

CASE REPORT

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# Anesthesia management of a complicated post-COVID-19 tracheomalacia case with Y-shaped stent in an elderly morbidly obese patient: case report

Baraa Tayeb<sup>1,2,3\*</sup> , Hazem Alahwal<sup>1,2</sup>, Nezar Gargori<sup>1,2</sup> and Abdulaziz Boker<sup>1,2,3</sup>

## Abstract

**Background** Members of anesthesia teams are involved in the management of COVID-19 infection cases at many stages particularly during acute airway interventions. Here, we describe a series of airway procedures to manage complex post-COVID-19 tracheomalacia in a high-risk patient.

**Case presentation** A 67-year-old female with a medical history of diabetes mellitus, hypertension, and morbid obesity and recent COVID-19 infection requiring prolonged intubation presented to our hospital in severe respiratory distress. She was found to have long-segment tracheomalacia requiring multiple airway surgical procedures and stenting. During her hospital stay, she suffered multiple cardiac arrests due to respiratory failure and was not stabilized until airway tailored custom stent was inserted. She was later discharged with no significant long-term sequel.

**Conclusions** It is important for the anesthesia staff, as part of the airway management plan team, to recognize the exact location and the anatomy of tracheomalacia. Certain anatomical deviations could affect our usual airway management pathways. Failure to do that can lead either to airway obstructions or detrimental hypoxia.

**Keywords** Tracheomalacia, COVID-19, Airway, Stent, Critical care

## Background

COVID-19 pandemic has resulted in increased incidence of intubation especially in high-risk population. This includes patients with advanced age, multiple comorbidities, and obese patients. Prolonged intubation due to COVID-19, like other causes, has increased mortality, morbidity, and post-intubation sequelae. As with many

aspects during COVID-19 pandemic, anesthesia teams are involved at many stages, including initial acute care as well as dealing with intermediate and long-term complications of this pandemic (Hur et al. 2020).

Patients surviving prolonged period of post-COVID-19 intubation have higher risk of developing a particular set of complications. These include restrictive lung disease, tracheal stenosis, tracheoesophageal fistula, and tracheomalacia. Many factors contribute to the development, progression, and the severity of these complications.

In this case report, we present our experience of anesthesia management of a complex patient with repeated airway maneuvers to manage a long tracheal tracheomalacia segment post-COVID-19-related prolonged endotracheal intubation. Prior to publication, patients' legal designate consent and ethical board approval by the

\*Correspondence:

Baraa Tayeb  
btayeb@kau.edu.sa

<sup>1</sup> Department of Anesthesia and Critical Care, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia

<sup>2</sup> Anesthesiology Services Section, King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia

<sup>3</sup> Clinical Skills and Simulation Centre, King Abdulaziz University, Jeddah, Saudi Arabia

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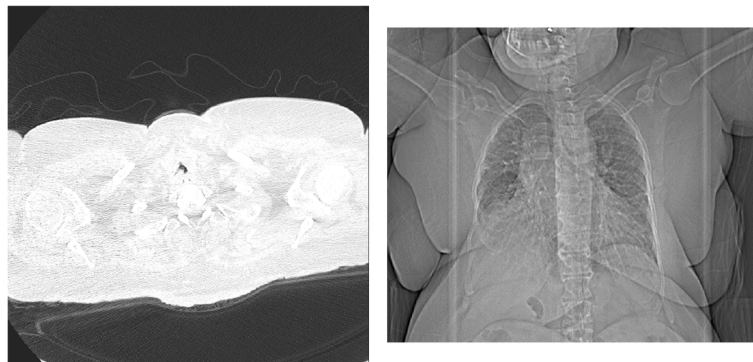
### Case presentation

A 67-year-old female with a medical history of diabetes mellitus, hypertension, and morbid obesity (body mass index of 45.7) had COVID-19 infection requiring prolonged intubation. She was intubated for approximately 1 month, followed by an unremarkable extubation. Two weeks after discharge, the patient presented to a local hospital with shortness of breath and stridor. Chest and neck computerized tomography (CT) scan showed tracheal stenosis starting at the level of cricoid cartilage. The patient was intubated and transferred to our hospital for further management.

