



Predictive factors for complications associated with penetrated fish bones outside the upper gastrointestinal tract

Qingguo Chen¹ · Hanqi Chu¹ · Ting Tong² · Yanling Tao¹ · Liangqiang Zhou¹ · Jin Chen¹ · Yun Liu¹ · Liyan Peng¹

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Abstract

Purpose To investigate predictive risk factors for complications associated with migrating fish bones in the surrounding tissue of upper gastrointestinal tract.

Methods A retrospective analysis over 12 years was conducted of 45 cases of buried fish bones in the surrounding tissue of upper gastrointestinal tract with complications. Meanwhile, a control group, including 39 cases of prolonged buried fish bones in the surrounding tissue of upper gastrointestinal tract without complications, was set. Patient clinical data were collected and analyzed to predict the risk factors for complications.

Results The results of Chi-square test and univariate analysis both showed a significant difference in length of fish bone (> 2 cm), a history of concurrent medical illness (diabetes mellitus and renal hypofunction), symptoms (medium or heavy pain and dysphagia), and duration of significant symptoms (> 7 days) between the complication group and non-complication group. Multivariate analysis further identified length (> 2 cm), diabetes mellitus, medium or heavy pain, dysphagia, and duration of significant symptoms (> 7 days) as independent risk factors for complications.

Conclusions The consequences of fish bones migrating outside the upper gastrointestinal tract are various in different people. Awareness should be raised when encountering a patient ingesting a long fish bone, having a history of diabetes mellitus, presenting with significant discomforts, or these discomforts lasting for a long time. This study will help practitioners counsel their patients on the risks and benefits of surgery versus observation of this condition.

Keywords Fish bone · Penetration · Upper gastrointestinal tract · Risk factor · Complication

Introduction

Foreign bodies in the upper gastrointestinal tract are commonly encountered in otolaryngologic outpatient clinics or emergency room, and fish bones are the most frequently observed, especially in Asian countries [1]. Fish bones may migrate out of the gastrointestinal tract due to their sharp and pointed structures, especially after repeat forcefulness of swallowing. There have been a few cases reported that fish

bones migrated to adjacent structures such as thyroid gland, cervical spine, internal jugular vein, common carotid artery, and subcutaneous neck [2–6], which may lead to serious and life-threatening complications. However, extraluminal migration of fish bones remaining quiescent for years without causing any complications was also encountered in our clinic. The reason remains ambiguous. Here, we compared 45 cases of migrating fish bones presenting with complications with 39 cases without complications to find out the risk factors for complications that could help to maintain a high index of clinical suspicion and promote early intervention.

✉ Liyan Peng
liyanpeng2500@163.com

¹ Department of Otolaryngology-Head and Neck Surgery, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Jiefang Avenue 1095, Wuhan 430030, China

² Department of Otolaryngology-Head and Neck Surgery, Taikang Tongji (Wuhan) Hospital, Sixin North Road No. 322, Hanyang District, Wuhan, China

Materials and methods

Patients

This was a retrospective study of cases of fish bones migrating outside the upper gastrointestinal tract between February

2005 and December 2017. The study was approved by the Institutional Review Board. A total of 45 patients with complications were contained in the complication group. The range of impaction duration was from 5 to 36 days and the average time was 8.3 days. A total of 39 patients without complications were contained in the non-complication group. These patients refused to accept further treatment. The range of impaction duration was from 24 to 55 months and the average time was 37.2 months. All patients were admitted through the emergency department, otolaryngologic outpatient clinics, or referred from other hospitals. The following data were collected: age (years), gender, concurrent medical illness, length, species, shape and impaction level of fish bones, symptoms, duration of significant symptoms, examinations, treatment, and complications.

