Tracheoesophageal fistula as a complication after ingestion of a button battery. Case report and literature review

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Abstract

Ingestion of a (button) battery is an increasing phenomenon in paediatrics and can have detrimental effects. We present a 15-month-old girl who ingested a button battery, which was removed 8 hours after ingestion. A week after removal, the girl was readmitted and a tracheoesophageal fistula was discovered. She was treated surgically.

Accidental button battery ingestion requires prompt recognition and removal, because of the risk of severe complications, which can already occur after 2 hours of oesophageal impaction. There is no consensus on treating tracheoesophageal fistulas. To reduce morbidity and mortality, a multidisciplinary team approach and follow-up are crucial.

Introduction

Children and toddlers frequently put objects in their mouth and unintentionally swallow foreign bodies. Ingestion of batteries is increasing as a result of the growing popularity of electronic devices. They can cause serious damage by electrochemical injury when they lodge in the oesophagus. Quick action to remove the battery is necessary to avoid complications. Perforation by impaction in the oesophagus can already arise after 2 hours. Even after relatively fast removal, serious complications can still occur and therefore a good follow-up is needed.

Case report

We encountered a previously healthy 15-month-old girl who had ingested a 20mm button battery (figure 1), which was removed several hours after ingestion in a local centre. The day after removal, she developed fever and a chest X-ray showed a left-sided pneumonia infrahilar in the left lower lobe. A chest computed tomography (CT) revealed no pneumomediastinum. Antibiotic treatment (amoxicillin-clavulanic acid) was initiated, and she left the hospital after 3 days. A week after removal, the girl started to vomit and drool without having fever. She was readmitted and

Figure 1: Chest X-ray shows the step-off sign on the lateral view and bilaminar structure: double-density or double-ring/halo shadow on the posterior-anterior view. Size: 20mm.

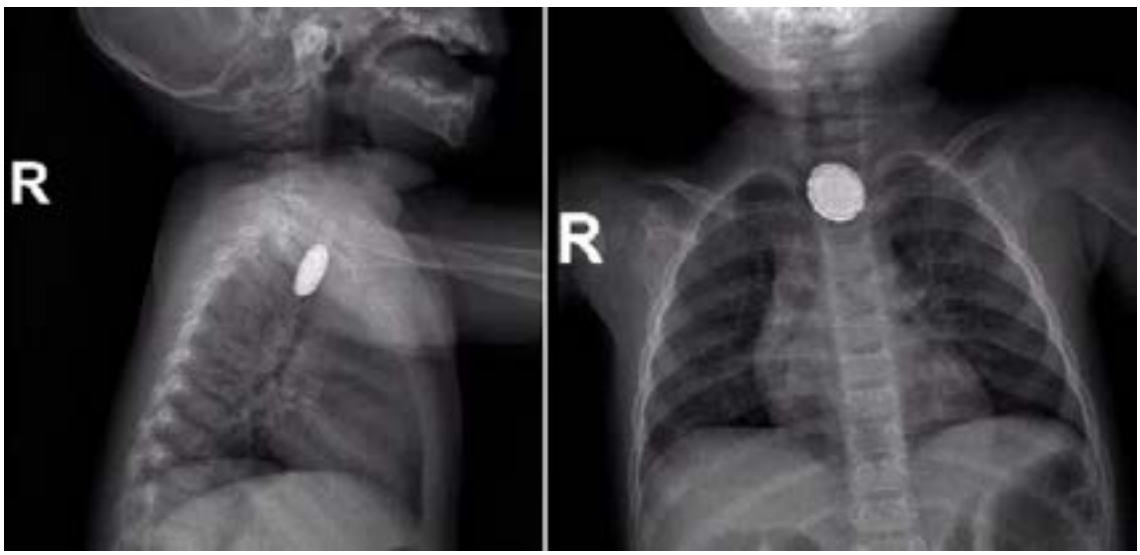
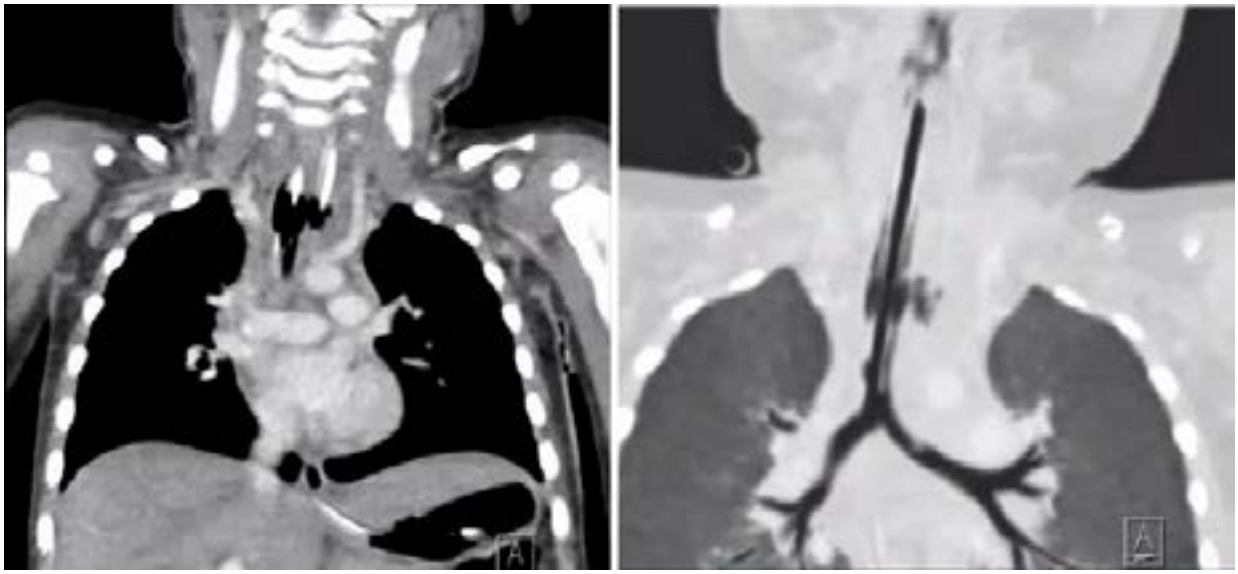


