

In the name of GOD

Caustic Ingestion

A red plastic bucket is filled with various household cleaning products. Visible items include a large white bottle of bleach, a yellow bottle of dish soap, a blue bottle of all-purpose cleaner, a green bottle of floor cleaner, and a white scrub brush. The products are arranged in a way that they appear to be spilling out of the bucket, creating a sense of clutter and potential hazard.

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SUMS 1399



Epidemiology

- 50%: in children ≤ 5 y/o: True?
- Cosmetics and household cleaning substances
- M predominance in < 12 years of age : unintentional
- F predominance in >13 years: suicide.
- Inappropriate storage
- Education and safety:
 - Warning labels and safety caps.
 - Stored and handled: accessibility
 - Use of secondary containers.

ALKALI



- Alkaline: most caustic ingestions
- Household **bleach**:
 - sodium hypochlorite: conc. : 5-10%, unintentional ingestion: minimal injury to the GI tract
 - Ingestion of large quantities: serious damage
- **Sodium hydroxide** (NaOH) or lye:
 - in drain, oven cleaners and dishwasher detergent.
 - severe injury to the GI tract: perforation and strictures

ACID

- Acid ingestion: <5% of all caustic ingestions
- Battery fluids (sulfuric), and swimming pool cleaners (hydrochloric).



PATHOPHYSIOLOGY

The severity of injury is dependent on the:

- $\text{pH} < 2$ and $\text{pH} > 12$: highly caustic
- High density: pass rapidly: serious burns in the lower esophagus and stomach.
- Strong acids: usually pass rapidly through the esophagus: damage in the stomach and duodenum.

- The physical state:
 - Solid: supraglottic and oropharynx area.
 - Powdered or crystalized: airways, pharynx, and upper esophagus.
 - Liquid agents:
 - increased surface area exposure: circumferential injury.
 - pass through the esophagus reaching the stomach and small bowel: more extensive injury
- The amount:
 - Alkaline: tasteless: larger quantities ingested.
 - Acids : unpleasant taste: limit the amount of acid ingested

Tissue injury

- Acids:
 - coagulation necrosis: eschar formation: limit acid penetration and ↓ depth of injury.
 - ↓ viscosity rapid transit to the stomach: gastric injury is more common: prepyloric area.
- Alkaline:
 - bind with tissue proteins: liquefactive necrosis and saponification: increased depth of injury.

Timeline of injury

- Esophageal injury: within minutes after ingestion, and persists for hours afterward.
- Mucosal sloughing and ulceration: 4 - 7 d after ingestion.
- Fibroblasts: around day 4 or 5 after ingestion.
- Deep ulceration into the muscle layer: perforation
- Day 10 postingestion, esophageal repair begins.
- Epithelialization of denuded tissue begins 1 month after initial exposure.
- The tensile strength of the injured tissue is low during the 1st 3 wks after injury.
- Starting in week 3, scar retraction occurs: stricture formation

Clinical Presentation

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- No complaints with NL physical examination → circulatory shock or severe respiratory distress.
- Drooling, vomiting, refusal of intake by mouth, and abdominal pain.
- Mouth lesions: erythema and or ulcers of the lips and oral mucosa.
- Hoarseness and stridor: upper airway involvement
- Dysphagia and odynophagia: esophageal injury
- Epigastric pain and bleeding: stomach involvement.
- Sign of esophageal perforation
- ≥ 2 : vomiting, drooling, or stridor: serious esophageal injury.



- The presence or absence of symptoms: not predict the likelihood or extent of GI injury.
- The presence or absence of oral lesions: a poor indicator of esophageal injury.
- 12% of asymptomatic children: severe esophageal burns
- 82% of symptomatic children had no esophageal burns.





CLINICAL ASSESSMENT

- History & physical examination
- Ingested material, pH, volume, timing
- Accidental or intentional: ?volumes
- Airway assessment and evaluation of the mouth for oral lesions.
- Evaluate the risk for hemolysis, DIC, renal failure, and liver failure: laboratory studies

- CXR including diaphragm:
 - air in the mediastinum: esophageal perforation
 - free air under the diaphragm: gastric perforation.
- Contrast study: not indicated
- **WBC > 20,000:** a predictor of mortality.



- EGD: a vital tool in the evaluation of patients
- The recommended timing: 12 - 24 hrs after caustic ingestion, until 96 hours.
- After a chest X-ray including diaphragm
- Avoided 5 - 15 days after caustic ingestion



- The most important initial factors: risk for respiratory compromise or shock.
- Initial management: airway assessment
- Supraglottic or epiglottic burns with erythema and edema: sign of airway obstruction: early endotracheal intubation.
- Fluid resuscitation: hemodynamic instability.
- admitted to the hospital, NPO, IV fluids
- Severe esophageal and gastric necrosis: antibiotic therapy and emergent surgery
- Shock, fever, or prostration: profound tissue damage: immediate surgical consultation.
- PPI or H2B



- Induced vomiting: to avoid re-exposing
- Charcoal: not absorb caustic agents.
- Consuming a weak acid or base to induce pH neutralization: an exothermic reaction.
- Consuming milk or water as a dilution: risk of vomiting

در منزل:

- از ایجاد استفراغ **اجتناب** شود.
- از خوراندن شیر یا آب **پرهیز** شود.
- از خوراندن ماده خنثی کننده **اجتناب** شود.
- سریعاً به بیمارستان انتقال داده شود.

در مرکز بهداشتی درمانی:

- از گذاشتن لوله معده **خودداری** شود.
- از شستشوی معده **اجتناب** شود.
- از تجویز مواد جاذب **پرهیز** شود.
- از راه دهان چیزی خورانده **نشود**.
- برای کودک سرم وصل شود.
- در فاصله زمانی 12 تا 48 ساعت از خوردن ماده سوزاننده جهت انجام اندوسکوپی ارجاع شود.

نحوه برخورد با کودکی که مقداری ماده سوزاننده خورده است:

**بهترین کار این است که هیچ
اقدامی انجام ندهیم.**

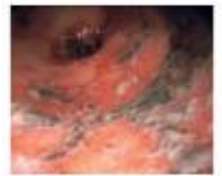
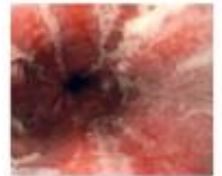
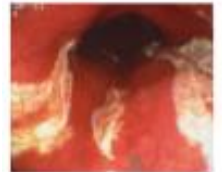
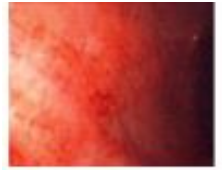
TABLE 18-2 CLASSIFICATION OF CAUSTIC INJURY

Grade	Visible Appearance	Clinical Significance
Grade 0	History of ingestion, but no visible damage or symptoms	Able to take fluids immediately
Grade 1	Edema, loss of normal vascular pattern, hyperemia, no transmucosal injury	Temporary dysphagia, able to swallow within 0 to 2 days, no long-term sequelae
Grade 2a	Transmucosal injury with friability, hemorrhage, blistering, exudate, scattered superficial ulceration	Scarring, no circumferential damage (no stenosis), no long-term sequelae
Grade 2b	Grade 2a plus discrete ulceration and/or circumferential ulceration	Small risk of perforation, scarring that may result in later stenosis
Grade 3a	Scattered deep ulceration with necrosis of the tissue	Risk of perforation, high risk of later stenosis
Grade 3b	Extensive necrotic tissue	High risk of perforation and death, high risk of stenosis

Source: Zargar SA, Kochhar R, Mehta S, Mehta SK. The role of fiberoptic endoscopy in the management of corrosive ingestion and modified endoscopic classification of burns. *Gastrointest Endosc* 1991;**37**:165–9.³⁷

Zargar's classification

- grade 0: normal
- grade 1: edema and hyperemia of the mucosa
- grade 2a : superficial ulcer, erosions, friability, blisters, exudates, hemorrhages, whitish membranes
- grade 2b : grade 2a + deep discrete or circumferential ulcerations
- grade 3a: small scattered areas of multiple ulceration and areas of necrosis with brown-black or grayish discoloration
- grade 3b: extensive necrosis
- grade 4: perforation





- grade 1: no treatment, the patient discharged home.
- 2a: observed for 1-3 days in the hospital: antibiotics and acid-suppression
- 2b: steroid?
- 2b or 3:
 - Liquids are given by mouth
 - unable to eat: gastrostomy or parenteral nutrition.
 - TPN: at least 3 weeks
 - PPI: to prevent GER
 - A broad-spectrum antibiotic: cephalosporin or gentamicin

PREVENTION OF STRICTURES

- Corticosteroids: controversial: ? reduce stricture formation
- Dexamethasone: 0.15 mg/kg/dose q8h
- Grade 2b esophageal lesions



