Three Cases of Persistent Laryngeal Edema Postradiation Therapy

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Radiation therapy (RT) for head and neck cancer, which has made remarkable progress in recent years, is one of the main treatment modalities because it can preserve organ function and morphology after treatment. However, while RT is widely used, complications have been reported, especially laryngeal edema, which can be an airway management problem during general anesthesia. Of the 3 cases of RT-induced laryngeal edema presented here, the first developed 4 days post-RT, the second manifested signs and symptoms associated with laryngeal edema after RT performed 4 years and 4 months previously, and the third exhibited severe laryngeal edema over a decade post-RT despite the absence of clinical signs and symptoms. Patients with a previous history of RT involving the head and neck region may encounter challenges in airway management due to laryngeal edema. Therefore, it is crucial to assess the airway preoperatively and devise a comprehensive airway management plan that encompasses various devices and techniques.

Key Words: Laryngeal edema; Radiotherapy; Chemoradiotherapy; Tracheal intubation; Fiber-optic laryngoscopy; Radiation therapy.

Head and neck cancers along with their respective treatment can affect the airway.[1–3] Preoperative assessment of the airway and appropriate contingency plans are imperative for patients requiring general anesthesia, particularly for those with identified high-risk airways. Individuals with anticipated ventilation and intubation difficulties necessitate a comprehensive preoperative airway evaluation, including a flexible fiber-optic bronchoscopy or computed tomography (CT) scan, and appropriate preparation for potentially deploying noninvasive airway management devices and invasive surgical interventions.

Although surgical resection is a mainstay of head and neck cancer treatment, radiation therapy (RT) is also often used as an adjunctive treatment,[3] and 15% to 59% of RT patients experience at least 1 episode of mild or severe laryngeal edema within 2 years of treatment.[4–7] RT-induced laryngeal edema has not been recognized as a major anesthetic management problem despite its high incidence.[8] However, since procedures to effectively irradiate specific areas of the body have been developed in recent years, it is likely that radiotherapy will be used more frequently for head and neck cancers. Consequently, the incidence of patients presenting with RT-induced laryngeal edema is expected to rise in the foreseeable future. Here, we report the anesthetic management of 3 cases involving laryngeal edema caused by RT for treating head and neck cancer.

Written consent was obtained from each patient to publish this case series (cases 1-3).

CASE PRESENTATION

Case 1

A 70-year-old woman (height 147 cm, weight 69 kg, body mass index [BMI] 31.9 kg/m^2) was diagnosed with recurrent squamous cell carcinoma of the tongue with cervical lymph node metastasis and was scheduled for cervical tumor resection 4 days after the completion of intensity-modulated RT (IMRT) of 50 Gy/25 fractions. IMRT was administered to the root of the tongue and the ipsilateral cervical lymph nodes without the addition of chemotherapy.

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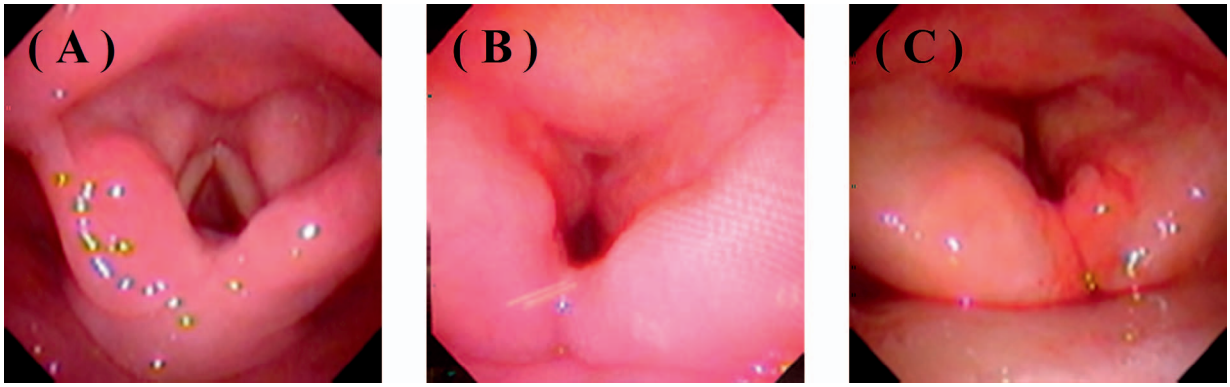
Figure. Laryngeal Edema Images



Flexible fiber-optic views demonstrating the laryngeal edema noted in case 1 (A), case 2 (B), and case 3 (C).

