Fishbone Perforated Appendicitis

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ABSTRACT

Ingested foreign bodies tend to pass through the gastrointestinal tract without incidence, and vast majority of cases do not need intervention. Rarely, these foreign bodies drop into the appendix and not likely to re-enter the normal digestive tract. We describe a case of a 72-year-old male patient who presented with right iliac fossa pain of 3-day duration. Clinical examination suggested classic acute appendicitis. Blood test results revealed leukocytosis. Computed tomography of the abdomen and pelvis showed evidence of acute appendicitis and a linear hyperdensity (foreign body) perforating the appendix. The patient was managed successfully with prompt laparoscopic appendectomy and removal of the foreign body which was confirmed to be a fish bone measuring about 10mm. While imaging diagnosis of fishbone in the appendix has been published, reports are few. To the best of the author's knowledge, fishbone induced perforated appendicitis has been described only in 2 cases (including this case) in the literature.

CASE REPORT

CASE REPORT

A 72 year-old Chinese male patient presented to the emergency department (ED) with right iliac fossa pain of 3 days. The pain was intermittent and colicky which lasted 10 minutes each time. He denied fever, vomiting, change in bowel habit or urinary symptoms. His past medical history includes hypertension, hyperlipidaemia, diabetes mellitus and ischaemic heart disease.

In the ED, his blood pressure was 163/75 mmHg, heart rate was 75 beats per minute, respiratory rate was 18 per minute with an oxygen saturation of 98% on room air. He was pyrexial with body temperature of 38.3°C. Initial blood tests showed raised white cell count of 13.15 x109/L (3.6 – 11.0). Clinical examination demonstrated localised rebound tenderness at right iliac fossa. The initial clinical impression was probably appendicitis. Computed Tomography (CT) of the abdomen and pelvis was therefore requested for further evaluation.

CT demonstrated a dilated appendix (up to 13 mm in calibre) with thickened and hyperenhancing wall. There was marked peri-appendiceal fat stranding [Figures 1 - 3]. A small amount of free fluid was seen in the right iliac fossa. Features were consistent with acute appendicitis. Of note, there was a linear hyperdensity measuring 10mm (likely foreign body) perforating and extending slightly beyond the appendix [Figures 1 – 3]. No free gas or an abscess collection was detected.

This patient was counseled and agreeable for surgery after the CT abdomen and pelvis was done confirming the diagnosis of acute appendicitis with perforation likely secondary to foreign body (? fishbone). Intraoperatively, there was small amount of purulent fluid localized in the right paracolic gutter.

The appendix was found to be in a retrocecal position and was strongly adherent to the caecum secondary to inflammation. Upon separation of the adhesions, there was a small perforation seen in the mid portion of the appendix with a foreign body measuring about 1 cm in length protruding from the mucosa [Figure 4]. The foreign body was gently removed with a laparoscopic grasper and was noted to resemble a fishbone upon close inspection [Figure 5]. The mesoappendix was then taken down by diathermy and the appendix was transected between endoloops and delivered via a specimen retrieval bag.

Post-operative recovery was uneventful and the patient was discharged well after 3 days. Follow up of the patient at the clinic 1 month later was uncomplicated.

The final histology of the appendix was acute appendicitis with regional peritonitis.

DISCUSSION

Etiology & Demographics:

Reports of fishbone-induced perforation of appendicitis are extremely unusual, despite there being a few reports of fishbone found in the appendix in the East Asian surgical literature [1, 2]. To the best of the author's knowledge, fishbone- induced perforated appendicitis has been described only in 2 cases (including this case) in the literature.

Generally foreign-body ingestion happens in more than 100,000 patients annually in the USA alone [3]. Approximately 75% of ingested foreign bodies are impacted at the cricopharyngeal sphincter of oesophagus, and >90% of foreign bodies pass through the digestive tract, with only a few causing impaction and severe complication [4]. Perforation of the digestive tract by ingested foreign bodies is rare, with <1% of ingested foreign bodies perforating the bowel [4]. Fishbones are the most commonly ingested objects and the most common cause of foreign body perforation of the gastrointestinal tract [5]. The terminal ileum is the most common site of perforation, followed by duodenal C-loop [4].

