the tracheal lumen, after the withdrawal of the orotracheal tube. Finally, the trachea was toileted with electrolyzed saline spray through the cannula, and the skin incision was closed. The process was finished within a quarter of an hour with minimal bleeding. The patient was decannulated after being on respirator support for one month. The findings of a virtual bronchoscopy of the stomal site performed 3 months after the decannulation were excellent (Figure 2).

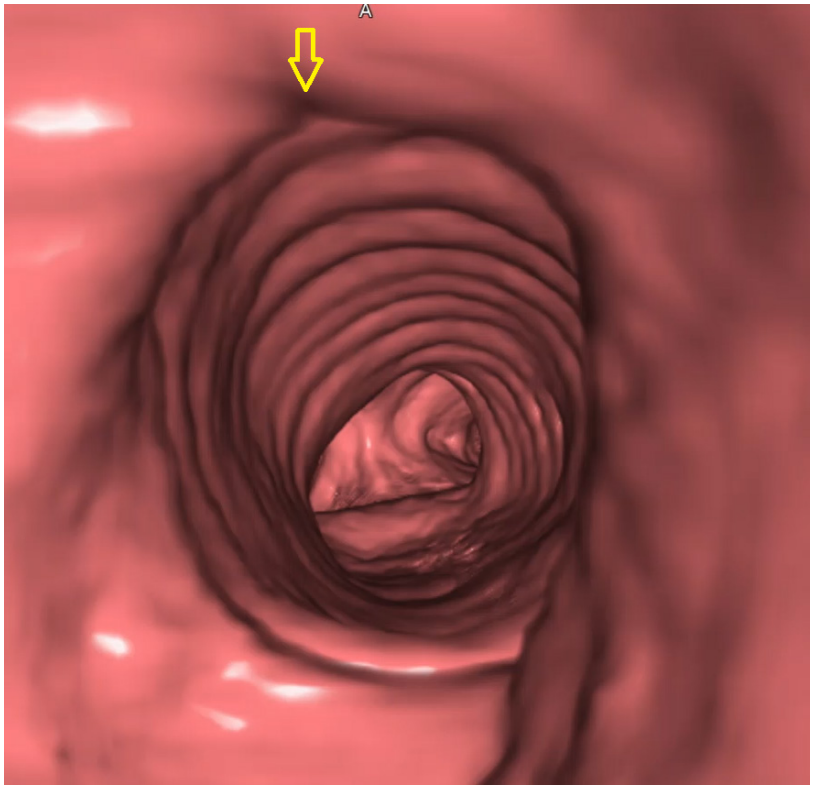

Figure 2: Virtual bronchoscopy of the stomal site after decannulation. Horse shoe flame work of the cartilage ring at the closed stoma (yellow arrow) was kept.

