

Epidemiological trends and outcomes of children with aural foreign bodies in Singapore

Menghao Duan¹*MBBS*, Gayathry Morvil¹*MBBS*, Junaidah Badron^{1,2}*MMED (Paediatrics)*, Sashikumar Ganapathy^{1,2}*MRCPC (UK)*

ABSTRACT

Introduction: Aural foreign bodies (FBs) are a common presenting complaint in emergency departments (EDs) worldwide. This study aims to describe trends and outcomes of aural FBs in the paediatric population, presenting to a tertiary hospital in Singapore.

Methods: A retrospective review of medical records was conducted of all children 0–16 years old with aural FBs who presented to KK Women's and Children's Hospital ED from 2013 to 2017. Clinical data that were collected include patient demographics, type of FB, ear compartment and laterality of FB, symptoms, duration of impaction, mode of removal, outcome in ED, and final disposition.

Results: There were a total of 1,003 cases. The largest age group consisted of 53.7% preschool children of 0–6 years. Males (61.7%) were more common than females (38.3%). FBs were predominantly organic materials (25.6%), followed by beads and stones (15.2%). Most FBs were found in the right ear (56.6%). The majority of patients were asymptomatic (62%). Symptoms observed included ear pain (20.1%), itch (4.8%) and bleeding (3.2%). FBs were removed by instruments (36.6%), suctioning (15.4%), syringing (8.2%), or a combination of methods (13.7%). In the ED, 73.9% of patients had an attempt at removal, among which 78.4% of FBs were successfully removed, 5.9% required specialist review, and 15.7% were unsuccessful.

Conclusion: The majority of paediatric aural FBs can be successfully removed in the ED. Emergency physicians should be trained and equipped with the relevant skills to remove aural FBs.

Ann Acad Med Singap 2022;51:351-6

Keywords: Aural, ear, emergency medicine, foreign body, paediatrics

INTRODUCTION

Aural foreign bodies (FBs) commonly present to the emergency department (ED) worldwide. Children represent the majority of the population, believed to be due to their inquisitive minds and experimental nature.¹ Aetiologies for aural FBs include accidental or intentional insertion of FBs into body orifices, ear irritation caused by rhinitis or otalgia, and habitual cleaning of the ear with cotton buds.² Certain pre-existing medical conditions such as hyperkinetic disorders and psychological developmental disorders also place children at a higher risk of FB insertion.³

In the past decade, aural FBs continue to be a public health concern, driving up healthcare expenditure and causing significant morbidity.⁴ Insertion of FBs in the upper aerodigestive tracts has been identified as a

common childhood injury, alongside drowning, falls and poisoning.⁵ These adverse effects impose significant financial burden on the socio-economic system. Healthcare costs based on procedures for FB extraction and length of hospitalisation incurred up to 50.8 million euros per year in a pan-European survey.⁴

There have been studies in countries worldwide reporting the epidemiology of FB but only few from Southeast Asia.⁶ In Malaysia, Chiun et al. reported the age distribution, clinical features and types of FB encountered over 4 years in a single tertiary hospital.⁷ There are differences in the 2 study outcomes and recommendations for FB removal. Such differences may also be noted when comparing developed and developing countries. Research done in developed countries has identified several factors contributing

¹ Department of Emergency Medicine, KK Women's and Children's Hospital, Singapore

² Paediatric Academic Clinical Programme, Duke-NUS Medical School, Singapore

Correspondence: Dr Menghao Duan, Department of Emergency Medicine, KK Women's and Children's Hospital, 100 Bukit Timah Road, Singapore 229899.
Email: menghao.duan@mohh.com.sg

This article was first published online on 3 June 2022 at annals.edu.sg

CLINICAL IMPACT

What is New

- This study describes epidemiological trends and outcomes of aural foreign bodies (FBs) in a paediatric population in Singapore.
- The majority of paediatric aural FBs were successfully managed by the ED physician and did not require specialist referral.

