Foreign body ingestion is a common clinical problem among children aged 6 months to 6 years [1–3]. The majority of swallowed foreign bodies pass harmlessly and spontaneously through the gastrointestinal (GI) tract. Only when foreign bodies become lodged or are associated with toxicity must they be identified and removed [1–7]. Radiologic localization of these foreign bodies is mandatory [8,9]. With advances in endoscopic techniques, foreign bodies can be removed safely in younger children by endoscopy under general anesthesia [10,11]. We analyzed the type and location of foreign bodies and reported our experience retrieving them from children via endoscopy under general anesthesia.

**METHODS**

The records of all children who underwent endoscopic examination between December 2001 and May 2006 because of suspected foreign body ingestion were reviewed. The indications for endoscopic examination...
and removal of foreign objects in our hospital include: (1) GI symptoms with highly suspected foreign body ingestion; (2) asymptomatic patients with coins in the esophagus after 6 hours of observation; (3) sharp foreign bodies or long objects (>3–4 cm) or button batteries in the stomach; (4) coins in the stomach which fail to move distally after more than 7 days. Endoscopy was performed under general anesthesia in the operating room by a pediatric endoscopist. Demographic data, the site and nature of the foreign body, clinical presentation, radiologic findings and endoscopic management were recorded and tabulated in a database. Possible complications were monitored during the course of endoscopic removal.

RESULTS

Of the 87 children who underwent endoscopic examinations because of suspected foreign body ingestion, 74 patients had endoscopically proven foreign bodies (male to female ratio, 43 to 31). The median age was 4 years (Figure); 68% were younger than 5 years. A total of 71 patients had positive findings on routine radiographs. One patient had a plastic lollipop stick (length, 8 cm) lodged in the stomach which was not visible on abdominal radiograph. Two patients had chicken bones lodged in the upper esophagus which were not visible on chest radiographs. None of the patients had esophageal disease such as esophageal stenosis secondary to corrosive injury or esophageal atresia after surgery. One of the patients had cerebral palsy and was mentally retarded. The most common types of foreign bodies were coins (n=42, 56.8%; mean age, 3.86±2.34 years), followed by button batteries (n=16, 21.6%; mean age, 3.13±2.55 years) (Table 1).

Foreign body ingestion was either witnessed by a parent or was described by the patient in 66 cases (89%). All patients were brought to our emergency room within 12 hours of foreign body ingestion. Six patients (8%) returned to our emergency room because the object had not passed out spontaneously within 1 week. The mean duration from ingestion to presentation to the emergency department was 6.5 hours (range, 1–10 hours).

In patients with foreign bodies lodged in the esophagus, 84% (32/38) had symptoms including odynophagia, cough, drooling, irritable crying, nausea and vomiting. Two patients presented with chicken bones located about 10 and 12 cm from the oral bite. Coins lodged in the esophagus were mostly located in the upper third portion (upper/middle/lower = 26/5/7). The size of the ingested coins ranged from 20 mm to 26 mm; the locations and the sizes are shown in Table 2. One patient had two 26 mm coins in the upper middle esophagus. Only one patient presented with erosive esophagitis due to a coin lodged in the esophagus.

In patients with foreign bodies lodged in the stomach, 48% (16/33) had symptoms such as nausea, vomiting and abdominal pain. Fourteen patients had ingested button batteries and all of them were removed

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**Table 1. Location and type of foreign body in 74 children**

<table>
<thead>
<tr>
<th>Location</th>
<th>n (%)</th>
<th>Type of foreign body (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophagus</td>
<td>38 (51.4)</td>
<td>Coin (24), bone (2)</td>
</tr>
<tr>
<td>Upper</td>
<td>26</td>
<td>Coin</td>
</tr>
<tr>
<td>Middle</td>
<td>5</td>
<td>Coin</td>
</tr>
<tr>
<td>Lower</td>
<td>7</td>
<td>Coin</td>
</tr>
<tr>
<td>Stomach</td>
<td>33 (44.6)</td>
<td>Coin (6), button battery (14), sharp object (8), other (5)</td>
</tr>
<tr>
<td>Duodenum</td>
<td>3 (4.0)</td>
<td>Button battery (2), staple (1)</td>
</tr>
</tbody>
</table>

**Table 2. Locations of ingested coins versus coin size in 41 children**

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of $1 coins</th>
<th>Number of $5 coins</th>
<th>Number of $10 coins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper esophagus</td>
<td>12</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Middle esophagus</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lower esophagus</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Stomach</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*The diameter of a $1 coin is 20 mm, a $5 coin is 22 mm, and a $10 coin is 26 mm.*
within 10 hours of ingestion (mean, 4.4 hours; range, 3–10 hours). The mean diameter of the batteries was 12.1 ± 1.5 mm (range, 9.1–13 mm). Six patients swallowed coins ranging in size from 20 mm to 26 mm (Table 2). Five of the patients returned to hospital for endoscopic removal after a 7-day observation period, and one returned after a 9-day observation period. Sharp objects, including a key, thumbtack, staple, screw, endodontic instrument, diode, hairpin and skewer were found in eight patients. Blunt objects, including a gold ring, magnet, light bulb, ring-pull and key ring were found in five patients. Obvious gastric damage such as gastritis, erosion and ulcer was found via endoscopy in 10 patients (13.5%); the objects that had caused the damage were button batteries (n = 7), a thumbtack (n = 1), a hairpin (n = 1) and a staple (n = 1).

