Burnt by His Cellphone During a Parachute Jump

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BACKGROUND: Many current cell phone (mobile phone, smartphone) batteries are lithium-ion. These batteries can overheat and catch fire under certain conditions. If it happens during a flight or air activity, this might compromise aviation safety. We report a case of a man whose phone caught fire during a parachute jump.

CASE REPORT: The individual, a member of Police Special Forces, is required to regularly perform parachute jumps. During the incident flight, the man had a cell phone in a pocket that ignited during the jump. He was able to land and then extract the phone with burns requiring acute medical care and later a skin graft.

DISCUSSION: This is a cautionary tale of lithium-ion batteries in flight. Many other situations could also occur with these batteries. There is little medical documentation of the risk of fire with lithium-ion batteries causing injuries during flight operations. To reduce the risk of fire, the devices should be powered down and phones should not be worn directly touching the skin. Damaged devices are more prone to overheating.

KEYWORDS: aerospace, battery fire, lithium-ion battery, skin burn injury, phone, smartphone.

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Lithium-ion batteries from a cell phone can be dangerous and ignite under certain circumstances. However, very little research is available regarding the consequences and dangers such as skin burns that may be caused by cell phone batteries.[5] The fire hazards and chemical dangers of lithium-ion batteries remain unexplored.[2] In July 2019, a mobile power bank with a lithium battery (portable charger) belonging to a Virgin Atlantic passenger caught fire in a seat on a flight from New York to London. The crew managed to put the fire out quickly and the pilot diverted to Boston's Logan International Airport, where all 217 passengers were safely evacuated from the plane.[8,9]

An overheated cell in a battery can ignite and cause a rapid conduction fire that can quickly reach intense temperatures of up to 900°C.[9] A battery in a phone consists of lithium-ion cells. The cells are connected in a series and separated by insulation sheets that provide insulation between the cells and the aluminum casing. Although the material used to construct the lithium-ion battery contains nonflammable materials, the electrolytes are flammable and the coating on the anode and cathode contains chemically reactive components.[2] For different reasons, the cells can be damaged, causing the electrodes to short-circuit and overheat. This increase in temperature can cause a chemical reaction between the highly flammable electrolytes and electrodes, leading to a thermal runaway.[2,7] This paper discusses a case of a 41-yr-old man whose phone caught fire during a parachute jump.

CASE REPORT

A 41-yr-old paratrooper policeman made a 8202-ft (2500-m) routing parachute jump. As soon as he jumped, his Crosscal® Trekker-X4 (Langevin, France) mobile phone was engulfed in flames. The phone was in the right pocket of his flame-retardant combat pants (NFM Group®, Ski, Norway). During the free fall phase, he tried to remove the phone from his pocket with his right hand, but the phone was too hot and embedded in his pants. This caused a burn on his fingers. He made many 360°

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Fig. 1. Initial burn on the day of the accident.

Fig. 2. Burn the day of the accident.

turns and opened his parachute tardily at the lowest altitude, attempting to reduce the time under canopy; in other words, to land as fast as possible. This jump was over an unrecognized area. After landing, he managed to get out of his trousers with the phone embedded in them. He was in contact with the burning phone for 3–4 min. Fortunately, he had insulated pants, which limited the contact from the flames to his skin. However, this did not protect the patient from the intense heat, which burned his skin. A military nurse who was present at the parachute club performed an advanced emergency protocol.[6] He cooled down the wound with a sterile hydrogel and gave the patient inhaled painkillers (Methoxyflurane). The nurse then took the patient to a military doctor near the parachute club. The total body surface area burned was estimated to be at 2%, with second- and third-degree burns (**Fig. 1**) on his thigh and second-degree burns on two fingers (index and thumb). The blisters were excised, the skin burn was washed with sterile water and cleaned with mild soap, and then covered with a large thickness of silver sulfadiazine cream and a bandage. The same bandage was redone every day for 1 wk, with water cleaning and silver sulfadiazine cream. The patient did not have any pain. The patient was seen by a burn specialist 7 d after the accident. Third-degree burns were confirmed on 1% of the skin with 1% second-degree burns (**Fig. 2**). After this consultation, the bandage consisted of dermal betadine with Vaseline-impregnated oil dressing. A skin graft was scheduled for the third-degree burn on his right thigh.