The incidence of fishbone induced perforated appendicitis remains unknown however; the incidence of all foreign bodies lodging in appendiceal lumens has been reported to range between 0.005% and 0.113% [6]. If the weight of the foreign bodies is greater than the bowel fluid content, they arrest in the caecum during transit and gravitate towards its dependent portion [6, 7, 8, and 9]. The appendiceal orifice expands and allows entry into its lumen. However in case of a retrocecal appendix, it is almost impossible for foreign body to enter the appendiceal lumen. Once in the appendix, peristaltic action is insufficient to expel foreign bodies back into the caecum [10] and may cause appendicitis or perforation [9, 11-13]. The primary inciting factor in the pathophysiology of appendicitis is obstruction of the lumen. Foreign bodies can obstruct the appendiceal lumen in the same manner as appendicoliths and precipitate appendicitis.

Careless eating, particularly in children, insensitive denture plates, poor vision, mental infirmity, inflammatory bowel conditions and drug addiction often are contributing factors. Thread-like in outline, offering no contrast in colour and giving but little sense of resistance in mastication, even when due care is taken in eating, fishbones are unwittingly swallowed [5, 6].

The likelihood of intestinal or even more rarely appendiceal perforation by fishbone is lessened by its ability, being flexible, to conform to the changing intestinal peristaltic pattern. Injury to intestinal tract resulting from foreign body ingestion tends to occur in areas of acute angulation but have been reported in all segments. In series reported by McManous [14], 73% occurred in the ileocecal area. The ultimate disposition of a fishbone after perforation varies. In most cases, it passes from lumen into the peritoneal cavity, or possibly sometimes for the bone to remain in the lumen and be discharged by the anus. Fishbones extruded from the intestine may migrate and have been found in an abscess of the liver, anterior surface of the great omentum, passing through the anterior abdominal wall and pierced the skin, and through urinary meatus [5, 6].

Clinical & Imaging Findings:

Fish is such a common food that the history of having eaten it before the onset of symptoms is not of much significance in diagnosis. Symptoms resulting from fishbone perforation closely mimic other intraabdominal conditions that diagnosis is seldom made preoperatively [14]. A wide spectrum of clinical presentations include generalized peritonitis, localized abscess formation, presence of inflammatory mass, localized peritonitis, obstruction, and occasionally haemorrhage. Seldom are patients aware of fishbone ingestion, hence adding to the difficulty of making the diagnosis. As in our case, patient history was non-specific and the clinical examination suggested classic acute appendicitis.

There are reports of foreign body-induced appendicitis developing 3-16 days after ingestion of long or sharp objects such as pins which appear to require longer transit times thus, abdominal plain radiographs should be obtained 12-48 hours after foreign body ingestion [10]. If clinically unremarkable a follow up radiograph 3 days later may be performed as normal bowel transit should cause evacuation of the object within this time [10]. However in this setting of suspected appendicitis, abdominal radiographs are of limited value and may be more misleading than helpful. Elevated white cell count or C-reactive protein level may help identify inflammatory process. Abdominal radiographs are unreliable in the diagnosis of fishbone perforation. Even when fishbones are sufficiently radio-opaque to be visualized on radiographs, large soft tissue masses and fluid can obscure the minimal calcium content of the bone, particularly in altered or obese patients. Another reason for not identifying fishbones on radiographs is the use of the peak kilovoltage setting, with subtle calcifications being more easily identified on low-kilovoltage (70kV) supine films, while the use of 90kV makes it more difficult to see the offending fishbone [5]. Plain radiographs have been shown to

have sensitivity of only 32% in cases of fish bone ingestion [5, 9, 15].

CT is the method of choice for identifying ingested foreign bodies, with the only limiting factor being reporter interpretation. Several susceptible areas have been described where foreign body perforation tends to occur and likely to be overlooked. Awareness of these "blind spots" and dedicated analysis of these areas is recommended. These areas include regions of acute angulation, such as ileocecal and recto-sigmoid junctions, hernia sac, Meckel's diverticulum and the appendix [16]. Usually the patients do not remember ingesting fish bones and occasionally present with varied and non-specific clinical manifestations and hence decreasing the index of clinical suspicion and it is not surprising that foreign body perforation is seldom diagnosed pre-operatively.

The region of perforation can be identified on CT scans as thickened intestinal segment, localized pneumoperitoneum, regional fatty infiltration, or associated intestinal obstruction, of which findings are non-specific. Definitive diagnosis is made by identification of the calcified foreign body [5]. Fishbone perforation appears on CT scans as a linear calcified lesion surrounded by inflammation, as shown in our case.