Statistical analysis

We applied SPSS (Statistical Package for Social Sciences) 19.0 program for statistical analysis in this study. The Chi-square test of independence was performed to find statistical difference between the complication group and non-complication group. Logistic regression models were applied to assess the variables associated with complications. First, a univariate analysis was performed to select factors of complications to be included in the multivariate analysis. These factors were selected from aforementioned clinical data in the complication group and non-complication group, including age, gender, concurrent medical illness, species, shape, impaction level and length of fish bone, symptoms, and duration of significant symptoms. Second, a binary logistic analysis was performed. Only significant factors obtained in the univariate analysis were subsequently subjected to multivariate logistic regression analysis. *P* value less than 0.05 was considered statistically significant.

Odds ratio (OR) and 95% confidence intervals were calculated for each parameter. The OR evaluates the risk of complications if a certain factor exists. A receiver operating characteristic curve (ROC) was generated to get the best cutoff point for complications. The area under the curve (AUC) for each potential predictor was calculated. An AUC

value close to 1 means an excellent ability to discriminate. Through the ROC curve, the best cutoff with optimal specificity and sensitivity value was identified as that yielding the smallest value for $(1 - \text{specificity})^2 + (1 - \text{sensitivity})^2$. Differences were considered statistically significant when *P* values < 0.05.

Results

Epidemiology

The patient median age was 47.3 years in the complication group and 41.6 years in the non-complication group. The age distribution showed no difference. The male to female ratio in the complication group was similar to that in the non-complication group (1.05:1 and 1.29:1, respectively). The duration of significant symptoms for more than 7 days referred to 82.2% of patients in the complication group and 25.6% of patients in the non-complication group. More details about the epidemiology are shown in Table 1.

Impaction site, species, shape and length of fish bones

Fish bones in the two groups were predominantly impacted at or above the level of cricopharyngeus muscle with the commonest site at laryngopharynx, followed by oropharynx and nasopharynx. Other rare impaction sites referred to the level of T1–T6 vertebrae. A fish bone migrating to thyroid gland was seen in our study (Fig. 1a). The common fish species from which the fish bones came were silver carp, crucian carp, catfish and variegated carp. More than 90% of fish bones in the two groups were sharp and linear. The rest were triangular or irregular. Analysis showed no statistically significant difference in the impaction site, species and shape of fish bones between the two groups. The range of fish bone length was from 1.1 to 4 cm and the average length was 2.4 ± 0.3 cm in the complication group. The range of fish bone length was from 0.4 to 2.7 cm and the average length was 1.5 ± 0.2 cm in the non-complication group. The

Table 1 Clinical data of patients in the complication and non-complication groups

	Complication group	Non-complication group	<i>P</i> value
No.	45	39	
Age (> 50 years), <i>n</i> (%)	29 (64.4%)	20 (51.3%)	0.222
Gender (male), <i>n</i> (%)	23 (51.1%)	22 (56.4%)	0.627
Concurrent medical illness, <i>n</i> (%)	35 (77.8%)	16 (41%)	0.001
Shape of fish bone (sharp and linear), <i>n</i> (%)	44 (97.8%)	37 (94.9%)	0.474
Duration of significant symptoms (> 7 days), <i>n</i> (%)	37 (82.2%)	10 (25.6%)	< 0.001

Differences were considered statistically significant when *P* values < 0.05 (the same below)

Fig. 1 **a** CT scan image of neck (axial view) showing a thin sharp-ended foreign body embedded within the left thyroid gland (red arrow). The patient showed no discomforts and denied further treatment. **b** Three-dimensional CT (3D-CT) scan showing linear radiodense foreign body (red arrow) in the posterolateral wall of laryngopharynx (level C4/C6). The patient underwent tracheotomy (blue arrow) due to neck cellulitis

