Case reports on the lurking danger of mobile phone battery explosion

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Abstract
Eye injuries are commonly known to be as a result of road traffic accidents or physical assault but there is an emerging concern of injuries caused by phone battery explosion. With the common everyday use of mobile phones by Kenyans, it is important to highlight the potential risks of phone battery explosion. The explosion results in serious eye injuries from physical, thermal, and chemical injuries. We present three patients with eye injuries due to mobile phone battery explosion seen at the Kenyatta National hospital in Nairobi Kenya between July 2019 and August 2024. The patients had severe eye injuries. Their management included both surgical and medical treatment. The visual outcomes of the injured eyes ranged from moderate to severe visual impairment. The findings of this study show the profound impact of these types of injury on vision. It is recommended by the authors of this article that there is need to educate the public on the risks and preventive measures.

Key words: Mobile phone, battery, explosion, eye injury, case report

Introduction

Any eye doctor on call will tell you that the most frequent reason for emergency department visits related to the eye, is injury. The International Classification of External Causes of Injuries (ICECI) Coordination and Maintenance Group defines injury as a (suspected) bodily lesion resulting from acute overexposure to energy (mechanical, thermal, electrical, chemical, or radiant) interacting with the body in amounts or at rates that exceed the threshold of physiological tolerance (1). Eye injuries can be a significant cause of visual impairment. They involve damage the globe, eye tissues surrounding it, and the bony orbit as well.

Traditionally, eye injuries have been associated with accidents, incidences of physical assault and sports. However, ocular injury resulting from mobile phone battery explosions is an emerging cause which is gaining attention. Mobile phones have become an integral part of our daily lives. Their use is seen in all parts of the world, with billions of users in the globe across all demographics. However, there is a safety concern regarding these devices, particularly regarding phone battery explosions. The rising incidence of phone battery explosion necessitated public health focus on awareness and prevention.

Mechanism of phone battery related - ocular injuries

Eye injuries resulting from mobile phone battery explosion can range from mild injuries such as skin burns, and corneal abrasions to more severe vision threatening injuries such as ruptured globe. They can also lead to long term co-morbidities associated with severe visual impairment such as corneal scaring, glaucoma and even permanent disfigurement.

The mechanism of injury in mobile phone battery explosions is multifaceted. Most mobile phones are powered by lithium ion batteries. These types of batteries are most preferred due to their ability to hold large amounts of power relative to their size and weight. Unfortunately, several things can go wrong and cause these batteries to overheat. Overheating leads to thermal runaway. This is a phenomenon whereby the unregulated increase in temperature causes a rapid release of energy, that manifests as an explosion or battery fire (2). In addition, the use of mobile phone simultaneously while charging has been found to induce a greater load on the processor, which in turn leads to excessive heating of the device and eventually battery blast.

Because of the nature of lithium ion batteries, resulting injuries from their explosions can be complex. They can simultaneously cause mechanical, thermal and chemical

injuries. Mechanical parts from the phone can cause blunt force trauma or penetrating eye injuries with the possibility of leaving behind foreign bodies inside the eye. The heat or even in some instances fire resulting from their explosion typically lead to burns on the hand and face. These burns can be superficial on the skin, but may also be more severe ocular surface burns. The lithium component in these batteries can induce chemical alkali injury in the form of skin burns and corneal surface burns. Gases produced in these events can also contribute to chemical eye injuries.

When using a mobile phone for common activities such as making phone call, writing text messages or watching videos, it is normal to hold the device in close proximity to the face. It is natural to interact with mobile phones in this way. This close proximity to the face significantly increases the risk of sustaining eye injuries in the unfortunate event a battery explosion occurs. Slow reaction time is another factor that puts the eyes at a higher risk for injury in these incidences. When a phone is very close to the face, there's little time to react in the event a battery explosion occurs. The explosion would happen so quickly that there would be no opportunity to turn away or protect the eyes, leaving them completely exposed to the blast's effects.

Epidemiology

The reported incidence and prevalence of phone battery explosions, though relatively low compared to other causes of ocular trauma, is rising with the increasing use of smartphones globally. There is a growing number of cases reported each year. When it comes to the demographics, there is a study that showed that these injuries predominantly affected children and younger individuals, who are more likely to use smartphones frequently and may be less cautious about the potential risks (3). In addition, there is a socio-economic disparity in the incidence of such injuries, with lower-income populations being more vulnerable due to the prevalence of cheaper, less-regulated mobile phone devices

Materials and methods

We report the findings and management of 3 patients seen at the Kenyatta National and Teaching Hospital with mobile phone battery explosion between 2019 and 2024.