CT is superior over radiography in the diagnosis of fishbone perforation, although there are potential limitations of CT in detection of intraabdominal fishbones. Use of thinner CT slices allows the radiologists to better delineate and differentiate structures such as blood vessels from calcified foreign bodies [5]. The CT scans used in our study were obtained with 3mm slices with 3D reconstruction and this thickness is reliable in detection of fishbone in our patient. The orientation of foreign body in relation to an axial CT scan also can affect perception of the reviewer. Coronal and sagittal reconstructions are useful to overcome this limitation.

With regards to the CT protocols of contrast material, using oral and IV contrast may cause difficulty in detecting the fishbones. Oral contrast can obscure the fishbones in the intestinal lumen. This problem may be circumvented when only water is used to distend the stomach and bowel loops. If IV contrast is used, extra-luminal fishbone may be mistaken for blood vessels. Generally fishbones can be appreciated with careful windowing of the CT images. If the diagnosis is strongly suspected but cannot be confirmed with initial contrast-enhanced CT scan, unenhanced CT should be repeated [5].

In our institutional practice, CT scan is preferred over ultrasound abdomen if imaging study is required for patients with suspected appendicitis. In this patient, CT abdomen and pelvis was obtained to exclude the differential diagnosis of right-sided diverticulitis which is not infrequently seen in our local population. CT scan may also show associated complications and helps in pre-operative planning. CT scan with IV contrast in portal venous phase revealed inflammatory features of appendicitis with fish bone perforating through the appendiceal luminal wall [Figures 1-3]. No abscess was observed.

Acknowledging the rarity of this disease entity, clinicians should seek detailed history of food ingestion over the past 2 weeks when foreign body is suspected on CT imaging.

Treatment & Prognosis:

Fish bone induced appendicitis –especially when perforated and with periappendiceal abscess- is unlikely to respond to non-operative management with intravenous antibiotics and percutaneous drainage. The treatment of intestinal or appendiceal perforation from any cause is entirely surgical.

The radiological finding of a foreign body resulting in perforated appendicitis allowed us to be more meticulous in the inspection of the surrounding bowel and determine whether there was any fistulation or perforation in other segments. The foreign body could also become a nidus for infection resulting in intra-abdominal sepsis if it was not removed. Therefore, preoperative CT imaging would have been helpful as a guide to aid the surgeon in removal of the foreign body at the same setting as the appendectomy. In our case, prompt appendectomy, drainage of any infection and foreign body removal were performed. Our patient underwent an uneventful post-operative recovery.

Differential Diagnoses:

Foreign body appendicitis

The main differential in this case was foreign body induced appendicitis. CT imaging shows dilated appendix ≥ 7mm, abnormal enhancement of appendiceal wall and surrounding inflammation, focal bowel wall thickening of adjacent caecum/ terminal ileum. Hyperdensity (foreign body) is usually within or adjacent to the appendix. A variety of foreign bodies was either found incidentally in appendices or felt responsible for appendicitis (Table 1) [17].

Foreign body intestinal perforation

Appendix is normal. Foreign body may be demonstrated. CT imaging shows focal bowel wall thickening and surrounding inflammation. Free gas may be present.

Appendiceal tumour

Primary malignant neoplasm of the appendix include mucinous cystadenocarcinoma (90%), colonic-type adenocarcinoma (10%), lymphoma (<1%) or carcinoid (which is common, and usually incidental at appendectomy). CT imaging features include soft tissue density mass infiltrating and/or obstructing the appendix. There is usually little surrounding infiltration [18].

Cecal diverticulitis

Inflamed diverticulum with circumferential mural thickening and preserved enhancing pattern of thickened colonic wall were the two most statistically significant findings of diverticulitis that distinguish right-sided colonic diverticulitis from colonic carcinoma. The associated imaging features include high-density contents, pericecal inflammatory changes and thickening of lateral conal fascia [19].

Cecal carcinoma

Tumour mass may obstruct appendiceal orifice resulting in dilated appendix but there is no periappendiceal inflammation. Eccentric mass and mural thickening and lymphadenopathy suggest tumour rather than appendicitis. This is found usually in older adult patients [20].

Small bowel neoplasms (with or without perforation)

The neoplasms of the small bowel are: adenocarcinoma, carcinoids, gastrointestinal stromal tumours (GIST), lymphoma and metastases [21].

