CASE REPORT

Ingested Button Battery Retrieved by a Modified Magnet Endoscope

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Ingestion of button battery (BB) by toddlers has been seen with increasing frequency over the past decade. Significant morbidity may develop if the ingested BB cannot be removed in time. Herein, we describe 2 infants whose ingested BBs were smoothly and successfully retrieved, from a stenotic esophagus and stomach, by the use of a self-made modified magnet endoscope. [*J Chin Med Assoc* 2007;70(3):132–135]

Key Words: esophageal stenosis, ingested button battery, magnet endoscope

Introduction

Management of ingested button battery (BB) varies depending on its anatomic location and the potential risk of corrosive leakage which may cause severe tissue injury and subsequent perforation. There is agreement that if the BB is constantly lodged in the esophagus, immediate removal is necessary.[1,2] A dilemma still exists in the management of ingested BB distal to the esophagus, i.e. whether or not to aggressively retrieve,[3] adopt a wait-and-watch policy with repeated radiographs,[4,5] or even perform a laparotomy in refractory situations.[1] However, prompt retrieval with a less invasive technique, if possible, can be valuable for both the patient and physician's comfort.

With proper endoscopic technique, direct visualization of the mucosal condition of the esophageal and gastric lumens and concomitant prompt retrieval of the erroneously ingested BB may still be justified.[4,6] In the following 2 infants, an effective, safe and rapid technique of a modified magnet endoscope (MME) was used to successfully retrieve the BBs, which were lodged due to anatomic causes of a stenotic esophagus and outlet of the stomach, without any complications. Herein, we report this technical procedure because it seems convenient and useful.

Case Reports

Case 1

A 1-year-old boy, 10 kg, was brought to our pediatric emergency room because of poor feeding with persistent vomiting for 2 days. He was an extremely premature infant with birth weight of 830 g and gestational age of 26 weeks. Chest radiograph showed a BB, supposedly lying in the lower portion of the esophagus. After the accuracy of the diagnosis was confirmed by flexible endoscope (FE) via the nasal route, an FE method to retrieve the ingested BB was arranged.

In our pediatric endoscope room, we did an *in vitro* test with a similar type of BB and several available but small (for infant use) retrieval devices including basket, alligator jaws, tripod forceps, rat tooth forceps and magnet head tube. All the devices, except the magnet head, were incapable of securely capturing the BB, mainly due to the slippery surface of the BB. A magnet head tube (Cook Co., Bloomfield, IL, USA) of outer diameter (OD) 12F and length 80 cm, the only available size at the time, could effectively attract and securely hold the BB once it came closer to the BB, to within a range of 1.5 cm. Then, we made an MME; the magnet head tube was placed alongside the shaft of an FE (Olympus ENF typeP4, OD 3.5 mm), with the

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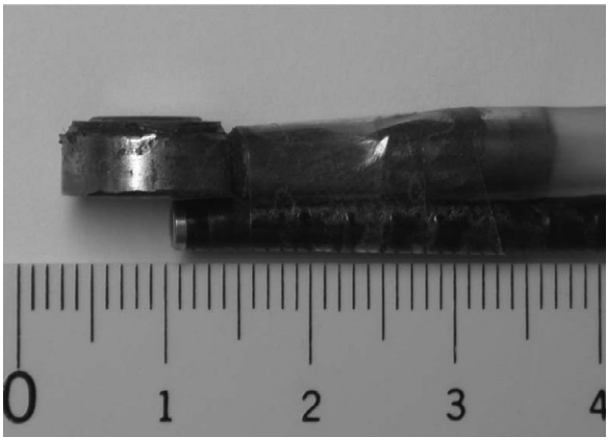

Figure 1. A close up view of the modified magnet endoscope. A magnet tube is banded alongside a flexible endoscope with its head 0.5 cm down from the head of the endoscope. A button battery, with an eroded surface, is attracted by the magnetic head and sits in the gap between the heads of the scope and magnet tube.

magnet tip about 0.5 cm behind the scope head in order to avoid the flexion portion. Both heads were completely wrapped together with a piece of thin adhesive tape. The caught BB could strongly fix between the gap of the 2 heads (Figure 1). Then, the distal portion of the magnet tube was also similarly taped alongside the FE shaft, about 30 cm, for easy handling.

The patient was placed in a supine position and intravenous sedation with ketamine 0.2 mg/kg and midazolam 0.3 mg/kg was administered. Topical anesthesia with 2% lidocaine was applied around his oropharynx. The MME was gently passed, via the hole of a bite-block, into his throat. Under scopic view control, the MME was advanced into the esophageal lumen. In the lower 3rd of the esophagus, the BB came into view and it was located in the posterior dependent portion proximal to a narrowed ring. The ring seemed to be fixed and fibrotic; it measured about 22 cm from the mouth, and the dimension was estimated by MME to be 8 mm in diameter and 5 mm in length. This was obviously too narrow for the BB to pass through. As the MME head preceded towards the BB, the scope vision was suddenly partially blocked, indicating that the BB had been caught by the magnet head. Then the MME was withdrawn gradually until it was totally out of the mouth. During the MME procedure, a simultaneous check of the whole esophagus lumen mucosa revealed only mild erosion proximal to the stenotic ring. Total time of the MME retrieval procedure was about 3 minutes. The surface of the retrieved BB was intact, and its size was 12 mm in diameter and 5 mm in thickness. The boy was started on a light diet and was discharged the next day. The cause of the esophageal stenosis remained undiagnosed after series studies including pH probe and computed tomography scan, but the stenosis was successfully dilated by balloon technique 1 month later.

