The Darn Things that Kids Put into their Mouths: Foreign Body and Caustic Ingestion

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Objectives

1. Identify clinical problems associated with common foreign body ingestion and caustic ingestion.
   - Coin
   - Sharps
   - Batteries
   - Magnets

2. Describe management of foreign body ingestion and caustic ingestion.
Historical Trivia

- First recorded pediatric foreign body ingestion (1692)
  - Frederick the Great
    - shoe buckle at 4 years of age
Foreign Body: Epidemiology

- Peak between 6 months to 3 years of age
- > 110,000 FB ingestion in pediatric population in US (2011)  
  • Underestimated
- Extremely low mortality rates  
  • 1 death among 2206 children
- Coins are most common in North America & Europe compare to fish bones (Asia)
- Variation in ages  
  • Children: coins (up to 70%)  
  • Adults: meat/ fish bones

1 American Assoc of Poison Control Center’ National Poison Dada System (NPDS)
Locations of Foreign Bodies

- Oropharynx: 5-10%
- Esophagus: 20%
- Stomach: 60%
- Beyond stomach: 10%
  (Duodenum, IC valve, rectum)
Do They Pass

Passage within 4-6 days

- **Pass Spontaneously (80-90%)**
- **Endoscopic Removal (10-20%)**
- **Surgery (1% or less)**
Stuck at Esophagus

- 60-70% proximal esophagus (UES or thoracic inlet)
- 10-20% midesophagus (aortic notch or left main bronchus)
- 20% distal esophagus (LES)
Potential sites of no passage

- Pylorus
- Duodenal C loop with its fixed retroperitoneal location
- Ileocelecal valve
CASE #1 - Coin

- 2 years old female
  - Swallowed coin 5 days
  - No symptoms
  - Mom advised to observe
  - Started to complain of abdominal pain
  - Outside ED
    - coin in esophagus
  - Transferred to Cook ED
CASE #1-Coin

- EGD with FBR
  - Penny at the mid-esophagus
  - Two deep ulcers
- Admitted for observation
  - Advanced diet
  - PPI + sucralfate
- Discharge
- Follow-up
Coin

- Most common FB that retained in the esophagus
- No Passage Out of Stomach Based on Size
  - Diameter >2 cm
  - Length >5 cm (children)
  - Length >3 cm (infant)
- Teen/Adults
  - Length >10 cm (duodenal C loop)
Conditions that Prevents Passage

- Strictures and rings
- Dysmotility
- Achalasia
- Eosinophilic esophagitis
- Tight Nissen fundoplication
- Congenital defects (TEF)
Where is the coin?

60-90% are radio-opaque
Coin/ Blunt Objects

- **Asymptomatic**
  - Esophagus
    - observe 12-24 h for possibly spontaneous passage to stomach
  - Repeat XR in 12-24 hours

- **Symptomatic**
  - Proximal esophagus (eg. cough, stridor, respiratory distress)
  - Middle/ distal esophagus (eg. pain, drooling, dysphagia)
  - **Always** remove
Removal Techniques

- Flexible endoscopy
- Rigid endoscopy
  - Surgeon
  - proximal esophagus
- Magill Forceps
  - oropharynx or UES
- Bougienage dilators
  - push coins into stomach
- Foley catheter technique

10-20% of children with foreign bodies ingestion are managed endoscopy.
CASE #2 - Sharps

- 3-1/2 years old male
  - Swallowed nail 4 hrs prior to the ED
- AXR: Object at LUQ suggestive in stomach or colon
- Leave or Take-out?
CASE #2 - Sharps

- EGD w/ FBR
  - Distal duodenum
**Special Consideration: Sharps**

- **Sharp Objects**
  - Bones, safety pins, paperclips, needles, toothpicks
- **Risk of complications (high as 35%)**
- **Straight pin can pass uneventfully**
  (if blunt end head first)
- **Sites of perforation**: esophagus, C-loop of duodenum, terminal ileum, ICV, sigmoid
Sharps

- Retrieve **ALWAYS** if possible: esophagus, stomach or duodenum
- Esophagus need protection from sharp objects
  - Protector hood
- Jackson’s axiom “Advancing points perforate and **trailing points** don’t”
Sharps Beyond the Retrieval Site