Clinical Implications

- The study identifies clinical factors contributing to successful aural FB removal in children.
- Training ED physicians to remove aural FBs and anticipate difficult removal is recommended.

to unsuccessful removal.^{8,9} In such cases, early referral to the specialists for potential removal under general anaesthesia should be considered.¹⁰ However, resource-poor regions may grapple with the lack of appropriate instruments and a poorly established referral system to the specialists. This presents a unique set of challenges to reduce complications associated with aural FB extraction, and emphasises the need for proficiency of primary care doctors.¹¹

The management for aural FB in paediatric patients remains a challenge for many physicians, given the varying levels of experience. While most FBs have a benign course, several cautionary tales of progression to severe complications have been reported.¹² The external ear canal is a small, enclosed and sensitive space where any form of instrumentation or procedure may be challenging. Complications arise as a result of prolonged FB impaction or repeated attempts at removal.⁸ These complications include, but are not limited to, canal abrasions, haematomas, tympanic membrane injuries, otitis media or externa, and mastoiditis.¹²

This study aimed to describe trends and outcomes of aural foreign bodies in the paediatric population, presenting to a tertiary hospital in Singapore. We recorded the characteristics of the patients and FBs commonly encountered in our practice. By comparing our results with other studies, we aim to identify potential areas of improvement to reduce disease morbidity and mortality.

METHODS

A retrospective study was conducted on paediatric patients aged under 16 years old, presenting to the ED

of KK Women's and Children's Hospital for aural FBs, over 4 years from 2013 to 2017. The KK Women's and Children's Hospital is one of 2 tertiary paediatric centres in Singapore's public sector. We included all patients diagnosed with aural FBs according to the International Classification of Diseases, Ninth Revision (ICD-9) Codes 931, 38010, 3849 and 7847. The search criteria were also expanded to include any diagnosis with the keywords "foreign bodies", "ear canal", "tympanic membrane" and/or "pinna". Patients with FBs in the respiratory and gastrointestinal tracts were excluded.

Each patient was assigned a unique identification number, and clinical notes of all relevant patients were retrieved anonymously via the Sunrise Clinical Manager (SCM) electronic medical record software. Patient information included age, race and sex. Data surrounding the ED attendance including types of FB, ear laterality, ear compartment, duration of impaction, symptoms, mode of removal, outcome in the ED, and final disposition were collected. Patients who had an onward referral to ear, nose and throat (ENT) specialists had further data obtained on their complications and treatments.

Following data collection, patients were grouped according to the removal attempts in the ED. The relationship between clinical factors and FB removal attempt was examined using the chi-square test of independence. A *P* value of <0.05 indicated statistical significance. FBs were categorised into 13 classes based on materials. Results were presented using simple descriptive analysis, as proportions in tables.

The study was approved by the SingHealth Institutional Review Board. The requirement for informed consent was waived due to the use of anonymised data and the low feasibility of retrospectively obtaining consent from a large number of patients.

RESULTS

There were a total of 1,003 paediatric cases over the 4-year period. The largest age group consisted of 539 (53.7%) preschool children aged 0 to 6 years. The remainder included 407 (40.6%) children aged 7 to 12 years and 57 (5.7%) above 12 years. The median age was 5.8 (interquartile range 4.3–7.8) years. The cohort constituted of 619 (61.7%) males and 384 (38.3%) females, with a male-to-female sex ratio of 1.6:1.

The most common objects were organic materials (25.6%), including paper, cotton bud, tissue and erasers, followed by beads and stones (15.2%), inorganic material (12.1%), as well as toys (9.8%) (Table 1). There were 31 cases involving insects and 11 cases involving button batteries. More than half (568, 56.6%) of the

Table 1. Types of aural foreign bodies

No.	Type of foreign bodies	No. of patients	%
1	Organic material: paper/cotton bud/tissue/sand/eraser/cloth/glass	257	25.6
2	Inorganic bead/sequin/stone	153	15.2
3	Inorganic material: plastic/styrofoam/blue tack/sponge/foam	122	12.1
4	Inorganic toy: crayon/sticker/magnet/toy	98	9.8
5	Organic food/plant/seed	98	9.8
6	Pencil lead/pen	75	7.5
7	Earring	64	6.4
8	Playdough/plasticine	36	3.6
9	Organic: insect	31	3.1
10	Metals: metal foil	22	2.2
11	Button battery	11	1.1
12	Others: artificial turf/earpiece/hairpin/thermometer	9	0.9
13	Tooth/hair	7	0.7
14	Unspecified	20	2.0
Total		1003	100

FBs were found in the right ear, 380 (37.8%) in the left ear and 55 (5.5%) had bilateral involvement. Most FBs (926, 92.3%) were predominantly lodged in the external auditory canal and could be seen on direct visualisation.

