Bronchoscopic management of critical central airway obstruction by thyroid cancer: Combination airway stenting using tracheal and inverted-Y carinal self-expanding metallic stents

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ABSTRACT

Central airway obstruction (CAO) can result from various benign and malignant etiologies. Anaplastic thyroid cancer (ATC) is the most aggressive form of thyroid cancer. Rapid airway compromise is the main cause of death in ATC. We report a patient with ATC who presented with a large neck mass leading to CAO with long segment tracheal and right main bronchial compression and respiratory failure. Urgent Rigid Bronchoscopy was performed for airway stabilization and patient was managed with a combination airway stenting approach. A combination of self expanding, metallic, covered inverted Y and straight tracheal stents was used to stabilize the near complete airway structure. We herein highlight the role of therapeutic rigid bronchoscopy with airway stenting as an efficacious treatment modality for management of malignant CAO.

KEY WORDS: Airway stent, bronchoscopy, central airway obstruction, self-expanding metal stent, thyroid carcinoma

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INTRODUCTION

Central airway obstruction (CAO) is defined as obstruction of major airways (trachea, carina, and proximal major bronchi singly or in combination) as a consequence of benign or malignant disease. Thyroid cancer and masses can lead to CAO either by local invasion or by extrinsic compression effect on the major airways.[1] Anaplastic thyroid cancer (ATC) is the most aggressive form of thyroid cancer with an extremely poor prognosis. Rapid airway compromise is the main cause of death in patients with ATC.[2] Maintenance of a patent airway remains challenging in these patients. Surgical resection with reconstruction is the treatment of choice, but many patients are inoperable due to extensive spread of tumor into adjacent structures. Similarly, tracheostomy can be technically difficult in the case of a large bulky thyroid mass, especially if there is intrathoracic extension and compression/invasion of the trachea.[3] Tracheostomy is ineffective and may be extremely risky to attempt in patients with intrathoracic tumor involvement of the trachea and entails risk of airway loss. Therapeutic rigid bronchoscopy with tracheobronchial stent insertion is an alternative and efficacious treatment modality for management of malignant CAO.[4,5] More recently, utilization of metallic inverted Y-stents has been reported for the management of obstruction near the main carina.[6] We report a patient with anaplastic carcinoma

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of thyroid with extensive local spread with intrathoracic tumor extension leading to a long segment (>90% length infiltration and extrinsic compression) involvement of the trachea and proximal major bronchus who presented in respiratory failure and was managed successfully via rigid bronchoscopy and combination airway stenting.

CASE REPORT

A 38-year-old male presented to emergency department with complaints of rapidly worsening shortness of breath since 2 days. Further enquiry on history revealed that patient had a painless swelling over the anterior aspect of neck since last 15 years that had rapidly increased in size over the preceding 2 months. The patient also complained of pain and heaviness over the right side of chest. The pain was poorly localized and was nonpleuritic. There was no history of cough, hemoptysis, dysphagia, and fever. There was no other significant past, personal, or occupational history. At the time of presentation, the patient appeared anxious, drowsy, diaphoretic and in severe respiratory distress with visible use of accessory muscles of respiration. A loud stridor was audible. Respiratory rate was 36/min with paradoxical respiratory movements, blood pressure 162/98 mmHg, heart rate 142/min, and oxygen saturation while breathing room air was 76%. On local examination, a large multilobulated, firm swelling was visible and palpable over the midline neck with fullness extending till the sternal notch [Figure 1a]. Swelling was immobile and nontender. Two days before presentation, the patient had been evaluated at another center and investigated. Computed tomography (CT) scan of the neck and thorax was performed which revealed [Figure 1b and c] a large heterogeneous mass with areas of extensive central necrosis in relation to the right lobe of thyroid with right paratracheal extension causing >90% long tracheal luminal and significant right main bronchus compression. Fine-needle aspiration cytology (FNAC) from the neck swelling had been performed following which the breathlessness worsened and the patient was referred to our facility. FNAC revealed poorly differentiated anaplastic carcinoma of thyroid.

