

Intestinal Perforation Secondary to Pits of Jujube Ingestion: A Single-Center Experience with 18 Cases

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Published online: 18 January 2019
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Abstract

Background Ingestion of jujube pits is a common clinical problem, which can be difficult to diagnose and life-threatening if accompanied with intestinal perforation and peritonitis. In this study, 18 cases of intestinal perforation caused by ingestion of jujube pits were reviewed and summarized to discuss the clinical characteristics, diagnosis and treatments.

Methods From 2012 to 2018, a total of 18 patients diagnosed as intestinal perforation due to ingested pits of jujube in our center were retrospectively reviewed and the manifestations, laboratory tests, imaging examinations and treatment strategies were summarized.

Results The patients comprised of 11 males and 7 females with an average age of 63.5 years. The main clinical manifestation was abdominal pain. Twelve patients (67%) presented to the emergency department with signs of localized peritonitis. CT imaging revealed positive findings in 17 (94%) patients. Conservative treatments were attempted in 3 patients, and the other 15 patients received emergency surgical exploration, where 7 patients had more than one perforation identified during surgery. Five patients were admitted in the surgical intensive care unit after surgery. The average length of stay of all 18 patients was 9.8 days (range 5–24 days).

Conclusion Ingestion of jujube pits is a common clinical problem and potentially leads to intestinal perforation and peritonitis. CT imaging is the first imaging modality of choice. Patients with milder symptoms might be managed with cautious conservative treatment, and patients with more than one perforation can be identified during surgery.

Introduction

Foreign body (FB) ingestion is a common clinical problem all over the world. Based on the ingested object-related factors and on the structural or functional abnormalities that preexist in the gastrointestinal (GI) tract [1], the instant risk to patients ranges from negligible to life-threatening events. Most of the FBs can pass through the alimentary tract uneventfully [2, 3] or be removed under urgent or

selective endoscopy [4], but $\leq 1\%$ FB ingestions can cause perforation, obstruction and fistula, ultimately requiring surgery [2, 3, 5]. It is estimated that in the USA, 1500 people die annually due to FBs in the upper GI tract [6].

Jujube, also known as Chinese date, has been widely consumed as both food and herbal medicine all around the world [7]. The pit of jujube, which appears like the pit of an olive with very sharp points at each end, can easily penetrate the intestine when ingested. Most of the patients were unable to recall the episode of FB ingestion because of relatively indolent interval between the ingestion and the occurrence of symptoms; the accurate diagnosis and subsequent timely management remain challenging under certain circumstances. In this study, we retrospectively

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summarized the clinical characteristics and treatment strategies of intestinal perforations caused by the ingestion of jujube pits in 18 patients.

Patients and methods

From November 2012 to April 2018, 18 patients diagnosed with intestinal perforation due to ingestion of jujube pits were admitted in our center. All clinical details, laboratory and radiologic results, and therapeutic interventions were retrospectively collected from the department's database. Informed consent was obtained from all individual participants included in this study.

Results

Clinical findings

A total of 18 patients (11 males and 7 females, mean age 63.5 years, range 27–93 years, median age 64.5 years) were included in our study. The clinical features of all included patients are presented in Table 1. All patients visited the emergency department of our center with the chief complaint of abdominal pain. Of the 18 patients, 9 (50%) patients managed to recall a history of jujube consumption. The food types consumed by the patients included porridge, snacks as well as herbal medicines. Among the 9 patients with definite jujube consumption history, 8 patients developed abdominal pain within 24 h, while 1 patient had an indolent interval for 3 days between digestion and the presence of symptom. Other commonly presented symptoms apart from abdominal pain were nausea in 14 (82%) patients and vomiting in 11 (65%) patients. Of the 17 patients, 11 (65%) patients had temperatures >37.2 °C, with the highest temperature of 39.6 °C in a 75-year-old female. Of the 18 patients, 12 (67%) patients had localized peritonitis, 4 (22%) patients had abdominal tenderness during physical examination, and 2 (11%) patients visited the emergency department with diffused peritonitis.

