Button Battery Ingestion: An Analysis of 25 Cases

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Background: Button batteries represent a distinct type of foreign body. Serious complications can be resulted, particularly when the battery is impacted in the esophagus. The potentially detrimental effects of button battery ingestion have often been overlooked in Taiwan. We surveyed patients following button battery ingestion to define the characteristics and outcomes of this population.

Methods: The records of 25 patients with button battery ingestion that had been reported to the Taipei Veterans General Hospital Poison Control Center from July 1988 through January 1998 were retrospectively reviewed.

Results: Button battery ingestion occurred most commonly in male children (N=20; 80%) and children under 3 years of age (N=19; 76%). Most children were asymptomatic (N=22; 88%). Two children suffered abdominal pain, and one suffered dyspnea and stridor. Reported complications included black stools (N=3) and tracheoesophageal fistula formation (N=1). Two children underwent endoscopic battery removal, and batteries passed the entire gastrointestinal tract in all other subjects. The interval between battery ingestion and passage when documented (N=16) was never more than 5 days.

Conclusion: Most ingested batteries passed through the gastrointestinal tract without any adverse effects. An initial roentgenogram should be obtained promptly to determine battery location and diameter, and the battery's chemical composition should be determined when possible. Esophageal impaction of the batteries requires emergency endoscopic or surgical removal. For patients without esophageal impaction, conservative intervention is recommended in the absence of symptoms and signs of injury.

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Key words: button battery, foreign body.

Foreign body ingestion is a commonly encountered problem in the pediatric emergency room. Button batteries represent a distinct type of foreign body, since serious complications can result when a battery is impeded during its transportation through the gastrointestinal (GI) tract, especially when impaction occurs within the esophagus.[1,2] Litovitz and Schmitz[1] reviewed 2320 cases of button battery ingestion and delineated the characteristics and outcomes of this particular group of patients. Based on the results of their National Button Battery Ingestion (NBBI) survey, they found an average of 24% yearly increase in reported cases between 1983 and 1990 in

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the United States.[1] Taiwan lacks such epidemiological information, and the potentially detrimental effects of button battery ingestion have often been overlooked. Accordingly, a survey of patients following button battery ingestion was undertaken to define the characteristics and outcomes of this population.

METHODS

The Taipei Veterans General Hospital Poison Control Center (TVGH-PCC) utilizes a 24-hour telephone hotline, which functions as one of the emergency consultation services and case registries for medical institutions in Taiwan. Upon being notified of a case of intoxication by a medical facility, TVGH-PCC staff collect the patient's basic demographic data as well as details of the incident leading to the exposure to the toxic substance, clinical symptoms and signs, and patient disposition. Via frequent follow-up telephone calls every 1 to 2 days for 3 to 6 times until a definite outcome was documented, the clinical course of each case is established. Patients who had ingested button batteries and had been reported to the TVGH-PCC from July 1988 through January 1998 were included in the study. The age, gender, and presenting symptoms of the patients, as well as the initial roentgenographic localization of the button batteries, the interval between battery ingestion and battery passage, and the patient's clinical course and complications were all collected and analyzed retrospectively. The type, size, composition, and discharge state of the button battery were not known for all patients.

RESULTS

Twenty-five patients were reported to have ingested button batteries (Table 1). Twenty (80%) patients were male, and the ages ranged from 8 months through 8 years, with an average of 2.6 ¡ 1.8 years (mean ¡ SD). The numbers of patients reported each year ranged from none to four, with no obvious increase in the incidence from year to year (Fig. 1). Most patients (N=22, 88%) were asymptomatic at initial presentation. Among the three symptomatic patients, two suffered abdominal pain and one suffered dyspnea with stridor. Roentgenographic