On admission to our hospital, a repeat CT scan of the chest revealed a 3-cm thoracic inlet segment of persistent severe collapse potentially representing tracheomalacia and mild bilateral COVID-19 pneumonia changes (Fig. 1). On day 3, the patient underwent bronchoscopy and tracheal dilation resulting in visually patent airway. The patient was then extubated (summary of surgical procedures in Table 1). On day 4, while still in ICU, the patient was intubated again using awake flexible bronchoscopy due to respiratory distress. Repeat CT showed persistent tracheal stenosis representing tracheomalacia. On day 12, the surgical team had attempted to insert a tracheal stent but failed due to equipment malfunction. On day 14, a tracheal stent (Y stent L 110–5-50 adjusted to 990–30-15) with the proximal tip at 1 cm below the vocal cords was inserted. This presented a unique challenge. The balloon of 7.0 mm endotracheal tube (ET) was at the level of the vocal cord risking leak and vocal cord trauma. A smaller size ET, 6.5 mm, was causing excessive air-leak and/or easy dislodgement. The decision was made to insert 7.0 mm tube, with partially inflated balloon to prevent audible leak. The patient showed remarkable improvement and was extubated the following day.

The patient had difficulty coughing and expectorating airway secretions. On day 16, the patient needed another urgent intubation due to respiratory distress and underwent stent shortening of the proximal end to be able to insert an ET and avoid vocal cord injury due to the ET balloon inflation. The patient had many repeated episodes of dislodgement of distal end of the ET tube and the proximal stent end. These episodes manifested as severe shortness of breath, complete airway obstruction, and cardiac arrests.

On day 18, the patient was brought emergently to the OR because of desaturation and carbon dioxide retention, and the decision was made to provide a secured airway connection. It was agreed to insert a regular tracheostomy to avoid prolonged usage of ET for this patient. The operation was completed successfully with insertion of size 7 mm ID soft-seal cuff Portex tracheostomy tube. Unfortunately, on day 31, the distal end of the tracheostomy tube was dislodged from the proximal end of the airway stent resulting in complete airway obstruction. The patient was taken back to the operating room for emergency re-insertion of the tube. Due to unavailability of desired sized tracheostomy tube, she was transferred to surgical intensive care unit (SICU) intubated, and on day 34, the patient underwent tracheostomy tube insertion with a size 6 cuffed non-fenestrated SHILEY. Afterwards, during her SICU stay and despite the tracheostomy tube, the patient had multiple hypoxic cardiac arrests and was resuscitated successfully. It was determined that at the proximal location of the stent, the distal end of the tracheostomy tube was getting dislodged and causing hypoventilation resulting in repeated hypoxic cardiac arrest. To avoid this, on day 35, the patient underwent a tracheostomy tube exchange with a size 6 cuffed non-fenestrated tube with a manually adjusted distal end to fit into the proximal end of the stent. Thereafter, the patient did not have any more hypoventilation events and the rest of the hospital stay was uneventful. On day 45,



