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Foreign Body Ingestion During the COVID Pandemic : A Retrospective Single Centre Review

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Foreign Body Ingestion During the COVID Pandemic : A Retrospective Single Centre Review

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Keywords

Foreign body, children, battery ingestion, caustic ingestion

Total Word Count: 2266

What Is Already Known:

It has been well established that foreign body ingestion is associated with paediatric morbidity and mortality. Specifically, it has been shown that foreign bodies such as button batteries and magnets are associated with increased mortality and morbidity.

1. This study will aim to address concerns associated with a rising trend noted in foreign body ingestion in the paediatric population.
2. This study will aim to establish the significance of the impact of the coronavirus pandemic on the trend of rising foreign body ingestion.
3. This study will aim to impact public health campaigning to reduce foreign body ingestion in the paediatric population.

What This Study Adds:

This study adds additional information to the impact of coronavirus pandemic on foreign body ingestion. It may inform of potential causative factors leading to ingestion, such as closure of schools and nurseries, working from home and self-isolation.

1. This study will add further information with regards to the increase trend noted in foreign body ingestion during the pandemic.
2. This study will add information with regards to factors associated with the coronavirus pandemic on foreign body ingestion in a single paediatric tertiary care centre.
3. This study will add information with regards to public policy and public health campaigning for paediatric care.

Abstract

During the COVID pandemic in 2020 there were many changes in provision of healthcare and environments for children. We noted an apparent increase in the number of children presenting with ingested foreign bodies and due to the potential impact of injury from this, further investigated this phenomenon.

Method:
Using a prospective electronic database, data was collected for patients presenting with foreign body ingestion from 20th March to September 2020 and was compared to the same time period the year prior as a control.

Results:
During the pandemic 6 month period reviewed, it was observed that 2.5 times more children presented with foreign body ingestion (n=25) in comparison to the control group (n=10). Button batteries were the most commonly ingested object followed by magnets. An increase in surgical intervention and serious morbidity in three cases was seen during the COVID pandemic.

Conclusion:
These findings raise concerns in terms of both increased frequency and severity in outcomes of foreign body ingestion during the COVID pandemic. Given the current return to increased national restrictions and ongoing disruption to healthcare and home and work environments, further awareness of the danger of foreign body ingestion and batteries is needed. We recommend public heath campaigns to highlight this danger.

Project ID 2956.

Introduction

The COVID pandemic started to emerge in December 2019 with the WHO declaring the outbreak as a public health emergency of concern in January 2020 [1]. The first cases of coronavirus arrived in the UK at the end of January 2020. On the 3rd April 2020, the Royal College of Paediatrics and Child Health issued a position statement on delayed access to medical care during the pandemic [2]. At the time of publication, the NHS 111 service was being accessed by 15 times the average number of people that would be expected to contact them for advice. The college set out a clear set of guidelines to reassure the general population that paediatric patients will continue to receive the care that they need during this international crisis and that timely access to care should be sought either through community services or secondary healthcare.

During the COVID pandemic, it has been noted that hospitalisation in the paediatric population has faced different challenges compared to the adult population. There has been a significant reduction in paediatric admissions across European countries during the coronavirus pandemic [3,4]. In the UK, paediatric service provision was reconfigured. As part of London's North Central regional response to COVID, paediatric patients were directed to Great Ormond Street Hospital to facilitate adult hospitalisation. During this time period, a notable increase in foreign body ingestion was observed.

It has previously been reported that 50-60 deaths per year in the UK are secondary to foreign body ingestion, with the most common foreign bodies encountered in the paediatric population being button batteries, coins and high-powered magnets [5]. Notably, Litovitz[6] reported 12.6% of children who ingested a 20mm battery suffered severe or fatal injuries. In addition to this, a more recent study in France has investigated an evolving trend of urgent endoscopies in children over a 6 month period (February to July 2017). With a total of 237 referrals, 68% were found to be associated with foreign body ingestions. Of those, 25.2% had ingested a battery and 26.4% had ingested coins [7]. Such findings consequently add further weight to an evolving picture of an increase in foreign body ingestion and associated mortality in the paediatric population.

Whilst the paediatric population has largely been protected from COVID-related illness, children and their caregivers have been significantly impacted by closure of schools, nurseries and enforcement of social distancing [8, 9]. Moreover, a wide variability in the degree to which students returned to school following the UK's first national lockdown has been observed, which may be a result of parental preferences or requirements to self-isolate [10]. With this in mind and an increased presentation of children with foreign body ingestion, we sought to review the incidence, management and outcomes of referrals to our institution during the early months of the national lockdown compared with our experience before the pandemic.

Methodology

Participants were initially involved in the study as a result of a noted anecdotal trend of increased foreign body ingestion. The research question was subsequently developed to investigate whether this trend is associated with the coronavirus pandemic.

An observational, cross-sectional study design was employed. A retrospective data base was used to collect all patients referred with foreign body ingestion during the COVID pandemic and a year prior to the COVID pandemic. The study was conducted in a single institution department of Specialist Neonatal & Paediatric Surgery, Great Ormond Street Hospital and was registered within the trust as an audit (Project ID 2956).

The trust's electronic patient record system was used as a search engine to identify patients with foreign body ingestion for both groups. Patients were selected if coded with 'foreign body ingestion'. The inclusion/exclusion criteria for this study are as follows in **Table 1**. No patients were actively recruited to the study and therefore no patients required assignment for intervention. Ethical approval was not required and there was no requirement to individually disseminate findings.

Risk of confirmation bias was minimised by collecting all patients with foreign body ingestion in the first instance and subsequently allocating into pandemic and control populations. Patients were assigned to the 'pandemic' group if referred between March 2020 to September 2020, which encompasses the dates of school closure from 20th March 2020 to September 2020. The control group was defined as foreign body ingestion between the period of March 2019 to September 2019; one year prior to the COVID pandemic.

The data collected reviews basic epidemiology, foreign body type, time to referral, location of foreign body and management type. Both conservative and surgical management was included, as well as associated complications. Fisher's exact test was used for statistical analysis with $P<0.05$ considered to be significant.

Results

During the pandemic 6 month period, 25 patients were admitted with foreign body ingestion as compared with only 10 patients in the pre-pandemic control group. This amounted to a two and a half times greater number rise in cases. During the pandemic a reduction in total number of hospital admissions was noted at Great Ormond Street Hospital. The number of foreign body ingestions in this study accounts for 0.141% of total hospital admissions during the coronavirus pandemic in comparison to 0.041% in the control group ($p<0.05$). This indicates that foreign body ingestion is not a result of trends in total hospital admissions.

The demographics and average time before presentation of these cases are summarised in **Table 2**. All patients were previously fit and well excluding one patient in the pandemic group who had mild developmental delay and one in the control group with congenital heart disease. The commonest foreign bodies encountered during the pandemic were button batteries (10), magnets (6) and coins (3). Notably, a significant increase in the number of button batteries ($p=0.04$) and magnets ($p=0.04$) was observed in the pandemic group in comparison to controls (**Figure 1**). The majority of these foreign bodies during the pandemic were found within the stomach (9) followed by the oesophagus (9) (**Figure 2**).

The management of these foreign bodies varied as per the type of foreign body, location and clinical picture. Surgical management included endoscopic retrieval, laparoscopy and/or laparotomy. Conservative management was based on active observation of the patient either clinically and/or with serial X-ray imaging. During the pandemic, two thirds of patients required surgical retrieval compared with only one third of patients during the control period ($p=0.12$; **Figure 3**). Three patients during the pandemic developed significant complications following their foreign body ingestion.

