

The removal of coins from the upper esophageal tract of children by emergency physicians: a pilot study

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ABSTRACT

Objective: There are few reports in the medical literature describing removal of a coin from the upper esophageal tract of a child by an emergency physician. However, given the nature of their training and practice, emergency physicians are well suited to perform this common procedure. We describe our experience with this procedure.

Methods: This was a retrospective review of a continuous quality improvement data set from a university-based tertiary care pediatric emergency department between Nov. 1, 2003, and Mar. 31, 2004.

Results: Thirteen children, with a median age of 20 months, underwent rapid sequence intubation and had coins successfully removed from their upper esophageal tract by emergency physicians. In 10 cases, the coin was visible at laryngoscopy and removed with Magill forceps. In 3 cases this approach failed and a Foley catheter was used to remove the coin. One child suffered a tonsillar abrasion and two sustained minor lip trauma, but all were extubated and discharged home from the emergency department with no significant complications. Eleven of the 13 patients were successfully followed up, and the parents reported no problems.

Conclusions: This pilot study suggests that the removal of a coin from the upper esophageal tract by an emergency physician can be both safe and effective. A larger study is needed before this procedure can be generally recommended.

Key words: foreign body; airway; intubation; sedation; procedure

RÉSUMÉ

Objectif : La littérature médicale comporte peu de rapports décrivant l'extraction par un médecin d'urgence d'une pièce de monnaie logée dans l'œsophage supérieur d'un enfant. Cependant, étant donné la nature de leur formation et de leur pratique, les médecins d'urgence sont tout à fait préparés à effectuer cette intervention courante. Nous décrivons notre expérience avec cette intervention.

Méthodes : Il s'agit d'une revue rétrospective d'un ensemble de données sur l'amélioration continue de la qualité provenant d'un département d'urgence pédiatrique universitaire de soins tertiaires entre le 1^{er} novembre 2003 et le 31 mars 2004.

Résultats : Grâce à l'intubation en séquence rapide, des médecins d'urgence réussirent à retirer des pièces de monnaie logées dans l'œsophage de treize enfants dont l'âge moyen était de 20 mois. Dans dix cas, la pièce de monnaie était visible au laryngoscope et fut retirée à l'aide d'une

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Received: Apr. 5, 2004; final submission: Aug. 13, 2004; accepted: Aug. 16, 2004.

This article has been peer reviewed.

Can J Emerg Med 2004;6(6):434-40

pince de Magill. Dans trois cas, cette méthode échoua et on eut recours à une sonde de Foley pour extraire la pièce. Un enfant subit une abrasion des amygdales et deux autres subirent un traumatisme mineur aux lèvres, mais tous furent extubés et renvoyés à la maison sans complications importantes. Un suivi fut fait auprès de onze des treize patients et les parents ne signalèrent aucun problème.

Conclusions : Cette étude pilote suggère que l'extraction d'une pièce de monnaie logée dans l'œsophage supérieur par un médecin d'urgence peut être à la fois sûre et efficace. Une étude de plus grande envergure s'impose avant de pouvoir recommander cette intervention de façon générale.

Introduction

The ingestion of coins by children is a common worldwide phenomenon.^{1,2-4} Although coins that traverse the esophagus almost always pass spontaneously and rarely cause complications,^{5,6} those that lodge in the esophageal tract typically require removal.⁷⁻¹¹ Coins that reach the lower esophagus often pass spontaneously into the stomach, but coins in the upper esophagus are less likely to do so;^{8,12} consequently, the proximal third of the esophagus is the most common location of esophageal coins in children presenting to the emergency department (ED).^{7,12-14} Complications from retained esophageal coins are rare but potentially serious, including esophageal perforation,^{11,15-18} airway obstruction with cyanosis,¹⁹ extraluminal coin migration,¹³ pneumomediastinum,¹⁹ tracheoesophageal fistula²⁰ and fatal aortoesophageal fistula.²¹ Minor mucosal injuries may occur in cases where the coin has been present for less than 24 hours, but the likelihood of significant complications increases with coins that have been lodged for 3 days or more.^{10,22}