The patient was being managed for diet-controlled diabetes mellitus type 2 (DMT2) and hypertension and was taking irbesartan (100 mg/d) and amlodipine (5 mg/d) for treatment of hypertension. She had no reported allergies to any drugs or foods and had a history of a partial glossectomy secondary to the tongue squamous cell carcinoma. Routine preoperative physical examinations did not reveal any indications of a difficult airway or intubation.

Although she did not show any signs or symptoms indicative of laryngeal edema, such as dysphagia, we planned to assess her laryngeal anatomy preoperatively since the patient had just completed RT. Moderate sedation was provided with midazolam (3 mg) and propofol (10 mg) along with oxygen (40 L/min) administered through a high-flow nasal cannula. Despite the swelling of the arytenoid cartilages, the vocal cords were discernible using a flexible fiber-optic scope (Figure A). We felt that mask ventilation and tracheal intubation were viable and opted to proceed with general anesthesia via rapid induction. Under 100% oxygen, a remifentanil infusion (0.3 μg/kg/min), propofol (30 mg), midazolam (1 mg), and rocuronium (40 mg) were administered. A flexible fiber-optic scope was inserted into the right naris and advanced into the trachea, and nasal intubation with a 6.5-mm cuffed spiral tracheal tube was performed while the larynx was visualized with a video laryngoscope (Airway Scope, Pentax Corporation). General anesthesia was maintained with desflurane (4%) with 40% oxygen and a continuous infusion of remifentanil (0.1-0.15 μg/kg/min). After completion of the operation, a video laryngoscope was used to verify that laryngeal edema was not exacerbated. A cuff-leak test was performed, and the patient was extubated awake without difficulty. The patient had no complications during recovery or after returning to the ward, where she was carefully monitored.

Case 2

A 72-year-old man (height 175 cm, weight 67 kg, BMI 21.8 kg/m^2) was diagnosed with radiogenic osteomyelitis of the jaw following treatment for oropharyngeal squamous cell carcinoma and subsequently was scheduled for a partial mandibulectomy. The patient underwent chemoradiotherapy 4 years and 4 months prior, consisting of cisplatin and IMRT with a dose of 70 Gy in 33 fractions to the pharynx as well as adjuvant chemotherapy including docetaxel, cisplatin, and tegafur/gimeracil/oteracil potassium.

The patient was being managed for DMT2 and hypothyroidism and was taking sitagliptin (50 mg/d) for treatment of diabetes mellitus but denied any medications for hypothyroidism. He had no reported allergies to any drugs or foods and had no history of surgery or anesthesia. In addition, trismus, cervical mobility limitation, and dysphagia were noted as complications of previous RT. Preoperative airway evaluation using a flexible fiber-optic scope revealed swelling of the arytenoid cartilages and false vocal folds (Figure B), and thus, an awake fiber-optic nasal intubation was planned.

Under supplemental oxygen (6 L/min) by face mask, an infusion of dexmedetomidine (6 μg/kg/h) was administered for 10 minutes, followed by a fentanyl bolus (50 μg). Once an appropriate level of moderate sedation was achieved under spontaneous breathing, the dexmedetomidine infusion rate was reduced (0.6 μg/kg/h). Topical anesthesia of the oropharyngeal mucosa was achieved through 10 puffs of a 4% lidocaine spray applied to the posterior aspect of the tongue and the base of the palatopharyngeal and palatoglossal arches. A 6.0-mm cuffed spiral tracheal tube was gently advanced through the nasal cavity and past the vocal cords using a flexible fiber-optic scope. General anesthesia was maintained with sevoflurane (1%) with

40% oxygen and remifentanil infusion (0.15-0.25 μg/kg/min). After completion of the planned operation, an air leak was detected during the cuff-leak test. A tube exchange catheter was inserted through the tracheal tube and into the trachea, and the tracheal tube was removed under visualization using the fiber-optic scope. The patient was monitored in the operation room for an additional 30 minutes following the removal of the tube exchange catheter. The patient had no complications during recovery or after returning to the ward, where he was carefully monitored.

