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Evaluation of the medical economics and safety: two methods for the endoscopic removal of jujube pits

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Research involving Human Participants and/or Animals This research involved Human Participants
Informed consent As it is a retrospective study, there is no need to obtain informed consent from patients. The study was
approved by the institutional ethical review board in Beijing Shijitan Hospital, Capital Medical University.

Evaluation of the medical economics and safety: two methods for the endoscopic removal of jujube pits

Abstract Objective To evaluate the medical economics and safety of two methods for the endoscopic removal of jujube pits, one with a transparent cap combined with a stone basket and the other with a transparent cap combined with foreign body

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forceps. **Methods** Consecutive patients with a suspected jujube pit ingestion in the esophagus between January 2008 and December 2017 were enrolled into the study. 53 patients who met the criteria were divided into two groups. Group A patients were treated by a transparent cap combined with a stone basket and group B patients were treated by a transparent cap combined with foreign body forceps. The following clinical data were collected: age, sex, location of jujube pits, complications, operation time, extraction success and average hospital costs. **Results** A total of 53 patients who met the criteria were enrolled into the study; 29 cases in group A and 24 cases in group B. Endoscopic removal was successful in 98.1% (52/53) of the patients and the remaining 1.9% (1/53) required surgery. Severe complications were less frequent in group A than group B (p=0.017). Surgery time was not significantly different between the two groups (p=0.647). The extraction success in group A was higher than in group B (p=0.001). The medical costs including the total cost, inspection, treatment, radiation and drug cost were not significantly different between the two groups (p>0.05 in all cases). **Conclusion** Endoscopic baskets are suitable for cases of jujube pit ingestion and have a higher extraction success and a lower proportion of severe complications. Surgery time was not significantly extended and the medical costs did not increase.

Key words jujube pit, endoscopic treatment, stone basket, foreign body forceps

Introduction

Foreign body impaction (FBI) is considered an emergency situation. Studies have shown that 80–90% of all FBI trapped in the esophagus pass spontaneously whereas the remaining 10–20% of cases require an endoscopic intervention for removal [1]. If the foreign body is too large to pass though the physiological or pathological stricture, it is often blocked by the stenosis. A foreign body ingestion will require a non-operative intervention in about 10% to 20% of cases and less than 1% of patients will require a surgical procedure [2]. Several previous studies have reported that bony FBs account for more than half of all identified FBs [3][4][5]. Some studies have shown that jujube pits and bones (excluding fish bones) were the most common objects [6], especially on weekdays [7], due to the abundance of jujube in China [8]. Due to its special shape, the tips of jujube pits often damage the esophageal mucosa, especially the upper esophagus. In this study, the medical economics and safety of a transparent cap combined with a stone basket and foreign body forceps were compared.

Materials and methods

Study population

A retrospective study was performed in adult patients with a suspected jujube pit ingestion in the esophagus who visited the emergency department, outpatient clinic or during hospitalization in the Beijing Shijitan Hospital, Capital Medical University. Patients were recruited from January 2008 to December 2017 and a total of 53 patients were enrolled. First, a physical examination evaluated the patients´ general condition and assessed signs of complications. Subsequently, radiological examinations were performed in all patients to assess the presence, location, size, configuration and number of ingested jujube pits. This included plain film radiography, computed tomography (CT) and esophagography with barium and/or cotton. Patients were excluded if they left the gastroenterology department before being examined, if the jujube pits were not found on imaging, if there was a suspected perforation of the esophagus, or if the jujube pit was adjacent to the great artery. Esophagogastroduodenoscopy was performed, not only confirm the diagnosis but also to rule out jujube pit ingestion. A flow diagram of the study inclusion strategy is shown in Fig. 1 and some typical images are presented in Fig. 2. The study was approved by ethics committee of the Beijing Shijitan Hospital, Capital Medical University. As it was a retrospective study, there was no need to obtain informed consent from patients and all data were collected and analyzed anonymously.

Methods

53 patients who met the criteria were divided into two groups. Group A patients were treated by a transparent cap combined with a stone basket and group B patients were treated by a transparent cap combined with foreign body forceps. The following clinical data were collected: age, sex, location of jujube pits, including upper esophagus (22 cm away from the upper incisor teeth), mid-esophagus (22–30cm away from the upper incisor teeth) and lower esophagus (30cm from the terminal of mid-esophagus to esophagogastric junction), complications, surgery time, extraction success and average hospital costs. The complications were divided into two types according to the degree of injury; mild and severe. Mild was defined as ulceration or laceration with or without minor bleeding that stopped

spontaneously after endoscopic removal and severe was defined as grievous mucosal damage that required spray hemostatics or was a suspected perforation.

