Foreign Body Aspiration

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Grand Rounds Presentation
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Foreign Body Aspiration

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Epidemiology

• Major cause of accidental death
• 17,000 ER visits (aspiration + ingestion) in 2000
• 1,500 die each year due to FB aspiration
• Majority < age 3
• Male > Female
Aspiration in young children

- Lack of molar teeth
- Poorer mastication
- Tendency to put things in mouth
- Playing with things in mouth
- Immature protective laryngeal reflexes
# Foreign body

<table>
<thead>
<tr>
<th>Foreign body</th>
<th>Number of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watermelon seeds</td>
<td>593</td>
<td>39.7</td>
</tr>
<tr>
<td>Peanut</td>
<td>203</td>
<td>13.6</td>
</tr>
<tr>
<td>Sunflower seeds</td>
<td>145</td>
<td>9.7</td>
</tr>
<tr>
<td>Bean</td>
<td>100</td>
<td>6.7</td>
</tr>
<tr>
<td>Nuts</td>
<td>52</td>
<td>3.5</td>
</tr>
<tr>
<td>Other organic FBs</td>
<td>249</td>
<td>16.7</td>
</tr>
<tr>
<td>Inorganic FBs</td>
<td>151</td>
<td>10.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1493</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
More than 200 stores in 31 states pulled tubs of Mini Fruity Gels off shelves because of safety concerns.

Cover story

Gel candies ‘like rubber stoppers’ linked to deaths

Consumer calls prompted action at one major chain

By Gary Strauss
USA TODAY

Michelle Enrielle’s life essentially ended April 10, 1999, when she fell into a coma after allegedly swallowing a popular gel-like candy made by Taiwan-based Sheng Huang Jen Foods. Unable to breathe for nearly 30 minutes after collapsing in her San Jose, Calif., home, the fourth-grader sustained brain damage from which there was virtually no chance of recovery, says her physician, Elaine Pico. Three weeks ago on July 30, Gil and Yvonne Enrielle awoke to find that their daughter, 12 years old by then, had died.

``Even though everyone told us she would never recover, we still had high hopes that she’d come back to us as a normal kid,” says Gil Enrielle, a 48-year-old engineer at a semiconductor equipment maker. “All this over a piece of candy. It’s like bringing a gun into your house and not knowing when it will go off. We’re still in shock.”

Long popular in Asian countries, the gel candy has been removed in recent days from store shelves of three major U.S. retail chains — Safeway, Albertsons and Costco — in at least 31 states, Mexico and the United Kingdom.

The candies are marketed under a variety of brand names, including Fruit Poppers, Jelly Yam and Mini Fruity Gels. The candies also have been linked to last year's choking deaths of 3-year-old Deven junichi of Morgan Hill, Calif., and Arturo Lopez, a Seattle 2-year-old. A Canadian girl, whose name has not been made public, also died last year.

Deaths prompt retailers to remove gel candy from shelves. The jellies, which until last year were sold primarily in small Asian and See COVER STORY next page.
Symptoms and Physical findings

- Cough
- Dyspnea
- Wheezing
- Stridor
- Cyanosis
- Decreased breath sounds
- Tachypnea
- Rhonchi
- Somnolence

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Number of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sudden onset of coughing</td>
<td>1266</td>
<td>67.1</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>910</td>
<td>48.2</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>521</td>
<td>27.6</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>196</td>
<td>10.4</td>
</tr>
<tr>
<td>Other</td>
<td>130</td>
<td>6.9</td>
</tr>
</tbody>
</table>
Age Difference
Distribution of FB in airway

• 70% Right main bronchus in adults
• Higher variability in young children
  – Head/ body position
  – Supine/ Prone position
• Carina usually positioned left of midline ;
  Right of midline in 34 % children (Tahir N 2008)
Complications

- Mortality after bronchoscopy < 1%
- Bronchiectasis
- Pneumonia / bronchitis
- Subcutaneous Emphysema
- Pneumothorax / pneumomediastinum
- Granulation tissue and hemorrhage
- Cartilage destruction
- Airway compromise
- Death
Diagnosis

• History
• Physical Exam
• Radiography
History of choking

• Highly sensitive (> 90%) for aspiration
• Specificity: 45 – 76%
• Classic history:
  – Choking episode followed by coughing spells
Physical Exam

- Sensitivity: 24-86 %
- Specificity: 12-64 %
- Decreased unilateral breath sound
- Unilateral Wheezing
- Stridor
Chest x-ray

• Normal in 20- 40 % of cases
• Most are radiolucent (food origin)
• Inspiratory/ expiratory film
• Air-trapping on expiration
• Atelectasis
• Infiltration
• Consolidation
Hyperinflation of Right lung
Coin(s) in esophagus

Sagittal orientation on lateral

Coronal orientation on PA
Double lumen sign
# Batteries

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panasonic SP391</td>
<td>Li1154</td>
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<tr>
<td>Panasonic SP317</td>
<td>Maxell 394</td>
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<tr>
<td>Maxell 386</td>
<td>Maxell 371</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
</tr>
<tr>
<td>Maxell 394</td>
<td>Hearing Aid Battery</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
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<tr>
<td>Maxell 371</td>
<td>Hearing Aid Battery</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
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<td>Maxell 362</td>
<td>Maxell 321</td>
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<tr>
<td>Maxell 362</td>
<td>Maxell SR626W</td>
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<tr>
<td>Sony Lithium</td>
<td>GP Lithium CR2032</td>
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<tr>
<td>GP CR2025</td>
<td>GP CR2025</td>
<td><img src="https://via.placeholder.com/150" alt="Image" /></td>
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</tbody>
</table>
Battery

