Two cases with postintubation tracheal stenosis after COVID-19 pneumonia

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Abstract

Only a small percent of all intubated SARS-CoV-2-positive patients survive because of the development of severe respiratory and multiorgan failure. The development of tracheal stenosis after orotracheal intubation or tracheostomy is a dangerous complication with gross consequences for the patient and medical staff. Endoscopic interventional procedures could be used in simple tracheal stenosis and surgical resection and anastomosis are reserved for complex stenosis or after unsuccessful endoscopic treatment. We present two cases with tracheal stenosis as a complication of prolonged intubation in COVID-19 survivors which was diagnosed up to 6 months after discharge. Clinical management and surgical techniques are also discussed.

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Introduction

Only a small percent of all intubated patients survives because of the development of severe respiratory and multiorgan failure. We present two cases with significant (4 mm and 5 mm free airway diameter) tracheal stenosis (TS) as a complication of prolonged intubation and tracheostomy in COVID-19 survivors which was diagnosed up to 6 months after discharge. Clinical management and surgical techniques are also discussed.

Case #1

A 63-year-old woman was admitted to the Thoracic Surgery Department with complaints of inspiratory stridor, dry cough, shortness of breath, and fatigue for 3 months after SARS-CoV-2 positive pneumonia, acute respiratory distress syndrome (ARDS), acute respiratory failure, and invasive mechanical ventilation for 26 days. Lab tests were in a normal range. On the CT scan, a TS at the level of the upper thoracic aperture, located 17 cm from the tooth arcade and 5 cm from the tracheal carina was visualized (Figure 1A). The stenotic part was 17 mm long with a minimum diameter of 5 mm. Fiberoptic tracheobronchoscopy (FTBS) showed complex TS beginning at the level of the third tracheal ring and spreading along the subsequent three tracheal rings (Figure 1B). Under general anesthesia with a laryngeal mask, tracheal resection and reconstruction as well as left lobectomy of the thyroid gland were performed. After a neck collar incision, a nodular transformation of the left thyroid lobe was revealed and a left lobectomy was performed. Pretracheal fascia was opened and the cervical trachea was dissected sharply as lateral blood supply was preserved. The TS was localized too deeply and in the mediastinal trachea and a T-shaped extension of the incision was performed until proximal partial sternotomy. The stenosed part with the three tracheal rings was resected (Figure 1 C,D). An end-to-end tracheal anastomosis was performed with interrupted absorbable sutures. The neck incision and partial sternotomy were closed. A protective chin-chest suture was placed and removed on the 7th postoperative day. The pathohistology result revealed tracheal stenosis with squamous cell epithelial metaplasia, localized ulcers, hemorrhages, granulation tissue proliferation, fibrosis, and

mononuclear inflammation. The left thyroid lobe was diagnosed as a multinodular colloid goiter.

The patient was discharged on the 8th postoperative day uneventfully. Follow-up FTBS performed after 2 months demonstrated a trachea with a well-formed scar along the resection line, with a more pronounced fibrous ring on the right, but without lumen blockage (Figure 2). At 1-year follow-up the patient is in excellent overall condition and without restenosis.

Case #2

A 28-year-old pregnant woman was admitted with complaints of shortness of breath, inspiratory stridor, and fatigue for 6 months. She had COVID-19 pneumonia 9 months ago with ARDS, which necessitated being hospitalized and intubated for 45 days. The baby was delivered prematurely through a cesarean section. The patient was tracheostomized on the 2nd postoperative day and was extubated 1 month later. Due to the very large tracheostomy orifice, it was closed with 3 stitches. Lab tests and blood-gas analysis were normal. CT scan showed TS with a minimum diameter of 4.0 mm in the proximal third of the trachea, at the level of the lower edge of thyroid gland lobes (Figure 3). FTBS showed complex stenosis starting at the level of the 3rd tracheal ring. Kocher cervicotomy under general anesthesia with a laryngeal mask was performed. Massive adhesions around the trachea, thyroid gland, and esophagus were visualized after linea alba was opened. An isthmotomy and debridement were performed using a harmonic scalpel. The stenotic part was resected about 2.5 cm. An end-to-end anastomosis was performed with interrupted sutures - 000 Vicryl, and a leak test was performed. Thyroid isthmus was recovered over the anastomosis for buttressing effect. A protective chin-chest suture was placed which was removed on the 7th postoperative day. The pathohistological result showed a tracheal wall with focal superfi-

