Evaluation and Management of Pediatric Aerodigestive Tract Foreign Bodies

Jeffrey P. Simons, MD
May 11, 2013

Division of Pediatric Otolaryngology
Department of Otolaryngology
Children’s Hospital of Pittsburgh of UPMC
University of Pittsburgh School of Medicine
Outline

- History
- Foreign Bodies of the Airway
- Foreign Bodies of the Esophagus
- Prevention
Foreign Bodies

- Fourth leading cause of accidental death in toddlers.
- Incidence has been constant over past several decades.
- Aspiration or ingestion.
- Common age group → 1-4 years.
  - <5 yrs – 84% of cases
  - <3 yrs – 73% of cases
- M>F (2:1)
History

- Foreign body removal from esophagus described as early as 6th century by Aetius Amidenus.
- Advised removing object with forceps if it was visible.
- If object wasn’t visible, “the patient is given a piece of raw meat on a string, which is to be pulled up after he has swallowed it, in hopes that the intruder may be thus dislodged.”
History

  - 937 FB cases
  - Mortality with observation ➔ 23%
  - Mortality with bronchotomy ➔ 27%

- Killian G. Direct endoscopy of the upper air-passages and esophagus; its diagnostic and therapeutic value in the search for and removal of foreign bodies. *J Laryngol Rhinol Otol* 1902; 17: 461.
  - First endoscopic removal of airway FB (1897).
History: Chevalier Jackson

- Chevalier Jackson (1865-1958)
- Born in Pittsburgh
- Grade school on Greentree
- Parents poor
- Frequently bullied as a child
- Boyhood hobbies of wood and metal working
- Age 12—successfully retrieved tools lost in an oil well by inventing a barbed harpoon
- College—Western University of Pennsylvania
- Medical School—Jefferson Medical College
History: Chevalier Jackson

- Influenced by Jacob Solis Cohen in Philadelphia (1838-1927)
- Specialist in Diseases of the Nose and Throat
- Jewish Civil War Surgeon—Union Army
- Father of Laryngology in America
History: Chevalier Jackson

- Studied in London under Sir Morell Mackenzie (1837-1892)
- $126 passage to England
- Observed “impractical device...to visually inspect the esophagus.”
- Crown Prince Frederick of Germany
History: Chevalier Jackson

- Practiced laryngology in Pittsburgh from 1886 until 1916.
- Became skilled at FB removal from airway and esophagus.
- Developed many instruments.
- Practiced on a “maniken board” before each case.
- 1910–1916 ➔ Worked as laryngologist at Western Pennsylvania Medical College (University of Pittsburgh)
- 1912 ➔ Elected Chair and Professor of Laryngology at the University of Pittsburgh
- 1916 ➔ Moved to Philadelphia as Chair of Laryngology at Jefferson Medical College
History: Chevalier Jackson

- Became simultaneous Chair of Bronchoscopy and Esophagoscopy at 4 medical colleges in Philadelphia.
- “Father” of broncho-esophagology.
- First President of ABEA (1917).
- A founder of the A.C.S.
- Decreased mortality rate from upper aerodigestive tract foreign bodies to <2%.
History: Chevalier Jackson

- Maintained a machine shop/workshop throughout his career to develop instruments.
- Never patented instruments.
History: Chevalier Jackson

- Excellent artist.
- Kept notebooks of his FB removal cases with color drawings.
History: Chevalier Jackson

- Trained and promoted many young assistants.
- Avoided England because antivivisection laws prevented practice on dogs.
History: Chevalier Jackson
History: Chevalier Jackson
History: Chevalier Jackson
History: Chevalier Jackson
Fig. 2.—The author's bronchoscopes of the sizes regularly used. Various other lengths and diameters are on hand for occasional use for special purposes. With the exception of a 4 mm. × 35 cm. size for older children, these special bronchoscopes are very rarely used and none of them can be regarded as necessary. For special purposes, however, special shapes of tube-mouth are useful, as, for instance, the oval end to facilitate the getting of both points of a staple into the tube-mouth.