- Small bowel adenocarcinoma

It most commonly occurs in the jejunum within 30cm of ligament of Treitz. It presents as annular, ulcerative or nodular, moderately enhancing mass lesion with circumferential thickened wall and often presents with intussusceptions [22].

- Carcinoid tumour

Carcinoid tumour is a well-differentiated neuroendocrine tumour usually originating in digestive tract. Midgut (jejunoileal) carcinoids (45%) accounts for most cases of carcinoid syndrome. Appendiceal carcinoids (16%) are the most common tumour of the appendix. CT shows solitary enhancing submucosal mass which is better visualized with enteric water as contrast agent. Mesenteric extension of small bowel tumour is shown as heterogenous mesenteric mass due to direct invasion or nodal metastasis associated with calcification within the mesenteric mass. Tumour may show spiculation with stellate pattern and tethering and retraction of small bowel loops. Although CT may not always reveal the small primary mass in the wall of the small bowel, CT is an excellent technique to show the mesenteric extension of tumours and liver metastases [23].

- Gastrointestinal Stromal Tumour (GIST)

GIST is the commonest mesenchymal neoplasm in the small bowel. CT enterography is the best imaging test for diagnosis. Contrast enhanced CT shows endoluminal and exophytic mass with defined border showing heterogenous enhancement with central necrosis. There is associated aneurysmal dilatation of the small bowel lumen due to cavitation and apparent luminal enlargement. Liver, omental and mesenteric metastases are common [24].

- Small bowel metastases and lymphoma

Intestinal metastases

Small bowel metastases can be caused by intraperitoneal seeding, direct extension from adjacent tumours, or by haematogenous spread. Colon and ovarian carcinomas are the most frequent site of origin of intraperitoneal metastases that can affect the small bowel wall. CT findings include small contrast-enhancing nodules along the serosal surface. In advanced disease, these nodules encase the small bowel and cause obstruction. Advanced stages of pancreatic, biliary, or colonic malignancies tend to infiltrate adjacent small bowel loops. Haematogenous metastases commonly originate from bronchial carcinoma, breast carcinoma, melanoma and renal cell carcinoma. There are no pathognomonic findings for any metastases, but typically, they present as short, segmental, contrast-enhancing, wall thickening or as masses, causing transient intussusception or ulceration with bleeding [25].

Intestinal lymphoma

On CT, lymphoma may appear as (a) a nodular filling defect larger and more varied in shape than lymphoid hyperplasia; (b) a discrete polyp that may be the lead point of an intussusception (c) a long, distensible infiltrating lesion with ill-defined, thick walls with or without aneurismal dilatation of the lumen; or (d) a large exocentric mass extending into adjacent tissues [22].

Traumatic haematoma

In unenhanced CT, hyperattenuating haematoma is seen within the bowel. Active bleeding is better assessed in contrast enhanced CT or CT angiogram, where it is seen as linear, pooled or swirled focal collection of hyperdense intraluminal contrast extravasation [26].

Non-steroidal anti-inflammatory drug (NSAIDs)-induced ulceration

NSAIDs use is one of causes of small bowel ulcers and strictures. This disease is induced by chronic use of NSAIDs (> 6 months) causing small bowel ulceration, haemorrhage, and eventually, strictures. These lesions are very difficult to detect radiologically because they resemble normal plicae circulares and usually do not manifest as a complete obstruction [27].

Crohn's disease

In the acute phase, CT shows stratified wall thickening of discontinuous small bowel segments with "comb sign" and proliferation of mesenteric fat and lymphadenopathy. In the chronic phase, CT shows luminal narrowing, loss of mural stratification, abscesses, fistulas, sinus tracts, mesenteric fibrofatty proliferation and mildly enlarged lymph nodes [28].

TEACHING POINT

Although ingested foreign bodies typically pass through the digestive tract without incidence, physicians should be aware that in rare cases appendicitis may result from perforation caused by foreign bodies (such as fishbone) and hence, good clinical history together with active search for foreign bodies on imaging should clinch the diagnosis. Radiological finding of a fishbone behooves the surgeon to look for and remove the fishbone, which could otherwise become a nidus for intra-abdominal infection, as well as prompts the surgeon to actively look for and manage possible associated complications such as bowel fistulation or perforation in other segments, in addition to performing the appendectomy.