**Fig. 1** Proximal tracheomalacia at the inlet of the thoracic cavity

**Table 1** Surgical operations completed and anesthetic management

Time	Surgical procedure	Anesthetic management	Surgical notes
Day 3:	Rigid and flexible bronchoscopy for diagnosis and tracheal dilatation	General anesthesia, patient pre-intubated and transferred after extubation (SICU)	Under general anesthesia and supine position, rigid bronchoscopy was inserted under the guidance of scope. 6.5 followed by 7.5 and 8.5 and mechanical dilatation was done. The lumen is patent and no need for more intervention. The patient tolerated well the procedure and transferred to SICU
Day 12	Rigid bronchoscopy for Stent placement	General anesthesia, transferred to SICU with 7.0 mm ET	Under GA and in supine position, flexible bronchoscopy started followed by intubation under vision by bronchoscopy. Examination was done with suction of excessive secretions. Hyperactive posterior tracheal wall was noted. Measurement was done right stem bronchus 1.5 cm wide left bronchus 4 cm wide. Trachea, from carina to vocal cord, measure 10 cm long. Stent was fashioned to these sizes and inserted into the applicator but the applicator did not pass through the rigid bronchoscope as it was fixed recently with narrowing of the lumen and fixation. It has been decided to abort procedure and the patient was re-intubated and transferred to SICU
Day 16	Emergency intubation and stent shortening	General anesthesia, transferred to SICU with 7.0 mm ET	Under GA in supine position rigid bronchoscopy was done under vision the area was confirmed the stent Y-stent (L110-5-50) and adjusted to 90-30-15. Deployment of stent and adjustment of position under rigid and flexible bronchoscopy was done
Day 18	Tracheostomy tube insertion	General anesthesia, transferred to SICU with 7 mm regular tracheostomy	Patient called emergently to the OR because of desaturation and CO <sub>2</sub> retention. Fiberoptic showed very thick secretions up to right and left main and segmental bronchus and stent is patent. Tracheostomy done and patient transferred to SICU in stable condition
Day 31	Emergency Tracheostomy tube re-insertion	General anesthesia, transferred to SICU intubated	Under GA and supine position, intubation and suctioning of secretion was done. Bronchoscopy showed stent in place and patent tracheostomy tube patent, no available size 6 or 7 tracheostomy tube so decision was taken to abort procedure
Day 34	Rigid bronchoscopy and tracheostomy tube exchange	General anesthesia, transferred to SICU with adjusted 6 tracheostomy tube	Using boggy, an old tracheostomy tube removed and new one size 6 cuffed non-fenestrated inserted and visualized in place using fiberoptic
Day 35	Fiberoptic scope and tracheostomy tube exchange	Sedation anesthesia, transferred to SICU with adjusted 6 tracheostomy tube	While maintaining spontaneous ventilation, and in supine position, tracheostomy tube was removed, stent visualized by fiberoptic scope done and size 6 cuffed tracheostomy tube inserted inside the stent. A 2nd look was done by fiberoptic, airway patency was confirmed down to the carina

**Table 1** (continued)

Time	Surgical procedure	Anesthetic management	Surgical notes
Day 45	Tracheostomy tube exchange	General anesthesia	<p>Under GA and in supine position patient was intubated with 6.5 ET and tip placement confirmed by flexible bronchoscopy to be within the pre-existing tracheal stent. Injection of local lidocaine with epinephrine 1:10,000 in the previous tracheostomy site then we proceeded with widening of tracheostomy stoma blade for skin incision and subcutaneous dissection along with tracheal dilator. Cuffed ET was visualized from stoma and was pulled gradually then a tracheostomy tube SHILEY (size 6 non-cuffed non fenestrated) was inserted through tracheal stent and the correct desired positioning has been confirmed using flexible scope down to carina with no obstruction</p>

she underwent a final tracheostomy tube exchange for a SHILEY size 6 non-cuffed non-fenestrated tube. Later, the patient was discharged with no long-term sequelae.

Two months later, the patient was admitted for uneventful stent removal and subsequent closure of the tracheostomy site. The patient is back to normal life and was in stable condition at follow-up 1 year after last discharge from the hospital.

## Discussion

Prolonged intubation is a well-known cause of post-extubation tracheomalacia and stridor. Tracheomalacia is caused by micro-changes in the tracheal soft tissue and cartilage resulting in excess collapsibility of the trachea. It can be primary congenital or secondary due to significant chronic irritation such as inflammation, long-term intubation, malignancy, infection, or external compression. Stridor secondary to tracheomalacia occurs usually when the tracheal diameter is reduced to less than 3.5 mm. The efficacy of medical management of tracheomalacia is limited, and it usually requires surgical intervention. If left untreated, tracheomalacia has the potential of high morbidity and even mortality (Hur et al. 2020; Agarwal et al. 2007; Carden et al. 2005; Feist et al. 1975; Yang and Tracheomalacia 2021).

Limited publications are found on anesthesia management of tracheomalacia and tracheal/bronchial stents. Most of such data are coming from pediatric case series. The largest published was the study by Valerie et al. (2005), comparing the stents versus aortopexy in 25 patients; they showed that aortopexy patients had increased early postoperative complications but with better long-term outcomes than tracheal stents. No similar data on adult patients are reported. A recent scoping review showed the progressive development in the field of materials and clinical outcomes with tracheal stents in adults with benign conditions (Valerie et al. 2005; Johnson et al. 2021).

