Nonfatal Button Battery Ingestions with Severe Esophageal or Airway Injury: 231 Cases

Case #	Year	Author	Age	Sex	Imprint	Diam (mm)	Chemistry	Intended Use	Time to Removal	Battery Location	Complications	Signs and Symptoms	Procedures and Treatment	Days to Normal Feeding (approx)
1	1982	cited in 2 pubs: Janik (1982); Votteler (1983)	25 mo	M	EPX 825	23	MnO2	camera	5 days	upper esophagus	5 mm tracheoesophageal fistula enlarged to 3 cm later; cardiac arrest secondary to anoxia	cyanosis, tachypnea, dysphagia	endoscopic battery removal; gastrostomy; thoracotomy; esophagostomy; lower esophagus ligated; discharged ~28 days post ingestion; colon interposition performed about 7 months post ingestion	>7 mo
2	1983	Litovitz & NBIH	16 mo	U	EPX 825	23	MnO2	unknown	6 hours	upper esophagus (cricopharyngeus)	esophageal perforation with spontaneous closure within 6 weeks	symptomatic but specific symptoms not described	steroids; antibiotics	unk
3	1984	cited in 3 pubs: Maves (1984); Maves (1986); Litovitz (1985) & NBIH	10 mo	F	EPX 13	15.6	mercuric oxide	camera	~18-22	upper thoracic esophagus	tracheoesophageal fistula 4 weeks post ingestion; stricture at burn site; fistula closed spontaneously; RLL pneumonia; pseudomonas septicemia; tracheomalacia	18-22 hours of irritability and dysphagia; refused food; fever; copious black saliva	removal by esophagoscopy 18-22 hours post ingestion; severe circumferential burn with charred material, worse anteriorly; home on NG tube feedings after 3 weeks; gastrostomy 15 weeks post injury; dilatation failed so attempted retrograde dilatation via gastrostomy; 8 months post ingestion esophagectomy required; tracheomalacia with ventilatory insufficiency requiring tracheotomy; decannulated and eating >2 years post burn	> 2 yrs
4	1984	McNicholas	3 y	M	unk	unk	alkaline	camera	~3 weeks	upper esophagus	4 cm posterior esophageal wall inflamed; tracheoesophageal fistula (.5 cm wide, 2 cm long) 4 cm above carina	chest infection unresponsive to antibiotics; drooling, refusal to swallow, coughing with swallowing post removal	removal by esophagoscopy; gastrostomy; 7 weeks post ingestion surgical closure of TE fistula; mild narrowing of esophagus post op requiring 2 dilations	~2 mo
5	1986	Van Asperen	9 mo	F	unk	16	mercuric oxide	camera	~8 days	upper esophagus (T1)	large tracheoesophageal fistula 1.5 cm below vocal cords; necrosis and edema of esophageal wall at impaction site; esophageal stricture; septicemia	coryza x 1 week; 2 days croupy cough, respiratory distress, intolerance of solid food; melena; respiratory difficulty and tachypnea; fever	removal by rigid esophagoscopy; gastrostomy for feeding; parenteral alimentation; weekly dilations of esophagus for esophageal stenosis; in hospital > 2 months; home on tube feedings until fistula resolved 5 months after initial injury but stricture persisted	> 5 mo
6	1987	Kost	18 mo	M	unk	20	lithium	unknown	29 days	upper esophagus	esophageal burn and stricture involving a 5 cm segment of upper esophagus	drooling, vomiting, irritable, refusing solids and liquids, otitis media; brought to ED or clinic 6 times over a month with fever, decreased oral intake, vomiting, cough, rhinorrhea, noisy breathing	endoscopic removal from esophagus; 7 months of frequent esophageal dilations, progressing to less frequent dilations	> 7 mo
7	1987	Rivera & Maves	3 y	M	PX 825	23	MnO2	unknown	~48 hours	upper esophagus	circumferential burn of cervical esophagus at cricopharyngeus; perforated esophagus with free air in soft tissues of neck; esophageal stricture	pain and dysphagia	removal by esophagoscopy; recurrent dilations required for > 2 years	> 2 yr
8	1988	Sigalet	4 mo	M	M 76	11.6	unk	camera	~30 hours	upper esophagus; negative pole anterior	battery mistaken for cardiac lead or thermistor probe on x-ray; not diagnosed until nasogastric tube passage failed; 3 cm esophageal burn starting 2 cm below cricopharyngeus; 2-3 mm tracheoesophageal fistula developed on 3rd post op day, later 5 mm in size; tracheomalacia; difficulty feeding until 1 year of age	severe respiratory distress; difficulty feeding; tachypnea; fever	removal by rigid esophagoscopy; conservative management attempted with decompressing gastrostomy and feeding jejunostomy; fever and increased tracheal secretions occurred; 6th hosp day diverting cervical esophagostomy; 3 months later resected retrotracheal portion of esophagus and reconstructed esophagus using colon interposition	
9	1989	Vaishnav	16 mo	F	unk	20 (originally reported as 10 mm but parent reinterview-ed by author)	MnO2	watch	~4 weeks	upper esophagus at thoracic inlet	large tracheoesophageal fistula (1 cm diameter fistula) which recurred twice after repair	dysphagia x 4 weeks prior to removal; feeding problems continued after removal	endoscopic removal; nasogastric tube feeding; surgical repair ~ 7 weeks post ingestion; fistula recurred 6 weeks later; 3 mm diameter TE fistula repaired again; 2nd recurrence required resection of 3 cm length of esophagus surrounding fistula and end-to-end anastomosis with omohyoid muscle mobilized between trachea and esophagus	
10	1990	NBIH	2 y	M	unk	unk	unk	unknown	>48 hrs	esophagus (mid)	suspected tracheoesophageal fistula (based on tx provided)	initial dx: croup	endoscopic removal; tracheostomy; esophageal resection	> 1 mo
11	1990	NBIH	child	U	386 A	11.6	MnO2	walkman	9 days	esophagus	diagnosis missed on 3 x-rays & 7 ER visits over 9 days; unknown specific injury that required esophageal resection	persistent vomiting	esophageal resection and anastomosis	unk
12	1992	Litovitz	10 mo	F	BR 2016	20	lithium	watch	9.5 hours	upper esophagus	1 cm2 burn in esophagus; scar tissue in larynx; esophageal stenosis in cricopharyngeal area	irritable; refused solid food; progressive dysphagia	removal by laryngoscopy; repeated esophageal dilation required over 5 years	~ 5 yr
13	1993	Gordon	18 mo	F	unk	unk	unk	hair dryer	3 days	upper esophagus	esophageal perforation (blind pouch posterior to esophagus); stricture developed at 7 weeks requiring resection with primary anastomosis; 3 subsequent esophageal dilations required	dysphagia x 3d prior to removal	removal by esophagoscopy	> 2 mo < 2 yr
14	1993	NBIH	11 mo	M	CR 2025	20	lithium	handheld computer game	6.75 hours	distal esophagus	esophageal perforation 12 hours post ingestion; tension pneumothorax; empyema (tx'd then recurred); pulmonary abscess	vomiting	endoscopic removal; attempted to push battery into stomach unsuccessfully; chest tube; decortication of lung to tx empyema; hospitalized 35 days, discharged, returned to ER for drainage of another large empyema; tube feedings x 3-4 mos	>3-4 mo

15	1993	NBIH	8 y	M	unk	unk	unk	watch	1 day	left mainstem bronchus	left lower lung collapsed; circumferential burn to bronchus	pleuritic chest pain	removal by rigid bronchoscopy	unk
16	1994	NBIH	18 mo	F	CR 2016	20	lithium	calculator	~4 days	esophagus (mid)	esophageal perforation; tracheoesophageal fistula; esophageal stricture still present 3 years post ingestion	fever, sore throat, difficulty swallowing	endoscopic removal from esophagus; surgical repair for TE fistula	> 3 yr
17	1996	Senthilkumaran	5 mo	M	unk	~ 22	unk	toy	12 days	upper esophagus (T2)	tracheoesophageal fistula at T2-T3	difficulty breathing, fever, choking; hospitalized x 10 days for recurring chest infection prior to diagnosis; cough associated with drinking persisted after battery removal	removal by esophagoscopy; patient NPO after TE fistula detected and fed parenterally x 3 weeks then by nasojejunostomy; TE fistula healed 6 weeks after battery removal (about 8 weeks post ingestion)	> 8 wk
18	1996	NBIH	13 mo	M	unk	20	lithium	camera	≤2.5 hours	upper esophagus (cricoid)	mild subglottic edema; stridor persisted > 1 month; all symptoms resolved by 6 months	coughed, choked, vomited immediately after ingestion	laryngoscopy/bronchoscopy; tracheostomy tube x 6 weeks for persistent stridor	
19	1997	Wall	13 mo	M	unk	unk	unk	unknown	3 hours	esophageal inlet	circumferential burns of esophagus at cricopharyngeus; desaturation; respiratory compromise	stridor	tracheotomy 29 days post ingestion, extubation tolerated 75 days post ingestion without respiratory sequelae or esophageal dysmotility	> 75 days
20	1997	NBIH	3 y	F	PX 825	23	MnO2	unknown	>3 days	cervical esophagus	severe burns in esophagus and trachea	inability to swallow; evaluated by physician and presumed viral illness	cervical esophagostomy; gastrostomy placement	unknown
21	1997	NBIH	11 mo	M	CR 2016	20	lithium	unknown	>24 hours	upper esophagus	circumferential burns of esophagus; esophageal stenosis	drooling; refused to eat or drink	stent placed in esophagus for 3 weeks; dilatation x 2	> 5 wk
22	1997	NBIH	8 mo	M	unk	>21	lithium	calculator	2.5 hours	upper esophagus	severe esophageal burns; coughing and choking with food ingestion; stricture	coughing and choking episodes for a year	endoscopic removal from esophagus; esophageal dilatation 2 months post ingestion	1 yr
23	1998	NBIH	18 mo	F	unk	unk	unk	unknown	>12 hours	mid esophagus	esophageal and tracheal perforations; tracheoesophageal fistula	unknown	endoscopic removal; unknown procedures or outcome	unknown
24	1999	Samad	4 y	F	CR 2032	20	lithium	sole of shoe	36 hours	mid esophagus	L hydropneumothorax; esophageal perforation	respiratory distress 6 h after removal	removal by esophagoscopy (3 attempts required); chest intubation for drainage of hydropneumothorax; esophageal perforation closed spontaneously	~ 1 mo
25	1999	Samad	5 y	F	CR 2032	20	lithium	sole of shoe	5 hours	distal esophagus	esophageal perforation; child died from unrelated railway accident 3 months after discharge	dysphagia	endoscopy showed ulceration and necrosis of distal esophagus but battery perforated through esophageal wall and was removed surgically from the paraesophageal space; esophageal perforation closed spontaneously	~ 9 days
26	1999	Grossweiler	1.5 y	M	unk	20	lithium	unknown	unk	esophagus	esophageal perforation; mediastinitis; esophageal stricture developed weeks later	difficulty swallowing food	endoscopic removal from esophagus	unk
27	1999	NBIH	14 mo	M	unk	≥20 mm	lithium	calculator	4 hours	upper esophagus (T2-T3)	"charred" esophagus; tracheoesophageal fistula	drooling and coughing after removal	endoscopic removal from esophagus; location established 30 mins post ingestion but removal delayed to 4 hours because child had recently eaten; surgical repair of TE fistula 11 days post ingestion; pin-hole esophageal perforation at 8 months	> 8 mo
28	1999	NBIH	11 mo	M	unk	≥20	lithium	remote car door opener	5 hours	mid esophagus	esophageal and tracheal burns (presume tracheoesophageal fistula based on surgical procedure); esophageal stenosis	unknown	endoscopic removal; surgical repair of trachea and esophagus 5 months post ingestion; tube feedings for protracted period; frequent esophageal dilations over 7 years resulting in 2nd esophageal reconstruction; only one additional dilatation required over next 2 years	> 7 yr
29	2000	Chiang	20 mo	M	CR 2032	20.0 (based on imprint code; author gives battery diamerter 23 mm)	lithium	unknown	3 days	upper esophagus (T2)	small tracheoesophageal fistula (negative pole in contact with anterior wall); pneumomediastinum; TE fistula healed by 11 weeks after foreign body removal	difficulty swallowing x 3 days, fever, drooling, intermittent choking, persistent cough, lethargy, tachypnea, mild dehydration, coarse breath sounds; intraesophageal bubbling on positive pressure ventilation	removal by rigid esophagoscopy under general anesthesia; nasojejunal tube inserted for feeding	> 11 wk
30	2002	Chan	1 y	M	unk	23	unk	unknown	1 day	upper esophageal orifice	tracheoesophageal fistula closed spontaneously after 8 months conservative therapy	dyspnea; stridor	endoscopic removal from esophagus	unk
31	2002	NBIH	12 mo	M	CR 2032	20	lithium	digital camera	~2 days	upper esophagus	10 mm ulcer of anterior wall of upper esophagus with necrotic center; ulcer extended 50% of esophageal circumference and 10 mm vertically; tracheoesophageal fistula just above carina; TE fistula persisted > 6 weeks; final outcome unknown	fever, wheezing, respiratory distress, refusing solids & liquids, increased WBC	removal by esophagoscopy; gastrostomy tube placed but cough and vomiting occurred with use so parenteral nutrition implemented and continued at home	unk
32	2002	Anand	3.5 y	M	unk	~21	unk	unknown	10 days	upper esophagus (T1-T2)	tracheoesophageal fistula diagnosed 1 day after battery removal, closed spontaneously with conservative management including tube feedings for 28 days after battery removal	dysphagia, cough, "cold" x 10 days, fever, weakness, drooling; removed 10 days post ingestion; severe coughing with oral intake after removal	removal by esophagoscopy from 3-4 cm below cricopharynx	unk
33	2002	Tibballs	11 mo	M	DL 2025	20	lithium	unknown	9 hours	mid esophagus at T-4	very large tracheoesophageal fistula identified 7 days post ingestion (and post battery removal); unable to achieve adequate ventilation	crying, refusal of solids then decreased liquid intake, agitation, unable to sleep, stridor, choking, inability to swallow; hypoxia	removal by esophagoscopy under general anesthesia; urgent repair of the fistula done on cardiopulmonary bypass; 2 cm defect in esophagus; esophagus and tracheal defects sutured; remained intubated for 8 days; feeding began on the 9th post-op day; mild stricture of esophagus at level of the repair	~ 16 days
34	2002	NBIH	2 y	M	CR 2032	20	lithium	ab belt (abdominal exerciser)	16.5 hours	upper or mid esophagus	tracheoesophageal fistula; esophageal strictures	stridor, gagging on foods, coughing up mucous	endoscopic removal; battery in esophagus on x-ray 2-3 hours post ingestion but removal delayed until 16.5 hours post ingestion as child had eaten; repeated dilatations of esophageal strictures	~ 17 mo

