


Abdominal CT manifestations in fish bone foreign body injuries: What the radiologist needs to know

Acta Radiologica Open
10(7) 1–8
© The Foundation Acta
Radiologica 2021
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/20584601211026808
journals.sagepub.com/home/arr


Devendra Kumar¹, Anirudh Venugopalan Nair¹ , Pankaj Nepal²,
Tariq ZA Alotaibi³, Mahmoud Al-Heidous¹ and David Blair Macdonald^{4,5}

Abstract

Fish bone is one of the most common foreign body ingestions encountered in the emergency department. Fish bone perforations occur most commonly in segments with acute angulation like the ileocecal region and rectosigmoid junction and can present acutely with obstruction and free air or with chronic complications like abscess and sepsis. Radiologists should be familiar with the high-risk clinical scenarios, the CT appearance of radiopaque fishbones, and the spectrum of imaging findings related to gastrointestinal (GI) tract so as to direct management and timely referral to GI endoscopists and surgeons.

Keywords

Fish foreign body, computed tomography, gastrointestinal tract, injury

Received 8 April 2021; Accepted 2 June 2021

Introduction

Fish bone foreign body (FFB) is the most common type (up to 84%) of ingested foreign bodies encountered in the emergency department.^{1–4} It is more common in Asian countries, where the rate of fish consumption is higher. FFB ingestion is common in extremes of age associated with impaired swallowing in the pediatric age group and in the elderly.^{4,5} While the majority of ingested fish bones pass spontaneously 10–20% of cases fail to pass,^{4,6} and in a small minority of 1% of ingested FFB, result in complications requiring surgery.^{6–8} FFB is difficult to visualize on plain radiographs with low sensitivity ranging from 25% to 39%, but high specificity up to 91% when visible.^{6,9,10} Other factors that affect visibility include size, site of arrest or impaction, and radiodensity which varies with fish species. From most radiodense to least dense on CT scan, the different fish species range from bass, catfish, drum tilapia, salmon, trout, red snapper, to tilefish.^{9–12}

History taking can be confounded as the patients often do not recall eating fish thereby diverting clinical suspicion to other common causes of acute abdominal pain. Moreover, the symptoms may be delayed by a time lag of

weeks, months, or even years after the accidental ingestion of FFB. Therefore, the radiologists must have knowledge of the imaging appearance and maintain a high index of suspicion even when the antecedent history is absent. A myriad of abdominal complications may occur with FFB ingestion, such as bowel wall impaction, full thickness perforation, with or without intra-abdominal abscess formation, and intraperitoneal dislodgement. CT of abdomen and pelvis is the investigation of choice in

¹Department of Clinical Imaging, Al Wakra Hospital, Hamad Medical Corporation, Doha, Qatar

²Department of Radiology, St Vincent's Medical Center, Bridgeport, CT, USA

³Department of medical imaging, Ministry of National Guard-Health Affairs, Riyadh, Saudi Arabia

⁴Department of Radiology, University of Ottawa, Ottawa, ON, Canada

⁵Department of Medical Imaging, The Ottawa Hospital Research Institute, Ottawa, ON, Canada

Corresponding author:

Anirudh Venugopalan Nair, Department of Clinical Imaging, Al-Wakra Hospital, Hamad Medical Corporation, PO Box 82228, Doha, Qatar.
Email: dranirudhnair@gmail.com



localizing FFB and in evaluation of complications related to FFB.

In this article, we will discuss the etiopathogenesis of abdominal complications due to FFB, gamut of imaging features, intraoperative images for correlation, available treatment options, and pitfalls with image interpretation.

Etiopathogenesis

In adults, about 80% of cases of foreign body ingestion are associated with orodental risk factors such as wearing dentures, reduced tactile sensation of the palate.^{6,7,13} Risk of FFB ingestion increases in elderly, history of alcohol or intravenous drug use, cognitive impairment, and oropharyngeal dysfunction.^{6,14} The use of chopsticks and cutlery to eat boned fish and fish deboning in the mouth are also risk factors for accidental FFB ingestion.¹⁵ Children are more prone to foreign body ingestion due to the tendency for mouthing, lack of tooth limiting ability to chew, inability to differentiate edible from inedible foods, and distractions while eating.¹¹ In the pediatric age group, FFB is commonly located in the oropharynx, particularly in the tonsils and tongue base, due to the relatively larger size of tonsils when compared to adults.¹⁶ The large size tonsils act as a barrier for distal propagation of FFB. In adults, the most common sites of FFB impaction sites are oropharynx, hypopharynx, oral cavity, and the esophagus.^{2,17,18}

