Disk Battery Foreign Bodies In Children And Major Outcomes In The Southern Part Of South Nigeria

A Umana, M Offiong, R Mgbe, A Etiuma, A Adekanye, A Ewa, V Ette

Abstract

Consuming disk battery (DB) foreign bodies by children has increased in Southern Part of South Nigeria. This parallels the increasing use of electronic house hold and recreational devices particularly the remote control operated MP3 musical players in homes and cars in our region. In the period between 2009 and August 2011, six children age ranged 13 months to 3 years were diagnosed and managed for DB foreign bodies (3 nasal and 3 esophageal). There were major sequelae in 5 (83.3%) cases. These included: an esophageal-pleural fistulae/ hydropneumothorax, a tracheoesophageal fistulae and 3 nasal septal perforations. The batteries sizes were CR2025 lithium cells in the esophagus and 12 mm- LR44 Button cell in the nasal cavity. Whilst recent case reports of DB foreign bodies in the developed world show that ingestions usually are benign, the situation in our region, a rapidly developing economy, is that of major sequelae. There appears to be a general lack of awareness on the dangers of DB foreign bodies, therefore a tendency for delayed presentation to hospital, initial misdiagnosis and delayed referral for endoscopic removal. These are established but preventable risk factors for the development of major sequelae. The appearance of DB on plain chest radiograph is sincerely mistaken for a 50Kobo coin which hitherto was the commonest circular opaque foreign body in our region. Notable in our series is the association of major sequelae whenever the anode (-ve) surface of the DB was facing the nasal septum in the nostrils or the trachea or pleural cavity in the esophagus. This appears to be an added risk factor. DB foreign bodies will continue to present with major sequelae in our region unless urgent public awareness campaign on their dangers is undertaken.

INTRODUCTION

Disk batteries (DB) are small, coin-shaped batteries with expanding use in electronic household and recreational products such as remote control devices for MP3 Car stereos, toys, and etc.1-5 They have become a common foreign body ingested or put in the nose by children within the age range 1-6 years with a peak of 1-3.1

The incidence of ingestion has greatly increased from only 8 reported cases before 1983 to over 56,000 cases as at 2009.1,2 This increase parallels increasing use of electronic devices. The incidence in Sub-Saharan Africa is not known.

Literature reports that only 10% of patients who ingest disk batteries report symptoms while the others remain asymptomatic and are passed in their stool within 2-7 days.8 However, disk battery foreign bodies are very dangerous, and causes major sequelae especially when lodged in the aerodigestive tract. Established risk factors to lodgment and major sequelae include: the size, type, quality of the battery whether leak proof or not, the status of the battery whether new or spent and delayed endoscopic removal.

Factors responsible for delayed endoscopic removal may include unwitnessed ingestion or insertion, lack of awareness of the danger of DB hence delayed presentation to hospital, or misdiagnosis (including being mistaken for a coin).1,4 The mechanisms of disk battery injury include; direct corrosive action due to leakage, low voltage burns, toxic absorption of substances, and pressure necrosis.7,9 Most disk battery systems generate alkaline electrolytes of 26-45% potassium or sodium hydroxide at the anode (-ve pole). These solutions are strong enough to cause liquefaction necrosis of tissue.1

Esophageal complications are usually life-threatening, especially in children and may include tracheoesophageal fistulas, other esophageal perforations, and strictures requiring repeated dilations. Other reported complications include: vocal cord paralysis from recurrent laryngeal nerve damage, mediastinitis, pneumothorax, pneumoperitoneum,
tracheal stenosis, tracheomalacia, aspiration pneumonia, emphysema, lung abscess, and spondylodiscitis. 

Batteries localized beyond the esophagus rarely need to be retrieved unless the patient manifests signs or symptoms of GI injury (abdominal pain, tenderness) or a large-diameter battery fails to pass beyond the pylorus. Daily inspections of all stools or weekly radiographs are recommended to confirm battery passage.

Whilst recent reports of DB ingestion in the developed world show that DB ingestions usually are benign despite increasing incidence, this emerging condition in our region has been associated with major clinical outcome. The aim of our work was to review the cases seen in our centre and evaluate the possible risk factors that may be responsible for the major outcome and recommend measures to reduce the incidence of DB foreign bodies and major outcome.

MATERIALS AND METHOD

This was a retrospective review of the records of children treated for DB lodgments in the nose and aerodigestive tract at two Otalarynology Departments of the University of Calabar Teaching Hospital, Calabar and the University of Uyo Teaching Hospital, Uyo both in South-South Nigeria. The period under review was between 2009 and August 2011. The patients’ age, sex, duration of ingestion/insertion at presentation, type and size of battery, direction of anode (-ve) surface, endoscopic findings and sequelae were analyzed. Diagnosis of disk battery foreign body was based on clinical history, symptoms and imaging studies.

