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Radiation-Associated Airway Necrosis

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ABSTRACT

Background: Chondronecrosis is one of the complications that occurs after radiation treatment of the chest and mediastinal tumors, with necrosis usually developing months to years after treatment. Upper airway perichondritis and necrosis of the cricoid cartilage, larynx, and upper trachea have been observed as a complication of radiation therapy for head and neck cancers as well. Tracheal chondronecrosis, on the other hand, is a rare complication after radiation treatment.

Case Report: We report a case of delayed chondronecrosis of the distal trachea that developed 8 years after radiation treatment using iodine-125 seeds to treat mediastinal adenocarcinoma.

Conclusion: Treatment options for chondronecrosis of the distal trachea are based on the location and extent of the airway chondronecrosis and can be either balloon bronchial dilatation with stent placement or surgical resection and anastomosis.

INTRODUCTION

Perichondritis and chondronecrosis of the trachea are well-recognized complications following radiation treatment. Fibrosis, necrosis, and, eventually, stenosis of the airway usually develop months to years after exposure to radiation treatment. Distal tracheal necrosis is a rare complication after radiation. This case illustrates a late presentation of chondronecrosis of the distal trachea and bilateral main bronchi.

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CASE REPORT

A 66-year-old woman presented to a primary care physician with a 4-month history of progressive shortness of breath and dyspnea on exertion. These symptoms were associated with stridor, productive cough, and occasional hemoptysis. Her medical history was significant for hypothyroidism, gastroesophageal reflux disease, and a mediastinal mass diagnosed 10 years previously as primary mediastinal adenocarcinoma. The mass was treated with chemotherapy and mediastinal radiotherapy. Four years later, the tumor recurred and she underwent mediastinoscopy and implantation of iodine-125 seeds within the mediastinum. Since then, she has been in remission. She smoked 1 pack per day for 40 years but stopped 10 years ago.

On examination, she was comfortable with acute distress. Her vital signs were within normal limits and saturating 100% on 2 liters of oxygen. A scar from the prior mediastinoscopy was visible on her neck, and her chest examination was significant for stridorous breathing bilaterally with normal effort and good air movement bilaterally. The remainder of the examination was unremarkable.

Computed tomography (CT) scan of the chest indicated a severe wall deformity with cartilage loss of the distal trachea and the proximal part of the bilateral main bronchi (Figure 1, arrow). Because of the patient's respiratory symptoms and the imaging findings, Thoracic Surgery was consulted. A full evaluation of the esophagus and airway under general anesthesia showed a normal esophagus except for 25% circumferential narrowing 25 cm from the incisors. Airway inspection with flexible bronchoscopy revealed complete disruption of the tracheal wall with cavitation and loss of epithelium as a result of severe necrosis at the distal third. The carina and

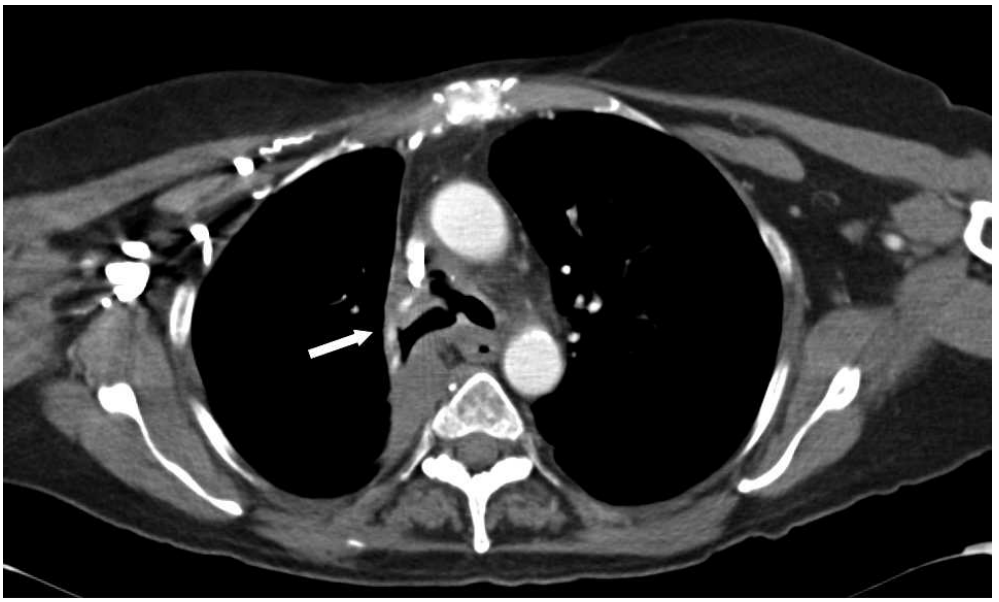

Figure 1. Computed tomography scan of the chest showing a severe airway wall deformity with cartilage loss of the distal trachea and the proximal part of bilateral main bronchi (white arrow).

bilateral main bronchi were difficult to identify because of severe necrosis and anatomical distortion of the proximal part of both main bronchi (Figure 2). Multiple airway dilatations were attempted using balloon bronchoplasty, especially at the distal trachea and bilateral main bronchi. The anatomical distortion made it difficult to implant any type of stent, considering the depth of tissue damage with necrosis and the risk of bleeding from the adjuvant, highly vascularized organs. However, postdilatations, the patient had a remarkable drop in peak ventilatory pressure, and the bronchoscope was removed with uneventful recovery. Two years later, she continued to have significant improvement in her shortness of breath and was able to tolerate the majority of her daily activities.

