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Case Report

Facial Burn Due to Static Electricity - Induced Fire - A Rare Clinical Entity

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Abstract

Regardless of the cause, concentrated oxygen therapy (OT) is one of the most critical first-line considerations in the management of hypoxemia in palliative care patients. Oxygen is also a known flammable gas and has previously been reported to cause a fire in circumstances involving OT through direct contact with a flame or through electrical triggers in a closed environment. However, the fire-triggering role of static electricity (SE) in the human body is poorly understood with respect to patients receiving OT. Presently described is a case of a facial burn due to SE-induced fire in a patient with metastatic breast cancer who was receiving palliative OT, with the goal of drawing attention to possible risks to patient safety of using palliative nasal OT.

Keywords: Fire, ignition, oxygen, palliative, static electricity

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Static Electricity (SE) is known as an imbalance of spontaneous electric charges within or on the surface of a substance after a contact or separate of two conducting or insulating material, leading to a separation of positive and negative electrons between the materials on contact. [1] A static electric charge in human body can occur when the two surfaces contact and separate between each other, depending on the physical and chemical structure of the materials.[2]

The energy, which is stored as a static electricity on an object, includes a high voltage but low amperage of energy, and varies depending on the size of the material and its capacitance. During a touch to a material, this energy can be discharged in less than a microsecond, leading to a spark which may ignite the flammable gas.[3] Free oxygen (O_2) alone is not flammable, however, it may cause severe burn reactions in patients by entering reactions with flammable substances through high heat or electrical sparks, particularly in patients receiving oxygen and flammable anesthetic gases together. [4] Five or six decades before, this clinical entity had been ignored in the operating rooms, and serious fires had been observed frequently. Therefore, during the O_2 use when the flammable substances are present in the environment, careful attention should be paid in order to avoid a possible fire that might be triggered by an organic flame or an electrical spark.[5] Thus, all surgical and anesthetic equipment including the table should be connected to the earthing line, providing the release of SE charge to the environment, without causing any ignition. The substances, which can readily and rapidly react with O^2 and then lead to fire, are nitrogen compounds. Vaseline or glycerin-based creams, which include a large amount of nitrogenous organic compounds, are highly flammable objects and have the ability to ignite easily, even though they are soaked. In case of applying the Vaseline or

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organic-based creams to the body surface in patients receiving intensive OT, SE might cause a sudden onset of fire.[4] One another important point to note is that such a fire induced by SE might also lead to more severe and life-threatening dangerous fires in entire hospital.[6] Therefore, although rare, we would like to draw attention to this unexpected but even more possible event which might easily occur when considering the many physical and chemical points regarding the static electricity-induced ignition.

Case Report

A 67-year-old female patient with a medical past history of advanced stage breast cancer for 6 years of diagnose was hospitalized for palliation of severe hypoxia and tachypnea due to developing progression in lung metastasis. Arterial blood gas values on admission were as follows; pH: 7.32, sO_2: 53, PO_2: 34 mmHg, PCO_2:45 mmHg, and HCO_3:22 mEq/L, indicating a respiratory acidosis. O2 was initially administered at a flow rate of 2 L/minute by mask and then was increased to a flow rate of 4 L/min by nasal cannula due to inability to achieve an adequate arterial O_2 saturation in control blood analysis. On the 2nd day of oxygen initiation, patient's general status along with hypoxia in arterial blood samples were improved, however, patient still required a continuous O_2 therapy at a flow rate of 2 L/minute which could maintain the patient's arterial O_2 saturation within normal limits. Single agent gemcitabine at a dose of 1000 mg/m^2 (on days 1 and 8, every 3-week cycle) was initiated for the systemic control. A few days after the initiation of the first cure of chemotherapy, an interesting and uncommon case of 1st to 2nd degree of burn on patient's face occurred. On physical examination, patient was having difficulty breathing, and there was a 1st to 2nd degree of burn on patients' face, particularly in the nasolabial regions and nose wings as well as in hair and eyelashes. According to the explanation of the patient's relatives; when they had stretched out their hand over the patient's nose to correct the position of the nasal cannula, they had heard a "clicking" sound, and then had seen flames suddenly, resulting in a fire on patient's face (Fig. 1). They initially had tried to put out the fire by covering patient's face with their hands, however, their hands and shirts had also been burned. Finally, they had been able to put out the fire by covering patient's face with a towel for about 15-20 second. They also noted that there was no flammable object in the room, such as smoke and other sources of ignition.

Figure 1. Facial burn injury due to static electric induced fire.

Hospital technical service checked the oxygen system in the patient's room, and could not find a problem with the gas system. Moreover, they verified that the gas in nasal cannula was pure O_2 by analyzing the gas samples taken from the O_2 system in patient's room. Besides, hospital physics engineers wrote a report concluding that the fire was more likely to be ignited by SE.

Patient was treated with topical antibiotic creams and epithelisant pomade and burn wounds were completely improved within 2 weeks.

Discussion

In general, combustion reactions occur when a chemical compound reacts with oxygen.[6] Following parameters are needed for combustion reaction; oxygen, combustible substances, and a specific ignition temperature.[4] Static electricity is known to be able to cause a possible fire, particularly in case of using the oxygen as a medical application. Thus, the commity of American Society of Anesthesiologists, has strengthened the existing warning regarding the risk of SE-related injury.[7]

One of the most important issue that makes such combustion reactions easier is the presence of flammable substances on body area where the static electrical discharge occurs. In our case, shortly before the incident, patient and her relatives had been wearing cotton clothing, and patient had applied local Vaseline-like cream on her face. Several methods can be practically performed in order to prevent these kinds of incidents. For instance, removing or preventing an accumulation of static charge appears to be as easy as opening a window. Moreover, increasing the moisture content of the air by using a humidifier, making the atmosphere more conductive, or using an air ionizer can help prevent the static charge.[7] Additionally, other simple and practical approaches to prevent SE charge include not wearing nylon and wool clothes during hospital stay, not applying organic-based creams on body area such as face and neck, and if possible, using an antistatic agent such as fabric softeners and dryer sheets to prevent and remove static cling.[8] Of note, although there is generally an illustrated warning on the drug box of combustible medical creams or pomades which indicate that these products

may easily cause a fire by any source of flame, an additional warning regarding the SE should also be placed on the drug boxes, reminding that they may also be easily ignited by SE.[9–11]

In conclusion, it is a major fact that such a rare but life-threatening condition is not generally taken into account by physicians and patients. Therefore, the country's health authorities, practitioners, and other allied health personnel should behave more sensitive on this issue and should inform the patients and their relatives regarding this problem before initiating oxygen therapy.

Disclosures

Informed Consent: Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

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