Diagnostic assessment

The results of laboratory tests and imaging examinations were also retrospectively inspected and are summarized in Table 1. The leukocyte counts of 17 (94%) patients exceeded the upper limit of normal ($9.5 \times 10^9/L$), and the percentages of neutrophil granulocyte (NEUT%) of all 18 patients were higher than 75%, which was the upper limit of NEUT%.

All patients underwent CT examinations, and positive findings can be categorized into three aspects: FB, perforation and obstruction. Among 18 CT imaging reports, FBs were identified in 11 (61%) patients with a characteristic description of high-density shadow shaping like a shuttle with sharp points at each end or appeared as a ring depending on the orientation of the pit when the CT imaging was performed. Of the 18 CT imaging reports, 12 (67%) patients were suspected with perforation of GI tract based on the evidences of free gas or local fluid accumulation (Fig. 1). In several CT scans, the signs of pit piercing the intestine and incarcerated in the intestinal wall were visualized directly. Obstruction was another sign that was commonly seen and was revealed in 11 of the 18 CT scans (61%). The sign of accumulation of chime proximal to a shuttle-shaped high-density shadow has an important diagnostic value (Fig. 2). Of the 18 CT reports, 6 (33%) reports demonstrated all three aspects of positive findings at the same time, while one patient had a past history of ureteral carcinoma radical operation, and none of the three aspects were reported. The retrospective review of CT images confirmed the signs of jujube pits in the alimentary tract in all patients. Prior to CT imaging, ultrasound examinations of the abdominal region were performed in 6 patients, where 2 (33%) patients had nonspecific signs of obstruction, while the other 4 were negative. The X-ray plain films of abdomen were obtained in 7 patients, all of which revealed nonspecific signs of obstruction, and free intraperitoneal gas was suspected in 1 patient (14%).

Therapeutic intervention

Treatment therapies, locations of perforations and special circumstances revealed during or after the surgery are displayed in Table 2. Among the 18 patients included in this study, 15 patients underwent emergency laparotomy. The pits of jujube, if identified during surgery, were extruded through the perforation site (Fig. 3). After that, perforation repair was performed in 9 patients. Apart from perforation repair, jejunostomy was performed in 1 case, where the perforation was found in the transition zone of descending and horizontal parts of the duodenum. Enterectomy and anastomosis were performed in other 5 patients because of severe contamination and extreme edema of the intestinal wall, and 4 patients had more than one perforation detected during the surgery. Perforation location was confirmed either by CT scans or during the surgical exploration and is summarized in Fig. 4. Of the 18 perforations, 2 (11%) perforations were detected in the duodenum and the other 16 were located in the jejunum-ileum. No perforation was detected in stomach, colon or rectum. There is a subtle tendency of the perforation location concentrating toward the terminal ileum. More

Table 1 Clinical characteristics, laboratory tests and imaging examinations of 18 patients