Figure 2: Images from gastro- and bronchoscopy.
A) Bronchoscopy image of the trachea showing the fistula between trachea and oesophagus, left lateral side of the trachea (±10mm).
B) Gastroscopy image demonstrating the large fistula with the cuffed tube in the trachea
C) Gastroscopy image after placing the endotracheal tube beyond the fistula to avoid ventilation problems.

Figure 3: CT scan
Perforation presumably of the anterior wall of the oesophagus and the left wall of the trachea at level Th1-Th2 with limited air and fluid. Local enhancement around the perforation in the superior mediastinum may be associated with local mediastinitis.

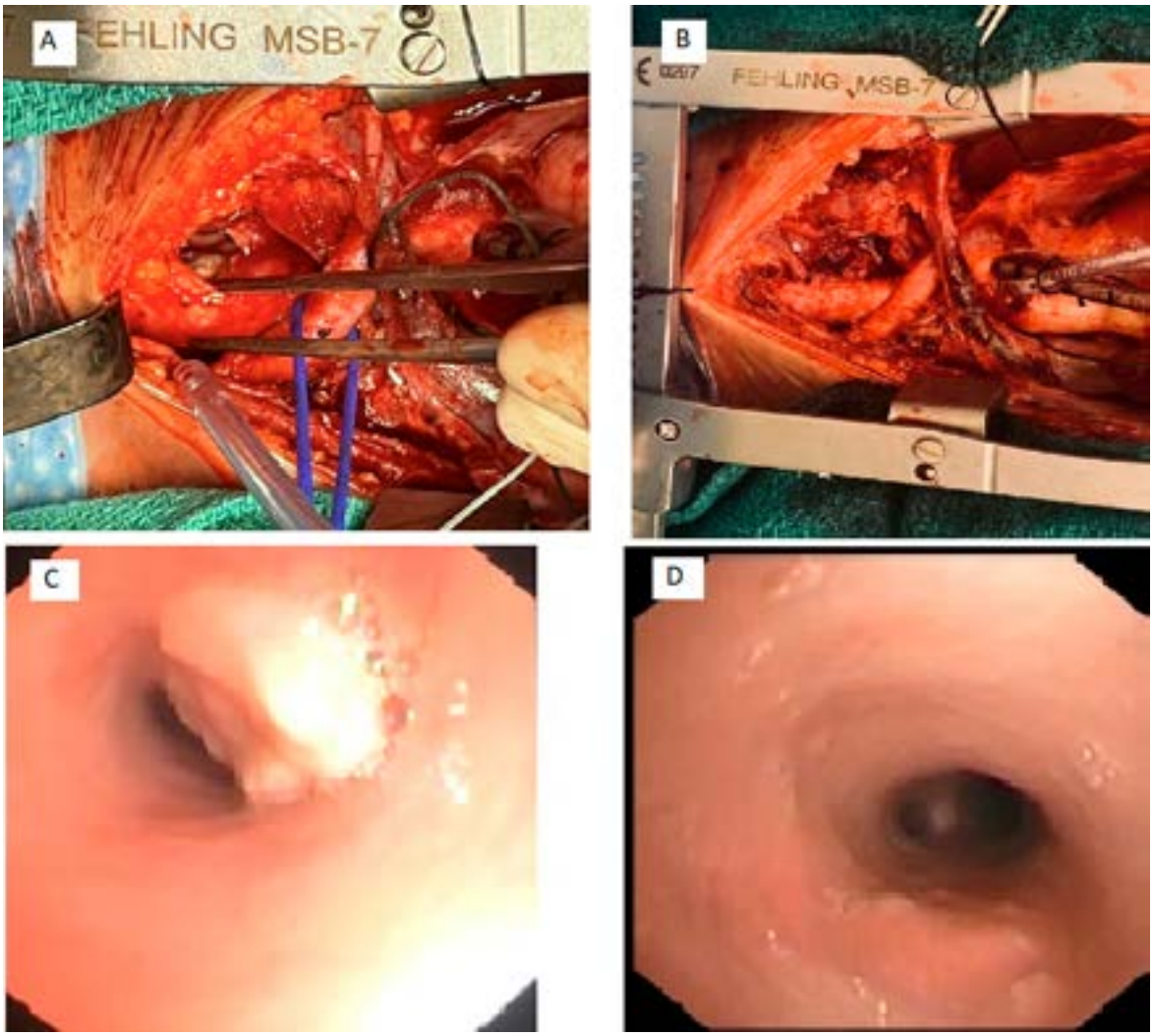


transferred to our university hospital. A large perforation of 15-20mm with fistulisation between oesophagus and trachea was discovered during gastro- and bronchoscopy (figure 2), and a repeated chest CT revealed mediastinitis (figure 3). A surgical approach through sternotomy was performed with the use of a cardiopulmonary bypass to maintain oxygenation during the reconstruction. A near transection of the mid-oesophagus and a large defect in the membranous part of the mid-trachea were identified. The necrotic part of the oesophagus was resected, followed by a primary repair of the oesophagus by end-to-end anastomosis. The tracheal defect was reconstructed with a pedicled sternocleidomastoid muscle flap (figure 4a+b). Perioperative bronchoscopy showed full coverage of the tracheal defect (figure 4c). She was extubated six days later. She suffered from transient unilateral vocal cord paralysis. Twelve days after surgery, a barium swallow X-ray was performed because of persistent coughing and choking during