Case 2

A 9-month-old male infant, 8 kg, was referred to our hospital for a known BB in his abdomen, which had been misingested 5 days previously. The patient's parents stated that it was a new alkaline BB of about 12 mm in diameter and 6 mm in thickness. The infant had presented with irritability in recent days. All 3 follow-up abdominal radiographs that had subsequently been taken in the 4 days revealed a round radio-opaque object in the stomach area. The parents were very anxious and concerned about the associated complications. Therefore, the infant was admitted for a check and, if possible, prompt retrieval.

After fasting for 6 hours, the infant was restrained in the supine position with intravenous sedation and topical anesthesia (same dosage as in case 1) in his nasal tract and pharynx. Initially an FE was nasally introduced, through the esophagus, to the stomach to search for the BB and to simultaneously check the whole stomach. The ingested BB was confirmed to be located in the dependent portion of the stomach body. In the stomach, there was significant mucosa erosion and edema over the pylorus region that might be the cause preventing the BB from passing through. Initially, several attempts at endoscopic retrieval (5 mm OD, with an inner channel) with different instruments (forceps, grasping claws, baskets) all failed because of the limited space and the slippery surface of the BB.

Then, the MME was introduced through the mouth, via the hole of a bite-block, and gradually advanced into the stomach under direct scope vision without difficulty. In the stomach, we manipulated the MME head with aid of turning the patient's position, to search for the BB. After the BB came into view, the MME was manipulated to approach and attempt to attract it. Capture of the BB was demonstrated by the scope vision becoming partially blocked (by the caught BB). Then, the MME was gradually withdrawn via the oral cavity without difficulty and removed, along with the bite-block, out of the mouth. The entire time for this removal procedure took less than 4 minutes.

Closer examination of the BB with the naked eye showed that its case was already corroded, with diffused sloughs around the crimped edge, but there was no visible leakage of its contents. The infant tolerated the procedure well and was discharged home with no medication after recovery from sedation, and the parents

were relieved from anxiety. One month after discharge, the patient continued to be symptom-free.

Discussion

In the above 2 cases with asymptomatic histories, both esophageal and stomach lesions were accidental findings, and were probably the main causes of blockage of the spontaneous passage of the ingested BB. In case 1, the esophageal stenosis might already have existed, it may have been iatrogenic or caused by manipulations,[7,8] such as a series of prolonged feeding catheterizations during the premature infant's complicated postnatal course.[9] In case 2, the pyloric edema might already have existed or developed later under stimulation by the corroding BB.

There is general agreement that if the BB has moved beyond the esophagus, then just close observation is needed,[10,11] and intervention should be considered only when the patient is symptomatic or in a high-risk situation.[5,12,13] Others advocated prompt intervention when the BB diameter is over 15 mm, when the patient is under 6 years of age, or when the BB has remained in the stomach for over 48 hours.[3] Obviously, the longer the BB remains in the stomach, the more likely it will undergo disassembly and damage mucosa.[14] However, an aggressive and safe removal of the erroneously ingested BB from the esophagus or stomach can prevent the need for prolonged and periodic observations, parental anxiety, multiple radiographs, unpredictable lodgment (Meckel's diverticulum or stenosis), and subsequent surgical intervention when indicated.

A variety of methods can be used to remove an ingested BB under fluoroscopic guidance, including net, forceps, magnets, Foley catheter, or a combination of these techniques. Faigel et al[15] reported that the Roth net is the best device for retrieving BB from stomach in an *in vivo* study of adult pigs. For safety, during FE manipulation in the stomach, both the target object and the retrieval device should be under direct visualization. However, the FE (Olympus EVIS GIF-100, OD 9 mm) and the conventional retrieval instruments they used are too big for operating in small children or infants. In addition, we had done an *in vitro* study to capture the BB with other small retrieval devices, but all failed. Volle et al[16] and McDermot et al[17] described the removal of BB from the esophagus and stomach in children by the use of an orogastric magnet tube under fluoroscopic control. They found that the technique was simple, effective, well tolerated and could avoid the need for general anesthesia and surgery. However, there is a radiation risk, potential inability to withdraw the BB past the cricopharyngus[18] and the need to use a Foley catheter to further extract the BB into the oropharynx. Ito et al[19] have reported their experience of difficulties in grabbing and holding the BB, which they cited as a cause of failure. In addition, a BB in the oropharynx not carefully secured may be swallowed into the esophagus again or even aspirated into the trachea, causing more hazards.[20,21]

The risk of MME should be weighed against the risk of the ingested BB and the anxiety of both parents and physicians. Successful BB retrieval may depend on the experience level of the endoscopist and the device chosen. In the presence of a skilled infantile endoscopist and good patient sedation, an effective MME retrieval may be justified. In our opinion, there are several advantages to this technique: (1) it can offer direct visual guidance, minimize mucosa trauma and provide an examination through the approach body lumen; (2) capture of the BB is evident by its consistently blocking a part of the scope vision during manipulation; (3) the attracted BB is lodged in the gap between the 2 heads, which can, or at least partially, protect it from dislodgment when moving through anatomic narrowings such as at the esophagogastric or cricopharyngeal regions; (4) this procedure can be carried out anywhere where the MME is available; and (5) there is no radiation exposure. The only disadvantage may be the large breadth of the MME, which may injure the mucosa during manipulation. However, this can be eliminated by choosing a smaller magnet tube (or only a magnet head is enough) with a more powerful magnet and skillful endoscopy performance.

With the increased use of miniature electronic devices, the incidence of accidental BB ingestion is rising,[22,23] and physicians are increasingly likely to be faced with a BB as an ingested foreign body. Therefore, we highly recommend that the endoscopy room be equipped with a powerful, small and lightweight magnet device that can be used to make a MME for the rapid and safe retrieval of the threatening BB, as described in the above 2 cases.

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