No./sex/ age	FB recall	Food type	Interval (days) [†]	Symptoms	Tem (°C)	Physical examination	WBC (*10 ⁹ /L)	NEUT %	CT images		Other examinations		
									FB	Perforation	Obstruction	Ultrasound	X-ray
1/M/65	Yes	Snack	3	Nausea Vomiting	37.0	Right upper abdomen tenderness	14.82	87.6	✓	✓	(-)	NP	NP
2/F/58	Yes	Herb	1	NR	38.5	Left upper abdomen localized peritonitis	9.89	85.7	✓	✓	✓	NP	Free gas? Obstruction
3/M/65	No	NR	NR	Nausea	37.3	Lower abdomen localized peritonitis	7.00	76.0	(-)	(-)	✓	Obstruction	Obstruction
4/F/75	No	NR	NR	Nausea Bloating	39.6	Left lower abdomen localized peritonitis	14.41	80.9	✓	(-)	(-)	NP	Obstruction
5/M/93	No	NR	NR	Nausea Vomiting	37.4	Lower abdomen localized peritonitis	15.34	92.1	(-)	✓	(-)	NP	NP
6/M/54	Yes	Snack	1	Nausea Vomiting	38.3	Right lower abdomen localized peritonitis	10.87	77.3	✓	✓	(-)	NP	NP
7/M/82	No	NR	NR	Nausea Vomiting	36.5	Diffuse peritonitis	10.43	87.3	(-)	(-)	✓	NP	Obstruction
8/M/83	No	NR	NR	Nausea Vomiting	36.5	Diffuse peritonitis	18.14	89.9	✓	✓	✓	NP	Obstruction
9/M/79	No	NR	NR	No	38.0	Lower abdomen localized peritonitis	12.63	85.3	✓	(-)	✓	Obstruction	NP
10/M/ 62	Yes	Porridge	1	Nausea Vomiting	37.1	Peritonitis localized around umbilicus	10.68	79.2	✓	✓	(-)	Negative	NP
11/F/27	Yes	Porridge	1	Nausea Vomiting	38.0	Lower abdomen localized peritonitis	11.14	91.1	✓	✓	✓	Negative	NP
12/F/56	No	NR	NR	No	38.0	Right lower abdomen tenderness	19.12	89.4	✓	✓	✓	NP	Obstruction
13/M/ 74	Yes	Porridge	1	Nausea Vomiting	37.5	Right lower abdomen localized peritonitis	19.30	94.0	✓	✓	✓	NP	NP
14/F/50	No	NR	NR	Nausea Vomiting	38.0	Right lower abdomen localized peritonitis	14.18	92.0	(-)	(-)	✓	Negative	NP
15/F31	Yes	Porridge	1	Nausea Vomiting	36.6	Right lower abdomen localized peritonitis	17.87	87.9	(-)	✓	✓	NP	NP
16/M/ 64	Yes	Porridge	1	Nausea Bloating	36.5	Right lower abdomen localized peritonitis	12.70	89.5	(-)	(-)	(-)	Negative	Obstruction
17/M/ 59	No	NR	NR	No	NR	Right upper abdomen localized peritonitis	20.78	92.5	(-)	(-)	✓	NP	NP

Table 1 continued

No./sex/ age	FB recall	Food type	Interval (days) [†]	Symptoms	Tem (°C)	Physical examination	WBC (*10 ⁹ /L)	NEUT %	CT images FB	CT images Perforation	Obstrucion	Other examinations Ultrasound	Other examinations X-ray
18/F/66	Yes	Herb	1	Nausea Vomiting	37.8	Upper abdomen tenderness	20.51	90.6	✓	✓	✓	NP	NP

FB foreign body, WBC white blood cell count, NEUT% percentage of neutrophil granulocyte, CT computed tomography, NP not performed, NR not reported

[†]Interval between the ingestion and the presence of symptom

✓: This aspect of finding was diagnosed in the original report of the CT scan

(-): This aspect of finding was not mentioned in the original report of the CT scan

than one perforation was detected in 7 of 15 patients (47%) during surgery, where 4 patients underwent enterectomy and anastomosis as mentioned above. The pits were not found during surgery in two cases, and only closure of perforation was performed. The pits were rediscovered in the colon by the following CT scans and were ultimately excreted in stool uneventfully. Of the 15 patients, 5 patients were admitted in SICU because of either severe intraperitoneal contamination or instability of the vital signs. All 5 patients were recovered well and were transferred to general ward shortly after. The average length of stay (LOS) of surgically treated patients was 10.3 days (range 5–24 days, median LOS: 9 days) with the development of only one complication of surgical site infection in the patient with the longest LOS.

Of the 18 patients, 3 patients received conservative treatments because of either patient’s refusal of surgery or relatively milder symptoms. Short-term fasting and oral liquid paraffin administration were applied in these patients, and the range and severity of peritonitis were cautiously monitored. The symptoms of all 3 patients were relieved shortly after, with the pits identified in stool, and they were released from the hospital after full restorations of oral intake. The average LOS of conservatively treated patients was 7 days (range 5–9 days, median LOS: 7 days). All the patients had smooth recovery without the occurrence of any further complications.