35	2002	NBIH	12 mo	M	CR 2032	20	lithium	unknown	~2 days	esophagus	tracheoesophageal fistula	upper respiratory symptoms including aspiration of food	2 weeks on total parenteral nutrition, then G-tube, later J-tube feedings; tube feedings continued for 1.5 months; endoscopy 2.5 months post ingestion showed complete healing of TE fistula	~ 2.5 mo
36	2003	Petri	12 mo	M	CR 2032	20	lithium	unknown	3-9 days in esophagus; passed spontane-ously	upper esophagus at thoracic inlet	tracheoesophageal fistula (5 mm diameter) at C7-T1 level, likely developed 9 days post ingestion (based on symptoms) but not diagnosed by esophagoscopy until 28 days post ingestion	irritable, refusing food, drinking only small amounts, vomiting, fever, coughing with eating, rhonchi & stridor after drinking; recurring fever, dehydration and upper respiratory tract infections over 4 weeks; 30% of weight lost in first 18 days post ingestion	battery passed spontaneously; hyperbaric oxygen treatment (3 week course) for TE fistula	6-7 weeks
37	2003	NBIH	20 mo	M	CR 2025	20	lithium	unknown	4-6 hours	esophagus	3 cm long burn of anterior esophagus; tracheoesophageal fistula evident 8 days post ingestion	pulmonary congestion	removal by rigid endoscopy; surgical repair of TE fistula; transesophageal feeding tube for persistent leak around repair site which subsequently healed spontaneously; repeated dilations for esophageal stricture required over next 7 months	> 7 mo
38	2003	NBIH	13 mo	M	unk	unk	lithium	unknown	4-7 days	esophagus	esophageal perforation; tracheal stenosis; tracheoesophageal fistula; tracheal perforation; tracheitis; brain damage resulted from injury	progressive dysphagia and respiratory distress over 1 week	endoscopic removal; perforated esophagus and TE fistula present; intubated; gastrojejunal feeding tube; tracheal reconstruction for tracheal stenosis; primary repair of esophageal perforation; additional surgical attempts to correct tracheal narrowing at anastomosis site	> 1 yr
39	2004	Alkan	16 mo	F	CR 2032	20	lithium	unknown	≥3 days	upper esophagus (T1-T2)	large tracheoesophageal fistula of left anterolateral wall of esophagus, 5 cm above carina	presented with choking, vomiting, unable to swallow; tachypnea and fever developed 6 hours after removal (esophagram showed no leakage); readmitted with dysphagia, fever, cough, drooling about 12 days post ingestion	removed by rigid esophagoscopy; antibiotics; steroids after removal; gastrostomy tube placed but TPN required due to tube retraction; TE fistula persisted after 5 weeks conservative management; surgical repair required; no fistula or stenosis on 10th post op day	≥ 8 wk
40	2004	Lin	10 mo	F	unk	20	suspect lithium based on diameter	personal digital organizer	6 hours	upper (cervical) esophagus	circumferential 2nd to 3rd degree burns; esophageal perforation (small) described on post op day 1 and closed spontaneously by post op day 14	drooling; refused to eat; fever	removal by rigid esophagoscopy; bronchoscopy also done; perforation managed conservatively with esophageal rest (nasogastric tube feeding)	15 days
41	2004	Imamoglu	2.5 y	F	unk	22	MnO2	calculator	17 days	upper esophagus	tracheoesophageal fistula	coughing and choking during feeding	removal by rigid endoscopy (first attempt failed, second successful); tracheostomy; NG tube feedings for 1 month after removal; surgical closure of fistula ~ 7 weeks post ingestion; asymptomatic after closure	~ 9 wk post ingestion
42	2004	Okuyama	20 mo	M	unk	20	suspect lithium based on diameter	unknown	1 week	upper esophagus	large (12 mm) tracheoesophageal fistula; post-op transient paralysis of left recurrent laryngeal nerve; mild esophageal stenosis required dilatation x 2; no recurrent fistula 6 months post op	dysphagia x 1 week; battery identified on chest x-ray and removed; dysphagia, cough, dyspnea developed 1 week after removal	treated with esophageal rest for 2 weeks after fistula noted; primary repair performed 4 weeks after ingestion of battery as respiratory symptoms and difficulty swallowing persisted; fistula divided and trachea and esophagus were repaired; sedated and paralyzed for 1 week post op for healing	
43	2004	cited in 2 pubs: Bekhof (2004); Bekhof (2005)	6 weeks	F	G13	11.6	manganese dioxide or silver oxide (2 batteries)	unknown	>24 hours	upper esophagus	tracheoesophageal lacerations and fistulas	respiratory distress progressing to respiratory failure and feeding problems; fever; tachycardia; high pitched cry; leukocytosis and thrombocytosis	intubation and ventilation x 1 month; 2 batteries removed by esophagoscopy; jejunostomy tube feedings; pneumothorax required chest tube; tracheal resection and end-to-end anastomosis done 6 months later but one fistula persisted; hospitalized x nearly 1 year; esophageal repair planned in the future	> 1 yr
44	2004	NBIH	20 mo	F	CR 2032	20	lithium	talking book (suspected source)	6 days	esophagus	noncircumferential burns with considerable granulation tissue and erosions; 2-3 months post ingestion esophagus showed significant scarring and damage of 1/3 of esophagus with ulcers that hadn't healed; improved by 7 months post ingestion	coughing and decreased appetite for 6 days prior to removal; soft diet x 3 months; choking on food and required it to be cut into tiny pieces	endoscopic removal from esophagus; repeated esophagoscopy and dilations done several times over 7 months post ingestion	> 7 mo
45	2004	NBIH	2 y	M	CR 2032	20	lithium	digital ear thermometer	8 hours	upper esophagus	esophageal burns; esophageal perforation detected on barium swallow 3 days post ingestion, healed 13 days post ingestion; stricture developed	choking and coughing after ingestion; difficulty swallowing soft solids post ingestion	x-ray 2 hours post ingestion showed battery in esophagus but child transferred to another health care facility for removal; tube feedings until esophageal perforation healed; dilation of esophageal stricture required every 3-4 weeks for 14 months post ingestion; tube feedings until 16 months post ingestion; occasional difficulty with solid foods still reported 28 months post ingestion	> 16 mo
46	2004	NBIH	20 mo	F	CR 2016	20	lithium	remote control	10 hours	esophagus	esophageal burns; esophageal narrowing developed	screaming and vomiting immediately post ingestion; over month post removal, progressively increased difficulty swallowing solids; residual difficulty swallowing meat 1 year post ingestion	endoscopic removal (delayed because child transferred to another facility for removal); esophageal dilatation 2 months post ingestion; 2nd dilatation later	> 1 yr

47	2004	Stubberud & NBIH	9 mo	F	unk	20	lithium (suspected based on diameter)	handheld video game (child found battery on floor)	15-16 hours	esophagus	battery seen in esophagus on x-ray 90 mins post ingestion but not removed until 15-16 hrs; esophageal and tracheal perforation detected 4 days post ingestion; 3 cm defect in posterior tracheal wall involving carina, right and left main stem bronchi; 4-6 cm esophageal defect	vomiting within 30 mins of ingestion; tarry stools, fever and stridor post removal evaluated and diagnosed as respiratory illness 2 days post ingestion; brought back 4 days post ingestion listless	endoscopic removal; battery dislodged from esophagus into stomach then retrieved; surgical repair of esophageal and tracheal perforations 4 days post ingestion; ECMO required; mid section of esophagus removed and ends closed into pouches; severe intrathoracic infection and pneumonia, pneumothorax and difficulty with oxygenation treated with antibiotics, chest tubes, bronchoscopies and intubation; additional surgical procedure 1 week after first to repair trachea again; esophageal tissue used to reconstruct posterior trachea; additional surgery 13 weeks post ingestion - spit fistula; tube feedings continued > 28 months; esophageal reconstruction 18 months post ingestion with colonic interposition	> 28 mo
48	2005	Bekhof - 2005	11 mo	F	unk	unk	unk	unknown	4 hours	upper esophagus (opposite T2)	swelling of esophageal mucosa; refused solid food; esophageal stenosis	vomiting	flexible endoscopic retrieval failed; used rigid endoscopy to remove; esophageal dilatation required x 3	unk
49	2006	NBIH	2 y	M	unk	size of quarter	unk (suspect lithium based on size)	toy phone	3 days	esophagus	severe inflammation of esophagus from 15-18 cm from incisors; ulceration, eschar and exudate on 3/4 of esophageal circumference (at 15 cm); mediastinitis; tracheoesophageal fistula noted 4 days post ingestion; esophageal perforation presumed as free air in mediastinum; TPN until 12 days post ingestion - perforation healed and feeding started	refused food, chest pain	endoscopic removal (rigid first, battery fragmented, largest piece fell into stomach; flexible esophagoscopy followed)	13 days
50	2006	NBIH	11 mo	M	CR 2025	20	lithium	unknown	~16 hours	upper 1/4 of esophagus	circumferential burns of esophagus; "grade 3"; lost to follow-up	circumferential necrosis and eschar in upper 1/4 of esophagus	endoscopic removal (delayed as thought was a coin); tube feeding for 12 days or more; lost to follow-up	> 12 days
51	2006	NBIH	2 y	F	unk	20	lithium (suspected based on diameter)	flashlight	12 days	esophagus	tracheoesophageal fistula (diagnosis not made until 6-7 months post ingestion although symptoms present from time of removal)	dysphagia and cough; difficulty feeding and cough with drinking persisted x 6-7 months; resolved spontaneously by 20 months post ingestion	evaluated by pediatrician x 3 before diagnosis made (treated for URI); endoscopic removal; TPN x 1 month then began feeding	20 mo
52	2006	NBIH	16 mo	M	CR 2025	20	lithium	remote control	12 hours	upper esophagus	severe circumferential burn; unable to swallow some solids for at least 15 months	gagging and choking; productive cough; decreased O2 sat	endoscopic removal	15 mo
53	2007	Nagao	8 y	M	unk	20	lithium	TV remote	2 hours	larynx	burns of postcricoid area and severe edema of laryngeal arytenoids; bilateral vocal cord paralysis	wheezing, respiratory distress, crying	endoscopic removal	unk
54	2007	Hammond	15 mo	M	unk	22	lithium	unknown	~1 week	upper esophagus	large (2 cm diameter) tracheoesophageal fistula involving > 1/3 of tracheal posterior circumference for at least 4 tracheal rings; right vocal cord palsy	1 week of cough; battery removed and choking and coughing continued during feeding	tracheal repair with bovine pericardial patch; esophagus resected; gastric interposition; postop sedation and intubation for 3 weeks with nasojejunal nutrition; right vocal cord palsy presumed secondary to iatrogenic recurrent laryngeal nerve injury requiring tracheostomy; 3 esophageal dilations required	>3 mo
55	2007	Bernstein	11 mo	F	CR 2032	20	lithium	unknown	5 hours	upper esophagus or hypopharynx; level of cricopharyngeus	bilateral vocal cord palsy due to damage to recurrent laryngeal nerves in tracheoesophageal groove; corrosive injury of anterior and lateral hypopharynx; unable to speak	respiratory distress, bilateral vocal cord palsy	laryngoscopic removal; intubation x 5 days; prolonged nasogastric tube feeding	unk
56	2007	NBIH	1 y	M	DL 2032	20	lithium	Tamagotchi (toy pet); battery removed by older sibling	3 hours	upper esophagus	circumferential 2nd and 3rd degree burns; tracheal narrowing and esophageal scarring	choking; respiratory distress; fever x 2 days; stridor and inability to eat solids persisted for > 10 months; lost to follow-up	intubated; feeding tube placed	> 10 mo
57	2007	NBIH	2 y	F	CR 2032	20	lithium	bicycle computer	10 days	upper esophagus	2nd and 3rd degree ulceration on one side of esophagus, 1st degree on other side; strictures developed	refused food other than liquids; vomited and cried when given solids; fever; vomiting; melena; black, tarry stools	endoscopic removal from esophagus; hospitalized x 1 month; tube feedings for > 6 weeks; dilations required at 3 week intervals	> 4 mo
58	2007	NBIH	11 mo	F	CR 2032	20	lithium	unknown	2-3 days	esophagus	persistent respiratory symptoms after removal required intubation and ventilator support; "poor prognosis" reported; lost to follow-up	vomiting, respiratory symptoms	endoscopic battery removal from esophagus	unk
59	2007	NBIH	9 y	M	CR 2025	20	lithium	TV remote control	5 hours	lower esophagus	severe burns in esophagus	unknown initial symptoms; when feeding tube removed c/o chest pain and nausea after eating	endoscopic battery removal from esophagus; tube feedings required for 1 month post ingestion	> 6 wk
60	2007	NBIH	14 mo	M	CR 2032	20	lithium	computer	8 hours	upper esophagus	esophageal perforation (not detected until 3rd endoscopy 5 weeks post ingestion); perforation into larynx described as "laryngeal cleft"	after removal: difficulty swallowing food and fluids; these precipitated coughing; persistent stridor, dyspnea and frequent aspiration of unthickened liquids after removal of feeding tube 3 months post ingestion; lost to follow-up	endoscopic removal (after transfer to a children's hospital); nasogastric feeding x 3 months	> 3 mo