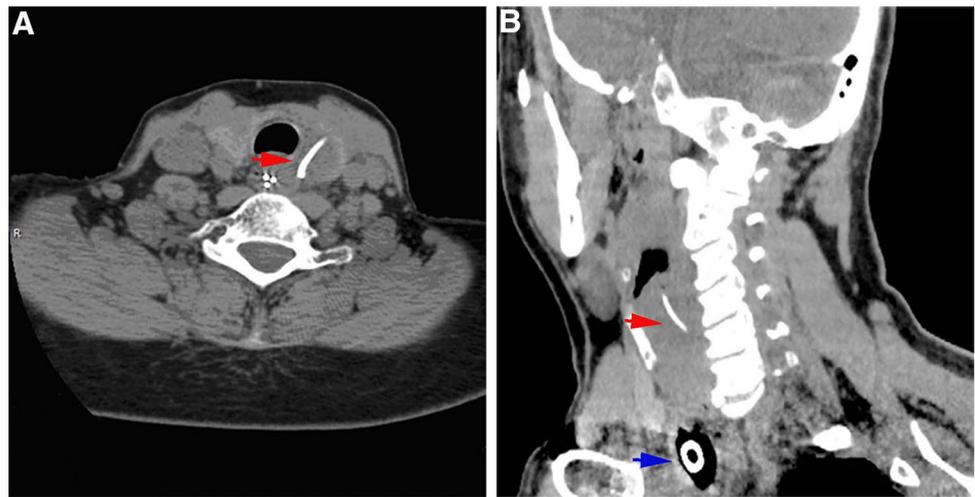


Table 2 Impaction level, length, type, and shape of fish bones in the two groups

	Complication group	Non-complication group	<i>P</i> value
<i>n</i>	45	39	
Level			
Nasopharynx	1 (2.2%)	1 (2.6%)	0.918
Oropharynx	12 (26.7%)	13 (33.3%)	0.505
Laryngopharynx	30 (66.7%)	24 (61.5%)	0.625
Others	2 (4.4%)	1 (2.6%)	0.643
Length (> 2 cm)	31 (68.9%)	12 (30.8%)	<0.001
Species			
Silver carp	11 (24.4%)	9 (23.1%)	0.883
Crucian carp	9 (20%)	10 (25.6%)	0.538
Catfish	8 (17.8%)	6 (15.4%)	0.769
Variegated carp	5 (11.1%)	6 (15.4%)	0.563
Grass carp	5 (11.1%)	4 (10.3%)	0.899
Black carp	3 (6.7%)	2 (5.1%)	0.766
Others	4 (6.7%)	2 (5.1%)	0.504
Shape			
Sharp and linear	41 (91.1%)	37 (94.9%)	0.504
Others	4 (8.9%)	2 (5.1%)	0.504

frequency of fish bone (> 2 cm) in the complication group was statistically higher compared with the non-complication group. The detailed information in each group is shown in Table 2.

Clinical presentations

The mean duration of significant symptoms after fish bone ingestion was 12.6 days in the complication group and 5.2 days in the non-complication group. The degree

Table 3 Clinical symptoms in the two groups

	Complication group	Non-complication group	<i>P</i> value
<i>n</i>	45	39	
Hemoptysis	5 (11.1%)	1 (2.6%)	0.275
Hoarseness	2 (4.4%)	0 (0)	0.183
Medium or heavy pain	27 (60%)	4 (10.3%)	<0.001
Dysphagia	16 (35.6%)	3 (7.7%)	0.005
Neck discomfort	21 (46.7%)	15 (38.5%)	0.449
Foreign body sensation	28 (62.2%)	29 (74.4%)	0.235
Fever	9 (20%)	1 (2.6%)	0.014
Others	5 (11.1%)	3 (7.7%)	0.873

Some patients presented with multiple symptoms

of pain was divided into mild, medium and heavy pain according to the description of patients. The predominant symptoms included medium or heavy pain, neck discomfort and foreign body sensation in the complication group. Neck discomfort and foreign body sensation were the main symptoms in the non-complication group. Only a minority of patients showed hemoptysis, hoarseness, or fever. Analysis showed no statistically significant difference in these symptoms (hemoptysis, hoarseness, neck discomfort, and foreign body sensation) between the two groups. The frequency of medium or heavy pain, dysphagia, and fever in the complication group was statistically higher than that in the non-complication group. The majority of patients presented with multiple symptoms. Red swelling and fever of neck skin were a typical physical sign for complications, thus this sign was not included in the analysis. More information about the clinical manifestations is shown in Table 3.