Discussion

Ingestion of FB as a common clinical scenario can occur in anyone, and it can be at times a life-threatening condition without accurate diagnosis and timely treatment. Ingestion of some highly dangerous objects such as high-powered magnets, large button batteries, narcotic packages and super absorbent objects can be associated with risk factors like underlying psychiatric conditions [8], imprisonment [9], defective capabilities due to extremely young age [10] or abuse of alcohol and drugs [11] and is usually intentional and repetitive [12]. However, the FBs that cause intestinal perforation are food related, and there is a wide spectrum of FBs including bones of animals [13, 14], shells of seafood [15, 16], toothpicks [17, 18], dentures [19] and seeds of fruits as in our case series. Ingestion of food-related FBs is usually unintentional and can be easily neglected by both patients and doctors [18], which is in accordance with our study results (50%). As far as we are concerned, it is safe to assume that the majority of ingested jujube pits that simply pass the alimentary tract spontaneously without causing any discomfort are overlooked by both patients and researchers due to relatively short (<3 cm) and narrow (<0.5 cm diameter) [20] size of the

Fig. 1 CT scan of a 31-year-old male who experienced abdominal pain after consuming porridge of jujubes as breakfast. Axial CT images show a round calcific mass in the small intestine (black arrow in **a**), which is visualized as a shuttle-shaped shadow lodged within bowel wall (black arrow in **b**) with the help of coronal CT multiplanar reconstruction, and extraluminal free gas (white arrow) can be seen in both images

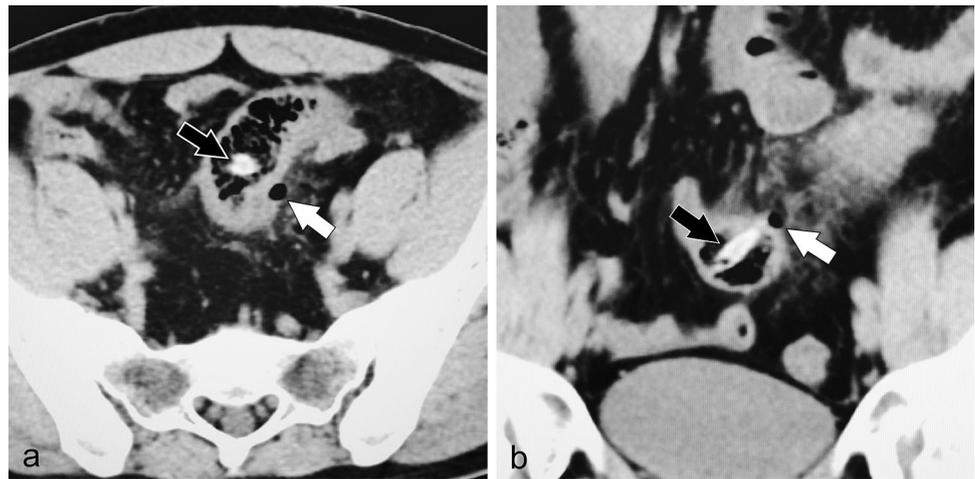
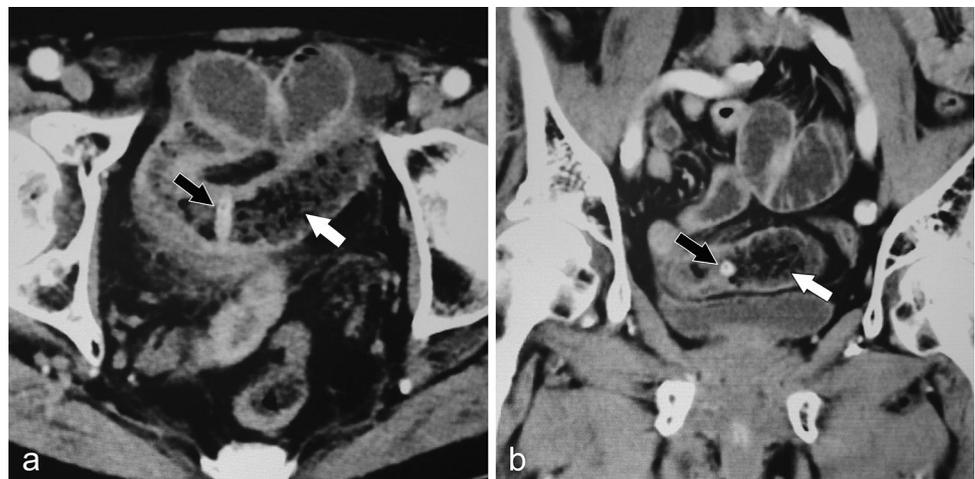