61	2008	Grisel	3 y	F	unk	~ 20.0	lithium	unknown	12 hours	upper esophagus at thoracic inlet	injury through mucosa into muscular layer of upper esophagus; 9-10 mm tracheoesophageal fistula developed 7 days post ingestion 2 cm distal to cricoid cartilage and 5 cm above carina; negative pole facing anteriorly	coughing followed by fussiness, dysphasia, drooling; projectile vomiting	removal by rigid esophagoscopy about 12 h post ingestion; spontaneous closure of TE fistula 70 days post ingestion; TE fistula recurred 84 days post ingestion and failed to close spontaneously by 103 days; transtracheal surgical repair done	~112 days
62	2008	Slamon & NBIH	17 mo	F	unk	20	lithium suspected	digital ear thermometer	~4 days	mid esophagus	large tracheoesophageal fistula involving trachea and right mainstem bronchus with 2nd 1.0 cm fistula developing later into left mainstem bronchus; required ECMO due to the failure of conventional mechanical ventilation, but gas exchange continued to be inadequate; back to OR - found anterior wall of trachea absent and entire lower half of trachea into proximal mainstem bronchi bilaterally involved in fistula	respiratory distress, productive cough, fever; dysphagia; hypoxemia; ventilation, oxygenation and hemodynamics deteriorated with continued airway soiling through the TE fistula; ARDS, mediastinitis, and progressive atelectasis developed secondary to loss of minute ventilation through the fistula; complete consolidation of left hemithorax; gastric distention	removal by esophagoscopy; necrotic, friable, edematous mucosa; 2 lumens, one was a fistula to the trachea and right mainstem bronchus; gastrostomy tube placed; esophagus divided and stapled; flap of intercostal muscle mobilized and sutured onto the tracheal deficit; flap edema occluded the airway, requiring PEEP; 6 days after admission returned to OR because of bleeding; pericardial patch closure of the tracheal defect was done and reinforced with the muscle flap; cervical esophagostomy; Horner's syndrome	
63	2008	Sudhakar	1.5 y	M	unk	unk	unk	unknown	~4 days	upper esophagus	esophageal ulcerations; pneumothorax; spondylodiscitis at T1-2 with prevertebral extension; narrowing of tracheal lumen; mediastinitis	coughing, vomiting, refusal of food, irritable, fever; neck pain, restricted neck movement and fever occurred 6 weeks after ingestion causing readmission 8 weeks post ingestion	removed by esophagoscopy; antibiotics for spondylodiscitis and mediastinits	14 days
64	2008	NBIH	9 mo	M	CR 2032	20	lithium	keyless car entry	~5 days	esophagus	circumferential erosions, considerable edema, small esophageal perforation	vomiting and fever x 5 days before battery identified in esophagus; TPN x 2 weeks; continued difficulty swallowing solids 4.5 months post ingestion	endoscopic removal	> 4.5 mo
65	2008	NBIH	12 mo	F	CR 2032	20	lithium	scale	8-9 hours	esophagus	tracheoesophageal fistula 1 cm diameter diagnosed 7 days post ingestion; fistula closed by 7 weeks post ingestion and child back on normal diet	child readmitted to hospital 7 days post removal with fever, difficulty eating and swallowing and vigorous coughing/choking with drinking	unsuccessful removal attempt 3-4 hours post ingestion; transferred to another hospital and removed 8-9 hours post ingestion; after fistula diagnosed, treated with NG feeding x 18 days	7 mo
66	2008	NBIH	3 y	F	2032	20	lithium	unknown	4-5 days	upper esophagus	inflammation and erosion in proximal esophagus; circumferential injury with most damage anterior; perforation	coughing, choking, sore throat, inability to eat solids	brought to ER with initial complaints and sent home with diagnosis of URI; brought back 4 days later; endoscopic removal of battery from esophagus; TPN, then tube feedings; on clear liquids 3 weeks post ingestion then lost to follow-up	unk (> 3 wk)
67	2008	NBIH	13 mo	M	CR 2032	20	lithium	iHome remote control	7 days	upper esophagus	tracheoesophageal fistula noted at removal; injury not circumferential	vomiting and crying after ingestion of battery; developed cough and vomiting after each attempt to eat solids	child sent home from emergency dept with negative chest x-ray (battery above extent of first film); endoscopic removal; hosp x 11 days, sent home NPO on TPN and nebulizers; fistula healed by 6 weeks weeks post ingestion	
68	2008	NBIH	9 mo	F	CR 2025	20	lithium	remote control for DVD	5 days	esophagus	esophageal perforation; extensive circumferential burns; diverticulum formed where battery was lodged; trachea collapsed when attempted to extubate child post op; respiratory arrest occurred; child re-intubated; sepsis developed due to mediastinitis; home on pureed diet 2 weeks after battery removal; esophageal narrowing	cough (hospitalized x 2 for suspected croup before diagnosis made - no x-ray done); coughed up blood; unable to tolerate solids 3 months post ingestion, requiring pureed foods	endoscopic removal of battery from esophagus; esophageal dilatation 3 months post ingestion	> 3 mo
69	2009	Hamilton & NBIH	9 mo	F	CR 2032	20	lithium	singing Xmas card	~9 hours	hypopharynx	mucosal injury and vocal cord paralysis; required re-intubation after battery removal for dyspnea and stridor, then tracheostomy	dyspnea, stridor, vomiting	removal by rigid esophagoscopy; supraglottoplasty and tracheostomy 28 days after battery removal; home on tube feedings 38 days post removal; at 7 months post ingestion tracheotomy removed with significant vocal cord recovery	> 2 mo
70	2009	Raboei	22 day	F		11.6	unk	toy	> 18 hours	upper esophagus (level of T1/T2)	circumferential burns; small perforation in esophageal wall; discharged after 7 days; returned to ED about 3 weeks post ingestion with dysphagia	no initial symptoms; dysphagia developed 3 weeks post ingestion	removal attempt by flexible endoscopy failed; battery ultimately removed by rigid endoscopy aided by use of Foley catheter; esophagoscopy, esophageal dilatation and laparoscopic gastrostomy done 3 weeks post ingestion; dilatation under general anesthesia done every 2 weeks x 3 months, every 3 weeks for the next 6 months, then monthly for 3 months; by 18 months tolerated oral feed	> 1 yr
71	2009	NBIH	14 mo	F	CR 2025	20	lithium	unknown	9 hours	upper esophagus (level of clavicle)	mucosal burns and edema; tracheoesophageal fistula; required intubation and mechanical ventilation x 1 month	vomiting, respiratory distress, possible respiratory arrest, coughing with food and fluid intake	endoscopic removal from esophagus; j-tube inserted	> 3 mo
72	2009	NBIH	23 mo	F	CR 2032	20	lithium	watch	8.5-9 hours	upper esophagus sphincter	burns of posterior and lateral esophagus; total vocal cord paralysis	initially choked, then vomited x 20 mins; presented 8 hours later to ED with stridor	battery removed with grasping forceps 8.5-9 hours post ingestion; reintubated due to post-op stridor and total vocal cord paralysis	unk
73	2009 report; occurred 2006	NBIH	20 mo	F	2032	20	lithium	bathroom scale	>6 weeks	upper (cervical) esophagus	esophageal strictures; vocal cord paralysis; requires tracheostomy and G-tube	respiratory symptoms x 6 weeks with multiple diagnoses: croup, allergies, asthma; losing weight and spitting out food; lost 1/3 of body weight; difficulty swallowing liquids	battery removed from upper esophagus just below vocal cords; battery eroded through esophagus (beyond esophageal lumen) and encapsulated with tissue; tracheotomy and G-tube required for at least 2.5 years	> 2.5 yrs (not yet feeding normally)

Cases 1 to 73 above were included in the publication:
Litovitz T, Whitaker N, Clark L, White NC, Marsolek M: Emerging battery ingestion hazard: Clinical implications. Pediatrics 2010;125(6): 1168-77. epub 24 May 2010.
Cases below occurred or were identified after compilation of data for this publication.