RESULTS

There were 6 cases of DB foreign bodies treated in the period under review. There were 3 males and 3 females. Their ages ranged from 13 months to 3 years. The duration of ingestion/insertion and lodgments ranged from about 72 hours to 7 weeks. The anode (-ve) surfaces of the DB were directed either to the posterior or the anterior or the left posteriolarateral esophageal walls. In the nose the anode (-ve) surfaces were directed to the septom in all 3 cases. Table - I

There were 3 (50%) 12mm LR44 Button cell and 3 (50%) CR2025 Lithium cells. The statuses of the batteries were loose in 4 (66.7%) cases while in two (33.3%) instances the patients removed the DB from source, the remote device of an MP3 Car Stereo. (Table – II)

Major complications occurred in 5 (83.3%) patients and a benign outcome in 1 (16.7%) patient. (Table – I) All the patients with DB in the nose (100%) had septal perforation. In the esophagus, one patient (33.3%) had a benign outcome while one each developed tracheoesophageal fistula (33.3%) and esophagopleural fistulae/hydropneumothorax (33.3%). (Figure 1)

Perforations failed to heal with conservative management in all (100%) of cases of septal perforation. Spontaneous healing of the esophagopleural fistula occurred after 3 weeks of conservative management. The tracheoesophageal fistula had a feeding gastrostomy to rest the esophagus but after 6 weeks of failed conservative management, the fistula was closed by surgical repair via external neck approach. No mortality was recorded.

Figure 1

Table I: Age, Sex, Duration and Site of lodgments, Anode direction and Sequelae of DB ingestion

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Sex</th>
<th>Site of Lodgments</th>
<th>Duration of ingestion</th>
<th>Direction of Anode (-ve)</th>
<th>Sequelae</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>f</td>
<td>Lt Nostril</td>
<td>3 weeks</td>
<td>Septum</td>
<td>Septal perforation</td>
</tr>
<tr>
<td>3</td>
<td>m</td>
<td>Lt Nostril</td>
<td>unknown</td>
<td>Septum</td>
<td>Septal perforation</td>
</tr>
<tr>
<td>2.5</td>
<td>m</td>
<td>Lt Nostril</td>
<td>5 days</td>
<td>Septum</td>
<td>Septal perforation</td>
</tr>
</tbody>
</table>

Table 11: Type, Size, Status and Source of DB

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>Status</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Button Cell - LR44</td>
<td>12mm</td>
<td>Loose</td>
<td>Unknown</td>
</tr>
<tr>
<td>Lithium - CR2025 3V</td>
<td>20mm</td>
<td>In source</td>
<td>MP3 remote Device</td>
</tr>
<tr>
<td>Button Cell - LR44</td>
<td>12mm</td>
<td>Loose</td>
<td>Unknown</td>
</tr>
<tr>
<td>Lithium - CR2025 3V</td>
<td>20mm</td>
<td>In source</td>
<td>MP3 remote Device</td>
</tr>
</tbody>
</table>

Figure 1: Plain radiograph of DB in the digestive tract.
**Figure 3**
Figure 1(a) AP view showing DB in esophagus

**Figure 4**
Figure 1(b) Lateral view showing DB in esophagus

**Figure 5**
Figure 1(c) DB in descending colon / Pneumothorax.

**Figure 6**
Figure 1(d) DB in descending colon / Hydropneumothorax
Early published case reports of ingestion of disk batteries were concerned with serious sequelae because of delayed endoscopic removal.\(^1\) Whilst recent case reports of DB ingestion in the developed world show that ingestions usually are benign, the situation in our region South-South Nigeria, a developing economy, is that of serious sequelae (esophageal pleural fistulae, hydropneumothorax, tracheoesophageal fistulae and nasal septal perforation).

The patients in our series were children aged 13 months - 3 years. This agrees with literature reports.\(^1\) There were equal males and females in our series but these numbers are too small to give a sex incidence in our region. The anatomical sites of lodgments were the esophagus and the anterior nasal cavity proper.

The Sources of batteries in our series were mostly loose battery in the home or directly removed from poor child tamper proof DB sources. Accessibility of DB to children is known to determine the incidence DB ingestion. It has been reported that more than one half of disk battery ingestions (53%) occur immediately following removal from a product. Another 41% involved batteries that are loose, either sitting out or discarded.\(^5\) A spent cell which no longer has enough power for the intended device may still maintain considerable residual voltage while new cells are 3.2 times more likely to be associated with clinically significant outcomes.\(^1\) Therefore, careless disposals of spent DB and non child tamper proof DB sources are important risk factors for DB Foreign bodies in our region.