Foreign bodies were found in the duodenum in three patients. Plain radiograph of the abdomen revealed a button battery in the stomach in two of them. However, the batteries had moved into the duodenum after general anesthesia and could not be removed by endoscopy. They were eliminated spontaneously in stool the following day during hospitalization. Radiologic examination of the third patient (age, 6 months) showed a radio-opaque foreign body but its location could not be identified. A staple was found in the duodenum by endoscopy in this infant and the foreign object was successfully removed by forceps.

In this series, the success rate for endoscopic retrieval of foreign bodies was 97.3% (72/74). A total of 11 patients were hospitalized for further observation (range from 1 day to 4 days). There were no major complications such as esophageal or retropharyngeal abscess or GI perforation during the course of foreign body ingestion. Endoscopic retrieval of foreign bodies went smoothly in all patients.

**DISCUSSION**

Foreign body ingestion occurs mostly in children, especially in those younger than 5 years [1–11]. Rapid diagnosis and management are important to minimize morbidity and complications [8,9]. We successfully removed foreign bodies from 74 pediatric patients via endoscopy over a period of 6 years. This is the largest series of foreign body ingestion in children in Taiwan; 97% (72/74) were removed successfully via endoscopy. None of the children in our series presented with major complications.

Cheng and Tam reported that the most commonly ingested objects by children were coins (49%) and fish bones (29%) [2]. However, in our series, the most common foreign bodies were coins (49%) and button batteries (22%). The reason for the discrepancy may be the way in which the data were collected. We excluded fish bones from our study because they are easily removed by direct laryngoscopy by an otolaryngologist.

Foreign bodies in the esophagus should be removed within 24 hours because of the risks of erosion, perforation and fistula formation [10–17]. In this series, 95% of the foreign bodies in the esophagus were coins, and most were lodged in the upper esophageal sphincter (72%). The upper third esophageal area is the narrowest area, and when obstructed by a foreign body, vomiting, nausea, dysphagia and aspiration commonly result, and the foreign body is less likely to pass through spontaneously [14]. Eighty-eight percent of our patients had GI symptoms and all of them had coins lodged in the upper third of the esophagus.

In our study, four asymptomatic patients presented with coins in the esophagus. All were eventually removed by endoscopy because the coins had not passed spontaneously after 6 hours of observation. However, a randomized clinical trial published in 2005 found that 25–30% of asymptomatic esophageal coins will pass spontaneously without complications [18]. The authors recommended a period of observation of 8–16 hours before attempting an invasive procedure to remove them. Based on that report, we may change our observation period to 16 hours for asymptomatic patients with coins in the esophagus.

The success rate for removing the coins from the esophagus by endoscopy was 100%. Hamed et al reported that the success rate for removing coins from the esophagus by Foley catheter is 94% [19]. However, Foley catheter technique should be performed under fluoroscopy by an experienced radiologist. We suggest removing coins in the esophagus by endoscopy.

Esophageal foreign body is frequently associated with esophageal abnormalities such as atresia and persisting stenosis, as well as mental retardation and acute psychosis [14,15]. In our series, an 8-year-old mentally retarded boy with cerebral palsy accidentally swallowed a plastic lollipop stick. Although it lodged in the stomach, it was longer than 4 cm and could not be digested by gastric acid, so we decided...
to remove it by endoscopy. There were no patients with esophageal abnormalities; it may be because our sample size was small and our database limited.

Most foreign bodies in the stomach, especially coins, do not need to be extracted immediately because the majority of them will be eliminated spontaneously [4,5,9,10]. The transit time in the series of children observed by Hachimi-Idrissi et al was 3.8 days [5]. The recommended management strategy is to “wait and observe” for 1–2 weeks. However, this strategy should not be applied to long sharp objects (>3–4 cm) and batteries [1]; prokinetic agents or laxatives are recommended for children with such foreign bodies [5]. We performed endoscopic retrieval of coins from the stomach if they were not eliminated spontaneously within 7 days. The observation period can be as long as 2 weeks in asymptomatic patients with coins lodged in the stomach.