Our patient developed tracheomalacia secondary to prolonged intubation due to COVID-19. The location of tracheomalacia at the inlet of the thoracic inlet presented a challenge for airway management. Stenting is common in limited segment tracheomalacia (Yang and Tracheomalacia 2021; Thompson and Cotton 2006); however, the proximal location in our patient presented a challenge. First, a customized stent was inserted to keep the stent below the vocal cords. This was successful in keeping the tip of the stent 1 cm below the vocal cords which was another obstacle for placing an endotracheal tube or a tracheostomy tube. With the use of the right fit sized ET (7.0 mm), the balloon will be at the level of the vocal cord risking vocal cord trauma,

and a smaller ET can cause air-leak and/or easy dislodgement. Despite our initial anticipation that switching from ET to tracheostomy will reduce or solve the recurrent potentially catastrophic disconnection from the tracheal stent, recurrent dislodgement of the distal end of the regular tracheostomy tube presented ongoing challenge. In our patient, these dislodgements resulted in recurrent hypoxic cardiac arrest. Once this was realized by the airway team, a decision was made to customize the distal end of a tracheostomy tube to better engage with tracheal stent preventing any future hypoxia.

Many factors may have contributed, to a variable degree, to this patient's prolonged and complicated hospital course. Patient factors include the patient advanced age, diabetes milieu, recent COVID-19 infection, and morbid obesity. Lesion anatomical factors include the location and length of the tracheomalacia segment. Mechanical and equipment-related factors included the need to custom fashioned y-stent and the very particular set of equipment needed to place, replace or adjust the stent. In addition, the customization needed of this stent, makes it more challenging due to lack of prior experience with adjusted well-fitted proximal connection to the upper airway adjunct airway choices.

Among the above-mentioned factors, many of them might have interacted with each other and aggravated the patient clinical condition at many phases of her intrahospital course. The recent chest infection with increased and thickened airway secretions is needed to be cleared through this long bifurcated stent. Such situation needed very strong cough efforts which is less likely in this patient due to her age, convalescence period post-previous SICU stay for 1 month, vocal cord dysfunction due to interference by ET balloon, and excessive weight. Also, the increased airway secretion situation has been made worse by repeated micro-aspiration around the ETT due to partially inflated cuff due to its proximity to the vocal cord and the leak of upper airway secretions between the tracheal stent outer wall and the tracheal inner wall.

This patient management presented many practical challenges. Most of these challenges were related to the recurrent catastrophic complete airway obstruction in a patient with a potentially difficult airway. Successful management of such high-risk case required high levels of planning, staffing, teamwork, and clear communications and collaborations within and between various teams. The on-call airway team and portable difficult airway trolley were called and utilized in a frequent basis for this patient care. The readiness to manage

such high-risk situation is very crucial for favorable case outcome.

## Conclusions

It is important for the anesthesia staff, as part of the airway management plan team, to recognize exact location and the anatomy of tracheomalacia. Also, they need to be very familiar with dimensions of all airway management instruments, parts, and devices used as it relates to the proximal end of long tracheal stents. This becomes even more important especially in anatomical location that could affect our usual airway management pathways at proximal tracheal sections and or larynx. Otherwise, failure to provide better matching between various airway tools can either lead to airway obstructions or and negative effects resulting in mismanagement of the airway and or detrimental hypoxia.

## Abbreviations

CT	Computerized tomography
ET	Endotracheal tube
GA	General anesthesia
OR	Operating room
SICU	Surgical intensive care unit

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None.

## Authors' contributions

All authors have read and approved the manuscript. BT (idea, writing manuscript, review manuscript, supervision). HA (writing manuscript, review manuscript). NG (writing manuscript, review manuscript). AB (idea, writing manuscript, review manuscript, supervision).

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## Availability of data and materials

N/A.

## Declarations

### Ethics approval and consent to participate

Ethics approval by the King Abdulaziz University Hospital (Chairperson: Prof. H. Alzahrani on January 30, 2022) have been obtained. Consent to participate was obtained from the next of kin.

### Consent for publication

Written informed consent has been obtained from the next of kin.

### Competing interests

The authors declare that they have no competing interests.

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