This included, complex tracheo-bronchial injury with two subsequent re-constructive operations and a prolonged Paediatric Intensive Care Unit admission following ingestion of a button battery. The second two complications refer to bowel perforations following ingestion of magnets which resulted in a prolonged surgical admissions and intravenous antibiotic therapy.

Discussion

We have observed an increase in the number of paediatric referrals for foreign body ingestion during the COVID pandemic. Notably, the number of referrals requiring surgical management in comparison to conservative management for foreign body ingestion has also significantly increased in this period. Moreover, it is observed that during the COVID pandemic, the most commonly ingested foreign body was a button battery followed by magnets. Both button batteries and magnet ingestion are recognised to be associated with increased mortality and poor outcomes. Consequently, this has been seen to result in prolonged paediatric intensive care admissions in previously fit and healthy children [11]. These findings raise concerns in terms of both increased frequency and severity in outcomes of foreign body ingestion during the COVID pandemic.

It is noted that the demographic features of this study are in line with that of previous research investigating foreign body ingestion in paediatrics. The median age of referral with foreign body ingestion in this study was between 3-4 years. This is in keeping with previous studies which indicated that 2-4 years of ages are most at risk of ingesting foreign bodies [12-14]. Furthermore, it has been identified that the stomach and oesophagus are the most frequently referred location of foreign body which is also in line with previous research [15].

In light of the picture described during the COVID pandemic, it is essential to consider features of foreign body ingestion which lead to more aggressive surgical management, such as delayed presentation and type of foreign body. During the COVID pandemic, a greater range in time to presentation with foreign body ingestion (0-56 days) was observed, compared to controls where all patients in this studies population were found to have presented immediately. The delay in presentation was noted to be in association with unwitnessed foreign body ingestion and lack of diagnosis on initial presentation to medical teams during the COVID pandemic. Families during the COVID pandemic experienced disruption of home environments, with children unable to attend school or nurseries as well as changes in work routines and environment. Additionally, the overall pattern described of reduced presentations of paediatric patients to hospital during the COVID pandemic may also contribute to

the delay in presentation which may be a result of avoidance of hospitals during the COVID pandemic [3,4].

Additional features associated with the need for surgical management include type of foreign body ingested. With technology ever evolving, the use of button batteries in day to day life has increased, thus resulting in ease of access at home. Over the last two decades, the ingestion of button batteries has become of increasing concern in the paediatric population [16]. With children spending more time at home during the COVID pandemic, it is important to consider this as a factor in the increased number of referred swallowed button batteries in this study. In addition, it is important to note the increased number of magnets swallowed and the associated medical and surgical complications. Magnets pose significant risk when one or more is ingested and thus consideration in the development and manufacturing of children's toys with magnets is identified as an area of concern.

When considering weaknesses of this study, the increase in cases witnessed could be attributed to the reconfiguration of services in the North London region, with Great Ormond Street Hospital as the paediatric hub. Nevertheless, when accounting for the four patients in this study who fell outside of the usual catchment area, a significant increase in referrals with foreign body ingestion was still noted. In the pre-pandemic era, the majority if not all the patients in our network hospitals would also have been discussed with us for a potential transfer of care. Furthermore, it is essential to note the relatively small sample size of patients in this study. Consequently, future research should consider a national data collection on foreign body ingestion during the COVID pandemic to improve generalisability of results.

Public health campaigning has previously resulted in successful behavioural changes, as well as impacting advertising and manufacturing companies [17]. Moreover, public health campaigning has been noted to have positive outcomes in reducing foreign body ingestions globally [18, 19]. With an increase frequency and severity of foreign body ingestion shown during the COVID pandemic, it is proposed that public health campaigns should target the paediatric population during pandemic and advocate for increased awareness of risks and medical emergencies associated with foreign body ingestion.

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Data Sharing Statement for ICMJE Requirements

Statement	Response
Will individual participant data be available (including data dictionaries)?	Yes
What data in particular will be shared?	All of the individual participant data collected during the trial, after deidentification.
What other documents will be available?	Statistical analysis plan, Data collection code.
When will data be available?	Immediately following publication. No end date.
With whom?	Anyone who wishes to access the data.
For what types of analyses?	Any purpose.
By what mechanism will data be made available?	Proposals should be directed to naomi.festa@GOSH.nhs.uk. To gain access, data requestors will need to sign a data access agreement.

Patient and Public Involvement Statement

How was the development of the research question and outcome measures informed by patients' priorities, experience and preferences?

Patients were initially involved in the research as a result of an anecdotal trend noted of increased foreign body ingestion. The research question was subsequently developed to investigate if this is associated with altered social situations as a result of coronavirus pandemic.

How did you involve patients in the design of the study?

Patients were involved in the study if coded with 'foreign body ingestion' on the trusts electronic patient record system. No patients were therefore prospectively assigned to a control group. The study design was therefore an observational cross-sectional study.

Were patients involved in the recruitment to and conduct of the study?

No patients were actively recruited to the study. Information was collected retrospectively on patients referred with foreign body ingestion. Patients were not recruited to a control or 'treatment' group as the control group was defined by time specific dates outside of the pandemic. There was no active treatment or intervention in this study. The group of interest were patients admitted during specified dates within the coronavirus pandemic.

How will the results be disseminated to study participants?

The public may be involved through public health campaigning to address the danger in foreign body ingestion. Dissemination of the results of the study to patient groups is not applicable in this instance.

For randomised controlled trials, was the burden of the intervention assessed by patients themselves?

This study was not a randomised controlled trial and so no intervention was indicated.

Table 1. Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Paediatric population 0-16yrs Admitted or referred under GOSH General Surgical and/or shared with the ENT Department Surgical or conservative management	Adults Admissions under ENT Tricheobezoar PICA Food bolus impaction Fish bones History of foreign body but foreign body not identified Caustic ingestion

Table 2. Demographic data of foreign body ingestion during coronavirus pandemic.

	Pandemic (n=25)	**Control (n=10)**
Male	14 (56%)	5 (50%)
Age (median, range)	3 (10 months – 14 years)	3 (1-14 years)
Median days prior to presentation, (range)	0* (0-56)	0* (0-3)

*0 days refers to immediate presentation to medical professional following foreign body ingestion

Figure 1. Type of foreign body ingested.