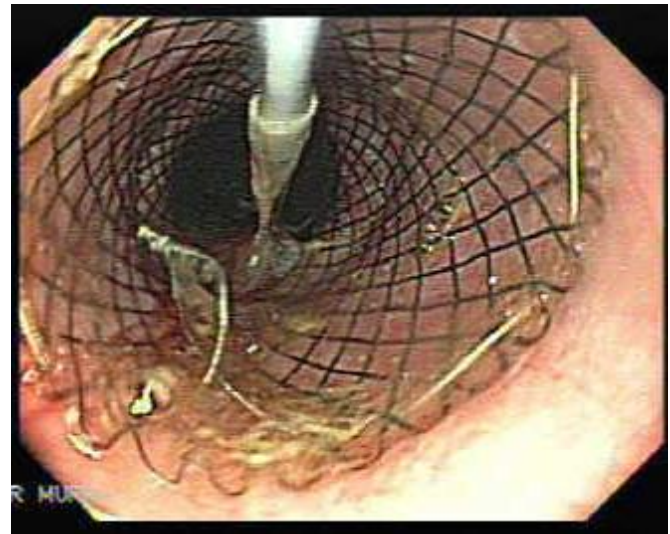
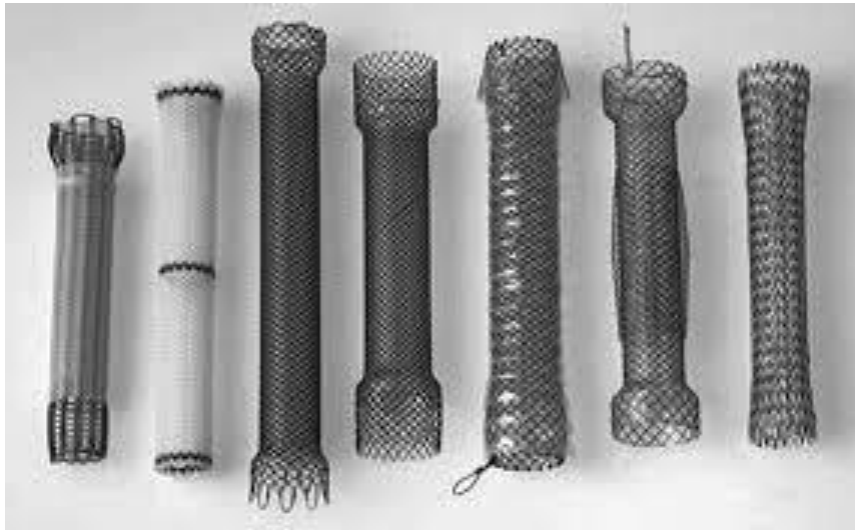


- Caustic ingestion with associated signs of infection, peritonitis, or mediastinitis.
- Full-thickness injury: at high risk for perforation



- Patients treated with steroids should also be treated with antibiotics
- Steroids may mask signs of perforation and infection

Esophageal stent



Complications



- Acute:
 - aspiration pneumonia
 - respiratory failure
 - systemic complications (liver & kidney).
 - upper gastrointestinal bleeding
 - perforation

- **Late**: 3 weeks after the ingestion.
- Esophageal **stricture**: 77% with grade IIb & 100% with grade III
- Others: achalasia, GER
- Barium swallow: by the end of the 1st month, at least for grade 2b and 3 lesions.

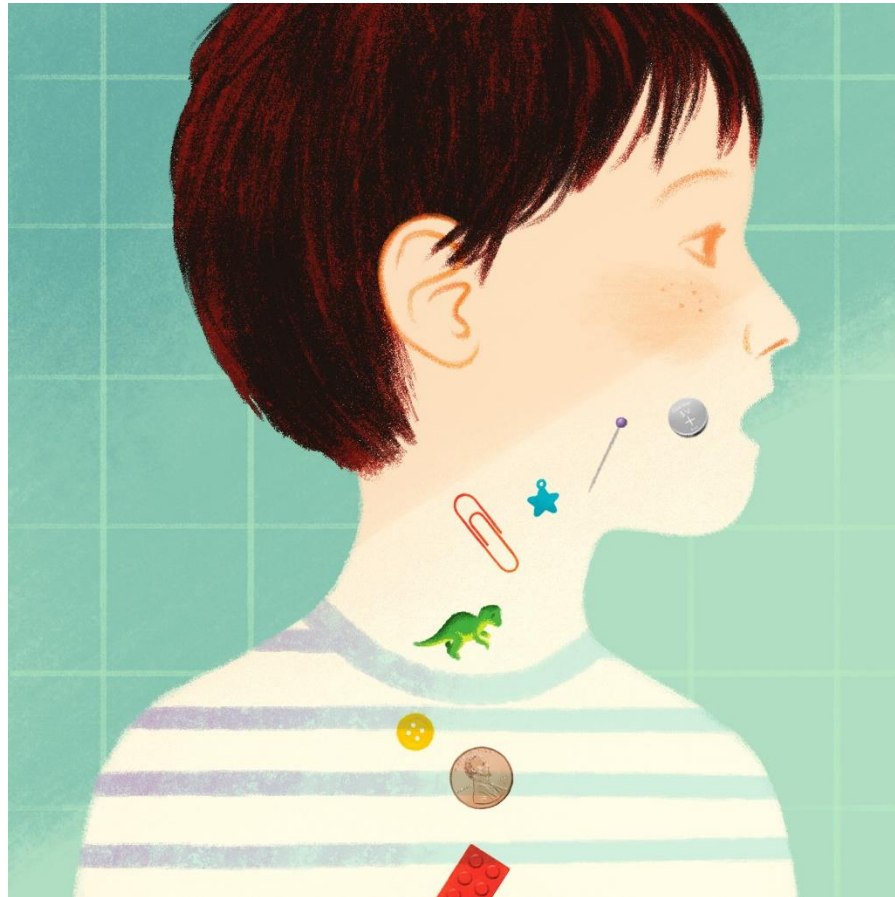
Management of stricture: Endoscopic
Dilatation: 1-2 months after ingestion.