- Beyond duodenum, not symptomatic:
  - Follow radiographically every 5 days
- Surgery if object fail to progress further in intestine for > 3 days
Complications

- Mediastinitis
- Strictures (esophagus)
- Fistulas
- Esophageal diverticula

- Perforations
  - 75% occurs in the ileocecal valve

- Obstructions
  - Congenital malformations (Meckel’s diverticulum)
  - Prior surgery

- <1% extraluminal migration
CASE #3: Batteries

- 2 yo girl with babysitter
  - Swallowed a “coin”
  - Drooling, decreased PO, difficulty swallowing, difficulty breathing, cough, and “not acting like herself”
  - Brought to Cook ED
CASE #3: Batteries
Batteries

- Children (<6 years old): majority
- Largest registry of ingested batteries (2,382 patients)
  - 2,320 button/disk batteries
  - 62 cylindrical batteries-less common, lower injury
- Button battery (major or fatal outcomes)
  - 6.7-fold increase from 1985 to 2009 due to increase use of 20-25mm lithium button batteries

NPDS (National Poison Data System)
Batteries

- CDC report from 2012:
  - Period 1995-2010
  - 10% required hospitalization
  - 14 fatalities
    - 7 months to 3 years old
    - Involve button batteries
    - Nonspecific symptoms
Types of disk batteries

- Mercuric oxide
- Silver oxide
- Manganese oxide
- Zinc
- Lithium

All contain 20-45% of potassium or sodium hydroxide
Mechanisms for Injury by Batteries

- Pressure ischemic necrosis
- Electrical Discharge
  - Current at negative pole of battery with tissue, cause local hydrolysis of tissue, hydroxide production → corrosive tissue injury.
- Leakage of battery content (especially in stomach) → alkaline solution
- Mercury poisoning (only 1 case reported)
  - Rare - mercuric oxide button battery off the market since 1995
  - No reports since 2004
Batteries

- Age: worse < 4 years old
- Size matters: worse ≥ 20mm
- Ingestion of more than 1 battery
- Unwitnessed ingestion or unknown time of ingestion
- Misdiagnosis at initial presentation
- Delayed removal of the battery (esophagus)
- **Lithium cells:** worse clinical outcomes
  - Lightest metal, long shelf-life, cold tolerance
  - High energy density thus generate more hydroxides, more rapidly
Special Consideration

DON’T BE FOOL
20 mm batteries vs 21 mm Nickel coin
Batteries

- Disc battery in the esophagus
  - Destruction begins
    - within 1 hour (mucosa)
    - 2 to 4 hours (full-thickness)
    - 8 to 12 hours (perforation)
  - Always extract even if asymptomatic
  - Admit for at least 24 h
  - Risk of perforation, mediastinitis, exsanguination, stricture, vocal cord paralysis
  - NG placement
  - Follow-up barium study
    - at 3-6 weeks
Disk Batteries

- **Battery in stomach**
  - Conservative approach
  - <2 cm diameter can pass spontaneously
  - Pass within 72 hours
  - Extraction if >48 hours

- **Battery in intestine**
  - No movement >5 days: surgery
  - Symptoms: surgery
CASE #4 Magnets

- 3 years old male
  - Swallowed tiny magnet balls
  - No symptoms
  - Went to urgent care

- Observed at home
- PCP repeated XR in 2 days
- Sent to Cook ED
CASE #4 Magnets
CASE #4 Magnets

- Contrast study
- No extravasation or signs of perforation
- Advance diet
- Discharge
  - PPI
Magnets

- First report of bowel perforation due to ingestion of multiple magnets - 1995
- High powered magnets (rare earth magnets - boron, neodymium) are 5-10x more powerful than traditional iron magnets
  - Desk toys, magnetic construction sets, jewelry
Magnets

- Greater 50% of ingestion involve 2-6 magnets
- Dangerous: strong attraction across bowel walls leading to
  - Pressure necrosis
  - Ulceration
  - Bowel perforation
  - Fistula formation
  - Bowel obstruction
- Single magnet pose no problems
- REMOVAL:
  - if in esophagus
  - 2 or more needs to remove

Management of Magnet

History of Magnet Ingestion

Single magnet ingestion

Radiography

Confirmation of single magnet ingestion

Symptoms or radiographic features of obstruction?

