

Foley catheter extraction for esophageal coin removal in children: The role of sedation

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Foreign body ingestion is a frequent cause of pediatric emergency department visits, particularly among children under four years of age.^[1] Coins are the most commonly ingested non-food foreign bodies that become lodged in the esophagus.^[2,3] and timely removal is recommended to prevent mucosal injury.^[4,5] Although endoscopic extraction is effective, it requires general anesthesia and operating room resources, which increases cost and prolongs care. For this reason, the Foley catheter extraction technique has been widely used as a rapid, anesthesia-free alternative in appropriately selected patients.^[6-8] While the Foley technique is well established, procedural success may vary depending on patient cooperation and technical factors. Sedation is commonly used in pediatric emergency practice to reduce anxiety and movement.^[9,10] Yet its potential contribution to the success of Foley catheter extraction has not been clearly defined in the limited available literature. This study aims to evaluate the outcomes

Abstract

Objectives: This study aims to evaluate the outcomes of Foley catheter extraction for esophageal coin removal in children and to determine the factors influencing procedural success, with particular focus on the role of sedation.

Patients and methods: Between January 2015 and December 2024, a total of 90 pediatric patients presenting with esophageal coin ingestion were retrospectively reviewed. Following the exclusion of patients who underwent primary endoscopic removal, the remaining 72 patients were evaluated in two groups based on the sedation approach: the sedated group (13 males, 9 females; mean age: 43.1 ± 26.6 months; range, 9 to 108 months) and the non-sedated group (31 males, 19 females; mean age: 48.4 ± 29.4 months; range, 9 to 144 months). Demographic characteristics, coin location, time from ingestion to presentation, extraction method, sedation use, and complications were recorded. Sedation (intravenous midazolam 0.1 mg/kg) was selectively administered when poor cooperation was anticipated. Failure after three attempts prompted endoscopic removal. Sedated and non-sedated groups were compared using chi-square and Fisher's exact tests.

Results: Among the patients who underwent Foley catheter extraction, 22 received sedation, and 50 were managed without sedation. Overall success was 77.8% (56/72). Success was higher in sedated patients (90.9%, 20/22) than in non-sedated patients (72.0%, 36/50), although this difference did not reach statistical significance (odds ratio: 3.89; $p = 0.122$). Complications were minimal and limited to nasopharyngeal migration ($n = 2$) and vomiting ($n = 2$); importantly, all complications occurred in the non-sedated group. No respiratory or sedation-related adverse events occurred. The mean post-procedure observation time was significantly longer in the sedated group (3.1 vs. 2.1 h).

Conclusion: Foley catheter extraction is a safe and effective method for esophageal coin removal in children. Non-sedated extraction was successful in the majority of cases, while sedation may be considered in selected patients where poor cooperation is anticipated.

Keywords: Coin ingestion, esophageal foreign body, Foley catheter, midazolam, pediatric sedation.

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of the Foley catheter extraction method in pediatric patients presenting with coin ingestion at our center and to assess factors influencing success, with particular attention to the possible role of sedation.

PATIENTS AND METHODS

This retrospective study was conducted at the Department of Pediatric Surgery, Trakya University Faculty of Medicine, between January 2015 and December 2024. Although a total of 90 patients presenting with coin ingestion were initially reviewed, 18 patients who underwent primary endoscopic removal were excluded. Consequently, 72 patients were enrolled and divided into two groups based on the sedation approach performed: Sedated group (13 males, 9 females; mean age: 43.1 ± 26.6 months; range, 9 to 108 months) and non-sedated group (31 males, 19 females; mean age: 48.4 ± 29.4 months; range, 9 to 144 months). The inclusion criteria were as follows: (1) pediatric patients (aged 0-18 years) who presented to the emergency department with a witnessed or suspected coin ingestion; (2) radiologically confirmed coin impaction in the proximal or mid-esophagus; and (3) management by attempted Foley catheter extraction as the initial removal method. Patients who underwent endoscopic removal of the foreign body under general anesthesia without an attempt at Foley catheter extraction were excluded from the study. The extraction method was not applied to patients with coins located distally in the esophagus. Informed consent was obtained from the legal guardians of all participants before the procedure. Standard procedural consent for catheter extraction was obtained from the legal guardians as part of routine clinical care. Given the retrospective design and the use of anonymized records, the requirement for additional informed consent for research purposes was waived by the institutional review board. The study was conducted in accordance with the Declaration of Helsinki and was approved by the institutional review board (TÜTF-GOBAEK 2026/82).

