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Case report

Case report: Airway burn☆

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ABSTRACT

Although the incidence of airway burns that occur when the endotracheal tube is ignited by the electrocautery is low, it is right to assume that the resulting injuries may be severe and even fatal. A case is presented of fire caused by the rupture of an endotracheal tube secondary to contact with the electrocautery during the resection of a facial tumor. In this case, the primary sources of fire were oxygen at a non-minimal FiO_2 used for ventilation, and the high-powered electrocautery used for resection and bleeding control. This report will cover the methods for preventing airway fires and the emergency treatment should they happen. Despite the low incidence, both anesthesiologists as well as surgeons must have in mind an emergency treatment of airway fires and must have knowledge of preventive methods.

Reporte de caso: quemadura de la vía aérea

Palabras clave:
Manejo de la vía aérea
Carcinoma basocelular
Obstrucción de la vía aérea
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RESUMEN

La quemadura de la vía aérea, consecuencia de encender un tubo endotraqueal con electrocauterio, presenta escasa incidencia, pero puede provocar lesiones graves o incluso la muerte. Se presenta un caso de un incendio causado por rotura del tubo endotraqueal secundario a contacto con electrocauterio durante una resección de tumor facial. En este caso las causas primarias de fuego fueron el oxígeno a FiO2no mínima empleado para la ventilación, y la electrocauterización de alta potencia utilizada para la resección y el control de la hemorragia. En este reporte se nombran los métodos de prevención de un incendio de las vías respiratorias y el tratamiento de urgencia cuando se produce. A pesar de su baja incidencia, anestesiólogos y cirujanos deben tener un tratamiento de urgencia de incendios de vía aérea en mente y estar al tanto de los métodos de prevención.

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Case description

A 54 year-old patient was scheduled for facial tumor resection. The pathology result revealed a basal cell carcinoma involving the entire right malar area and part of the mouth. The patient was going to receive a free microvascular graft for reconstruction. It was decided to secure the airway by means of fiberoptic-guided (Pentax 3.5 mm) nasotracheal intubation, which was done uneventfully. For maintenance, the patient received balanced anesthesia with fentanyl drip managed by infusion pump, and inhaled isorane at 0.8 MAC. Forty-five minutes into the procedure, a flame was seen coming from the surgical area. Fresh gas flow was shut and the nasotracheal tube was removed. Charred material was observed along the length of the tube, together with a hole 3 cm from the upper end of the tube caused by the electroscalpel (Fig. 1).

Orotracheal reintubation was performed using the blind digital technique because the planes had been lost after resecting the tumor. The airway was then flushed with 500 cm^3 of normal saline solution. Steroids were initiated at a dose of 200 mg of hydrocortisone every 4 h. A fiberoptic bronchoscopy revealed a healthy airway, pale carina and source bronchi, and the presence of charred material. The surgery was resumed and a new bronchoscopy performed at the end of the surgery (8 h) revealed charred material and reddened carina and source bronchi. A tracheostomy was performed because of the altered nasal and oral anatomy resulting from the extent of the resection, and the patient was then transferred to the ICU (Fig. 2).

In the immediate post-operative period in the ICU, the patient required mechanical ventilation in the Assist/Control mode followed by CPAP, with no complications associated with the ventilation mechanics or the oxygenation. There were complications associated with gastrointestinal bleeding that had hemodynamic repercussions and required multiple red blood cell transfusions. This affected the evolution of the graft and resulted in the development of areas of necrosis. The patient was discharged from the ICU after 10 days. While on the ward waiting to be rescheduled for graft surgery, the patient developed nosocomial pneumonia and died (see Figs. 1 and 2).

Fig. 2 – Extensive resection of the tumor that involved the eyeball down to the ramus of the ipsilateral mandible. Source: authors

Considerations

Incidence data regarding fires in the operating rooms vary, mainly because physicians do not report these types of incidents. Fire may happen during oral cavity, neck, heart and open thoracic surgery. The incidence is approximately 0.5–1.5%[1] and, of these events, 21% are airway fires favored by the presence of oxygen-rich atmospheres (concentrations greater than 23%).[2,3] In order for them to occur, there needs to be what has been called the fire triangle: ignition (electroscalpel, laser),[4–6] fuel (in this case inhaled agents), and an oxidizer like oxygen that reduces the need for energy to start the fire.[2,6] In order to avoid the fire, these three components must not be allowed to come together despite the fact that they are always in close proximity. Almost any material used in surgery may act as fuel – sponges, the patient's fat, the alcohol used for cleaning the skin.[6,7] In order to understand the pathophysiology of the injury, we can use the analogy of a fire in a confined space, given the composition of the orotracheal tube. The tube is made of PVC (polyvinylchloride), a material commonly found in the homes, and 75% of its components such as hydrochloric acid and carbon monoxide are toxic.[8]

The injury goes through several stages, starting with the thermal injury followed by the chemical injury.[8,9] The injury that develops over the first 24 h is characterized by an inflammatory process of the mucosa that

Fig. 1 – Tube with burn hole 3 cm from the upper end. Source: authors

ranges from edema to de-epithalization, forming a pseudomembrane and then an obstruction after approximately 48–72 h.[8,9] The lung parenchyma injury is characterized by varying degrees of interstitial and alveolar edema, neutrophil infiltrates, hyaline membranes and areas of atelectasis.[8,9] Moreover, there is a 50% reduction in lung compliance due to increased lung fluid volume and lymphatic flow.[8]

To manage this event during the anesthetic procedure, the first thing is to close gas flow, remove the burnt ortracheal tube, reintubate the patient, flush the bronchi with normal saline solution, perform a fiberoptic bronchoscopy to visualize the extent of the lesion and flush thoroughly; management with bronchodilators is controversial, but it is said that it increases mucociliary function[9,10]; the recommended mode of ventilation is CPAP[9]; steroids and antibiotics are not recommended[11]; tracheostomy will depend on the individual patient; and fiberoptic bronchoscopy must be repeated after six weeks.[12]

Although surgical fires are rare, even more so in the airway, we need to be mindful of the need to prevent them, recognize the risk of fire in the procedure to be performed, and ascertain that there are no oxygen leaks, in particular in patients taken to facial or airway surgery.[5,11,13]

Continuing education and communication among the staff, together with the knowledge of the fire prevention protocols in surgical procedures may reduce the occurrence of fires.[14,15] The use of oxygen supplementation is the predominant cause of most fires, since combustion is significantly increased in oxygen-rich environments with FiO_2 greater than 45%.[15] According to the recommendations, it is only up to the surgical team to prevent surgical fire events[16] by paying close attention to key aspects such as avoiding oxygen-rich atmospheres, wetting gauzes and sponges, maintaining the edges of towel orifices as far away from the incisions as possible, covering scalp and facial hair with gelatin, using bipolar instead of monopolar electrocautery for coagulation, keeping at hand a syringe with 50 cm^3 of water, and inflating the endotracheal tube cuff with saline solution instead of air.[8,15,16]

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Conflicts of interest

The authors have no conflicts of interest to declare.

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