Case 3

A 75-year-old man (height 176 cm, weight 78 kg, BMI 25.1 kg/m^2) was diagnosed with squamous cell carcinoma of the lower alveolus and gingiva and scheduled for a marginal mandibulectomy. Twelve years ago, he was treated for hypopharyngeal squamous cell carcinoma with chemotherapy and carbon ion RT (CIT), consisting of cisplatin and 16 fractions of 57.6 Gy to the pharynx with the first 36 Gy delivered to the lymph node area and the remaining 21.6 Gy to the primary site. In the following year, he underwent neck dissection for recurrent cervical metastases.

The patient's medical history included angina, atrial fibrillation, diet-controlled DMT2, and hypertension. He was taking aspirin (100 mg/d) and apixaban (10 mg/d) for treatment of angina and atrial fibrillation and carvedilol (2.5 mg/d), amlodipine (5 mg/d), verapamil (40 mg/d), and valsartan (80 mg/d) for treatment of hypertension. He had no reported allergies to any drugs or foods and had no history of surgery or anesthesia except for neck dissection. Routine preoperative physical examinations did not reveal any indications of a difficult airway or intubation.

Given that the patient had received chemoradiotherapy more than 10 years previously, laryngeal edema was not considered a major concern. General anesthesia was rapidly induced with a continuous infusion of remifentanil (0.2 μg/kg/min) and boluses of fentanyl (50 μg), propofol (80 mg), and rocuronium (50 mg). Nasal intubation with a 7.0-mm cuffed spiral tracheal tube was attempted using a video laryngoscope, but we were unable to pass the tube beyond the vocal codes. Laryngeal edema was observed using a flexible fiber-optic scope (Figure C), and a smaller sized 6.0-mm cuffed spiral tracheal tube was placed under fiber-optic guidance. General anesthesia was maintained with sevoflurane (1%) with 40% oxygen and remifentanil infusion (0.08-0.1 μg/kg/min). After completion of the operation, fiber-optic laryngoscopy was performed to assess if the laryngeal edema had not worsened, followed by a cuff-leak test prior to removal of the tracheal tube. After extubation, the patient had no complications during recovery or after returning to the ward, where he was carefully monitored.

DISCUSSION

RT is the primary treatment modality that enables preservation of the laryngeal anatomy in patients with head and neck tumors. On the other hand, laryngeal edema resulting from RT can present challenges for airway management during the perioperative period.[1] Independent predictors of difficulties in airway management include a history of irradiation to the head and neck as well as the presence of a neck mass.[9] When these factors are present, the likelihood of a crisis situation (ie, cannot ventilate, cannot intubate) also increases.[9] RT-induced laryngeal edema is considered a detectable morphologic change that correlates with the incidence of functional impairment, including difficulties with speech[10] and swallowing.[11] However, there were no signs or symptoms related to laryngeal edema in cases 1 and 3. The risk of laryngeal edema resulting from RT has been reported to be 5% and 50% at 5 years following doses of 45 and 80 Gy, respectively,[12] and that risk doubles when combined with chemotherapy.[1] In our cases, RT using 70 Gy along with chemotherapy was used in case 2, in which the presence of laryngeal edema was noted.

The effectiveness of RT in head and neck cancer has increased in recent years due to high-precision RT such as IMRT[13] and CIT,[14] since these treatment modalities enable the minimization of irradiating normal tissue around the tumor, thereby reducing tissue damage.[15,16] However, to minimize the risk of moderate laryngeal edema, the mean dose of RT delivered to the larynx is recommended to be less than 43.5 Gy at 2 Gy/fraction from a study that included more than 90% of IMRT cases.[7] In our cases, moderate laryngeal swelling was observed in case 1 after 50 Gy at 2Gy/fraction and severe swelling in case 2 after 70 Gy at 33 fractions, consistent with the findings of the previous study.[7]

On the other hand, since CIT is relatively new, the risk for laryngeal edema remains unclear, and the only case report involves severe laryngeal necrosis after CIT of 70 Gy at 35 fractions.[17] In case 3, 36 Gy was given to the cervical lymph node area, and the remaining 21.6 Gy was administered to the primary gingival area more than 10 years ago. Thus, although CIT is suggested to be selectively effective to the malignancy area, it seems to be far from free of causing radiation injury, at least in terms of laryngeal edema.

