

## Long-term follow-up after laser-induced endotracheal fire

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### Abstract

The objective of this presentation is to outline long-term complications and their management in contrast to acute measures after endotracheal laser-induced fire. This case focuses on a 56-year-old patient in whom an endotracheal fire occurred during CO<sub>2</sub> laser surgery. Despite local swelling and evidence of acute lung injury, the patient was extubated the following day under single-shot cortisone and inhalation of dispersed adrenaline under assisted spontaneous breathing. Wound healing was assessed by regular flexible bronchoscopy and spirometry. Fourteen weeks after uneventful recovery, the patient presented with acute inspiratory stridor, related to a tracheal stenosis 2.5 cm distal to the glottic level. After tracheal end-to-end anastomosis, further follow-up was uneventful. Early extubation under ITU conditions avoided the need for tracheostomy and its sequelae. However, tracheal stenosis did not become apparent before week 14. While in acute management of laser-induced endotracheal fire a conservative approach was established successfully, the risk of further long-term complications implies the need for a prolonged follow-up regime even in cases of less extensive burns.

**Key words:** Laser Surgery, Endoscopy; Complications

### Case report

A 56-year-old patient was referred to the anaesthesiology intensive care unit from a district general hospital on 23 December 1999. Six hours prior to the referral, this patient had undergone excision of bilateral vocal fold granulomas with a CO<sub>2</sub> laser under general anaesthesia when ignition of the endotracheal tube followed by combustion of inflammable gases occurred. A metal-sheathed laser-resistant endotracheal tube had been used. The O<sub>2</sub>-concentration was kept at 30 per cent maximum while intravenous anaesthetics were employed. Laser power and mode were unknown.

#### Physical examination

On arrival we saw an intubated and sedated patient. Both ears, nasal cavities and the nasopharynx were unremarkable. The oropharynx, in particular the base of the tongue showed marked inflammation with traces of carbonized material. Both aryepiglottic folds and the epiglottis were markedly swollen and covered with fibrinous exudate. The O<sub>2</sub>-saturation was kept between 93 to 96 per cent under 30 per cent oxygen delivered by pressure-controlled ventilation with positive end-expiratory pressure. Maximum airway pressure was limited to 30 mmHg. All other vital parameters were within normal limits. No cardiocirculatory support was needed.

#### Acute management

Despite evidence of a developing acute lung injury with radiological findings of bilateral infiltrations as well as a F<sub>i</sub>O<sub>2</sub>/P<sub>a</sub>O<sub>2</sub><300 mmHg, a consensus decision was made for early extubation the following day. Flexible bronchoscopy was performed immediately after extubation. This

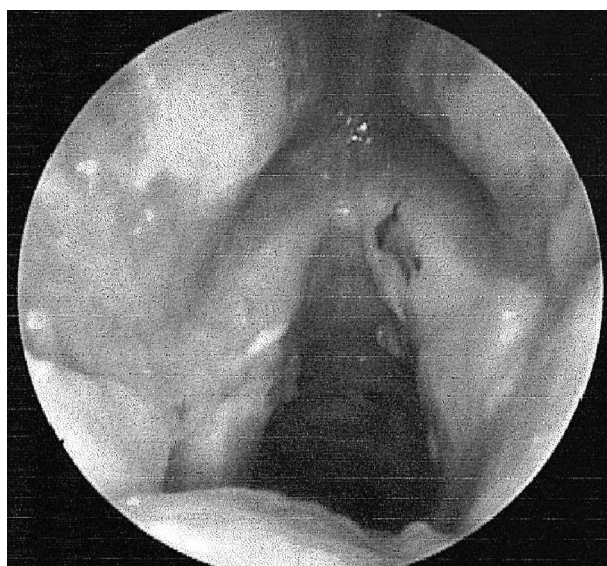


FIG. 1  
Day 21 post-incident: Marked fibrinous coating of both vocal folds, subglottic and supraglottic space.

revealed marked traces of carbonization 4 cm distal to the subglottic level, fibrinous coating of all laryngeal levels and oedematous swelling of the vocal folds (Figure 1). At first, there was marked inspiratory stridor. Ventilation via a facial mask employing assisted spontaneous breathing (ASB) with continuous positive airway pressure (CPAP) of 8 mmHg minimum, a single-shot dose of 250 mg cortisone and repeated inhalation with dispersed adrena-

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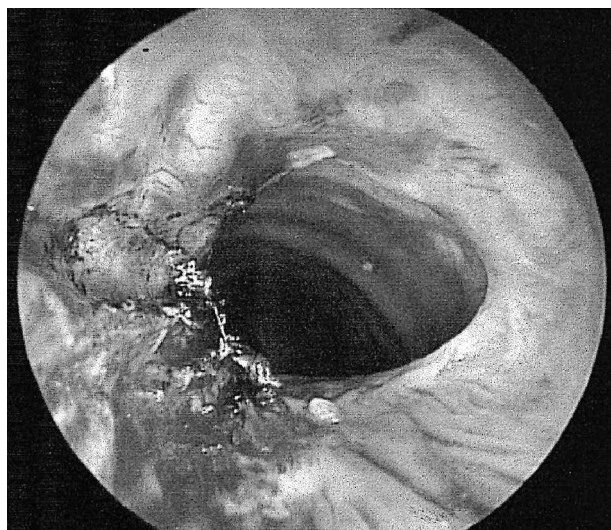


FIG. 2

Rigid tracheoscopy 14 weeks post-incident: Tracheal stenosis 2.5 cm distal from the glottic level.

line helped to stabilize the respiratory situation. Local oedema slowly disappeared. There was no vocal fold paralysis seen. However, fibrinous coating remained during the following days and there was a marked mucosal defect, following laser surgery and burn necrosis, on vocal fold level.

