

Disk Battery Ingestion And Tracheoesophageal Fistula – A Comparative Review Of Two Cases.

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Citation

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Abstract

The incidence of disk battery ingestion is increasing and parallels the increasing use of electronic devices.^{1,2} Children less than 6 years are mostly involved with a peak incidence in 1 to 3 year old.³ Most ingested disk battery pass harmlessly through the gastrointestinal tract⁴. Lodgments in the aerodigestive tract require immediate endoscopic removal to prevent or minimize major sequelae or fatality such as esophageal perforation, Tracheoesophageal Fistula (TEF) and aorta-esophageal fistula.^{3,5,6} TEF secondary to disk battery ingestion has been reported within 4-6hrs of ingestion and lodgment.^{4,7} We saw for the first time in our region, South-Eastern Nigeria, two babies aged 13 and 14 months with disk battery ingestion and lodgment in the esophagus of 6-7weeks and 48-72 hours duration respectively. They presented within 4 months between September, 2010 and January, 2011. The first baby was misdiagnosed and managed by the family physician and pediatrician for respiratory tract infection and later Asthma without significant improvement. The second baby was promptly and correctly diagnosed and appropriately managed. Both babies had endoscopic evaluation and removal of the Disk battery of similar type (Lithium) and size (20mm). Lodgment was in the lower cervical esophagus, 12-14 cm from the upper incisor tooth in both cases. Tracheoesophageal fistula was an accompanying major sequelae within 48-72 hour of lodgment in one baby while the other baby ran a relatively a benign course without esophageal perforation despite over 6 weeks of lodgment. The anode (-) surface of the disk battery was forward facing in the baby with TEF and backward-facing in the baby with the benign course. The forward-facing anode (-) surface of impacted disk battery seemed independent of duration of lodgment as a risk factor to the rapid development of tracheoesophageal fistula. This further highlights the need for a prompt endoscopic evaluation and removal of impacted disk battery in the esophagus. Nigeria is a rapidly developing economy with increasing use of electronic devices; therefore an aggressive awareness campaign is needed to prevent increasing incidence and morbidity that accompany late presentation to the hospital. A high index of suspicion is needed by family physicians and pediatrician to for early diagnosis and reduced complications and mortality of disk battery ingestion in children in Nigeria. The relevance of simple plain radiograph of the neck, chest and abdomen in a seeming comfortable and well child with suspicion of foreign body ingestion is emphasized.

INTRODUCTION

Disk Batteries (DB) are small coin shaped battery used in Electronic devices such as remote controls, calculators, hearing aids and watches. The increasing use of electronic devices has parallel the increasing incidence of Disk Battery ingestion from 6 reported cases before 1983^{1,2} to over 56,000 in one series from 1985 – 2009.³ Cases of impaction are increasing from 1% reported in 1990-1993 to 18% In 2008.³

They are frequently swallowed by children under the age of 6 years with a peak incidence in 1 to 3 year old.³ Literature documents a higher incidence in males.

DB is formed by compacting metals and metal oxides on either side of an electrolyte soaked separator.⁷ The unit is then placed in a 2 part metal casing held together by a plastic

grommet.⁸ The grommet electrically insulates the anode from the cathode. Most disk battery systems generate alkaline electrolytes of 26-45% potassium or sodium hydroxide at the anode. These solutions are strong enough to cause liquefaction necrosis of tissue⁴.

Most ingested disk battery pass harmlessly through the gastrointestinal tract⁴. Impactions in the Aerodigestive pathway carry major sequelae or fatality such as esophageal perforation, Tracheoesophageal Fistula (TEF) and aorta-esophageal fistula.^{3,5,6}

Known diameter of ingested disk battery vary in size from about 5.8 – over 20mm and in weight from 1-10g.⁸ Batteries less than 15mm in diameter almost never lodge in the esophagus⁹. Sizes > 20mm in diameter are at risk of

impaction.⁸

In the last decade, 92% of disk battery removed from fatal ingestions or major outcomes were 20mm lithium cells. Most were imprint code CR 2032 or CR 2025. CR represents the battery chemistry, 20 the diameter and 32 the thickness of the battery.⁸

The quality and size of the battery are important risk factors for sequelae or fatality such as tracheoesophageal fistula.^{2, 10, 11.}

TEF secondary to disk battery ingestion has been reported within 4-6hrs of ingestion and lodgment,^{4, 7} therefore; prompt endoscopic removal of large disk battery foreign body is advocated. Most complications require a more conservative to delayed surgical approach⁴ Long term follow-up after management is advocated because of reported cases of stricture or recurrence following healed fistulae.