feeding, which initially did not show evidence of re-fistulisation. However, when reperforming this exam again on day 21 postoperatively, a small tracheoesophageal fistula was demonstrated. This was treated conservatively: diet with only solid food and thickened drinks with the improvement of complaints. Repeated barium swallow X-ray 51 days after surgery showed spontaneous resolution of the fistula. She recovered well but still needs repeated oesophageal dilatations because of recurrent stenosis. The girl has no tracheal or respiratory sequelae (figure 4d).

Discussion

Management of foreign body ingestion, especially button batteries, is challenging because of the serious and fatal complications, e.g. oesophageal perforation, spondylodiscitis, tracheoesophageal fistula, and oesophageal-aortic perforation (1). Larger disk batteries (20-23mm) have a tendency to result in higher morbidity, especially when they are impacted in the oesophagus (2,3). Additionally, age under 4 years is described as a risk factor for fistulisation (4). Injury can occur rapidly, within 2 hours after ingestion, and is caused by three different mechanisms: alkaline-induced liquefactive necrosis, low-voltage burns due to electrical discharge, and pressure necrosis (2, 3). Symptoms can be variable, non-specific, and differ according to the impaction site: drooling, vomiting, dysphagia, coughing, stridor, shortness of breath, irritability, and fever (5). To confirm the diagnosis (double ring/halo sign) and location of the button battery, a two-view (anterior-posterior and lateral) X-ray of the entire neck, chest, and abdomen is important (5). Imaging by contrasted computerized tomography (or MRI after battery removal)

