

Electrocautery-Ignited Surgical Field Fire Caused by a High Oxygen Level during Tracheostomy

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Tracheostomy is a relatively common surgical procedure that is performed easily in an operating room or intensive care unit. Open tracheostomy is needed in patients requiring prolonged ventilation when percutaneous tracheostomy is inappropriate. Sometimes, it is difficult to achieve bleeding control in the peritracheal soft tissue, and in such cases, we usually use diathermy. However, the possibility of an electrocautery-ignited surgical field fire can be overlooked during the procedure. This case report serves as a reminder that the risk of a surgical field fire during tracheostomy is real, particularly in patients requiring high-oxygen therapy.

Key words: 1. Tracheostomy
2. Airway

CASE REPORT

Our patient was a 76-year-old man with a coronary artery bypass graft due to unstable angina. During the postoperative period, the patient developed the adult respiratory distress syndrome due to pneumonia. A blood gas analysis showed a PaCO₂ concentration of 45 mmHg, PaO₂ concentration of 63 mmHg, and a pH of 7.40 during intermittent mandatory ventilation at a rate of 12 breaths per minute, a tidal volume of 500 mL, a positive end expiratory pressure of 10-cm H₂O, and FIO₂ of 100%. After two weeks of mechanical ventilation, tracheostomy was required. The neck was prepared with povidone iodine, surgical drapes were placed, and tracheostomy was started. After neck incision, subcutaneous tissue and pretracheal fascia dissections were performed using a monopolar electrocautery device to secure hemostasis. After the identification of tracheal rings, the second and the third

rings were incised vertically along the midline by using a scalpel, and to control minor bleeding in the paratracheal area, an electrocautery device was used. However, during its use, a loud pop was heard and a flame erupted from the surgical site. Initially, we attempted to control the fire by applying manual pressure with a surgical towel but were unsuccessful because of the pure-oxygen spillage through the cuff and the use of positive end-expiratory pressure. We quickly disconnected the ventilator, removed the endotracheal tube, and extinguished the flame in the surgical field by using a saline spray. A tracheostomy tube was then inserted uneventfully. The skin at the peri-tracheostomy site was deeply burnt (Fig. 1), but flexible bronchoscopy revealed no definite thermal injury of the trachea. Unfortunately, the follow-up chest X-ray showed progressive pulmonary infiltration, and the patient subsequently succumbed to a multiorgan failure after unsuccessful recovery efforts.

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Fig. 1. Photograph showing extensive burn injury around the tracheostomy site.

DISCUSSION

Surgical field fires are dangerous to patients and surgeons, but unfortunately, many patients undergoing tracheostomy do not tolerate low FIO_2 . All fires require the following three elements: an oxidizing agent, an ignition source, and fuel. During tracheostomy, the oxidizing agent is supplemental oxygen, the ignition source is the electrocautery device, and the fuel is the endotracheal tube. Smith and Roy [1] reported that all 18 of the reported tracheostomy fires were started by the electrosurgical unit and that the fuel was the endotracheal tube in 7 cases (39%) and the patient's drape in 4 cases (22%). In addition, all 18 fires occurred while supplemental oxygen was being used.

Some case reports have described airway fires occurring when monopolar electrosurgical devices were used during tracheostomy [2], although this type of injury has been reported during bronchial sleeve resection, otolaryngeal surgery, and bronchoesophageal fistula repair [1,3]. During tracheostomy, when an open trachea is present, the surgical field may become oxygen-enriched. Furthermore, when an airway fire occurs during tracheostomy with an endotracheal tube located just proximal to the tracheostomy opening, a flame is often seen venting from the tracheostomy opening, and this venting can cause an extensive burn injury to the distal aspect of the tracheobronchial tree [4].

To minimize the risk of fire during tracheostomy, surgeons

must maintain FIO_2 at the lowest possible level. On the other hand, when FIO_2 levels are higher than 50%, an electro-surgical device should never be used to enter the trachea. In a previous study, it was shown that endotracheal tubes can be ignited in a 25% oxygen atmosphere [5]. Bailey et al. [6] recommended that the following minimal precautions be taken to prevent fires during elective tracheostomy: 1) oxygen-air and/or helium mixtures (as permitted by patient condition) be used to reduce combustibility; 2) electrocautery devices be used sparingly, and if used, the voltage be set at a low level, particularly when the trachea is exposed during surgical resection; 3) a bipolar rather than a unipolar electrocautery device be used to prevent/minimize current leakage; and 4) saline or water be used instead of air to inflate the endotracheal tube cuff. Ho et al. [7] reported that CO_2 flooding of the surgical field reduces the risk of fire in patients who cannot tolerate ventilation interruption or require high inspired O_2 concentrations.

Surgeons should be aware of the possibility of airway fire and the means of preventing its occurrence during tracheostomy. Our experience cautions that electrocautery be approached carefully in patients requiring high-oxygen therapy.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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