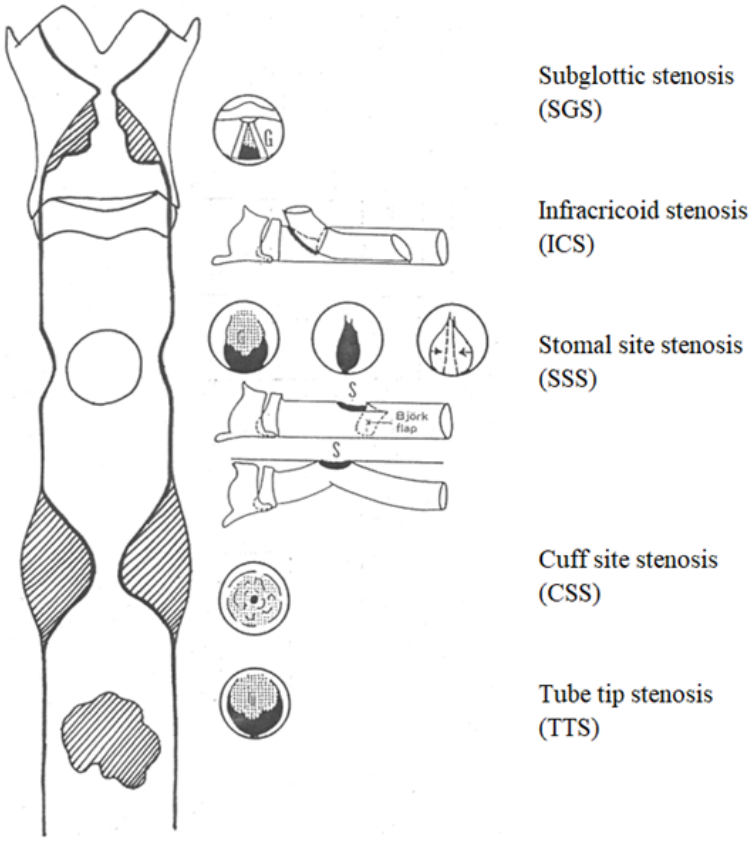

Figure 3: Modified classification of post-tracheostomy stenosis [Harley-Maeda (1)].

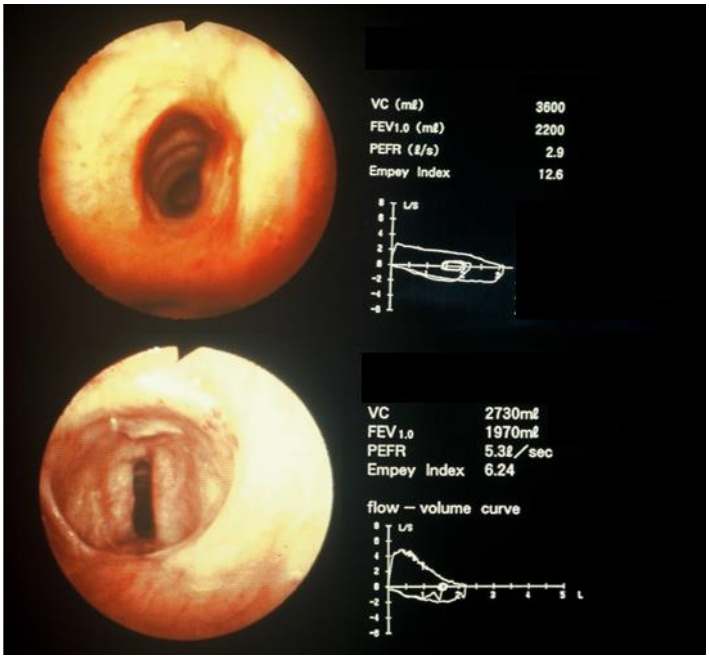

Figure 4: Fixed and inspiratory types of post-tracheostomy stenosis.

Top: Cuff site stenosis with circular cicatricial changes in the tracheal lumen Fixed type stenosis; i.e., an Empey index (EI) of >10, was seen on both the expiratory and inspiratory flow-volume curves. The EI is a measure of large airway stenosis. It is calculated as the forced expiratory volume in one second (ml)/expiratory peak flow (L/min) ratio, and an EI of >10 is indicative of functional stenosis [5].

Bottom: Stomal site stenosis with saber sheath tracheal collapse. The EI was normal, but the flow-volume curve exhibited a flow plateau in the inspiratory phase. The assumed inspiratory EI was >10.

Discussion

Tracheal stomas are usually produced by making vertical linear cuts in 2 or 3 cartilage rings, performing oval fenestration, or using a Björk U-shaped flap [2,4] (Figure 3). However, these procedures destroy the continuity of the cartilage ring framework and increase the risk of SSS and tracheal collapse after Dec annulation [5] (Figure 4, bottom). Our procedure preserves the horseshoe frame of the cartilage rings. The intact rings at the stomal edge spontaneously close after decannulation and prevent the trachea collapsing at the stomal site. In addition, in our procedure, no sharps are required to produce the stoma, except for a skin incision used to reduce bleeding from fat tissue, the main hemorrhagic site, and the risk of injury to the thyroid or innominate artery is reduced.

Cannulation with a PCT kit has been our first-choice tracheostomy procedure since 2000. It facilitates smooth insertion of the cannula. The PCT kit is convenient, especially for obese patients or those with short necks, who are at risk of mediastinal intubation or injury to the innominate artery or tracheal membrane.

Conclusions

As the number of patients who require tracheostomies has risen due to the increased need for respiratory support for COVID-19-related pneumonia, a standard tracheostomy procedure should be re-established to prevent surgical complications.

Acknowledgements

This article is dedicated to the memory of Dr. Masazumi Maeda (1934-2020), a tracheobronchoplasty pioneer.

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