On day 10 the patient was referred to the Otorhinolaryngology ward from the intensive care unit. Minimal invasive ventilation with 4 l/minute oxygen was continued during five periods of 10 minutes each during daytime. Although oxygen concentration occasionally dropped below 92 per cent, the patient did not complain of any further shortness of breath. Mild infiltration, markedly in the right superior lobe, had almost disappeared on the chest X-ray by day 12. Spirometry showed normal results, and the patient was discharged from hospital on day 16.

#### Follow-up

During out-patient follow-up, hoarseness continued and full re-epithelialization of both vocal folds was complete by week 10. Spirometry showed mild obstruction only. A ventilation/perfusion scintigram confirmed the finding of a mild ventilation deficit in the right upper lobe, otherwise there were no further abnormalities.

During week 14 the patient presented with acute inspiratory stridor. While clinical examination showed only minimal synechia at the vocal fold level, a coronal reconstruction of an axial computed tomography (CT) scan revealed a tracheal stenosis, about 2.5 cm distal to the glottic level, reducing the tracheal diameter to 7.5 mm (Figures 2 and 3). Functionally, this resulted in severe irreversible respiratory obstruction. Thus, partial tracheal resection with an end-to-end anastomosis was performed the following week. The patient was extubated under bronchoscopy three days later with no further dyspnoea.

A follow-up bronchoscopy under general anaesthesia during week 19 showed some granulating tissue in the anastomosis region, that could be removed with a Nd:YAG laser at 10 W in contact mode. Further respiratory function tests were all normal. The patient, who is currently undergoing voice therapy, complains of some episodes of shortness of breath while speaking. This could be related to the remaining mucosal defect on the vocal fold level. Otherwise, he is back at work with no further complaints.

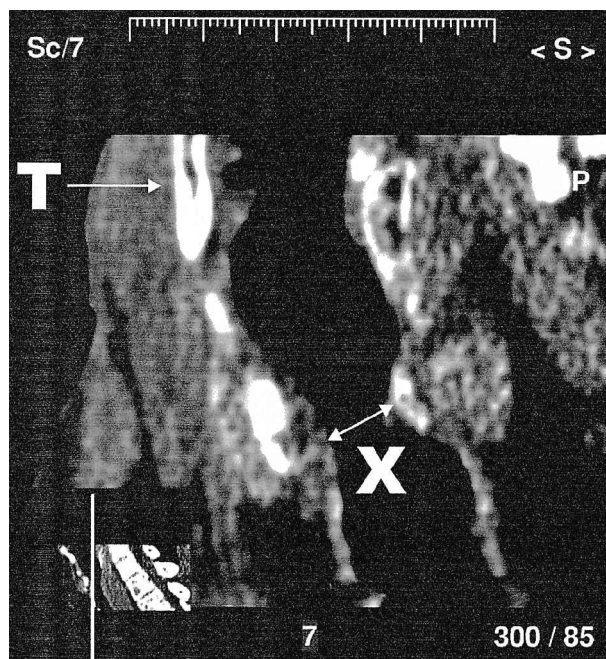


FIG. 3

Pre-operative CT scan in sagittal plane reconstruction revealing a tracheal stenosis 2.5 cm distal to the glottic level (X) (T = Thyroid cartilage).

#### Discussion

Following the increasing experience with laser-tissue interaction, catastrophic events such as endotracheal fires have become more and more rare. While training in prevention is important, the authors present this case in order to outline a possible low-interventional regime in the unfortunate case when an endotracheal fire occurs. In current literature, suggestions are made to avoid laser-induced fires by either employing jet ventilation or ventilation via a rigid bronchoscope.<sup>1,2</sup> However, some authors do admit that the risk of endotracheal fire cannot be eliminated completely, especially if endotracheal tubes are employed.<sup>1-4</sup> Emergency procedures comprise immediately stopping the oxygen and anaesthetic gas flow, the removal of burning material, extinguishing the fire and re-intubation with an endotracheal tube followed by immediate bronchoscopy.<sup>1,3,5,6</sup> Yet there is little reported about the sub-acute and long-term management of an endotracheal fire. Ossoff *et al.*<sup>5</sup> noted that most severe burns were seen after polyvinyl chloride tube ignition in an animal experiment, but warned that ash from silicone tubes could induce silicosis as a long-term effect.

Schramm *et al.*<sup>5</sup> suggested frequent rigid bronchoscopy and early tracheostomy in order to aid ventilation under positive end-expiratory pressure. While we followed this regime in general, we decided to extubate the patient as early as possible and introduced continuous positive airway pressure ventilation under O<sub>2</sub> saturation monitoring instead. The rationale was 1) to avoid tracheostomy which could be a cause for additional inflammation and possible tracheal wall necrosis and 2) to allow mucociliary clearance of the upper airways at an early stage without additional irritation from the exterior. The authors regard this management as feasible as long as there is no severe laryngeal or pharyngeal oedema, entailing the need for tracheostomy, or severe pulmonary oxygenation deficit. To answer the latter, a ventilation/perfusion scintigram proved to be helpful. This case demonstrates that a conservative approach in the acute phase management can help to avoid

secondary complications during this period – however, a marked tracheal stenosis did not become clinically apparent before week 14. Therefore, we recommend follow-up of these patients for about six months. Most information was gained from pulmonary function tests in conjunction with a coronary reconstruction of an axial neck CT scan, that eventually made the case for tracheal end-to-end anastomosis.

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