

# Gastrointestinal transit time of radiopaque ingested foreign bodies in children: experience of two paediatric tertiary centres

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## Abstract

**Introduction:** Foreign body (FB) ingestion is a common paediatric emergency. While guidelines exist for urgent intervention, less is known of the natural progress of FBs passing through the gastrointestinal tract (GIT). We reviewed these FB transit times in an outpatient cohort.

**Methods:** A retrospective review was performed on all children ( $\leq 18$  years) treated for radiopaque FB ingestion at two major tertiary paediatric centres from 2015 to 2016. Demographic data, FB types, outcomes and hospital visits (emergency department [ED] and outpatient) were recorded. All cases discharged from the ED with outpatient follow-up were included. We excluded those who were not given follow-up appointments and those admitted to inpatient wards. We categorised the outcomes into confirmed passage (ascertained via abdominal X-ray or reported direct stool visualisation by patients/caregivers) and assumed passage (if patients did not attend follow-up appointments).

**Results:** Of the 2,122 ED visits for FB ingestion, 350 patients who were given outpatient follow-up appointments were reviewed (median age 4.35 years [range: 0.5–14.7], 196 [56%] male). The largest proportion (16%) was aged 1–2 years. Coins were the most common ingested FB, followed by toys. High-risk FB (magnets or batteries) formed 9% of cases ( $n=33$ ). The 50<sup>th</sup> centile for FB retention was 8, 4 and 7 days for coins, batteries and other radiopaque FBs, respectively; all confirmed passages occurred at 37, 7 and 23 days, respectively. Overall, 197 (68%) patients defaulted on their last given follow-up.

**Conclusion:** This study provides insight into the transit times of FB ingested by children, which helps medical professionals to decide on the optimal time for follow-up visits and provide appropriate counsel to caregivers.

**Keywords:** Complications, epidemiology, foreign body, gastrointestinal tract, paediatric

## INTRODUCTION

Foreign body (FB) ingestion is a common paediatric emergency. A vast majority of ingested FBs in the gastrointestinal tract (GIT) are expelled spontaneously,<sup>[1]</sup> while a minority may require endoscopic retrieval.<sup>[2,3]</sup> Ingested FBs may be categorised as low risk (coins, beads or marbles) or high risk (batteries, multiple magnets or sharps) depending on the potential complications.<sup>[4-7]</sup> While some cases of ingested FBs result in severe morbidity, a vast majority of FBs are no cause for alarm.<sup>[8,9]</sup> While guidelines exist for the prevention and management of complications of high-risk FB,<sup>[10,11]</sup> less is known of the natural progress of FBs that are allowed to pass through the GIT. A few reports have quantified the rates of

spontaneous passage in the paediatric GIT,<sup>[12,13]</sup> and some have attempted to quantify the exact transit times of the ingested FBs.<sup>[14]</sup> The characteristics of the FBs, such as their shape and size, affect these transit times.<sup>[15,16]</sup>

The present study aimed to: (a) determine the GIT transit times for commonly ingested radiopaque FBs in an outpatient cohort;

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**Received:** 01 Nov 2021 **Accepted:** 07 Sep 2022 **Published:** 25 Apr 2023

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**How to cite this article:** Ang CX, Mun WK, Aw MM, Lin D, Chong SL, Ong LY, *et al.* Gastrointestinal transit time of radiopaque ingested foreign bodies in children: experience of two paediatric tertiary centres. Singapore Med J 2025;66:24-7.

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**DOI:**  
10.4103/singaporemedj.SMJ-2021-408

and (b) review the outcomes of the children in this outpatient cohort (i.e. discharged from the emergency department [ED] and given subsequent outpatient clinic review for the FB ingestion).

## METHODS

A retrospective review was performed on all children ( $\leq 18$  years) who presented to the ED and were treated for radiopaque FB ingestion at two major tertiary paediatric centres (KK Women's and Children's Hospital and National University Hospital, Singapore) from 1 January 2015 to 31 December 2016. The two centres offer specialist care for the nation's paediatric population. The local national cut-off age for providing paediatric care is 18 years.