- True emergency
- Double lumen sign
- Leakage of battery contents
- Toxic effect
- Pressure necrosis
- Electrolytic reaction and mucosal burn
Fluoroscopy

• Normal in 53 % of FB patients (Even L 2005)
• Sensitivity: 47%
• Specificity: 95%
• Mediastinal shift
• Paradoxical movement of the diaphragm
CT scan

- Hong SJ 2007
- Retrospective
- 42 patients
- Can visualize radiolucent FBs

<table>
<thead>
<tr>
<th>Diagnostic results of spiral CT</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>100</td>
</tr>
<tr>
<td>Specificity</td>
<td>60.7</td>
</tr>
<tr>
<td>Accuracy</td>
<td>94.1</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>93.3</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>100</td>
</tr>
</tbody>
</table>
Rule of thumb

• Perform bronchoscopy if another one of the following is positive:
  – History
  – PE
  – Radiography

• Bronchoscopic evaluation is warranted on the basis of a positive history alone
Table 1
Sensitivity and specificity of diagnostic tools for AFB diagnosis

<table>
<thead>
<tr>
<th>Study [Ref.]</th>
<th>N</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoeve et al, 1993 [8]</td>
<td>115</td>
<td>81</td>
<td>33</td>
</tr>
<tr>
<td>Metrangelo et al, 1999 [6]</td>
<td>87</td>
<td>96</td>
<td>76</td>
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</table>

<table>
<thead>
<tr>
<th>Physical examination</th>
<th>Radiography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (%)</td>
<td>Specificty (%)</td>
</tr>
<tr>
<td>86</td>
<td>26</td>
</tr>
<tr>
<td>24</td>
<td>64</td>
</tr>
<tr>
<td>78</td>
<td>37</td>
</tr>
<tr>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>84</td>
<td>12</td>
</tr>
<tr>
<td>80</td>
<td>60</td>
</tr>
</tbody>
</table>
Medical management

• The role of beta-2 agonist remains unclear
• Alleviation of discomfort
• Expelling foreign body could be life threatening
• Not a replacement for bronchoscopy
Age-appropriate Bronchoscope

<table>
<thead>
<tr>
<th>Size</th>
<th>Diameter (mm)</th>
<th>Age Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>4 mm</td>
<td>Premie-Neonate</td>
</tr>
<tr>
<td>3</td>
<td>5 mm</td>
<td>0-6 months</td>
</tr>
<tr>
<td>3.5</td>
<td>5.7 mm</td>
<td>6-18 months</td>
</tr>
<tr>
<td>4</td>
<td>7.1 mm</td>
<td>18-36 months</td>
</tr>
<tr>
<td>5</td>
<td>8 mm</td>
<td>3-8 years</td>
</tr>
<tr>
<td>6</td>
<td>8 mm+</td>
<td>&gt;8 years</td>
</tr>
</tbody>
</table>
Bronchoscopes

Fig. 2  Comparison of two types of pediatric bronchoscopes.
Optical forceps
Anesthesia

• Availability of experienced Pediatric anesthesiology team
• Daytime vs. night team
• If unstable, securing airway always a priority over fasting guidelines
• Pulse oximetry
• Spray cords with 2% topical lidocaine to avoid laryngeal spasm
• Ventilation via bronchoscope
Roth net retrieval device

Sepehr A et al. 2007
Fiberoptic bronchoscopy

- Useful when FB migrates to distal bronchi
- Introduced via endotracheal tube or LMA
Role of Tracheotomy

- Incidence 0.5 - 3%
- Large FB in subglottic or proximal trachea
- Concomitant tracheotomy could be performed if FB too big or sharp to pass through glottic area
- Significant laryngeal edema
Postoperative Care

- Admission / observation
- Clear liquid diet
- Chest x-ray
- Chest physiotherapy
- Antibiotics
  - In cases of delayed diagnosis
Summary

• A positive history of choking event followed by coughing is an indication for bronchoscopic evaluation

• Radiographic evaluation is helpful in localization and identification of foreign body.

• Battery aspiration warrants emergent bronchoscopy

• Knowledge of age-appropriate instrument and communication with surgical team are paramount in the management of foreign body aspiration
Thank You
Chevalier Jackson, MD
Errors to Avoid in Suspected Foreign Body Cases

- Do not reach for the foreign body with the fingers.
Errors to Avoid in Suspected Foreign Body Cases

- Do not hold up the patient by the heels.
Errors to Avoid in Suspected Foreign Body Cases

- Do not fail to have a roentgenogram made.
Errors to Avoid in Suspected Foreign Body Cases

• Do not fail to search endoscopically for a foreign body in all cases of doubt.
Errors to Avoid in Suspected Foreign Body Cases

• Do not pass blindly an esophageal bougie or other instrument.
Errors to Avoid in Suspected Foreign Body Cases

• Do not tell the patient he has no foreign body until after X-Ray examination, physical examination, indirect examination and endoscopy have all proven negative.
The following aphorisms afford food for thought.

• Educate your eye and your fingers.
The following aphorisms afford food for thought.

• Be sure you are right, but not too sure.
The following aphorisms afford food for thought.

• Follow your judgment, never your impulse.
The following aphorisms afford food for thought.

• Cry over spilled milk enough to memorize how you spilled it.
The following aphorisms afford food for thought.

• Let your left hand know what your right hand does and how to do it.
The following aphorisms afford food for thought.

• Nature helps but she is no more interested in the survival of your patient than in the survival of the attacking pathogenic bacteria.