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Case Report

Prolonged Button Battery Exposure Leading to Severe Ocular Injury without Heavy Metal Poisoning

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Keywords

Button battery · Ocular exposure · Heavy metal

Abstract

Introduction: Prolonged exposure to a complete button battery can cause severe tissue necrosis in the eye and permanent impairment of visual function. The main mechanism of injury is the current generated by the hydrolysis of tissue fluid at the negative electrode and the production of hydroxide ions. ***Case Presentation:*** A 3-year-old girl went to the local hospital because of swelling and pain in her right eye of 12-h duration. The local doctor performed an orbital CT (computed tomography) scan and found a foreign body between the right eyelid and the eyeball. The foreign body was removed immediately under general anesthesia. In addition, it was found that the foreign body was a button battery, but it prolonged 39 h from the onset of the child's symptoms. The child underwent a second operation in our hospital and received amniotic membrane transplantation combined with conjunctival flap coverage. Topical corticosteroid and antibiotic eye ointment were continued for 3 months after surgery. Local pigmentation was seen, there was no symblepharon, but the cornea was still opaque and the visual acuity was only FC (finger count). In this particular case, heavy metal testing conducted on the child's blood fortunately revealed that the levels were within the normal range. ***Conclusion:*** Early

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detection and urgent removal of button battery are crucial in order to minimize exposure time. We should also be concerned about heavy metals in the blood. Children should be kept away from button batteries as much as possible to avoid such injury.

Introduction

Tissue damage from button battery exposure is common in the digestive tract, nasal cavity, and ears [1]. In the digestive tract, esophagus burns and esophagus stenosis will occur, and the electrolyte released will corrode the esophagus and cause esophagus perforation, gastric perforation [2]. In the nasal cavity, it will cause nasal stenosis, mucosal ulceration of the nasal septum, cartilage necrosis, and even perforation of the nasal septum [3]. In the ear, it can cause narrowing of the ear canal, perforation of the tympanic membrane, hearing loss, otochondritis, and facial paralysis [4]. There have been several case reports of button battery damage to the eye [5–7], which can cause loss of vision, pigmentation, and symblepharon. Here, we present a case of severe ocular injury after exposure to a button battery. The CARE checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see https://doi.org/10.1159/000536469).

Case Presentation

A 3-year-old girl was presented to the local hospital with a 12-h history of ocular swelling and pain in her right eye. She lived with her grandmother, a farmer. The local doctor found a large number of yellow-brown granular foreign bodies in the conjunctival sac, conjunctival hyperemia, and edema. The doctor rinsed the conjunctival sac, but no other foreign bodies were found. On admission, an orbital CT scan revealed a metallic foreign body between the right eyelid and the eyeball (shown in Fig. 1). Simultaneously, the symptoms worsened and yellow-brown foam appeared in the conjunctival sac. The foreign body was immediately removed under general anesthesia. During surgery, a button battery was found in the superonasal fornix, the local tissue was burned and necrotic, and the superonasal cornea showed flaky yellow-brown degeneration, which was considered to be caused by a burn (shown in Fig. 2). The necrotic fascia and conjunctiva were removed after removal of the button battery. It had been 39 h since the onset of symptoms in the child. As in other cases, the child could not clearly express where the button battery came from and how it entered the eye.

After the operation, the child was transferred to our department for further treatment. As the child did not cooperate with the examination, we performed a second surgery under general anesthesia to further understand whether the child had scleral dissolution and to prevent the occurrence of symblepharon. During surgery, the conjunctiva and fascia of superonasal fornix were absent, the sclera was exposed, and there was no necrosis (shown in Fig. 3). We further removed the remaining necrotic tissue, then transplanted the amniotic membrane, and transferred the adjacent conjunctiva to cover it. Due to our surgery, the patient was exempted from daily separate the bulbar and tarsal conjunctiva treatment for the first week postoperatively.

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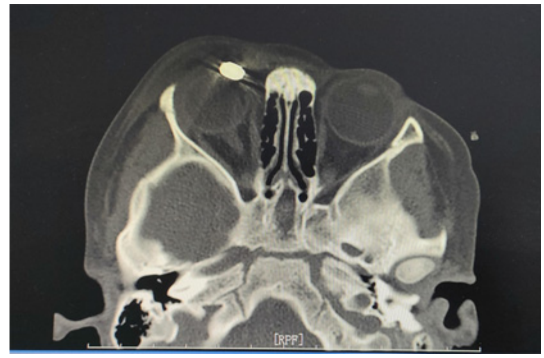

Fig. 1. Orbital CT shows a metallic foreign body between the eyeball and the eyelid.