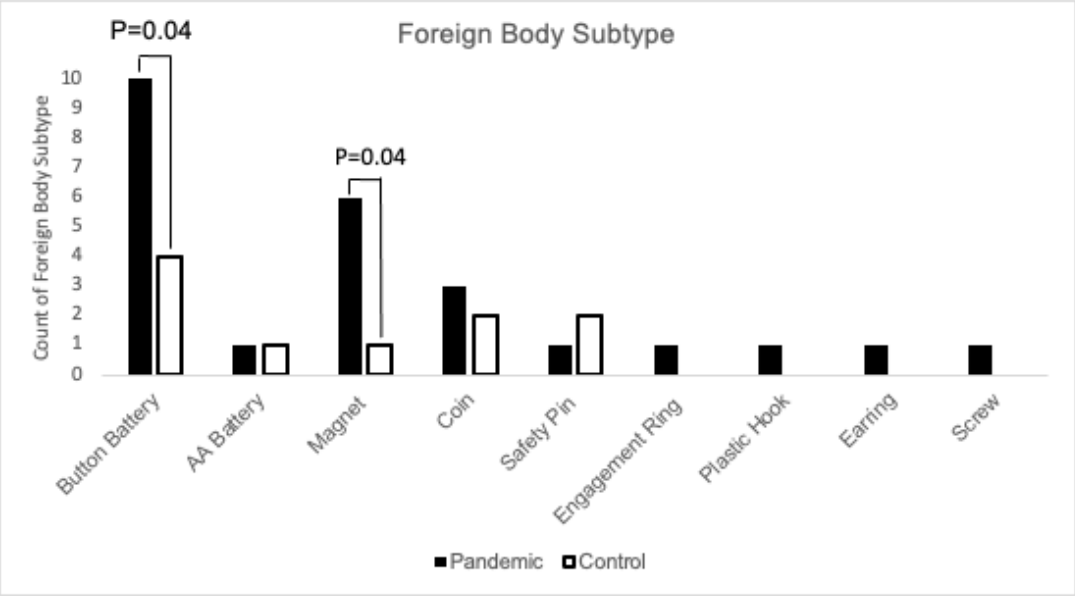


Figure 2. Location of identified foreign body.

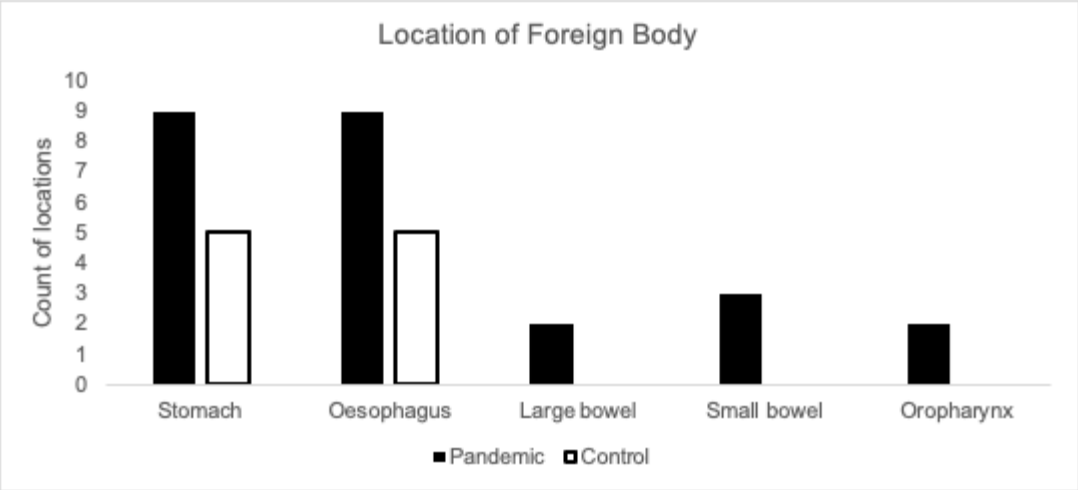
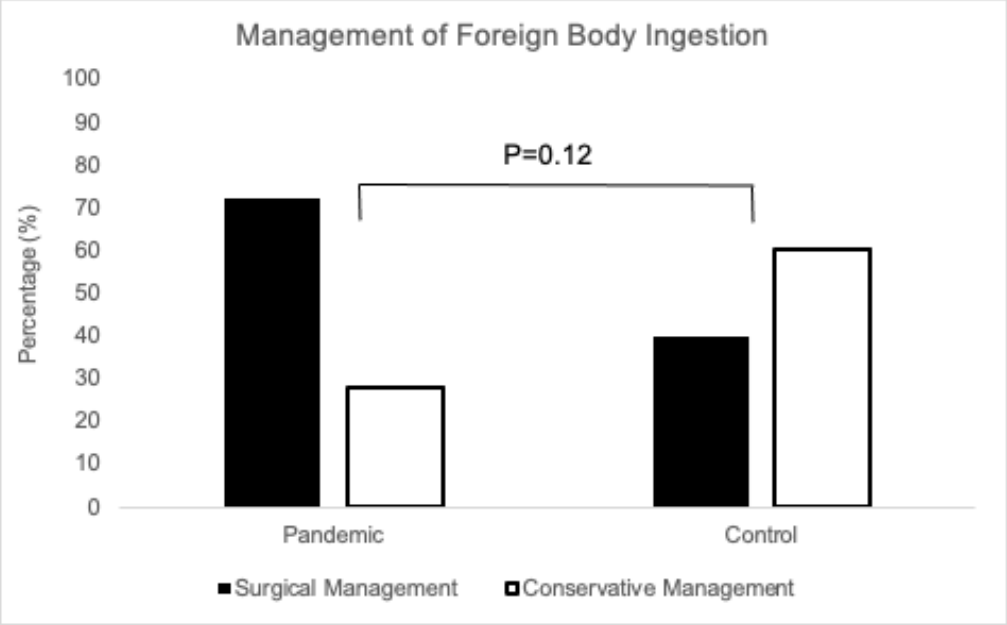


Figure 3. Management of Foreign Body Ingestion.



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Keywords

Foreign body, children, battery ingestion, caustic ingestion

Total Word Count: 2488

What Is Already Known:

1. Foreign body ingestions, specifically button batteries and magnets, are associated with mortality and morbidity.
2. Cases of button battery ingestions are an increasingly concerning cause of fatality in the paediatric population over the past decade.
3. During the coronavirus pandemic, the home and work environment underwent significant disruption, with many children unable to attend school or nursery and caregivers working from home.

This study aims to explore trends associated with cases of rising foreign body ingestions in the paediatric population and to establish the impact of the coronavirus pandemic on this trend.

What This Study Adds:

1. Support reports from other countries depicting an increase of foreign body ingestion in children during the pandemic.
2. Further evidence supporting the literature depicting an increase in morbidity associated with foreign body ingestion.
3. Weight to support public health campaigns aimed to tackle paediatric foreign body ingestion.

Abstract

During the COVID pandemic in 2020 there were many changes in provision of healthcare and environments for children. We noted an apparent increase in the number of children presenting with ingested foreign bodies and due to the potential impact of injury from this, further investigated this phenomenon.

Method:
Using a prospective electronic database, data was collected for patients presenting with foreign body ingestion from March to September 2020 and was compared to the same time period the year prior as a control.

Results:
During the pandemic 6 month period reviewed, it was observed that 2.5 times more children presented with foreign body ingestion (n=25) in comparison to the control group (n=10). Button batteries were the most commonly ingested object followed by magnets. An increase in surgical intervention and serious morbidity in three cases was seen during the COVID pandemic.

Conclusion:
These findings raise concerns in terms of both increased frequency and severity in outcomes of foreign body ingestion during the COVID pandemic. Given the ongoing national and international restrictions and disruption to healthcare, home and work environments, further awareness of the danger of foreign body ingestion and batteries is needed. We recommend public heath campaigns to highlight this danger.

Project ID 2956.

Introduction

The COVID pandemic started in December 2019 with the WHO declaring the outbreak as a public health emergency in January 2020,[1]. The first cases of coronavirus arrived in the UK at the end of January 2020. On the 3rd April 2020, the Royal College of Paediatrics and Child Health issued a position statement on delayed access to medical care during the pandemic,[2]. At the time of publication, the NHS 111 service was being accessed by 15 times the average number of people that would be expected to contact them for advice. The college set out clear guidelines to reassure the general population that paediatric patients will continue to receive the care they need during this international crisis and that timely access to healthcare should continue to be sought.