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FIGURES

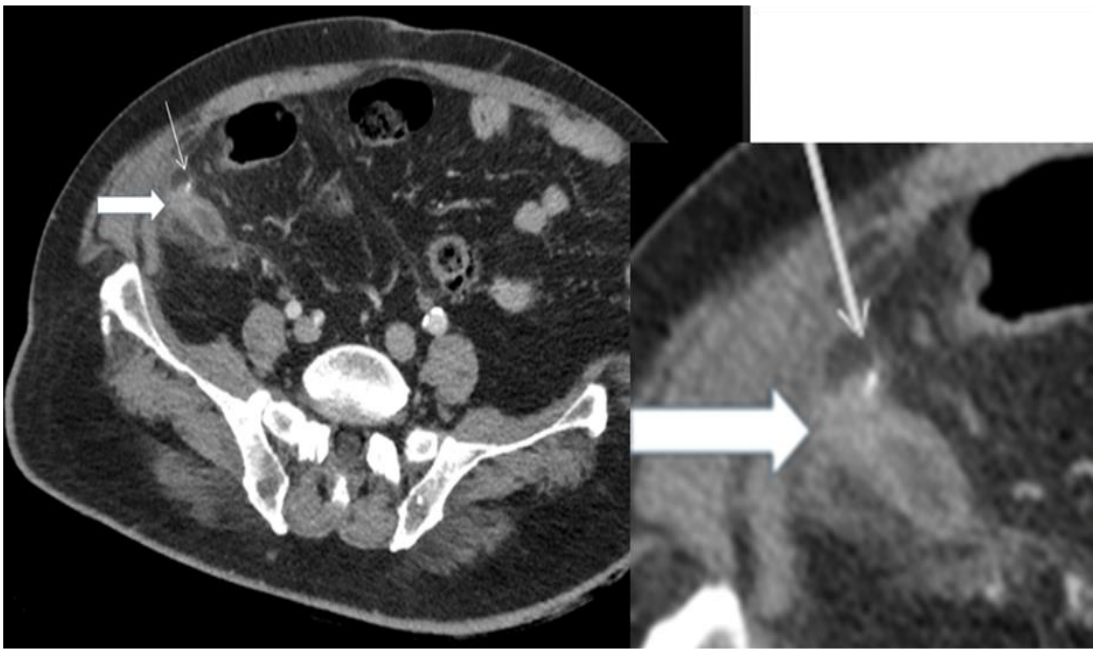

Figure 1: 72-year-old male with fishbone perforated appendicitis.
Findings: Contrast-enhanced CT abdomen pelvis in portal venous phase in axial planes show dilated appendix associated with appendiceal wall thickening and enhancement as well as periappendiceal stranding (thick white arrow) in keeping with acute appendicitis. There is 10 mm linear hyperdensity (likely foreign body) at the tip of appendix, which appears to perforate and extend beyond the confines of appendix (thin white arrow).
Technique: Contrast-enhanced CT (Philips 256 slice scanner, protocol 120kVp, 3mm slice thickness, 85 ml Omnipaque IV contrast, portal venous phase).