Figure 4: Images taken during Tracheoplasty and images of Bronchoscopy after procedure
a) Situation before tracheoplasty with a near transection of the mid-oesophagus and large defect in the membranous part of the mid-trachea
b) Image taken after tracheoplasty with sternocleidomastoid muscle flap in situ.
c) Bronchoscopy right after tracheoplasty showing a sternocleidomastoid muscle flap situated at the former fistula opening
d) Bronchoscopy 3 months after tracheoplasty showing good healing of the trachea with muscle flap. The distal 1/3rd of the mucosa is discretely elevated and rough on the pars membranacea with normal color of the mucosa.



should be performed to identify complications: mediastinitis, fistulas, and spondylodiscitis, especially in patients with severe symptoms (haemorrhage, hemodynamic problems, respiratory problems, severe back pain, etc) or in case of severe mucosal damage after removal (5).

Both the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and the North American Society for Paediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) advocate for an imminent removal of a button battery from the oesophagus under general anaesthesia (5,6). During the transport and waiting time, honey (5-10mL) or sucralfate 500 mg can be administered, to mitigate the button battery-induced injury, if the ingestion was less than 12 hours ago, the child is stable without signs of perforation, able to swallow, and older than 1 year of age. This should however not delay the transport to the hospital nor the endoscopic procedure (5).

After endoscopic removal, the caustic burn and inflammation may continue to evolve, causing mucosal injury and eventually fistulisation, posing difficulties with airway management or vascular involvement (1,7). All patients should be admitted and monitored, and suspicion of complications should be evaluated using imaging techniques (5). The presence of respiratory symptoms may indicate tracheal complications and/or vocal cord problems (8). When mucosal injury is present after removal, a second endoscopic exam 2 to 4 days later may be considered (5). Before starting enteral feeding, a barium swallow X-ray can reveal a perforation, and treatment of a fistula is discussed later in this article (5). The extent and location of oesophageal injury determine the long-term follow-up with contrast oesophagograms and/or repeated endoscopies to detect the formation of strictures and to dilatate them (5). The follow-up is individualized for each patient.

Ingestion of button batteries can also cause laryngeal nerve paralysis, which affects the vocal cords, as present in our case. Although the precise mechanism is unclear, there are a few assumptions. Firstly, the button battery may directly cause pressure on the laryngeal nerve, or the nerve may be damaged as a consequence of infiltration of corrodent (9,10). Secondly, the laryngeal nerve may be impaired following the release of the trachea during surgery (9,10). Bilateral vocal cord paralysis is more common when the impaction was close to the hypopharynx (10). The time to recover from paralysis is not clear and needs further investigation (10).

In the second part of the discussion, we would like to pay attention to the treatment of one of the delayed complications; the tracheoesoph-

Table 1: Literature review of clinical course/management and complications of oesophageal perforations after button battery ingestion

Case	Age (year)	Time to presentation (hours)	Clinical course/management	Complications/Outcome	Ref.
1	1,4	588	Thoracotomy, ECMO, oesophagostomy, gastrostomy, mechanical ventilation, resuscitation, re-thoracotomy twice, aortic stent, jejunostomy, second gastrostomy, oesophageal drain	Full left lung atelectasis, aortic bleeding, arteria spinalis anterior syndrome with paralysis both legs	(2)
2	1,4	2,5	Gastroscopy and rigid bronchoscopy, conservative approach	-	(2)
3	1,0	72	Gastroscopy, conservative approach, swallowing problems for 2 months	-	(2)
4	4,5	5	Gastroscopy, conservative approach	-	(2)
5	1,1	?	Gastroscopy, bronchoscopy, nasogastric tube, IV antibiotics, tracheal and oesophageal reconstruction: partial median sternotomy with tracheal end-to-end re-anastomosis, primary repair of oesophageal perforation + local strap muscle interposition	Intermittent croup 3,5y after injury, tracheal granulation tissue without stridor	(3)
6	2	2	Gastroscopy, conservative approach, nasogastric tube 25 days		(6)
7	1,3	24	Resuscitation (3x cardiac arrest), open laparotomy	Death due to hypovolemic shock : ulceration of midoesophagus and haemorrhage from large arterial source	(6)
8	6	2,5	Gastroscopy, conservative approach, parental feeding, IV antibiotics	Oesophageal fluid collection	(6)
9	0,9	27	Gastroscopy, conservative approach, nasojejunal tube, repeat oesophagram, gastrostomy	Vocal cord paralysis with normal trachea	(6)
10	1,7	10,5	Gastroscopy, bronchoscopy, nasogastric tube, mechanical ventilation, repeat endoscopy, IV antibiotics, surgical correction of proximal oesophagus to an cervical oesophagostomy (spit fistula) and temporary closure of distal oesophagus, gastrostomy	Vocal cord paralysis, mediastinitis, stricture at the cervical oesophagostomy	(6)
11	3	36	Mechanical ventilation, nasogastric tube, surgical repair by combined right cervical incision and complete median sternotomy with segmental resection of trachea and oesophagus followed by primary anastomosis and right sternohyoid muscle interposition.	Oesophageal fluid collection	(7)
12	2	72	Gastroscopy, bronchoscopy, mechanical ventilation, nasogastric tube, primary tracheoesophageal repair and inferiorly based sternocleidomastoid muscle flap between trachea and oesophagus	Aspiration pneumonitis	(9)

