Delayed endoscopic removal of sharp foreign body in the esophagus increased clinical complications

An experience from multiple centers in China

Jingjing Yuan, MS\textsuperscript{a,b,}\textsuperscript{*}, Mengjie Ma, MS\textsuperscript{a,b,}\textsuperscript{*}, Yang Guo, MD\textsuperscript{a,b,}\textsuperscript{*}, Bili He, MD\textsuperscript{c}, Zhenzhai Cai, MD\textsuperscript{d}, Bin Ye, MD\textsuperscript{e}, Lei Xu, MD\textsuperscript{f}, Jiang Liu, MD\textsuperscript{g}, Jin Ding, MD\textsuperscript{h}, Zhongfa Zheng, MD\textsuperscript{i}, Jianhua Duan, MD\textsuperscript{j}, Liangjing Wang, MD, PhD\textsuperscript{a,b,}\textsuperscript{*}.

Abstract
Foreign bodies impaction in the esophagus is a common clinical emergency. The aim of this study was to investigate the clinical features of foreign body ingestion, and to analyze the risk factors of complications during the endoscopic procedure.

From 18 general hospitals in Zhejiang Province in China, 596 patients who underwent gastroscopic removal of ingested foreign bodies were prospectively recruited. Patient characteristics, clinical features, foreign body features, clinical outcomes, and complications were documented.

The most common types of foreign body in the esophagus were sharp objects (75.9%), including fish bones (34.0%), chicken bones (22.1%), and fruit nuclei (17.1%). The remaining types were non-sharp objects (24.1%), including food bolus (14.6%). Most objects were lodged in the proximal esophagus (75.9%). Foreign body-related complications occurred in 63 patients (10.5%), including hemorrhage (5.0%), perforation and infection (6.5%). The complication rate was increased by 4.04- and 8.48-fold when endoscopic retrieval was performed after impaction for over 24 and 48 hours, respectively, after impaction, as compared with within 12 hours. Logistic regression analysis revealed that the patients with sharp objects developed more complications than those with non-sharp ones (odds ratio, 2.85; 95% confidence interval, 1.08–7.50; \( P = .034 \)). However, complications were unrelated with the location in the esophagus or length of foreign bodies (\( P > .05 \)).

Sharp objects were the most frequently ingested foreign bodies in the esophagus in China. The prevalence of complications was increased in the patients with long foreign body retention time (>24 hours) and sharp objects. Sharp foreign bodies in the esophagus are recommended to be removed within 24 hours.

Abbreviations: ASGE = American Society for Gastrointestinal Endoscopy, CI = confidence interval, ESGE = European Society of Gastrointestinal Endoscopy, FB = foreign body, GI = gastrointestinal tract, NASPGHAN = North American Society for Pediatric Gastroenterology, Hepatology and Nutrition, OR = odds ratio.

Keywords: complications, endoscopy, esophagus, foreign bodies

1. Introduction

Foreign body (FB) ingestion is a common medical emergency accounting for 4% of all emergency endoscopies, secondary to the gastrointestinal (GI) bleeding.\textsuperscript{[1]} In adults, the most common FB is food bolus in Western world.\textsuperscript{[1,2]} However, in Asian countries, sharp FB including fish bones, chicken bones, fruit nuclei and dentures are the most common ingested objects.\textsuperscript{[3,4]} Most impacted FB can pass through the GI tract spontaneously. However, 10% to 20% still need clinical intervention, mostly endoscopic management, while less than 1% even require surgery.\textsuperscript{[5]} The successful removal rate by endoscopy could reach up to 95%.\textsuperscript{[1,3,4,6]} According to the latest guidelines and consensus established by the American Society for Gastrointestinal Endoscopy (ASGE),\textsuperscript{[5]} the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN),\textsuperscript{[7]} and the European Society of Gastrointestinal Endoscopy (ESGE),\textsuperscript{[8]} the primary clinical treatment for ingested FBs is endoscopic management.

Under endoscopy, the most common local lesions include mucosal edema, erosion, laceration, ulcer, and oozing. FB-related complications comprise hemorrhage, perforation, obstruction, retropharyngeal or mediastinal abscess formation, and FB migration into facial spaces of the neck.\textsuperscript{[1,1,3,9]} Among complications, 3% to 20% were reported to be caused by FB
The type and location of FBs, and duration of impaction were correlated with the occurrence of complications. Specifically, sharp objects could increase the risk of perforation.

