

Case Report

Cardiac arrest following ventilator fire: A rare cause

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ABSTRACT

Operating room fires are rare events, but when occur they result in serious and sometimes fatal consequences. Anaesthesia ventilator fire leading to cardiac arrest is a rare incident and has not been reported. We report a near catastrophic ventilator fire leading to cardiac arrest in a patient undergoing subtotal thyroidectomy. In the present case sparks due to friction or electrical short circuit within the ventilator might have acted as source of ignition leading to fire and explosion in the oxygen rich environment. The patient was successfully resuscitated and revived with uneventful recovery and no adverse sequelae. The cardiac arrest was possibly due to severe hypoxia resulting from inhalation of smoke containing high concentrations of carbon monoxide and other noxious gases.

Key words: Anaesthesia ventilator, carbon monoxide poisoning, cardiac arrest, operating room, subtotal thyroidectomy

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INTRODUCTION

Operating room (ORs) fires related to anaesthesia ventilator mishaps are extremely rare events, but when they do occur, result in serious and sometimes mortal consequences. Most of these fires are related to surgical factors like inflammable antiseptics or electrocautery.^[1,2] Cardiac arrest associated with ventilator fire has not been reported in the published English literature.^[3] We report a near-fatal incident of cardiac arrest following ventilator mishap and successful revival of a patient who underwent subtotal thyroidectomy.

CASE REPORT

A 65-year-old 60 kg ASA grade I female patient underwent subtotal thyroidectomy for diffuse multinodular colloid goiter. Pre-anaesthetic check up revealed normal cardiorespiratory systems. All investigations including electrocardiogram (ECG), echocardiography and chest X-ray were within normal limits. Routine general anaesthesia was administered and maintained using O₂/N₂O/Isoflurane/Fentanyl/Vecuronium and IPPV with an electrically driven volume-controlled anaesthesia ventilator. During the operation, intravenous fluids were administered based

on haemodynamic parameters. At the end of near-completion of surgery, a moderately loud explosive sound was heard from the anaesthesia ventilator. This was followed within seconds by the appearance of smoke and an orange flame from the control panel of the ventilator. Within minutes, both the smoke and the flame increased significantly and engulfed the ventilator, leading to complete melting of its parts [Figure 1]. The patient was disconnected immediately from the ventilator and ventilated with an AMBU[®] resuscitation bag. Meanwhile, oxygen, nitrous oxide and electric supply of the anaesthesia apparatus and ventilator were disconnected and the fire was extinguished by spraying water. The anaesthetic and surgical teams shifted the patient out of the fire area to another adjacent operation theatre along with the AMBU[®] bag. In the OR, the patient was reconnected to the monitor and another anaesthesia work station and ventilation was started with 100% oxygen. The approximate time between disconnection of endotracheal tube (ETT) and ventilation with 100% oxygen was 2–3 min. Meanwhile, we noticed absence of pulse and oxygen saturation with ECG showing tracings of asystole. Cardiopulmonary resuscitation (CPR) was started and the lungs were ventilated with high flows (12 L/min) of 100% oxygen. Following 3–4

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Figure 1: The melted and charred parts of the excel anaesthesia ventilator

min of CPR and i.v. atropine 3 mg and adrenaline 2 mg (1 mg + 1 mg), the patient showed return of spontaneous circulation (ROSC). Thereafter, the patient maintained a heart rate of 110–120 bpm, BP 100/70 mmHg and oxygen saturation of 93–94%. A 12-lead ECG, serum troponin A, serum electrolytes and ABG were obtained to rule out other causes of cardiac arrest, and were within normal limits. Once the patient's circulation was restored and maintained for 15–20 min, the remaining part of the surgery was allowed to complete. The total duration of anaesthesia was approximately 180 min. After the completion of the procedure, the neuromuscular blockade was antagonized with neostigmine 3.0 mg and glycopyrrolate 0.4 mg. The subject emerged from anaesthesia with no abnormal sequelae. She was observed and monitored in the post-anaesthesia care unit (PACU) for 24 h and then discharged on the fifth post-operative day. She was followed-up after 2 weeks and later monthly with no reported adverse sequelae of the event. The incident was notified to the manufacturer of the ventilator and is under an investigation stage to determine the cause of the incident.

DISCUSSION

Among all OR fires, equipment-related fires are extremely rare incidents, probably because of strict electrical safety standards, good design of equipment and routine inspection and preventive maintenance. However, when these occur, the consequences are often disastrous for both the patient and the OR personnel,^[1] particularly in poorly equipped hospital set-ups. Historically, OR fires or explosions caused by anaesthesia equipment were attributable to flammable

anaesthetic agents.^[2-5] Berry *et al.* reported a case of carbon monoxide poisoning during desflurane anaesthesia.^[3] Kanno *et al.* have reported combustive destruction of the anaesthetic circuit expiratory valve^[4] and explosions within the anaesthesia machine were reported by Castro *et al.*^[5] Fires in electronic equipment are actually caused by short circuits or electrical overloads. Normally, they create some smell or vapors, and these are controlled by stopping the flow of electricity to the device. Sometimes, the fire can flare up without these warnings, as noted in our case. To cause fire, an oxidizing agent, a source of heat and a flammable material or fuel must be present. In the present case, sparks due to friction or electrical short circuit might have acted as the source of the ignition, which led to fire and explosion in the oxygen-rich environment. Fire mishaps in ventilators are prevented by routine pre-use checkups and device service as per minimum standards mentioned in the user manual.

Cardiac arrest following ventilator fire is also a rare incident. Because this mishap occurred intraoperatively, the first priority was to immediately shift the patient out of the danger area to protect from further thermal damage. Although we disconnected the patient from the ventilator immediately, some smoke-rich gases were delivered by the ventilator. As other causes of cardiac arrest were ruled out, we suspected carbon monoxide toxicity as one of the causes for severe hypoxaemia and cardiac arrest.^[6,7] Although cooximeter analysis helps in the estimation of carboxyhaemoglobin (COHb), it is not routinely available in sub district-level hospital set ups. We managed the patient with high flows of 100% oxygen. The half-life of COHb is between 4 and 6 h with room air, which further drops to 40–90 min and 15–30 min if the patient is receiving normobaric 100% oxygen and hyperbaric oxygen, respectively.^[7] Although hyperbaric oxygen is the treatment of suspected CO poisoning, high-flow normobaric 100% oxygen can still be life saving. Timely and effective resuscitation helped us to revive the patient successfully.

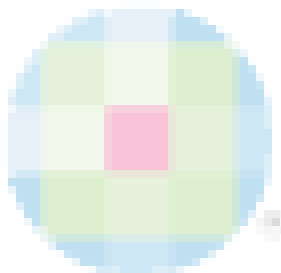
In conclusion, ventilator fires, although infrequent, can be disastrous. Although the patient did not suffer thermal injury, the OR team should be prepared to handle any eventuality arising out of such disaster. Prevention of fires requires attention from everyone in the OR to hospital authorities who make purchasing decisions. The knowledge and vigilance of the OR teams in preventing fire and a quick response during

such incidents appears a necessity. Having a stringent quality control and ensuring electrical safety of medical equipment cannot be overemphasized to prevent such potentially fatal problems.

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