Geometry, sharpness, and length of the FFB play an important role in subsequent development of complications.¹⁹ Sharp, linear bones have a higher risk of mucosal laceration, perforation, and subsequent penetration into the adjacent tissues. Although, there is no specific length of FFB that can be attributed to clinical symptoms and imaging manifestation of impaction or bowel perforation, FFBs that are smaller tend to be often asymptomatic and pass through without any gastrointestinal (GI) tract complications, while those with sharp ends and increased length can result in impaction and perforation. In general, an FFB longer than 6–10 cm usually will not progress through the curvature of the duodenum.^{1,11,19} Distal migration of FFB in the GI tract can be complicated with impaction, bowel perforation, bleeding, hematoma, abscess, and fistula.

Clinical diagnosis

Patients are usually unaware of having ingested FFB, and may present with acute, chronic, or acute on chronic abdominal symptoms. Patient symptoms vary depending on the site of perforation and degree of inflammation. In cases with FFB in the stomach, patients may present with non-specific abdominal pain mimicking peptic ulcer disease, acute cholecystitis, pancreatitis, or gastritis.

Perforations of the stomach and duodenum may present with protracted subacute and less severe clinical features compared to rest of the GI tract.²⁰ Lower GI FFB may mimic other more common acute abdominal conditions such as acute appendicitis, renal colic, acute diverticulitis, and colitis.²¹ In our series, all of the patients were referred for CT abdomen and pelvis to assess for acute causes of pain, and there was no pre-CT clinical suspicion of suspected FFB injuries.

In long-standing cases of FFB impaction, patients may present with recurrent inflammation or chronic inflammatory mass, which may masquerade as neoplasm both clinically and radiologically.^{22,23} This ambiguity may be partly due to lack of awareness about the appearance of FFB and the long-standing inflammatory reaction surrounding it.

Imaging modalities

Plain abdominal radiographs have low sensitivity in detecting abdominal FFB, sensitivity ranging from 25% to 39%.^{6,9,10} Ultrasound may identify foreign bodies and it has the advantage of radiation-free assessment, real-time imaging combined with clinical palpation, and targeted attention to the symptomatic area. However, its use is not popular in the emergency setting of undifferentiated or GI abdominal pain.⁷ Definitive diagnosis of FFB is established on CT by demonstrating a linear hyperdense foreign body. CT can detect calcified foreign bodies measuring as small as 0.5 mm.²⁴ Routine CT scans will depict any food bolus particles with calcium.

We use multiplanar reconstruction of the portal venous phase contrast enhanced CT using a slice thickness of 0.5–1.5 mm. The use of intravenous contrast agents helps depict the bowel wall layers and relationship of perforated foreign bodies, abscesses, and other complications. Theoretically, non-contrast CT scans may have higher sensitivity using the high intrinsic contrast of the calcified fishbone against non-enhanced bowel, analogous to the advantages of CT renal colic scans for detecting calcified renal stones. However, the specific history of fishbone ingestion is rarely or never available before scan protocol, so radiologists must be able to detect the calcified foreign bodies on a post contrast scan in the majority of cases. A non-contrast and contrast enhanced scan may be justified if there is a strong suspicion or on a follow-up study. We do not routinely administer oral contrast in the emergency setting, and it should be avoided in cases of suspected or possible foreign body ingestion. Faint calcification of FFB will usually be obscured by positive oral contrast, and in such cases, a delayed repeat scanning without oral contrast can be done. Careful examination of scout images may improve detection and specificity in some of these cases as well.

Review of imaging features

Stomach and small bowel loops

Perforation is less likely in the stomach than other sites in the GI tract presumably due to greater volume capacity. According to the literature review, gastric impaction and perforation are most likely to occur along the lesser curvature at the incisura.²⁵ The FFB may perforate the gastric stomach wall leading to perigastric inflammation or abscesses in adjacent organs, such as liver, pancreas, or spleen in extreme cases.²⁰ A FFB within the stomach with high-risk geometry of FFB and/or clinical symptoms is an indication for immediate endoscopic retrieval since FFB passing distal to stomach will no longer be retrievable and has a high rate of intestinal perforation in the literature reported to occur in 15–35% cases.²⁶

The incidence of FFB impaction and subsequent perforation is more commonly seen in small bowel loops owing to the acute angulation at multiple sites and smaller caliber, as opposed to a relatively linear transit course and greater capacity within large bowel loops^{7,20} (Figures 1–4). Small

bowel perforation occurs more commonly at sites of acute angulation such as ileocecal region and terminal ileum.²⁷