We analysed data from electronic medical records and radiology images and reports. Demographic data, FB types, serial radiographic reports, outcomes and hospital visits (ED and outpatient appointments) were recorded. All cases discharged from the ED with outpatient follow-up were included.

We excluded: (a) patients who were not given follow-up appointments; (b) patients admitted to inpatient wards from the ED; (c) patients who underwent endoscopic removal of FBs (esophagogastroduodenoscopy); and (d) patients discharged with follow-up appointments to the otorhinolaryngology clinic, as the FB was in the upper airway and not the GIT, or for food-related FB ingestions such as fish or chicken bone, which were not the focus of this research.

Serial radiography was defined as any radiographic study that was repeated in order to detect retention or expulsion of the radiopaque FB. Serial radiographs were analysed — the first radiograph was taken from the first ED visit and compared with subsequent radiographs performed at outpatient follow-up visits to ascertain the retention or expulsion of FBs.

In all cases, no medical treatment (e.g. fibre or GIT motility drugs) was given to encourage FBs to be passed as per the local medical practice for non-emergent FB ingestions. We used the following time points to calculate the time taken for the passage of the FB: (a) confirmed passage: time taken from ingestion to direct visualisation of the FB in stools or to time of the first abdominal radiograph confirming non-visualisation of FB in the abdomen; (b) assumed passage: time taken from ingestion to scheduled outpatient follow-up.

Foreign bodies were classified as low risk or high risk, depending on the type of FB and the potential complications.<sup>[17]</sup> Low-risk FBs included coins, round objects (beads or marbles), small toys, single magnets or jewellery, while high-risk FBs included batteries, multiple magnets or sharp objects.

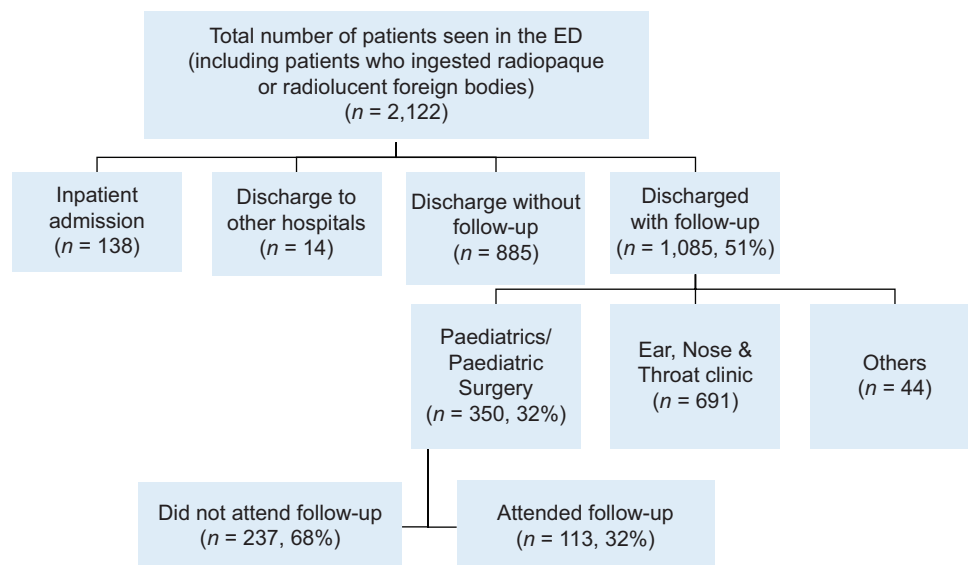
This study protocol (2016/2261) was approved by the Centralised Institutional Review Board.

## RESULTS

During the study period, a total of 2,122 patients with a diagnosis of FB ingestion were seen in the ED. Subsequently, 350 patients were discharged with outpatient follow-up appointments [Figure 1]. The median age of these patients was 4.35 years (range: 0.5–14.7), and 196 (56%) were male. The largest proportion was aged 1–2 years (16%), and the majority (70%) of the children were aged below 6 years [Figure 2].