We have learned that button batteries may contain heavy metals. Previous literature has reported that button battery ingestion can cause mercury or lithium poisoning in the digestive tract [8]. To our knowledge, there have been no reports of heavy metal poisoning due to ocular exposure to button batteries. In this case, because the eye was exposed to a button battery for a long time, we tested for the heavy metal concentrations in the blood. The results showed that the blood mercury concentration was less than 1 μg/L, and the blood metallic lithium concentration was 0.00961 mmol/L, which did not reach the toxic level (>1.3 mmol/L [9]). We also tested for manganese and silver and found them to be within the normal range. The child had no symptoms of heavy metal poisoning.

The girl was then given steroid eye drops 4 times daily and steroid eye ointment twice daily and gradually tapered over 3 months. After 3 months, her vision was severely impaired only the FC, and the cornea was opaque and had foci of flaky burn degeneration. Fortunately, there was only conjunctival pigmentation in the superonasal fornix and no symblepharon. The parents are satisfied with our treatment, even though the patient's vision cannot be restored.

Discussion

Button batteries are present in many toys and electronic products and pose a threat to children due to their small size and smooth surface. It is generally believed that there are three mechanisms that cause tissue necrosis: (1) leakage of alkaline electrolyte; (2) generation of an electric current that hydrolyzes tissue fluid and produces hydroxide ions at the negative electrode of the battery; and (3) compression damage to adjacent tissues. The main mechanism of injury is the current generated by the hydrolysis of tissue fluid at the negative electrode of the battery and the production of hydroxide ions. Therefore, the tissue in contact with the negative electrode of the battery is the most serious site of injury. It can be seen that the negative electrode has rusted (shown in Fig. 4) and the child's bulbar conjunctiva was severely necrotic and the cornea had a burning lesion (shown in Fig. 2), indicating that the negative electrode was facing the eyeball. A second exploratory surgery was performed to avoid scleral necrosis and symblepharon. As it had been a long time since the button battery had been removed, there were severe eye damage and permanent visual impairment. Early detection and emergency removal of foreign bodies are therefore crucial.

Given the precedent of heavy metal poisoning from button battery exposure in the digestive tract, although the site of exposure in this case is not the digestive tract, the exposure

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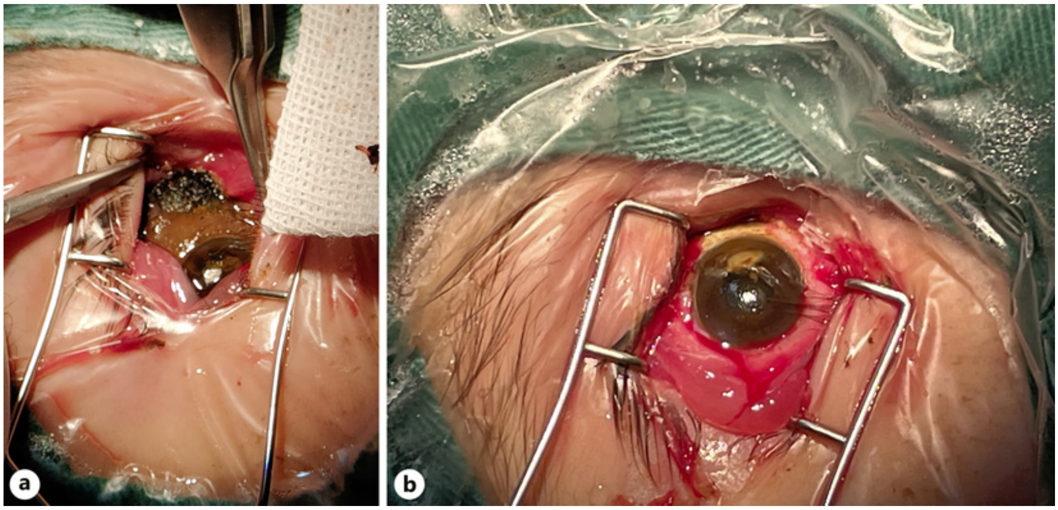

Fig. 2. Images from the first surgery. **a** Severe necrosis of the local tissue after removal of the button battery. **b** Removal of the necrotic conjunctiva and fascia and a brown lesion on the cornea, which is considered to be burn degeneration.