74	2009	NBIH	3 y	M	CR 2025	20	lithium	battery package	3.5 hours	proximal esophagus	transmural esophageal necrosis bilaterally with mucosal injury anteriorly	witnessed ingestion; child initially asymptomatic; pain and drooling evident later	battery removed endoscopically; NG tube placed; 3-day hospitalization; fed thru nasogastric tube for 4 weeks	> 6 wk
75	2010	Tan & Gill (abstract) & NBIH	14 mo	F	CR 2032	20	lithium	unknown	4 weeks (conflicting histories of symptom onset)	mid esophagus; negative pole facing posteriorly	spondylodiscitis at T1-T2 intervertebral disc; erosive changes of T1 and T2; posterior bulging of intervertebral disc of T1-T2 into canal; polypoid lesion in proximal esophagus (granulation tissue); neck pain resolved shortly after initiation of antibiotics	esophageal battery identified and removed after 4 weeks of persistent cough (with 3 ED visits); abrupt onset of torticollis 5 weeks after removal of battery from esophagus; neck flexed with restricted range of motion and tenderness on palpation	battery removed by rigid endoscopy; spondylodiscitis treated with antibiotics (IV ampicillin/sulbactam) for 4 weeks (in hospital), then two weeks oral amoxicillin/ clavulanate after discharge	2 d
76	2010	NBIH	14 mo	F	CR 2032	20	lithium	automobile key fob	2 days	battery at cricopharyngeal level in esophagus	90% circumferential burns of esophagus with greatest injury posteriorly; partial vocal cord paralysis	child whispering, unable to cry; wheezing; difficulty swallowing	battery removed by endoscopy; nasogastric tube feedings x 7 weeks then advanced to pureed foods but had trouble swallowing liquids; readmitted to ICU for respiratory distress; tracheostomy 2 months after battery ingestion; feeding tube reinserted	at 3 mo still on tube feedings; follow-up ongoing
77	2010	NBIH	17 mo	M	CR 2025	20	lithium	remote control	6 hours	proximal esophagus	circumferential, cork-screw-like burn; vocal cord paralysis; subglottic and peritracheal edema at level of cords	voice soft and hoarse; expiratory stridor; aspirates clear liquids; drooling; high fevers; retching; stridor when upset	endoscopic removal of battery; feeding through nasojejunal tube x 3 weeks, then G-tube inserted for feeding	at 2 mo still on tube feedings; follow-up ongoing
78	2010	NBIH	16 mo	F	CR 20??	20	lithium	battery package	6 days	proximal esophagus just below cricopharyngeus; negative pole anterior	damage to 50% of esophageal circumference; persistent aspiration without evidence of TE fistula; persistent wheezing; esophageal stricture	stridor and cough x 6 days; stridor and wheezing for > 4 weeks post battery removal	endoscopic removal of battery; esophageal dilatation 2 months post battery removal	tolerating pureed foods only 2 mo post removal
79	2010	NBIH	11 mo	F	CR ????	20	lithium	unknown	3 days	mid esophagus	severe esophageal damage requiring surgical resection of portion of esophagus; perforated esophagus; severe, recurring esophageal strictures requiring stent (failed) then mitomycin C	vomiting; refused to eat	endoscopic removal of battery; portion of esophagus resected; cervical spit fistula; esophagus surgically reconnected 3 months after battery removal; esophageal stent placed; mitomycin C applied to resolve strictures	initially fed thru G-tube; 3 years post ingestion remains unable to swallow some solid foods
80	2010	NBIH	20 mo	M	CR 2025	20	lithium	battery package	unk	unknown	2 "holes" in esophagus; subsequent scarring requiring 6-7 dilations	unknown	endoscopic removal of battery; 6-7 dilations	unk
81	2010	NBIH; Australian Associated Press	12 mo	M	unk	unk	unk	toy	7 days	esophagus	tracheoesophageal fistula	cold symptoms initially; vomiting 1 week after ingestion	endoscopic removal; surgical separation (or resection) of esophagus with spit fistula and G-tube	unk
82	2010	NBIH	2 y	M	unk	20	lithium	loose	18-19 hours	proximal esophagus just below cricopharyngeus; negative pole anterior	bilateral vocal cord paresis (R>L) with upper airway obstruction requiring tracheostomy 3 weeks after battery removal for > 15 months; L cord regained some function by 11 months; R cord still paralyzed at 15 months post ingestion	stridor, drooling, hoarse, fussy, unable to swallow; respiratory distress	endoscopic removal; tracheostomy	unk
83	2010	Biswas	15 mo	M	unk	20	lithium	unknown	≥6 days	upper esophagus just below cricopharyngeus	tracheoesophageal fistula	presented with 6 days of cough and poor feeding; stridor evident	endoscopic removal of button cell; trachea partially obstructed by necrotic tissue overlying tracheoesophageal fistula; tracheostomy tube and gastrostomy tube placed; fistula closed spontaneously within 4 weeks	~ 6 mo
84	2010	Kimball	9 mo	F	unk	20	lithium	unknown	30 days	upper esophagus (intrathoracic)	erosion into esophageal muscularis with contained posterior perforation which healed spontaneously after 8 days of esophageal rest; esophageal stricture (50% narrowing) noted 6 weeks post removal	fever, otalgia and anorexia x 3 days; vomiting; persistent cough x 4 weeks; stridor; dysphagia	endoscopic removal of button battery; TPN; NG tube; single esophageal dilatation 3.5 months after removal	unk
85	2010	Kimball	13 mo	M	unk	unk	lithium	unknown	7 days	upper esophagus (at thoracic inlet)	tracheoesophageal fistula; intermittent croup still occurring 3.5 years after injury	lethargy, progressive dysphagia, mild respiratory distress x 7 days	endoscopic removal of battery; gastrojejunostomy tube placed; tracheal and esophageal reconstruction including tracheal end-to-end reanastomosis, primary repair of the esophageal perforation and muscle interposition between the trachea and esophagus; recurring stridor and respiratory distress required multiple procedures to remove granulation tissue and apply mitomycin C	unk
86	2010	NBIH	18 mo	M	unk	≥ 20	unknown	DVD remote	2 weeks - 2 months	proximal esophagus - cricopharyngeal area	esophageal strictures developed 2 months after removal	unknown initial symptoms; subsequent difficulty swallowing solids with gagging and drooling persisting more than a year after battery removal	endoscopic removal; dilatation every 1-2 months for about 18 months; mitomycin C used with improvement	> 1.5 yr
87	2010	Parray	4.5 y	F	BR 2330	23	lithium	unknown	>24 h	upper esophagus	Circumferential necrosis of upper esophagus. Developed esophageal perforation with subcutaneous emphysema, right tension pneumothorax, hypoxic episode and pneumomediastinum during endoscopic retrieval. Post-op mediastinitis with hemodynamic instability, 5 day intubated ICU stay. Required gastrostomy feeding tube and esophageal stent	24 hours dysphagia and food refusal	Multiple attempts over >90 mins to remove battery using McGill forceps, flexible endoscopy, and repeated air insufflations with battery adherent to mucosa; mechanical ventilation; chest tube; IV antibiotics and vasopressors; gastrostomy tube; esophageal stent	> 12 days
88	2010	Garey	22 mo	U	unk	unk	unk	unknown	unk	thoracic esophagus	esophageal perforation healed after 24 days esophageal rest (NPO)	unknown	unknown	unk

89	2010	Garey NBIH (this case is duplicated on Fatal Cases list, case 32; child died nearly 2 years and 10 months after	10 mo	F	unk	20	lithium	unknown	>8 hours	cervical esophagus	tracheoesophageal fistula; died (found unresponsive) nearly 2 years and 10 months after the battery ingestion	initial gasping and choking; cyanosis. Stridor developed.	tracheostomy required; unknown other procedures	unk
90	2011	NBIH	9 y	M	unk (suspected 2005)	20	lithium	unknown	≥4 days (based on symptom onset since ingestion not witnessed and denied by child)	mid esophagus just above level of carina	esophageal burns in posterior esophagus with eschar formation sparing anterior 2/3 of esophagus; esophageal perforation diagnosed at T3-T4 level on esophagram one day after removal; perforation reconfirmed 5 days after removal; healed spontaneously by 12 days post removal; esophageal stricture requiring dilation	child presented with sore throat, upper back pain, sensation of something in throat, inability to take solids, and emesis.	Endoscopic removal of battery from esophagus. Dilating endoscopy 1 month post ingestion showed mid-esophageal granulation tissue and stricture; repeat barium swallow 4 months post ingestion was normal and no subsequent dilations were required	~ 6 weeks
91	2011	NBIH	18 mo	F	unk	unk	unk	unknown	~11-12 weeks	upper esophagus at thoracic inlet	esophageal stricture at thoracic inlet requiring about 30 dilatations	Nonspecific symptoms followed unwitnessed ingestion, including rhinitis, otitis, strep pharyngitis, spitting up food, wheezing, stridor	Battery removed by flexible endoscopy. Adherent to tissue. Feeding began immediately post op and child managed at home. Dilation required about 30 times over next 2.5+ years, initially weekly, beginning about 3 weeks post removal	>2 years
92	2011 report (case occurred in 2005)	NBIH	2 y	M	unk	unk	unk	unknown	suspected 8-12 months based on symptom duration	mid esophagus	Tracheomalacia compromising the trachea by 60-70%. Granulation tissue and an esophageal stricture present immediately above the battery. Right innominate artery compression	8-12 months of dysphagia with regurgitation of solid foods and some liquids; weight loss	Endoscopic removal of battery. Persistent midesophageal stricture with granulation tissue, polyploidy changes of mucosa and pseudo diverticula. G-tube placed. Esophagoscopy with dilation every 2 weeks then every month	unk
93	2011	NBIH	3 y	M	unk	unk	unk	unknown	~1 day	mid esophagus	"significant" corrosive damage in mid-esophagus and at the gastroesophageal junction. Injury extended into the muscular layer. No perforation. Unknown if later complications	Abdominal pain for a day after suspected coin ingestion	unknown	unk
94	2011	NBIH	6 y	F	CR 2032	20	lithium	watch	4 hours	esophagus	Esophageal ulceration; esophageal stricture developed requiring dilation at least 3 times	Throat pain on swallowing	Endoscopic removal of battery from esophagus; repeated dilations	~3 mo
95	2011	NBIH	15 mo	M	unk	20	lithium	car key fob	5-14 days	mid esophagus (T6-T7 level on chest x-ray)	deep posterior ulcer; esophageal stricture	vomiting, diarrhea, high fever, drooling diagnosed as "GI bug"; melena developed; 7 lb weight loss	G-tube placed for feeding; repeated esophageal dilation required	unk
96	2011	NBIH	12 mo	M	CR 2025	20	lithium	DVD remote	>2 days	esophagus	tracheoesophageal fistula; collapsed lung	Anorexia, fever, coughing up blood	surgical repair of esophagus with removal of 2 inches of esophagus; unsuccessful esophageal stent; prolonged hospitalization (>19 weeks); persistent leak in esophagus; g-tube for feeding; >65 total procedures	> 10 mo
97	2011	NBIH	unk	M	unk	unk	unk	unknown	unk	esophagus	tracheoesophageal fistula	dyspnea, vomiting, choking; respiratory arrest 2 days after battery removal but was resuscitated	endoscopic battery removal	unk; > 1 mo
98	2011	NBIH	15 mo	M	unk	20	lithium	remote control	1.5-2 weeks	esophagus	esophageal perforation	refusal to eat for 1.5-2 weeks; vomiting up everything	endoscopic removal of battery; esophageal perforation; surgical attempt to close the hole in the esophagus was only partially successful	unk
99	2011	NBIH	14 mo	M	unk	20	unk	unknown	4 hours	upper esophagus (in neck); negative pole facing posteriorly	esophageal ulcer; periesophageal abscess (0.5*2.5 cm) in neck (retroesophageal) noted 9 days post ingestion; esophageal narrowing	vomiting, coughing, drooling	endoscopic removal of battery; TPN for about a week; several dilations for esophageal narrowing	> 5 mo
100	2011	Spiers & NBIH	9 mo	M	CR 2032	20	lithium	guitar tuner	14 hours	distal esophagus; just above gastroesophageal junction; negative pole facing posteriorly	After endoscopic battery removal, the child had a mediastinal air leak (esophageal perforation) which slowly healed. He was sent home after a week in the hospital. Twenty-seven days after the ingestion and subsequent removal, the child developed an aortoesophageal fistula. He began to vomit, bleed, gasp, and experienced body stiffness and respiratory arrest. The child had developed an aortoesophageal fistula which was repaired, representing the first known survivor of a battery-induced AE fistula. Post operatively, the child has an esophageal stricture requiring dilation.	Child presented with coughing, spluttering, and inability to swallow fluids 12-15 hours post ingestion of the battery. Twenty-seven days after the ingestion and subsequent removal, the child began to vomit, bleed, gasp, and experienced body stiffness and respiratory arrest	The battery was removed endoscopically. Endoscopy was repeated when the child was re-admitted 27 days later. Endoscopy showed extensive esophageal ulceration with persistent ooze which was injected with adrenaline, causing further massive hemorrhage. Laparotomy was done, opening the esophagus and oversewing the posterior esophageal ulcer, enabling stabilization. A CT angio showed an aortoesophageal fistula, necessitating repeat surgery with resection of the damaged aortic segment and end-to-end anastomosis of the aorta. (Stabilization occurred over about 14 hours.) The child continues to require intermittent balloon dilation for an esophageal stricture.	unk; > 5 mo
101	2011	Wills (corrected 12/29/2013 to remove data inadvertently inserted from another case)	2 y	F	unk	unk	unk	flashlight	days	mid or upper esophagus	esophageal burn and perforation; tracheal damage; tracheoesophageal fistula	presented with days of worsening cough, loss of appetite and pneumonia-like symptoms; one month post removal unable to eat or swallow	2 surgical procedures including tracheal reconstruction; ventilated for 1 week; will require additional surgery for esophageal reconstruction	unk