Examinations

A flexible laryngoscope for all patients did not show the existence of a foreign body in the nasopharynx, oropharynx and laryngopharynx except local edema, hyperaemia, or pseudomembrane formation on the surface of mucosa. All patients took a computed tomography (CT) scan and the length of fish bones was measured. They all underwent rigid endoscopy or oesophagogastroduodenoscopy (OGD) without positive findings except mucosal edema and hyperaemia. The diagnosis that fish bones completely penetrated gastrointestinal tract was mainly attributable to the consultations between otolaryngologists and radiologists. In the non-complication group, a CT scan was repeatedly performed to confirm that the fish bones were still impacted in the surrounding tissue of upper gastrointestinal tract. In general, there was no obvious change in the impaction site, shape and length of fish bones during the follow-up period.

Treatment

In the complication group, the predominant patients underwent surgical intervention with fish bones successfully removed. The most commonly performed procedure was surgical exploration in neck under general anaesthesia with the help of an ultrasound scan or intraoperative X-ray photography. A case of fish bone impaction in the nasopharynx was removed under nasal endoscope with navigation. Two cases of fish bone impaction in the parapharyngeal space were removed by transoral approach with navigation. One patient with neck abscess was unable to bear the potential risk of surgery and refused to accept further treatment. The final outcome was unknown due to lost to follow-up.

Concurrent medical illness

About 77.7% of patients in the complication group and 41% in the non-complication group had concurrent medical illnesses, including diabetes mellitus, hypertension, heart disease, chronic obstructive airway disease, or renal hypofunction. The prominent concurrent medical illnesses were diabetes mellitus, hypertension, and renal hypofunction in the two groups. A few patients were diagnosed with heart disease, chronic obstructive airway disease or others. Analysis showed no statistically significant difference in these illnesses (hypertension, heart disease, and chronic obstructive airway disease) between the two groups. The frequency of diabetes mellitus and renal hypofunction in the complication group was statistically higher compared with the non-complication group. Some patients suffered from multiple

Table 4 Concurrent medical illnesses in the two groups

	Complication group	Non-complication group	P value
<i>n</i>	45	39	
Diabetes mellitus	21 (46.7%)	5 (12.8%)	0.001
Hypertension	19 (42.2%)	15 (38.5%)	0.726
Heart disease	4 (8.9%)	5 (12.8%)	0.820
Chronic obstructive airway disease	3 (6.7%)	4 (10.3%)	0.553
Renal hypofunction	11 (24.4%)	2 (5.1%)	0.032
Others	2 (4.4%)	1 (2.6%)	0.643

Part of patients suffered from multiple chronic diseases

concurrent medical illnesses. More information about concurrent medical illness is shown in Table 4.

Major complications

All these complications arose before surgery. The predominant complications were neck mass (17, 37.8%) and neck cellulitis (13, 28.9%). The following complications were neck abscess (12, 26.7%), false aneurysm (1, 2.2%), and vocal activity limitation (2, 4.4%). Neck abscess includes retropharyngeal abscess (5, 11.1%), parapharyngeal abscess (6, 13.3%), and nasopharyngeal abscess (1, 2.2%). A 59-year-old man suffered from neck cellulitis and presented with progressive dyspnea 3 days after ingesting a fish bone. Flexible laryngoscopy revealed serious edema of epiglottis, aryepiglottic fold, and posterior wall of laryngopharynx, but without any evidence of a foreign body. Emergent tracheotomy was performed. Then a CT scan of neck revealed a linear radiodense foreign body in the posterolateral wall of laryngopharynx (level C4/C6) (Fig. 1b). Neck masses were commonly found around thyroid, submaxillary gland, subcutaneous neck, sternocleidomastoid, and carotid sheath. About 26.7% of these complications were neck abscess, including retropharyngeal abscess, parapharyngeal abscess, and nasopharyngeal abscess. Two cases were complicated with vocal activity limitation. One rare complication was false aneurysm due to the fish bone penetrating internal jugular vein.