NO

Close follow up til magnet is evacuated in bowel movement

YES

Multiple magnet ingestion

Radiography

Urgent surgical review even if asymptomatic

--If risk for additional ingestions

Surgical removal
CASE #5 MILD Caustic

- 13 months old male
  - home with grandmother
  - 2 detergent pods and swallowed solution
  - Vomited x 1
  - crying, coughing
  - Poison Control
  - ED: Drooling, swollen lips, no hypoxia, sleepy
CASE #5 MILD Caustic

- Bx: Mild reactive changes in the stomach
- Admitted:
  - Acid suppression,
  - Advanced his diet
  - Discharged
- Follow-up:
  - Good condition
Caustic Ingestions

- 5,000-18,000 accidental caustic ingestion reported per year in US (underestimated - only 10% reported)
- Alkali ingestions > acidic ingestions
- Two peaks of age distribution
  - Under 5 years old
  - 20-30 years old (intentional & larger volume)
- 1960s increased incidence due to usage of liquid alkaline cleansers
- The Poison Prevention Packaging Act (1970)
  - Limited concentration of caustic agent to 10%
  - Child-resistant containers
Laundry Detergent Pod (LDP) Ingestion

- Pods are **BAD**
  - Water-soluble membrane (polyvinyl alcohol)
  - Contains higher concentration surfactant components (Ethoxylated alcohols, propylene glycol, alkylbenzene sulfonate) → caustic injury
  - Intoxication from propylene glycol → lactate, metabolic acidosis
  - CNS effect from ethoxylated alcohols
- Small case series (Beuhler MC et al. 2013)
  - 3 of 4 patients needed intubation (respiratory; mental status changes)
  - 1 of the 4 had airway injury
Caustic Ingestion

### Alkaline
- Drain cleaner, oven/grill cleaner, dishwasher detergent, lye
- Most common: Developed countries (West)
- Odorless & tasteless & not immediately painful
- Liquefaction necrosis: liquefy tissue by dissolving lipid leading to deeper penetration
- Erythema, deep ulcers, perforation

### Acid (15% of CI)
- Concentrated vinegar, swimming pool cleanser, toilet/industrial cleaners
- Most common: Developing countries
- Bitter taste & immediately painful
- Coagulate protein resulting in an eschar (partially inhibits deeper damage)
- Deep ulcer, perforation (large volume)
2 years old female

- Swallowed industrial strength 12.5% bleach (obtained from work-dairy farm)
- Cry, bleeding lips, drooling and vomiting en route to local ED
- Transferred to Cook ED
- Ulcers in mouth, drooling
CASE #6 SEVERE Caustic
CASE #6 SEVERE Caustic

- Follow-up UGI: 4 weeks
CASE #6 SEVERE Caustic
CASE #6 SEVERE Caustic Stenosis

Balloon dilation

Mucosa Tear
Caustic Ingestion

- Degree of damage is related to the alkalinity
  - pH 9-11: rarely cause significant injury
  - pH >11: severe burns
  - Household bleach has concentration of 5% to 10% with pH 11-12
- Products in granules or crystal more dangerous due to better adherence to mucosa
Caustic Ingestions Presentation

- Pain, dysphagia, drooling, refusal to swallow, stridor
- Visible mouth lesions
  - Absence oral lesions does NOT correlate with degree of injury
- Gastric perforation
  - Shock, fatal
  - Hemorrhagic pancreatitis
  - SB perforations
  - Peritonitis
Caustic Ingestion

- Visible oral ulcers do not predict the extent of damage
- 378 pediatric patients over 10 year period with caustic ingestion

Symptoms
- (298 patients)
  - 82% Grade 0/1
  - 18% Grade 2
  - 2% later stricture

No symptoms
- (80 patients)
  - 88% Grade 0/1
  - 12% Grade 2
  - 1% later stricture