For symptomatic patients, endoscopy has been regarded as the primary tool for removing impacted FB in the esophagus. According to the latest guidelines of the ASGE and ESGE, emergent endoscopy is recommended for impacted sharp-pointed objects within 24 hours, although the application of endoscopy for impacted food bolus is still controversial. Intravenous sedation is employed for the successful removal; however, it might not always be available because of the emergent situation. As the types of impacted FB differ between Asian and Western countries, the management approaches vary largely under different clinical conditions. This prospective study aimed to prospectively investigate the clinical features of FB ingestion and endoscopic removal in the esophagus, and to summarize the related risk factors of endoscopic complications in multiple endoscopy centers in China.

2. Methods

2.1. Patients

Patients with suspected FB ingestion in the esophagus who signed the consent forms were recruited between October 2015 and August 2016 in 18 tertiary hospitals in Zhejiang Province in East China. By using a uniform questionnaire, data on demographic and clinical variables including age, sex, past medical history, and clinical symptoms, were collected.

2.2. Endoscopic procedure and foreign bodies

All endoscopic management procedures were conducted by experienced specialists. Every endoscopist has more than 5 years’ experiences in diagnosis and treatment of digestive system diseases and finished the esophagogastroduodenoscopy independently more than 200 cases. During the procedure, impacted FBs were removed using accessory devices including rat-tooth forceps (FG-47L-1, Olympus, Japan), polyectomy snares (SD-6L-1, Olympus, Japan; REF-6031, Boston, USA), and dormier baskets (FG301-Q, Olympus, Japan; MWB-2X4, COOK, USA). All the patients were sedated with general anesthesia using 50 to 100 μg fentanyl and 1 to 2 mg/kg propofol or local anesthesia using 2% lidocaine mucilage.

After FB removal, macroscopic characteristics, reports including esophageal mucosal lesions, were recorded. Specifically, the features and locations of FBs, and the complications were described. Normally, FBs shorter than 2.5 cm could pass through the whole digestive tract, so we defined FBs less than 2.5 cm as short, and those longer than 6.0 cm as long in accordance with the guidelines or consensus of the ASGE and ESGE.

2.3. Statistical analyses

Data were analyzed using STATA Version 13.0 (StataCorp: College Station, TX). The Pearson chi-square or Fisher exact tests were used for categorical and ordinal variables. To summarize the independent predictive factors for related complications, multivariate analysis was performed with a logistic regression analysis. The odds ratio (OR) was calculated to assess the risk of the related factors. A P value of less than .05 was considered statistically significant.

3. Results

3.1. Patient characteristics

We enrolled 595 patients with suspected FB ingestion who were admitted to the endoscopic centers of 18 tertiary hospitals. Of the patients, 89 underwent a laryngoscopy first on the basis of the obvious throat pain complaints or positive imaging examination that suggested upper FB existence. FBs were found on laryngoscopy in only 9 patients, and were failed to remove; thus, another endoscopic management procedure was required. Among all the suspected patients, 561 had FBs visible under endoscopy. Underlying upper gastrointestinal tract diseases could affect the physiological function of the esophagus. In our study, 89 patients (15.0%) had GI diseases during endoscopic examination, including 52 with esophageal carcinoma, 18 with benign esophageal stricture, 12 with reflux esophagitis, and 5 with hiatal hernia (Table 1). Of the 595 patients, 573 patients (96.3%) had obvious symptoms after FB ingestion, of which approximately 10% had more than one symptom. Among these, 383 patients had odynophagia (64.4%), 262 had dysphagia (44.0%), and 91 had chest pain (15.3%). Other less common symptoms included nausea and vomiting (7 cases, 1.2%), abdominal pain (5 cases, 0.8%), and hematemesis (4 cases, 0.7%) (Fig. S1, http://links.lww.com/MD/D48).