Fig. 2 79-year-old male came to the emergency department with signs of localized peritonitis. A pit of jujube incarcerated in the intestinal wall (black arrow) and chime accumulated in the proximal bowel (white arrow) are evident on CT



jujube pit. In contrast, according to the retrospective analysis of 116 publications the longer and the sharper objects like toothpicks were reported to either lodge in the intestine or migrate into the adjacent organs at the time of removal [18]. Therefore, a more aggressive management including early gastroscopy and urgent surgery is recommended when the ingestion of toothpick is suspected.

Aged people are revealed as a relatively vulnerable population in our study (where the age of 14 out of 18 patients (78%) was >55 years) mainly for two reasons. On the one hand, jujube is considered as a traditional Chinese food and is mainly accepted and consumed by aged people in the form of either herbal medicine or a component of porridge [7]. On the other hand, reduced palate sensitivity because of denture or peripheral neuropathy is more commonly seen in elderly patients and can increase the risk of unintentional ingestion of jujube pits significantly [21, 22]. According to the American Society for Gastrointestinal Endoscopy (ASGE), regardless of object type,

FB ingestions mostly occur in toddlers and younger children with a peak incidence between the ages of 6 months and 6 years [23].

The clinical presentations of intestinal perforation secondary to FB ingestion can vary with the location and size of the perforation as well as with the age of the patient. Patients in the emergency department with localized peritonitis accompanied by high temperatures and leukocyte counts as in 13 patients (72%) in our study can be misdiagnosed as a wide spectrum of acute abdominal diseases including acute appendicitis, cholecystitis, pelvic inflammatory disease or even ureteral colic. In search for accurate diagnosis, CT is considered as a sensitive and accurate method to identify the location and complications caused by ingested sharp or pointed FBs and is the first imaging modality of choice [24–26]. However, ultrasound imaging or X-ray may be initially applied in patients to rule out other acute abdominal diseases mentioned above, especially without recalling the FB ingestion history, but the