Large bowel loops

There is high propensity for the FFB to get impacted at sites of acute angulation, like ileocecal junction and rectosigmoid. Due to the presence of haustration, FFB can get impacted at sites of haustra, this along with transiting faecal bolus with peristalsis may further complicate the impaction of FFB resulting in perforation²⁷ (Figures 5–7). Fish bone foreign body perforation of the colon is also predisposed by underlying diverticulosis, stricture, or cancer.²⁷ Colonic perforation can further complicate as colovesical fistula.⁷

Meckel's diverticulum

Meckel's diverticulum is a true diverticulum arising from the antimesenteric border of the small intestine. It can be as long as 5 cm with diameter up to 2 cm. Fish bone can get impacted in this blind ending Meckel's diverticulum during

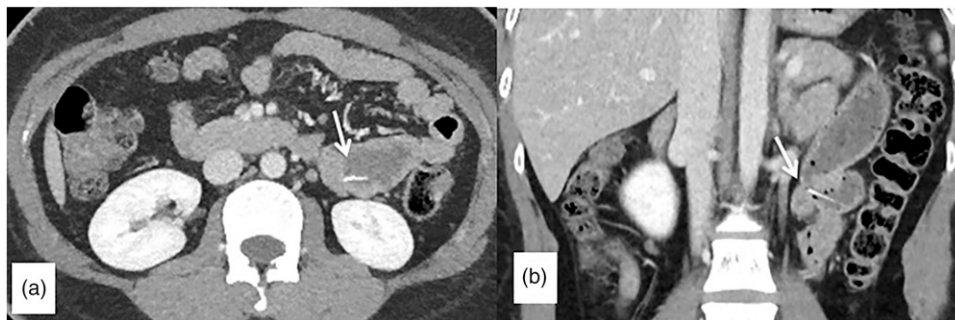


Fig. 1. 27-year-old woman with left lower abdominal pain. Contrast enhanced CT axial (a) and coronal (b) images showing a 2.5 cm long FFB within the proximal jejunal loop without wall thickening or penetration (white arrow). The patient was conservatively managed with inpatient admission for 3 days and patient passed the FFB on day-3 without any complications.

Note: FFB: fish bone foreign body.

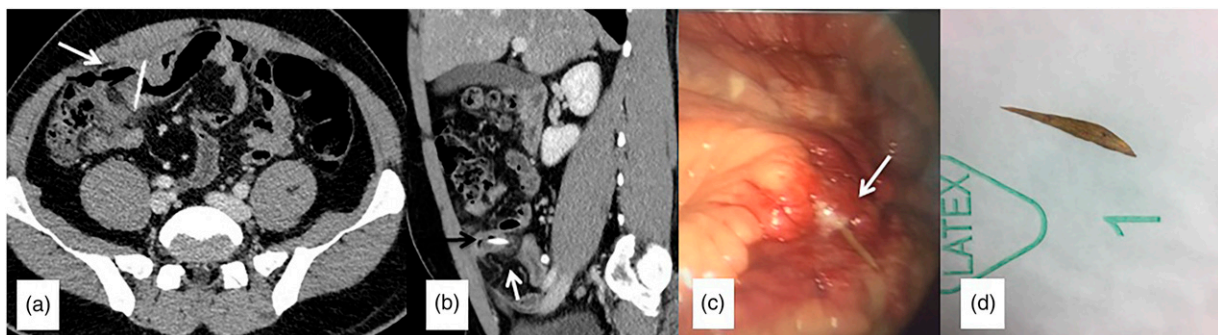


Fig. 2. 34-year-old man with right iliac fossa pain and clinical suspicion of acute appendicitis. Contrast enhanced CT abdomen; axial (a) and sagittal (b) show FFB (white arrow) causing full thickness penetration through the thickened distal ileum with surrounding soft tissue stranding. Laparoscopy (c) showing corresponding FFB penetration and perforation, with gross specimen post-FFB removal (d).

Note: FFB: fish bone foreign body.