Table 1. Clinical Characteristics of 25 Patients Who Ingested Button Batteries

	N (%)
Age (years)	
0-1	4 (16)
1-2	8 (32)
2-3	7 (28)
3-4	1 (4)
4-5	4 (16)
>5	1 (4)
Roentgenographic localization	
Esophagus	1 (4)
Stomach	13 (52)
Small intestine	2 (8)
Not performed	9 (36)
Interval between ingestion and passage	
Endoscopic removal	2 (8)
2 days	5 (20)
3 days	7 (28)
4 days	3 (12)
5 days	1 (4)
Unknown	7 (28)
Outcome	
Uneventful	21 (84)
Black stools	3 (12)
Tracheoesophageal fistula	1 (4)

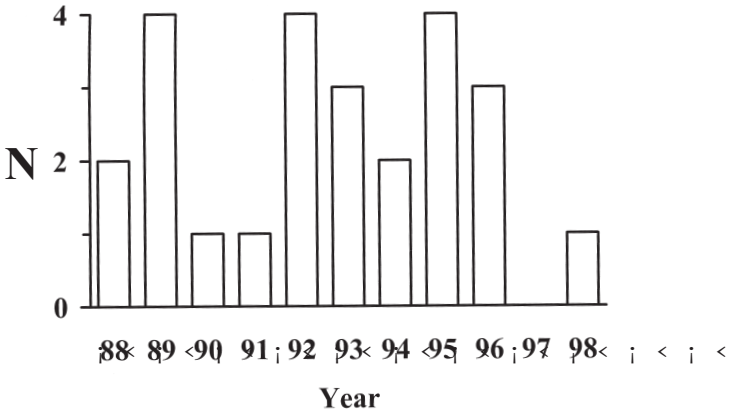

Fig. 1 The distribution of cases of button battery ingestion reported to the Taipei Veterans General Hospital Poison Control Center

localization was performed in 16 (64%) patients: 13 (52%) were located in the stomach, two (8%) in the small bowel, and one (4%) in the esophagus. Reported complications included black stools (N=3) and tracheoesophageal fistula formation (N=1). The black stool was present for less than 2 days. The batteries were endoscopically removed in two patients, and all the other batteries passed spontaneously in the remaining patients. The time between battery ingestion and passage among documented children (N=16) was never more than 5 days. The parents of seven patients, among whom five had ingestion roentgenographically proven and two had battery ingestion witnessed, did not notice the passage of the ingested batteries. The case complicated by the tracheoesophageal fistula was the patient with dyspnea and stridor. This 1-year-old boy ingested a 23-mm diameter button battery, which had lodged at the upper esophageal orifice. The battery was removed endoscopically the day after ingestion and the tracheoesophageal fistula closed spontaneously after 8 months of conservative treatment.

DISCUSSION

To our knowledge, this is the first survey of button battery ingestion in Taiwan. However, the case number was surprisingly small. All records of patients collected were of children aged 8 years or less, with 2-year-old children as the most commonly reported age group. Three (12%) children were symptomatic, one had esophageal impaction, and four (16%) had complications. Our results were comparable to the National Button Battery Ingestion (NBBI) survey,[1] in which 2320 cases of button battery ingestion were collected and reviewed. In the study conducted by Litovitz and Schmitz, children less than 5 years of age were the most frequently affected accounting for 61.8% of ingestion cases and the largest number in the 1- and 2-year-old age groups. Male patients predominated (58.7%). About one tenth of the patients were symptomatic, and a more diverse set of presentations was reported, with most symptoms related to the GI tract. The time taken for battery passage was up to 73 days. In their series, only 16 (0.69%) patients had esophageal impaction. Two patients had major complications, namely esophageal stricture, and both were in children with esophageal impaction.

