Case Report

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Fire in the Airway: A Case report

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Abstract

Tracheostomy is a surgical procedure in which both the surgeon and anaesthetist share responsibility for managing the airway. Although rare, airway fire is a serious complication of tracheostomy with the potential for devastating patient morbidity and mortality. This article discusses a case of airway fire during tracheostomy and explores the factors contributing to this risk

Keywords: Airway fire; Tracheostomy; Unipolar cautery; Inflammability index.

INTRODUCTION

Airway fire is a rare but feared intra-operative adverse event that can occur during tracheostomy. Despite its rarity, if an airway fire does occur, it can have severe consequences if not managed immediately. This case report describes an operating room fire that occurred during tracheostomy in an intubated patient. The fire resulted from a combination of an oxygen-rich environment, a polyvinyl chloride endotracheal tube, and the heat generated by an electrosurgical unit.

CASE REPORT

A 39-year-old male patient, who had previously undergone external ventricular drainage (EVD) for intraventricular haemorrhage and subarachnoid haemorrhage (SAH), was on mechanical ventilation. Due to prolonged ventilation, the patient was scheduled for an elective tracheostomy. After

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standard American Society of Anaesthesiologists (ASA) monitoring were attached, anaesthesia was induced with propofol, fentanyl, and vecuronium, and maintained with 2% sevoflurane in a 1:1 air-oxygen mixture. During the surgical procedure, the surgeon accidentally ruptured the endotracheal tube (ETT) cuff resulting in inadequate ventilation and desaturation. To maintain adequate ventilation, the patient was hand-ventilated, and the fraction of inspired oxygen (FiO_2) was increased to 100%. While the surgeon used unipolar cautery, a fire was noticed at the surgical site. Immediate actions were taken to address the fire: oxygen supply was discontinued, the ETT was disconnected from the machine, and the surgical site was flooded with normal saline. After extinguishing the fire, the cautery was switched to bipolar mode, and anaesthesia was maintained with a 70:30 air-oxygen mixture and 2% sevoflurane. Fortunately, there was no serious soft tissue injury, and the tracheostomy tube was safely inserted. The patient remained hemodynamically stable throughout the procedure. After confirming the tracheostomy tube's position, the ETT was removed and a bronchoscopic examination was done to rule out airway injuries. The patient was transferred back to the Neuro-Surgical Intensive Care Unit (NSICU) in a hemodynamically stable state. A post-operative chest X-ray was taken to rule out pneumothorax, and the results were normal.

DISCUSSION

Airway fires can occur due to the ignition of airway tissues or the endotracheal tube by electrocautery or lasers.[1] While literature often cites airway fires during laser procedures, there is less documentation on incidents involving electrosurgical procedures.

Fire requires three elements: an oxidizing agent (such as oxygen or nitrous oxide), a combustible material (e.g., endotracheal tube), and a source of ignition (such as laser or electrocautery).[2] It is important to distinguish between electrosurgery and electrocautery:

- Electrosurgery involves coagulating or cutting tissue by passing a high-frequency current through it.

- Electrocauteryrefers to the transfer of heat from a preheated object.

There are two types of electrosurgical units:

1. ***Unipolar:*** A high-density current produced by the generator passes through the active electrode at the instrument's tip, with the ground pad collecting the current and completing the circuit.
2. ***Bipolar:*** Current flows through one tip of the forceps and is collected by the other tip to complete the circuit. This localized current flow minimizes damage to surrounding tissues.

Oxygen becomes flammable at concentrations of 25% (inflammability index-0.263). The inflammability index indicates the percentage of oxygen required to support combustion.[3] Polyvinyl chloride (PVC) has a high inflammability index and ignites when oxygen concentration exceeds 25%.

Three key factors related to the endotracheal tube are its positioning, seal, and the use of saline for inflation. The cuff is particularly vulnerable to damage. To mitigate risks, the cuff should be placed away from the surgical field, either just above the carina or above the incision site.[4] Ensuring no cuff leaks and using saline or sterile water to fill the cuff may reduce the risk of fire by acting as a fire retardant.

When airway fire occurs with an endotracheal tube in place, a "blowtorch" flame is often seen through the tracheostomy opening, which can limit burn injuries to the distal tracheobronchial tree.

Prevention of airway fire during tracheostomy involves several safety measures:

1. Reinforce co-ordination and communication between the anaesthesia and surgical teams.[5]
2. Use bipolar diathermy for haemostasis.
3. Ensure haemostasis before opening the trachea.
4. Use a cold scalpel for tracheostomy instead of diathermy.[6]
5. Maintain the lowest possible FiO_2 during the procedure.
6. Use suction systematically to remove oxygen and flammable debris.
7. Periodic training regarding airway fire management.

In the event of an airway fire, the surgeon should immediately turn off the electrosurgical unit, remove the electrode from the fire site, and flood the area with normal saline. The anaesthesiologist should cut off the oxygen supply by disconnecting

the ETT from the oxygen source or removing the tube entirely, anticipating potential difficulties with reintubation. The airway should be examined thoroughly, and a chest X-ray should be performed to rule out pneumothorax. Monitor for respiratory distress and provide appropriate antibiotics and steroid therapy as needed.

CONCLUSION

Airway fire is a known but underreported complication of tracheostomy. Understanding the causes and implementing preventive measures can significantly reduce the incidence of this serious complication. Effective coordination between the surgeon and anaesthesiologist is crucial in procedures involving shared airway management. It is essential for all clinicians involved to be aware of the causes, prevention strategies, and management of airway fire.

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