Medical records of patients who presented to the emergency department with coin ingestion and were found to have a coin lodged in the esophagus radiologically were reviewed retrospectively. Demographic data, the location of the coin in the esophagus, the time elapsed between coin ingestion

and hospital admission, the extraction method (Foley catheter extraction/endoscopy), the use of sedation, and any complications were recorded.

Sedation was not routinely administered but selectively used when the attending pediatric surgery resident anticipated poor cooperation based on the child's agitation, anxiety, or inability to tolerate catheter manipulation. Children who appeared calm and cooperative underwent the procedure without sedation. Sedation was avoided only when intravenous access was not feasible or when deemed unsafe by the treating physician. For patients selected at the discretion of the resident pediatric surgeon, sedation was administered using intravenous midazolam (Zolamid®; Vem İlaç, İstanbul, Türkiye) at a dose of 0.1 mg/kg before attempting Foley catheter extraction.

The standardized procedure involved obtaining informed consent from the legal guardians and performing the technique under the following conditions (excluding sedation): The Foley catheter extraction procedure was performed in the resuscitation room of the pediatric emergency department. Continuous patient monitoring, including pulse oximetry and cardiorespiratory monitoring, was maintained throughout the procedure, and full resuscitation equipment was readily available in the procedure area in case of potential complications. The technique was performed without fluoroscopic guidance using a blind approach.

Patients were positioned in the lateral decubitus position during the procedure. Nursing staff assisted the operator as necessary to stabilize the child and ensure procedural safety. The procedures were performed by pediatric surgery residents under the supervision of attending pediatric surgeons experienced in foreign body extraction. A 10 Fr silicone Foley catheter was inserted through the nasal route and advanced beyond the impacted coin. The balloon was then inflated with 5-8 mL of air (max 8 mL), after which gentle traction was applied to retrieve the coin. Up to three attempts were allowed for Foley catheter extraction. If the coin could not be removed after three attempts, the procedure was considered unsuccessful, and endoscopic removal under general anesthesia was subsequently performed. Cases in which the coin migrated into the stomach during the procedure were considered successful.