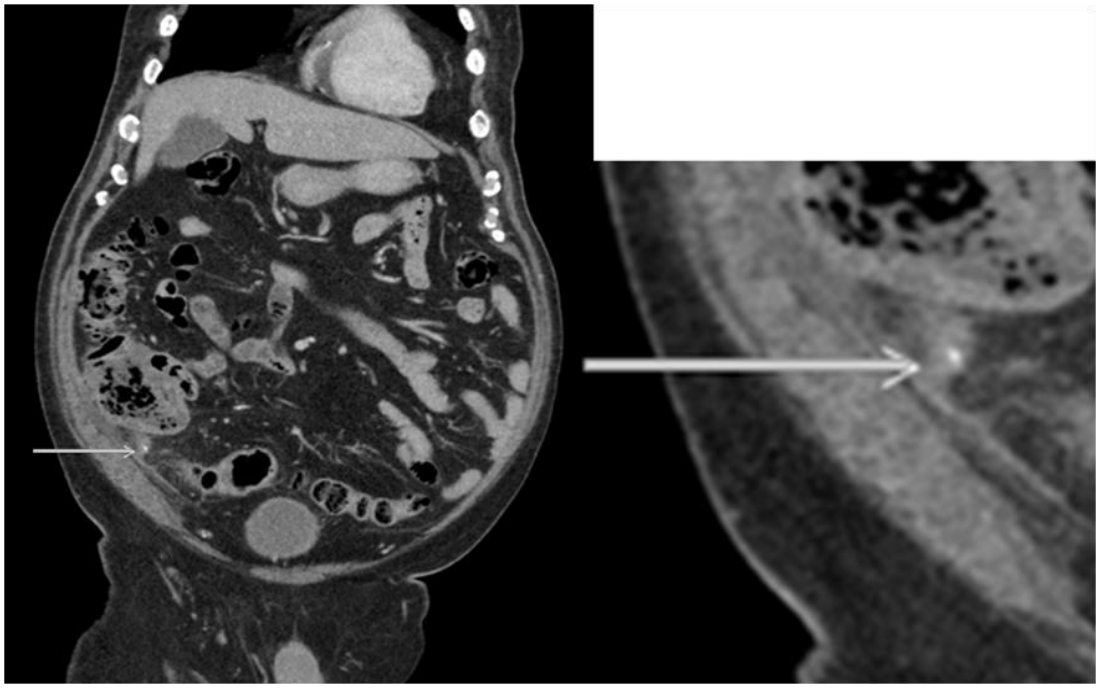

Figure 2: 72-year-old male with fishbone perforated appendicitis.
Findings: Contrast-enhanced CT abdomen pelvis in portal venous phase in coronal planes show dilated appendix associated with appendiceal wall thickening and enhancement as well as periappendiceal stranding in keeping with acute appendicitis. There is 10 mm linear hyperdensity (likely foreign body) at the tip of appendix, which appears to perforate and extend beyond the confines of appendix (thin white arrow).
Technique: Contrast-enhanced CT (Philips 256 slice scanner, protocol 120kVp, 3mm slice thickness, 85 ml Omnipaque IV contrast, portal venous phase).