Several techniques for managing pediatric upper esophageal coins are described in the medical literature. These include the use of Magill forceps,^{9,16} the use of a Foley (balloon) catheter,^{10,23,24} the use of a balloon catheter in conjunction with toothed forceps,²⁵ endoscopy,^{7,26,27} and the use of a bougie to advance the coin into the stomach.^{26,28} A review of relevant literature revealed only 34 cases of esophageal coins managed entirely by emergency physicians without consultation.²³⁻²⁵ Three of these cases described coin removal,^{23,24} and the remainder described bougienage to advance the coin into the stomach.²⁸ Given that emergency physicians have experience and training in pediatric airway management, including rapid sequence intubation (RSI),²⁹ the use of Magill forceps,³⁰ and the use of procedural sedation to facilitate foreign body removal from other body cavities,³¹ we found the paucity of literature describing emergency physician management of upper esophageal coins surprising.

During 2003, several of our emergency physicians (E.J.V., T.K.D., J.A.M., B.B.B. and A.K.) developed an interest in

the removal of foreign bodies from the upper esophageal tract and incorporated this procedure into their clinical practice. Using a proactive continuous quality improvement (CQI) process, they developed general guidelines and began removing upper esophageal coins from children presenting to our ED. The objective of this study is to describe our ini-

Table 1. General guidelines for emergency physicians for the removal of coins from the upper esophageal tract of children

Suggested Procedural Indications

- Coin at or above the level of the clavicle on chest x-ray.
- Time of coin ingestion relatively certain and <72 h (<24 h preferred).
- No history of esophageal pathology or prior esophageal foreign bodies.
- No history of difficult intubations or known airway abnormalities.
- No contraindication to the use of succinylcholine.
- No evidence of acute airway compromise.
- Adequate *nil per os* (npo) time.*
- Parental consent for the procedure obtained.
- No clinically significant underlying medical conditions.

Preferred Procedural Technique

- All patients to be endotracheally intubated and monitored throughout the procedure.
- Preferred medications for rapid sequence intubation (RSI) are atropine, etomidate, and succinylcholine.
- First technique is to visualize the esophagus using a laryngoscope and remove the coin under direct visualization with Magill forceps. A Foley catheter is suggested as a second technique if the coin cannot be visualized or grasped with forceps.
- Visually inspect the esophagus for injury.

Preferred Post-Procedural Care

- Extubate in the ED after conclusion of the procedure and resolution of the medication effects from the RSI.
- Intravenous dexamethasone after extubation to minimize potential airway swelling.
- Observe in the ED until awake, alert, asymptomatic, and able to eat and drink without apparent difficulty.
- Phone follow up with family arranged.

*Given the absence of evidence-based npo durations, the responsible attending physician should individualize care on a case-by-case basis.

tial emergency medicine experience in the removal of coins from the upper esophageal tract of children. This preliminary report could form the basis for larger studies examining the safety and efficacy of the procedure.

Methods

We retrospectively reviewed a CQI data set from our tertiary university-based pediatric ED from Nov. 13, 2003, through Mar. 31, 2004. During this time, emergency physicians attempting coin removal followed the general guidelines described in Table 1, which recommend RSI followed by coin removal using Magill forceps. If this approach fails, the guidelines suggest the physician can pass a Foley catheter into the esophagus below the suspected level of the coin, inflate the balloon and withdraw the catheter with the balloon inflated.^{10,23–25} Procedural monitoring included continuous pulse oximetry and cardiac monitoring, and vital sign measurements at least every 5 minutes.

Emergency physicians recorded key data on CQI forms and made follow-up phone calls after several days had passed. When this follow-up was unsuccessful, certified letters were sent, instructing family members to call the ED. Data included date of birth, date of visit, gender, foreign body description, procedure-related complications, and telephone follow-up results. Information gathered from the medical record included whether the patient had

been transferred from another ED, the presumed duration the foreign body had been present in the esophagus, the *nil per os* (npo) time prior to the procedure, whether a respiratory therapist was present during the procedure, physician training in pediatric or general emergency medicine, medications administered, whether the coin was visible at laryngoscopy, whether a Foley catheter was necessary, the time from intubation to coin removal, from intubation to extubation, from intubation to sedation recovery, and total time in the ED. An electronic CQI spreadsheet was developed. After data entry, patient identifiers were removed and this de-identified data set served as our study data.

Descriptive statistics were generated using functions provided in Excel 2003 (Microsoft Corporation, Redmond, Wash.). Given that our data are not normally distributed, we present our results as medians and interquartile ranges (IQRs).