A total of 622 (62%) patients remained asymptomatic. Among those who experienced symptoms, the most frequent presenting complaint was ear pain or discomfort (209/1003, 20.1%). Some patients presented with ear pruritus (48/1003, 4.8%), bleeding (32/1003, 3.2%), hearing loss (13/1003, 1.3%) and tinnitus (2/1003, 0.2%). The duration of impaction varied from hours to several days, although 445 (44.5%) patients presented within 24 hours of witnessed FB insertion or onset of symptoms.

The mode of removal (Table 2) depended on the type and location of the FBs; 367 (36.6%) FBs were removed with the use of instruments. The instruments were a combination of alligator forceps, Jobson Horne probe, 90-degree hook and Tilley's forceps. Other methods utilised in the ED included suctioning (155/1003, 15.4%), syringing (82/1003, 8.2%), and a combination of different methods (137/1003, 13.7%).

Of the 1,003 patients (Fig. 1), 741 (73.9%) had an attempt at removal in the ED. No attempt was made for 231 (23%) patients, who consequently required a referral

Table 2. Mode of removal of aural foreign bodies

Mode of removal	No. of patients	%
Instruments		
Alligator forceps	165	16.5
Jobson Horne probe	83	8.2
90-degree hook	27	2.7
Tilley's forceps	92	9.2
Suctioning	155	15.4
Syringing or flushing	82	8.2
Combination of methods	137	13.7
Unspecified	31	3.1
No attempt	231	23.0

to the outpatient ENT clinic. Thirty-one patients (3.1%) had unspecified data on removal attempt. A comparison table was drawn between patients who had an attempt at FB removal in the ED and those with no attempt made (Table 3). Chi-square independence test showed that between the 2 groups, age ($P=0.003$), sex ($P=0.012$) and types of FBs ($P<0.001$) differed significantly.

Among those who had attempts at removal, 581 (78.4%) FBs were successfully removed by the emergency physician in the ED, without sedation or general anaesthesia. Forty-four (5.9%) patients required a consult with ENT physicians and had the FBs removed by them on the same day of the ED visit. These consisted of patients who were referred directly to ENT without any prior attempt at removal. There were 116 (15.7%) patients with unsuccessful removal in the ED and they were given an ENT appointment for the next working day. A myriad of factors contributed to the unsuccessful attempts—patient factors (20/116, 16.9%), physician factors (10/116, 8.5%), nature of FB (24/116, 20.8%), or a combination of the above.

More than half or 576 (57.4%) of the patients were discharged from the ED with no follow-up appointment. A total of 410 (40.9%) were referred to the outpatient ENT clinic for further management. Of note, 12 patients required admission for examination and extraction of the FB under general anaesthesia. Two of them had impacted button batteries, and 4 involved organic food including plants and seeds. These objects are known to cause severe complications and warrant immediate ENT referral at the ED.

DISCUSSION

Our patient demographics consisted predominantly of children aged 0–6 years old and males. The most