102	2011	NBIH	3 y	F	unk	20	lithium	unknown	>2 days	mid esophagus	tracheoesophageal fistula	initial cough and fever; anorexia; lethargy; unwitnessed ingestion	2 surgical procedures; feeding tube; 3 weeks in ICU	> 4 mo
103	2011	Jarugula	5 mo	M	unk	< 12.4 (enlarged on x-ray)	unk	unknown	~24 hours	upper esophagus	granulomatous inflammatory mass eroding posterior mediastinum and C7, T1, and T2 vertebral bodies with spinal cord impingement; transient weakness of right upper limb, then left side; esophageal stricture	decreased feeding, cough and vomiting x 24 h; 2 weeks after removal developed noisy breathing and feeding problems	endoscopic battery removal; antibiotics; gastrostomy tube feeding; external spinal brace; repeated esophageal dilatation	unk
104	2011	Jarugula	1 y	M	unk	< 24.6 mm (enlarged on x-ray)	unk	unknown	24 hours	upper esophagus	esophageal necrosis 2-3 cm below cricopharynx; 3 cm tracheoesophageal fistula (evident on day 7)	unknown	endoscopic removal; defunctioning esophagostomy; gastrostomy tube feedings	unk
105	2011	Yalcin	2 mo	F	unk	unk	unk	unknown	unk	proximal esophagus	bronchopneumonia; tracheoesophageal fistula 4 cm proximal to carina; esophageal stenosis	hospitalized for bronchopneumonia requiring ventilator support (battery on chest x-ray misinterpreted as artifact	endoscopic removal; gastrostomy and jejunostomy; tracheoesophageal fistula closed spontaneously after 8 weeks of esophageal rest; repeated esophageal dilatation required over subsequent 2 years	2 yr
106	2011	Yalçin	18 mo	F	unk	unk	unk	unknown	unk	proximal esophagus	tracheoesophageal fistula 4 cm proximal to carina	readmitted a few days after battery removal due to coughing, pneumonia and respiratory difficulty	Gastrojejunal catheter placed for feeding but subsequently displaced; total parental nutrition given through central venous catheter for 3 weeks; tracheoesophageal fistula repaired surgically by interposition of a sternothyroid muscle flap	unk
107	2011	Yalcin	5 mo	F	unk	unk	unk	unknown	unk	proximal esophagus	tracheoesophageal fistula; esophageal stricture; subglottic stenosis; dysfunctional swallowing	unknown	endoscopic removal of battery; tracheostomy; gastrostomy; tracheoesophageal fistula persisted 4 months after ingestion; fistula repaired surgically through cervical incision with muscle flap interposition; esophageal dilatation; anterior cricoid split with costal graft	unk
108	2011	Wu	9 y	F	unk	20	lithium	unknown	6 hours	distal esophagus	contained perforation of distal esophagus resolved spontaneously in 8 days	unknown	endoscopic removal under fluoroscopic guidance (fluoroscopy used because of severe esophageal edema and necrosis impairing direct visualization of the battery); total parenteral nutrition x 8 days	>8 days
109	2011	Kim	16 mo	F	unk	21	lithium	unknown	3 days	upper intrathoracic esophagus	tracheoesophageal fistula	cough	endoscopic battery removal associated with ventilatory compromise; surgical repair of tracheoesophageal fistula	unk
110	2012 (occurr-ed in 2010)	Patel; NBIH	15 mo	M	CR 203?	≥ 20.0	lithium	watch	<6 hours	upper esophagus at esophageal inlet	bilateral vocal cord paralysis; respiratory compromise; aspiration; anterior esophageal ulcer at cricopharyngeal level	persistent stridor (before and after battery removal); persistent aspiration requiring G-tube placement; respiratory compromise required tracheostomy	battery removal via laryngoscopy; remained tracheostomy-dependent 2 years post ingestion; feedings by G-tube	>2 yr
111	2012	NBIH; Young	19 mo	F	CR2032	20	lithium	unk	possibly	upper esophagus (intrathoracic); negative pole facing posteriorly	esophageal microperforation; abscess; spondylodiscitis; osteomyelitis; prevertebral cellulitis (C7-T2 involved); follow-up MRI at 4 and 12 weeks showed resolution	cough x 10 days prior to presentation, treated with amoxicillin for suspected pneumonia; trouble swallowing; fever; choking on food; neck pain unresponsive to ibuprofen developed 2 weeks to 1 month after battery removal; irritability, discomfort relieved by sitting upright, restricted neck movement, and tenderness to palpation	battery removed by rigid esophagoscopy; esophagram showed no leakage on post-op day 1; discharged home on post-op day 4; spondylodiscitis treated with intravenous ampicillin/sulbactam for 6 weeks	unk
112	2012	Harjai	1 y	M	unk	15	lithium	toy electronic harmonium	20 days	upper esophagus	large tracheoesophagal fistula at T1	sudden onset hoarseness followed by fever, cough, cyanosis, excessive drooling	intubated for 72 hours for ventilatory support (prior to diagnosis of battery ingestion); battery missed on x-ray; endoscopic removal; surgical closure of fistula due to large size; interposed strap muscles of neck	unk
113	2012	NBIH	6 y	F	CR 2032	20	lithium	unk	3 days	upper esophagus	circumferential burn; esophageal stricture	dysphagia; stridor after removal	endoscopic battery removal; unknown if dilation required	a few weeks
114	2012	NBIH	2 y	F	unk	20	lithium (2 batteries)	play kitchen set	unk	upper esophagus (C6)	circumferential eschar; mild supraglottic and glottic edema; endoscopic dilation required 3.5 and 5 months post removal	fussy, drooling, vomiting, "gurgling"; hypoxic epidoses; stridor after battery removal; raspy voice	endoscopic removal of 2 batteries from upper esophagus; intubated	unk
115	2012	NBIH	3 y	F	CR 2025	20	lithium	DVD remote	12 hours	distal esophagus	esophageal narrowing on imaging with no apparent impact on eating	abdominal, throat and shoulder pain; lethargy	endoscopic removal of battery	unk
116	2012	Soccorso	3 y	M	unk	20	lithium	unk	20 hours	distal esophagus	esophageal perforation; hydropneumothorax developed one day after removal	initial symptoms not described; battery mistaken for coin	thoracotomy; T-tube inserted in esophagus to create an esophago-pleura-cutaneous fistula; gastrojejunal tube	unk
117	2012	NBIH	13 mo	M	unk	unk	unk	Remote control for portable DVD player	unk (day of ingestion)	upper esophagus (above cords)	tracheal damage; severe burns	dyspnea; pain; coughing	tracheostomy required; feeding tube; multiple surgical procedures and hospitalizations	unk
118	2012	NBIH	2 y	F	CR 2032	20	lithium	night light attached to crib	5 hours	mid esopahgus	esophageal perforation (healed spontaneously); circumferential necrosis	chest pain	endoscopic removal of battery; esophageal dilation	2-3 weeks
119	2013	NBIH	23 mo	F	unk	20	lithium	unk	unk (11 hours to 3 days)	proximal esophagus at thoracic inlet	tracheoesophageal fistula; bilateral vocal cord paralysis; esophageal stricture; narcotic and benzodiazepine dependency; cardiopulmonary arrest (resuscitated)	respiratory distress, decreased oral intake, drooling, cough, fever, stridor, tachypnea, decreased O2 sat	surgical repair of tracheoesophageal fistula with end-to-end anastomosis; tracheostomy x 18 months; J-tube for feeding > 22 months	>22 mo

120	2013	Panella (patient D)	8 mo	M	unk	20	lithium (suspected based on diameter)	unk	>72 hours	proximal esophagus	esophageal perforation with neck abscess	coughing and fussiness x 1 week prior to presentation; sent home from ED; returned next day with vomiting, diarrhea, and inability to swallow secretions	endoscopic removal of battery; feeding tube placed; anterior neck swelling developed on post op day 2 and neck abscess communicating with esophagus was drained in OR; 2 weeks later a contained fistulous tract noted and drained externally - resolved in another 7 days; hospitalized 24 days; child asymptomatic but lost to follow-up	unk
121	2013	Panella (patient E)	34 mo	M	unk	20	lithium (suspected based on diameter)	unk	24 hours	proximal esopahgus (just below throacic inlet)	tracheoesophageal fistula 4.5 cm below vocal cords	difficulty swallowing; excessive drooling; about 8 days after removal developed cough and decreased oral intake and was rehydrated; 4-5 weeks after removal again had hesitancy with feeding and barium esophagogram showed extravasation of barium (TE fistula)	endoscopic removal of battery; feeding tube placed; gastrostomy tube placed; transcervical TE fistula repair wth interposition of sternohyoid rotational muscle flap	~3 mo
122	2012	Simonin	16 mo	M	CR 2032	20	lithium	remote control	48 hours	proximal esophagus	bilateral vocal cord paralysis; esophageal erosion; infraglottic edema	acute respiratory distress; stridor; cough	endoscopic battery removal; intra-vocal cord steroid injection; glottic balloon dilatation; unilateral posterior cordotomy	unk (sent home on enteral feeding on day 19)
123	2012	Malik	10 mo	M	unk	~20	lithium	unk	unk	mid esophagus	tracheoesophageal fistula developed 4 days after battery removal; large defect on posterior wall of distal trachea including the carina; initial portions of right and left mainstem bronchi were absent; esophageal stenosis at surgical anastomosis site	cough and irritability present initially; 4 days after removal child presented with respiratory distress, tachypnea, tachycardia, coarse bilaterial wheezing, rhonchi and stridor	endoscopic removal of battery from esophagus; surgical repair of tracheoesophageal fistula included 1) esophageal isolation, cervical esophagostomy, and gastrostomy tube placement; 2) total esophagectomy via right thoracotomy, and 3) reverse gastric tube esophageal replacement	>4 yr
124	2013	Russell	15 mo	M	CR 2032	20	lithium	for baby monitor; left loose on nightstand	6 hours	mid esophagus (at level of carina)	7 mm tracheoesphageal fistula between esophagus and right mainstem bronchus; narrowing of proximal right mainstem bronchus persisted after spontaneous closure of fistula	no initial symptoms; one week after removal child developed fever, tachypnea, oral refusal, diarrhea and abdominal distension	battery removed by rigid esophagoscopy; tracheoesophageal fistula closed spontaneously in one month with nasogastric feeding and esophageal rest (without operative repair)	> 6 weeks
125	2013	Eshagi	10 mo	M	unk	≥20.0	lithium	unk	>5 days	upper esophagus	spondylodiscitis (diminished height of T1-T2 vertebral disc and irregularity of adjacent endplates on MRI)	5 days of irritability and crying with refusal to eat and drink; fever developed; child admitted for diagnostic workup and battery found in upper esophagus on x-ray; battery expelled through spontaneous vomiting prior to esophagoscopy and the procedure was not done; about a month after the initial symptoms, the child developed neck stiffness, restricted neck mobility (fixed in hyperextended position), and fever, with tenderness over upper thoracic vertebrae	intravenous antibiotics x 6 weeks with symptom resolution	unk
126	2013	NBIH	3 y	M	CR 2025	20	lithium	unk	6-7 hours	mid esophagus	5 cm partial thickness, non-circumferential burn of esophagus; fever developed post removal; esophageal stricture	crying; pain	battery removed endoscopically; NG feeding x 17 days; one dilation required 2 months post ingestion	3 mo
127	2013	NBIH	7 days	M	AG 13 (2 batteries)	11.6	MnO2	lighted tweezers; fed batteries by sib	unk	2 batteries ingested: esophagus (1); stomach (1)	tracheoesophageal fistula; necrosis of fingers and toes; renal infarction	respiratory failure; hypoperfusion of extremities following embolization of thrombus (ECMO complication); renal infarction	battery removal; ECMO respiratory support; tube feeding; multiple surgical procedures to repair esophageal and tracheal damage	unk
128	2013	Media & NBIH	18 mo	F	unk	unk	unk	unk	many days	esophagus	esophageal perforation	fever, lethargy, coma, hoarse, cough	endoscopic removal from esophagus; G-tube feedings	unk
129	2014	Hand	10 mo	M	unk	unk	unk	unk	18 hours	mid-upper esophagus	esophageal perforation (right posterolateral); pneumothorax evident day after removal; noncircumferential mucosal burn; 50% stenosis of esophagus at site of burn	"decompensated" on anesthesia induction for chest tube insertion requiring immediate needle decompression of pneumothorax	difficult endoscopic removal of battery from esophagus (embedded in wall); emergent chest tube insertion to decompress pneumothorax; pneumothorax healed spontaneously	>12 days
130	2014	Pandey	2 y	F	unk	20-23	lithium	unk	5 days	mid esophagus	2 cm tracheoesophageal fistula	dehydration, fever, tachypnea, tachycardia, feeble pulses	endosopic removal of battery immediately followed by thoracotomy and primary repair of the tracheoesophageal fistula	unk
131	2014	Pandey	3 y	F	unk	22	lithium	unk	unk	upper or mid-esophagus	retropharyngeal abscess; tracheoesophageal fistula (mid esophagus) diagnosed at 4 weeks	presented with swelling of neck, dyspnea, inability to swallow saliva 2 days following removal of a reported 22 mm (likely 20 mm enlarged on x-ray) lithium cell from the esophagus; developed choking and coughing when feeding begun at 4 weeks	endoscopic removal of battery; antibiotics; feeding gastrostomy; thoracotomy and repair of tracheoesophageal fistula	unk
132	2014	Ruhl	17 mo	M	unk	unk	lithium	unk	~4 months	cervical esophagus	esophageal ulceration; esophageal double-lumen (parallel false lumen); esophageal stenosis	presented with 4-month history of cough, reflux and failure to thrive	flexible endoscopic removal; segmental resection of severe esophageal stricture with primary anastomosis; subsequent mild stenosis treated with two esophageal dilations	unk
133	2014	Jump	28 mo	F	unk	20	lithium	unk	≥6 days	upper esophagus	mediastinitis; discitis and osteomyelitis of T1 and T2; mild stenosis of proximal esophagus	lethargy; refusal to lie supine or walk	removal by rigid esophagoscopy; hospitalized for one month; antibiotics; gastrostomy tube; cervical brace	1-8 mo
134	2014	Liao	11 mo	F	unk	unk	unk	unk	7 days	mid esophagus	tracheoesophageal fistula	dysphagia; fever; cough	35 day hospitalization; feeding tube; closed spontaneously after 4 months	
135	2014	Liao	3 y	F	unk	unk	unk	unk	4 days	esophagus	tracheoesophageal fistula	unknown	28 day hospitalization; feeding tube; antibiotics; fistula closed spontaneously	
136	2014	Liao	3 y	F	unk	unk	unk	unk	5 days	esophagus	tracheoesophageal fistula	unknown	21 day hospitalization; feeding tube; antibiotics; fistula closed spontaneously	

