Airway fire during double-lung transplantation

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Abstract

Airway fire is a well-documented event during airway surgery with devastating outcomes. Individuals involved in the care of these patients should be aware of this possible complication and precautions needed to prevent this complication.

Keywords: Airway • Transplantation • Lung • Operating theatre safety

CLINICAL SUMMARY

A 64-year old male with end-stage chronic obstructive pulmonary disease was evaluated and listed for double-lung transplant at our institution. Once suitable organs were available, the patient underwent double-lung transplantation.

The patient was intubated with a left-sided double lumen endotracheal tube (ETT) and bilateral anteroaxillary thoracotomies were performed. The left side was approached first and with contralateral single-lung ventilation, the hilum was dissected. The pulmonary arteries and veins were isolated and divided sequentially using a vascular stapler (Multifire Endo GIA™, Covidien Surgical, Mansfield, MA). Finally, the left bronchus was incised and while haemostasis was being achieved with the electrocautery, an ignition flame was seen arising from the left bronchus and the laparotomy sponge which was being used for haemostasis caught fire. At the time of this incidence, single right-lung ventilation was being performed with 100% FiO2. The flaming sponge was immediately removed and saline was infused into the chest cavity. Simultaneously, the patient was disconnected from the ventilator. Immediate bronchoscopic examination revealed a small area of burn at the left bronchial stump. The ETT was charred and its lumen had melted (Figs 1 and 2). This was replaced with a new double lumen ETT. The distal end of the left bronchus was trimmed until a good blood supply was noted. As a precautionary measure, a pedicled intercostal muscle flap was harvested from the fifth intercostal space and wrapped around the left bronchial anastomosis.

A Valsalva test (30 cmH2O) did not demonstrate any air leak. Post-transplantation, the lung function was good; however, due to deconditioning the patient required prolonged mechanical ventilation and on postoperative day 4 underwent tracheostomy. Routine postoperative surveillance bronchoscopy demonstrated progressive narrowing of the left main stem anastomosis ultimately requiring balloon dilation and temporary stent placement. The patient ultimately weaned from mechanical ventilation, tolerated decannulation and was discharged home without any further complications.

DISCUSSION

Fire within the chest cavity is a well-documented event during airway surgery [1] that poses dangers to the patient as well as to the operating theatre personnel. Preventive measures should be taken whenever surgery involving the airways is planned. Three components that are necessary for a fire to occur are: (i) a combustible material (i.e. dry laparotomy sponge, polyvinylchloride (PVC) ETT and alcohol-based skin antiseptics), (ii) an oxidizing agent (oxygen and nitrous oxide) and (iii) a source of ignition (electrocautery and laser).

The standard ETT is made of PVC due to its pliability and low toxicity; however, it has a high potential for being combustive in an atmosphere containing >25% of oxygen. The ETT is positioned within the trachea or proximal main stem bronchus and the seal that the cuff provides are also important factors in the prevention of fire. Upon opening the airway, the presence of an air leak around the ETT cuff should raise concern for improper positioning or malfunctioning cuff. For lung transplantation, the optimal position for the distal cuff is just below the carina within the left main stem bronchus. This protects the cuff from being incised inadvertently by the operating surgeon while opening the airway. In addition, filling of the cuff with saline as opposed to air may also reduce the risk of fire [2].

Moreover, the use of wet laparotomy sponge seems to be a better barrier against surreptitious sparks from electrocautery [1] and the use of bipolar electrocautery would minimize the amount of leakage of current [3]. Some surgeons prefer diathermy to scalpels [4], especially in patients with haemostatic deficiencies; even if a scalpel is used to
incise the airway, diathermy may be required to secure haemostasis [3]; some critically ill patients, precisely those who require double-lung transplant off-pump, may not tolerate apnoea or the use of low concentration of oxygen. In addition to using the lowest possible voltage for the electrocautery [3], the surgical field should be flooded with carbon dioxide [5].

In conclusion, fire during airway surgery is rare but may result in serious airway injury [1 2 4 3 5] and possible death [4]. Surgeons and operating theatre personnel should familiarize themselves with the factors associated with airway fires, preventive measures to avoid fire and techniques to extinguish fire should it occur.

The following measures should be taken to prevent chest cavity fires during lung transplantation:

(i) Every personnel involved in the operating theatre should be familiar and educated about the potential of airway fires and be versed in the institutionally set preventive and therapeutic measures.

(ii) Lowest percentage of FiO2 should be used while operating on the airway. During off pump double-lung transplantation, the ipsilateral pulmonary artery may need to be snared down to improve arterial oxygen saturation by eliminating the intrapulmonary shunt through the non-ventilated lung.

(iii) Continuous suction of the ipsilateral ETT to decrease the amount of oxygen near the electrocautery.

(iv) Flooding the operating field with carbon dioxide during division of airways and achieving homeostasis.

(v) Ensuring that there is no air leak from the ETT cuff in the operative field.

(vi) Avoid using electrocautery and/or minimize the output of the electrocautery.

(vii) Avoid dry sponges when cauterizing near the airway.

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REFERENCES