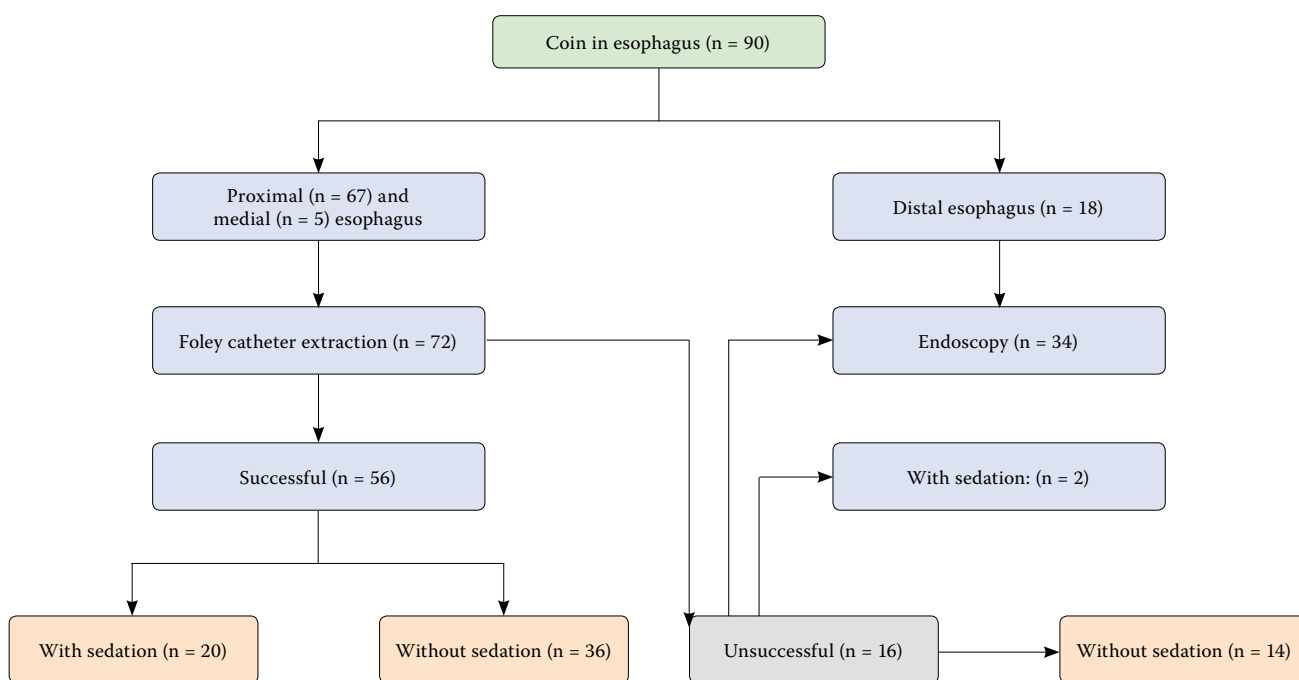


Figure 1. Flowchart of patient selection, treatment allocation, and procedural outcomes. Of 90 children presenting with an esophageal coin, 72 with a proximal or mid-esophageal coin underwent Foley catheter extraction and 18 with a distal coin underwent primary endoscopic removal. Foley catheter extraction was successful in 56 patients (20 with and 36 without sedation) and unsuccessful in 16 (2 with and 14 without sedation); unsuccessful cases subsequently underwent endoscopic removal under general anesthesia.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics for Mac, version 29.0 (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed with the Shapiro-Wilk test. Continuous variables were expressed as

mean $\pm$ standard deviation (SD) and compared between the sedated and non-sedated groups using the Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages and compared using the Pearson chi-square test or Fisher's exact test, as appropriate. The association

TABLE 1
Comparison of baseline characteristics

	Sedated group (n = 22)			Non-sedated group (n = 50)			Total (n = 72)			p
	n	%	Mean $\pm$ SD	n	%	Mean $\pm$ SD	n	%	Mean $\pm$ SD	
Age (month)			43.1 $\pm$ 26.6			48.4 $\pm$ 29.4			46.8 $\pm$ 28.5	0.463*
Sex										0.796†
Male	13	59.1		31	62.0		44	61.1		
Female	9	40.9		19	38.0		28	38.9		
Coin location										1.000†
Upper esophagus	21	95.5		46	92.0		67	93.1		
Mid esophagus	1	4.5		4	8.0		5	6.9		
Time to presentation (h)			10.8 $\pm$ 23.5			11.2 $\pm$ 22.8			11.1 $\pm$ 22.9	0.284*
Observation time (h)			3.1 $\pm$ 1.2			2.1 $\pm$ 0.9			2.4 $\pm$ 1.1	< 0.001*

SD, standard deviation; *, Mann-Whitney U-test; † Fisher's exact test / Chi-square test.

TABLE 2
Comparison of outcomes between sedated and non-sedated groups

	Sedated group (n = 22)		Non-sedated group (n = 50)		OR	95% CI†	<i>p</i> *
	n	%	n	%			
Successful extraction	20	90.9	36	72.0	3.89	0.80-18.87	0.122
Failed extraction	2	9.1	14	28.0	-	-	-
Total	22	100	50	100	-	-	-

OR, odds ratio; CI, confidence interval; *, calculated using Fisher's exact test; †, odds ratio for successful extraction (Sedated group vs. Non-sedated group).

between sedation and successful extraction was estimated by the odds ratio (OR) with its 95% confidence interval (CI). A two-tailed *p* value < 0.05 was considered statistically significant.

RESULTS

Following the screening and exclusion process outlined in the study flowchart, as shown in Figure 1, a total of 72 patients who underwent the Foley catheter extraction method were actively analyzed. Among these patients, 22 received sedation and 50 underwent the procedure without sedation. The mean age was 43.1 ± 26.6 months in the sedated group and 48.4 ± 29.4 months in the non-sedated group (*p* = 0.463). The most common site of coin impaction was the upper esophagus (n = 67, 93.1%), followed by the mid-esophagus (n = 5, 6.9%). There were no statistically significant differences between the groups in terms of age, gender, coin location, or time to presentation, as shown in Table 1.

The overall success rate of Foley catheter extraction was 77.8% (56/72). Eight patients (six in the sedated group and two in the non-sedated group) experienced migration of the coin into the stomach during the procedure; these cases were classified as successful outcomes since the foreign body cleared the esophagus, thereby eliminating the risk of impaction.

In the sedated group, 20 of 22 patients (90.9%) had successful extractions, while 36 of 50 patients (72.0%) were successfully treated in the non-sedated group. Although the success rate was notably higher in patients receiving sedation, this difference did not reach statistical significance (*p* = 0.122), as shown in Table 2.