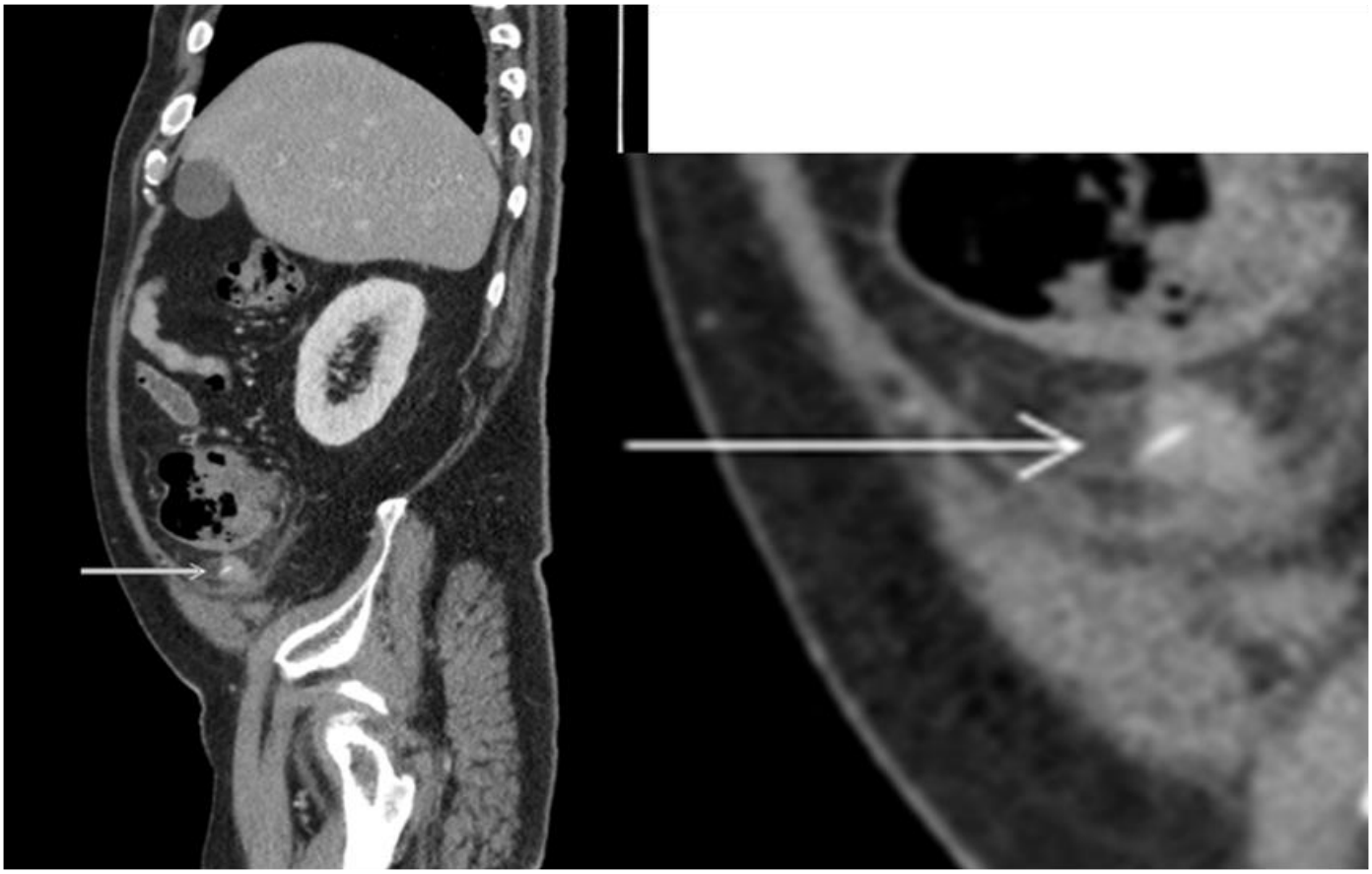

Figure 3: 72-year-old male with fishbone perforated appendicitis.
Findings: Contrast-enhanced CT abdomen pelvis in portal venous phase in sagittal planes show dilated appendix associated with appendiceal wall thickening and enhancement as well as periappendiceal stranding in keeping with acute appendicitis. There is 10 mm linear hyperdensity (likely foreign body) at the tip of appendix, which appears to perforate and extend beyond the confines of appendix (thin white arrow).
Technique: Contrast-enhanced CT (Philips 256 slice scanner, protocol 120kVp, 3mm slice thickness, 85 ml Omnipaque IV contrast, portal venous phase).

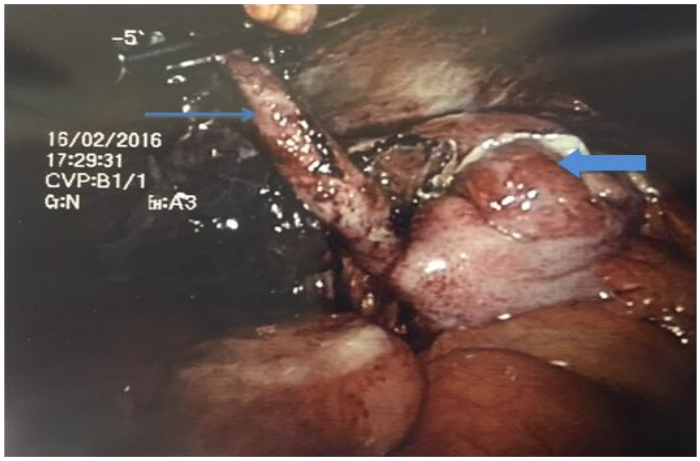

Figure 4: 72-year-old male with fishbone perforated appendicitis. Findings: Intra-operative surgical photograph shows an inflamed and dilated appendix with perforation in the mid body (thin blue arrow) secondary to a fish bone which was retrieved as well as an acutely inflamed caecum (thick blue arrow).

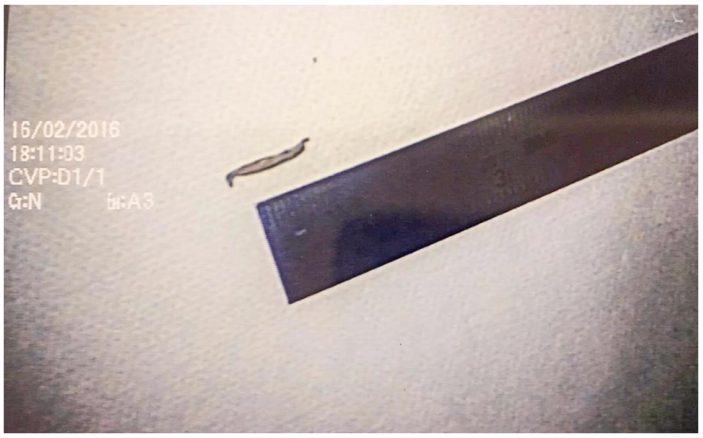

Figure 5 (left): 72-year-old male with fishbone perforated appendicitis. Findings: Post-operative photograph shows the foreign body (fishbone) retrieved measuring about 10mm.