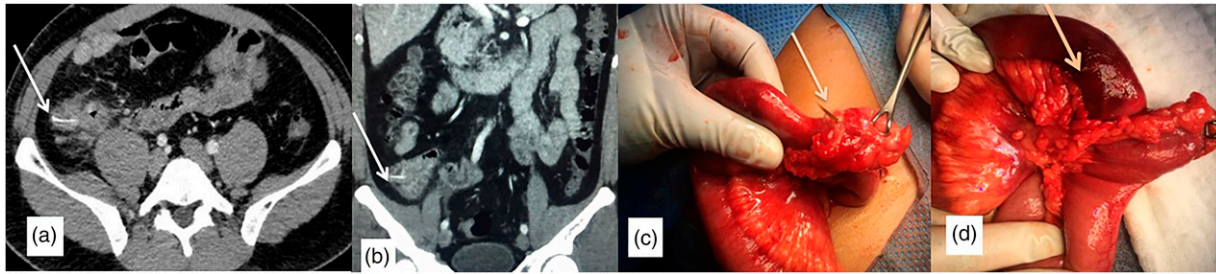


Fig. 3. 38-year-old man with right iliac fossa pain and clinical suspicion of acute appendicitis. Contrast enhanced CT abdomen; axial (a) and coronal (b) showing FFB (white arrow) causing full thickness penetration into the peritoneum with focal concentric ileal wall thickening, surrounding peritoneal stranding, and free fluid. (c, d) Laparotomy showing FFB penetrating the ileal wall with edematous bowel wall (white arrow).

Note: FFB: fish bone foreign body.

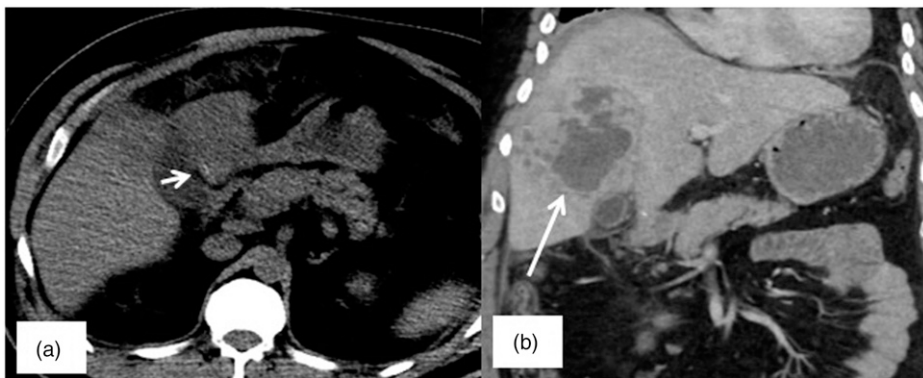


Fig. 4. 47-year-old man presenting with fever and abdominal pain. (a) Plain CT axial image showing FFB in gastroduodenal junction showing full thickness penetration, with tip penetrating the liver (short white arrow); (b) coronal portal venous phase showing abscess formation in right hepatic lobe (long white arrow). The FFB was surgically removed and liver abscess was drained.

Note: FFB: fish bone foreign body.

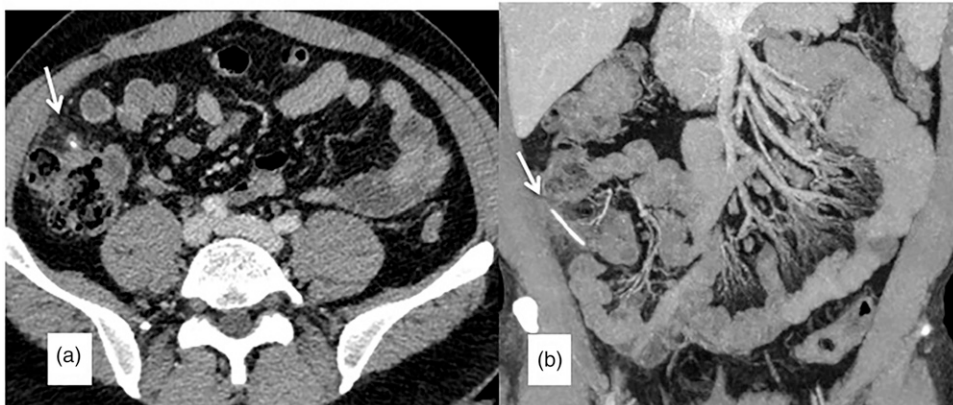


Fig. 5. 38-year-old man with right iliac fossa pain and clinical suspicion of acute appendicitis. Contrast enhanced CT abdomen; axial (a) and coronal (b) showing 4 cm long FFB (white arrow) causing full thickness penetration of anterior cecal wall and extending into peritoneal surface with perforation sealed by FFB with surrounding fat stranding. Laparoscopic removal of FFB and local suturing was done.