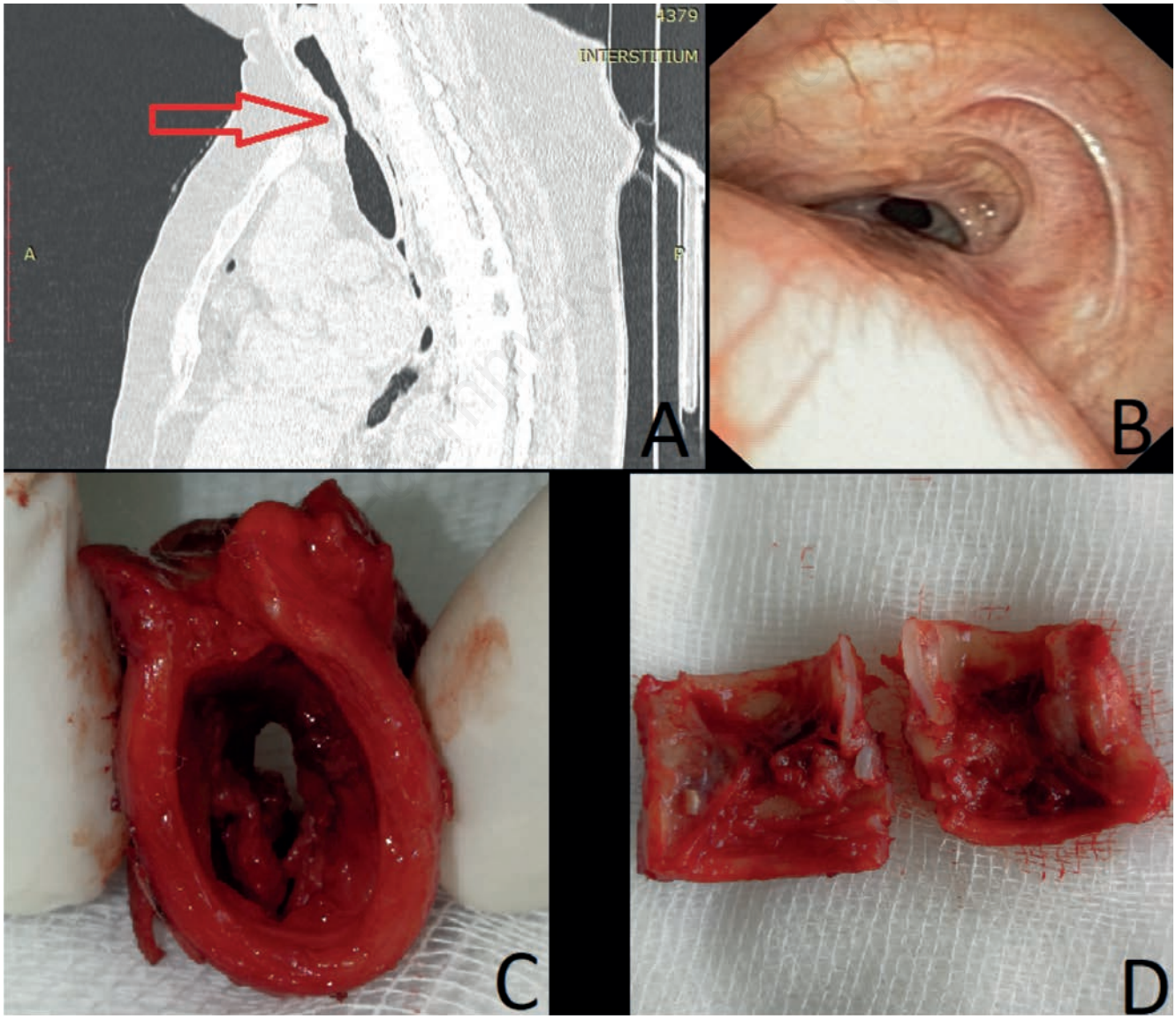

Figure 1. Case #1. A) CT image demonstrating tracheal stenosis. B) Imaging of complex tracheal stenosis during fiberoptic tracheobronchoscopy. C,D) Postoperative specimen of tracheal stenosis.

cial ulceration of the lining epithelium and proliferation of granulation tissue. Along the entire length, there was thickening of the wall from muscle layer hyperplasia and pronounced fibrosis with metaplastic ossification of the cartilage plate.

FTBS after surgery confirmed a stable anastomosis. The patient was discharged on the 11th postoperative day uneventfully. Two months after the surgery no worsening had been reported.

Figure 2. Case #1. Fiberoptic tracheobronchoscopy, performed 2 months postoperatively, demonstrating a mild scar along the resection line.

Discussion

This manuscript describes two cases with tracheal stenosis as a complication of prolonged intubation in COVID-19 survivors.

Postintubation tracheal stenosis (PITS) have incidence of 0.6-6% [1]. In most studies, TS are classified as simple or complex. The simple stenoses include granulomatous, web-like, and concentric scarring, all characterized by short segment (<1 cm) of endoluminal obstruction, lack of tracheomalacia, or loss of cartilage support. On the other hand, the complex stenoses comprise long segments (>1 cm), tracheal wall involvement, followed by cicatricial contraction, possibly associated with tracheomalacia [2]. The presented cases were with concentric cicatricial TS, involving the tracheal wall, and were larger than 1 cm, therefore they were classified as complex TS.

Typically, TS is symptomatic when it exceeds 75% of the airway diameter and the unobstructed part is less than 5 mm [3]. The two main diagnostic modalities are CT scan and FTBS. They localize the site, diameter, anatomy, and extension of the stenosis.

Two other studies reported tracheal stenosis after mechanical ventilation in COVID-19 patients [10,11]. However, this is the first study that reports the minimal diameter of the stenosis (5 mm and 4 mm, respectively). Moreover, this study shows that time to establish the stenosis after discharge is significant and could be up to 6 months (as in Case #2), whereas the reported time to establish stenosis varies between 10 and 18 days in Gervasio *et al*. [10] and 34-47 days in Miwa *et al*. [11]. Tracheal stenosis should be recognized as a potential complication after COVID-19 and careful follow-up is required. Clinical manifestations of tracheal stenosis mimic post-COVID-19 complaints and should be considered in case of COVID-19 complaints of prolonged and unresolving cough or dysphagia after mechanical ventilation.

Surgical resection and reconstruction offer optimal treatment for PITS [4]. Surgery is recommended in complex stenosis, restenosis after numerous other methods, and in the presence of a tracheoesophageal fistula. The contraindications include long TS