The patient's skin graft was performed 3 wk after the accident (**Fig. 3** and **Fig. 4**). The plastic surgeon removed buttock skin and transplanted it onto the wound on the thigh. The skin graft was a success. The wound care consisted of the nurse washing the area with sterile water and mild soap for a duration of 3 wk. The wound was covered by a fatty tulle grass bandage. The wounds healed very well and the patient was authorized for physical activity in his sports and returned to work 60 d after the accident. He had no complaints of any pain or disability.

DISCUSSION

As a special forces police officer, this patient was well experienced in parachute jumping with more than 500 jumps, as they conduct drills for high jumps with oxygen. A special forces police officer is trained to be strong and a pain-resistant person. He is prepared to react to unusual situations under stress. This phone accident with an inexperienced skydiver could have been tragic, as the person might not have opened his parachute, he may have lost consciousness because of the pain, or not steered his parachute correctly with a risk of bad landing (i.e., in a tree, in a lake, etc.). Critical structures of the parachute could have also caught fire (such as the harness, line, or canopy). While the patient was focused on getting out his phone, he neglected to look at the altitude or at the other skydivers.

The flame-retardant combat pants worn by the patient limited the burning process. They are made of 93% meta-Aramid, 5% para-aramid, and 2% antistatic. These combat clothes are designed to protect an individual for 4 s, which is the average time to escape an intense fire in a building or a vehicle. Even though the patient experienced a faster than average parachute flight, the burning phone was on him for more than 4 s; it was on him between 3 to 4 min. When the patient landed on the ground the burns were quickly cooled by the nurse, which limited their damage. The ambient air temperature was 25°C on the ground and 16°C at 8202 ft (2500 m); however, this was likely not the cause of the fire.

Care of a lithium-ion battery skin burn is similar to the care for thermal burns. The objective is to achieve healing as quickly as possible. If the healing process takes longer than desired, eventual complications may arise. Skin grafting can be an integral part of the management for certain burns. Thin skin grafts accelerate and improve healing. Total skin grafts treat the skin sequelae and show less scarring. Thin skin grafts are necessary in case of deep burns, or after a directed healing phase in case of intermediate burns.[1] After a directed healing phase of 21 d, this

Fig. 3. Skin graft 3 wk after the accident.

Fig. 4. Skin graft 3 wk after the accident.

patient had a thin skin autograft. His skin healed without burn scar contracture 3 mo after the accident.

The main reasons that a lithium battery catches fire are structural defects, technical defects, or improper use such as mechanical damage caused by dropping, damage to the protective casing caused by a pointed object, bending, thermal strain by external heating, overloading, or exposure to excessive temperature.[4] The contact with a metal-like key can also act as a conductor and initiate thermal runaway, with the destruction of the battery.[5,7] In this case, we did not find the cause of the explosion of the lithium battery. It was probably a short circuit from a structural or technical defect. Indeed, the patient did not handle the battery, he did not use the wrong charger, charge the battery too long, or drop his phone. We cannot explain why the phone ignited once the patient exited the plane and was in the air. It may have been caused by an increase in the pressure and oxygen during the free fall, which are two compounds that are favorable components for a combustion.

In this case, we could not have prevented this accident. To reduce the risk of lithium battery fire, it is recommended not to charge the phone to more than 99% (avoiding charging it all night) to limit overheating, not expose the battery to collision or fall, humidity, and heat sources, and to use the right phone charger. By using a fireproof phone or computer case composed of three layers of fiberglass, which can resist heats up to 1000°C, one can highly improve the chances of preventing a fire occurring in a plane or during parachute jumps.[3]

When a lithium-ion battery catches fire, it is best to not touch it and just let it burn. If it is necessary to put out the fire (in a house, in a plane, etc.), the best approach is to use an aerosol extinguishing system to cool the battery and avoid thermal runaway.

Military medics and doctors perform parachute jumps with lithium-ion battery devices such as a vital signs monitor, ultrasound machine, and syringe-pump. For flight safety, it is necessary to have an aeronautical certification or dedicated packaging for these devices. In conclusion, lithium-ion battery burns are rare but can be dangerous, especially in aeronautical activities.

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