Note: FFB: fish bone foreign body.

its distal small bowel transit. This blind ending loop traps the linear fish bone, and the inherent peristalsis of the adjoining bowel increases the chance of FFB impaction and perforation (Figure 8). Although we encountered a single case of Meckel's diverticulum, the diagnosis of FFB impaction was only made at the time of surgery and not at the time of CT scan.

Extra-compartmental dislodgement

Fish bone foreign body during its transit can penetrate and get completely dislodged from the bowel segments and lie at a remote location within the same compartment or pierce the fascial planes to lie in a different organ or compartment. The sites of such dislodgement include the liver, pancreas, anterior abdominal wall muscles, pelvic muscles,

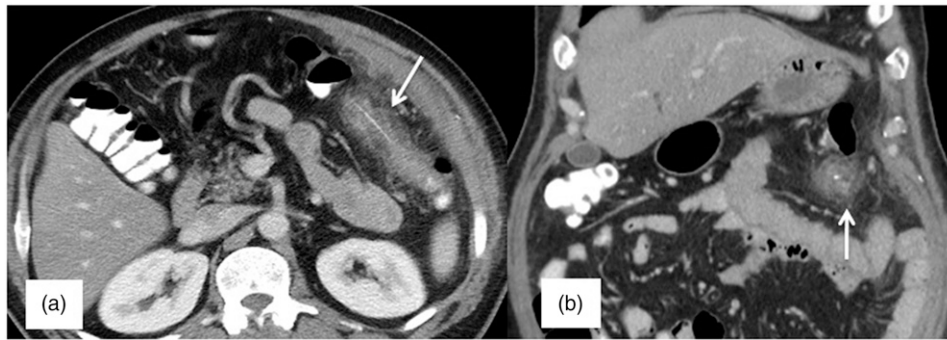


Fig. 6. 42-year-old woman presenting with left upper quadrant abdominal pain and clinical suspicion of diverticulitis. Contrast enhanced CT axial (a) and coronal image (b) showing impacted FFB (white arrow) in transverse colon with focal concentric wall thickening, surrounding fat stranding, and peritoneal thickening. The FFB was removed by colonoscopy. Note: FFB: fish bone foreign body.

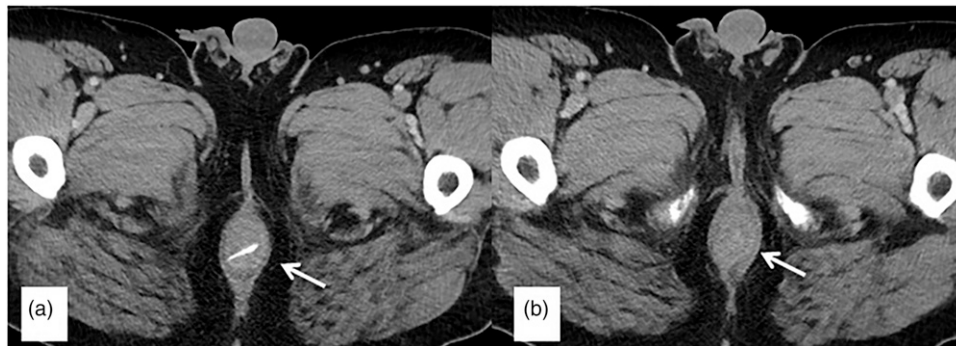


Fig. 7. 34-year-old man presenting with anal pain and bleeding, clinical suspicion of hemorrhoids. Contrast enhanced CT axial images (a, b) showing FFB in anorectal junction with impaction causing concentric wall thickening (white arrow). There were no complications in abdomen due to FFB transit. The FFB was removed by colonoscopy. Note: FFB: fish bone foreign body.

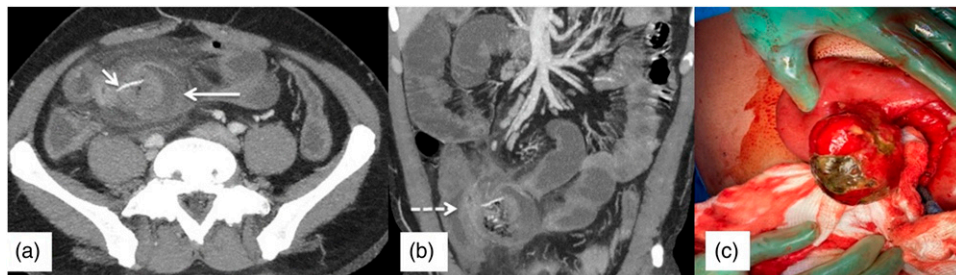


Fig. 8. 38-year-old man with right iliac fossa pain and clinical suspicion of complicated appendicitis. Contrast enhanced CT abdomen; axial (a) and coronal (b) showing FFB (short white arrow) contained within a rim enhancing mesenteric collection (long white arrow) with internal air and fecal material. The adjacent bowel loops are thickened (dashed white arrow). (c) Intraoperative findings showed mass like hard fecal mass with thick pus around the perforated Meckel's diverticulum.

or retroperitoneal muscle compartments. The site of involvement may be complicated by abscess formation and hematoma (Figure 9).