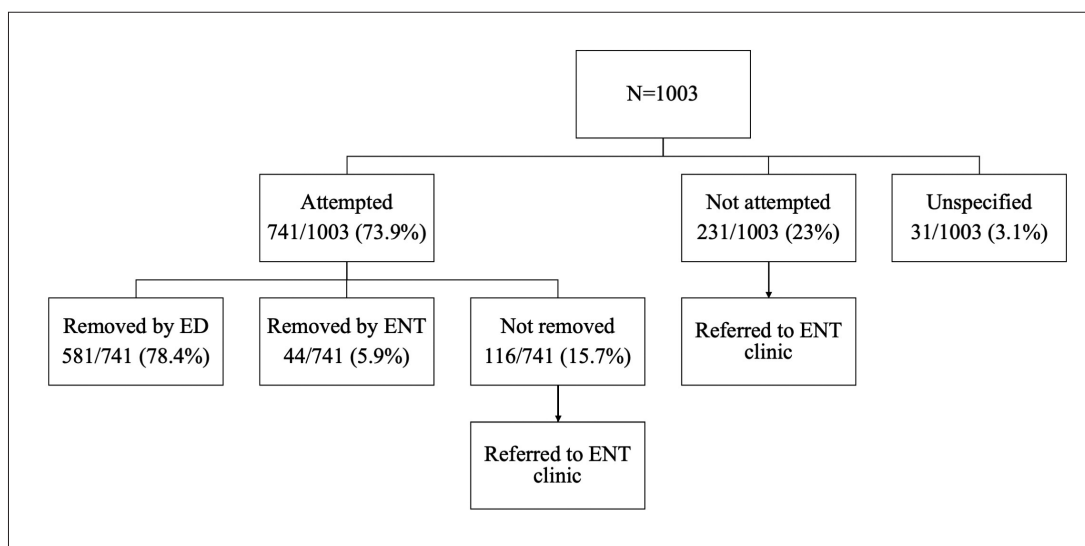


Fig. 1. Flowchart of all patients from presentation to emergency department, attempted/not attempted removal of aural foreign bodies, and final disposition.

ED: emergency department; ENT: ear, nose and throat

common type of FBs was organic materials. The majority of FBs were found in the right ear, most patients remained asymptomatic, and presented within 24 hours to the ED. The removal of FB was done with instruments, suctioning or syringing.

Of the 1,003 patients, 73.9% had an attempt at FB removal in the ED and among those attempted, 78.4% were successfully removed by ED physicians. More than half of the patients were discharged from the ED.

In our population, the highest incidence of aural FB was in preschool children aged 0–6 years. It was consistently observed that most aural FB cases arise from this age group, and the rate of incidence decreases as age increases.^{11,13} This is postulated to be the age where children are most active and exploratory in nature. They are driven by general curiosity and a whim to insert FBs into their body orifices, usually with household objects. Adult supervision is crucial during this period and educational advice should be provided opportunistically to all caregivers.

Organic materials were the most common type of aural FBs, consisting of paper, cotton bud and tissue fragments. Similarly, these objects were also reported to be of the highest incidence in Ireland,¹⁰ and were also common in Papua New Guinea¹³ and Nigeria.¹¹ Small inorganic objects such as beads and stones were the next most common FBs. These objects are easily available in the household and are likely to be inserted into the ear by unsupervised children.¹⁴

Aural FBs were found to be predominantly lodged in the external auditory canal (EAC). The EAC is divided

into cartilaginous and bony portions, which are lateral and medial, respectively. The osseous passage is very vascular and is lined with a sensitive thin layer of skin. As a result, trauma to this area causes bleeding and pain. Most FBs were inserted superficially and lodged in the lateral aspect of the ear canal, which may explain why most patients remained asymptomatic.¹⁵ In a separate study at the Pediatric Hospital of Turin,¹⁶ a retrospective analysis of 100 aural FB cases in children aged 0–12 years found a significant proportion presenting with hearing loss, ear fullness and otalgia.¹⁶ These symptoms were relatively rare in our population.

FBs lodged in the ear for a prolonged period often result in inflammatory reactions, sensitising the EAC and causing oedema, hence making the removal process more challenging. In the Children's Hospital of Wisconsin, FBs removed between 24 hours and 1 week had a lower success rate compared to those who presented within a shorter period.⁸ It was encouraging that the majority of our patients presented within 24 hours from the onset. However, while caregivers should be advised to seek treatment at the earliest time possible, Kumar suggested in his study that most ENT FBs do not require immediate removal and instead, can be undertaken the next day in a more ideal environment.¹⁷

The majority of aural FBs in our study were successfully removed in the ED. All FBs were assessed by the attending ED physician before deciding to attempt removal. We reported a 78% success rate among those deemed suitable for an attempt, an improved result compared to the previous Singapore study, which