Statistical analysis

Categorical data are presented as percentages and continuous data are presented as the mean ± standard deviation. Comparisons of continuous variables were performed using the Student t test. Categorical variables were compared using the Pearson x^2 test or Fisher exact test. p values of < 0.05 were considered as statistically significant. Analyses were performed using the SPSS software, version 20.0 (SPSS Inc., Chicago, IL).

Results

2.1 Characteristics and outcome of patients in group A and group B

64 patients with a suspected jujube pit ingestion were admitted to our hospital from January 2008 to December 2017. A total of 53 patients who met the study criteria were enrolled in the study; 29 cases in group A and 24 cases in group B. Endoscopic removal was successful in 98.1% (52/53) of patients and the remaining 1.9% (1/53) required surgery. The mean age was 61.7± 12.6 years in group A and 63.8±16.6 in group B. The percentage of female cases was higher than male cases; 19 vs 10 and 16 vs 8, respectively. Age and gender distribution were not significantly different between the two groups; age (p =0.605) and gender (p = 0.930). The locations of the ingested jujube pits that were found in the esophagus and incarceration time were not different between the two groups (p=0.570, p=0.875). Table 1

2.2 Safety comparison between the two groups

Mucosal injury was observed in the two groups after endoscopic removal and severe complications were less frequent in group A than B (p=0.017). 2 patients in group A were treated with ice saline or 1:10000 norepinephrine, while in group B, 1 patient required intravenous anesthesia. Surgery time was not significantly different between the two groups (p=0.647). In total, there were 5 failed cases with foreign tongs which was successful with a stone basket. The extraction success in group A was higher than group B (p=0.001). Table 2

2.3 Health economics indexes

Two strategies were compared in a cost analysis; endoscopic baskets (strategy 1, Group A) and foreign body forceps (strategy 2, Group B). The inputs used were the results of the clinical study, hospital data of endoscopic activity and market prices. The total cost, inspection, cost, radiation and drug cost were not significantly different between the two groups (p=0.077, 0.218, 0.587, 0.060 and 0.124 respectively). Table 3

Discussion

Foreign body ingestion is a commonly encountered problem worldwide in endoscopy [9]. The complications induced by esophageal foreign bodies in adults are associated with a high mortality rate and are more common and more serious than complications in children [8]. The ingestion of foreign bodies by adults is generally accidental and these foreign bodies are commonly food items, especially sharp objects [10][11]. The American Society for Gastrointestinal Endoscopy (ASGE) has suggested that only 10% to 20% of foreign bodies may need to be removed endoscopically, but most patients in China are treated endoscopically [7][12][13]. The differences between foreign body ingestion between Chinese and Western populations may result from the differences in dietary customs and cultural background [14]. In recent years, Hetian jujube is more favored by Chinese people, especially the elderly. Thus, a considerable proportion of patients present to the endoscopic department due to jujube pits incarceration.

Foreign body management is divided into three categories according to ASGE: urgent and non-urgent endoscopic removal [15]. Emergency cases include esophageal obstruction, disk battery and sharp pointed objects in the esophagus. Urgent cases include esophageal objects that are not sharp and pointed, esophageal food impaction without complete obstruction, objects > 6 cm at or above the duodenum and magnets within endoscopic reach. Non-urgent cases include coins, objects > 2.5 cm in diameter and disk batteries in the stomach that can be observed for up to 48 hours if asymptomatic (the batteries should be removed if it is longer than 48 hours) [16]. The esophageal wall is thin with no serosal membrane encasing the outer layer. Long-term lodging of foreign bodies in the esophagus causes pressure changes in the wall and a resultant perforation [13]. Due to its length (mostly >2cm) and sharp

ends (like a shuttle), jujube pits need to be removed urgently. Fig. 3

53 cases were recruited for analysis in the current study. Notably, jujube shell impaction cases tended to be female (35/53 (66.0%)), older in age and located in the upper esophagus (88.7%,47/53). This is consistent with a previous report from Chen [14]. All cases were divided into two groups according to treatment in order to evaluate the value of a transparent cap combined with a stone basket for the dislodgment of jujube pit impaction. Age and gender distribution were not significantly different between the two groups.