| Characteristics | No. of patients | Percentage (%) |
|-----------------|-----------------|----------------|
| Age (yr)        |                 |                |
| <15             | 31              | 5.2            |
| 15–59           | 334             | 56.1           |
| ≥60             | 230             | 38.7           |
| Gender          |                 |                |
| Male            | 278             | 46.7           |
| Female          | 317             | 53.3           |
| Reason of FB ingestion |            |                |
| Incidentally    | 576             | 96.8           |
| Intentionally   | 19              | 3.2            |
| Associated upper GI diseases |       |                |
| Esophageal carcinoma | 52       | 8.7            |
| Benign esophageal stricture | 18       | 3.0            |
| Reflux esophagitis | 12       | 2.0            |
| Hiatal hernia   | 5               | 0.8            |
| Other upper GI diseases∗ | 18       | 3.0            |
| Symptoms with FB|                 |                |
| Odynophagia     | 383             | 64.4           |
| Dysphagia       | 262             | 44.0           |
| Chest pain      | 91              | 15.3           |
| Nausea and vomiting | 7          | 1.2            |
| Abdominal pain  | 5               | 0.8            |
| Hematemesis     | 4               | 0.7            |
| Complications with FB |         |                |
| Hemorrhage      | 30              | 5.0            |
| Perforation     | 33              | 5.5            |
| Other complications† | 9           | 1.5            |

Table 1: Characteristics of 595 patients with suspected FB ingestion.

*Other upper GI diseases: including 1 esophageal submucous eminence, 1 esophageal ulcer, 2 esophageal varicosity, 2 esophageal diverticulium, 1 heterotopic gastric mucosa in the esophagus, 2 gastric cancer, 4 gastric ulcer, 1 residual gastrectomy and anastomomatics after gastrectomy, 1 peptic ulcer, 1 duodenal ulcer.
† Other complications: 9 infections without abscess formation.
3.2. Endoscopic outcomes and characteristics of foreign bodies

As the symptoms displayed by patients were often urgent and painful, the time interval from patient complaint to endoscopic management was recorded. Of the patients, 285 (50.8%) were treated with endoscopy management within 12 hours; 193 (34.4%), from 12 to 24 hours; 40 (7.1%), from 24 to 48 hours; 12 (2.2%), from 48 to 72 hours; and 31 (5.5%), longer than 72 hours.

The FBs in 426 patients were anatomically lodged at the proximal segment of the esophagus (75.9%), followed by the middle (15.2%) and distal segments (8.9%). According to the size of the FBs, 311 FBs (57.5%) were shorter than 2.5 cm, and 230 were with size longer than 2.5 cm (26.0%) (Table 2). In addition, 20 patients lacked records of the length of the FBs because the detected FBs were food boluses either pushed into the stomach or destroyed by piecemeal extraction. The most common type of ingested FBs in the esophagus was sharp objects (75.9%), including fish bones (34.0%), chicken bones (22.1%), fruit nuclei (17.1%). The other type was non-sharp objects, including food bolus (14.6%), and coins (4.3%) (Fig. S2, http://links.lww.com/MD/D48). According to the emergent situation, 428 cases (28.1%) were removed under general anesthesia (Table 2 and 35). According to the emergent situation, 428 cases (28.1%) were removed under general anesthesia (Table 2 and 35). In 17 cases, the FB was pushed into the stomach. The remaining 15 cases that were not removed were mainly associated with sharp FBs and local oral anesthesia. The univariate and logistic regression analyses indicated that general anesthesia could increase the successful removal rate by 9.9% (P = .017) (Tables 5 and 6). Two patients required surgery, 1 patient had esophageal stenting for esophageal stricture, 6 patients were hospitalized to continue chemotherapy or radiotherapy, 1 patient died from multiple organ dysfunction syndrome, and the remaining patients successfully received with conservative treatment and were discharged.

### Table 2

| Characteristics of 561 visible FB under endoscopy. | No. of FB | Percentage (%) |
|--------------------------------------------------|-----------|----------------|
| Type                                             |           |                |
| Blunt*                                           | 135       | 24.1           |
| Sharp†                                           | 426       | 75.9           |
| Length (cm)                                      |           |                |
| <2.5                                             | 311       | 57.5           |
| 2.5–6.0                                          | 222       | 41.0           |
| >6.0                                             | 8         | 1.4            |
| Location (cm)                                    |           |                |
| <25                                              | 426       | 75.9           |
| 25–35                                            | 85        | 15.2           |
| >35                                              | 50        | 8.9            |
| Duration time (hours)                            |           |                |
| <12                                              | 285       | 50.8           |
| 12–24                                            | 193       | 34.4           |
| 24–48                                            | 40        | 7.1            |
| 48–72                                            | 12        | 2.2            |
| >72                                              | 31        | 5.5            |

* Blunt FB: including food bolus (14.6%), coins (4.3%), etc.
† Sharp FB: including fish bones (34.0%), chicken bones (22.1%), fruit nuclei (17.1%), etc.
‡ Length: 20 cases lacked records of length.