In view of impending respiratory arrest at the time of presentation, endotracheal (ET) intubation was attempted in the emergency room. A 7 mm size ET tube was negotiated with difficulty and the patient was initiated on mechanical ventilation. However, ventilating the patient was very difficult and peak airway pressures were very high. In view of difficulty in ventilation (high FiO_2 of 1.0, peak airway pressure of 45–50 cm of H_2O, high-level $EtCO_2$ of 55–60 mmHg and persistent hypoxemia), pulmonary medicine referral was sought. Urgent rigid bronchoscopy was planned for securing the airway and airway restoration via airway stent insertion. The patient was shifted to the interventional pulmonology suite on mechanical ventilation. Hemodynamic monitoring was initiated. Dexmedetomidine infusion (0.75 mcg/kg over 10 min followed 0.5 mcg/kg/h) was administered while the rigid bronchoscopy operator was ready with the ventilating tracheobronchoscope. Flexible bronchoscopy through the ET tube was considered but as the patient was in impending respiratory arrest, a direct rigid bronchoscopy was considered the preferable option thereby minimizing any delay and risk of worsening hypoxemia during the flexible bronchoscopy. After administration of intravenous fentanyl (75 mcg) and hydrocortisone (100 mg), ET tube was removed and quick rigid bronchoscopic intubation was performed using the conventional technique without the utilization of a laryngoscope using a size 11 ventilating tracheobronchoscope (Karl Storz, Germany). Ventilation was done through the side ventilation port of the ventilating bronchoscope using 100% oxygen. Jet ventilation was not utilized. During the initial rigid bronchoscope insertion, the patient was breathing spontaneously. Ventilation was performed by the anesthetist using the conventional anesthesia workstation using bag. As soon as the scope was maneuvered beyond the vocal cords, near complete tracheal obstruction due to mucosal infiltration and extrinsic compression was visible starting 2 cm below the vocal cords. The rigid bronchoscope was gently and swiftly negotiated and carinal visualization was obtained. However, right main bronchus was seen to be extrinsically compressed. After carinal visualization, airway pressures reduced, oxygenation improved (SpO_2 98%), and CO_2 levels reduced. As airway had been temporarily secured, muscle relaxant (intravenous atracurium (30 mg) was administered and oxygenation was continued for 3 min. A thorough suctioning of airway secretions was performed using a therapeutic video bronchoscope (Olympus 1T-180 videobronchoscope, 6.0 mm diameter and 3.0 mm working channel, Olympus Medical Systems Corporation, Tokyo, Japan.) inserted through the rigid bronchoscope. The

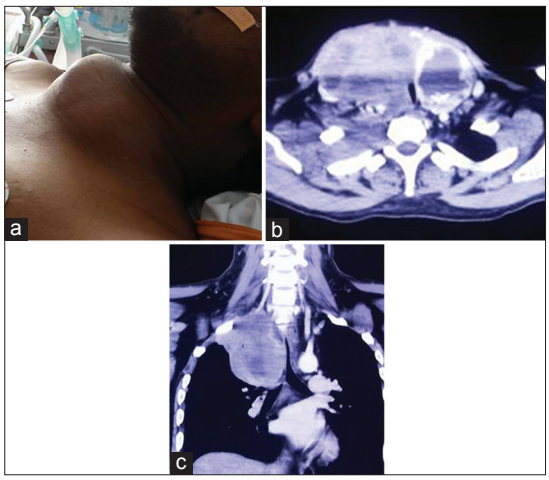

Figure 1: (a) External appearance of the large tense swelling over the midline neck, (b) computed tomography neck showing large heterogeneous enlargement of bilateral thyroid with significant tracheal luminal compromise. The trachea is reduced to a slit-like opening, (c) computed tomography thorax (mediastinal window) coronal reconstruction images demonstrating the superoinferior extent of the massive thyroid mass causing >90% narrowing of the trachea and extending above the right main bronchus narrowing it