Clinical findings

Patient 1

Here we report the case of a 17-year-old male who sustained eye injuries resulting from battery phone explosion on the 18th of February 2024. He reported to have been using his mobile phone while it was charging. There was a marked rise in temperature from the device. Subsequently it exploded leading to injuries involving the face and both eyes. He presented to an eye hospital shortly after the he sustained the injury. Upon arrival, quick examination was done, and both his eyes were flushed with 3 liters of normal saline. Presenting visual acuity was perception of light for the right eye. Examination findings for the right eye are as seen in *figure 1*. Presenting visual acuity for the left eye was 6/18 as a result of grade 1 chemical/ thermal injury. He was started on treatment while awaiting debridement in theater. Medications started were Ciprofloxacin eye drops, Prednisolone eye drops, Cyclopentolate, artificial tears, oral vitamin C and oral doxycycline. The corneal epithelium was later noted to have sloughed off on its own while awaiting the debridement procedure and it was not necessary to perform debridement. Remnant conjunctival foreign body was removed on the slit lamp. A bandage contact lens was placed on the right eye and medications continued. Patient was discharged 2 days later. He was seen on follow up at the outpatient clinic 2 weeks later on the 26th February 2024. Vision was noted to be 6/24 for the right eye and 6/9 in the left eye as a result of corneal scarring.

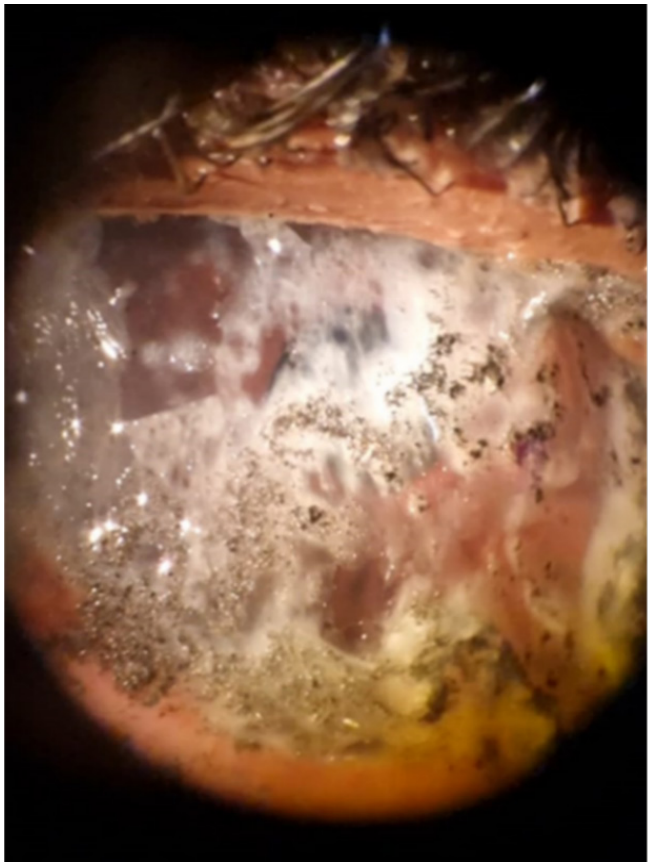

Figure 1: Slit lamp photograph of patient 1 (© Shannize Kenduiwa)

The photo shows right eye burns involving the lashes. The corneal is hazy with foreign bodies on the corneal surface. The corneal epithelium sloughing off.

Patient 2

The 2nd case is that of a student who sustained severe eye injury in July 2019. Prior to this he had no known ocular conditions. His mobile phone battery exploded after catching fire from a candle he was using while studying during a power outage. He sustained extensive left eye injury that was mechanical, chemical and thermal in nature. He was taken to theater where left eye lid laceration repair, and corneal scleral laceration repair was done.