Hospitalisation in the paediatric population has faced different challenges in comparison to the adult population during the COVID pandemic. There has been a significant reduction in paediatric admissions across European countries during the coronavirus pandemic,[3,4]. In the UK, paediatric service provision was reconfigured. As part of London's North Central regional response to COVID, paediatric patients were directed to Great Ormond Street Hospital (GOSH) to facilitate adult hospitalisation. During this time period, a notable increase in foreign body ingestion was observed.

It has previously been reported that 50-60 deaths per year in the UK are secondary to foreign body ingestion, with the most common foreign bodies encountered in the paediatric population being button batteries, coins and high-powered magnets,[5]. Notably, Litovitz[6] reported 12.6% of children who ingested a 20mm button battery suffered severe or fatal injuries. In addition to this, a more recent study in France has investigated an evolving trend of urgent endoscopies in children over a 6 month period (February to July 2017). With a total of 237 referrals, 68% were found to be associated with foreign body ingestions. Of those, 25.2% had ingested a battery and 26.4% had ingested coins,[7]. Such findings add further weight to an evolving picture of an increase in foreign body ingestion and associated mortality in the paediatric population.

Whilst the paediatric population has largely been protected from COVID-related illness, children and their caregivers have been significantly impacted by closure of schools, nurseries and enforcement of social distancing,[8,9]. Moreover, a wide variability in the degree to which students returned to school following the UK's first national lockdown has been observed, which may be a result of parental preferences or requirements to self-isolate,[10]. With this in mind and an increased presentation of children with foreign body ingestion, we sought to review the incidence, management and outcomes of referrals to our institution during the early months of the national lockdown compared with our experience before the pandemic.

Methodology

Participants were initially involved in the study as a result of a noted anecdotal trend of increased foreign body ingestion. The research question was subsequently developed to investigate whether this trend is associated with the coronavirus pandemic.

An observational, cross-sectional study design was employed. A retrospective data base was used to collect all patients referred with foreign body ingestion during the COVID pandemic and a year prior to the COVID pandemic. The study was conducted in a single institution department of Specialist Neonatal & Paediatric Surgery, GOSH and registered within the trust as an audit (Project ID 2956).

The trust's electronic patient record system was used as a search engine to identify patients with foreign body ingestion for both groups. Patients were selected if coded with 'foreign body ingestion'. The inclusion/exclusion criteria for this study are as follows in **Table 1**. No patients were actively recruited to the study and therefore no patients required assignment for intervention. Ethical approval was not required and there was no requirement to individually disseminate findings.

Risk of confirmation bias was minimised by collecting all patients with foreign body ingestion in the first instance and subsequently allocating into pandemic and control populations. Patients were assigned to the 'pandemic' group if referred between March 2020 to September 2020, which encompasses the dates of school closure from 20th March 2020 to September 2020. The control group was defined as foreign body ingestion between the period of March 2019 to September 2019; one year prior to the COVID pandemic.

The data collected reviews basic epidemiology, foreign body type, time to referral, location of foreign body and management type. Both conservative and surgical management were included, as well as associated complications. Fisher's exact test was used for statistical analysis with $P<0.05$ considered to be significant.

Results

During the pandemic 6 month period, 25 patients were admitted with foreign body ingestion compared with only 10 patients in the pre-pandemic control group. This amounted to a two and a half times greater number rise in cases. In the pandemic group, four patients were referred from outside the usual catchment area and when accounting for this, a significant increase in referrals with foreign body ingestion was still noted (2.1 times greater). During the pandemic a reduction in total number of hospital admissions was noted at GOSH. The number of foreign body ingestions during the COVID pandemic accounts for 0.0141% of total hospital admissions compared to 0.0041% in the control group ($p<0.05$), indicating that foreign body ingestion is not a result of trends in total hospital admissions.

The demographics and average time before presentation of these cases are summarised in **Table 2**. All patients were previously fit and well excluding one patient in the pandemic group with mild developmental delay and one in the control group with congenital heart disease. The most common foreign bodies encountered during the pandemic were button batteries (10), magnets (6) and coins (3). Notably, a significant increase in the number of button batteries ($p=0.04$) and magnets ($p=0.04$) was observed in the pandemic group compared to controls (**Figure 1**). The majority of these foreign bodies during the pandemic were found within the stomach (9) followed by the oesophagus (9) (**Figure 2**).

The management varied as per the type of foreign body, location and clinical picture. Surgical management included endoscopic retrieval, laparoscopy and/or laparotomy. Conservative management was based on active observation of the patient either clinically and/or with serial X-ray imaging. During the pandemic, two thirds of patients required surgical retrieval compared with only one third of patients during the control period ($p=0.12$; **Figure 3**). Three patients during the pandemic developed significant complications following their foreign body ingestion; this included, complex tracheo-bronchial injury with two subsequent re-constructive operations and a prolonged Paediatric Intensive Care Unit admission following ingestion of a button battery. The second two complications refer to bowel perforations following ingestion of magnets which resulted in a prolonged surgical admissions and intravenous antibiotic therapy.

Discussion

An increase in the number of paediatric referrals for foreign body ingestion has been observed during the COVID pandemic. Notably, the number of referrals requiring surgical management in comparison to conservative management for foreign body ingestion has also significantly increased in this period. Moreover, during the COVID pandemic, the most commonly ingested foreign body was a button battery followed by magnets. Both button batteries and magnet ingestion are recognised to be associated with increased mortality and poor outcomes. Consequently, this has been seen to result in prolonged paediatric intensive care admissions in previously fit and healthy children,[11]. These findings raise concerns regarding increased frequency and severity in outcomes of foreign body ingestion during the COVID pandemic.

The demographic features of this study are in line with that of previous research investigating foreign body ingestion in paediatrics. The median age of referral with foreign body ingestion in this study was between 3-4 years. This is in keeping with previous studies which indicated that children aged 2-4 years are most at risk of ingesting foreign bodies,[12-14]. Furthermore, this study has identified the stomach and oesophagus as the most frequently referred location of foreign body which is also in line with previous research,[15].

The association between the COVID pandemic and an increased trend in paediatric foreign body ingestion has been witnessed internationally. In Italy, a study reviewed attendances to Emergency Department due to foreign body ingestion from February to April 2020 compared to the 4 years prior. A statistically significant increase in button battery ingestions ($P<0.001$) was noted during the pandemic,[16]. Further, Sapountzi[17] investigated Ear Nose and Throat (ENT) emergency admissions during the COVID pandemic and found that whilst attendances for ENT symptoms showed a statistically significant reduction, attendances for foreign body ingestions continued to remain high. The findings from this study echo this trend and thus highlight the importance of raising awareness to increasing rates of foreign body ingestion.

During the COVID pandemic, a greater range in time to presentation with foreign body ingestion (0-56 days) was observed compared to controls where all patients in

this study were found to have presented immediately. When considering time to presentation, this study reviewed time, in days, to presentation and referral of foreign body ingestion to GOSH as one entity. This therefore excluded time to transfer and time to surgical intervention as not all patients required intervention. Whilst Emergency Departments and General Practice underwent significant reconfiguration across London during the pandemic, all acute referrals to GOSH both pre and post COVID are via local Emergency Departments and therefore this does not confound the time to presentation and referral. In support of the trend witnessed in this study regarding delayed time to presentation with foreign body ingestion, a recent study by Yu[18] found a longer duration from ingestion to consultation and increased likelihood of requiring operative management for retrieval in adults with foreign body ingestion. This led to increased rates of hospitalisation during the pandemic compared to controls (15/25 vs 5/25; $p < 0.005$). Whilst these results are based on an adult demographic, reducing generalisability of results, it reinforces our findings and raises a concerning picture of delayed presentation and increased morbidity in both paediatric and adult populations.

