Pediatr Radiol (1989) 19: 361–365

Pediatric Radiology

Originals

Catheter removal of blunt esophageal foreign bodies in children

Survey of the Society for Pediatric Radiology

J. B. Campbell and V. R. Condon

Department of Radiology, The Children's Hospital, Denver, Colorado and Primary Children's Hospital, Salt Lake City, Utah

Abstract. The membership of the Society for Pediatric Radiology was surveyed to determine the safety and efficacy of the Foley catheter technique. Completed questionnaires were returned from 148 institutions. Sixty-four institutions reported that they were currently removing blunt esophageal foreign bodies utilizing the balloon catheter. Over 2500 patients were reported as having been treated utilizing this technique. Only one potentially serious but reversible complication was observed.

The use of various devices to remove esophageal foreign bodies dates from antiquity [1, 2]. Somewhat more recently (1831), the founder of Dartmouth Medical School, Nathan Smith, M.D., introduced a new instrument for the extraction of coins and other foreign substances from the esophagus [3]. With development of the esophagoscope and modern anesthesia, endoscopic removal became the preferred mode of treatment [4]. In the 1960's surgeons began reporting their successes in removing esophageal foreign bodies in children utilizing a Foley catheter in order to avoid the potential hazards of general anesthesia and endoscopy (5–8). Utilization of this form of treatment has steadily increased nationwide, particularly among radiologists, so that a substantial amount of experience has now been accumulated. Because the vast majority of patients with blunt esophageal foreign bodies are children (9), the membership of the Society for Pediatric Radiology was surveyed to determine the safety and efficacy of the Foley catheter method of removal of esophageal foreign bodies.

Material and methods

The entire membership of the Society for Pediatric Radiology was surveyed by mail. A single response per institution was requested and tabulated. The questionnaire consisted of 47 questions and it took approximately 20 minutes to complete.

Results

Number of respondents

Completed questionnaires were returned from 148 institutions. Fifty-eight pediatric hospitals responded. Twenty-eight (48%) indicated that they were currently removing blunt esophageal foreign bodies utilizing a balloon catheter. Ninety general hospitals responded of whom 36 (40%) indicated that they were using the technique.

Number of patients

Over 2500 patients were reported as having been treated by the Foley catheter method. The average number of patients so treated at each institution was 6 per year and the overall success rate was 95%. The method had been utilized for terms ranging from 6 months to 20 years. The mean duration was 7 years.

Types of foreign bodies

The majority of respondents indicated that they attempted to remove blunt, radiopaque objects only, most of which were coins. Some indicated that they

Table 1. Type of foreign body removed by Foley catheter (62 responses)

Blunt, radiopaque only	36	(58%)
Blunt, opaque or nonopaque	17	(27%)
Anything other than sharp objects	9	(15%)

Table 2. Factors in history considered important (57 responses)

Time since ingestion	56	(98%)
Type of foreign body	53	(93%)
Previous esophageal disease	51	(89%)
Respiratory distress	47	(82%)
Known medical problems	43	(67%)
Previous foreign body	37	(65%)

Table 3. Elapsed time since ingestion beyond which catheter removal not attempted (48 responses)

0–12 hours	2	(4%)
13–24 hours	9	(19%)
25–36 hours	10	(21%)
37–48 hours	8	(17%)
3– 7 days	10	(21%)
8–14 days	6	(12%)
15–21 days	3	(6%)

Table 4. Esophagram prior to removal

Do not perform esophagram	46	(72%)
Do perform esophagram	16	(25%)
No response	2	(3%)

Table 5. Use of co-participants

Yes	39	(61%)
Routinely	19	(30%)
Sporadically	20	(31%)
No	25	(39%)

would on occasion remove non-opaque material, especially recently ingested food (Table 1).

History

Most of the respondents indicated that they personally spoke with the parent or caretaker although a few shared this responsibility with the attending physician. In addition to the type of foreign body, the elapsed time since ingestion was a critical factor in deciding whether to proceed with catheter removal or refer the child for endoscopy (Table 2). This varied considerably from one institution to another, however (Table 3). The responses were sometimes qualified by comments such as, "Would first perform cautious esophagram after one week" or, "Will remove after 48 hours only if airway is not narrowed" or, "I do not try as hard after 36 hours".