137	2014	NBIH	16 mo	F	unk	20	lithium	toy	10 hours	upper esophagus	esophageal perforation; noncircumferential necrotic area about 270 degrees around esophagus; negative battery pole facing posteriorly	initial gagging and choking	TPN; esophageal perforation detected about 17 days post ingestion; closed spontaneously	
138	2014	Hamawandi	30 mo	F	unk	unk	unk	unk	≥7 days	esophagus	esophageal perforation	unknown	surgical closure; gastrostomy tube feeding; chest tube drainage; antibiotics x 28 days; 36-day hospitalization	
139	2013	NBIH	2 y	M	unk	unk	lithium	key fob	unk	esophagus	unspecified esophageal burns	unknown	feeding tube in place for one month, expected to be in place for 6 months	
140	2013	NBIH	14 mo	M	CR 2032	20	lithium	unk	~5 hours	upper esophagus	circumferential burns of esophagus; extensive swelling required 3 days intubation; readmitted 16 days post ingestion with dehydration and 6-7 lb weight loss; avoiding meat one year later	cough; dehydration; weight loss	endoscopic removal (multiple attempts required before successful)	
141	2013	NBIH	17 mo	M	CR 2016	20	lithium	book light	~15 hours	upper esophagus	esophageal burns; mediatstinitis (on MRI) with small air pockets treated with antibiotics	initial symptoms: vomiting; unable to swallow	endoscopic removal from esophageal inlet (negative pole posterior); intubated x 4 days; hospitalized x 16 days; antibiotics; gastrostomy tube	
142	2013	NBIH	13 mo	M	unk	20	lithium	remote control	3-30 days	mid esophagus	tracheoesophageal fistula visible at time of battery removal (described as large gaping slash fistula)	respiratory distress; wheezing; fever; poor feeding	endoscopic removal from mid esophagus; intubated x 1 month; gastrostomy tube; surgical repair of fistula planned but lost to follow-up	
143	2014	NBIH	14 mo	M	unk	>20	lithium	unk	~4-6 weeks	esophagus	respiratory arrest; esophageal ulcer	choking or vomiting x 4-6 weeks whenever child ate; respiratory arrest during or after placement of tubes in ears; intubated, then battery in esophagus identified; barking cough	endoscopic removal; intubation	
144	2014	NBIH	3 y	F	2025	20	lithium	video camera	11.5 hours	upper esophagus	circumferential burn with necrosis; esophageal narrowing and some difficulty swallowing	refusing food; pain; difficulty swallowing	endoscopic removal	
145	2014	NBIH	10 mo	M	unk	20	lithium	keychain	<24 hours	upper esophagus	small esophageal perforation resolved spontaneously; suspected abscess formation at anterolateral aspect of upper thoracic esophagus	hoarse cry; refusing solids; coughing; drooling	difficult removal by rigid esophagoscopy	
146	2011	Khaleghnejad Tabari	9 mo	M	unk	5	unk	unk	≥5 days	proximal esophagus	tracheoesophageal fistula	presented with cough and cyanosis x 5 days, with cough, dyspnea and cyanosis continuing after removal	battery removal by laryngoscopy; tracheoesophageal fistula repaired surgically	
147	2011	Khaleghnejad Tabari	2.5 y	M	unk	unk	unk	unk	≥8 months	distal esophagus	tracheoesophageal fistula into right bronchus	vomiting after ingestion of solid food and productive cough x 8 months	battery removal by esophagoscopy; thoracotomy to repair tracheoesophageal fistula	
148	2011	Khaleghnejad Tabari	2 y	F	unk	unk	unk	unk	≥8 days	unk	tracheoesophageal fistula	presented with dysphagia and choking x 8 days; fever developed post removal	thoracotomy to repair tracheoesophageal fistula	
149	2011	Khaleghnejad Tabari	3 y	F	unk	unk	unk	unk	~1.5 months	upper esophagus	tracheoesophageal fistula	presented with cough, dyspnea, dysphagia and vomiting	Tracheoesophageal fistula repaired through neck incision	
150	2014	Fuentes	7 y	F	unk	20	lithium	unk	6 hours	upper esophagus	esophageal stenosis	initial sialorrhea and vomiting	endoscopic removal of battery; balloon dilatation x 4 beginning 4 weeks post ingestion	
151	2014	Fuentes	2 y	M	unk	20	lithium	unk	a few hours	upper esophagus	esophageal stenosis	vomiting	endoscopic removal of battery; 3 cm burn; esophageal dilatation required (once)	
152	2014	Zapf	20 mo	F	2032	20	lithium	unk	7 hours	upper esophagus	severe necrosis of esophagus; tracheoesophageal fistula developed between days 4 and 10; mediastinal emphysema	presented with cough and dyspnea; stridor and severe dyspnea after removal	endoscopic removal; nasogastric tube; after 4 months the fistula was not closing spontaneously thus surgical closure was performed; revision of the closure was required due to persistent leakage	
153	2014	Tiedeken	3 y	F	unk	20	lithium	unk	6 months	mid esophagus	esophageal tear; mediastinitis; esophageal stricture	persistent cough for 6 months diagnosed as GERD and asthma, worsened over the 2 days prior to presentation	endoscopic removal showed thin, friable esophageal wall, ulceration and abundant granulation tissue formation; endoscopic balloon dilations x 2 for strictures	
154	2015	NBIH	3 y	M	unk	20	lithium	bathroom scale; new battery	4 hours	esophagus	esophageal perforation (free medistinal air on CT) treated conservatively with TPN and hospitalization for 1 week; repeat CT confirmed healing of perforation	pain, vomiting food, "looked quite unwell"	removed endoscopically 4 hours after ingestion	
155	2014	Youth Health Magazine; Fairfax Media Digital; Daily Mail Australia	8 mo	M	unk	unk	lithium	unk	~4 days	upper esophagus	trachesophageal fistula; vocal cord paralysis secondary to abscess around recurrent laryngeal nerve	wheezing and coughing on presentation; bronchiolitis initially suspected and treated with inhaler	esophagectomy and cervical spit fistula; feeding gastrostomy tube; multiple major surgical procedures (at least 5) in the 3 months post ingestion to attempt tracheal and esophageal repair; still on ventilator 5 months post ingestion; suffered seizures, brain bleeds, infections	
156	2015	Gopal M	3 y	F	unk	≥20	lithium	unk	36 hours	upper esophagus	large tracheoesophageal fistula at C7-T1 level	difficulty swallowing prior to removal; cough and fluid aspiration evident on first post-op day	removed by rigid esophagoscopy; surgical repair through combined right cervical incision and median sternotomy with resection of a segment of both the trachea and esophagus followed by primary anastomosis; esophageal leakage noted on 12th post-op day and esophageal diversion was accomplished with a cervical esophagostomy and feeding gastrostomy; esophageal continuity was re-established 3 months later	

157	2015	Peters	4.5 y	U	unk	unk	unk	unk	~6 months	thoracic esophagus	tracheosphageal fistula	unknown	removed by rigid esophagoscopy; feeding gastrostomy; delayed repair of TEF (with resection of esophageal segment) after 6 weeks of esophageal rest; 2 hospitalizations (21 days total); 2 esophageal dilations subsequently required	unk
158	2013	Hall	6 weeks	M	unk	unk	unk	unk	unk	upper esophagus	esophageal perforation; hoarse voice and left recurrent laryngeal nerve palsy noted post esophageal reconstruction (unclear if present pre-op)	unknown	cervical esophagostomy; feeding gastrostomy	
159	2013	Hall	5 y	U	unk	unk	unk	unk	unk	upper esophagus	trachesophageal fistula; left vocal cord paralysis	unknown	cervical repair of tracheosphageal fistula	
160	2014	Plumb	3 y	M	unk	unk	unk	unknown	~24 hours	mid esophagus	discitis and osteomyelitis at T3-T4 with extensive paraspinous phlegmon and mediastinitis diagnosed 5 weeks after battery removal; esophageal perforation with contained leak posterior to esophagus; mild esophageal stricture	child with underlying hydrocephalus, hypotonia, developmental delay and pulmonary hypertension presented with tachypnea, decreased tolerance of food and low grade fever; battery ingestion diagnosed and battery removed; 5 weeks post battery removal child presented with fussiness with feeding, pain with sitting up or rolling over, increased work of breathing and intermittent fevers	endoscopic battery removal; prolonged IV antibiotics and esophageal rest	
161	2014	Kankane	18 mo	M	unk	20	lithium	unknown	>1 month	mid esophagus	tracheoesophageal fistula at T1-T2	presented with fever, cough, shortness of breath, decreased food intake, vomiting, drooling; treated with oxygen, IV fluid and antibiotics for more than a month without improvement; severe acute malnutrition developed; tachycardia, tachypnea, nasal flaring, retractions	feeding jejunostomy x 6 weeks followed by surgical repair of fistula	
162	2015	NBIH	12 mo	M	2025	20	lithium	glasses for use with 3D TV	≥6 days	mid esophagus	mediastinitis; esophageal stricture	presented with "rattling chest" for several days	difficult removal due to granulation tissue; prolonged TPN; dilation of esophageal strictures required every 4 weeks for at least 5 months	unk
163	2014	Kieu	14 mo	M	CR 2032	20	lithium	unknown	1-5 days	proximal esophagus	spondylodiscitis (polypoid granulation on posterior esophageal wall and inflammatory phlegmon adjacent to spondylodiscitis at C7-T3)	presented with abnormal neck posturing, poor feeding, drooling, cough, fever; battery removed; one week later child presented again with neck hyperextension and inspiratory stridor	battery removed by esophagoscopy; IV antibiotics (ticarcillin/clavulanate)	
164	2015	Makhubu	16 mo	F	unk	20	lithium	unknown	2 days	proximal esophagus	tracheoesophageal fistula(s); cardiac and respiratory arrests leading to brain edema requiring brain surgery	initial: vomiting; rash; difficulty breathing; fever	battery removal by endoscopy; esophageal diversion (cervical spit fistula); multiple attempted repairs of TE fistula	
165	2014	Daily-mail.com	18 mo	F	unk	~20	unk	unknown	8 weeks	esophagus	esophageal stricture	initial: vomiting with eating x 8 weeks; listless; weight loss; struggling to breathe	battery removal; esophageal dilation x 5	
166	2014	Daily-mail.com	11 mo	F	unk	unk	unk	kitchen scale	20 hours	esophagus	esophageal stricture (11 cm scar in esophagus)	initial choking and crying; fever after removal; unable to eat solids for 2 months	battery removal; dilation	2 mo
167	2015	Smith	4 mo	M	unk	11.6	unk	unknown	>155 hours	upper esophagus	corrosion of spine; 3 vertebrae damaged and collapsed; battery mistaken for shirt button on x-ray	initial cough and breathing problems; battery removed > 15 hours after ingestion; 4 weeks later presented with corrosion of part of spine	battery removal; 8 months in body cast; 5 years later he can walk but has motor limitation (unable to fully raise head)	
168	2015	Barabino (case described in 2 articles)	5 y	M	CR 2032	30	lithium	unknown	~3 days	mid esophagus	esophageal perforation developed 7 days after battery removal; severe, deep mildly bleeding ulceration of esophageal wall	presented with 3 days of epigastric pain and history of possible coin ingestion	esophagoscopy initiated but when severity of ulceration noted, a lateral thoracotomy was done to exclude damage to aorta; direct contact between battery and aorta excluded by transillumination; battery pushed to stomach then removed; parenteral nutrition, omeprazole and antibiotics started; esophageal perforation developed 7 days after battery removal and was treated conservatively with full recovery	
169	2015	Onotai	3 y	M	unk	~20	lithium	unknown	~6 months	upper esophagus	esophageal stricture	presented with 6 month history of poor feeding, chronic cough and progressive difficulty breathing; drooling; mild respiratory distress.	removal by rigid esophagoscopy; serial esophageal dilations required; 3 month hospital stay	>3 mo
170	2015	NBIH	2 y	F	unk	20	lithium	unknown	6-7 days	distal esophagus	mediastinitis; esophageal erosions; pericardial effusion	vomiting; altered diet but able to eat soft food and drink fluids; dark stools	removed endoscopically	unk
171	2015	Singh	10 mo	F	unk	≥20	lithium	unknown	unk	cricopharyngeal area	bilateral vocal cord palsy; tracheostomy required for delayed acute respiratory distress	stridor; refusing food; drooling; dramatic improvement after battery removal, but stridor recurred about 2 weeks post removal and tracheostomy required 2 months post removal for acute stridor with inability to intubate	removed endoscopically; tracheostomy	unk