- Very late: malignancy.
- 1000 to 3000 -fold increase

FB Ingestion

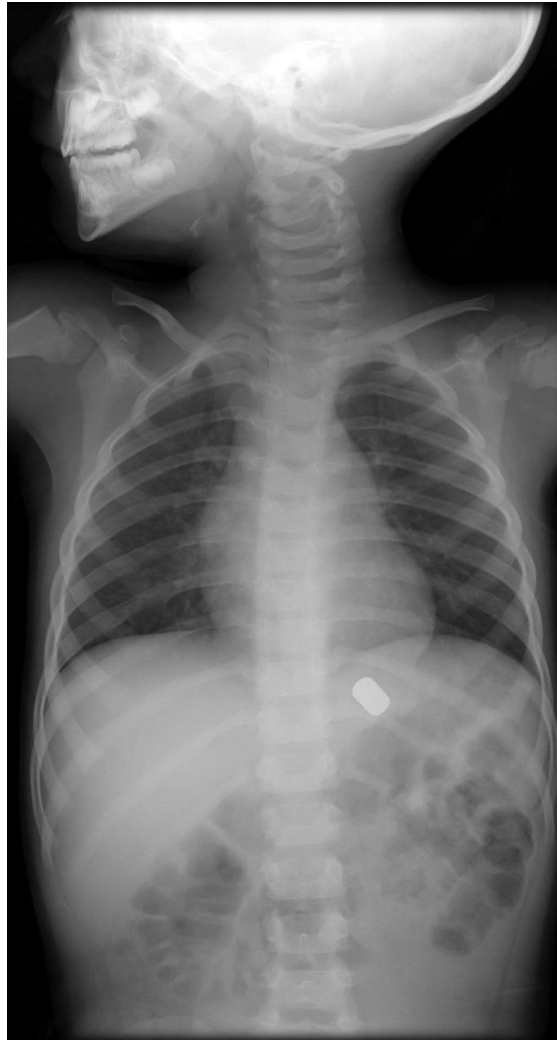


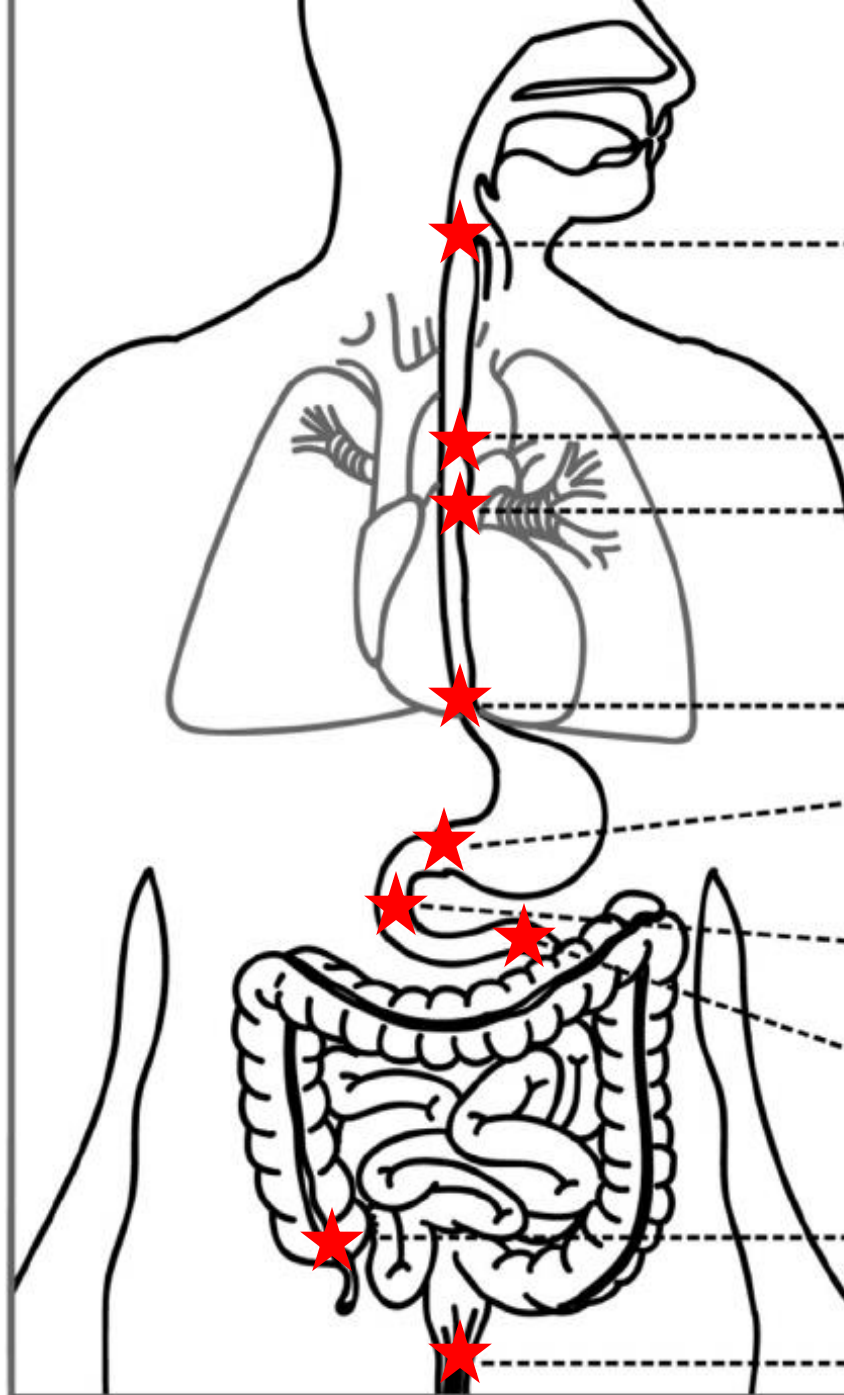
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- Witnessed: respiratory symptoms, difficulty controlled secretion, drooling, dysphagia, choking, vomiting, abdominal pain, chest pain,...
- Unwitnessed: fever and wheeze

Radiologic Evaluation

- Neck: AP, Lat
- Chest: AP, Lat
- Abdominal plain X ray





Esophagus

Cricopharyngeus muscle is the most common site of esophageal impaction (75%).²⁴ FB at or above cricopharyngeus muscle warrants otorhinolaryngology consult.²¹

Aortic arch, left main bronchus, and gastroesophageal junction are also common levels of esophageal impaction. Any FB in the esophagus should be removed, except for coins, which can be observed for 12-24 hours before endoscopic removal.²¹

Pylorus

Blunt object with width > 2.5 cm have difficulty passing through and should be removed endoscopically.²¹

Duodenal C-loop

Blunt object with length > 6 cm have difficulty passing through and should be removed endoscopically.²¹

Ligament of Treitz

Most common location of perforation by long ingested object.²⁵

Ileocecal Valve

Common site of obstruction.^{18, 24-26}

Rectum/Sigmoid Colon

Objects longer than 10 cm or object located in sigmoid colon are associated with failure by transanal extraction.⁶⁵

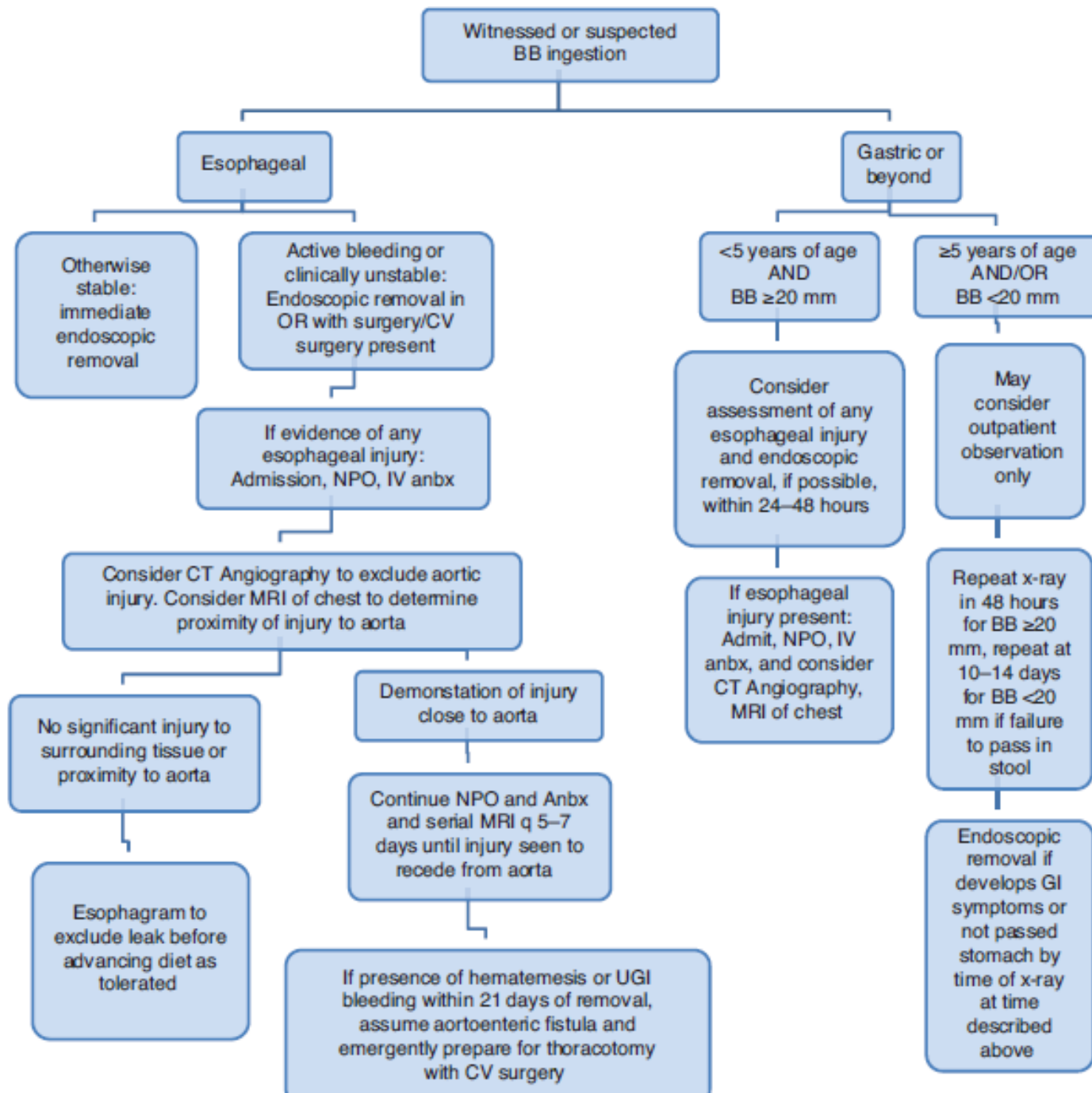
BOX 18-1 *Indications for Urgent Foreign Body Removal*

- Signs of respiratory distress
- Signs of esophageal obstruction such as inability to manage secretions
- Button battery in the esophagus
- Sharp objects
- Objects ≥ 5 cm in length and/or ≥ 2 cm in width
- Multiple high-powered magnets
- Signs of intestinal obstruction, such as fever, abdominal pain, or vomiting
- Foreign body has been impacted in the esophagus for more than 24 hours or for an unknown period of time

Disc Batteries



- In esophagus: emergently removed within 2 hr of presentation regardless of NPO time: mucosal injury: 1 hr of contact time and involve all esophageal layers within 4 hr
- < 6 y/o with batteries ≥ 15 mm: remove if present in the stomach ≥ 4 days
- Conservative approach for children ≥ 6 y/o or if the battery is ≤ 15 mm .
- Stools should be checked and repeat radiographs if the battery has not passed within 10 -14 days.