size 11 scope was removed and subsequent intubation was performed with size 14 rigid tracheobronchoscope. A tracheobronchial covered self-expanding Y metallic stent (dimensions: Tracheal limb - 18 mm × 60 mm, Right bronchial limb - 14 mm × 15 mm, left bronchial limb - 14 mm × 25 mm, Ottomed, Mitra and Co., India) was deployed at the level of lower trachea near carina. Following Y-stent insertion, both the left main and the right main bronchus distal to the stent were patent. As the tracheal limb length was insufficient to completely cover the upper tracheal involvement, a second tracheal (18 mm × 60 mm) covered self-expanding metallic stent was deployed co-axially into the tracheal limb of the Y-stent to cover and expand the upper trachea. Proximal end of tracheal stent was positioned 2 cm below the vocal cord [Figure 2b]. The distal end of tracheal stent was overlapped (2 cm) on the proximal end of tracheobronchial Y-stent. Thus, luminal patency was maintained in both the trachea and bilateral main bronchi. No balloon dilatation was required in either of the stents to open them up. Subglottic area was patent.

Poststent deployment, the patient was ventilated with supraglottic airway device (I-gel) and dexmedetomidine infusion was stopped. Airway pressures came down to 20–24 cm of H_2O and $EtCO_2$ became normal in the range of 34–38 mmHg. After the procedure, the patient was maintaining oxygen saturation with FiO_2 of 0.3. The patient was shifted to respiratory intensive care unit for observation and I-gel was removed after 4 h when the patient was fully alert, responding to verbal commands with adequate respiratory efforts. Postprocedure X-ray chest showed the correct positioning of both the tracheal and tracheobronchial Y-stent [Figure 2a and b]. The patient was discharged 2 days later and advised for further follow-up in the oncology services.

DISCUSSION

Benign and malignant thyroid enlargements are potential cause for CAO. Mechanisms of CAO by thyroid masses include extrinsic tracheal compression, tracheal infiltration, or a combination of both. The incidence of airway obstruction secondary to thyroid enlargement varies widely in the literature, ranging from 16% to 60% based on the population studied.[7] Anaplastic thyroid cancer (ATC) represents <2% of all thyroid cancers, with an annual incidence of 1.2–3.8/100,000 individuals, but it accounts for up to 40% of thyroid cancer mortality and thus has the worst prognosis among the thyroid cancers.[8] It has a very aggressive clinical course. The usual presentation is a rapidly enlarging thyroid mass with features of local spread and airway involvement. Clinically, patients present with rapidly worsening dyspnea, dysphagia, stridor, and nerve palsy. Rapid airway compromise is the main cause of death in patients with ATC.[2] A combined treatment of surgery, radiotherapy, and chemotherapy is the treatment of choice for ATC. However, when the thyroid tumor is locally advanced involving vital structures such as airways, blood vessels, and extension into the intrathoracic cavity, surgery is often not feasible.[9] In patients presenting with life-threatening airway obstruction with thyroid masses and especially mid/lower tracheal obstruction, tracheostomy is difficult due to the presence of large anterior neck swelling and may be extremely risky. In such settings, interventional therapeutic rigid bronchoscopic techniques may be life-saving and often the only efficacious and rapid treatment modality for maintaining airway patency in acute setting.[10]

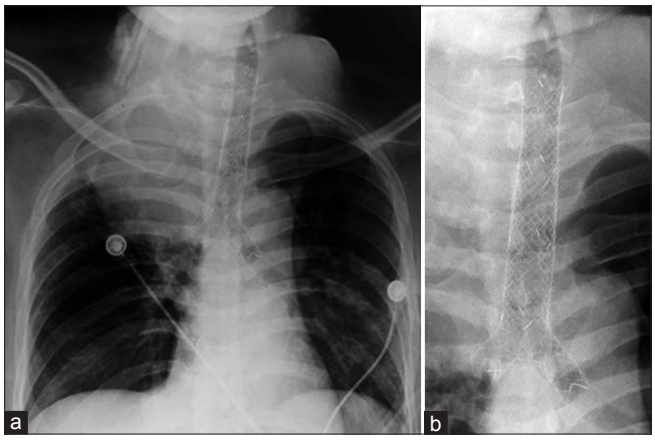

Figure 2: (a and b) Poststenting images showing the deployed tracheal and Y-stents with complete restoration of the airway