Table 2 Outcomes of treatments of 18 patients

No./sex/ age	Treatments	Location of perforation	Special circumstances	ICU	LOS (days)
1/M/65	Perforation repair	Descending part of duodenum	The pit was found in the horizontal part of duodenum	Yes	14
2/F/58	Perforation repair	40 cm distal to the ligament of Treitz	The pit was not found during surgery and was excreted in stool afterward	Yes	9
3/M/65	Perforation repair	60 cm proximal to ileocecal valve	No special circumstances	No	7
4/F/75	Enterectomy + anastomosis	100 cm proximal to ileocecal valve	No special circumstances	No	7
5/M/93	Enterectomy + anastomosis	150 cm distal to the ligament of Treitz	Two perforations located in the opposite positions of the intestinal wall	Yes	9
6/M/54	Enterectomy + anastomosis	80 cm distal to the ligament of Treitz	Three perforations in total. The pit caused two more perforations after drifting from the original position	No	10
7/M/82	Enterectomy + anastomosis	150 cm distal to the ligament of Treitz	Two perforations located in the opposite positions of the intestinal wall	Yes	24
8/M/83	Perforation repair	Middle part of jejunum-ileum	Two perforations located in the opposite positions of the intestinal wall	Yes	9
9/M/79	Perforation repair	100 cm distal to the ligament of Treitz	Two perforations located in the opposite positions of the intestinal wall	No	12
10/M/ 62	Perforation repair + jejunostomy	Descending part of duodenum	Apart from perforation repair, jejunostomy was performed	No	19
11/F/27	Perforation repair	Middle part of jejunum-ileum	Two perforations located in the opposite positions of the intestinal wall	No	6
12/F/56	Perforation repair	40 cm proximal to ileocecal valve	No special circumstances	No	9
13/M/ 74	Perforation repair	40 cm proximal to ileocecal valve	The pit was not found during surgery and was identified in the ascending colon in the CT images afterward	Yes	8
14/F/50	Laparoscopic perforation repair	Terminal ileum	No special circumstances	No	5
15/F31	Enterectomy + anastomosis	Middle part of jejunum-ileum	Two perforations located in the opposite positions of the intestinal wall	No	7
16/M/ 64	Conservative treatments	20 cm proximal to ileocecal valve	The patient was relieved after fasting and oral liquid paraffin administration	No	7
17/M/ 59	Conservative treatments	Jejunum-ileum	The patients refused surgery and were relieved after fasting and oral liquid paraffin administration	No	5
18/F/66	Conservative treatments	Jejunum-ileum	The pit drifted into the colon in the CT image 1 day after. The patient was relieved after fasting and oral liquid paraffin administration	No	9

ICU intensive care unit, LOS length of stay

accurate rate of diagnosis can be extremely low as shown in our study. The initial reports of CT imaging mainly concentrated on three aspects including FBs in the digestive tract, perforation of intestinal wall and obstruction of proximal bowel. The detection rate can be as high as 94% (17 out of 18 patients) in our study by combining all the three aspects with the fact that pits could be identified in

the CT images of every patient when inspected retrospectively. The presence of proximal accumulation of chime of a shuttle-shaped high-density shadow is a characteristic sign of intestinal stasis caused by incarcerated jujube pit in the digestive tract. The preferred diagnostic examination option of other FBs should consider both the object-related characteristics and the symptoms of the patients.

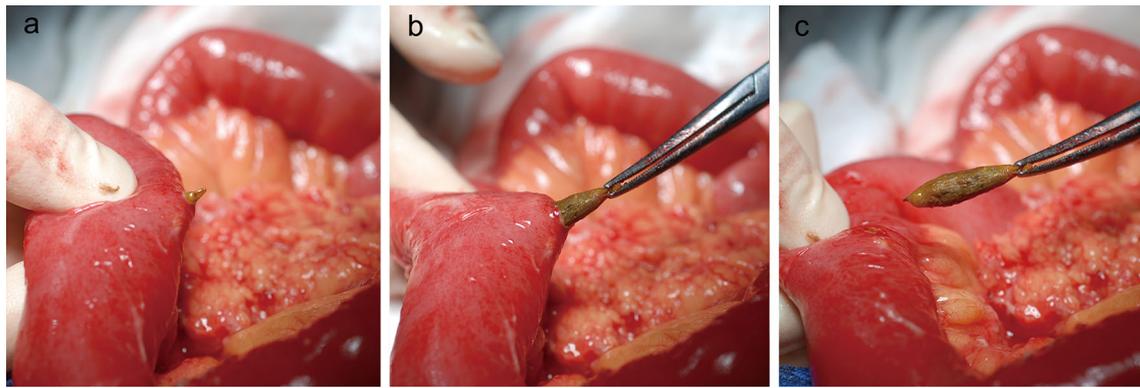


Fig. 3 A pit of jujube was extruded through the perforation site of the intestinal wall

