Posterior glottic stenosis following prolonged intubation for COVID-19

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Abstract
Prolonged tracheal intubation (TI) may be necessary in critically ill patients requiring airway protection and ventilatory support. The presence of an endotracheal tube can generate inflammation, fibrosis and scarring resulting in laryngotracheal stenoses including subglottic and posterior glottic stenosis (PGS). If a patient requires continued TI and ventilatory support beyond 7 days, a tracheostomy is often performed to both facilitate weaning from mechanical ventilation and minimize the occurrence of fibrotic laryngotracheal complications. Patients with COVID-19 present a unique challenge, as this population may require TI during a systemic inflammatory process typified by respiratory inflammation, hypoxemia, and acute respiratory distress syndrome. Early tracheostomy has been discouraged in COVID-19 patients given the high potential for aerosolized transmission to health care workers and other patients during these procedures. The advice to continue TI in COVID-19 patients beyond the typical 7-day window is supported by expert consensus and National society recommendations. In this case report, we present a patient who developed PGS following prolonged TI for COVID-19. We suggest that the incidence, severity and complications related to PGS may be amplified in these patients given the underlying proinflammatory nature of COVID-19, society recommendations for delaying tracheostomy, and an increased risk of laryngotracheal stenosis with prolonged TI. This case highlights a unique sub-set of patients, that is, those requiring prolonged mechanical ventilation and TI with COVID-19, which may increase their risk for PGS. This population could benefit from early screening and intervention efforts to prevent long-term morbidity from PGS and other complications of prolonged TI.

Keywords: COVID-19, Posterior glottic stenosis, Tracheostomy, Tracheal intubation, Mechanical ventilation, Intubation injury

Tracheal intubation (TI) represents an important, life-saving measure for critically ill patients.[1] However, prolonged TI can result in laryngotracheal complications. Two well-known conditions are posterior glottic stenosis (PGS) and subglottic stenosis, which can both cause significant morbidity for patients. Typically, spontaneous breathing trials are performed as soon as feasible to assist with weaning mechanical ventilation. If spontaneous breathing trials fail to support extubation after 7 days, tracheostomy is considered to assist in weaning mechanical ventilation and reducing the incidence of laryngotracheal complications.[2]

COVID-19 represents a novel, severe respiratory disease where ~20% of patients requiring hospitalization also require TI and mechanical ventilation.[3] The American Academy of Otolaryngology—Head and Neck Surgery (AAO-HNS) has recommended delaying tracheostomy for at least 2 weeks for COVID-19 patients due to the aerosol-generating nature of the procedure, which places health care workers and other patients at high-risk for contracting the virus.[1] In addition, there is evidence that COVID-19 triggers a cytokine storm causing increased proinflammatory and reduced anti-inflammatory cytokines, possibly promoting fibrosis, and scar formation.[4]

Thus, the triad of the proinflammatory nature of COVID-19,[4] increased PGS risk with prolonged intubation, and the AAO-HNS recommendations for delayed tracheostomy, creates a special clinical situation that could increase the incidence and severity of PGS in this population. We describe the case of a patient presenting with PGS following prolonged intubation for COVID-19.

Clinical case
A 47-year-old man with obesity (body mass index: 33.1) and poorly controlled type-2 diabetes mellitus (Hgb-A1c: 10.6%) presented to his local emergency department with shortness of breath and was diagnosed with COVID-19. During his illness, he was intubated for seven days but developed stridor shortly after extubation. He was reintubated for eight additional days prior to undergoing tracheostomy. He was ultimately decannulated before discharge.

One month later he presented to his local emergency department with increased work of breathing and again required TI.
Reintubation was difficult secondary to edematous vocal folds, requiring 2 attempts with video laryngoscopy. He was unable to be extubated, and a revision tracheostomy was performed. He remained tracheostomy dependent and was referred to our tertiary care laryngology clinic for further evaluation and management.