172	2015	NBIH	21 mo	M	unk	20	lithium	unknown	unknown	cricopharyngeal area	left vocal cord paralysis on presentation; extensive necrosis of esophageal wall; esophageal perforation (right side); 1 cm diameter tracheoesophageal fistula developed over a few days 3 cm from carina in upper mediastinum	unknown	endoscopic removal of battery; surgical repair of tracheoesophageal fistula	unk
173	2015	Schroter	21 mo	F	unk	≥20	lithium	unknown	3-6 weeks	anterior to upper esophagus	mid-tracheal narrowing due to compression of posterior tracheal wall by battery; bilateral vocal cord paralysis; esophageal stricture	3-week history of decreased oral intake and upper respiratory symptoms (cough, congestion), eventually refusing to eat anything for 3 days, spitting out any food or water; 5 lb weight loss over 3 weeks; lethargy (decreased tone and strength); severe dehydration (sunken eyes, dry mucous membranes, one wet diaper in 24 hours, poor skin turgor, tenting, delayed capillary refill); malnutrition; esophageal edema (esophagus separated anteriorly from tracheal air column on chest x-ray; stridor developed over the few months post removal	esophagoscopy performed but battery not visualized and appeared to have eroded through the esophageal wall (anterior esophageal mass seen); debris and inflammation in esophagus; bronchoscopy showed considerable mid tracheal narrowing; battery removed surgically through a neck incision - battery walled off between esophagus and trachea; numerous esophageal dilations required due to stricture and diverticulum development; stridor developed over the few months post removal and bilateral vocal cord paresis and persistent airway compression were noted requiring a tracheostomy tube	unk
174	2014	NBIH; Leinwand (Case 12)	20 mo	F	2025	20	lithium	unknown	~3 days	proximal espophagus	esophageal stricture; necrotic areas visualized in esophagus	reported asymptomatic initially; after removal some difficulty swallowing; choking on food	endoscopic removal of battery; repeated esophageal dilation; speech therapy	unk
175	2014	NBIH; Leinwand (Case 13)	20 mo	M	unk	unk	unk	unknown	unk	proximal espophagus	tracheoesophageal fistula; vocal cord paralysis (unilateral, complete); esophageal stricture	presented with drooling; pointing to neck	endoscopic removal of battery; multiple esophageal dilations; gastrostomy tube for feedings; spit fistula and esophageal hiatus closure to allow TEF to heal; reanastomosis of esophagus and spit fistula takedown	unk
176	2015	NBIH; Leinwand (Case 9)	11 mo	M	unk	≥20	lithium	key gob	28 hours	proximal espophagus	unilateral vocal cord paralysis	presented with cough, dysphagia, fever; unable to drink safely	endoscopic removal; gastrostomy tube for feedings x 5 months	> 5 mo
177	2015	NBIH; Leinwand (Case 10)	15 mo	F	unk	20	lithium	unknown	unk	proximal espophagus	esophageal stricture	presented with decreased oral intake; coughing/spitting after eating; fever; upper respiratory symptoms	endoscopic removal; esophageal dilation; multiple esophageal dilations; hospitalized ~ 6 days	unk
178	2015	NBIH	5 y	F	2032L	20	lithium	toy	2-3 days	distal esophagus	esophageal perforation	chest pain and refusal to eat or drink x 48 hour	endoscopic removal after CT ruled out vascular involvement; total parenteral nutrition; 2 week hospitalization	unk
179	2015	Leinwand (Case 1)	2 y	M	unk	unk	unk	unknown	6 hours	proximal esophagus	esophageal perforation into retropharyngeal soft tissue at C4 level (contained) which resolved 16 to 23 days post ingestion	emesis and drooling post ingestion	endoscopic removal (unsuccessful flexible esophagoscopy followed by rigid esophagoscopy)	~25 days
180	2015	Leinwand (Case 5)	6 y	M	unk	unk	unk	unknown	2.5 hours	proximal esophagus	prior history of repaired tracheoesophageal fistula and subsequent battery ingestion; noncircumferential esophageal ulceration with eschar formation; contained esophageal perforation (focal fluid filled collection) evident 4 days post ingestion which resolved without intervention	hematemesis developed 1-2 hours post ingestion; vomited up battery; dysphagia and pain developed 4 days after ingestion	NPO after contained perforation noted; TPN; antibiotics	unk
181	2015	Paolini	14 mo	M	CR 2032	20	lithium	unknown	>1 week	proximal esophagus	esophageal ulcerations; laryngotracheitis; recurrent aspiration; tracheoesophageal fistula	presented with persistent cough and wheezing	endoscopic battery removal; surgical repair of tracheoesophageal fistula done after one month of conservative management	unk
182	2016	Soni	3 y	M	unk	≥20	lithium	unknown	~20 days	distal esophagus	esophago-pericardial fistula; pneumopericardium; staph septicemia	presented with intermittent fever for 20 days, then suddenly developed difficulty breathing and abdominal pain; tachycardia and tachypnea present; marked intercostal retraction; pericardial rub	endoscopic removal from esophagus; antibiotics; air leak resorbed gradually and resolved with conservative therapy alone	unk
183	2015	Burn	2 y	F	unk	20-25	lithium	key fob (accessed new battery from package)	<24 hours	esophagus	esophageal perforation into lung; suspected tracheoesophageal fistula	pain	endoscopic removal of battery from esophagus; G-tube; surgical repair of fistula; on ventilator x 6 days post-op; 8 week hospitalization; multiple procedures	>2 mo
184	2016	Pickles	17 mo	M	unk	20	lithium	remote control	unknown	esophagus	esophageal perforation; tracheoesophageal fistula; paresis of one vocal cord	fever, vomiting	feeding tube inserted; spit fistula; tracheoesophageal fistula repair; esophageal dilations; esophageal reconnection	unk
185	2015	Walton	2 y	F	unk	20	2032	unknown	3-5 weeks	mid esophagus	partial collapse of T3 and T4 vertebral bodies; acute discitis; mucosal ulceration and granulation at impaction site; esophageal stenosis	5-weeks of coryza, anorexia, fever, decreased oral intake; 3 weeks of malaise; torticollis; pain on neck movement; reluctance to lie down flat (preferred sitting up)	button battery removed; IV antibiotics x 4 weeks; multiple esophageal dilations from 4 to 12 months after battery removal	>12 months
186	2016	Lochanie	2.5 y	F	unk	20	lithium	unknown	≤3 hours	mid esophagus	bilateral vocal cord palsy	witnessed, asymptomatic battery ingestion; inspiratory stridor immediately following post-op extubation; immediately reintubated for 24 hours then extubated with recurring stridor but no respiratory distress; discharged home on 10th post-op day	battery removal by rigid esophagoscopy under general anesthesia; nasogastric tube inserted	unk

187	2015	NBIH	2.5 y	M	unk	20	lithium	unknown	7 hours	proximal esophagus	bilateral vocal cord paresis diagnosed ~24 hours after ingestion (post removal); cord function recovered in ~ 2 months with normal voice	poor intake; noisy breathing; difficulty breathing; coughing and throat clearing	battery removed; adenotonsillectomy for severe obstructive sleep apnea; no tracheostomy required	1 day
188	2015	Smith	17 mo	F	unk	20	lithium	unknown	~1 week	mid to distal esophagus, compressing distal trachea; negative pole anterior-facing	circumferential burn; tracheoesophageal fistula 2.5 cm above carina	one-week history of a respiratory illness, progressive dysphagia, croupy cough, tachypnea, and tachycardia	battery removed by flexible esophagoscopy; gastrostomy tube placed; tracheoesophageal fistula repaired through transcervical approach	unk
189	2016	Seth	2 y	F	unk	20	lithium	unknown	4 days	esophagus	esophageal perforation	gagging; unable to swallow, lethargic	endoscopic removal	unk
190	2016	Lee	11 mo	F	unk	~20	lithium	unknown	2 weeks	proximal esophagus	erosion and perforation of posterior esophageal wall; esophageal stricture	pooling secretions and feeding intolerance x 2 weeks; presented with cough and repeated emesis 6 months later at which time an esophagram showed a proximal esophageal stricture	laryngoscopic removal; repair of posterior esophageal perforation; prolonged stay in pediatric ICU; dilation of esophageal stricture	> 60 mo
191	2016	Houas	18 mo	F	unk	unk	unk	unknown	48 hours	proximal esophagus	tracheoesophageal fistula (15 mm diameter) resolved spontaneously within 3 weeks	dysphagia with solids; violent coughing episodes; tachypnea; drooling; fever; bilateral bronchial rales	endoscopic removal of battery	unk
192	2016	Eliason	26 mo	M	CR 2032	20	lithium	unknown	6 hours	proximal esophagus	localized esophageal injury at level of cricopharyngeus (superficial charred mucosa and muscular layers); left vocal cord paralysis diagnosed 6 weeks after removal with aspiration of thin and thick liquids; proximal esophageal stricture; oral aversion secondary to history of aspiration	2 hours of excessive drooling and refusal of food; 6-weeks after removal presented with new-onset hoarseness and productive cough concerning for aspiration; laryngoscopy showed left true vocal fold immobility	battery removed by rigid esophagoscopy; multiple esophageal dilations; admissions for intensive feeding therapy; multiple injection medialization procedures required to prevent aspiration	unk
193	2014	NBIH	22 mo	M	CR 2032	20	lithium	toy	4.5 hours	proximal esophagus (cricopharyngeal area)	localized esophageal injury at level of cricopharyngeus (deep ulceration, circumferential erythema and thickening); esophageal stricture	initial choking; bradycardia; choking and vomiting with eating developed 3 months post-ingestion and lasted until ~20 months post-ingestion	battery removed by rigid esophagoscopy; intubation; steroids, proton pump inhibitors; nasogastric tube feedings for 9 days	10 weeks, then choking with eating developed 3 months post-ingestion and a stricture was diagnosed; ~20 months post-ingestion, normal eating resumed
194	2014	NBIH	12 mo	M	CR 2025	20	lithium	remote control	4.5 hours	proximal esophagus	circumferential esophageal ulceration; hematemesis; esophageal stricture	irritability; hematemesis	multiple unsuccessful endoscopic removal attempts; pushed battery into stomach; laparotomy to remove the battery from the stomach; blood transfusion; gastrostomy tube insertion; total parenteral nutrition; 2 dilations of esophageal stricture	8 mo
195	2015	NBIH	22 mo	F	CR 2016	20	lithium	calculator	11 hours	proximal esophagus	50% circumferential esophageal eschar; severe esophageal erythema and edema; persistent fever and tachycardia; hypotension; right upper lobe of lung collapsed; vocal cord paralysis; esophageal stricture	crying; drooling	battery removed by rigid endoscopy; intubation, ventilation, sedation and paralysis; vasopressors; diuretics; nasogastric tube feedings; tracheostomy	7 mo
196	2016	NBIH	34 mo	F	CR 2025	20	lithium	toy	2 hours	mid esophagus	esophageal burn (near the aorta, 4 mm); dysphagia; esophageal stricture	unknown	endoscopic removal of battery	unk
197	2016	NBIH	13 mo	F	CR 2032	20	lithium	TV remote control	8 days	mid esophagus (at the thoracic inlet)	tracheoesophageal fistula below the thoracic inlet	cough; refusing to eat; oxygen desaturation	nasogastric tube feedings; nasojejunal tube feedings	10 weeks
198	2016	NBIH	20 mo	F	CR 2032	20	lithium	toy	18 hours	mid-lower esophagus	circumferential burns to mid-lower esophagus; esophageal perforation and fistula (3 mm from the aortic arch); stridor; formation of fibrinous banding near the trachea; edema in the mediastinum	refusal to eat; vomiting	endoscopic removal of battery; intubation, ventilation, sedation, and oxygen; racemic epinephrine, antibiotics, steroids; nasogastric tube feedings; PICC line placement; surgical removal of fibrinous banding	1 mo
199	2016	NBIH	10 mo	M	unk	20	lithium	remote control	24 hours	esophagus	tracheoesophageal fistula; airway obstruction; esophageal abscess; hypotension; unmanageable oral and nasal secretions; tracheal stenosis	fever	endoscopical removal of battery; intravenous feedings; intubation, ventilation, paralysis; surgical repair of the fistula (2 procedures); gastrostomy-jejunostomy tube placement	> 85 days
200	2016	NBIH	17 mo	M	unk	20	lithium	remote control	>48 hours	supraclavicular esophagus	esopahageal necrosis; esophageal stricture	fever; drooling; vomiting	esophageal resection (7 cm); gastrostomy tube placement; intubation; drain placement for secretions	> 60 days
201	2016	NBIH	8 mo	F	CR 2032	20	lithium	portable speaker	4 hours	proximal esophagus	esophageal injury resulting in bilateral vocal cord paralysis	stridor	endoscopic removal of battery; nasogastric tube feeding	unk
202	2015	Walsh	17 mo	F	unk	unk	lithium	scale	3 hours	esophagus	tracheoesophageal fistula	unknown	endoscopic removal of the battery; tube feeding	unk
203	2015	Walsh	2 y	F	unk	unk	lithium	unknown	~5 days	esophagus	tracheosophageal fistula	refusing food; "sick"	endoscopic removal of battery; partial esophajectomy; surgical creation of spit fistula; gastrostomy tube placement for feeding	unk