Preliminary evaluation

One hundred per cent of respondents indicated that they obtained a plain film study initially to determine the exact location of the foreign body and to accurately characterize the type of foreign body lodged in the esophagus. Contrast examination of the esophagus was employed infrequently (Table 4). In general, when an esophagram was performed, it was done only if the foreign body was lodged in a location other than the thoracic inlet, if the foreign body was non-opaque, if there was a history of previous esophageal disease or if perforation was suspected.

Informed consent

Some type of informed consent was obtained by almost all of the radiologists. It was usually verbal. Only 7 (11%) obtain written consent at the present time.

Removal technique

Route of catheter insertion was distributed quite evenly between nasal and oral. The Foley balloon is inflated with opaque medium by most radiologists (water soluble media – 70%; barium – 22%) and air is used by some (8%). Fluoroscopy is employed during removal of the foreign body by all of the radiologists. Placing the patient into the prone oblique position prior to removing the foreign body was favored by the majority of radiologists. Only a small number (7%) allow the patient to remain in a supine position. A majority (70%) also invert the fluoroscopic table into a head down position at the time of foreign body removal. Fifty-nine of the sixty-four institutions reported that they have resuscitation equipment, including laryngoscope and forceps, in the room when the foreign body is removed. Five (8%) reported that such equipment is not present in the room, but is available.

Involvement of other physicians

The respondents were evenly divided as to whether or not another physician would be required to be immediately available to the radiology department during the procedure with 53% favoring this policy. A sizable number of radiologists used non-radiologists as coparticipants during the procedure (Table 5). Non-radiologists who serve as coparticipants are usually pediatric surgeons, but also include pediatricians, otolaryngologists, and anesthesiologists. One radiologist indicated that parents are included as coparticipants (Table 6). Several institutions (16%) re-

ported that *non-radiologists* are utilizing balloon catheters for removal of esophageal foreign bodies. Some of these physicians perform this as a cooperative procedure with the radiologist providing fluoroscopic assistance. Some, however, are utilizing the method without fluoroscopy (Table 7).

Complications

Ninety-one per cent of respondents reported no type of complication in any of their patients. Complications were reported in 10 patients, an incidence of 0.4% (Table 8). In 6 cases, the foreign body was pulled from the esophagus and lodged in the nasal cavity. Esophageal mucosal injury was inferred in two instances in which bloody mucus was expectorated after the procedure. Followup on both cases was normal. One radiologist reported accidentally placing the Foley catheter into the trachea and inflating the balloon temporarily prior to successfully intubating the esophagus. This was tolerated without incident. There was one potentially serious but reversible complication. A child with cyanotic congenital heart disease, transposition of the great arteries, experienced severe hypoxia during the procedure. This was successfully managed without apparent sequelae.

Catheter complications elsewhere

Respondents indicated that they had heard of several complications of the catheter technique occurring in other institutions that they had not personally observed. They often indicated that the information was of uncertain documentation. Eighteen indicated that they had heard of a death in the Boston area and eleven others understood that there had been aspiration of a coin into the airway in a patient in the Boston area, but were not sure of the outcome. One reported hearing of an esophageal mucosal tear and one observed a right upper lobe infiltrate on radiographs obtained following a coin removal elsewhere. Five reported reading of complications of the method in the medical literature, but were unable to recall the specific reference or the specific complications.

Complications of Endoscopy

Complications of esophagoscopy were described both within the respondents' institutions and outside of their institutions (Table 9). Several esophageal perforations occurred. Usually, these were well tolerated. There were two instances of mediastinitis and subsequent death, however. There was one instance of death occurring during endoscopy to remove a coin from the esophagus which was attributed to problems with ventilation of the child. Another instance of "near death" in the same institution occurred in a child who developed a similar ventilatory problem. There were no permanent sequelae with this second patient.

Table 6. Co-participants (39 institutions)

Pediatric surgeon	19
Pediatric surgeon or otolaryngologist	5
Pediatric surgeon or pediatrician	3
Pediatric surgeon or emergency physician	2
Anesthesiologist	2
Pediatrician	2
Anesthesiologist or otolaryngologist	2
Pediatrician or anesthesiologist or otolaryngologist	1
Pediatric surgeon or anesthesiologist or pediatrician	1
Gastroenterologist	1
Emergency physician	1
Parents	1

Table 7. Catheter use by non-radiologists (24 institutions)

Emergency room	12
Radiology department	7
Operating room	2
Radiology or emergency room	1
Emergency room or operating room	1
Office	1

Table 8. Complications of catheter method (over 2500 patients)