Types of GI tract injuries and treatment options

There is no specific length of FFB that can be attributed to clinical symptoms and imaging manifestation of bowel perforation. Fish bone foreign bodies that are smaller tend to be asymptomatic and pass off without any GI tract complications, while those with unfavorable geometry such as sharp edges and increased length can result in impaction and perforation.²⁸ Attempt to remove FFB is made whenever possible when the FFB is in a retrievable site, associated with unfavorable geometry or with symptomatic patients.

When FFB is localized in the GI tract without any wall thickening or bowel injury, the treatment options are either

endoscopic retrieval or conservative management with observation. FFB in the stomach and duodenum proximal to the ligament of Treitz can be removed by both flexible and rigid endoscopies. Flexible endoscopy has more advantages and can be utilized for both diagnostic as well as therapeutic tools in management of foreign bodies and food bolus impaction in the upper GI tract. The success rate is higher than 95%, with complication rates of 0–5%.²⁹ There are different options for retrieval devices to be used with endoscopy, including grasping forceps, baskets, and snares. The choice of the retrieval device is determined by the size and shape of FFB, length of endoscopic device, its instrument channels, and preference/practice of the endoscopist. Similarly, FFB in the colon and rectum can be retrieved with colonoscopy and sigmoidoscopy. For FFB with unfavorable geometry and failed endoscopic removal, inpatient admission with close clinical observation is recommended. These patients in our series were admitted for

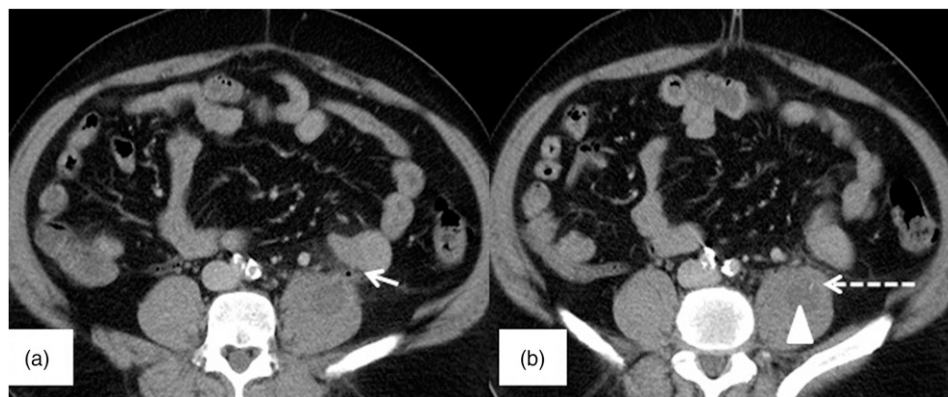


Fig. 9. 79-year-old woman presenting with fever and abdominal pain. Contrast enhanced CT axial images (a, b) showing fat stranding with pneumoperitoneum posterior to jejunal wall (short white arrow). Abscess formation in left psoas muscle (arrow head) and fish bone foreign body (dashed white arrow) seen within the psoas abscess at a remote location from site of this sealed bowel perforation.