Table 3. Comparison of attempted versus non-attempted foreign bodies

N=1003	Attempted n=741 (73.9%)		Non-attempted n=231 (23%)		P value
Age, years, no. (%)					0.003
0–6	405	54.7	147	63.4	
7–12	305	41.1	68	29.6	
>12	31	4.2	16	7.0	
Sex, no. (%)					0.012
Male	494	66.6	133	57.7	
Female	247	33.4	98	42.3	
Types of foreign bodies, no. (%)					<0.001
Organic	173	23.3	91	39.4	
Inorganic ^a	369	49.8	71	30.9	
Fruit/plant/seed, insect	92	12.4	20	8.5	
Battery	5	0.7	2	0.7	
Others ^b	68	9.1	16	7.1	
Unspecified	34	4.7	31	13.4	
Ear compartment, no. (%)					-
External auditory canal	719	97	166	71.8	
Middle ear	0	0	57	24.7	
Unspecified	22	3.0	8	3.5	
Duration of impaction, days, no. (%)					0.261
<1	330	44.5	117	50.7	
2–7	115	15.5	33	14.1	
>7	296	40.0	81	35.2	

^a Inorganic material: plastic/styrofoam/blue tack/sponge/foam, bead/sequin/stone, toy, crayon/sticker/magnet, pencil, playdough/plasticine

^b Others: earring, metal, tooth/hair, artificial turf/earpiece/hairpin/thermometer

recorded a success rate of 53%.⁶ The discrepancy between the 2 studies done at a decade-long interval could suggest improved skills and competency of the ED physicians. Our result is comparable to the Gupta et al. study in Australia, which reported a 72% success rate.¹⁸ The researchers also concluded that most aural FB cases can be managed in the ED setting. Several other studies shared poorer success rates: 53% in the US¹⁹ and 7% in Ireland,¹⁰ with both recommending an early referral to the specialists.

To have all FBs in children referred to the ENT specialist for management is not practical nor economically feasible. In our study, a small, selected group of patients (23%) was referred to ENT without an attempt in ED. Aural FB should be triaged based on its

type and location to optimise the chances of successful retrieval and lower complication rates, while avoiding unnecessary referrals. Smooth spherical objects were less graspable and had the worst outcomes, as shown by Dimuzio et al.¹⁹ Multiple attempts were also associated with lower success rates according to Schulze et al., as children became increasingly uncooperative.⁸

Among the few patients who required direct admission for examination and extraction under anaesthesia by ENT, 2 had impacted button batteries and 4 had plants and seeds. These objects are notorious for developing severe complications and warrant a more cautious management with urgent ENT review. Batteries can cause liquefactive necrosis of the ear epithelium from the leakage of its alkaline contents. Vegetative matter

may expand on contact with moisture and lead to high pressures in the enclosed ear canal space.²⁰ Fortunately, our patients received timely treatment and made good recovery. Live insects in the ear should also be killed by submersion to relieve patient symptoms prior to removal with instruments or irrigation.²¹

An area for further research could potentially include the competency and confidence of ED physicians in FB removal, as well as the equipment and resource available in the ED to support these procedures. While it is widely agreed that specialist opinion should be sought whenever there is anticipated difficulty, most straightforward cases can be effectively managed by the ED physician.

Limitations

Limitations of this study included possible incomplete or inadequate documentation and data. This was despite best efforts made to capture all data surrounding visits to the ED for the topic of interest. Significant types of data requested by the reviewers were not available, including sedation rates, seniority of operators, proportion of children with autism spectrum disorder or developmental delay. These were factors that could have contributed to FB removal outcomes. There was also a lack of information on follow-up ENT visits, resulting in limited data on complications that may have developed from the ED removal attempt. Cost analysis comparing resource utilisation in the ED and ENT outpatient clinics in the management of aural FB was not possible due to insufficient data.

CONCLUSION

Aural FBs remain a common occurrence, particularly among young and unsupervised children. Appropriate education to responsible caregivers is a primary intervention to reduce FB incidence. Our centre demonstrated a 78.4% success rate of attempted aural FB removal, and an overall 58% success rate among all patients presenting to ED with aural FBs. Training ED physicians to become better equipped with the relevant skill set and experience, as well as recognising situations where difficult removal is anticipated, could help in striking a balance between specialist resource allocation and ensuring good patient outcomes.

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