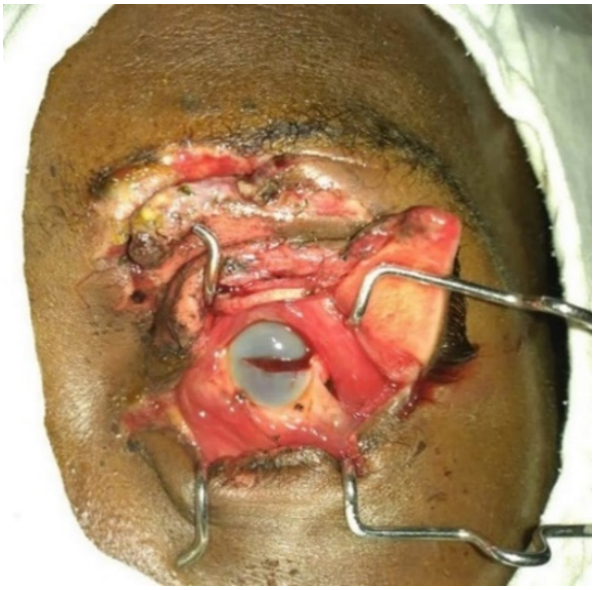

Figure 2: Intraoperative photograph of patient 2 (© Dr. Victor Omondi)

Figure 2 is a photograph showing a severely injured left eye. The photo shows thermal burns sustained on the eyebrows with extensive upper eye lid lacerations involving the eyelids. There is conjunctival injection and there is limbal ischemia involving about half of the inferior cornel diameter from 3 to 8 o'clock. The cornea is deeply hazy with a horizontal laceration involving more than half of the corneal diameter and extending to the sclera. There is a total hyphaema.

Patient 3

Patient 3 is a 15-year-old male who presented to the casualty department on the 26th August 2024 after sustaining trauma to the right eye. He had no history of prior ocular conditions. A phone battery that was buried in a heap of garbage that had been set on fire exploded and cause an open globe injury to his right eye. He was admitted and taken to theater for emergency right eye examination under anaesthesia and corneoscleral laceration repair. He was discharged a few days later on topical steroid and antibiotic eye drops. He was seen on follow up at the outpatient clinic on the 23rd of September 2024. The resultant visual outcome was light perception.

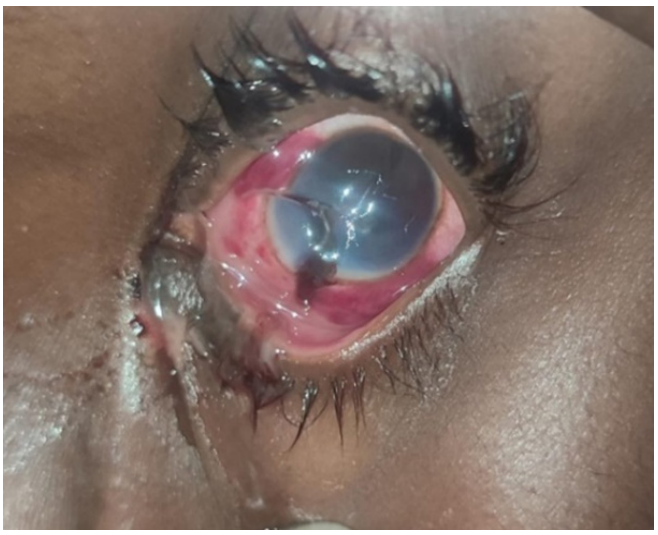

Figure 3 Photograph of the left eye patient 3 (© Mary Aduk)

Photograph of an injured left eye showing lower and medial lid skin burns, there is superonasal and inferotemporal subconjunctival hemorrhage. The corneal is hazy with limbal ischemia from 5 to 9 o'clock. There is a curved corneal scleral laceration nasally and a total hyphaema.

Discussion

Visual outcomes from available case reports on these types of eye injuries have been seen to be mostly poor (3)(4)(5). This is because the nature and combined mechanisms of injury lead to severe injuries as seen in the with the 3 patients in this study.

The long-term morbidity that individuals with these eye injuries experience are significant. They will require long-term follow up with eye care specialists and possibly even more complex and expensive surgeries to manage the after effects of the injuries. Visual rehabilitation and even psychological support to help these individuals cope with partial or total visual loss is an essential aspect that should not be overlooked. (6)

Cumulatively, the financial implication is great, not only to the individual and their families, but also to the health system.

Recommendations

This article aims to raise awareness on the risks associated with mobile phone usage, particularly regarding mobile phone battery explosions.

It is important to employ safe practices, such as avoiding phone use while charging and recognizing signs of overheating. Using the appropriate charger provided by the manufacturer is also important in preventing similar incidents. Proper battery disposal practices should also be adopted. Companies such as Safaricom offer an e-waste recycling program where customers can deposit electronic waste, not limited to phone batteries to any of their retail centers or offices, of for proper disposal and recycling. (7)

Ethical considerations

Informed consent was taken before the photos to be taken. The names of the patients remained anonymous, and their faces were concealed.

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