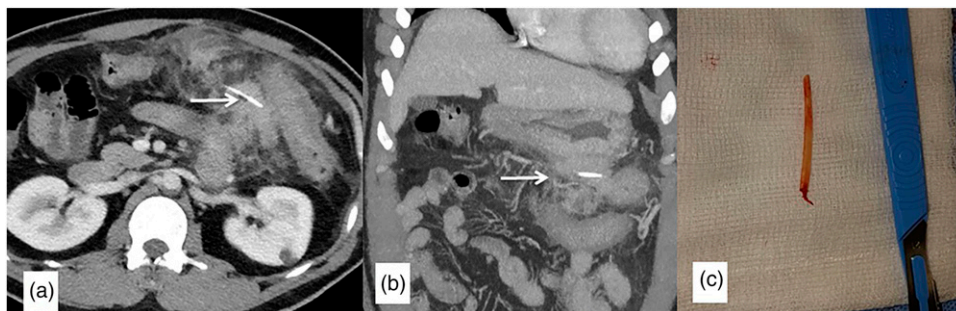


Fig. 10. 46-year-old man with severe upper abdominal pain with vomiting and clinical suspicion of pancreatitis. Contrast enhanced CT abdomen; axial and (a) coronal (b) images showing extensive stranding, peritoneal thickening surrounding the dropped FFB in gastrocolic ligament (white arrow) with diffuse wall thickening of gastric wall, jejunal loops, and transverse colon. The exact site of perforation could not be ascertained on CT scan, with FFB lying at a remote location from the site of perforation. The site of perforation was intraoperatively identified at the transverse colon, with (c) showing gross FFB post removal.

Note: FFB: fish bone foreign body.

observation for 3 days and were then discharged without complication.

When FFB is seen partly penetrating through the wall of the bowel segment or localized outside the perforated bowel at the vicinity of the perforated site with surrounding fat stranding, peritonitis or pneumoperitoneum, a laparoscopic removal of the FFB with local suturing of the injured bowel segment and drainage of abscess is the treatment option.

When FFB is localized at a remote location from the site of perforation, or if the site of perforation is difficult to determine on the CT imaging (Figure 10), a laparoscopy or laparotomy is considered to ascertain the site of bowel perforation and to repair the injured segment either by local suturing or rarely through an end-to-end anastomosis.

Diagnostic pitfalls

Localizing and diagnosing a FFB in CT scan is often challenging for radiologist in an emergency setting as the history of fish intake is often confounded. The radiologist should be aware of other rare but potential pitfalls that can mimic the appearance of FFB.

Chicken bone fragments and sometimes accidental ingestion of toothpicks can mimic a FFB.¹¹ Majority of food bolus particles which appears as radiodense foreign bodies including chicken bones are smaller in size and will safely pass through without causing any complications. Other potential pitfalls on CT include the presence of positive bowel contrast, which can completely obscure the FFB, artifacts related to fecal material within the colon, and contrast opacification of small blood vessels which can mimic FFB.

Conclusion

Fish bone foreign bodies are one of the most commonly ingested foreign bodies. Although the majority pass without complication, those that present for CT scan often have complications and high-risk features that require urgent endoscopy or surgical removal, bowel repair and drainage, or expectant management with clinical and imaging surveillance to ensure uncomplicated passage. Successful targeted treatment of FFB depends on accurate localization in the GI tract, identification of high-risk foreign body geometry, integration of clinical factors, and a knowledge of associated complications, so as to direct management and timely referral to GI endoscopists and surgeons. Fish bone foreign body impaction is more commonly encountered in Asia but is an important clinical entity globally and radiologists must be able to identify the small bone fragments, tailor CT protocols, and readout strategies to maximize detection, characterization, and minimize the morbidity of this condition.

Acknowledgements

The authors acknowledge Dr Hashim, Dr Moyad, Dr Atea, Dr Akram, Dr Haneer, and Dr Parag Mahajan for sharing their expertise and experiences in diagnosis and management of fish foreign bodies.

Author contributions

Guarantors of integrity of the article D.K., A.N. Article concept, design, manuscript drafting and revision for important intellectual content A.N. Manuscript editing B.M., D.K., A.N. Literature research, P.N., T.A., M.H., D.K., B.M., A.N. Images and legends T.A., D.K., A.N. Final version of manuscript is approved by all authors.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The publication of this article was funded by the Qatar National Library.

ORCID iD

Anirudh Venugopalan Nair  <https://orcid.org/0000-0001-7662-7668>

References

1. Mesina C, Vasile I, Valcea DI, et al. Problems of diagnosis and treatment caused by ingested foreign bodies. *Chirurgia (Bucur)* 2013; 108: 400–406.
2. Leong HK, Chan RK. Foreign bodies in the upper digestive tract. *Singapore Med J* 1987; 28: 162–165.
3. Velitchkov NG, Grigorov GI, Losanoff JE, et al. Ingested foreign bodies of the gastrointestinal tract: retrospective analysis of 542 cases. *World J Surg* 1996; 20: 1001–1005.
4. Kim HU. Oesophageal fish bone foreign body. *Clin Endosc* 2016; 49: 318–326.
5. Kim JP, Kwon OJ, Shim HS, et al. Analysis of clinical feature and management of fish bone ingestion of upper gastrointestinal tract. *Clin Exp Otorhinolaryngol* 2015; 8: 261–267.
6. Goh BKP, Tan Y-M, Lin S-E, et al. CT in the preoperative diagnosis of fish bone perforation of the gastrointestinal tract. *Am J Roentgenol* 2006; 187: 710–714.
7. Paixão TSA, Leão RV, de Souza Maciel Rocha Horvat N, et al. Abdominal manifestations of fishbone perforation: a pictorial essay. *Abdom Radiol* 2017; 42: 1087–1095.
8. Young CA, Menias CO, Bhalla S, et al. CT features of esophageal emergencies. *Radiographics* 2008; 28: 1541–1553.