Risk factors for complications

On univariate analysis, length of fish bone (> 2 cm), medium or heavy pain, dysphagia, fever, significant symptoms duration (> 7 days), a history of diabetes mellitus or renal hypofunction were found to be associated with complications, which was consistent with between-group comparison analysis results (Tables 1, 2, 3, 4). After multivariate analysis, length of fish bone (> 2 cm), significant

Table 5 Multivariate logistic regression analysis of factors associated with complications

	P value	OR	95% CI	
			Lower	Upper
Length of fish bone (> 2 cm)	0.045	12.835	1.058	155.744
Diabetes mellitus	0.026	22.244	1.436	344.525
Medium or heavy pain	0.003	351.235	7.042	5405.110
Dysphagia	0.023	56.814	1.761	832.480
Duration of significant symptoms (> 7 days)	0.002	233.514	7.492	4199.431

CI confidence interval, OR odds ratio

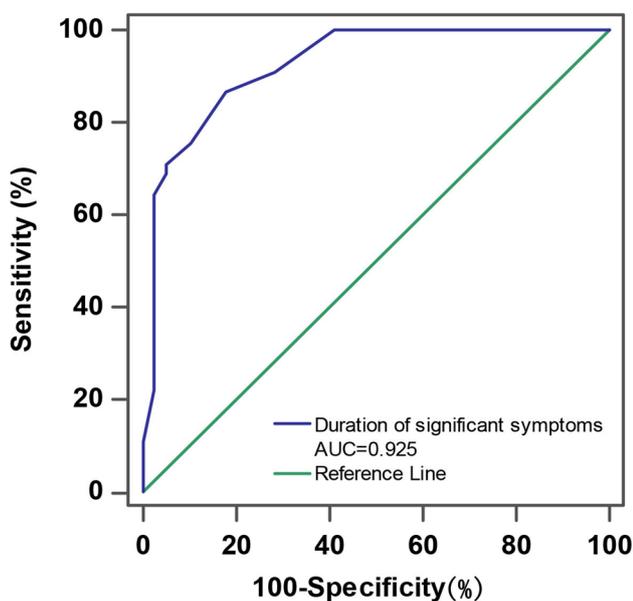


Fig. 2 Receiver operator characteristic curves demonstrating the utility of significant symptoms duration (> 7 days) for predicting complications of fish bones migrating outside the upper gastrointestinal tract

symptoms duration (> 7 days), medium or heavy pain, dysphagia, and diabetes mellitus were retained as independent risk factors for complications (Table 5). We also studied the predictive ability of significant symptoms duration in the occurrence of complications. The ROC curve for this parameter as a predictor of complications is shown in Fig. 2. The AUC was 0.925, suggesting that this parameter might be an important predictor of complications. Next, we determined the best threshold value of time point when complications occurred. Several cutoff points were selected. Such analysis yielded a value of 6 days for complications, which demonstrated a sensitivity of 86.67% and a specificity of 82.05%.

Discussion

Fish bone impaction is a common clinical problem which can be removed by the endoscopic treatment [7]. The majority of fish bones lodged intraluminally [6]. Fish bones migrating extraluminally are rare but may cause various complications. Neck cellulitis is a spreading bacterial infection which presents with diffuse swelling of neck and may cause laryngeal obstruction. Neck mass caused by foreign body impaction is a kind of chronic and limited infection. Inflammatory granulation tissues resulting from long-time stimulus of foreign items could surround fish bones. In our cases, neck masses were mainly distributed around submaxillary gland, thyroid, sternocleidomastoid, or carotid sheath, which may mimic submaxillaritis, thyroid neoplasms, or neck tumors. Neck abscess results from body's defensive reaction to foreign body and is an enclosed collection of liquefied tissue, such as pus. The reasons of vocal activity limitation can be attributable to cricoarytenoid joint fixation, damage of recurrent laryngeal nerve, or recurrent laryngeal nerve paralysis secondary to inflammatory reaction [8]. In our cases, hoarseness appeared several days after the ingestion of fish bones. Thus, it was presumed that vocal immobility was caused by spreading of inflammation to recurrent nerve.