(Abbreviations: ECMO = extracorporeal membrane oxygenation, IV = intravenous, ref. = reference)

ageal fistula. There is no consensus on how to treat tracheoesophageal fistulas caused by a button battery. In literature, one can find a conservative approach as well as different surgical techniques using autologous cartilage, pericardial patch, or muscle flap. This is based on retrospective reports. A recent systematic review by Poupore et al. which included 79 studies with 105 patients suggested a period of observation of 8 weeks if clinical status permits and in small fistula (smaller than 10mm) and this because of potential morbidity/mortality of surgery (recurrency, oesophageal stricture, recurrent laryngeal nerve damage, tracheomalacia) (4). Conservative approach with total rest of the oesophagus by nasogastric or jejunostomy tube feeding can result in spontaneous healing in a small tracheoesophageal fistula, but the time to closure is difficult to predict (7,10). These children may be at risk for mediastinitis, aspiration pneumonia, or respiratory problems that needs placement of a tracheostomy, and will be deprived of oral feeding during a prolonged period of time which also causes significant morbidity (7,11). Surgical repair should be considered for larger fistulas and important respiratory problems, but not immediately after removal because of the ongoing inflammation (12,13). A tracheal defect of up to 2 tracheal rings may allow primary anastomosis (12). In the past, multistage surgical interventions were considered because of the affected surrounding tissue (13). The interposition of tissue between the two suture lines is important to prevent re-fistulisation (11). For this purpose, different tissues have been used for instance sternal periosteum or vascularized tissue such as pericardium, pleura, or veins (14). Ripudaman et al described an anterior cervical approach to access the fistula. They performed an interposition of the sternocleidomastoid muscle to avoid recurrent fistulisation (13). In 1998 Holland et al also reported the use of a pedicled sternocleidomastoid muscle flap in a one-stage procedure in the management of recurrent fistula in a girl with oesophageal atresia (14). In this case, we also used the same approach. There was a small re-fistulisation after surgery, which was managed conservatively with success. More experience is needed to confirm the best technique to avoid re-fistulisation. This may however be influenced by the size and location of the fistula as well as the degree of inflammation and local tissue damage.

A poster is created by ESPGHAN to alert parents about the dangers of button batteries (https://espghan.info/files/EM012199_ESPGHAN_Button_Battery_Parental_Advice_Guide_211117_V0-6_SMB.pdf).

Conclusion

We present a case of a large tracheoesophageal fistula that was successfully repaired in a single-stage procedure with a sternocleidomastoid muscle flap interposition, after button battery ingestion. The likelihood of re-fistulisation can be reduced by using this alternative method. Because tracheoesophageal fistulas in children are life-threatening and uncommon, a multidisciplinary team approach in a specialized centre is required. This case highlights the challenges in terms of prompt diagnosis, surgery, airway management, the high risk of complications, and the follow-up of patients. Raising awareness about the risks of button battery ingestion and the importance of early intervention and also follow-up after removal is of utmost importance to prevent serious morbidity or death.

Conflict of interest statement

The authors of this case report declare that they have no conflict of interest. They do not have any affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this case report.

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