Flexible endoscopy has been the first choice for esophageal food bolus impaction since the first report in 1972 on the endoscopic removal of a foreign body [17]. A rigid hypopharyngoscope with compatible forceps can be used for foreign body extraction in a hypopharyngeal or upper oesophageal sphincter location [18]. The main benefit is a large working channel with greater grasping possibilities [19]. If the foreign body is located further down, rigid oesophagoscopy can avoid repeated oesophageal intubations when fragmentation of a food bolus would otherwise be difficult with a flexible endoscope. However, complication rates are higher with rigid oesophagoscopy (10%) than with flexible endoscopy (5%) [20]. Flexible endoscopes are the diagnostic and therapeutic method of choice for the identification and removal of foreign bodies with a success rate of > 95% and a complication rate of 0%-5% [21]. Devices used for the endoscopic management of foreign bodies include transparent caps, biopsy forceps, foreign body forceps such as rat-tooth, alligator-tooth or shark-tooth forceps, etc. [22]. The treatment of choice is influenced by many factors, including age and clinical condition, the size and the shape of the ingested foreign body, the anatomical location, the physicians´ skill level, the available instruments and the surgeons´ preference [23]. Transparent caps can be used either to aspirate an impacted food bolus in a steady manner or to protect the oesophageal wall from sharp or pointed objects [22]. Standard biopsy forceps are often inadequate due to their small opening width, although they can be efficient for small and soft objects [22]. The rat-tooth forceps are most commonly used. Rubber-tip forceps can be useful for small hard objects, such as pins, needles or blades [22].

There are previous reports on the use of foreign body forceps for the removal of jujube pits [22]. However, the jujube pit often slip from the foreign body forceps due to the spindle shape, thus resulting in secondary injuries. Endoscopic baskets such as

a Dormia basket, may also be useful, especially for round objects that cannot be grasped with other devices. Three, four and six-wire baskets are available [22]. In the present study, we demonstrate that endoscopic baskets are suitable for jujube pits that cannot be grasped with foreign body forceps (5 patients, 9.4%). The endoscopic baskets group had a higher extraction success rate, lower proportion of severe complication and surgery time was not significantly extended.

The market prices of the foreign body tongs are lower than that of endoscopic baskets. However, the cost-optimization analysis showed that strategy 2 (CNY2671) was not cost effective compared with strategy 1 (CNY2117). This is due to the higher incidence of complications and cost of drug treatment in strategy 2.

Conclusion

Endoscopic baskets are suitable for jujube pits ingestion, with a higher extraction success and a lower proportion of severe complications. Surgery time was not significantly extended and medical costs were not increased.

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Authors' contributions

All authors had access to the data and a role in writing the manuscript.

Disclosure of interest

The authors declare that they have no competing interest.

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Figure legends

Figure1 Entries and outcomes of all patients. A retrospective study was performed in adult patients (34-87 years old) with a suspected jujube pit ingestion who visited the emergency department, outpatient clinic or during hospitalization in the Beijing Shijitan Hospital, Capital Medical University from January 2008 to December 2017. 64 patients with a suspected jujube pit ingestion were admitted to our hospital during the study period. A total of 53 patients who met the criteria were enrolled into the study.

Figure 2 Illustrations of jujube pits: (A) A foreign body is diagnosed on esophagography with barium; (B) A coronal computed tomography scan of a jujube pit (arrow); (C) An axial computed tomography scan showing a jujube pit (arrow); (D) Endoscopic visualization of a jujube pit in the upper esophagus; (E) Endoscopic extraction with a stone basket; F View of the 2.5cm-long jujube pit after removal.

Figure 3 Characteristics of jujube pits: (A+B) The length of the hetian jujube is about 4-6 centimeters (similar to eggs). (C+D) and the length of its pit is about 2.5-3 centimeters, with a slender body and two sharp ends (like a shuttle).

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Figure 4 Some special situations: (A+B) Coronal computed tomography showed that a jujube pit was incarcerated in the upper esophagus (arrow), it was not detected during endoscopy and esophageal mucosal injury was only observed. (C+D) A jujube pit was pushed into stomach and then extracted by a stone basket. (E+F) A jujube pit that transferred to the duodenum was removed by a stone basket.