Foreign body into nasopharynx	6
Esophageal mucosal injury	2
Catheter placed into trachea	1
Hypoxia	1

Table 9. Complications of endoscopy

Esophageal perforation	31
Mediastinitis	4
Mediastinitis with death	2
Anesthetic reaction	3
Anesthetic death	1
Anesthetic "near-death"	1
Retroesophageal abscess	2
Esophageal hemorrhage	2
Esophageal hemorrhage, severe	1
Literature only	2
Aspiration pneumonia	1
Unnecessary anesthetic[a]	1

[a] Coin in stomach

Opinions of Non-Users

Pediatric radiologists *not* currently removing esophageal foreign bodies were questioned about their attitudes toward the Foley catheter method. Seventy-

seven per cent indicated that they approved of the technique and 69% acknowledged that they would begin offering the service if requested to do so by referring physicians.

Discussion

Approximately 20 years of experience with the Foley catheter method of removing esophageal foreign bodies has been accumulated. The frequency with which this technique is being utilized seems to be increasing as its safety and efficacy are documented (10–14). Pediatric radiologists have considerable experience with this approach and in over 2500 cases reported in this survey there was only one potentially serious complication, reversible hypoxia occurring in a child with cyanotic congenital heart disease.

The majority of the responding radiologists utilize the catheter technique to remove *blunt, opaque* objects only, they will forego the catheter approach if the foreign body has been in place in excess of 2 to 7 days, and they invert the radiographic table into a head down position at the time of foreign body extraction. These are all measures which are undertaken to insure that the method is safe for the patient. Steeply inverting the radiographic table virtually eliminates the possibility of aspiration of the foreign body onto the glottis producing airway obstruction [15]. Aspiration of a coin or other solid foreign body *into* the subglottic airway is highly unlikely whether or not the table is inverted. If a solid foreign body is of such size that it lodges in the esophagus, surgeons and anesthesiologists have noted anecdotically that the foreign body will not be small enough to pass through the vocal cords unless it somehow is fractured and becomes fragmented. Furthermore, extensive pathological studies of the larynx in infants and children [16] have revealed that there is direct correlation between the size of the laryngeal opening and the crownheel length. In order for a dime, which measures 18 mm in diameter, to fit through the larynx the patient must be nearly 5 feet tall. Thus, even the smallest coin likely to be swallowed is not going to be aspirated into the subglottic airway in the age group usually seen with esophageal coins.

One theoretical objection to the catheter method of removal of blunt, opaque esophageal foreign bodies is that by not performing the procedure under direct vision at endoscopy one may overlook or inadvertently extract a *non-opaque* sharp object which could damage the esophagus [17]. No such situation was encountered in this series of children and the likelihood of it occurring is remote. While it is not exceedingly rare to encounter more than one foreign body in the esophagus, they are almost always the same material, e. g. two nickels, three pennies. When dissimilar types of foreign bodies are found in the esophagus, the history is usually one of previous esophageal disease and/or chronic symptoms of partial esophageal obstruction. Additionally, the time of ingestion of the foreign body in question is usually unknown. These are not the types of patients in whom the catheter method is likely to be utilized, certainly not without an esophagram.

The authors made a concerted effort to document and analyze the one death that was reported to have occurred in the Boston area [18]. The radiologist involved was unwilling to release a detailed description of the incident. It appears that the case involved a young child in whom airway obstruction may have been a major factor. The exact details of the catheter method attempted are unknown. The radiologist presumably had no training or experience with foreign body removal, was not a pediatric radiologist, and the immediate availability of equipment to deal with acute airway problems is unknown.

Any method of intervention in medical practice carries some degree of intrinsic risk to the patient. Pediatric anesthesia by someone inexperienced in such endeavors and attempts at pediatric endoscopy by an individual with no training or experience may well be more hazardous than an inexperienced radiologist attempting to remove a coin from the esophagus with a Foley catheter. Local conditions may dictate which approach seems the most appropriate; hopefully, not influenced by "turf" and status considerations but by what is truly best for the child. Recent descriptions of the catheter method should result in an extremely safe procedure [12]. A radiologist interested in starting to utilize the catheter method without any previous training or experience may wish to initially enlist the assistance of one of his surgical or anesthesia colleagues as a coparticipant at least until some experience has been gained and both are comfortable that the radiologist is capable of proceeding on his own.