### Table 3

| Univariate analysis of risk factor for complications. |
|-----------------------------------------------------|
| Factors                                             | Complications |
| Gender                                              | (N1, %)       | (N2, %)       | P value |
| Male                                                |              |              |         |
| Female                                              |              |              |         |
| Age (yr)                                            |              |              |         |
| <60                                                 |              |              |         |
| ≥60                                                 |              |              |         |
| Associated upper GI diseases                        |              |              |         |
| One disease at least                                |              |              |         |
| No associated diseases                              |              |              |         |
| Symptoms with FB                                    |              |              |         |
| One symptom at least                                |              |              |         |
| No symptoms                                         |              |              |         |
| Anesthesia of endoscopy                             |              |              |         |
| General anesthesia                                  |              |              |         |
| Local anesthesia                                    |              |              |         |
| Duration time of FB (hours)                         |              |              |         |
| <12                                                |              |              |         |
| 12–24                                              |              |              |         |
| 24–48                                              |              |              |         |
| 48–72                                              |              |              |         |
| >72                                                |              |              |         |
| Location of FB (cm)                                 |              |              |         |
| <25                                                |              |              |         |
| 25–35                                              |              |              |         |
| >35                                                |              |              |         |
| Length of FB (cm)                                   |              |              |         |
| <2.5                                               |              |              |         |
| 2.5–6.0                                            |              |              |         |
| >6.0                                               |              |              |         |
| Type of FB                                          |              |              |         |
| Blunt                                               |              |              |         |
| Sharp                                               |              |              |         |

* N1, %: complications with foreign body.
* N2, %: no complications.
* Pearson Chi-square test.
* Fisher exact test.
* P value of < .05 was considered as statistically significant.

3.3. Complications and its attributing factors

Complications were found in 30 patients with hemorrhage (5.0%), 33 patients with perforation (5.5%), and 9 patients with infection (Table 1). Other common lesions included mucosal erosion (10.8%), laceration (9.1%), and ulcer (6.6%). According to the univariate analysis, among the risk factors attributed to the above-mentioned complications, older age (P = .018), long retention time (P < .001), and sharp FBs (P = .011) significantly increased the occurrence of complications (Table 3). Logistic regression analysis further indicated that sharp FBs (OR, 2.85; 95% CI, 1.08–7.50; P = .034) were associated with high risk of complications. Moreover, longer retention time significantly increased the occurrence of complications (P < .001). The risk increased dramatically by 4.04- and 8.48-fold with when the lodging time longer than 24 and 48 hours, respectively, as compared with less than 12 hours (Fig. 1).

3.4. Esophageal perforation and its attributing risk factors

Esophageal perforation was one of the most severe complications. The risk of perforation increased by 9.99- and 26.81-fold
when the FBs were retained for over 24 and 72 hours, respectively, as compared with less than 12 hours (Fig. 2). The univariate and multivariable analyses indicated that general anesthesia (OR, 5.92; 95% CI, 2.27–15.42; P < .001) and sharp objects (OR, 11.00; 95% CI, 1.23–98.86, P = .032) significantly increased the risk of perforation. However, no significant correlations were found between the incidence of perforation and the different FB locations or lengths of FBs (P > .05).

4. Discussion

Endoscopy remains a main intervention tool for removing impacted objects. However, large-scale populations with prospective and multi-center studies regarding the endoscopic management of FB are still lacking in China. In this study, the most common type of FB was fish bones, subsequently followed by chicken bones, fruit nuclei, and food bolus. This was similar to that shown in previous reports in China or other Asian countries in adults. In Western countries, food bolus was the major type of impacted FB in adults. This variation might be correlated with the geographical and cultural differences in dietary habits. In addition, patients had varied GI diseases and complications among the different countries. For example, in Western countries, approximately 30% of patients had upper GI diseases, including eosinophilic esophagitis, esophageal carcinoma, esophageal stricture, and hiatus hernia. It was concluded that these patients had a higher risk of food impaction. However, in our study, 15% of the patients had upper GI diseases, mainly including esophageal carcinoma and stricture. The incidence of diseases might be correlated with the lower percentage of food bolus impaction in our study.