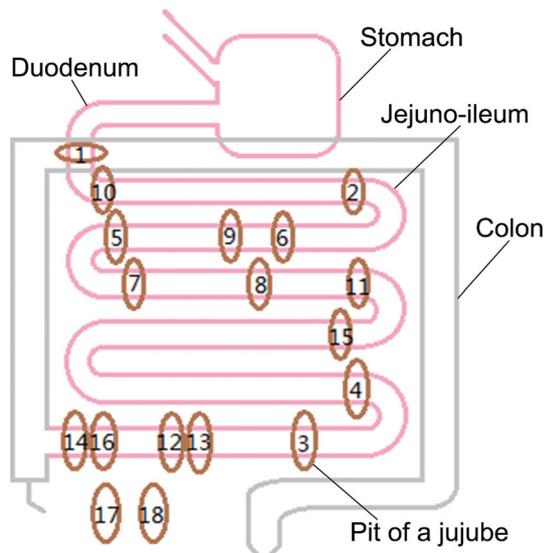


Fig. 4 Locations of perforations in 18 cases, each of which is represented with a brown oval. Patients No. 17 and 18 were treated conservatively, and the exact locations of perforations were unknown

Endoscopy was confirmed as the most effective technique in detecting and removing most of the FBs with a biopsy forceps in the proximal and distal GI tract [27, 28]. Small and blunt FBs like coins or single magnet almost universally pass through the entire GI tract, and when passed through the pylorus, only a follow-up X-ray might be sufficient [9].

All the perforations included in our study revealed by either the CT scans or surgical exploration were detected in the small intestine, 2 in the duodenum and 16 in the jejunum-ileum. About a third of perforations were identified in the terminal ileum, as it is thought to be a vulnerable region due to relatively thinner wall and narrower lumen as well as obstruction of the ileocecal valve [29]. The original regions where the localized peritonitis took place were approximately in accordance with the perforation locations when reviewed retrospectively. Since the two points of a

jujube pit are almost equally sharp, two perforations located in the opposite positions of the intestinal wall were common. More perforations or lesions can be caused if the pit is pushed away from the original position by the accumulated chime, making it significant to examine the proximal intestine as well as adjacent organs thoroughly. The pits of several patients were located distal to the perforation site and even identified in the colon. So, a repetitive CT scan is recommended in patients with a long delay before intervention, which can aid in the location of the pit during surgery. The choice of surgical procedure depends on intraoperative findings including the number and size of perforations as well as the severity of intraperitoneal contamination [30]. Perforation repair may be enough in case of small perforations with minor surrounding inflammation, while enterectomy and anastomosis with or without enterostomy may be of superior choices for multiple lesions or severe contamination [31].

If the penetration of the perforated site by the sharp point of the jujube pit is relatively small and if the pit is not incarcerated in situ, it might close spontaneously. Consequently, conservative treatment by means of fasting and close observation is sufficient in patients with milder symptoms [28]. It is expected that the spontaneous passage of the pit might take place within 4–6 days [4] and oral liquid paraffin administration could expedite this process according to our limited experience. Continuous observation of the patient's stool and regular imaging examinations with the aim to document the passage of the FBs are required until the pit has been passed through the entire alimentary tract. The exacerbation of either the range or the severity of the peritonitis as well as the stasis of the passing through progression for 3 days is considered as indications of surgical intervention [32, 33]. However, there are several limitations in the current study. This is a single-center study, with retrospective design, and hence, the number of patients included was limited. FBs of pediatric patients

were not included in this study, and so, our experience might be applicable for adults only.

Conclusion

Ingestion of jujube pits can lead to intestinal perforation causing localized or diffused peritonitis and needs accurate diagnosis and timely treatment. Aged people, as the primary consumers of jujubes, are at higher risk of jujube pits ingestion, and the treatment of which can be complicated and problematic. CT imaging is recommended as the first imaging modality of choice when there is a suspicion of jujube pits ingestion. Conservative treatment by means of fasting and close observation can be attempted in patients with milder symptoms, while emergent surgical exploration is recommended in patients with diffuse peritonitis. Multiple lesions or perforations could be identified during surgery, and thorough examination of the entire intestine and adjacent organs is necessary. Our experience is limited because of small sample size involved, and further evaluations of larger multicenter studies are warranted.

Acknowledgements Authors would like to thank Professor Yimu Jia who provided photographs taken during surgery.

Compliance with ethical standards

Conflict of interest The authors report no conflict of interest.

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

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