Hyperbaric oxygen therapy for extensive bronchial necrosis and dehiscence after lung transplantation

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Disclosures: The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Institutional Review Board number and date of approval: STUDY20050181: 6/15/2020.

Informed Consent Statement: The patient consented to publication of this case report.

Received for publication Feb 10, 2023; revisions received March 21, 2023; accepted for publication April 11, 2023; available ahead of print April 19, 2023.

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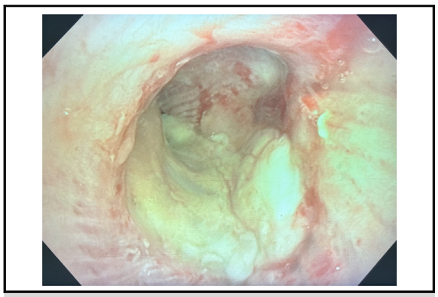
JTCVS Techniques 2023;19:166-8

2666-2507

https://doi.org/10.1016/j.xjtc.2023.04.005



Dehiscence of the bronchial wall with extensive necrosis of the membranous portion.

CENTRAL MESSAGE

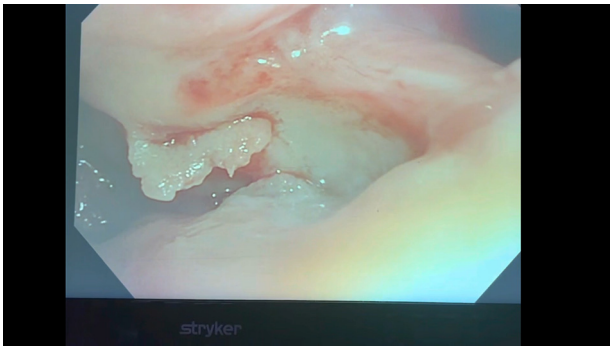
Bronchial necrosis can occur at the site of bronchial anastomosis after lung transplantation. HBOT is a treatment option for severe airway complications.

Video clip is available online.

Bronchial necrosis is a serious complication that can occur after lung transplantation and lead to bronchial dehiscence, stenosis, infection, and potentially loss of the transplanted lung.[1,2] Hyperbaric oxygen therapy (HBOT) can enhance wound healing, and thus is considered as potential treatment for bronchial complications.[1-5]

CASE REPORT

A 63-year-old man with idiopathic pulmonary fibrosis and diabetes mellites (hemoglobin A1c 6.2%) underwent a double lung transplantation with cardiopulmonary support. We trimmed the donor airway leaving only 2 cartilages above the secondary carina. The airway anastomoses were completed using continuous suture along the membranous portion and multiple interrupted figures of 8 sutures on the cartilaginous portion with 4 to 0 polydioxanone. The lung transplant surgery was uneventful, with stable hemodynamics. Primary graft dysfunction at 0, 24, 48, and 72 hours after lung transplant was 3, 2, 2, and 2, respectively. The patient was extubated on the fourth postoperative day. Bronchoscopic examination revealed no signs of ischemic reperfusion injury at this time. However, on postoperative day 15, bronchoscopy revealed bronchial wall necrosis within 2 cm of anastomosis bilaterally, and a transbronchial biopsy revealed moderate acute cellular rejection. The patient underwent steroid pulse therapy for 3 days with a dose of 1 g of Solumedrol intravenously. On postoperative day 36, a bronchoscopy examination revealed a dehiscence of the bronchial wall, with extensive necrosis of the membranous portion of the bronchus intermedius and occlusion of the basal segments in the right lower lobe (Video 1). Computed tomography scan demonstrated dehiscence of the airway at the right side anastomosis, with air ingress into the mediastinum (Figure 1). The bronchial dehiscence was treated with stent placement, and serial balloon dilatation was performed on the middle and lower lobe. A fully covered, self-expandable metallic stent (20 × 60 mm; AERO tracheobronchial stent, Merit Medical) was placed from the right main bronchus into the bronchus intermedius. YAG laser was used to open the stent to the right upper lobe. The stent was extracted on postoperative day 48 because the patient did not tolerate multiple bronchoscopies for sputum and mucus plugging. After stent removal, the airway dehiscence appeared sealed but the necrosis was still extensive. The decision to initiate HBOT to favor airway fibrosis or healing was made on postoperative day 50. The HBOT regimen consisted of a daily 90-minute session at 2.4



VIDEO 1. Bronchoscopy examination revealed a dehiscence of the bronchial wall, with extensive necrosis of the membranous portion of the bronchus intermedius and occlusion of the basal segments in the right lower lobe. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00128-1/fulltext.