Single magnet

- Within the stomach or esophagus:
 - Consider endoscopic removal
 - Follow with serial x-rays as outpatient and educate parents*
- Beyond the stomach:
 - Consider endoscopic removal
 - Follow with serial x-rays as Outpatient: Educate parents: Confirm passage with serial x-ray: If delayed progression, may use PEG 3350 or other laxative to aid passage



- Remove any magnetic objects nearby
- Avoid clothes with metallic buttons or belts with buckles
- Ensure no other metal objects or magnets are in the child environment



Multiple magnet or single magnet + metallic object

- All within the stomach or esophagus
 - endoscopic removal <12 hours
- Beyond the stomach:
 - Symptomatic: pediatric surgery
 - asymptomatic:
 - If no obstruction or perforation on x-ray, may remove by enteroscopy or colonoscopy if available or follow with serial x-ray
 - serial x ray in ED to check for progression every 4–6 hours

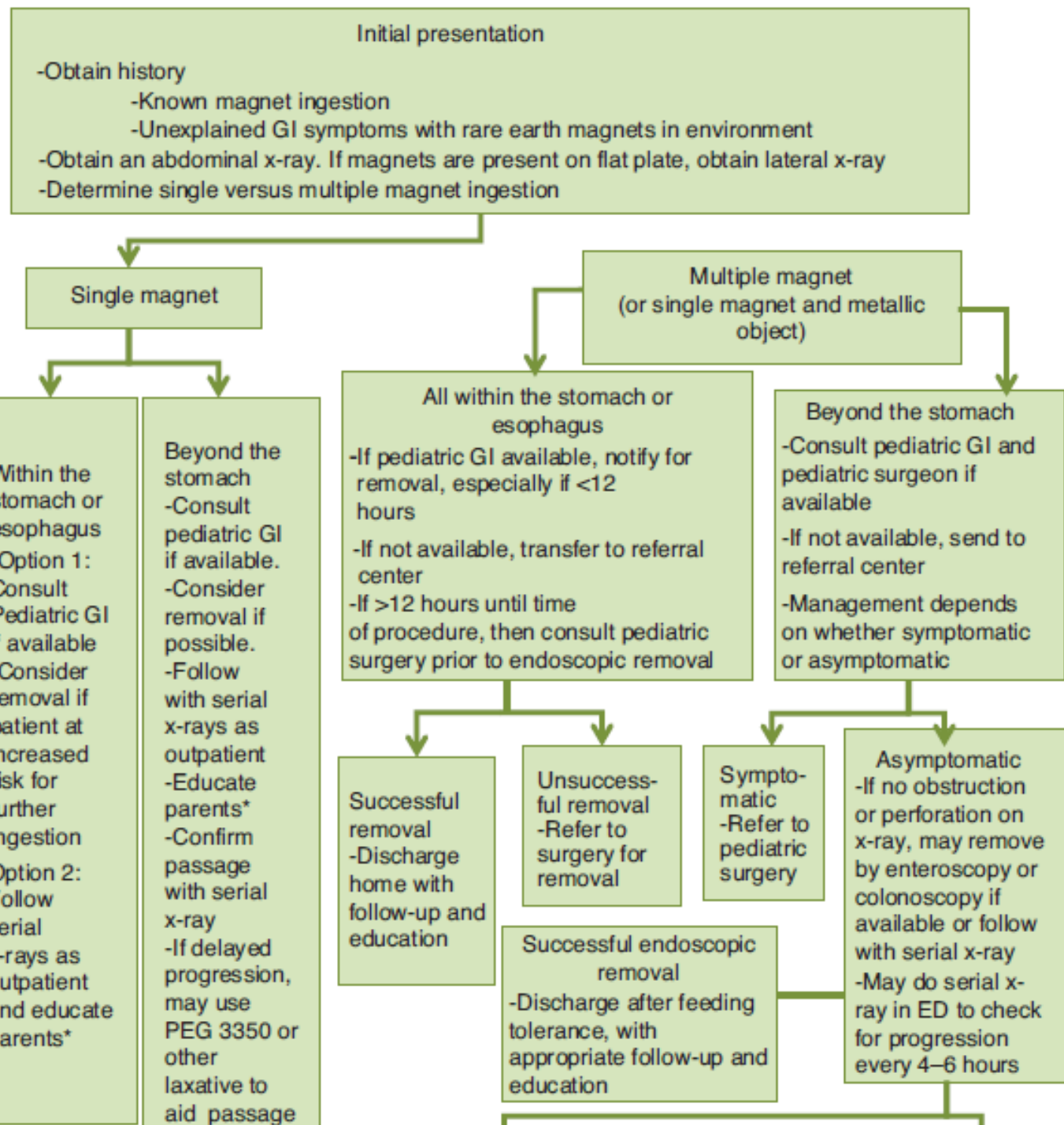
Multiple magnet or single magnet + metallic object

- No progression on serial x-rays
 - Admit for further monitoring and serial x-rays or surgical removal
 - May use PEG 3350 or other laxative to aid in passage
 - Continue serial x-ray every 8–12 hours. If no symptoms: surgical removal

Multiple magnet or single magnet + metallic object

- Progression of magnets on serial x-rays
 - Educate parents on precautions* and discharge with close follow-up
 - Confirm passage with serial x-rays
 - If at any time magnets do not progress or patient becomes symptomatic, admit to hospital for removal of magnets





removal if patient at increased risk for further ingestion

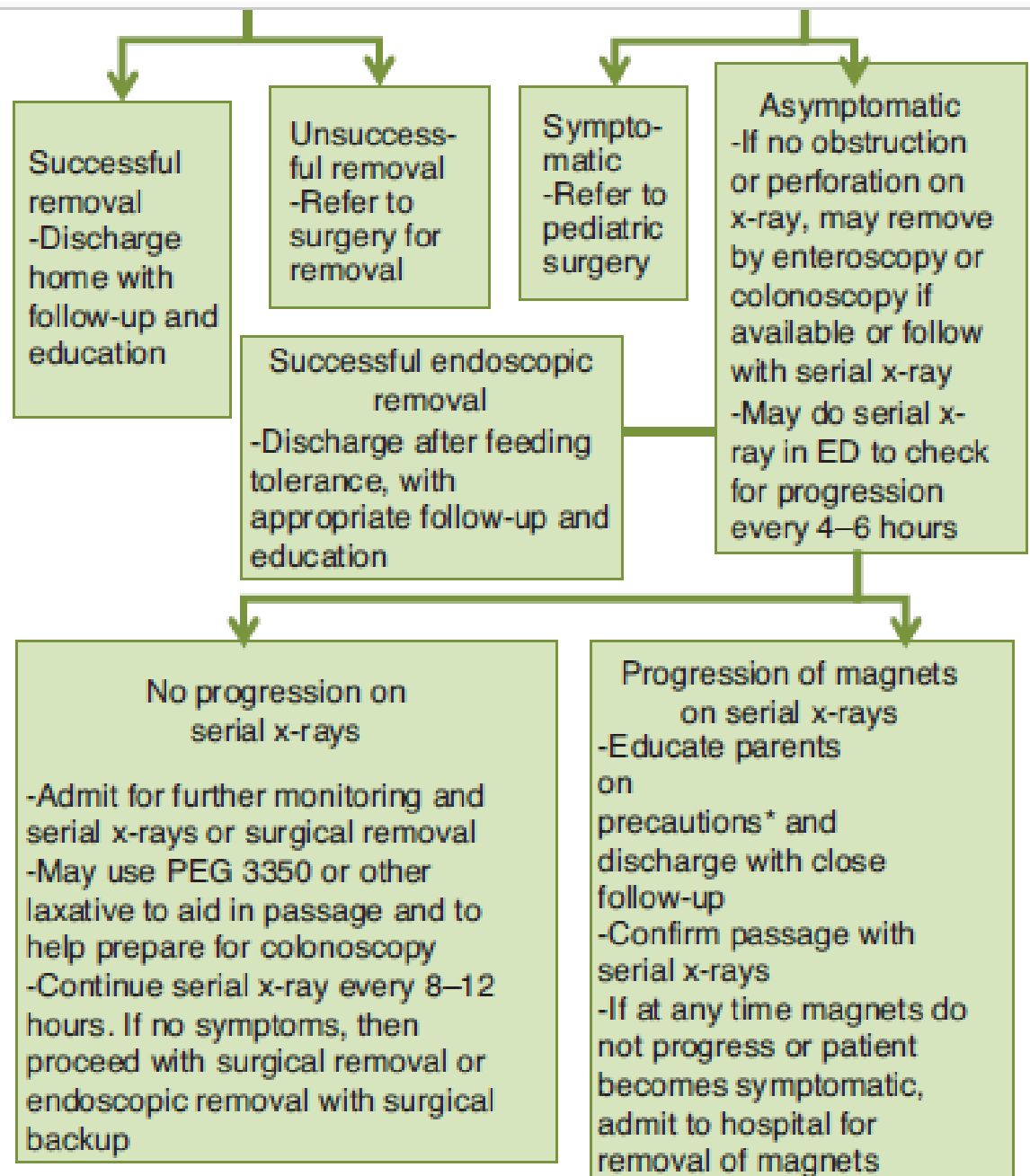
-Option 2: Follow serial x-rays as outpatient and educate parents*

with serial x-rays as outpatient

-Educate parents*
-Confirm passage with serial x-ray
-If delayed progression, may use PEG 3350 or other laxative to aid passage

*Parental education:

-Remove any magnetic objects nearby
-Avoid clothes with metallic buttons or belts with buckles
-Ensure no other metal objects or magnets are in the child environment for accidental ingestion

