The number of critically ill patients with complex airway problems is significant. Management of the complex airway includes interventions such as placement of an airway stent or tracheostomy. Common reasons for placement of an airway stent include severe malacia of the trachea and mainstem bronchi, tracheal stenosis, and tracheoesophageal fistulas. Occasionally, these patients also have obstruction at the glottic/subglottic region that cannot be addressed by an airway stent alone or have such poor pulmonary reserve that extubation is not possible. It is these complex airway patients whose management requires the simultaneous use of airway stents and tracheostomy devices. This patient population has never been adequately described in the literature nor the unique complications that can occur.

**Study Design/Methods**

Retrospective case series of patients whose airway management required the use of both a tracheostomy and an airway stent, with at least one of the devices placed at Henry Ford Hospital between 2004 and 2010.

Patients were identified from the Interventional Pulmonology QA database (IRB approved) for stents placed and the use of billing code for tracheostomy performance from the Henry Ford CPT billing database.

Data points collected include sex, date of tracheostomy, date of stent placement, type of stent and tracheostomy devices, indications for the placement of the stent and tracheostomy, whether tracheobronchoscopy or tracheostomy change was performed if performed, site of tracheostomy, whether the patient had experienced prior laryngeal surgery, stent placement, or tracheostomy with later decannulation, if ventilator support was needed prior to placement of the last device, and date of weaning from the ventilator.

Patients were excluded if the airway stent and tracheostomy appliance had no physical interaction when used simultaneously.

**Results**

At the Henry Ford Hospital Detroit campus, 2944 tracheostomy devices and 796 stents were placed between 2004 and 2010. From these patients, 42 airways were managed with the simultaneous usage of both a tracheostomy appliance and airway stent. Three of these patients were excluded from the study because there was no mechanical interaction between the two devices. Of the remaining 19 patients, 20 patients had an airway stent placed after tracheostomy and 19 prior to tracheostomy. There was a wide variety of tracheostomy devices identified with cuffed devices mostly used on patients requiring ventilator support. Stent usage was primarily Dumon Y (n=13), with 13 patients, an Ultraflex (n=1), and an Ultraflex (n=1) also occurring. Placement of both devices occurred without difficulty except in four ventilator dependent patients where a persistent ventilation leak required the removal of the stent. Complications within the first 10 postoperative days were identified if the patients required tracheobronchoscopy. 8 patients required early tracheobronchoscopy due to excessive secretions and mucus plugging (n=3), mechanical misalignment (n=4), and placement confirmation of airway during cardiac arrest resuscitation (n=1).

Management of the complex airway occasionally required the simultaneous usage of airway stents and tracheostomy appliances. Indications for the simultaneous usage of both devices included tracheal obstruction or ventilator dependent respiratory failure in the setting of tracheal injury or pulmonary obstruction from malacia and stenosis. Multilevel obstruction was seen clearly in 9 of our patient population where laryngeal stenosis was present in the setting of tracheobronchial malacia or tracheal stenosis from scarring or mass effect. Subglottic and glottic stenosis is difficult to manage by stenting alone. If addressing subglottic stenosis, chronic irritation to the undersurface of the vocal folds and granulation tissue formation is likely if the superior aspect of the stent is too high. If the superior aspect of the stent goes through the laryngeal inlet in the setting of glottic stenosis, aspiration easily occurs. Conventional treatment of symptomatic laryngeal stenosis typically includes tracheostomy placement. Management of the simultaneous lower airway obstruction may be beyond the reach of standard tracheostomy tubes, leaving the patient symptomatic if only the tracheostomy device is utilized.

The simultaneous usage of both devices occurs most often in patients whose airway is being managed with one device yet still requires prolonged intubation or ventilator usage. This is demonstrated by the 27 patients who required ventilator support at the time of placement of the second device. Placement of both devices becomes more difficult when on the ventilator because any leaking of air during ventilation will lead to hypoventilation of the patient. Failure to achieve an adequate seal when using both devices occurred in 4 patients and required removal of the airway stent. Of the 27 vented patients, 16 had a stent placed first and 11 started with a tracheostomy. The 14 initially stented patients experienced prolonged intubation, and thus tracheostomy was done to establish a stable airway and facilitate self ventilation. The remaining two stented patients had laryngeal stenosis that was not being addressed by the airway stent. In the 11 patients who started with tracheostomy placement, tracheobronchial malacia and distal tracheal stenosis not being addressed by the tracheostomy device was demonstrated in 5 and 4 of the patients respectively. If a tracheostomy is placed and the stent is removed, the issue being managed by the airway stent may not be adequately addressed by tracheostomy alone. The ultimate goal of placing both devices in a ventilated patient is permanent self ventilation. When the patient does not require the ventilator, goals when placing the second device depend on the patient and which device is already in place. In this population of 12 patients, 9 had a tracheostomy placed first and 3 started with a stent. Stents were placed in 3 patients in order to facilitate decannulation or to improve the airway of patients still symptomatic with a tracheostomy. In the patients with a tracheostomy, the stent was used to relieve symptomatic high tracheal stenosis or unaddressed stenosis/subglottic stenosis in 7 of the 12 patients. When placement of a tracheostomy in a self ventilating, stented patient is being considered, it is to address glottic/subglottic stenosis causing respiratory difficulty as evidenced by the 3 patients who had this completed.

While the simultaneous use of both devices is able to manage obstruction occurring at multiple levels, mechanical interaction of these devices occurs and creates a potential for respiratory complications beyond that which are inherent for each device. The most common complication of these complications is mechanical misalignment and airway obstruction. Diagnosis of respiratory difficulty in this population is often through direct examination via flexible fiberoptic scope exam. Using this procedure as a marker for possible complication within the first 10 days postoperatively, 8 patients were identified with 3 demonstrating excessive secretions and mechanical misalignment occurring in 4 patients. There was no association with any specific type of mechanical interaction between the two devices given that two of these patients had device interactions thorough the superior lumen, one through a window, and another via a U-shaped notch in the superior aspect of the stent. Nine tracheostomy changes occurred without difficulty. Given this risk of airway compromise, the question which has not been addressed is whether tracheostomy changes are necessary in this population. The number of tracheostomy changes have been tracked in our institution in an effort to reduce granulation tissue formation likely caused by chronic biofilm deposition and associated chronic inflammation seen with tracheostomy appliances. One of the four mechanical misalignments occurred with relation to a documented tracheostomy change and thus may have been avoided if the change had not occurred.

**Conclusions**

Airway management via the simultaneous usage of airway stents and tracheostomy devices is inadequately described in the literature. Their usage is indicated in the setting of multilevel obstruction or continued ventilator dependent respiratory failure in airways managed with one device yet demonstrate unaddressed pulmonary obstruction from malacia and stenosis. Flexible tracheobronchoscopy is invaluable in the diagnosis of complications such as mechanical misalignment and excessive secretions which can lead to respiratory compromise.

**References**