There are multiple aspects to consider when exploring factors associated with delay in presentation and referral during the pandemic. Delayed presentation may be associated with an unwitnessed ingestion in the context of dramatically affected health seeking behaviours during the COVID pandemic . Arshad[19] conducted a cross-sectional study in Pakistan to explore health seeking behaviour during the COVID pandemic and found a significant increase in self-medication and decrease in hospital attendances for a variety of conditions, including pneumonia, angina and cholera. Consequently, the impact of altered health seeking behaviours and avoidance of hospitals during the pandemic, should be considered as a potential factor contributing to delayed presentation with foreign body ingestion,[4]. Alternatively, incorrect diagnosis on initial presentation to medical teams may also contribute to delayed time to referral. This factor should be considered in the context of health care providers undergoing significant reconfiguration or using novel modalities for consultations. This further highlights the importance of raising awareness of current increasing trends of foreign body ingestion.

This study has observed an increase in operative management for foreign body ingestion during the COVID pandemic (p=0.12). It is possible that this increase may be directly associated with an initial delay in presentation and referral. Alternatively, increase in surgical management may be associated with type of foreign body ingested such as button batteries and magnets which due to high morbidity rates, require close surgical attention. Given that button battery ingestion has become an increasingly concerning cause of fatality in paediatrics,[20], public health campaigns should continue to raise awareness of the importance of immediate management and risks associated with foreign body ingestions.

The relationship between the COVID pandemic and increased foreign body ingestion is indirect but should be explored. Households during the COVID pandemic experienced significant disruption. UNESCO state that during the COVID pandemic, 1.37 billion students globally, have been unable to attend school resulting in an abrupt change family lifestyle,[21]. Pizzol[16] studied 101 cases of foreign body ingestion and found nearly all happened at home. The relationship between foreign body ingestion and the home environment has been previously explored. Litovitz[22] reviewed 8648 cases of battery ingestions in the paediatric population and found 61.8% of battery ingestions were obtained from household products. They also highlighted that manufacturers should redesign products to secure the battery compartment. Supporting these findings, this present study revealed that many foreign body ingestions such as magnets were associated with toys of an older sibling at home. Therefore, the home environment as well as the manufacture of household products and toys should cautiously be considered as an indirect factor contributing to the trend between the COVID pandemic and foreign body ingestions.

When considering weaknesses of this study the reconfiguration of services to GOSH must be considered. During the pandemic GOSH received an increased number of referring Emergency Departments to facilitate bed capacity across London. During the pandemic four patients in this study were referred from outside the catchment area of controls. To account for this potential confounding variable, these referrals were excluded to improve reliability of results. Following this, an increase in foreign body ingestions was still noted, occurring 2.1 times more frequently during the

pandemic in comparison to control group. This suggests that the increase trend in foreign body ingestion is not dependent on altered referring patterns. Furthermore, this study can not account for foreign body ingestion attendances which were not referred to GOSH and managed by general surgical teams during the pandemic. Subsequently the true number may be higher than what is observed in this study. Secondly, during the pandemic, a reduction in total number of hospital admissions was noted at GOSH yet the number of foreign body ingestions remained significantly high. However, it is important to acknowledge that much of GOSH's elective work was suspended during the pandemic thus limiting the generalisability of this data. As a result, this study has focused on foreign body ingestion independently of total hospital admissions. Finally, it is essential to note the relatively small sample size of patients in this study. Consequently, future research should consider a national data collection on foreign body ingestion during the COVID pandemic to improve generalisability of results.

To conclude, this study highlights a concerning trend of foreign body ingestion and associated morbidity. Delayed time to presentation witnessed during the COVID pandemic may be associated with altered health seeking behaviour and the observed increase in cases of button battery and magnet ingestion should be considered in the context of availability within the household. Both delay in time to presentation and type of foreign body ingestion may contribute to the observed increased rates of operative management for foreign body ingestion during the COVID pandemic.

Public health campaigning has previously resulted in successful behavioural changes, as well as impacting advertising and manufacturing companies,[23]. Public health campaigns have resulted in positive outcomes in reducing foreign body ingestions globally,[24,25]. With concerning trends regarding paediatric foreign body ingestion, it is proposed that public health campaigns should advocate for increased awareness of risks and associated medical emergencies.

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Contributors

PDC, HT and NF designed the concept, analysis and drafted the manuscript. All authors participated in data acquisition and critically reviewing the manuscript for intellectual contents.

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Competing Interests

None.

Ethics Statement

Research ethics approval was not obtained as no human participants were actively involved in the study. Information was collected retrospectively on patients referred with foreign body ingestion. Patients were not recruited to a control or ‘treatment’ group as the control group was defined by time specific dates outside of the pandemic. There was no active treatment or intervention in this study. The group of interest were patients admitted during specified dates within the coronavirus pandemic. Therefore, research ethics approval was not required.

Patient and Public Involvement Statement

Information was collected retrospectively on patients referred with foreign body ingestion. Patients were involved in the study if coded with 'foreign body ingestion' on the trusts electronic patient record system. No patients were

prospectively assigned to a control group. No patients were actively recruited to the study. There was no active treatment or intervention in this study. The study design employed an observational cross-sectional study.

The public may be involved through public health campaigning to address the danger in foreign body ingestion. Dissemination of the results of the study to patient groups is not applicable in this instance.

Table 1. Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Paediatric population 0-16yrs Admitted or referred under GOSH General Surgical and/or shared with the ENT Department Surgical or conservative management	Adults Admissions under ENT Tricheobezoar PICA Food bolus impaction Fish bones History of foreign body but foreign body not identified Caustic ingestion

Table 2. Demographic data of foreign body ingestion during coronavirus pandemic.

	Pandemic (n=25)	**Control (n=10)**
Male	14 (56%)	5 (50%)
Age (median, range)	3 (10 months – 14 years)	3 (1-14 years)
Median days prior to presentation, (range)	0* (0-56)	0* (0-3)

*0 days refers to immediate presentation to medical professional following foreign body ingestion

Figure 1. Type of foreign body ingested.