The illustrated instruments are as follows:
A. Infant's size, 4 mm. × 30 cm.; B. Child's size, 4 mm. × 30 cm.; C. Adolescent's size, 7 mm. × 40 cm.; D. Adult's size, 9 mm. × 40 cm.; E. Aspirating bronchoscope made in all the foregoing sizes, and in a special size, 5 mm. × 45 cm.
advantage. The projection of the blades in the side-curved grasping forceps should always be directed toward the left. If it is desired that they open in another direction this should be accomplished by turning the handle and not by adjusting the blade itself. If this rule be followed it will always be possible to tell by the position of the handle exactly where the blades are situated; whereas, if the jaws themselves are turned, confusion is sure to result. The forward-grasping forceps are always so adjusted that the jaws open in an up-and-down direction. On rare occasions it may be deemed desirable to turn the stylet of either forceps in some other direction relative to the handle.

Rotation Forceps.—It is sometimes desired to make traction on an irregularly shaped foreign body, and yet to allow the object to turn into the line of least resistance while traction is being made. This can be accomplished by the use of the rotation forceps (Fig. 20), which have for blades two pointed hooks that meet at their points and do not overlap. Rotation forceps made on the model of the laryngeal grasping forceps, but having opposing points at the end of the blades, are sometimes very useful for the removal of irregular foreign bodies in the larynx, or when used through the esophageal speculum they are of great service in the extraction of such objects as bones, pin-buttons, and tooth-plates, from the upper esophagus. These forceps are termed laryngeal rotation

Fig. 19.—Jaws of the author's side-curved endoscopic forceps. These work as shown in the preceding illustration, each forceps having its own handle and tube. Originally the end of the cannula and stylet were squared to prevent rotation of the jaws in the cannula. This was found to be unnecessary with properly shaped jaws, which wedge tightly.
History: Chevalier Jackson

A routine direct examination of the larynx of anesthetized patients after such an operation as, for instance, tonsillectomy, to see that the larynx and laryngopharynx are free of clot. To perform a bronchoscopy or esophagoscopy under these conditions would be reprehensible, but direct laryngoscopy for the seeking and removal of clots serves a useful purpose as a prophylactic of pulmonary abscess and similar complications.* Diagnosis of laryngeal conditions in young children is possible only by direct laryngoscopy and is neglected in almost all of the cases. No anesthesia, general or local, is required. Much clinical material is neglected. All cases of dyspnea or dysphagia should be studied endoscopically if the cause of the condition cannot be definitely found and treated by other means. Invaluable practice in esophagoscopy is found in the treatment of strictures of the esophagus by weekly or biweekly esophagoscopy bungingage.

In acquiring skill as an endoscopist the following paraphrased aphorisms afford food for thought.

1. Tolerate your eye and your fingers.
2. Be sure you are right, but not too sure.
3. Follow your judgment, never your impulse.
4. Cry over spilled milk enough to mention how you spilled it.
5. Let your mistakes worry you enough to prevent repetition.
6. Let your left hand know what your right hand does and how to do it.

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

*Dr. William Frederick Moore, of the Bronchoscopy Clinic, has recently completed statistical of all cases of post-mortem microscopical pulmonary abscesses that point strongly to aspiration of infected clot and other infective material in the trachea following mechanic (Lamb, W. E., Pulmonary Abscess. Journ. Am. Med. Assn., April 28, 1923, Vol. 85, pp. 1870-1871).
Removal of animal objects from the tracheobronchial tree is readily accomplished with the side-curved forceps. Leeches are not uncommon intruders in European countries. Small insects are usually coughed out. Worms and larvae may be found. Cocaine or salt solution will cause a leech to loosen its hold.

Foreign bodies in the upper-lobe bronchi are fortunately not common. If the object is not too far out to the periphery it may be grasped by the upper-lobe-branchus forceps (Fig. 90), guided by the collaboration of the fluoroscopist. These forceps are made so as to reach high into the ascending branches of the upper-lobe bronchus. Full-curved coil-spring hooks will reach high, but must be used with the utmost caution, and the method of their disengagement must be practiced beforehand.