It is interesting to note that radiologists who were not themselves currently removing esophageal foreign bodies were questioned in the survey about their attitudes toward the Foley catheter method. Over three quarters indicated that they approved of the technique and two thirds of them acknowledged that they would begin offering the service if requested to do so by the referring physician.

Acknowledgment. The authors wish to thank the many pediatric radiologists who took the time from their busy schedules to respond to the questionnaire.

References

1. Adams F (1985) Aegineta on Surgery, In: Adams F (ed) The Seven Books of Paulus Aegineta (seventh century). Gryphon, Birmingham, pp300-301
2. Chang JHT, Burrington JD (1973) Removal of coins from the esophagus: nothing new under the sun. Pediatrics 51: 313
3. Smith Nathan (1831) Description of a new instrument for the extraction of coins and other foreign substances from the oesophagus. In: Smith NR (ed) Medical and surgical memoirs. WA Francis, Baltimore, pp239-240
4. Jackson C, Jackson DL (1959) Diseases of the nose, throat and ear. Saunders, Philadelphia, p213
5. Aiken DW (1965) Coins in the esophagus: a departure from conventional therapy. Milit Med 130: 182-183
6. Bigler FC (1966) The use of a Foley catheter for removal of blunt foreign bodies from the esophagus. J Thorac Cardiovasc Surg 51: 759-760
7. Symbas PN (1968) Indirect method of extraction of foreign body from the esophagus. Ann Surg 167: 78-80
8. Brown LP (1968) Blind esophageal coin removal using a Foley catheter. Arch Surg 96: 931-932
9. Nandi P, Ong GB (1978) Foreign body in the oesophagus: review of 2394 cases. Br J Surg 65: 5-9
10. Shackelford GD, McAlister WH, Robertson CL (1972) The use of a Foley catheter for removal of blunt esophageal foreign bodies from children. Radiology 105: 455-456
11. Campbell JB, Quattromani FL, Foley LC (1983) Foley catheter removal of blunt esophageal foreign bodies. Experience with 100 consecutive children. Pediatr Radiol 13: 116-119
12. Campbell JB, Foley LC (1983) A safe alternative to endoscopic removal of blunt esophageal foreign bodies. Arch Otolaryngol 109: 323-325
13. Nixon GW (1979) Foley catheter method of esophageal foreign body removal: Extension of applications. AJR 132: 441-442
14. Sumner TE (1981) Esophageal foreign bodies: How should they be removed? Annual Meeting of American Academy of Pediatrics, New Orleans, LA, November 1-4
15. Campbell JB, Davis WS (1973) Catheter technique for extraction of blunt esophageal foreign bodies. Radiology 108: 438-440
16. Beckwith JB (1987) Personal communication
17. Campbell JB, Foley LC (1984) Foley catheter technique. Arch Otolaryngol 110: 63
18. Healy G (1981) Esophageal foreign bodies: how should they be removed? Annual Meeting of American Academy of Pediatrics, New Orleans, LA November 1-4

Received: 14 June 1988; accepted 18 July 1988

Dr. John B. Campbell
Department of Radiology
The Children's Hospital
1056 East 19th Avenue
Denver, CO 80218, USA

Commentary

On the preceding paper by R. Towbin, H. M. Lederman, J. S. Dunbar, W. S. Ball, and J. L. Strife: Esophageal edema as a predictor of unsuccessful balloon extraction

W. E. Berdon (Editor, Pediatric Radiology)

Department of Radiology, Columbia Presbyterian Medical Center, Babies Hospital, New York, New York, USA

What – another paper on Foley catheter extraction of an esophageal foreign body?

Yes – the Towbin paper was accepted for two reasons. First, it emphasizes the need for *early* diagnosis before there is esophageal edema. Secondly, it illustrates the potential danger of trying balloon extraction on an infant or toddler with an already partly compressed airway. Most patients with this problem have stridor or other respiratory problems but some do not. Surely it makes sense to screen the trachea in lateral projection, either on overhead films or by fluoroscopy before attempting balloon extraction? A fluoroscopic suite is no place for a respiratory arrest, and that includes the radiologist trying the procedure.

Conclusions

1. Always look at the airway in two projections before trying balloon extraction of an esophageal foreign body.
2. Don't try balloon extraction if the trachea is narrowed by esophageal edema.

Dr. W. E. Berdon
Columbia Presbyterian Medical Center
Babies Hospital
622, West 168th Street
New York, NY 10032, USA