We present the first 2 cases seen in our center to highlight a possible additional risk factor to the rapid development of tracheoesophageal fistula as a major sequelae within 48-72 hour of disk battery ingestion and lodgment in one of the patients and a benign course despite over 6 weeks lodgment in the other patient. Nigeria is a rapidly developing economy with increasing use of electronic devices Therefore, the incidence of DB ingestion, lodgment and complications in the esophagus will be on the rise in Nigeria.

We hope our article will encourage early presentation by parents, a high index of suspicion by family physicians and pediatricians for early diagnosis thereby ensuring prompt endoscopic evaluation, removal and follow up of the condition.

MATERIALS AND METHOD

We reviewed the records of 2 children admitted to the Otolaryngology (ORL) Department of the University of Calabar Teaching Hospital, Calabar - Nigeria with disk battery ingestion within 4 months, September, 2010 – January 2011. Diagnosis of disk battery ingestion was based on clinical history, symptoms and imaging studies. Radiological findings, endoscopic evaluation and management approach were compared.

RESULT

Two female patients aged 13 and 14 months were seen. There was eye witness report of suspected FB ingestion in one patient but absent in the other. Diagnosis was by clinical

history and symptoms, and confirmed by plain radiological examination of the neck, chest and abdomen.

The 13 month old baby presented in September, 2010 with a 6-7 week history of croupy cough and poor appetite. There was no eye witness account of foreign body ingestion. The diagnosis was missed by the Family Physician and Pediatrician. Child was being managed for respiratory tract infection and later asthma without significant improvement. There was no radiological investigation of the child until presentation to the ORL clinic. The 14 month old baby presented with a 2-day history of suspected foreign body ingestion and a 24 hour history of refusing food, in January 2011. The mother did not report to the hospital immediately since the child was not in apparent distress. With an increased index of suspicion by pediatrician following the case of the first child, diagnosis of foreign body ingestion in the second child on presentation to the children emergency room was prompt. In both patients, disk battery in the esophagus was confirmed by plain radiographs of the neck, chest and abdomen-Fig-1 a, 1b and 1c

Both babies had endoscopy evaluation and removal of foreign body without additional trauma to the esophagus. The type and size of the disk battery were the same, lithium-20mm. Fig-2 a, 2b The source of the batteries were remote controls of a car electronic musical device. Neither the manufacturers nor the manufacturing and expiring dates of the disk batteries could be determined.

In the 13months old baby, the anode (-) surface of the disk battery was directed backwards. There was significant granulations tissue formation on the posterior wall of the esophagus in response to mucosal injury and necrosis. In the 14month old baby, the anode (-) surface was forward facing with gross evidence of severe mucosal burns and necrosis on the anterior wall of the esophagus. Tracheoesophageal fistula was a complication. Fig-3a and 3b

Both children had nasogastric intubation under endoscopic guidance. The 13 month baby tolerated oral feeds after 5 days without signs of aspiration and so was discharged home on the 7th day post endoscopic removal of battery. Child is doing well after 4 months follow up.

The 14 month old baby had feeding gastrostomy after 3 weeks of nasogastric intubation to totally rest the esophagus. Light-Barium swallow imaging studies indicated aspiration from the lower cervical trachea. After 6 weeks, conservative management was stopped because of unrelenting aspiration

and cough on swallowing saliva. Surgical exploration and repair of tracheoesophageal fistula via an external cervical approach was done. The patient recovered without complication.