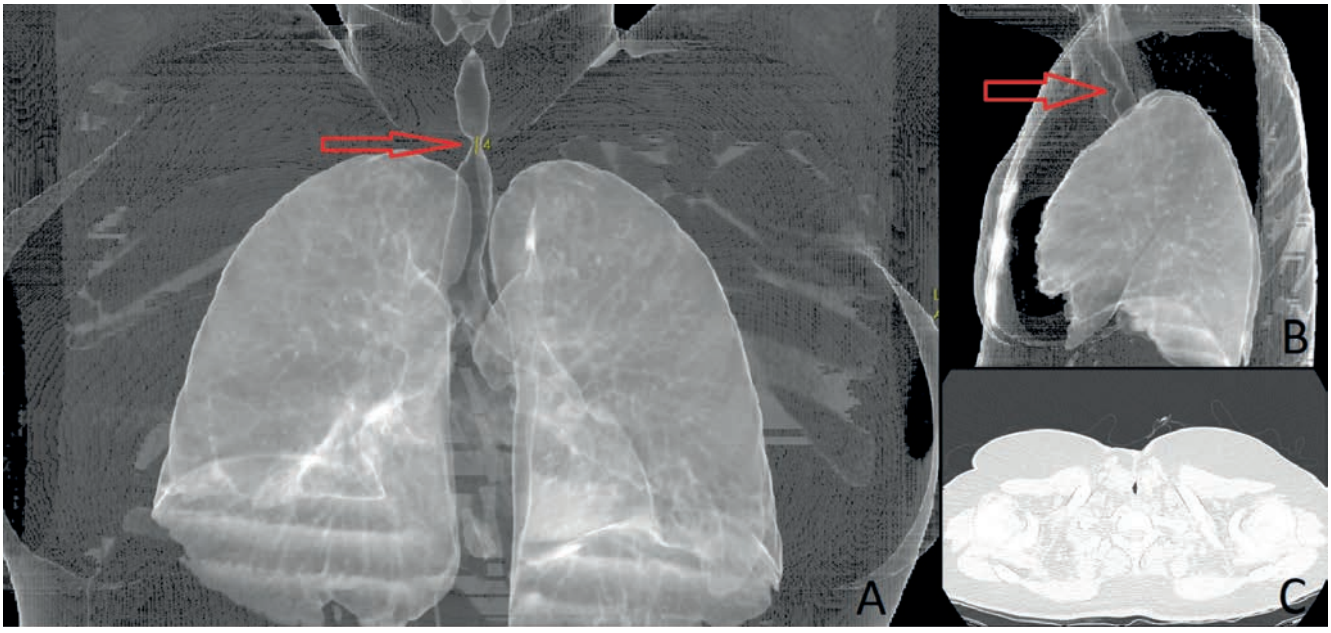

Figure 3. Case #2. CT image demonstrating tracheal stenosis.

segment (>50%), multiple focal stenoses, and poor surgical candidates [5].

Endoscopic therapeutic techniques include mechanical dilation, electrocauterization, argon-plasma coagulation, cryotherapy, laser ablation, and different types of endotracheal stents. Given the associated risk of perforation and the high likelihood of recurrence, dilation alone is seldom definitive treatment, especially for complex and advanced stenosis [6]. Tracheobronchoscopic methods are associated with a lower cure rate compared to surgery in treating PITS (43.5 *vs* 94.7%) [7].

From utmost importance for a successful operation is meticulous tracheal dissection with preservation of lateral tracheal blood supply, creation of tension-free anastomosis with the help of release maneuvers, and usage of absorbable sutures with tying the knots outside the tracheal lumen. Supra-resection release procedures include neck anteflexion, laryngeal (infrahyoid) and suprahyoid release. Infra-resection release procedures include manual blunt dissection, video-assisted mediastinoscopic release, hilar release, and reinsertion of the left main bronchus [8].

Perioperative major complications after tracheal resection and reconstruction are reported in 12.3% (including anastomotic dehiscence, vocal cord paralysis, restenosis, deglutition dysfunction) and minor complications were seen in 23% of patients (including temporary vocal cord dysfunction, superficial wound infection, anastomotic granulation tissue) [9].

Conclusions

The development of tracheal stenosis after intubation or tracheostomy is a dangerous complication with gross consequences for the patient and medical staff. Endoscopic interventional procedures could be used in simple tracheal stenosis and surgical resection and anastomosis are reserved for complex stenosis or after unsuccessful endoscopic treatment.

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