Penetrating Projectiles.—Foreign bodies that have penetrated the chest wall and lodged in the lung may be removed by oral bronchoscopy if the intruder is not larger than the lumen of the corresponding main bronchus (see Bibliography, 43).

Rules for Endoscopic Foreign Body Extraction
1. Never endoscope a foreign body case unprepared, with the idea of taking a preliminary look.
2. Approach carefully the suspected location of a foreign body, so as not to override any portion of it.

3. Avoid grasping a foreign body hastily as soon as seen.
4. The shape, size and position of a foreign body, and its relations to surrounding structures, should be studied before attempting to apply the forceps. (Exception cited in Rule 16.)
5. Preliminary study of a foreign body should be made in the distance.
6. As the first grasp of the forceps is the best, it should be well planned beforehand so as to seize the proper part of the intruder.
7. With all long foreign bodies the motto should be “Search, not for the foreign body, but for its nearer end.” With pins, needles, and the like, with point upward, search always for the point. Try to see it first.
8. Remember that a long foreign body grasped near the middle becomes, mechanically speaking, a “toggle and ring.”
9. Remember that the mortality to follow failure to remove a foreign body does not justify probably fatal violence during its removal.
10. Laryngeally lodged foreign bodies, because of the likelihood of dislodgment and loss, may be seized by any part first presented, and plan of withdrawal can be determined afterward.
11. For similar reasons, laryngeal cases should be dealt with only in the author’s position (Fig. 53).
12. An esophagoscopy may be needed in a bronchoscopic case, or a bronchoscopy in an esophageal case. In every case both kinds of tubes should be sterile and ready before starting. It is the unexpected that happens in foreign body endoscopy.
13. Do not pull on a foreign body unless it is properly grasped to come away readily without trauma. Then do not pull hard.
14. Do no harm, if you cannot remove the foreign body.
15. Full-curved hooks are to be used in the bronchi with greatest caution, if used at all, lest they catch inextricably in branch bronchi.
History: Chevalier Jackson

THE LIFE OF CHEVALIER JACKSON
An autobiography

The Life Of Chevalier Jackson:
An Autobiography

Chevalier Jackson
History: Chevalier Jackson
Foreign Bodies

  - Modern: coins (47%), food (28%), jewelry (5%), nails (3%), toys (3%)
  - Jackson: food (21%), safety pins (15%), nails (13%), coins (10%), buttons (7%)
  - All objects diameter <1.75 inches.
  - 99% of objects diameter <1.25 inches
  - M>F in both collections
Airway Foreign Bodies

- About 3000 deaths per year in the U.S.
- Must be on the DDx for nonspecific pulmonary symptoms such as coughing or wheezing.

Common Airway Foreign Bodies

- Food products (55-95%)
  - Peanuts (39%)
  - Raisins
  - Seeds
  - Other nuts
- Pieces of toys/plastic objects (5-15%)
- Metal objects (5-15%)
- In older children and adolescents, ½ of aspirated FBs are school supplies.

Dangerous Airway Foreign Bodies

- Latex balloons ➔ 1/3 of deaths from nonfood-related choking
- Hotdogs account for 17% of food-related choking deaths

Airway Foreign Bodies: Location

- Most common site ➔ right mainstem bronchus
  - Greater diameter
  - Smaller angle of divergence
- 1-7% of FBs can lodge in laryngeal inlet.
  - Large or irregular/sharp objects
  - Children < 1 y.o.
- 3-12% of FBs lodge in trachea.
Airway Foreign Bodies: Presentation

- **Initial symptoms**: coughing, choking, gagging
- Often an acute episode of gagging and choking.
- **Symptoms**:
  - Laryngeal FB ➔ stridor, hoarseness, croupy cough, sudden respiratory distress, aphonia, choking
  - Tracheobronchial FB ➔ stridor, cough, SOB
- About 50% of patients with foreign-body aspiration do not have a contributing history.
- **History of choking/coughing**
  - Specificity 90 %
  - Sensitivity 40 %

Airway Foreign Bodies

  - Only 41% of 143 FB aspirations were seen by physician within 24 hours of episode.