Our Institutional Review Board approved this study, and parental consent for the procedure was obtained.

Results

During the study period, 5 different pediatric emergency physicians and 1 emergency physician removed or supervised the removal of upper esophageal coins from 13 children. Table 2 shows that the median age of the children was 20 months (IQR, 13–29 mo; range, 5–91 mo), that

Table 2. Data for the 13 children who underwent removal of a coin from their upper esophageal tract during the study period

Patient	Age	Gender	Time from ingestion to ED presentation, h*	Location of coin (per MD chart notes)	Pre-procedure npo time, h	Transferred from another hospital
1	5 mo	M	24	Thoracic inlet	11	Yes†
2	9 mo	M	0.5	Above the clavicle	4	No
3	10 mo	F	3	Upper esophagus	4	Yes
4	13 mo	M	15	High esophageal	2 for liquids; 19 for solids	Yes
5	15 mo	M	36	Above the clavicles	5	Yes
6	19 mo	M	2	Very proximal	6	Yes
7	19 mo	M	1	Above the thoracic inlet	2.5 for liquids; 3.5 for solids	No
8	22 mo	F	5	Not recorded	5	Yes
9	23 mo	F	4.5	Proximal esophagus	7	No
10	2 yr, 5 mo	M	20.3	Above the clavicle	4	No
11	4 yr, 8 mo	M	14	Above the clavicles	At least 3	Yes
12	6 yr, 9 mo	M	22	Not recorded	24	Yes
13	7 yr, 7 mo	F	4	Sternal notch	10	Yes

npo = *nil per os*

*If transferred from another hospital, this is the time elapsed before presentation to our ED.

†Physician at referring hospital attempted removal with a Foley catheter.

9 of 13 (69%) were boys, and that most had been transferred from another hospital. Median time from coin ingestion to presentation at our ED was 5 hours (IQR, 3–20.25 h; range 0.5–36 h) and median npo duration prior to the procedure was 5 hours (IQR 4–7 h, range 2–24 h). All of the children had a pre-procedure chest radiograph showing coins in the proximal esophagus (Fig. 1).

All coins were successfully removed; most were pennies, and one child had 2 pennies removed (Table 3). In all cases, removal was first attempted with Magill forceps, and this was uniformly successful when the coin could be visualized (Table 4). For the 3 cases in which the coin was not visualized at laryngoscopy, a Foley catheter was used successfully. Table 5 shows that the median procedural duration from initiation of intubation to coin removal was 7 minutes (IQR 5–9 min; range 1–20 min) and median time from initiation of intubation to extubation was 10 minutes (IQR 7–14 min; range 5–84 min). Median time from sedation to recovery was 13 minutes (IQR 10–22 min; range 7–180 min) and the longest recovery time (180 min) was in a child who received multiple doses of midazolam. Most patients spent less than 3.5 hours in the ED, and no child stayed longer than 5 hours. All children were extubated and discharged home from the ED.

Three children sustained minor localized trauma, includ-



Fig. 1. Chest radiograph demonstrating typical upper esophageal coin (from Patient 10; see tables for Patient numbering).

Table 3. Outcome for 13 patients in study

Patient	Type of coin	Complications	Follow-up,* no. of days	Outcome
1	Penny	None	14	Doing well.
2	Penny	None	70	Doing well.
3	Penny	Tonsil abrasion	22	Doing well.
4	Penny	None	–	–
5	Penny	Small lip abrasion; coin slipped into nasopharynx during procedure.	4	Scratchy voice for 1 day, resolved. Doing well.
6	Penny	None	55	Doing well.
7	Quarter	None	–	–
8	Penny (2)	None	49	Doing well.
9	Penny	None	16	Doing well.
10	Nickel	None	7	Doing well.
11	Penny	None	14	Doing well.
12	Quarter	Small cuts to the lips	18	Sore throat for 1 hour. Doing well.
13	Quarter	None	15	Sore throat, fever 1 day post-procedure. Given antibiotics for "sinusitis." Doing well.