Nasopharyngeal migration of the coin occurred in two patients (4.0% of the non-sedated group),

and vomiting was observed in two patients (4.0% of the non-sedated group). All complications occurred in patients managed without sedation. No respiratory complications, aspiration events, or sedation-related adverse outcomes were recorded. Minor epistaxis was occasionally observed but required no intervention. The mean post-procedure observation time was significantly longer in the sedated group (3.1 ± 1.2 h) compared to the non-sedated group (2.1 ± 0.9 h) (*p* < 0.001) (Table 1).

DISCUSSION

The Foley catheter extraction technique has long been an established and widely used approach for the removal of esophageal coins in children. Within this well-defined clinical framework, our study contributes additional insight by exploring factors that may influence the success of this technique, particularly patient cooperation and the potential role of sedation. Large series in the literature have reported high success rates, such as fluoroscopy-assisted removal, achieving 85.5% success by Svetanoff et al.^[11] and the large non-sedated series by Erginel et al.,^[12] which documented a 94.17% success rate. These data confirm that the Foley catheter technique itself is neither novel nor experimental but rather a long-standing method with predictable performance characteristics.

Traditional predictors of successful Foley extraction include younger patient age and presentation within 24 h of ingestion,^[13] both of which characterized our cohort and likely contributed to the overall favorable results. Other procedural variables, such as the use of fluoroscopy versus a blind approach^[8] and the choice of balloon

inflation medium,^[14-16] have also been extensively evaluated in prior studies. Together, these factors form the conventional context in which the Foley technique is typically applied and interpreted.

However, beyond these technical and demographic considerations, our findings suggest that patient cooperation may be an additional modifiable determinant of procedural success. Children who struggle to tolerate catheter advancement or balloon traction may compromise the effectiveness of the technique, even when it is performed correctly. This observation raises a clinically relevant question: whether supportive measures that improve procedural conditions might enhance outcomes within the established Foley framework.

Sedation is widely used across pediatric emergency procedures and has been shown to improve cooperation, reduce anxiety, and limit movement, particularly in younger children.^[9,17] These benefits directly relate to the mechanical demands of the Foley technique, where steady catheter navigation and controlled traction are essential. Agitation can cause premature balloon displacement or interfere with optimal positioning. Recent controlled data further confirm the procedural usefulness and safety of midazolam-based sedation in brief pediatric interventions,^[10] supporting its relevance to this technique.

In our cohort, the success rate appeared higher in the sedated group compared with the non-sedated group (90.9% vs. 72.0%). However, this difference did not reach statistical significance ($p = 0.122$). Therefore, although sedation may facilitate procedural conditions in selected patients, our findings do not demonstrate a statistically significant association between sedation and procedural success.

Contrasting with studies that advocate strictly for non-sedated removal to preserve the cough reflex,^[12] our study demonstrated a high success rate (72%) in the non-sedated group, confirming that sedation is not universally required. This success rate is consistent with previously reported outcomes and supports the continued use of non-sedated extraction as a first-line approach in cooperative patients.

The relatively small number of sedated patients in our series may have limited the statistical power of this comparison. Larger prospective studies would be required to more clearly determine whether sedation has a measurable effect on procedural success.

Safety considerations are central to the use of the Foley catheter technique. Although concerns have historically been raised regarding airway compromise or aspiration during blind extraction, several studies have demonstrated that the procedure can be safely performed when appropriate patient selection and monitoring are ensured.^[6,7,11,12] In our clinical practice, the nasal route was routinely preferred as it allows for easier advancement of the catheter and better maintenance of the patient's position during the procedure. While minor, transient epistaxis was occasionally observed during catheter insertion, particularly in non-sedated patients, these events did not require intervention. No respiratory complications or sedation-related adverse events were observed.

Our study has certain limitations inherent to its retrospective design. First, sedation was administered at the discretion of the treating resident rather than through a randomized protocol, which introduces the possibility of selection bias. Second, the sample size of the sedated group was relatively small, which limited the statistical power of the comparative analysis.

Despite these limitations, our study provides valuable real-world data from a single center, demonstrating that Foley catheter extraction remains a safe and effective procedure with high success rates in appropriately selected patients. Sedation may be considered as a supportive measure in selected cases where poor cooperation is anticipated, rather than as a routine requirement for the procedure.

In conclusion, Foley catheter extraction is a safe and effective method for esophageal coin removal. Non-sedated extraction was successful in the majority of cases (72%) in our cohort. Although the success rate appeared higher in sedated patients (90.9%), this difference did not reach statistical significance. Sedation may therefore be considered in selected cases where poor cooperation is anticipated, rather than as a routine requirement for the procedure.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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