  - 85% of aerodigestive FBs diagnosed on first physician visit.
  - FB aspirations 7 times more likely to have delay in diagnosis than FB ingestions.
Airway Foreign Bodies: Presentation

- **Initial phase:**
  - 50-80% of FBs present in first week
  - History of choking followed by coughing and gagging
  - 20-50% not detected initially.

- **Asymptomatic interval:**
  - Follows acute episode.
  - Reflexes fatigue; bronchial relaxation.

- **Complication phase:**
  - Development of obstruction, erosion, or infection
  - Hemoptysis, pneumonia, lung abscess, systemic illness
Airway Foreign Bodies: Evaluation

- Physical exam: Bronchial FB
  - Decreased breath sounds on obstructed side.
  - Wheezing and decreased air entry.

- Physical exam: Tracheal FB
  - *Audible slap*: impact of mobile FB against the wall of the trachea on deep inspiration or coughing.
  - *Palpable thud* over trachea.
  - *Asthmatoid wheeze* over trachea.

- 5-40% of patients with airway FB have no obvious signs.

Airway Foreign Bodies: Radiology

- Radiologic studies
  - PA/Lat CXR
  - PA/Lat neck films
  - Inspiratory/expiratory films
  - Lateral decubitus films
  - Fluoroscopy
  - CT

- Most airway foreign bodies are radiolucent (~80%).

- Only patients with a stable airway should be taken for x-ray studies.

- PA/Lat neck films may be diagnostic for laryngeal FBs.

Airway Foreign Bodies: Radiology

- **CXR findings**
  - Radioopaque FB <25%
  - Air-trapping 32-66%
  - Atelectasis and pneumonia less common.
  - Normal CXR ~40%

- **CXR**
  - Sensitivity 68%-73%
  - Specificity 45%-67%

- Plain radiography is not sufficiently sensitive or specific for diagnosis of FB aspiration.

---

Airway Foreign Bodies: Bronchoscopy

- Required for any suspicion of FB.
- Should be performed if history, physical exam, or radiologic studies are positive (any of the 3).
- Both diagnostic and therapeutic.
- First-line therapy for all tracheobronchial FBs!

Airway Foreign Bodies: Bronchoscopy

- Must have experienced endoscopist, anesthesiologist, and OR team.
- Endoscopist responsible for checking equipment before procedure.
- Duplicate FB from parents very helpful for planning.

Airway Foreign Bodies: Bronchoscopy

- **Equipment**
  - Laryngoscope
  - Rigid bronchoscopes
  - Hopkins rod telescopes
  - Optical forceps
    - Alligator
    - Peanut
    - Cup
  - Nonoptical forceps
    - Forward-grasping
    - Rotation
    - Globular object
    - Hollow object
  - Rigid and flexible suction
  - Fogarty catheters
  - Ureteral baskets
  - Flexible fiberoptic bronchoscope
Airway Foreign Bodies: Bronchoscopy
Airway Foreign Bodies: Bronchoscopy
Airway Foreign Bodies: Bronchoscopy
Airway Foreign Bodies: Bronchoscopy

- Secretions gently suctioned.
- Shape and position of FB assessed.
- Vegetable material grasped gently.
- Attempt to protect sharp objects within bronchoscope.
- If possible, rotate FB into sagittal plane (largest laryngeal diameter).
- Caution not to drive FB further down.
Airway FB: Sunflower Seed
Airway FB: Nut (Almond)
Airway FB: Nut (Almond)
Airway FB: Carrot
Airway FB: Bead
Airway FB: Pen Clip
Airway FB: Pen Clip
Airway FB: Pen Clip
Airway FB: Pen Clip
Airway FB: Pen Clip