In case 1, surgery was scheduled only 4 days after RT, so the larynx was visually assessed before tracheal intubation. In case 2, airway edema was predictable given the patient had dysphagia after 70 Gy RT with chemotherapy. However, in case 3, we did not think laryngeal edema was a possible issue given that RT was performed ~12 years beforehand and he had no signs or symptoms suggestive of laryngeal edema. The incidence of severe laryngeal edema typically occurs within 4.5 months following RT, although sporadic occurrences have been reported after 17 months.[7] It is extremely uncommon to observe severe laryngeal edema more than 10 years post-RT, given the average dose administered in case 3. Therefore, the pathology for the laryngeal edema in case 3 remains unclear. However, according to other studies, notable risk factors contributing to the progression of laryngeal edema following RT include persistent smoking, postoperative infection, atherosclerosis, laryngopharyngeal reflux, diabetes mellitus, and local trauma.[18–20] Case 3 underwent cardiac stenting for angina pectoris, had DMT2 and hypertension, and smoked 20 cigarettes per day for 30 years until 10 years ago, indicating the presence of several laryngeal edema risk factors. Case 3 also received RT and cisplatin chemotherapy, which are reported to double the risk of RT-induced laryngeal edema compared with RT alone.[21] Thus, when individuals presenting with such risk factors are to undergo general anesthesia, a fiber-optic laryngoscopy or CT scan should be conducted to evaluate the condition of the larynx prior to induction of general anesthesia and/or tracheal intubation. In addition, ultrasonography may serve as a novel means of assessing the airway.[22]

Recent guidelines have stipulated that in the event of emergent airway obstruction resulting from unexpected laryngeal edema, preparations should include noninvasive airway management devices, such as video laryngoscopes, flexible fiber-optic scopes, supraglottic airway devices, lighted or optical stylets, or, as a last resort, invasive surgical interventions, such as cricothyrotomy or tracheostomy.[23] Furthermore, case 3 also presented with a history of cervical surgery (ie, neck dissection) and RT to the head and neck region, both of which pose a risk for difficulties with face mask ventilation resulting from limited neck extension.[24] Hence, preoperative evaluation of the patient's neck range of motion should be conducted, and, if required, ventilation should be carried out in a 2-handed manner or through the utilization of supraglottic airway devices.[24]

In case 1, we visualized the glottis under moderate sedation. Ventilation was considered attainable, and muscle relaxants were used. Tracheal intubation was executed using a video laryngoscope and a fiber-optic scope with due consideration given to the necessity for caution. Rocuronium was favored over succinylcholine due to the abbreviated duration of action of succinylcholine. If difficulties arose and tracheal intubation proved unattainable, sugammadex would have been used to quickly reverse the paralytic effects of rocuronium, and the patient would have been woken up. Postoperatively, a cuff-leak test should be conducted prior to extubation[25] in patients with laryngeal edema, and utilization of a tube exchange catheter to facilitate emergent reintubation may prove beneficial.[26] If dental treatment is performed under sedation without tracheal intubation in such patients, it is crucial to avoid deep sedation as it may impair the mechanisms for maintaining the airway patency.[27]

CONCLUSION

Patients who exhibit signs and symptoms associated with laryngeal edema, have received high RT doses, or have undergone RT within 2 years are generally considered to be at risk for laryngeal edema. However, in one of the cases presented here, we experienced a patient with severe laryngeal edema more than 10 years after RT despite the absence of clinical signs or symptoms. Patients with a history of RT to the head and neck region may be at an increased risk of encountering airway management difficulties. Therefore, it is crucial to perform an extensive preoperative airway evaluation and take appropriate preventive measures for managing critical airway situations.

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