DISCUSSION

Perichondritis and chondronecrosis of the trachea are well-recognized complications following radiation treatment but can also be caused by cervical and upper mediastinal surgeries. Invasive tracheal infections such as *Aspergillus fumigatus* have been reported to cause chondronecrosis as well.[1] Fibrosis and stenosis of the airway usually develop months to years after radiation treatment.[2,3] Necrosis of the cricoid cartilage, larynx, and proximal part of the trachea following radiation therapy has been well reported in the literature[4]; however, distal tracheal

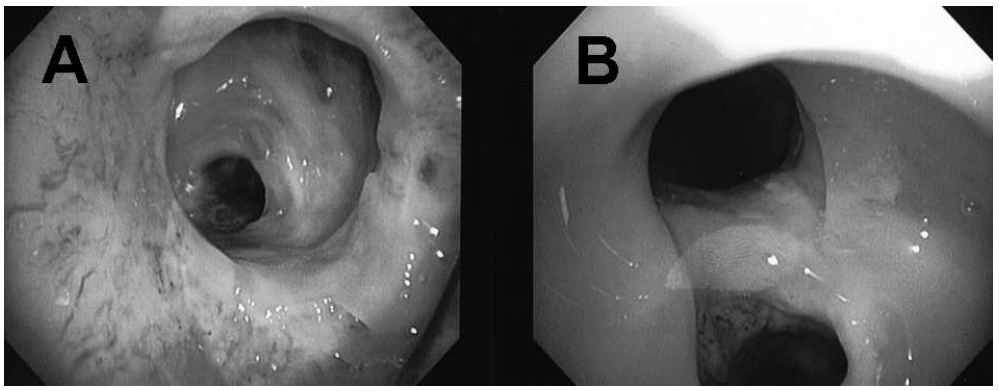

Figure 2. A flexible bronchoscopy view of (A) the lower third of the trachea and (B) the carina showing complete disruption of the tracheal wall with cavitation and the loss of epithelium from severe necrosis and narrowing of bilateral main bronchi.

necrosis is a rare complication in such patients[5] because of the narrow distance between the upper airway and the targeted head and neck tumors.[1]

This case illustrates a late presentation of chondronecrosis of the distal trachea and bilateral main bronchi 6 years following radiation treatment using implantable seeds. Predisposing factors for chondronecrosis following radiotherapy are the dose, port, and frequency of the treatment and the stage of the tumor. Airway injury and infection of the airway before or after radiotherapy are also risk factors for chondronecrosis.[6] A patient usually presents months to years following the radiation treatment with dyspnea on exertion and decreased levels of activity. Airway deformity and lack of normal secretion drainage cause respiratory infections with productive cough and occasional hemoptysis.[1] Diagnosis is based on clinical presentation, imaging, and bronchoscopy. Chest x-ray and CT scan of the chest usually show tracheal and bronchial narrowing of the distal trachea with anatomic distortion and cartilage loss of the airway, as shown in our case.[7] Typically, bronchoscopy reveals narrowing of the trachea with purulent exudates. Communication with anterior mediastinal space and organs has also been seen with different types of fistulas.[8] Tracheal biopsies usually demonstrate tissue necrosis and radiation-associated vasculopathy, with mononuclear cellular infiltration accompanied by occlusive thrombi and subendothelial edema.

Management

Radiation-associated chondronecrosis is usually diagnosed at advanced stages with significant tissue damage and anatomical distortion, so surgical intervention is of limited benefit.[9] Because of the vital neighboring organs and large vessels, therapeutic interventions usually are limited to bronchial dilatation and placement of a silicone stent.[10] No special endoscopic techniques or specific balloon pressure has been recommended in such cases. However, balloon pressure is based on the diameter of stenosis and the severity of necrosis. Each case should be treated individually based on the location, extent, and depth of the chondronecrosis and on provider experience.[9] Laryngopharyngectomy and tracheostomy can be performed for upper airway chondronecrosis. Sleeve resections and end-to-end anastomosis of the trachea have been performed for distal tracheal involvement with limited results.[7]

CONCLUSION

Airway perichondritis and chondronecrosis of the distal trachea are rare complications following radiation therapy. The clinic presentation is usually months to years after the initial exposure with diagnosis mainly by imaging and bronchoscopy. Treatment options are based on the location and the extent of the airway chondronecrosis and can be either balloon bronchial dilatation with or without stent placement or surgical resection and anastomosis. In our case, the airway necrosis was severe, and multiple balloon dilatations were performed.

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