Figure 1

Figure 1a: DB in 13 month old child



Figure 2

Figure 1b: DB in 14 month old child

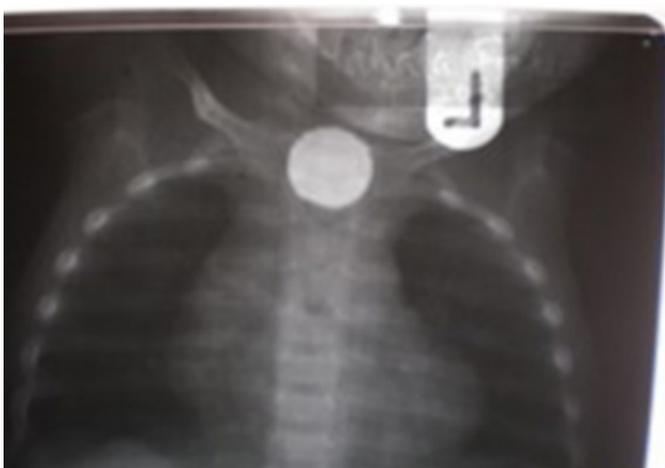


Figure 3

Figure 1c: DB in 14 month old child Lateral view



Figure 4

Figure 2a: anode (-) face of DB removed from 1a (left) and 1b (right)



Figure 5

Figure 2b: cathode (+) face of DB removed from 1a (left) and 1b (right)