In emergent FB impaction cases, patient outcome is often determined by clinical complications. As previously mentioned, the FB associated complications include hemorrhage, perforation, obstruction, severe mucosal laceration and abscess formation. Previous studies reported that the incidence of FB-related complications was 3% to 20%. Furthermore, we found that long retention time and sharp objects were the attributing risk factors of the aforementioned complications. The complication rate was increased by 4.04-fold when endoscopic retrieval was performed after impacted for over 24 hours as compared with within 12 hours. This finding has been demonstrated by other studies. A study of 401 cases in Hong Kong summarized that FBs trapped in the proximal esophagus or retained for over 48 hours

| Table 4 |
|---|
| **Table 4** | **Univariate analysis of risk factor for perforation.** |
| Factors | Perforation |
| --- | --- |
| Gender | (N, %) | (N, %) | P value |
| Male | 14 (42.4) | 264 (47.0) | .611 |
| Female | 19 (57.6) | 208 (53.0) | .857 |
| Age (yr) | | >.05 |
| <60 | 13 (39.4) | 352 (62.6) | .008 |
| ≥60 | 20 (60.6) | 210 (37.4) | .011 |
| Associated upper GI diseases | | >.05 |
| One disease at least | 4 (12.1) | 85 (15.1) | .804 |
| No associated diseases | 29 (87.9) | 477 (84.9) | .999 |
| Symptoms with FB | | >.05 |
| One symptom at least | 33 (100.0) | 540 (96.1) | .626 |
| No symptoms | 0 | 22 (3.9) | .001 |
| Anesthesia of endoscopy | | >.05 |
| Local anesthesia | 13 (39.4) | 415 (73.8) | .999 |
| General anesthesia | 20 (60.6) | 147 (27.2) | .999 |
| Duration time of FB (hours) | | >.05 |
| <12 | 7 (21.2) | 278 (52.6) | .001 |
| 12–24 | 3 (9.1) | 190 (36.0) | .001 |
| 24–48 | 8 (24.2) | 32 (6.1) | .001 |
| 48–72 | 5 (15.2) | 7 (1.3) | .001 |
| >72 | 10 (30.3) | 21 (4.0) | .001 |
| Location of FB (cm) | | >.05 |
| <25 | 25 (75.8) | 401 (76.0) | .999 |
| 25–35 | 5 (15.1) | 80 (15.1) | .999 |
| >35 | 3 (9.1) | 47 (8.9) | .999 |
| Length of FB (cm) | | >.05 |
| <2.5 | 12 (36.4) | 299 (58.9) | .011 |
| ≥2.5 | 21 (63.6) | 209 (41.1) | .011 |
| Type of FB | | >.05 |
| Blunt | 1 (3.0) | 134 (25.4) | .004 |
| Sharp | 32 (97.0) | 394 (74.6) | .004 |

| Table 5 |
|---|
| **Table 5** | **Univariate analysis of risk factor for successful esophagoscopic FB extraction rate.** |
| Factors | Successful FB extraction |
| --- | n (%) | P value |
| Gender | | | |
| Male | 254 (48.0) | .639 |
| Female | 275 (52.0) | .883 |
| Age (years) | | | |
| <60 | 321 (60.7) | .804 |
| ≥60 | 208 (39.9) | .804 |
| Associated upper GI diseases | | | |
| One disease at least | 83 (15.7) | .452 |
| No associated diseases | 446 (84.3) | .452 |
| Symptoms with FB | | | |
| One symptom at least | 511 (96.6) | .616 |
| No symptoms | 18 (3.4) | .616 |

*P value of <.05 was considered as statistically significant.*

*a* Pearson Chi-square test.

*b* Fisher exact test.

*c* Fisher exact test.
had increased the risk of complications. A study of 262 cases in a lower socioeconomic population found that 7.0% of the patients had complications, including perforation and bleeding, which were associated with the retention time and type of FBs. Esophageal FBs impacted for more than 24 hours might even have a 14.1-fold increase in the risk of complications. Apart from the retention time, the sharp feature of FBs could be another important attributing factor for complications. Lately, the ASGE and ESGE recommended therapeutic endoscopy for all cases of esophageal FBs within 24 hours after ingestion, especially for sharp-pointed objects within 6 hours. Here, we implicated that esophageal FBs, especially sharp objects, should be removed within 24 hours to decrease the incidence of devastating complications, which might be applicable to Asian populations.