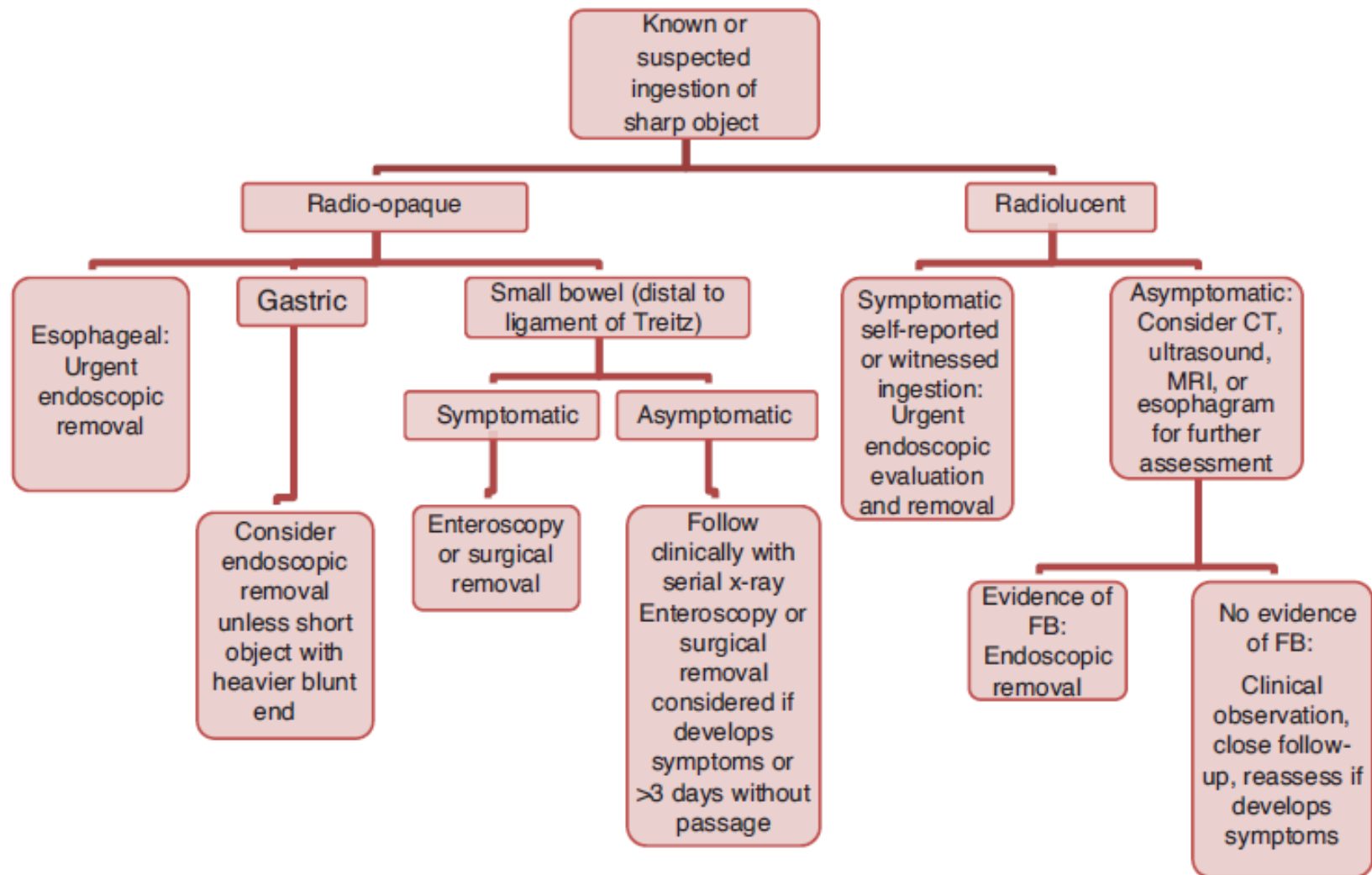


Sharp object

- Radio-opaque
 - Esophageal: Urgent endoscopic removal
 - Gastric: Consider endoscopic removal
 - Small bowel (distal to ligament of Treitz)
 - Symptomatic: surgical removal
 - Asymptomatic: Follow clinically with serial x-ray
 - surgical removal if symptomatic or >3 days without passage

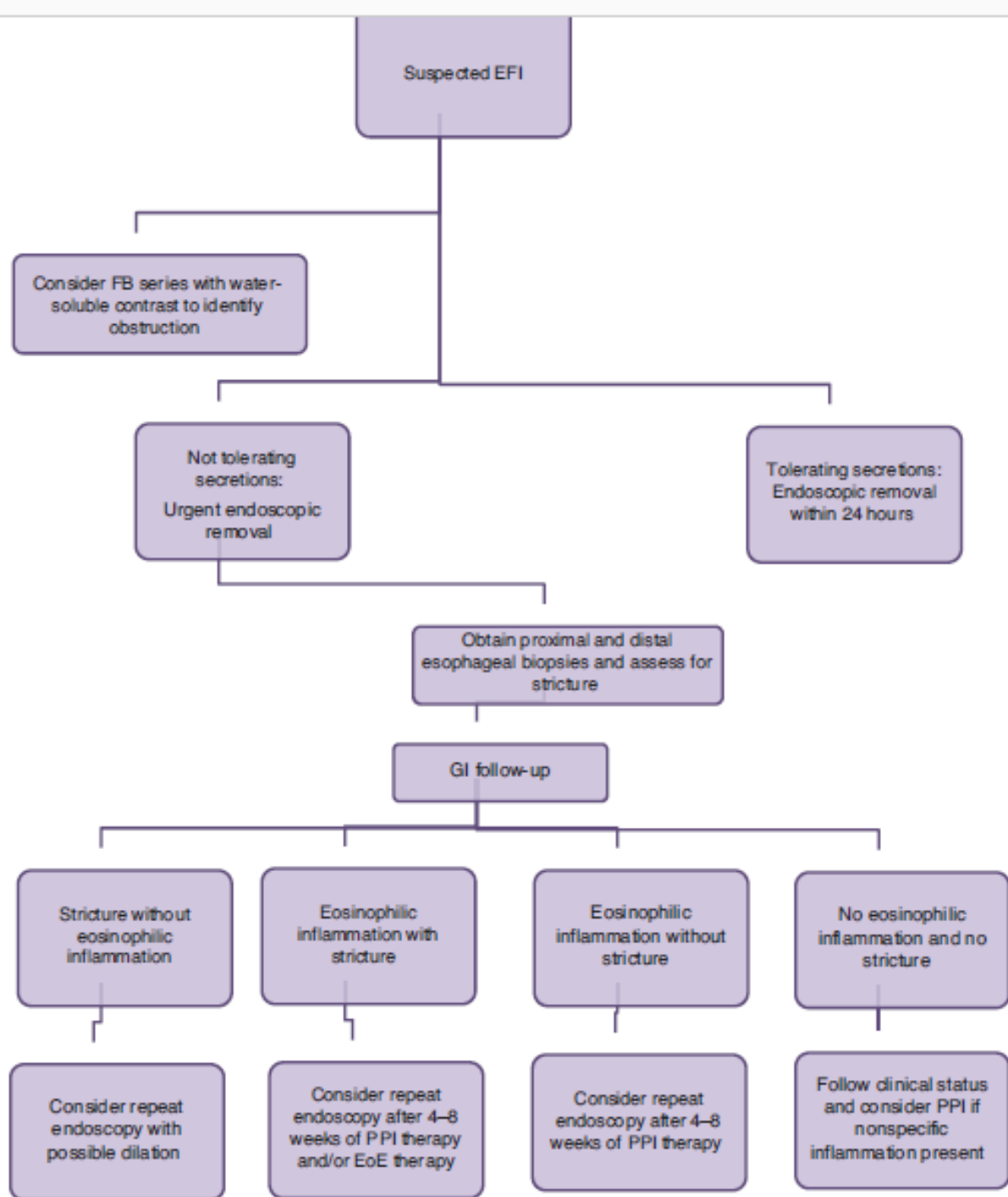
Sharp object

- Radiolucent
 - Symptomatic: self-reported or witnessed ingestion: Urgent endoscopic evaluation and re
 - Asymptomatic: Consider CT, ultrasound, MRI, or esophagram for further assessment