Several factors are responsible for a fish bone migration to extraluminal area, including shape and orientation of a fish bone [9], contraction of cricopharyngeus muscle when swallowing [10], contraction of neck muscles when neck moving, local infection of esophageal or pharyngeal wall and direct pressure necrosis [11]. Our study revealed that the most frequent lodgment site in the two groups was at the level of cricopharyngeus muscle, which is the narrowest part of esophagus. A linear and sharp fish bone with horizontal orientation is more likely to migrate extraluminally [9]. In this study, more than 91% of fish bones were linear and sharp and more than 80% of patients had tried to swallow bolus of food to dislodge the fish bones.

It has been barely reported that migratory fish bones outside the gastrointestinal tract remained quiescent for years without causing complications. However, such cases are occasionally encountered in our country because whole fish is often served without removal of the bones and there is a large sample of patients ingesting fish bones. It could be explainable that abundant adhesions formed due to adverse body reactions to foreign objects and completely surrounded the fish bones, which prevented the spread of inflammation [12]. We compared the clinical data of non-complication group with complication group and attempted to find the difference. To our knowledge, we are the first to identify the risk factors associated with complications by statistical analysis.

We noticed that many patients complained of obvious discomforts after ingestion. Next, the symptoms demonstrated different clinical courses in the two groups. In the non-complication group, the discomforts became less evident in a short time. Remaining symptoms included foreign body sensation in throat, neck discomfort or mild pain when swallowing without causing any inconvenience to normal diet and activity. That was the main reason why these patients ignored the fish bones and refused to accept surgical exploration. In the complication group, most patients presented with medium or heavy symptoms without relief in a short time. Some patients demonstrated intermittent presentations which became worse under poor physical condition, such as suffering from a cold, exhaustion, or poor sleep. In sum, patients in the complication group presented with more severe symptoms than that in the non-complication group and the significant symptoms lasted for a longer time in the complication group. It could be explainable that symptom is an indicator to assess the severity of physical condition. In addition, our analysis indicated that duration of significant symptoms for more than 6 days could increase the risk of complications. It was worth noting that a few patients presented with unusual and misleading symptoms, such as hoarseness and hemoptysis. That makes diagnosis difficult especially in the absence of a clinical history and a CT scan. Our study showed that CT is a highly accurate and effective tool in identifying fish bones in upper gastrointestinal tract, which is supported by recently published data in the literature [13–15].

Interestingly, the length of fish bones showed significant difference in the two groups. About 69% of fish bones in the complication group were longer than 2 cm and only 30.8% in the non-complication group. In a series of literatures referring to migrating fish bones with complications, the majority of fish bones had a length more than 2 cm [12, 16–18]. It is presumed that a long fish bone could penetrate soft tissue deeper and cause more damages, which increases the risk of complications.

In our study, patients with chronic diseases were more likely to be encountered with complications. There was significant association of diabetes mellitus with complications, especially with neck cellulitis and neck abscess. Similarly, Johari et al. reported that a history of uncontrolled diabetes mellitus can worsen the abscess formation with retained foreign body [17]. It is presumed that the presence of diabetes mellitus may reduce systemic resistance to pathogens or foreign items.

A strength of our study is that we assessed the risk factors for complications which will help practitioners counsel their patients on the risks and benefits of surgery versus observation. To be noted was that our study had some limitations. First, people have different pain tolerance levels, thus the description of pain extent was subjective. Second, due to

the rarity of cases with fish bones migrating extraluminally, this study was based on a small sample. These shortcomings might possibly bias some of our statistical results.

Conclusions

Risks for complications should be evaluated carefully when patients with fish bones migrating extraluminally present for treatment. We highlight the importance of early recognition and prompt surgical intervention especially when risk factors are present.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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