Disc or button batteries are small, disc-shaped power units commonly used in digital watches, hearing aids, calculators, cameras, and other electronic instruments. These batteries contain various heavy metals, including mercury, zinc, silver, nickel, cadmium, manganese, or lithium, and a concentrated alkaline electrolyte solution of 26% to 45% potassium or sodium hydroxide.[3,4] Complications from button battery ingestion can result from a combination of four mechanisms: (1) alkaline electrolyte leakage from the battery, (2) 'de novo' alkali production from external current, (3) pressure necrosis, and (4) metal toxicity.[3-11] The corrosive contents of these batteries and the potential for metal poisoning are concerns often cited as a reason to institute aggressive therapy, that is, endoscopic or surgical battery retrieval in such patients. Based on their findings in the NBBI survey, Litovitz and Schmitz,[1] advocated a noninvasive approach for most cases of button battery ingestion where an esophageal position was excluded, unless the patient showed signs or symptoms indicative of GI tract injury or a large diameter cell failed to negotiate the pylorus. Some authors have recommended endoscopic or surgical removal when there is roentgenographic evidence of a badly corroding battery,[12] however, this remains controversial.

In contrast to this, batteries lodged in the esophagus should be removed immediately. Complications of esophageal button battery impaction have included tracheoesophageal fistula formation, esophageal burns with or without perforation, and aortoesophageal fistula formation.[11] Burns have occurred in as little as 4 hours after ingestion, and perforation within as short a timeframe as 6 hours.[2] All reported cases have been associated with symptoms of irritability, pain, dysphagia, vomiting, or refusal to eat. Nevertheless, neither battery diameter nor symptoms have identified all patients with esophageal battery impaction.[1] A roentgeno-gram should be obtained promptly at presentation to determine the battery's location. In the NBBI series, at least 13.4% of patients who ingested batteries did not undergo diagnostic roentgenographic localization. In our series, only 64% (N=16) of patients had roentgenograms. Some authors have proposed various methods of blind retrieval of batteries from the

esophagus.[13,14] However, these methods did not allow direct inspection of the esophagus to determine the extent of injury and the presence of perforations.[1] Most batteries that lodged in the esophagus and caused esophageal injury were of large diameter (20 to 23 mm),[1] with only a few exceptions in infants. Following electronic miniaturization with smaller button batteries becoming more popular, the risk of esophageal impaction should reduce in time. Conversely, there is a growing number of cases in which batteries have been found lodged in the nose or ears.[12] Button batteries in the ear canal and nasal cavity also require immediate removal, as they may cause perforation of the nasal septum, tympanic membrane perforation or destruction, necrosis of the dermis of the external ear canal, facial nerve paralysis, or chondritis.[12]

When treating a patient that has ingested a button battery, the first step is to assess and maintain a patent airway and adequate ventilation when aspiration with subsequent tracheobronchial obstruction has occurred. Induction of emesis risks aspiration and esophageal or gastric perforation, is ineffective in removing batteries from the stomach, and should therefore be avoided.[12] Activated charcoal is also ineffective in managing alkali and metal poisoning and may mask hematochezia. H2 receptor antagonists and antacids have been used empirically for batteries lodged in the esophagus, stomach, and duodenum, and laxatives have been used to speed passage through the small and large bowels.[15] However, Rivera nad Maves[16] found no benefit from local administration of a neutralizing agent on esophageal burns. However, antacids containing aluminum or magnesium hydroxide were effective in reducing crimp dissolution in a simulated gastric environment (0.1 N HCL).[17] When the battery has passed beyond the esophagus, the patient should be observed for the presence of persistent vomiting, tarry or bloody stools, abdominal guarding or tenderness, poor appetite, fever, dyspnea, or any signs of toxicity. Hospitalization is seldom required when the patient is asymptomatic, and discontinuation of oral intake is not necessary for patients in whom the batteries have already passed through the esophagus, as it may delay gastric transit times. Repeat x-rays are indicated only when battery passage has not been confirmed within 4 to 7 days, and more frequent x-rays may be needed in patients less than 6 years of age who ingest batteries larger than 15 mm in diameter.[18] When mercury poisoning is suggested, especially in patients where the batteries split in the gastrointestinal tract or radiopaque droplets are evident in the gut, determination of blood and urine mercury levels may be helpful in determining the severity of poisoning and the need for chelation therapy. In the NBBI series, no clinical evidence of mercury toxicity occurred, although one patient demonstrated minimal elevation of blood mercury levels.[1]