As one of the most severe complications, perforation was found in 5.5% of our patients. This was strongly associated with the long retention time and sharp feature of the FBs, in accordance with previous reports. Previous studies indicated that objects longer than 6 cm increased the risk of perforation. However, this did not correlate with the anatomical locations and lengths of the FBs in our study. Hence, more investigations regarding sharp or long FBs are needed.

| Factors                      | No. of patients | No. of successful extraction | OR (95% CI) | P value a |
|------------------------------|----------------|------------------------------|-------------|-----------|
| Duration time                |                |                              |             |           |
| 12–24 h (vs < 12 h)         | 193            | 186                          | 1.12 (0.40–3.10) | .832      |
| 24–48 h (vs < 12 h)         | 40             | 37                           | 0.40 (0.10–1.62) | .198      |
| 48–72 h (vs < 12 h)         | 12             | 10                           | 0.13 (0.02–0.77) | .025      |
| > 72 h (vs < 12 h)          | 31             | 29                           | 0.53 (0.10–2.72) | .447      |
| Location of FB              |                |                              |             |           |
| 25–35 cm (vs < 25 cm)       | 85             | 81                           | 1.43 (0.44–4.64) | .557      |
| > 35 cm (vs < 25 cm)        | 50             | 48                           | 1.79 (0.37–8.80) | .471      |
| Length of FB                |                |                              |             |           |
| ≥ 2.5 cm (vs < 2.5 cm)      | 230            | 221                          | 1.41 (0.59–3.36) | .349      |
| Type of FB                  |                |                              |             |           |
| Sharp (vs Blunt)            | 426            | 401                          | 1.56 (0.56–4.34) | .397      |
| Anesthesia of endoscopy     |                |                              |             |           |
| General (vs Local)          | 150            | 149                          | 12.10 (1.56–93.80) | .017      |
| Age                         |                |                              |             |           |
| ≥ 60 yr (vs < 60 yr)        | 221            | 208                          | 0.99 (0.40–2.42) | .976      |
| Associated GI diseases      |                |                              |             |           |
| One disease at least         | 86             | 83                           | 2.21 (0.49–9.88) | .301      |
| (vs no diseases)            |                |                              |             |           |

*aBinary logistic regression analysis. P value of < .05 was considered as statistically significant.
In addition to the above-mentioned factors, we found that general anesthesia prior to endoscopy increased the risk of perforation, although it might increase the successful removal rate by endoscopy. Owing to its favorable effects on reducing procedural pain and patient comfort, general anesthesia using propofol has been a mainstay approach in endoscopy, especially for some interventional procedures. However, adding general anesthesia to endoscopy is still controversial. In the context of esophageal FB impaction, general anesthesia did not significantly lower the complication rate as compared to topical pharyngeal anesthesia. Our finding of increased rate of perforation might be correlated with delayed treatment timing, the severity of patient, procedural complexity, and endoscopist experience. Recently, the ASGE suggested that endotracheal intubation was required for patients with objects that are difficult to be removed, patients with multiple objects, or while using rigid esophagogastroduodenoscopy. Under some circumstances, general anesthesia to endoscopy is still controversial.

Figure 2. Multivariate analysis of risk factors of perforation. FB = foreign body, GI = Gastrointestinal tract. *Binary logistic regression analysis. A P value of <.05 was considered statistically significant.

5. Conclusion

Early management and risk stratification is the key for the emergency of FB ingestion in the esophagus. Our study highlighted that the most common FBs were sharp objects.
Moreover, sharp objects and long retention time strongly increased the incidence of complications, especially perforation. These implicate that sharp FBs should be removed within 24 hours after ingestion.

Author contributions

Conceptualization: Bili He, Zhenzhai Cai, Bin Ye, Lei Xu, Jiang Liu, Jin Ding, Zhongfa Zheng, Jianhua Duan.

Data curation: Jingjing Yuan, Mengjie Ma, Bili He, Zhenzhai Cai.

Investigation: Jingjing Yuan, Mengjie Ma, Liangjing Wang.

Methodology: Jingjing Yuan, Yang Guo, Zhenzhai Cai, Bin Ye, Lei Xu, Jiang Liu, Jin Ding, Zhongfa Zheng, Jianhua Duan, Liangjing Wang.

Project administration: Liangjing Wang.

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