There was delayed hospital presentation ranging from 3 days to 7 weeks in our series. This showed a lack of public awareness on the dangers of DB ingestion and lodgments hence the associated high morbidity in our region. This is not surprising because DB foreign body is an emerging condition and most cases in children are often not witnessed.

One case in our series had lodgments for significant durations with minor or no symptoms. Diagnosis was missed at initial hospital presentation by the referring physician. Therefore, awareness of the possibility of the condition and a high index of suspicion is needed for prompt diagnosis. The features of nasal foreign body lodged for days or weeks may include profuse, odorous, bloody unilateral rhinorrhoea accompanied by nasal obstruction.\(^10\) DB lodged in the esophagus typically present with irritability, food refusal, dysphagia and increased salivation. Coughing, difficulty in breathing or stridor may sometimes mimic lower airway involvement.\(^4\) Hence, in the presence of any of these symptoms or signs, DB foreign bodies should be considered a differential diagnosis. All suspected cases require plain
radiographs of the neck, chest and abdomen and a circular radio-opaque shadow with a peripheral double rim unlike a coin which has a single rim is typical.\textsuperscript{11}

In one patient the ingested DB was misdiagnosed as a coin after chest x-ray at a peripheral hospital. This prompted their anticipation that the foreign body will pass through the gastrointestinal tract without any sequelae. This is not surprising because, in the past, the 50Kobo coin was the commonest ingested circular foreign body in our region. The naira coins presently have extremely low purchasing power in Nigeria hence have become a rare foreign body in our children. However, in chest radiograph, DB looks similar to coins and could be easily mistaken for coins with dire consequences.\textsuperscript{11}

The ingested batteries sizes were 20-mm lithium cells in the esophagus and 12mm- lithium cell in the nasal cavity. These are established risks of lodgment which includes the relative size of the battery. Batteries less than 15mm in diameter almost never lodge in the esophagus. Sizes > 20mm in diameter are at risk of lodgment.\textsuperscript{3}

Tracheoesophageal fistulae, esophagopleural fistulae and pneumohydrothorax and septal perforation occurred in our series within 72 to 96hrs. This incidence of major sequelae is not suprising. Literature review shows that from 2000-2009, 92\% of disk batteries from fatal ingestions or those with major outcomes was 20-mm lithium cells.\textsuperscript{3, 5} Lithium cells generate more current hence associated with disproportionately more adverse effects.\textsuperscript{12, 13} Liquefaction necrosis or perforations that have been reported in literature within 2-6 hours of ingestion and lodgment.\textsuperscript{6, 14-16}

In the patient with esophagopleural fistulae and left pneumohydrothorax, the edges of the battery showed signs of fragmentation.-Figure: 1(b) This may be because lodgment was at the gastro esophageal junction and when a disk battery is in an acid environment, an electrochemical reaction occurs that leads to dissolution of the cathode, primarily in the crimp area. These may result in leakage of potassium or sodium hydroxide from the anode surface. These solutions are strong enough to cause liquefaction necrosis of tissue.\textsuperscript{3}

Notable in our series, is the association of serious sequelae independent of duration of lodgment whenever the anode (\textsuperscript{ve}) surface of the DB was adjacent to a soft tissue wall of a hollow anatomical structure, namely; the cartilaginous nasal septum, the tracheoesophageal walls and the esophagopleural walls. One patient with the anode surface of the DB inclined to the left lateral direction in the distal esophagus, developed esophagopleural fistulae and left hydropneumothorax within 96 hours of DB ingestion and lodgment. Another patient with the anode surface directed forwards in the cervical esophagus developed tracheoesophageal fistula within 72 hrs, while a 3\textsuperscript{rd} patient of same sex and age in which the anode surface was directed backward also in the cervical esophagus had a relatively benign outcome. In addition, 2 patients developed nasal septal perforation within one week with the anode surface directed to the nasal septum. This may be because all the DB in our series was lithium batteries, hence a tendency to the most severe tissue burns/liquefaction necrosis. Furthermore, mucosa contain proteins carry positive charges and when the mucosa is in constant contact with the negative charges of the anode surface, significant electrical reactions may occur causing tissue burns and liquefaction.

In conclusion, DB in the nose or esophagus in South-South Nigeria carries a high risk of major complications. The lack of awareness of DB as a dangerous foreign body, misdiagnosis and delayed referral for endoscopic removal appear to be the major risk factor to the development of major sequelae following DB ingestion in our region of Sub-Saharan Africa.

In the United State, the National Battery Ingestion Hotline created in 1982 has helped in reducing incidence of major outcomes.\textsuperscript{17} Therefore, there is urgent need for public awareness campaign on the dangers of ingested DB battery and delayed endoscopic removal. This will help to reduce incidence of this foreign bodies and prevent their major outcome in our region.

Furthermore, there is a need for an international prohibition of the manufacture and sale of non leak proof and poor secured sources of disk batteries.

References

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