204	2016	NBIH	14 mo	M	2032	20	lithium	unknown	>8 hours	esophagus at the upper esophageal sphincter	esophageal perforation; bilateral vocal cord injury; stridor	drooling, vomiting with feeding, respiratory distress	endoscopic removal of battery; intubation, ventilation, sedation; central line placement; tracheostomy; tube feedings	unk
205	2016	NBIH	10 y	F	unk	20	lithium	unknown	5 hours	mid esophagus	esophageal perforation; pneumothorax; pulmonary edema; generalized edema; kidney injury	chest pain	2 endoscopies to remove the battery (1 unsuccessful); nasogastric tube; bilateral chest tubes; intubation, ventilation, sedation; diuretics, antibiotics	unk
206	2016	Milford	11 mo	M	unk	unk	unk	unknown	unknown	upper esophagus	tracheoesophageal fistula (identified 4 days after battery removal)	tachypnea, cough, fever	endoscopic removal; sloughing and necrosis present at time of removal; defunctioning esophagostomy, Nissen fundoplication, placement of gastrostomy tube; thoracotomy to repair TEF ~3 weeks after esophagostomy, fundoplication and gastrostomy was done; 6 weeks after the TEF repair, the esophagostomy was reversed; repeated dilations required of esophagostomy site over a 7-month period	~3-4 days
207	2016	Milford	7 y	F	unk	unk	alkaline	watch	possibly one year	mid esophagus	esophageal stricture	dysphagia; coughing after feeding; recurrent respiratory tract infections; symptoms of aspiration; air-fluid level in esophagus above battery; foreign body found posterior to esophagus and medial to aortic arch	thoracotomy to remove alkaline button battery from an inflammatory esophageal stricture; stricture resected; primary esophageal anastomosis performed	likely 1 yr
208	2016	Abubakar	13 mo	M	CR 2025	20	lithium	TV remote control	30 h	upper esophagus	tracheoesophageal fistula	Following a difficult removal of a button battery from the esophagus, child had 7-months of choking during feeding; cough; vomiting; recurrent respiratory tract infections leading to several hospital admissions; weight loss	endoscopic removal of battery; repair of tracheoesophageal fistula (fistulous tract was transected and muscle flap placed between trachea and esophagus)	> 7 mo
209	2016	NBIH; ActionNewsJax.com	10 mo	F	CR 2032	20	lithium	TV remote control	5.5 hours	upper esophagus (cricopharyngeal area); negative pole anterior	circumferential esophageal burns; unspecified complications requiring 18 surgical procedures	mild stridor	removed with rigid esophagoscope after unsuccessful retrieval attempts using flexible scope	> 9 mo
210	2016	Şarkış	28 mo	M	unk	unk	unk	unknown	14 days	upper esophagus	pneumonia; hospitalized for 55 days	discomfort, refusal to eat, vomiting, slight wheezing	endoscopic removal of button battery from esophagus	unk
211	2016	NBIH	17 mo	F	unk	20	lithium	unknown	~5 months	proximal esophagus	esophageal stricture; spondylodiscitis C7-T2	persistent dysphagia x 5 months; vomiting started day of removal	endoscopic removal - no erythema or erosion present; edema and stricture noted on initial endoscopy; antibiotics for spondylodiscitis; lost to follow-up	unk
212	2015	Wilson	<1y	M	unk	≥20	lithium	unknown	>5 months	mid esophagus	esophageal stricture	vomiting; fever; weight loss; unable to eat solids; diagnosis missed for 5 months	vomiting; fever; weight loss; unable to eat solids; diagnosis missed for 5 months	>5 mo
213	2016	NBIH	18 mo	M	unk	20	lithium	unknown	unknown	proximal esophagus	esophageal stricture	vomiting; fever; coughing; choking	endoscopic removal; esophageal dilatation	> 4 mo
214	2016	NBIH	10 mo	F	2458	24	lithium	unknown	~3 hours	cricopharyngeal area	esophageal burn, hypotension, esophageal stricture	dysphagia; drooling	intubation, mechanical ventilation, feeding tube	> 5 mo
215	2016	NBIH	4 y	M	CR 2030	20	lithium	unknown	~2.5 hours	distal esophagus	esophageal burn requiring surgery to prevent AEF	unknown	endoscopic removal; surgery to reinforce the esophagus with muscle flap due to proximity to aorta	> 4 mo
216	2017	Chessman	12 mo	F	unk	20	lithium	unknown	~11 days	mid esophagus	16 mm tracheoesophageal fistula 12 mm above carina; mediastinitus; prolonged ICU care (25 days)	7-day history of fever, cough, vomiting, difficulty breathing; sent home, presented again 4 days later with worsening symptoms and started on antibiotics, presented a third time a day later with fever, tachypnea, desaturation, wheezing and dehydration	near total esophagectomy; cervical esophagostomy and gastrostomy; patch repair of trachea followed by tracheal stent	unk
217	2017	Duell	2 y	F	unk	<20 mm	lithium	key fob	unknown	esophagus	aorto-esophageal fistula; paralysis of legs	presented with diarrhea and vomiting; battery removed; hospitalized 8 days; about 5 days later developed hematemesis	surgical repair of aortoesophageal fistula; feeding tube	unk
218	2017	Dhal	18 mo	M	unk	20	lithium	scale	~2 weeks	mid esophagus	tracheoesophageal fistula	first presented with vomiting and fever, followed by cough which worsened over several weeks	endoscopic removal; gastrostomy tube placed for feeding; surgical repair of tracheoesophageal fistula after it failed to close spontaneously (over a month); repair began to leak, requiring another surgical procedure and use of a glue to close the leak	> 3 mo
219	2017	Sindi	15 mo	F	unk	unk	unk	unknown	~1 week	proximal esophagus	tracheoesophageal fistula and stricture	difficulty swallowing x 1 week prior to presentation; stridor x >5d; choking and cyanosis occurred post removal; periesophageal leakage of contrast noted on esophagram; repeat esophagoscopy >6 weeks after removal showed tracheoesophageal fistula	removal by flexible endoscopy; very deep, large esophageal ulceration with gangrenous tissue and local bleeding found; tracheoesophageal fistula repaired ~ 6 weeks after battery removal with pericardial patch interposition through a right thoracotomy; 3 months after TEF repair, child developed difficulting swallowing solids, choking and drooling and a tight esophageal fistula was found on esophagram; esophageal dilation was performed x4 3-8 months post TEF repair; no further issues were observed	~10 months

220	2017	Brancato	8 mo	F	unk	≥20 mm	lithium	unknown	<24 hours	mid esophagus (level of carina)	tracheoesophageal fistula diagnosed 11 days after battery removal; healed spontaneously with esophageal rest x 5 weeks	coughing, gagging, vomiting, mildly fussy; fever developed a day after removal, resolving by day 4; cough and tachypnea developed later	endoscopic removal of battery; G-tube feeding x 5 weeks	< 4 months
221	2017	Şencan	1 y	F	unk	20	lithium	unknown	>6 hours	upper esophagus	esophageal stricture; grade 3b esophageal injury	dysphagia; hypersalivation	removed by rigid esophagoscopy; dilation required x 1	unk
222	2017	Şencan	3 y	M	unk	20	lithium	unknown	>24 hours	mid esophagus	esophageal stricture; grade 3b esophageal injury	dysphagia; cough	removed by rigid esophagoscopy; dilation required x 1	unk
223	2017	Şencan	1 y	M	unk	20	lithium	TV remote control	1 month	upper esophagus	esophageal stricture; grade 3b esophageal injury; battery covered with granulation tissue	cough; decreased appetite; recurrent lung infection	difficult extraction; both rigid and flexible endoscopy used to retrieve battery; dilation x 8 required	unk
224	2017	Roberts	1 y	M	unk	unk	unk	bathroom scale	~24 hours	esophagus	1.2 cm tracheoesophageal fistula; collapsed left lung; hospitalized x 2 months	vomiting black liquid	battery removed endoscopically; surgical repair of tracheoesophageal fistula; prolonged induced coma	>2 mo
225	2017	NBIH	18 mo	F	unk	20	lithium	unknown	3-4 days	upper esophagus	large tracheoesophageal fistula noted at time of battery removal; abscess developed	presented with 3-4 days of cough and nonspecific respiratory symptoms	battery removed endoscopically; neck exploration with placement of flap between trachea and esophagus; tracheostomy; G-tube	still on tube feedings at 6 months
226	2017	USA Today	21 mo	F	unk	unk	unk	unknown	~10 hours	mid esophagus	tracheoesophageal fistula; esophageal stricture	difficulty breathing	unable to remove on intial attempt; transferred to second hospital for removal; feeding tube	>6 weeks
227	2017	Thatcher	13 mo	M	unk	≥20.0	lithium	unknown	6 hours	upper esophagus	bilateral vocal cord paralysis showing some but not complete improvement in 4 weeks; esophageal ulceration	respiratory distress (inspiratory stridor, retractions, tachypnea)	tracheostomy; nasojejunal tube	4 weeks
228	2017	NBIH	13 mo	M	unk	20	lithium	unknown	3 hours	upper esophagus	esophageal perforation; esophageal stricture; discitis at T3/T4	dysphagia, difficulty bending neck, fever, phlegmon	battery removed endoscopically	>1 month
229	2017	NBIH	20 mo	M	unk	unk	unk	remote control	20 hours	cricopharyngeal area	esophageal perforation	agitation, refusal to swallow	battery removed endoscopically; feeding tube	7 weeks
230	2017	NBIH	13 mo	M	CR2032	20	lithium	unknown	3 hours	cricopharyngeal area	abscess; bitlateral vocal cord paralysis; pneumonia	unknown	battery removed endoscopically; feeding tube; central line	>1 year
231	2017	NBIH	5 y	M	unk	unk	unk	unknown	4 days	distal esophagus	esophageal perforation	dysphagia, nose bleed	battery removed endoscopically; feeding tube	unk

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