9. Qureshi TA, Awan MS, Hussain M, et al. Effectiveness of plain x-ray in detection of fish and chicken bone foreign body in upper aerodigestive tract. *J Pakistan Med Assoc* 2017; 67: 544–547.
10. Evans RM, Ahuja A, Rhys Williams S, et al. The lateral neck radiograph in suspected impacted fish bones - Does it have a role? *Clin Radiol* 1992; 46: 121–123.
11. Geraci G, Sciume CC, Di Carlo G, et al. Retrospective analysis of management of ingested foreign bodies and food impactions in emergency endoscopic setting in adults. *BMC Emerg Med* 2016; 16: 42.
12. Woo SH, Kim KH. Proposal for methods of diagnosis of fish bone foreign body in the esophagus. *Laryngoscope* 2015; 125: 2472–2475.
13. Bunker PG, Aberdeen SD. The role of dentistry in problems of foreign bodies in the air and food passages. *J Am Dent Assoc* 1962; 64: 782–787.
14. Foo TH. Migratory fish bone in the thyroid gland. *Singapore Med J* 1993; 34: 142–144.
15. Arulanandam S, Das De S, Kanagalingam J. A prospective study of epidemiological risk factors for ingestion of fish bones in Singapore. *Singapore Med J* 2015; 56: 329–333.
16. Higo R, Matsumoto Y, Ichimura K, et al. Foreign bodies in the aerodigestive tract in pediatric patients. *Auris Nasus Larynx* 2003; 30: 397–401.
17. Ngan JHK, Fok PJ, Lai ECS, et al. A prospective study on fish bone ingestion. *Ann Surg* 1990; 211: 459–462.
18. Damghani M, Halavati N, Motamedi N. Foreign body in the upper airway and oesophagus: a seven years study from Iran. *J Pakistan Med Assoc* 2011; 61: 859–862.
19. Zhang X, Jiang Y, Fu T, et al. Esophageal foreign bodies in adults with different durations of time from ingestion to effective treatment. *J Int Med Res* 2017; 45: 1386–1393.
20. Lee K-F, Chu W, Wong S-W, et al. Hepatic abscess secondary to foreign body perforation of the stomach. *Asian J Surg* 2005; 28: 297–300.
21. Hunter TB, Taljanovic MS. Foreign bodies. *Radiographics* 200; 23: 731–757.
22. Kolbe N, Sisson K, Albaran R. Abdominal pain and hematuria: duodenal perforation from ingested foreign body causing ureteral obstruction and hydronephrosis. *J Surg Case Rep* 2016; 2016(2): rjw018.
23. Nicolas GN, Assaker R, Saliba C, et al. Foreign body ingestion causing recurrent diverticulitis. *Am J Case Rep* 2017; 18: 1123–1125.
24. Kaviani F, Javad Rashid R, Shahmoradi Z, et al. Detection of foreign bodies by spiral computed tomography and cone beam computed tomography in maxillofacial regions. *J Dent Res Dent Clin Dent Prospects* 2014; 8: 166–171.
25. Venkatesh SH, Venkatanarasimha Karaddi NK. CT findings of accidental fish bone ingestion and its complications. *Diagn Interv Radiol* 2016; 22: 156–160.
26. Sugawa C, Ono H, Taleb M, et al. Endoscopic management of foreign bodies in the upper gastrointestinal tract: a review. *World J Gastrointest Endosc* 2014; 6: 475–481.
27. Goh BKP, Chow PKH, Quah H-M, et al. Perforation of the gastrointestinal tract secondary to ingestion of foreign bodies. *World J Surg* 2006; 30: 372–377.
28. Hokama A, Uechi K, Takeshima E, et al. A fish bone perforation of the esophagus. *Endoscopy* 2014; 46: E216–E217.
29. Birk M, Bauerfeind P, Deprez P, et al. Removal of foreign bodies in the upper gastrointestinal tract in adults: European society of gastrointestinal endoscopy (ESGE) clinical guideline. *Endoscopy* 2016; 48: 489–496.