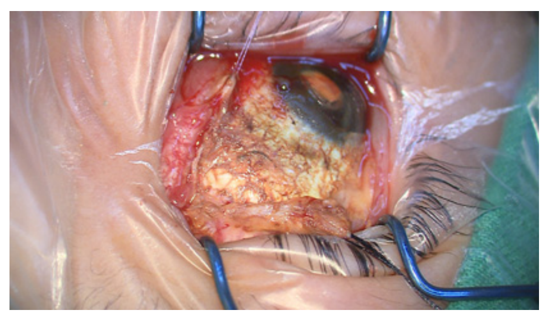

Fig. 3. Images from the second surgery. The conjunctiva and fascia superonasal fornix were found to be absent and the sclera was exposed.

time is approximately 39 h. To our knowledge, this is the longest exposure time currently reported in ocular cases. Furthermore, in the published cases of ocular exposure to button batteries, there are no reports of the presence of heavy metals. To avoid heavy metal poisoning in the child, we tested for heavy metals. We found that the blood mercury concentration was less than 1 μg/L and the lithium concentration was 0.00961 mmol/L, which did not reach the toxic concentration (>1.3 mmol/L). We also tested for manganese and silver, which were within the normal range. We considered that although the child's eye was exposed for a long time, it would not absorb as many heavy metals as the digestive tract. In addition, regular LR41 button batteries may have low levels of heavy metal and pose no risk to the human body. However, if the button battery is a counterfeit product, the heavy metal content may not be effectively controlled, which would pose a threat to children. Therefore, we insisted on testing for heavy metals and fortunately did not encounter the situation we were concerned about.

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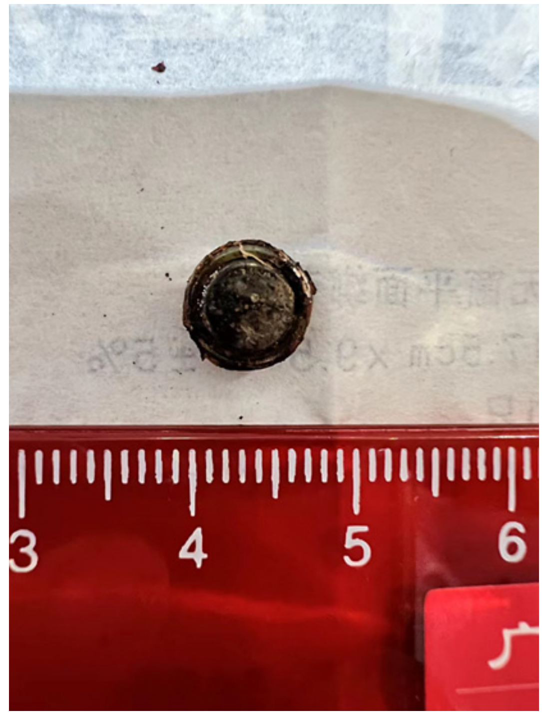

Fig. 4. The negative electrode of the button battery was rusted.

Conclusion

Prolonged exposure to a complete button battery can cause severe tissue necrosis in the eye and permanent damage to visual function. It should be removed urgently to reduce exposure time. We should also pay attention to whether there is heavy metal poisoning. Try to keep children away from button batteries to avoid such injury.

Acknowledgments

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Statement of Ethics

The study was reviewed by the Ethics Committee of the People's Hospital of Guangxi Zhuang Autonomous Region, and this retrospective review of patient data did not require ethical approval in accordance with local/national guidelines. Written informed consent was obtained from the parent of the patient for the publication of the details of their medical case and any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

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Author Contributions

Lifei Chen reviewed medical record, wrote original draft of case report, and revised intellectual content. Hui Huang, Jiuming Zhang, Qianqian Lan, Qi Chen, Min Li, and Fan Xu contributed to the treatment of this case such as making treatment recommendations, postoperative observation, and follow-up treatment. Haiyan Gan was the doctor who performed the first operation. Fen Tang provided valuable advice on the writing and revision of the manuscript. Haibin Zhong was the operator of the second operation, contributed to the postoperative observation and follow-up treatment and critically revised the manuscript and intellectual content.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its online supplementary material. Further inquiries can be directed to the corresponding author.

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