Few studies have reported the utilization of tracheal stenting in locally advanced thyroid cancer. Ribechini *et al*. reported 14 patients of tracheal obstruction due to locally advanced thyroid carcinoma of which ten patients had severe airway symptoms.[11] All 14 patients were managed with interventional therapeutic bronchoscopic procedures (four had tracheal stents, three were managed with neodymium-doped yttrium aluminum garnet laser, and in next seven both the procedures were combined). All patients showed significant improvement in airway symptoms. Tsutsui *et al*. retrospectively analyzed 35 consecutive patients in whom airway stenting was performed for laryngotracheal obstruction due to thyroid cancer.[12] Forty-five stents (12 silicone, 20 metallic, 13 T-tubes) were used in total of 43 interventions. All patients showed immediate symptomatic relief. Most common complications were supraglottic stenosis (12%) and stent migration (9%). The median survival time from stenting was 8 months. The 1-year survival rate was 40% in their study. Rajeev *et al*. reported 31 patients with anaplastic carcinoma of thyroid.[2] Out of the 31 patients, airway compromise was present in 11 patients. Five patients had tracheal stents inserted. Although there was immediate symptomatic improvement in airway symptoms, the median survival poststent insertion was only 27 days and there was no difference in survival in patients with ATC who had a stent inserted and those who did not. To the best of our knowledge, this is the first description of utilization of a metallic Y-stent in airway complications of advanced thyroid cancer. This, to our knowledge, is also

the first description of utilization of combination Y and straight metallic stents for near complete central airway restoration in advanced malignant airway obstruction.

Rigid bronchoscopy is the ideal instrument for airway control in patients with airway obstruction especially those in respiratory failure.[13] The main advantage is that the large lumen of the bronchoscope and ventilating port allow ventilation to continue while airway procedures are being performed through the channel. Flexible bronchoscope if required can be introduced through the rigid bronchoscope. In case of central obstructing growths, quick recanalization can be achieved using the mechanical coring method using the rigid bronchoscope. It allows all airway interventions to be performed safely and efficaciously. However, adequate training is a must and it requires teamwork between the assisting staff, anesthesiologist, and the interventional pulmonologist. Metallic Y-stents have emerged as the most efficacious and convenient to utilize devices for management of malignant obstruction or fistulization near the carina. Straight stents which are like cylindrical tubes cannot provide efficacious relief of an obstructing pathology at an airway bifurcation. Newly developed metallic Y-stents can be deployed even without the use of guidewires and fluoroscopy.[6] Since the tracheal limb of the Y-stent and the tracheal stent were of the same diameter, there are possibilities in certain situations that under expansion of the tracheal stent may result in a longer stent. However, we did not encounter any problem with under expansion leading to a longer stent. The dimension of the tracheal stent was based on the measurement performed using a flexible bronchoscope passed through the rigid bronchoscope after Y-stent deployment. A possibility of the requirement of dual stenting based on the CT appearance before bronchoscopy was considered by us before the rigid bronchoscopy procedure. It is important to consider this, especially when dealing with long segment CAOs. We usually keep stents of various commonly utilized sizes ready with us as a maintained stock in the bronchoscopy room as there may be an unplanned requirement during any airway stenting procedure. Maintaining an inventory is also important in case there are technical failure issues like nonopening/folding, etc., with a stent necessitating its removal. In our patient, dyspnea rapidly worsened following the FNAC examination. We cannot rule out the possibility of an intratumoral bleed following the needle intervention that converted a relatively stable airway into an unstable one leading to rapid respiratory status deterioration as a repeat imaging was not performed at our center. This highlights the need to choose the diagnostic modalities wisely in patients with CAO and facility of rigid bronchoscopy should ideally be at disposal. Securing the airway is of primary importance in these situations even before histopathological diagnosis if airway is under significant compromise.

CONCLUSION

Management of locally advanced thyroid carcinoma with airway involvement can be challenging. Airway stenting can achieve palliation in patients with thyroid cancer and airway obstruction. In these patients, stent placement may be a valuable bridge to other modalities of treatment like palliative radio and chemotherapy. Rigid bronchoscopy is the definitive modality of airway control in patients with airway obstruction and respiratory failure.

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Conflicts of interest
There are no conflicts of interest.

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