Sharp objects and batteries should be removed as soon as possible to prevent GI perforation, erosion or necrosis of the mucosa [3–6]. However, Eisen et al suggested that small batteries (<20 mm in diameter) that have passed beyond the esophagus need not be retrieved unless patients have GI tract symptoms and signs such as abdominal pain, abdominal distension or vomiting [7]. We performed endoscopic retrieval as soon as possible to avoid the risk of necrosis and corrosion of the mucosa caused by batteries.

Non-radio-opaque foreign bodies are difficult to detect on plain radiographs of the abdomen [20]. Animal bones are also not visible in every case because some of them are small. The sensitivity in detecting fish bone was only 26% in Cheng and Tam’s report [2]. In our series, three patients had ingested non-radio-opaque foreign bodies consisting of animal bones and a plastic stick. The plain radiographs of these patients revealed no specific findings and the diagnosis was made based on the description of the item by the patient. Contrast X-ray is recommended to detect non-radio-opaque foreign bodies lodged in the stomach because it is less invasive than endoscopy [1].

Major complications of foreign body ingestion are rare, but include sudden death from aspiration, esophageal fistula, retropharyngeal abscess and GI perforation [1,2,15,21–23] and batteries [1]; prokinetic agents and laxatives are recommended for children with such foreign bodies [5]. We performed endoscopic retrieval of coins from the stomach if they were not eliminated spontaneously within 7 days. The observation period can be as long as 2 weeks in asymptomatic patients with coins lodged in the stomach.

Non-radio-opaque foreign bodies are difficult to detect on plain radiographs of the abdomen [20]. Animal bones are also not visible in every case because some of them are small. The sensitivity in detecting fish bone was only 26% in Cheng and Tam’s report [2]. In our series, three patients had ingested non-radio-opaque foreign bodies consisting of animal bones and a plastic stick. The plain radiographs of these patients revealed no specific findings and the diagnosis was made based on the description of the item by the patient. Contrast X-ray is recommended to detect non-radio-opaque foreign bodies lodged in the stomach because it is less invasive than endoscopy [1].

Major complications of foreign body ingestion are rare, but include sudden death from aspiration, esophageal fistula, retropharyngeal abscess and GI perforation [1,2,15,21–23]. Minor complications include erosion or inflammatory change of GI mucosa. Most of these complications are caused by sharp objects and toxic or caustic substances. There were no major complications in our series; however, the minor complication rate was 15% (11/74). This could have been because all of our patients were brought to the emergency room within 12 hours and endoscopic removal was performed within 10 hours.

In conclusion, coins are the most common foreign bodies ingested by children. Diagnosis of a foreign body is based on eye-witness accounts, X-ray and endoscopic findings. Although negative radiologic findings cannot exclude foreign body ingestion, imaging study should be performed for any child who is suspected of having ingested a foreign body. Foreign bodies lodged in the esophagus, and sharp objects, long objects and batteries in the stomach should be removed as soon as possible. Endoscopic removal under general anesthesia is a safe and useful method for children.

REFERENCES


以內視鏡移除兒童誤食異物

林建亨¹ 陳安琪² 蔡政檨² 魏嵩慰²
薛凱中² 林維卿³
¹財團法人仁愛綜合醫院 兒科部
中國醫藥大學附設醫院 兒科部 ³放射線部

誤食異物如硬幣、魚骨頭、玩具的塑膠部位、電池等是兒科急診常見的主訴。雖然大多數誤食的異物會通過腸胃道，但仍有些兒童需非手術或手術的介入。我們在此報告一家醫學中心從 2001 年 12 月至 2006 年 5 月經回溯性病歷記載，共有 87 位病童因懷疑誤食異物而接受內視鏡檢查。其中有 74 位由內視鏡證實有異物。這些病童平均年齡為 3.4 歲 (從 6 個月至 13 歲)。異物最常卡在食道 (38 位，佔 51.4%)，其他則在胃 (33 位，佔 44.6%) 或十二指腸 (3 位，佔 4.0%)。異物的型態包括硬幣 (42 位，佔 56.8%)，鈕釦型電池 (16 位，佔 21.6%)，尖銳物 (9 位，佔 12.2%)，骨頭 (2 位，佔 2.7%)，其他 (5 位，佔 6.7%)。只有兩個異物 (鈕釦型電池) 位於十二指腸無法由內視鏡成功取出。它們滑入小腸並在隔天自動排出。在整個誤食異物及實施內視鏡取出的過程中沒有併發症。全部病童的結果都很順利，沒有罹病率及死亡率。由我們的經驗得知，經由全身麻醉施行內視鏡取出食道異物或胃部尖銳物、電池，對無法合作的兒童而言是個有效又安全的方法，可以避免異物造成的腸胃道損傷及破裂。

關鍵詞：內視鏡，誤食異物

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