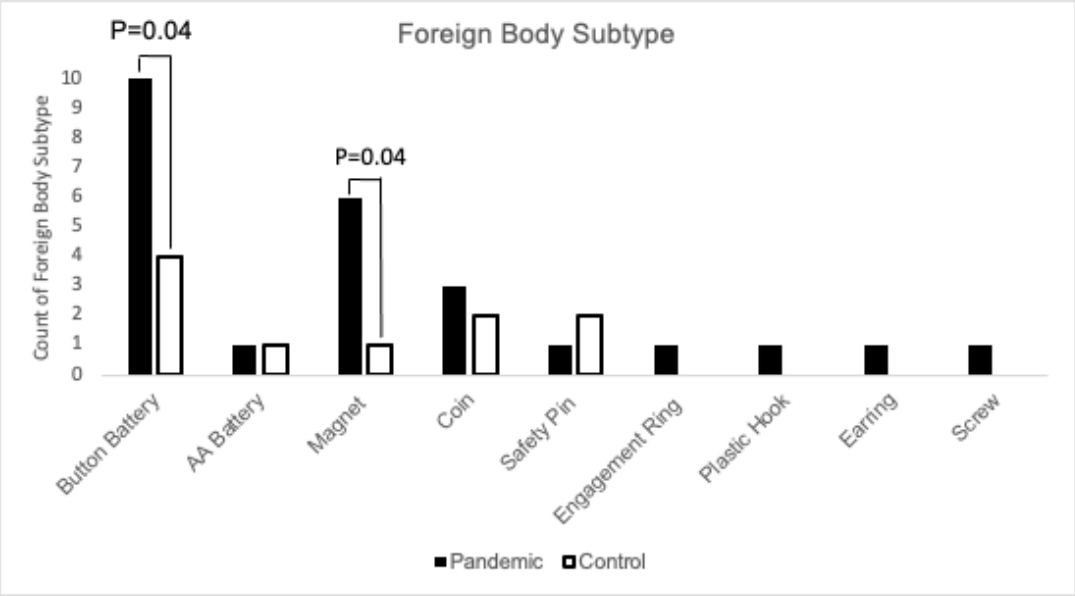


Figure 2. Location of identified foreign body.

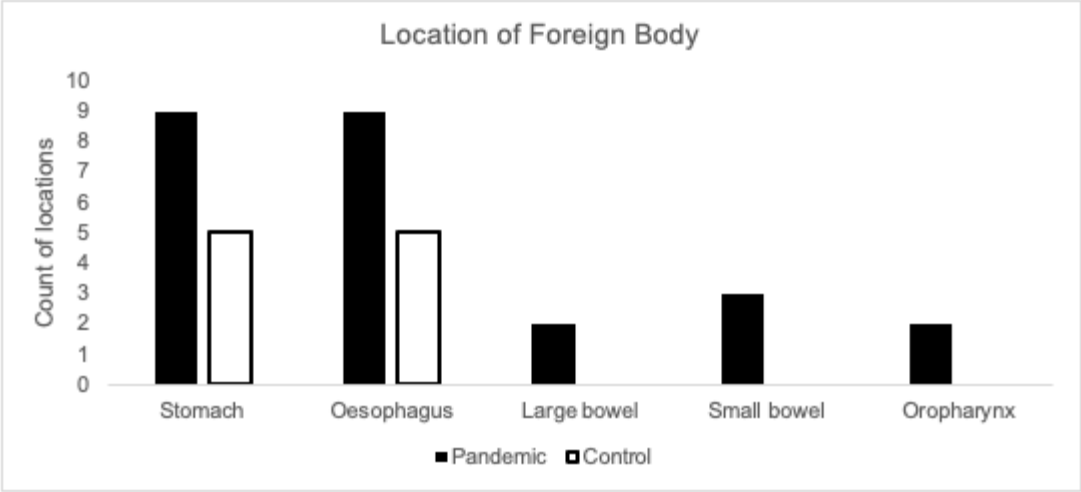
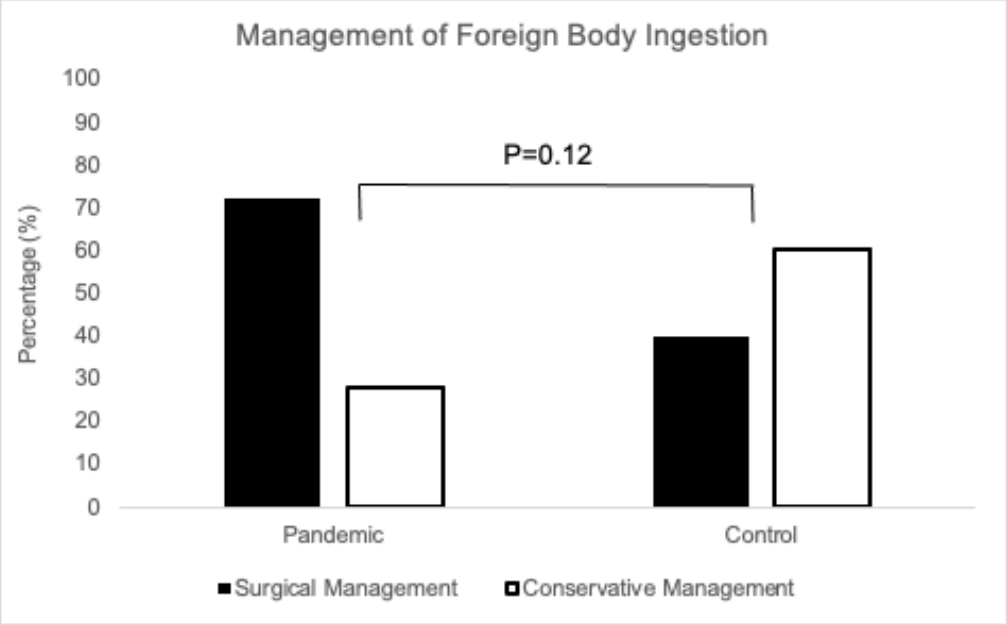


Figure 3. Management of Foreign Body Ingestion.



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Foreign Body Ingestion During the COVID Pandemic : A Retrospective Single Centre Review

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Keywords:	COVID-19

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Foreign Body Ingestion During the COVID Pandemic: A Retrospective Single Centre Review

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Keywords

Foreign body, children, battery ingestion, caustic ingestion

Total Word Count: 1943

What Is Already Known:

1. Foreign body ingestions, specifically button batteries and magnets, are associated with mortality and morbidity.
2. Cases of button battery ingestions are an increasingly concerning cause of fatality in the paediatric population over the past decade.
3. During the coronavirus pandemic, the home and work environment underwent significant disruption, with many children unable to attend school or nursery and caregivers working from home.

What This Study Adds:

1. This study demonstrates an increase in paediatric foreign body ingestions during the COVID pandemic in North London.
2. This supports literature from other countries reporting an increase in foreign body ingestion in children during the pandemic.
3. There was an increase in the percentage of button battery and magnets ingested which is of significant concern for potential morbidity and mortality.

Abstract

Introduction:

During the COVID pandemic in 2020 there were many changes in the provision of healthcare as well as home and educational environments for children. We noted an apparent increase in the number of children presenting with ingested foreign bodies and due to the potential impact of injury from this, further investigated this phenomenon.

Method:

Using a prospective electronic record, data were retrospectively collected for patients referred to our institution with foreign body ingestion from March to September 2020 and compared to the same period the year prior as a control.

Results:

During the 6 month pandemic period of review, it was observed that 2.5 times more children were referred with foreign body ingestion (n=25) in comparison to the control period (n=10). There was also a significant increase in the proportion of button battery and magnet ingestions during the COVID pandemic (p 0.04).

Conclusion:

These findings raise concerns of both increased frequency of foreign body ingestion during the COVID pandemic and the nature of ingested foreign bodies linked with significant morbidity. This may relate to the disruption of home and work environments and carries implications for ongoing restrictions. Further awareness of the danger of foreign body ingestion, especially batteries and magnets is necessary.

Project ID 2956.

Introduction

The COVID pandemic started in December 2019 with the WHO declaring the outbreak as a public health emergency in January 2020,[1]. The first cases of coronavirus arrived in the UK at the end of January 2020. On the 3rd April 2020, the Royal College of Paediatrics and Child Health issued a position statement on delayed access to medical care during the pandemic,[2]. The college set out clear guidelines to reassure the general population that paediatric patients will continue to receive the care they need during this international crisis and that timely access to healthcare should continue to be sought.