Coins were the most common FB ingested ( $n=134$ , 41%), followed by toys ( $n=62$ , 27%). High-risk FBs (multiple magnets, batteries or sharp objects) made up 21% ( $n=72$ ) of the cases [Figure 3].

Of the 350 patients who were discharged with outpatient follow-up appointments, a minority ( $n=113$ , 32%) attended the appointments [Figure 1]. Three patients who were



**Figure 1:** Chart shows the outcomes of patients.

initially discharged with outpatient follow-up appointments subsequently returned to the hospital and were admitted for endoscopic removal of the FB.

Thirty-three patients who ingested high-risk FBs were discharged with outpatient follow-up appointments. Notably, 23 (70%) of these patients defaulted on their appointments despite having ingested a high-risk FB.

More than 80% of FBs were expelled by Day 14 of ingestion. Half of the FBs were still retained in the GIT on Days 8, 4 and 7 for coins, batteries and other radiopaque FBs, respectively. All confirmed passage of FBs occurred by Day 37, 7 and 23 for coins, batteries and other radiopaque FBs, respectively [Figure 4].

## DISCUSSION

Our study provides insight on the expected transit times of various FBs. The American Academy of Family Physicians and British Columbia Children's Hospital Division of Pediatric Emergency Medicine Clinical Practice Guidelines suggest weekly follow-ups with radiographs to follow the course of radiopaque ingested FBs.<sup>[18,19]</sup>

Our results revealed that more than 80% of FBs were expelled by Day 14 of ingestion. Half of the FBs were still retained on Day 8, 4 and 7 for coins, batteries and other radiopaque FBs, respectively. With this new information in mind, physicians should give follow-up appointments in accordance with the expected transit times for FBs. This should be calculated from the day of ingestion (and not from the day of ED presentation, as some parents may wait for several days before bringing their child to the ED) to the scheduled follow-up visit. Serial radiographs should be compared, and any FB not expelled by the usual transit times should warrant more caution and possibly a deeper investigation. However, the 50<sup>th</sup> centile of FB retention is (literally) only half the story.

All confirmed passage of FBs occurred by 37, 7 and 23 days for coins, batteries and other radiopaque FBs, respectively. Hence, it is clear that there is a large variance in the transit times for various FBs. More importantly, there is also a large range in transit times for the same FB in different children. In the absence of clinical symptoms and red flags (intestinal obstruction, peritonitis or abdominal pain), it is reasonable to wait for a longer period of time, up to the maximum range for a particular FB, to see if it can be expelled naturally. This is supported by clinical practice guidelines, which suggest that most FBs are passed within 4 weeks.<sup>[17]</sup>

There was a slightly higher proportion of males who were discharged with outpatient follow-up appointments. This is not unlike the demographics seen in the ED, as corroborated by previous studies.<sup>[14,20]</sup> Not surprisingly, the age group of 1–2 years had the highest representation of children presenting to the ED for FB ingestion. Also, the most common FB being

ingested is the coin, as demonstrated by other international literature.<sup>[21]</sup>

One weakness of this study would be the lack of knowledge regarding outcomes of patients who failed to turn up for their follow-up appointments. We were not able to obtain the exact FB transit times for those cases. We presume that this might be due parents having had visual confirmation that the FB was expelled in the stool, and hence the need to return to

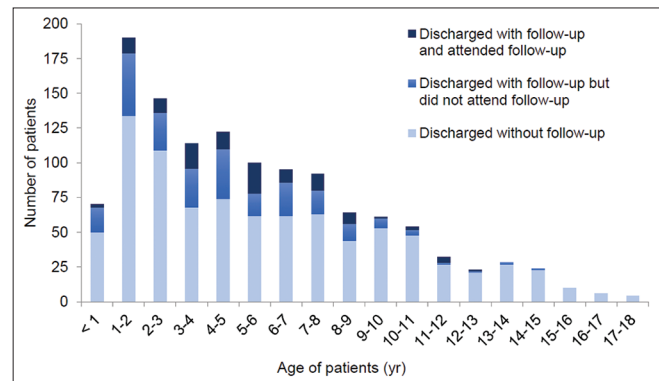


Figure 2: Graph shows the number of patients stratified by age.