Figure 6

Figure 3a: Tracheal perforation with endotracheal tube insitu

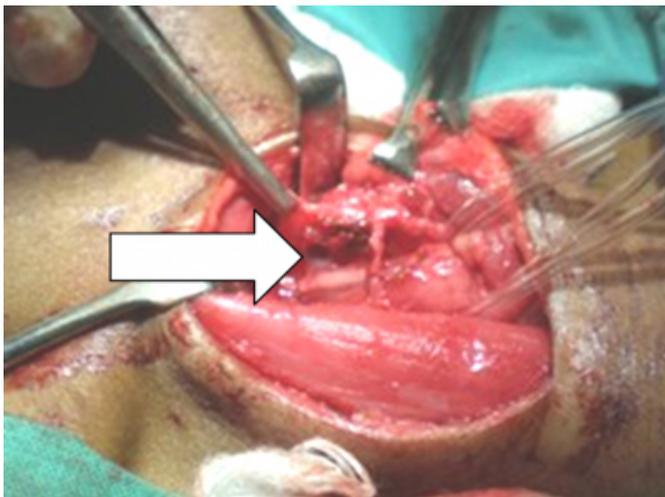


Figure 7

Figure 3b: Esophageal perforation with nasogastric tube insitu

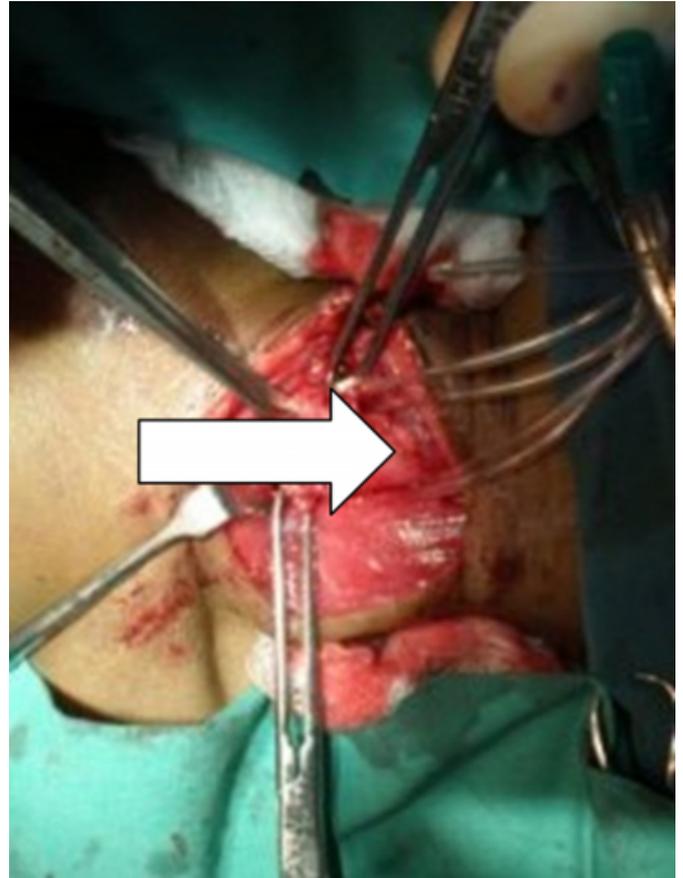


Figure 8

Figure-4a: Source of DB



Figure 9

Figure 4b: Insecure battery compartment



DISCUSSION

Disc battery ingestion, impactions and occasional sequelae in young children in the developed world is well documented in medical literature. Literature documents a higher incidence in males but both patients in our report were females. Our cases appear to be the first in our region, a rapidly developing world with a large market for electronic appliances. Therefore, the incidence of DB ingestion, lodgment and complications in the esophagus will be on the rise in Nigeria because increasing use of electronic devices parallels increasing incidence of Disk Battery ingestion.^{1,2,3,4}

The disk batteries removed in our patients were of 20mm diameter, a risk size for lodgments and injury in the oesophagus.⁷ There were no identification marks on the batteries and the leak-proof quality of both batteries was highly suspect but only one of our patients developed tracheoesophageal fistula.

Tracheoesophageal fistula as complications of disk battery lodgment is well reported with leakage of the alkaline electrolyte as an established risk factor. However, of note in our review is the severity of injury in relation to the anatomical direction of the anode (-) surface of the disk battery in allegory to the duration of lodgment. Severe mucosal and cartilage burns and necrosis with tracheoesophageal fistula occurred within 48-72 hours in the child with forward-facing anode (-) surface of the battery. In contrast, there was only significant granulation tissue reaction despite about 7 weeks of lodgment of disk battery of the same size but with backward facing anode (-) surface in the esophagus. Both children were females and of similar

ages, 13 and 14 months, therefore forward-facing anode (-) surface of the lodged disk battery may probably be the added risk factor to the rapid development of tracheoesophageal fistula. The 20mm lithium batteries have a higher capacitance and generate more current and produce more hydroxide more rapidly. Thus, the most severe tissue burns/liquefaction necrosis will occur adjacent to the anode.¹ Although, liquefaction necrosis or perforations have been reported within 4-6hrs of ingestion and DB lodgment⁴, the direction of the anode (-) surface of lodged batteries were not stated. Previous reporters may consider reviewing the anatomical direction of the disk battery in their series with regards to the extent of tissue damage in relation to the duration of lodgment.

Both batteries were from remote control devices whose battery compartments have an extremely poor child tamper proof measure (clip lock).Fig. - 4a, 4b

There is no consensus on the approach to the treatment of TEF. Our management approach was prompt endoscopic evaluation and removal of disk battery followed by a more conservative to delayed surgical repair rather than primary repair.^{4,12} Residual alkali can continue to cause tissue injury for day to weeks after endoscopic battery removal.¹ Therefore, primary repair of TEF when significant inflammation is still present can be associated with a high incidence of breakdown of repair, recurrent fistula, stricture, and substantial mortality rate. Several studies therefore recommend total rest of esophagus with nasogastric intubation and or gastrostomy intubation to allow for spontaneous healing of the TEF.¹³

The conservative to delayed surgical repair was not risk free. The child had aspiration, failure of resolution, and long hospital stay but recovered without recurrent fistula. These patients require long term follow up, therefore we are still following up the case with relatively mild esophageal injuries 4 months after endoscopic removal of disk battery was achieved.

Nigeria is a rapidly developing economy with increasing use of electronic devices. Therefore, there is need to prevent increasing incidence, encourage early presentation to the emergency room and reduce morbidity of disk battery ingestion in children.

Disk battery should be a very strong consideration whenever plain radiographs show a coin-like opacity in the Aerodigestive tract.

The relatively benign course despite 6-7 weeks lodgment in one case should not encourage delayed presentation to the hospital or appropriate referral.

Family physicians and Pediatrician need a high index of suspicion to prevent delayed diagnosis and referral for endoscopic evaluation, removal and follow up.

Appropriate legislation for improved child tamper proof sources of disk batteries in every country should be strictly enforced. The cover lid to battery compartment of electronic devices must be secured with screw and not clip locks for child safety. Manufacture of disk batteries that are not leak proof should be banned internationally.

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