It has previously been reported that 50-60 deaths per year in the UK are secondary to foreign body ingestion, with the most common foreign bodies encountered in the paediatric population being button batteries, coins and high-powered magnets,[3]. Notably, Litovitz reported 12.6% of children who ingested a 20mm button battery suffered severe or fatal injuries,[4]. In addition, a more recent study in France investigated an increasing trend of urgent endoscopies in children over a 6 month period (February to July 2017). With a total of 237 referrals, 68% were found to be associated with foreign body ingestions. Of those, 25.2% had ingested a battery and 26.4% had ingested coins,[5]. Such findings add further weight to an evolving picture of an increase in foreign body ingestion and associated mortality in the paediatric population.

Whilst the paediatric population has largely been protected from COVID-related illness, children and their caregivers have been significantly impacted by closure of schools, nurseries and enforcement of social distancing,[6, 7]. Moreover, a wide variability in the degree to which students returned to school following the UK's first national lockdown has been observed, which may be a result of parental preferences or requirements to self-isolate,[8]. With this in mind and seeing an apparent increase in presentation of children with foreign body ingestion, we sought to review the incidence, management and outcomes of referrals to our institution during the early months of the national lockdown compared with our experience before the pandemic.

Methodology

An observational, cross-sectional study design was employed. A prospective electronic data record was reviewed retrospectively to collect all patients referred with foreign body ingestion during a 6 month period of the COVID pandemic and the same time period a year prior. The study was conducted in a single institution department of Specialist Neonatal & Paediatric Surgery, Great Ormond Street Hospital (GOSH) and registered within the trust as an audit (Project ID 2956).

Patients were identified if coded as 'foreign body ingestion'. The inclusion/exclusion criteria for this study are as follows in **Table 1**. No patients were actively recruited to the study, therefore no patients required assignment for intervention and there was no requirement to individually disseminate findings.

Table 1. Inclusion and Exclusion Criteria.

Inclusion Criteria	**Exclusion Criteria**
Paediatric Population 0-16years Admitted or referred under GOSH General Surgical and/or shared with the ENT Department Surgical or conservative management	Adults Admissions under ENT Trichobezoar PICA Food bolus impaction Fish bones History of foreign body but no foreign body identified Caustic ingestion

Risk of confirmation bias was minimised by collecting all patients with foreign body ingestion in the first instance and subsequently allocating into pandemic and control populations.

Patients were assigned to the 'pandemic' group if referred between March 2020 to September 2020, which encompasses the dates of school closure from 20th March 2020 to September 2020. The control group was defined as cases referred between the period of March 2019 to September 2019; one year prior to the COVID pandemic.

The data collected included basic epidemiology, foreign body type, time to referral, location of foreign body and management type. Both need for admission and conservative or surgical management were recorded, as well as associated complications. Fisher's exact test was used for statistical analysis with $P<0.05$ considered to be significant.

Results

During the pandemic 6 month period, 25 patients were referred with foreign body ingestion compared with only 10 patients in the pre-pandemic control group. This represented a two and a half times rise in cases. In the pandemic group, four patients were referred from outside the usual referral area but when accounting for this, a significant increase in referrals with foreign body ingestion was still noted (2.1 times greater).

The demographics and average time to presentation are summarised in **Table 2**. All patients were previously fit and well excluding one patient in the pandemic group with mild developmental delay and one in the control group with congenital heart disease. The most common foreign bodies encountered during the pandemic were button batteries (10), magnets (6) and coins (3). Notably, a significant increase in the number of button batteries (p=0.04) and magnets (p=0.04) was observed in the pandemic group compared to controls (**Figure 1**). The majority of these foreign bodies during the pandemic were found within the stomach (9) followed by the oesophagus (9) (**Figure 2**).

Table 2. Demographic data of foreign body ingestion during coronavirus pandemic.

	Pandemic (n=25)	**Control (n=10)**
Male	14 (56%)	5 (50%)
Age, years (median, range)	3 (10months – 14years)	3 (1 – 14 years)
Median days prior to presentation, (range)	0* (0-56)	0* (0-3)

0* days refers to immediate presentation to medical professional following foreign body ingestion.

Management varied as per the type of foreign body, location and clinical picture. Surgical management included endoscopic retrieval, laparoscopy and/or laparotomy.

Conservative management was based on active observation of the patient either clinically and/or with serial X-ray imaging. During the pandemic 73% of patients required admission to GOSH compared to 40% in the control period and two thirds of patients required surgical retrieval compared with only one third of patients during the control period (p=0.12; **Figure 3**). During the COVID pandemic, a greater range in time to referral from time of foreign body ingestion, when known, was observed (0-56 days) compared to controls (0-3 days) but this did not reach statistical significance. (**Table 2**)**.** We assumed that referral was made the same day as presentation to the local hospital in both groups as would be in keeping with standard practice. Three patients during the pandemic developed significant complications following their foreign body ingestion. One patient had a complex tracheo-bronchial injury with two subsequent re-constructive operations and a prolonged Paediatric Intensive Care Unit admission following ingestion of a button battery and delay to presentation. Two other patients had bowel perforations following ingestion of magnets and required prolonged surgical admissions and intravenous antibiotic therapy.

Discussion

We observed an increase in the number of paediatric referrals to our institution for foreign body ingestion during the COVID pandemic.

Hospitalisation in the paediatric population has faced different challenges in comparison to the adult population during the COVID pandemic. There has been a significant reduction in paediatric admissions across European countries during the coronavirus pandemic,[9,10]. As part of North Central London's regional response to COVID, paediatric patients were redirected to GOSH directly from local Emergency Departments to provide capacity for local adult hospitalisation. The catchment area for referral to GOSH however remained the same and we would not expect foreign body ingestions to have be affected by this change, as they would ordinarily be referred to our centre at time of presentation for management even prior to COVID provision restructuring. During the COVID period a notable increase of more than double the number of foreign body ingestions was observed even considering the small number of additional out of area referrals during this time.

During the COVID pandemic period we also saw a significant increase in the proportion of button batteries and magnets ingested. Both button batteries and magnet ingestion are recognised to be associated with increased mortality and poorer outcomes leading to prolonged paediatric intensive care admissions in previously fit and healthy children,[11,12]. These findings raise concerns regarding increased frequency and potential severity in outcomes of foreign body ingestion during the COVID pandemic.

The demographic features of this study are in line with previous studies of foreign body ingestion in paediatrics. The median age of referral with foreign body ingestion in this study was between 3-4 years, in keeping with the literature showing that children aged 2-4 years are most at risk of ingesting foreign bodies,[13-15]. In our study the stomach and oesophagus were the most frequently referred location of foreign body which is also in line with previous studies,[16].

The association between the COVID pandemic and an increased trend in paediatric foreign body ingestion has been witnessed nationally and internationally. Recent

evidence, in keeping with our data, shows that ingestion of magnets has increased in the UK,[17]. In addition, a study in Italy reviewed attendances to Emergency Department due to foreign body ingestion from February to April 2020 compared to 4 years prior. A statistically significant increase in button battery ingestions was noted during the pandemic,[18]. Further, a study investigating Ear Nose and Throat (ENT) emergency admissions during the COVID pandemic found that whilst attendances for ENT symptoms showed a statistically significant reduction, attendances for foreign body ingestions continued to remain high,[19]. The findings from our study echo this trend and thus highlight the importance of raising awareness to increasing rates of foreign body ingestion.