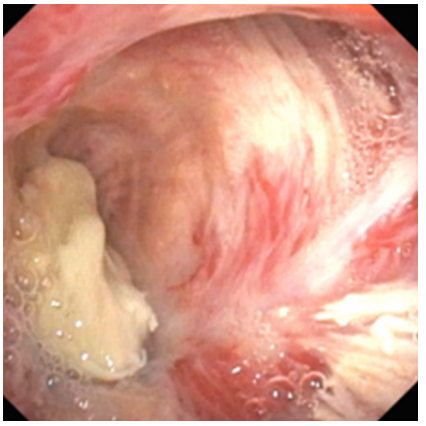


FIGURE 2. Predischarge bronchoscopy revealed that the membranous portion had been replaced by granulation tissue.

absolute atmospheres, using 100% oxygen for a total of 10 sessions. The patient completed the HBOT without any complications. Predischarge bronchoscopy revealed that the membranous portion had been replaced by granulation tissue (Figure 2). The patient was discharged 120 days after his lung transplantation and has survived without supplemental oxygen for more than 1 year. Since discharge, he has undergone bimonthly bronchoscopies, and we have performed debridement and balloon dilation for granulation tissue, but significant mechanical debridement has not been necessary. This study was approved by our Institutional Review Board (STUDY20050181, approved June 15, 2020), and written consent was obtained from the patient for the publication of this report.

DISCUSSION

HBOT can increase oxygen delivery, induce stem cell proliferation, and promote neovascularization and fibroblast proliferation; however, its use as a therapy for bronchial necrosis after thoracic surgery remains controversial.[1-5] Dickhoff and colleagues[3] reported a case of a patient who underwent central airway surgery and developed ischemia in an anastomosis, which was treated with HBOT and resulted in complete healing without necrosis or dehiscence. Mahmood and colleagues[2] reported a study aimed to determine the safety and effectiveness of HBOT in lung transplant recipients with necrotic airway plaques, 10 patients were treated with HBOT, starting 40 days after transplantation. Their study found that HBOT was well tolerated, and it may reduce the need for airway stent placement in patients with central airway stenosis. Endo and colleagues[4] reported that of the cases of postoperative ischemic bronchitis after lung cancer surgery that were treated with HBOT, 5 cases had resolved postoperative ischemic bronchitis, and 2 cases required further surgery. Tapias and colleagues[5] reported that 87% of patients with complications of tracheal anastomosis were completely treated with HBOT. The Duke transplant group conducted a randomized controlled clinical trial to determine whether HBOT can prevent central airway stenosis after lung transplantation. The trial compared standard care versus HBOT in subjects with extensive airway necrosis 4 weeks after transplantation. The trial was stopped early after 20 subjects due to no difference found between standard care and the HBOT groups in stenting, acute cellular rejection, or central airway stenosis. The authors also describe a significant shorter time for stenting in the HBOT group, which may be the result of accelerated fibrotic healing.[1] This was the reason why we decided to initiate HBOT in our patient. Our goal was to accelerate fibrosis and heal the airway dehiscence. We thought that airways stenosis could be later managed by stenting and dilation, but an unhealing dehiscence could lead to patient death due to mediastinitis or empyema in the setting of immunosuppression.

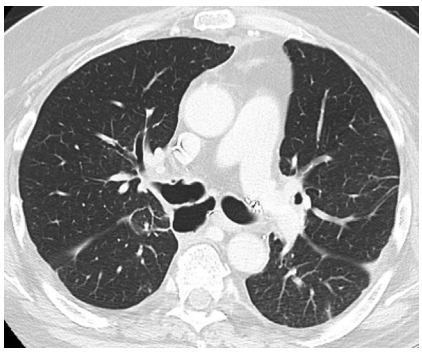


FIGURE 1. Computed tomography scan demonstrated dehiscence of the airway at the right side anastomosis, with air ingress into the mediastinum.

In our case, airway necrosis was found during a surveillance bronchoscopy 2 weeks after transplant. At that time,

we decided for conservative treatment. However, this patient developed extensive necrosis after steroid pulse for acute cellular rejection. Initially a stent was implanted to contain the dehiscence. Decision to start HBOT was favored by the extensive necrosis of the bronchus intermedius. The patient tolerated the treatment well without any complications.

CONCLUSIONS

We believe that HBOT is a viable treatment option for patients with severe and extensive bronchial necrosis, which is refractory to conventional therapies, including stent.

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