Esophageal food impaction

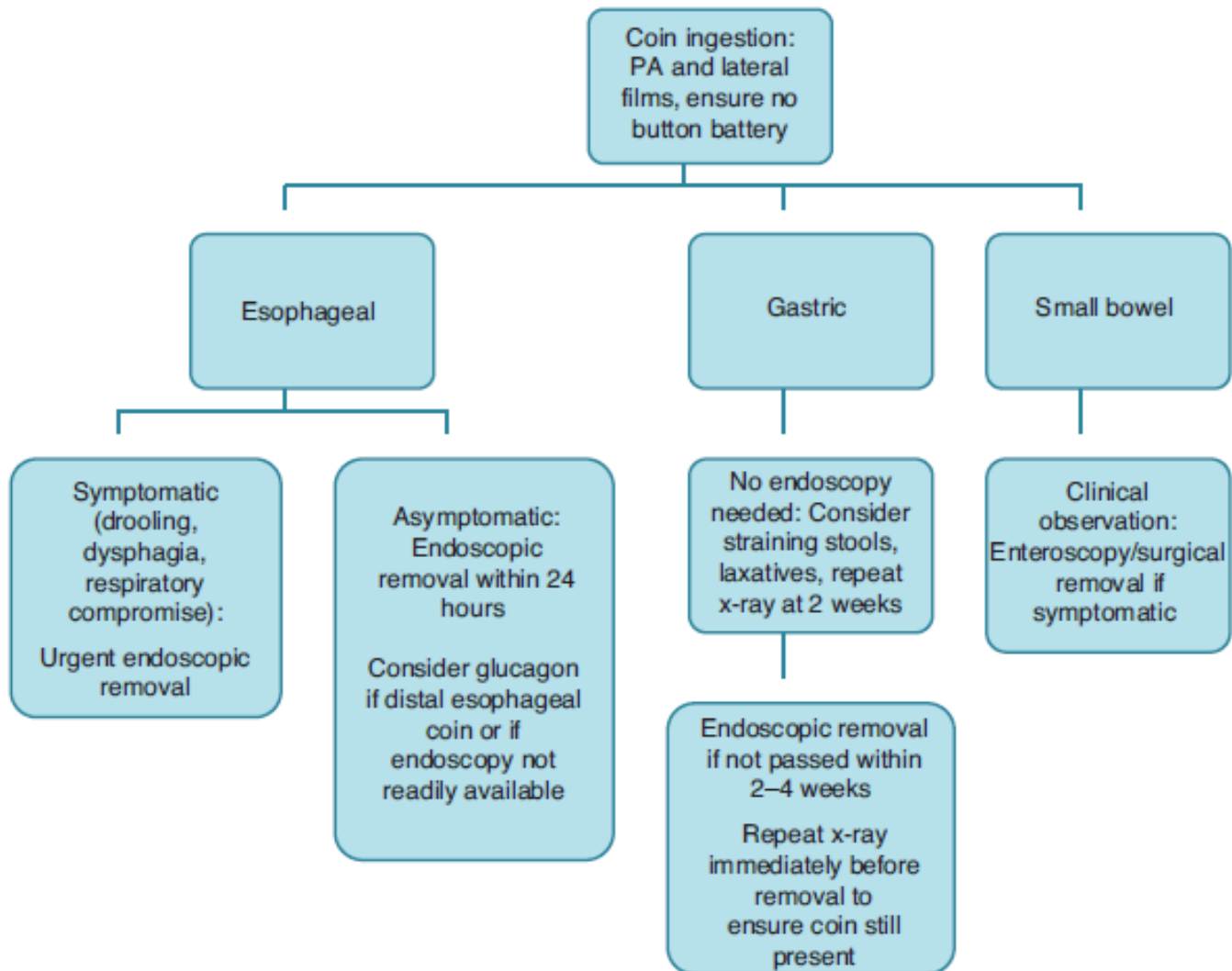
- Not tolerating secretions: Urgent endoscopic removal
- Tolerating secretions: Endoscopic removal within 24 hours
- PHX: esophageal atresia
- EOE



Coin:



- PA and lateral films, ensure **no button battery**
- Esophageal:
 - Symptomatic: Urgent endoscopic removal
 - Symptomatic: drooling, dysphagia, respiratory compromise
 - Asymptomatic: Endoscopic removal within 24 hours
- Gastric: No endoscopy needed: Consider straining stools, laxatives, repeat x-ray at 2 weeks
 - Endoscopic removal if not passed within 2–4 weeks
 - Repeat x-ray immediately before removal