During the COVID pandemic, a greater range in time to referral from ingestion of foreign body was observed in our study compared to the control period. This difference however did not reach statistical significance although our patient with the most significant morbidity had the longest delay in referral time

Households during the COVID pandemic have experienced significant disruption. UNESCO states that during the COVID pandemic, 1.37 billion students globally, have been unable to attend school resulting in an abrupt change in family lifestyle,[20]. Pizzol[18] studied 101 cases of foreign body ingestion and found nearly all happened at home. The relationship between foreign body ingestion and the home environment has been previously explored. Litovitz[21] reviewed 8648 cases of battery ingestions in the paediatric population and found 61.8% of battery ingestions were obtained from household products. Therefore, the disruption of the home environment during the COVID pandemic, should be considered a potential factor contributing to the increase of foreign body ingestion.

This study cannot account for foreign body ingestions in North London which were not referred to GOSH during the pandemic. Subsequently the true number may be even higher than we observed however, this number is likely to be small as both pre- and during COVID these patients would usually be referred to our tertiary centre. It is also important to note the relatively small sample size of patients in this study. Future research should consider a national data collection on foreign body ingestion during the COVID pandemic to improve generalisability of results.

Our study highlights a concerning overall increase in foreign body ingestion with an increased proportion of button battery and magnets seen. Public health campaigning has previously resulted in successful behavioural changes and resulted in positive outcomes in reducing foreign body ingestions globally,[22-24]. We support ongoing campaigns to advocate for increased awareness of risks and medical emergencies associated with foreign body ingestion especially in light of the ongoing disruption due to the global COVID pandemic.

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Contributors

PDC, HT, KC and NF designed the concept, analysis and drafted the manuscript. All authors participated in data acquisition and critically reviewing the manuscript for intellectual contents.

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Competing Interests

None.

Ethics Statement

Research ethics approval was not obtained as no human participants were actively involved in the study. Information was collected retrospectively on patients referred with foreign body ingestion. Patients were not recruited to a

control or ‘treatment’ group as the control group was defined by time specific dates outside of the pandemic. There was no active treatment or intervention in this study. The group of interest were patients admitted during specified dates within the coronavirus pandemic. Therefore, research ethics approval was not required.

Patient and Public Involvement Statement

Information was collected retrospectively on patients referred with foreign body ingestion. Patients were involved in the study if coded with 'foreign body ingestion' on the trusts electronic patient record system. No patients were prospectively assigned to a control group. No patients were actively recruited to the study. There was no active treatment or intervention in this study. The study design employed an observational cross-sectional study.

The public may be involved through public health campaigning to address the danger in foreign body ingestion. Dissemination of the results of the study to patient groups is not applicable in this instance.

Table 1. Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Paediatric Population 0-16years	Adults
Admitted or referred under GOSH	Admissions under ENT
General Surgical and/or shared with the ENT Department	Trichobezoar
Surgical or conservative management	PICA
	Food bolus impaction
	Fish bones
	History of foreign body but no foreign body identified
	Caustic ingestion

Table 2. Demographic data of foreign body ingestion during coronavirus pandemic.

	Pandemic (n=25)	**Control (n=10)**
Male	14 (56%)	5 (50%)
Age, years (median, range)	3 (10months – 14years)	3 (1 – 14 years)
Median days prior to presentation, (range)	0* (0-56)	0* (0-3)

0* days refers to immediate presentation to medical professional following foreign body ingestion.

Figure 1. Type of foreign body ingested.

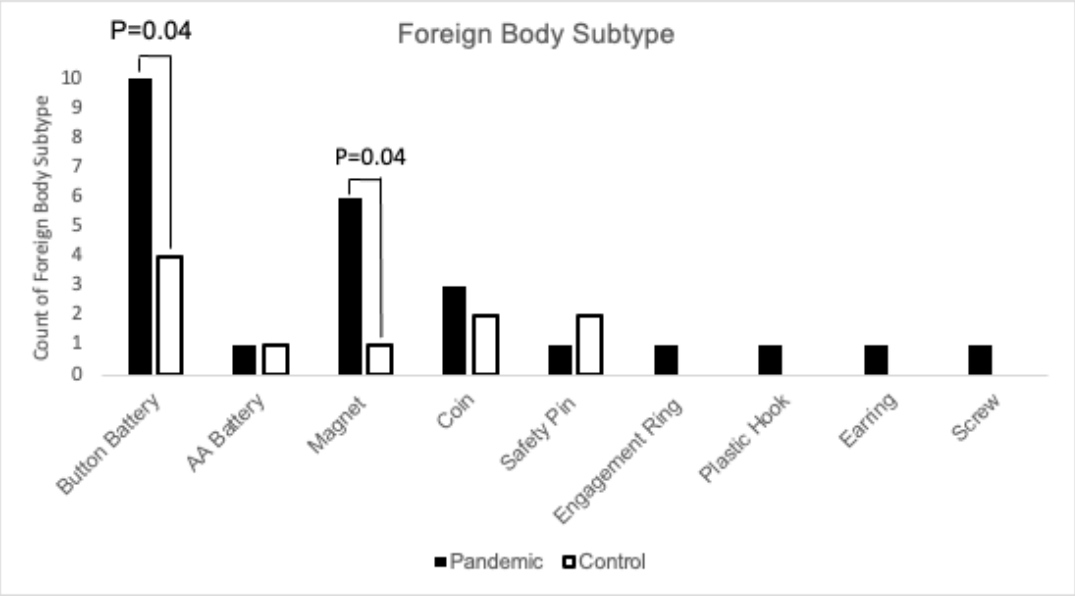

Figure 2. Location of identified foreign body.

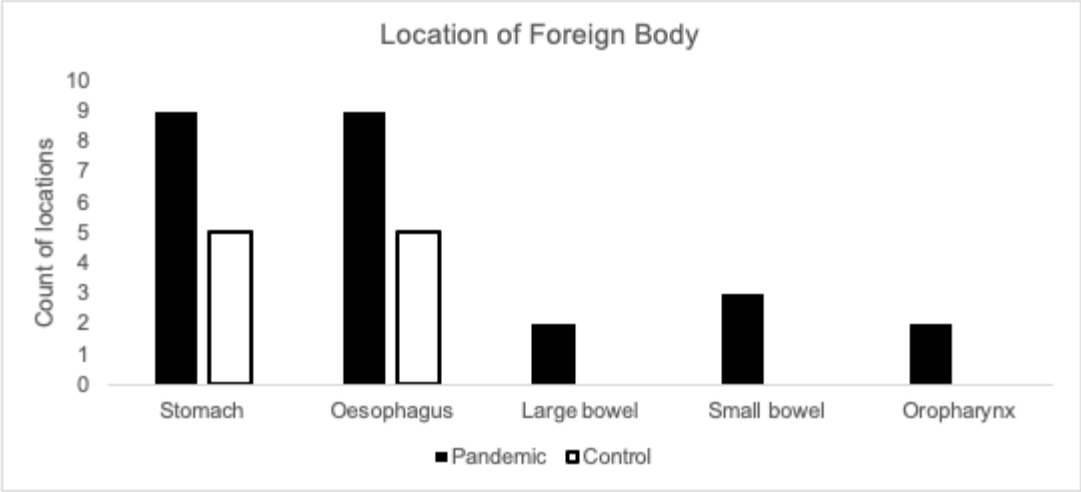

Figure 3. Management of Foreign Body Ingestion.