Mobile Phone-Triggered Thermal Burns in the Presence of Supplemental Oxygen

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In this case report, we present a patient who used a nasal cannula for oxygen supplementation and suffered deep, second-degree burns to his nose and left leg when an electrical spark shot out of the cable’s connection socket while the cellular phone was ringing and the cable was, simultaneously, being disconnected from the socket. The cellular phone, a device commonly thought by many people to be both useful and safe, thus has the potential to serve as a heat source that might ignite and cause burns. (J Burn Care Res 2007;28:348–350)

A 56-year-old man had been hospitalized for a left upper lobectomy in the thoracic surgery department. His past medical history revealed heavy smoking, up to a year, before his hospital admission and, subsequently, severe chronic obstructive pulmonary disease. On the sixth postoperative day, deep second-degree burns of both nostrils and the left upper shin were observed (Figure 1). The patient, who had been using a nasal cannula for oxygen supplementation, with a flow of 5 liters/min, had disconnected his cellular phone from its electrical charger cable while it had been ringing. As he pulled the cable out of the socket, the patient noted a spark originating from the cable’s connection socket. The spark ignited the patient’s plastic (polyvinyl) nostril cannula tubing, causing deep second-degree burns to both nostrils and to the nasal mucosa. In addition, the melted drops of the cannula caused a second-degree burn to his left shin and set his dressing gown on fire. The patient managed to remove the cannula and put out the fire. The patient suffered no consequent respiratory distress and was discharged on the next day, with a conservative burn treatment plan.

DISCUSSION

Currently, there are more than 1 billion mobile phones worldwide, and most patients are assumed to own one. Cellular phones allow hospitalized patients to communicate with flexibility and ease with their families, home, and friends. In addition, a significant percentage of hospitalized patients receive supplemental oxygen, and the combination of these two factors has the potential to lead to the unusual burn situation described in this report.

Various health hazards associated with mobile phones have been examined extensively, including intracranial tumors,1 damage to cognitive function,2 male infertility,3 damage to auditory function,4 undesirable effects on medical electronic devices,5 and more. However, the hazard of potential combustion near an oxygen source is yet to be described in the literature.

In general, a “fire triangle” consists of a heat source, fuel, and an oxidizer. The aim of conventional fire prevention is to remove at least one of these three fire elements. Unfortunately, in the case of this patient, these three elements coexisted: an electrical spark (heat source), a nasal cannula (fuel), and oxygen.

The “Heat Source”

During the execution of plastic surgery procedures, the main common heat sources are the electrosurgical unit itself and, to a lesser degree, lasers. The plastic surgeon is warned against their use in an oxygen-enriched atmosphere, which is defined as any oxygen concentration greater than 21%; yet, to date, the use of a cellular phone in an oxygen-enriched environment has not been identified as a potential hazard.

The only case of a fire caused by a cellular phone7
that has ever been described involved the ignition of petrol fumes in a gas station that occurred simultaneously with the ringing of a mobile phone. Although there are sparse data on the potential for the ignition of flammable fumes in petrol stations and, in fact, many consider it to be an urban myth, oil companies and the chemical industry have fairly stringent protocols to prohibit the use of cellular phones in high-risk, explosive areas. This risk is also acknowledged by certain mobile phone manufacturers.

Mobile phones can, theoretically, cause a fire in the presence of flammable vapor, either by sparks from the batteries, the ringer, from static electricity, or by electromagnetic waves. In the case presented here, the patient saw the spark originating from the phone’s cable connection socket just as the active charging cable was disconnected from the ringing phone. The spark served as the heat source in the “fire triangle.”

The Oxygen
The use of supplemental oxygen in home therapy for chronic obstructive pulmonary diseases, temporary supplemental oxygen in operating rooms, and during the postoperative period poses both fire and burn hazards. The majority of reported operating room fires occur in oxygen-enriched environments. Most of the burns occurring during treatment with supplemental oxygen are localized in the head and neck regions. This fact is attributed to the oxygen-rich atmosphere in the proximity of nasal cannulas and endotracheal tubes.

The Fuel
Devices made of plastic (polyvinyl chloride), such as endotracheal tubes, are a potential source for ignition during surgery when heat sources such as the electrosurgical unit or lasers are used near them and comprise the third element of the “fire triangle.” The polyvinyl chloride is a polymer that is derived from ethylene, which is a carbon obtained from petroleum and used chiefly as a raw material in the manufacture of alcohol and plastics. Previous reports in the literature have shown that polyvinyl chloride may serve as a fuel for fire. The melting point of polyvinyl plastics is 212°C. One of the principles of fire chemistry as related to oxygen is as follows: as the oxygen concentration increases, the autoignition temperature of materials decreases. As so, materials that cannot be ignited in normal air may burn in oxygen-enriched atmospheres, such as the one formed surrounding a nasal cannula. Under this principle, plastics may burn fiercely in an oxygen-enriched atmosphere. Therefore, ignition temperature of polyvinyl is decreased in the oxygen enriched environment and consequently would have been surpassed by the flames temperature (greater than 500°C).

It is the authors’ understanding that a direct flame created by the spark in the oxygen-enriched environment around the nasal cannula, caused the burn to both nostrils and ignited the PVC cannula, whereas the second-degree burn to the patients shin was due to hot melted drops of polyvinyl.

The broadening indications for supplemental oxygen have increased the number of home oxygen units. It is estimated that more than 600,000 oxygen units are operating in the United States. Because of the increasing prevalence of these home oxygen units, and the ubiquity of mobile phones, the risk of cell phones causing combustion burns during supplemental oxygen therapy must not be overlooked or dismissed lightly. The scarcity of such reports in the medical literature indicates that the actual risk for such an event is low, yet it poses a potentially serious and significant danger.

The American Lung Association has published guidelines for the safe use of home oxygen that prohibit smoking in any room in which oxygen is
being used and warns that the oxygen source should be kept at least 10 feet from a heat source or an electrical device which may spark.

It is our recommendation that patients and surgeons be further educated for safer use of cellular phones, ie, that they refrain from charging or using such phones near an oxygen source.

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