## Classification of caustic injury

<table>
<thead>
<tr>
<th>GRADE</th>
<th>Visible Appearance</th>
<th>Clinical Significance</th>
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<tbody>
<tr>
<td>Grade 0</td>
<td>History of ingestion, no visible damage</td>
<td>Able to take fluids immediately</td>
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<tr>
<td>Grade 1</td>
<td>Edema, loss of normal vascular pattern, hyperemia. No transmucosal injury</td>
<td>Temporary dysphagia, able to swallow within 0-2 days. No long-term sequelae</td>
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<tr>
<td>Grade 2a</td>
<td>Transmucosal injury, friability, hemorrhage, blistering, exudate, scattered superficial ulceration</td>
<td>Scarring. No stenosis if no circumferential damage. No long-term sequelae.</td>
</tr>
<tr>
<td>Grade 2b</td>
<td>Grade 2a + deep ulceration and/or <strong>circumferential</strong> ulcers</td>
<td>Small risk of perforation. Scarring may result in stenosis.</td>
</tr>
<tr>
<td>Grade 3a</td>
<td>Scattered deep ulceration with necrosis of tissue</td>
<td>Risk of perforation. High risk of stenosis.</td>
</tr>
<tr>
<td>Grade 3b</td>
<td>Extensive necrotic tissue</td>
<td>High risk of perforation &amp; death. High risk of stenosis.</td>
</tr>
</tbody>
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Zargar et al, 1991
Management of Caustic Ingestions:

Observation
- Asymptomatic
- Limited history of ingestion to taste or lick
- Clear fluids can be given
- Observe 4-6 hours and observe at home

Endoscopy within 12-24 hr
- Symptomatic
- Firm history of ingestion
- Intentional ingestion yet asymptomatic
- Oral burns
- Stabilized & hospitalized
  - Intubated: Respiratory tract is involved.
  - Grade 2 or 3 injury: ICU
Caustic Ingestion: Management

- **NG/ Transpyloric tube**
  - Grade 2b or greater
  - Stent and route for feeding (larger diameter the better)
  - NEVER place blindly

- **G tube**
  - Grade 3 to esophagus

- **TPN**

- **Antibiotics**
  - Fever
  - Grade 2b or greater

- **Steroids (Controversial) - effect in scar prevention**

- **Acid reduction**
Long-term Management

- Esophagus weakest at 1-3 weeks after ingestion
  - Collagen deposition not present until after second week
  - Avoid scope and dilation
- Grade 2 or greater
  - Rescope in 3 weeks
- Contrast studies for strictures
  - Scar retraction begins by 3 weeks and ongoing for several months
Caustic Ingestion: Longterm Problems

- **Stricture**
  - Balloon (longer stricture) or Bougies dilation
  - Triamcinolone injection
  - Perforation rate with dilation (0.4 to 32%)

- **Shortening of esophagus**
  - Sliding hiatal hernia
  - Worsened reflux (impaired LES sphincter pressure)

- **Dysmotility**
  - Alkaline injury with deeper mucosal injury
Long-term Management

- Surgery for non-responding esophageal stricture
  - Reconstruction with gastroplasty
  - Coloplasty (more functional failures compare to gastroplasty).
Caustic Ingestion: Longterm Problems

- Esophageal cancer (squamous cell and adenocarcinoma)
  - 1,000-3000 times higher than general population
  - Latency period (mean time of 41 years)
  - Periodic surveillance is necessary
  - Endoscopy performed 15-20 years after caustic ingestion for neoplastic screening
Foreign Body: TAKE OUT

- Symptomatic
- Coins in esophagus for >24 hours
- Coins in stomach ≥ 4 weeks
- Sharp objects
- Disk batteries in esophagus
- Disk batteries in stomach >48 h
- Big objects
  - >5 cm long (children) or >3 cm long (infants)
  - >2 cm diameter
- Over staying >1 week in same intestinal location
- High-powered magnets
Caustic Ingestion

- Visible oral ulcers do not predict the extent of damage
- Always evaluate if history is firm
- Damage can be lifelong

National Battery Ingestion Hotline website or 202-625-3333
www.poison.org/battery/guidelines.asp
References

- Beuhler MC et al. Laundry Detergent Pod Ingestions A case series and discussion of recent literature. Ped Emergency Care 29; 2013; 743-47.
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