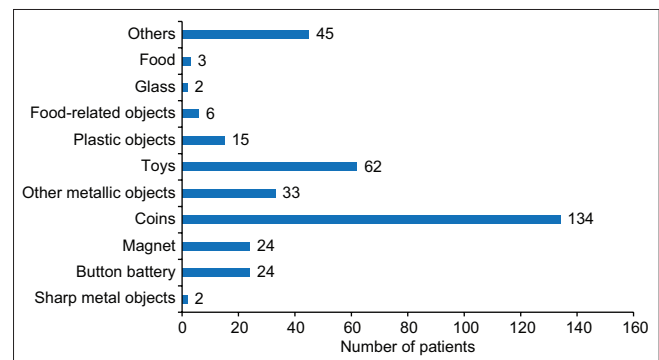


Figure 3: Graph shows the number of patients by types of foreign bodies ingested.

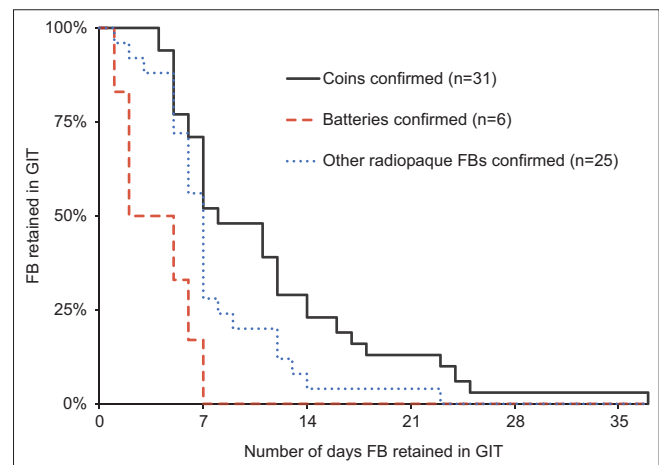


Figure 4: Graph shows the transit times of foreign body (FB) in the gastrointestinal tract (GIT).

the clinic for a follow-up appointment was reduced. Other possible reasons include subsequent admission for endoscopic removal of the FB, or visits to a private clinic for follow-up. The retrospective nature of our study did not allow us to determine the reasons.

Moreover, a number of children were not given follow-up appointments, which is reflective of on-the-ground practice where decisions are made based on clinical grounds. Hence, decision to discharge, follow-up or admit patients depended on each physician's risk tolerance level and level of clinical suspicion of FB ingestion.

A possible population which might not have been picked up includes patients who were managed in the community by general practitioners, other general EDs in the adult restructured hospitals or private hospitals. Though this number is likely small, it would still contribute to selection bias. As this is a retrospective study, the accuracy of data is dependent on caregiver's accounts (for visualisation of expelled FBs) and documentation by physicians.

One of the strengths of this study is that it analyses data from two major specialist paediatric hospitals in Singapore. This would cover almost all cases of FB ingestion in the nation, as the private paediatric healthcare sector in our nation is comparatively limited. Thus, the results obtained from this study would be applicable to the entire Singapore population.

There is a knowledge gap on the natural progress of FBs, with only a handful of studies quantifying the spontaneous passage of FBs.<sup>[11,22]</sup> This study adds to the knowledge of the spontaneous transit times of various FBs through the paediatric GIT. Additionally, our study shows that there is in fact a wide range in the time needed for spontaneous passage of FBs.<sup>[11]</sup>

In order to further the impact of the research, we could further analyse the data based on FB shape, size or density and provide FB transit times based on those factors. The current literature on this subject is limited, focusing mainly on the relationship between FB characteristics and rate of spontaneous passage, but does not define the duration expected for spontaneous passage of the FB.<sup>[20]</sup>

In conclusion, understanding the time period in which a vast majority of FBs are passed, as well as knowing the range of transit times for common FBs will provide information to medical professionals on deciding the optimal time for follow-up visits, and to counsel caregivers accordingly. We suggest that physicians schedule outpatient follow-up appointments 1–3 weeks from the day of ingestion. Any FB retained past the common transit times may warrant further investigation or intervention.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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