Laryngeal examination including videostroboscopy was performed, demonstrating immobility of both vocal folds with fixation in an adducted position (Fig. 1). He had no evidence of subglottic stenosis but had hypertrophic scar tissue with scattered granulation tissue in the posterior glottis (Fig. 1). He was diagnosed with PGS, presumably from prolonged intubation for management of COVID-19. Subsequently, he underwent surgical intervention including microdirect laryngoscopy with CO2 laser release and reduction of posterior glottic scar tissue, providing some improvement in his posterior glottic airway. He will require additional interventions before consideration for decannulation.

The patient consented to this case report, and the University of Michigan Institutional Review Board exempted the case from approval.

Discussion

This case highlights the recognized risk of PGS from prolonged TI, and its likely increased incidence with COVID-19 [5]. The COVID-19 pandemic mandated reconsideration of the typical paradigm surrounding the timing of tracheostomy for mechanically ventilated patients. Tracheostomy is an aerosol-generating procedure, causing increased risk of viral transmission to health care workers when performed in COVID-19 patients [1]. In addition, postprocedure tracheostomy care and education is time intensive and aerosol generating, further increasing exposure risk as well as use of personal protective equipment. Taking this into consideration, the AAO-HNS recommended delaying tracheostomy for intubated COVID-19 patients for at least two weeks, ideally in conjunction with negative COVID-19 testing [11]. This delay could increase PGS risk by as much as 21% per day after seven days of intubation [5]. Given the considerations for tracheostomy timing and underlying physiological proinflammatory state related to COVID-19, we anticipate that PGS will present more frequently in this patient population.

PGS can be caused by inflammation and scarring of the posterior cartilaginous and interarytenoid portions of the vocal folds following pressure and mechanical trauma from an endotracheal tube. Moreover, reduced antifibrotic cytokines seen in COVID-19 patients may further increase the risk of developing PGS. This proinflammatory nature of COVID-19 may cause additional sensitivity to the laryngotracheal complications related to prolonged TI. These factors could lead to an increased propensity for ulceration and scar formation of already traumatized laryngeal or endotracheal mucosa [4].

It has been reported in the literature that underlying medical conditions such as diabetes, obesity and chronic hypoxic/hypoxemic diseases increase the risk of PGS [5]. Interestingly, these same medical comorbidities place patients at higher risk for severe COVID-19 infection [2]. Therefore, patients who develop severe COVID-19 infections may also carry underlying risk factors for PGS progression if TI is required. The patient presented here did have underlying obesity and poorly controlled diabetes.

As increasing numbers of mechanically ventilated COVID-19 patients recover, we expect to see patients from this population presenting with PGS. A proactive approach to identifying early signs and symptoms of PGS in this population may help limit long-term sequelae including tracheostomy dependence. For example, patients with severe COVID-19 requiring prolonged TI may warrant additional attention and should be closely monitored during their postextubation ICU stay and on subsequent follow-up visits for dysphonia, stridor or overlapping risk factors for PGS. If these symptoms manifest, otolaryngology referral and screening with flexible laryngoscopy or videostroboscopy would enable identification of early hallmarks of PGS including granulation tissue, scar tissue and reduced vocal fold abduction. A low threshold for intervention would be important if early features of PGS are identified. Similarly, an iterative approach to tracheostomy timing recommendations for intubated COVID-19 patients is logical with improved safety protocols and growing clinical experience regarding the disease process.
As demonstrated by this case, patients with COVID-19 experiencing the triad of prolonged TI, proinflammatory effects of the virus, and delayed tracheostomy, are likely at increased risk for developing PGS. This represents a serious underlying disease process that could increase the rate of tracheostomy dependence and significant morbidity in this population. Treatment for PGS remains challenging, typically requiring multiple surgical interventions before decannulation, with permanent tracheostomy occasionally required. Thus, it is important to consider PGS as a potential long-term sequela for COVID-19 patients requiring TI. Carefully screening these patients for early signs or symptoms of PGS may lead to earlier diagnosis and intervention, hopefully reducing long-term morbidity.

Conflict of interest disclosures
D.H. is Deputy Editor-in-Chief of the Journal of Head and Neck Anesthesia. The remaining authors declare that they have no financial conflict of interest with regard to the content of this report.

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