Various treatment modalities have been advocated for the closure of acquired tracheoesophageal fistula, but spontaneous closure may occur without surgical intervention.[16,19,20] Senthikumaran et al.[16] noted that when the esophagus was given total rest and the peri-esophagitis settled quickly, there was a fair chance that the fistula may heal spontaneously. Samad et al.[11] recommended that a nonsurgical approach should be adopted initially after button battery removal, even when esophageal perforation was noted. On the other hand, Litovitz[2] reported five cases in which the batteries were lodged in the esophagus. Two of the patients died, one from an aortoesophageal fistula, and the other from a massive tracheoesophageal fistula and subsequent exsanguinations.

One patient developed a tracheoesophageal fistula and was successfully resuscitated from a cardiac arrest. Patients who develop tracheoesophageal fistula carry a high risk of morbidity and mortality. The choice of surgical intervention depends on not only whether the fistula will heal spontaneously, but also whether the patient risks serious complications such as aspiration pneumonia or hemorrhage.

The present retrospective analysis has two shortcomings. One is that it failed to document battery diameter and chemical composition. It is likely that the importance of the information was not appreciated. None of the patients in the present series had blood or urine mercury levels checked. As per the recommendation by Litovitz and Schmitz[1], an attempt should be made to identify both the battery's diameter and its chemical composition. When the battery's diameter is greater than 15 mm, the chance of esophageal impaction increases. Lithium batteries may be more harmful than other types of batteries, whereas zinc-air batteries in the esophagus may be

more benign.[3] The battery's diameter and composition can be established by looking at the imprint code of a duplicate battery, by measuring the battery compartment within the product, or by checking product or battery instructions and packaging. The other failure of this study was the small size of the series. The failure to demonstrated an increased incidence of button battery ingestion may have been because failure to utilize the TVGH-PCC emergency consultation hotline service by the medical facility or because patients did not present for medical attention due to the asymptomatic nature of button battery ingestion in most cases.

In summary, we found that most patients who ingested button batteries had benign courses. We also found that the potentially detrimental effects of button battery ingestion were often overlooked in Taiwan. Accordingly, the salient points in the management of patients with button battery ingestion included: 1) early roentgenographic localization of the battery, 2) identification of the diameter and composition of the battery, 3) endoscopic removal of the batteries lodged in the esophagus, and 4) expectant supportive treatment in patients with batteries passing the esophagus. For patients with esophageal perforation or tracheoesophageal fistula, conservative treatment should be attempted first with extreme caution and close monitoring. Warning labels should be applied to batteries and electronic instruments along with treatment instructions. Battery manufacturers should be required to educate the public the potential hazard of button battery ingestion, and manufacturers of battery-powered products should be urged to provide more securely fastened, child-resistant battery compartments.

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吞食鈕扣電池：25病例分析

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背 景： 吞食鈕扣電池可能導致嚴重的併發症，特別是當鈕扣電池卡在食道時。然而此一情形常爲國人所忽略，因此我們收集吞食鈕扣電池的病例以分析此類病患的特性與結果。

方 法： 對台北榮民總醫院毒藥物諮詢中心從1988年7月至1999年1月的十年半期間所接獲的二十五例吞食鈕扣電池報告進行回溯性地分析。

結 果： 病患主要爲男性(80%)與小於3歲的孩童(76%)；大多數的病患(88%)並無症狀，僅2例表現腹痛，1例有呼吸困難併有哮鳴音；三例病患有解黑便的情形，1例併發氣管食道瘻管；兩名孩童以內視鏡移除電池；在16位經由腸胃道排出電池的病患，其從吞食到排出的時間均在5天之內。

結 論： 吞食鈕扣電池的病患大多數不會產生症狀及併發症，但遇此類病患仍應進行放射線檢查以確知鈕扣電池位置。當鈕扣電池卡在食道時，應緊急以內視鏡或手術移除，而鈕扣電池未卡在食道的病患若無症狀顯示消化道傷害時，則可觀察並靜待其從糞便排出。

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關鍵字：鈕扣電池，異物。

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