*Two patients were lost to follow-up

Table 4. Details of the coin removal cases

Patient	Attending physician's training	Method of removal	No. of removal attempts	RT present	Medications used	Coin visible?*
1	PEM	Magill forceps	1	Yes	Et, Sx, Atr, Dex	Yes
2	PEM	Magill forceps	2†	Yes	Sx, Atr, Mdz	Yes
3	PEM	Magill forceps (×2 unsuccessful), then Foley	3†	Yes	Sx, Atr, Dex, Mdz, Pro	No
4	EP	Magill forceps	1	Yes	Et, Sx, Atr, Dex	Yes
5	PEM	Magill forceps (×1 unsuccessful), then Foley	2	Yes	Et, Sx, Atr, Dex	No
6	PEM	Magill forceps	1	No	Et, Sx, Atr, Dex	Yes
7	PEM	Magill forceps	2†	No	Et, Sx, Atr, Dex	Yes
8	Resident‡	Magill forceps	1‡	Yes	Et, Sx, Atr, Dex	Yes
9	PEM	Magill forceps	1	No	Et, Sx, Atr, Ket	Yes
10	PEM	Magill forceps (×2 unsuccessful), then Foley	3§	Yes	Et, Sx, Atr	No
11	PEM	Magill forceps	2†	Yes	Et, Sx, Atr, Dex	Yes
12	PEM	Magill forceps	2†	Yes	Et, Sx, Dex	Yes
13	PEM	Magill forceps	1	Yes	Et, Sx, Atr, Dex, Alb	Yes

PEM = physician with subspecialty training in pediatric emergency medicine; RT = respiratory therapist; Et = etomidate; Sx = succinylcholine; Atr = atropine; Dex = dexamethasone; Mdz = midazolam; Pro = propofol; Ket = ketamine; Alb = albuterol. *Coin visible at the time of laryngoscopy. †First attempt was done by a resident. ‡Removal done by the resident, with PEM at bedside. §All 3 attempts were by a PEM.

Table 5. Time course of coin removal procedure

Patient	Physician ID	Time, in minutes, from initiation of intubation			Total ED time, h
		To coin removal	To extubation	To recovery	
1	3	4	7	7	3
2	2	7	12	15	2.5
3	4	20*	84	180†	4.7
4	6	1	10	11	3.3
5	5	8	10	12	3
6	3	5	5	7	1.6
7	3	13	16	17	2.1
8	3	2	7	7	2.3
9	4	5	5	40‡	4
10	1	20	22	45	4.5
11	2	5	8	13	4.3
12	2	9	10	10	2
13	2	9	14	22	5

*The intubation took 13 of these 20 minutes.

†This patient received multiple doses of intravenous midazolam and propofol.

‡This patient received intravenous ketamine.

ing a 6.8-yr-old autistic boy who suffered minor cuts to his lips during intubation, a 10-month-old girl who suffered a small left tonsillar abrasion during coin removal, and a 15-month-old boy who sustained a single, small lip abrasion during intubation. A second complication occurred in the latter case, when the penny slipped up into the nasopharynx, necessitating the use of a nasally introduced Foley catheter to push it back down into the oropharynx for removal.

Follow-up was unsuccessful in 2 cases because families had disconnected phone numbers and did not respond to certified mail (Table 3). Successful follow-up in the remaining 11 cases ranged from 4 to 70 days and revealed no serious complications.

Discussion

This pilot study suggests that emergency physicians can safely remove pediatric upper esophageal coins. Unlike the 3 previous cases of coins removed from the esophageal tract by emergency physicians, our technique involved deep sedation and muscle relaxation, rather than physical restraint, to facilitate the procedure.^{23,24}

The technique of using Magill forceps to remove upper esophageal coins has been described by Janik and Janik, pediatric surgeons who removed coins from 36 endotracheally intubated children,¹⁶ and by Mahafza, an otolaryngologist who removed upper esophageal coins from children who were under inhalational anesthesia but not intubated.⁹ No complications were reported in either case series, and our experience is similarly positive.

A notable difference in our study is that emergency physicians managed the entire case, including RSI and foreign-body removal, in the ED. ED management minimizes delays related to consultation, procedure booking and transfer to the operating room. In addition, we believe it offers substantial time savings, and, for most US patients, cost savings to the patient.

Although promising, our pilot study has limitations, most importantly its small sample size. A larger study would more accurately estimate the frequency of uncommon but clinically important complications.

Conclusion

Upper esophageal tract coin removal by emergency physicians can be both safe and effective. Further study involving a larger number of patients is needed before this procedure can be generally recommended.

Competing interests: None declared.

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