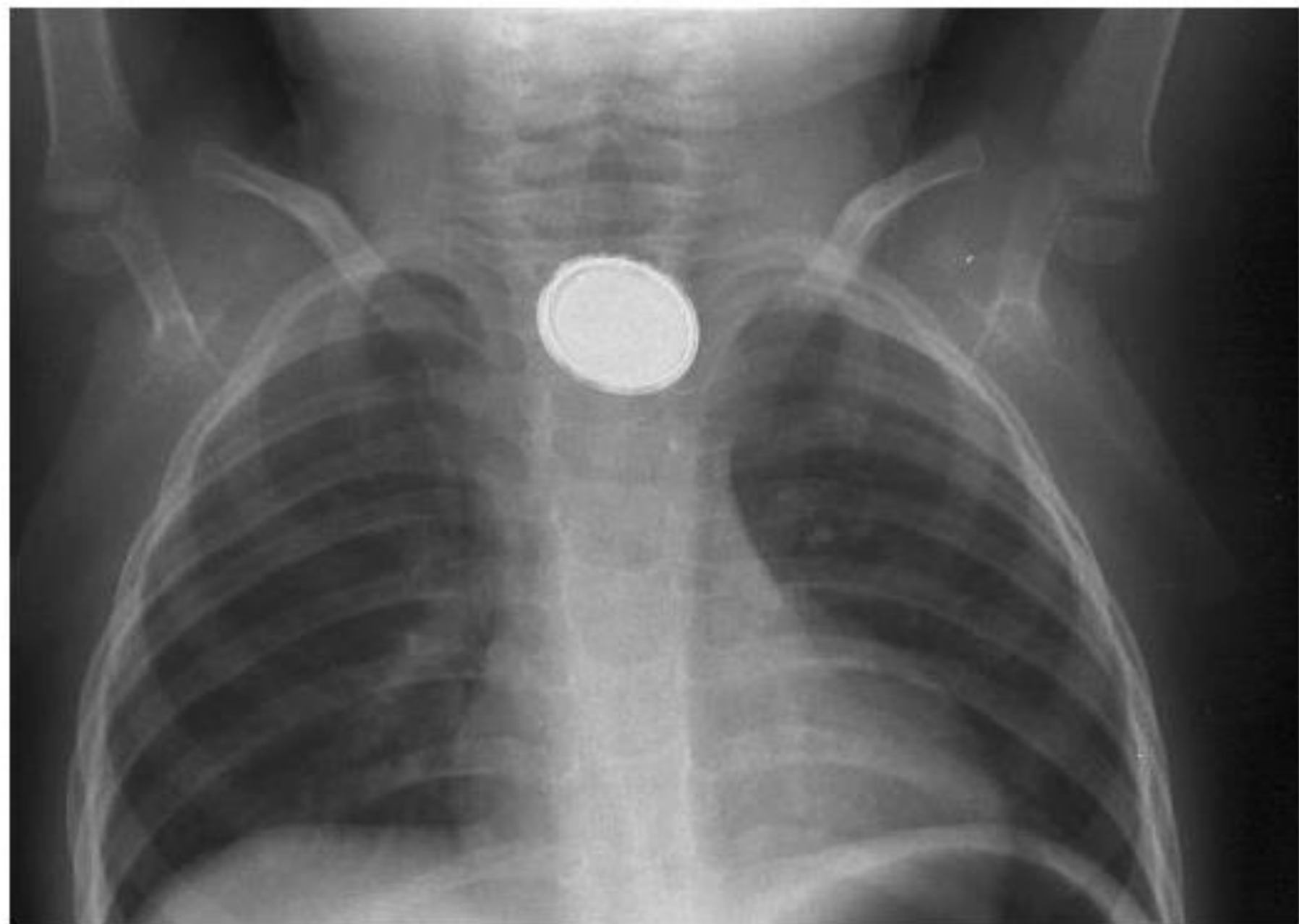


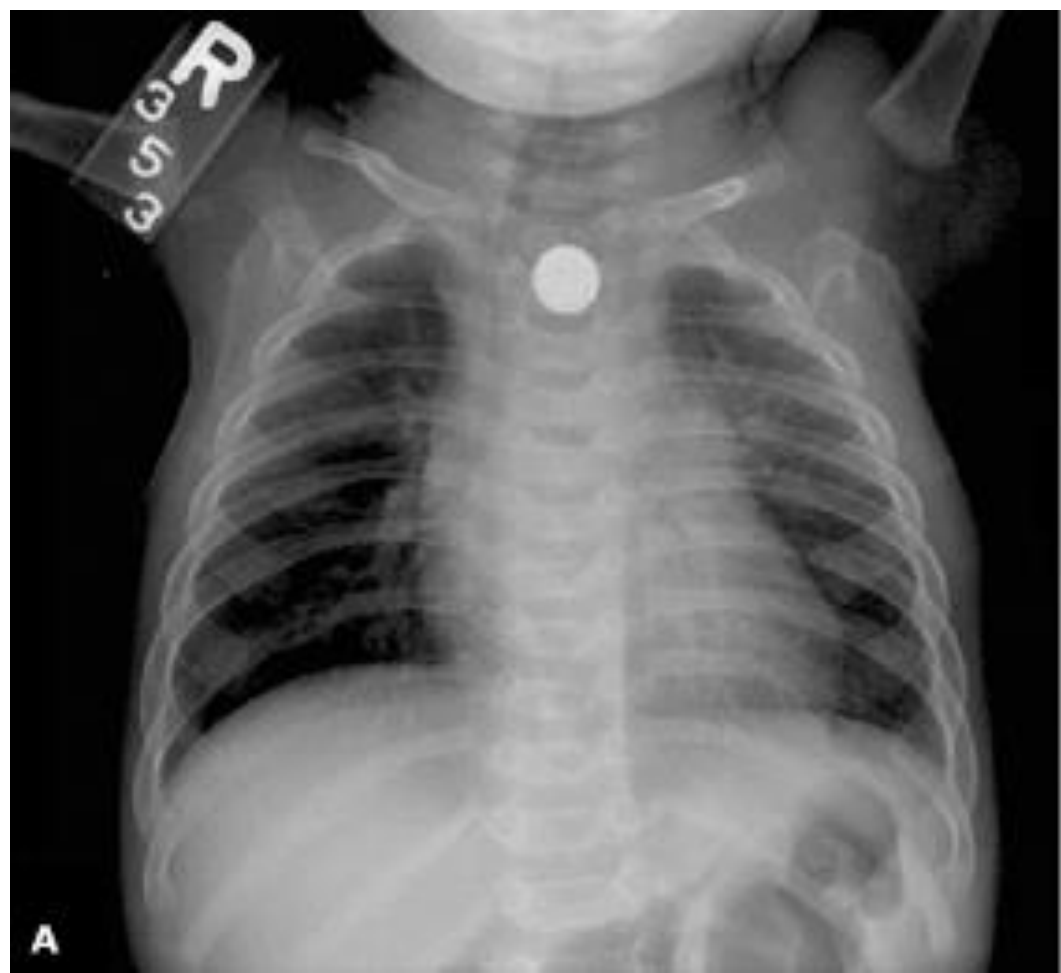
Cylindrical batteries

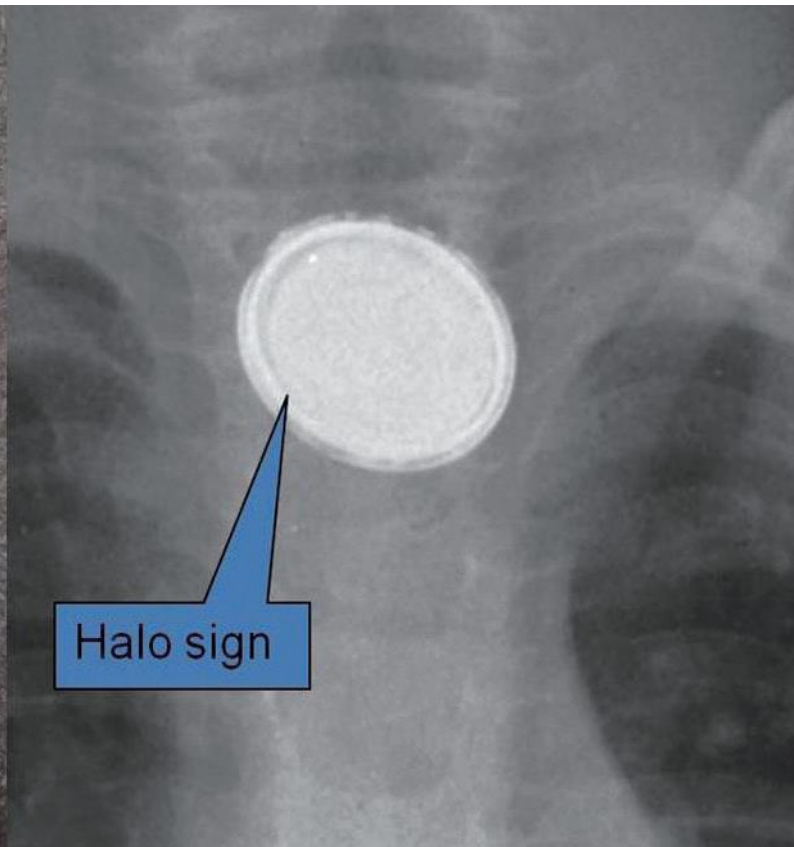


- Lower risk
- In the esophagus: remove urgently.
- In the stomach remain ≥ 48 : remove endoscopically.
- Rechargeable batteries may contain lithium









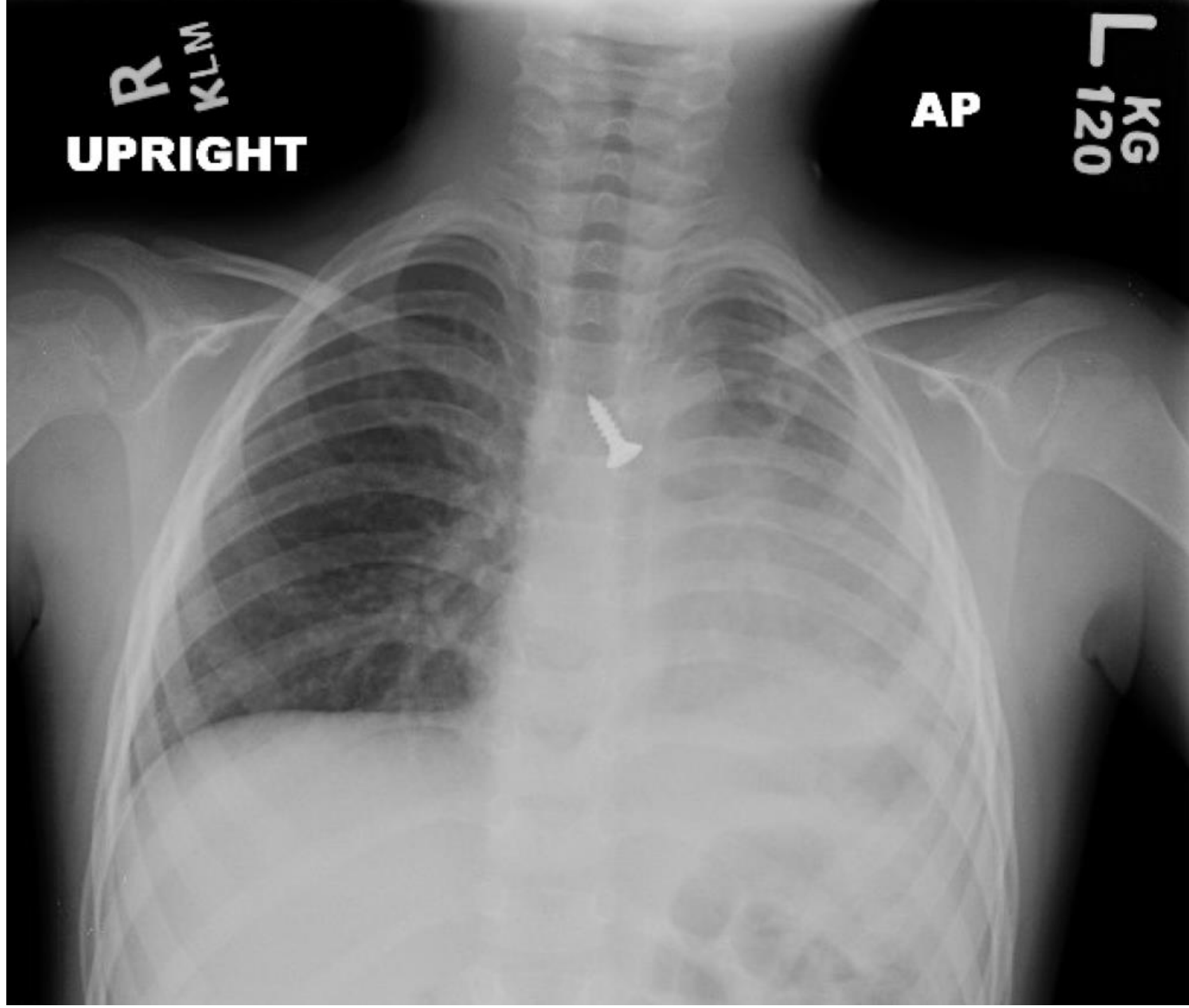
Halo sign



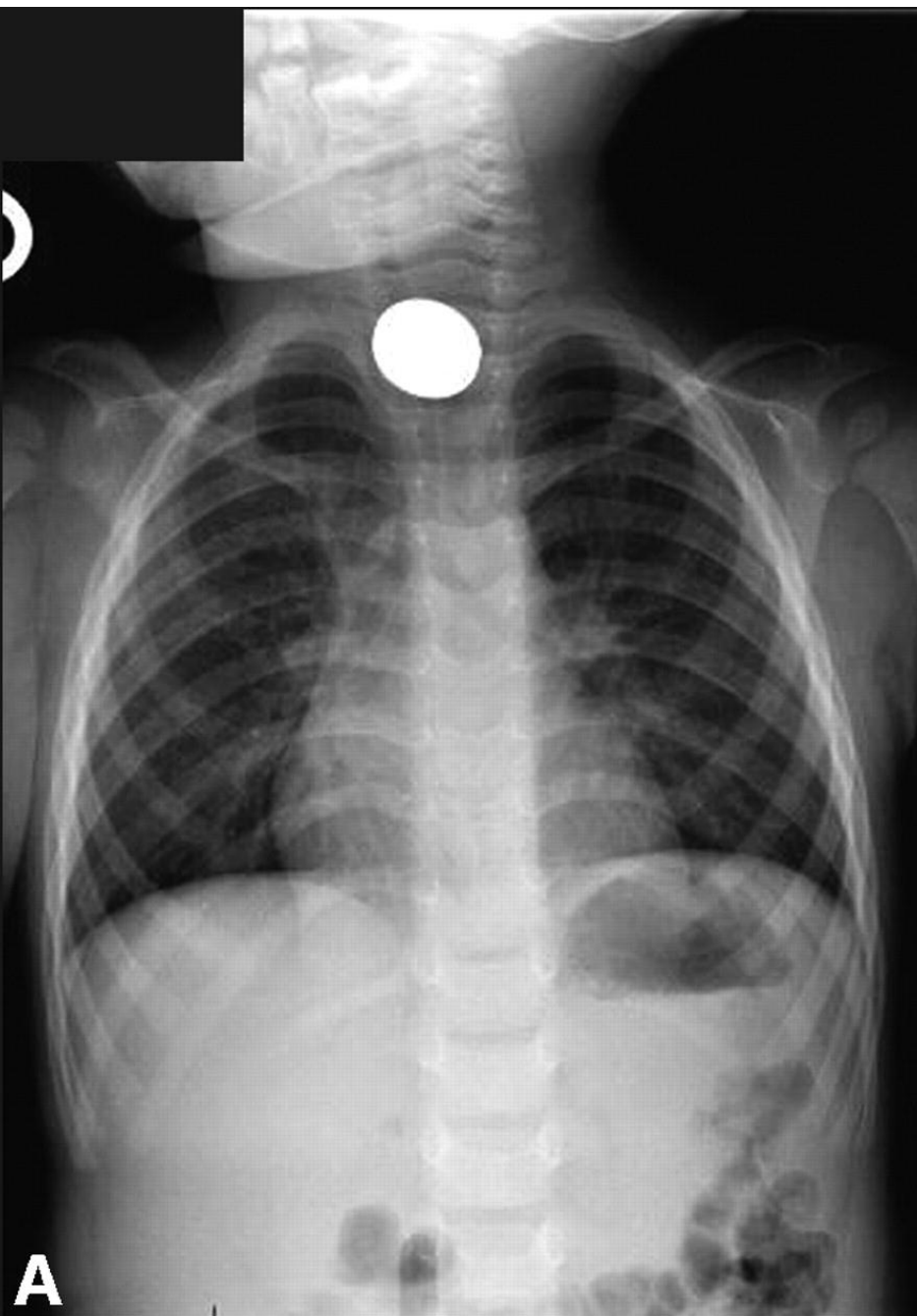
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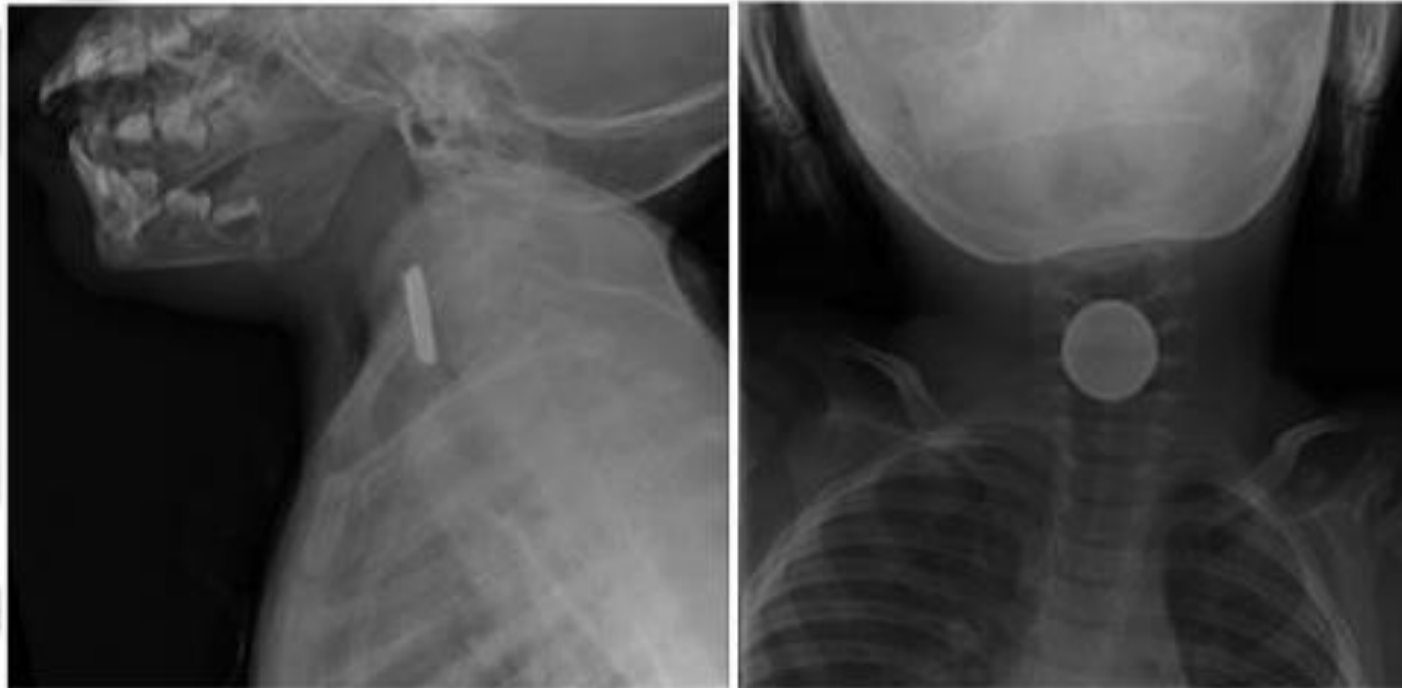
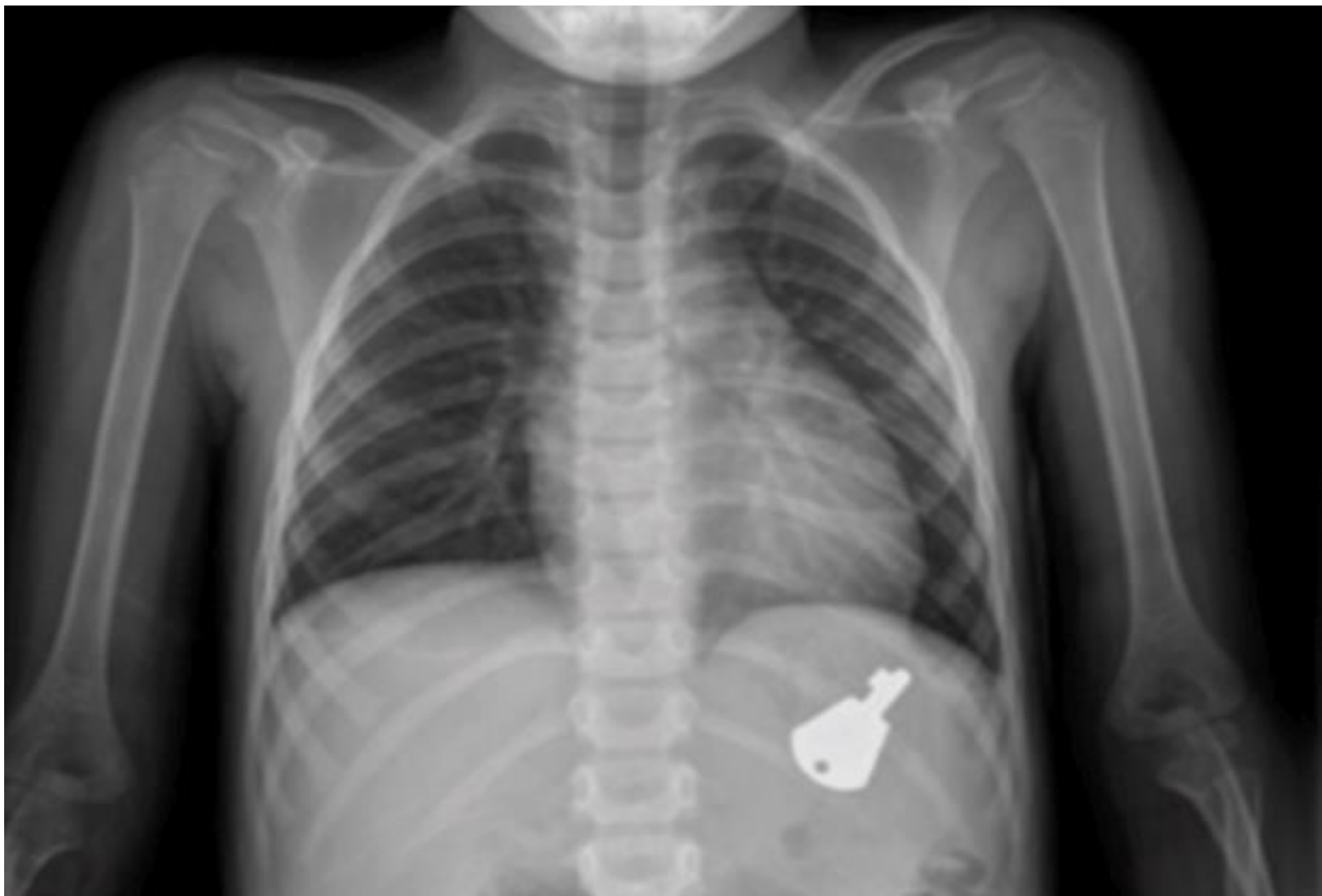


Figure 1. Lateral and Frontal View of Ingestion of a disk battery. Note the two-step pattern on the lateral radiograph and the double circle pattern in coronal plane on the frontal radiograph. (Adapted from Pediatric Foreign Body Ingestion - eMedicine 2010)



Thank you – Any Questions???