Metallic objects	Bobby pins Bullets Earring Endodontic file Fish hook Intrauterine contraceptive device Jackstone (child's game) Key	Lead shot and BB's Mercury, liquid Nails Needles Pins Safety pins Screws Tacks
Plant materials	Fruit seeds and pits Thorns	Wooden splinters and toothpicks
Animal or human materials	Bones and portions of bone Eggshell fragments Gallstones	Hair Parasitic worms Teeth and portions of teeth
Miscellaneous	Chewing gum Condom fragment Dental amalgam Fishing line Gambling dice Gastric tube tips Toothbrush bristles	Match fragment Paraffin Plastic pieces Stones Thermometer fragment Thread

Table 1: Previously reported intraappendiceal foreign bodies [22].

Etiology	Foreign bodies obstruct the appendiceal lumen and precipitate appendicitis.
Incidence	Unknown. However the incidence of all foreign bodies lodging in appendiceal lumens has been reported to range between 0.005% and 0.113%
Gender ratio	Unknown
Age predilection	Unknown. May occur at any age
Risk factors	Careless eating, insensitive denture plates, poor vision, mental infirmity, inflammatory bowel conditions and drug addiction
Treatment	Surgical appendectomy, drainage of any infection and foreign body removal
Prognosis	Good, particularly if diagnosed and treated timely
Findings on Imaging	Abdominal radiographs (AXR) may be helpful in first-line screening of foreign bodies with specific shapes, and obtained 12-48 hours after foreign body ingestion. However in this setting of suspected appendicitis, AXRs are of limited value and may be more misleading than helpful. CT scan shows inflammatory features of appendicitis with fish bone perforating through the appendiceal luminal wall.

Table 2: Summary table for fishbone induced perforated appendicitis.

	Findings on contrast enhanced CT Imaging
Foreign body appendicitis	Dilated appendix ≥ 7mm, abnormal enhancement of appendiceal wall and surrounding inflammation, focal bowel wall thickening of adjacent caecum/ terminal ileum. Hyperdensity (foreign body) within or adjacent to the appendix. A variety of foreign bodies found in appendices or felt responsible for appendicitis is listed in Table 1.
Foreign body intestinal perforation	Normal appendix. Foreign body may be demonstrated. Focal bowel wall thickening and surrounding inflammation. Free gas may be present.
Appendiceal tumour	Carcinoma, lymphoma or carcinoid. Soft tissue density mass infiltrating and/or obstructing the appendix. Usually little surrounding infiltration.
Cecal diverticulitis	Cecal diverticulum with mural thickening, high-density contents. Pericecal inflammatory changes. Thickening of lateral conal fascia.
Cecal carcinoma	May obstruct appendiceal orifice – dilated appendix but no periappendiceal inflammation. Circumferential cecal mass and lymphadenopathy suggest tumour rather than appendicitis. Usually in older adult patients.
Small bowel neoplasms (with or without perforation)	• Small bowel adenocarcinoma Annular, ulcerative or nodular moderately enhancing mass lesion with circumferential thickened wall and often presents with intussusception. • Carcinoid tumour Solitary enhancing submucosal mass better visualized with enteric water as contrast agent. Mesenteric extension of small bowel tumour is shown as heterogenous mesenteric mass due to direct invasion or nodal metastasis associated with calcification within the mesenteric mass. Tumour may show spiculation with stellate pattern and tethering and retraction of small bowel loops. • GIST Endoluminal and exophytic mass with defined border showing heterogenous enhancement with central necrosis. There is associated aneurysmal dilatation of the small bowel lumen due to cavitation and apparent luminal enlargement. • Small bowel metastases and lymphoma *Intestinal metastases* Small contrast-enhancing nodules along the serosal surface. In advanced disease, these nodules encase the small bowel and cause obstruction. Advanced stages of pancreatic, biliary, or colonic malignancies tend to infiltrate adjacent small bowel loops. Typically, they present as short, segmental, contrast-enhancing, wall thickening or as masses, causing transient intussusception or ulceration with bleeding. *Intestinal lymphoma* (a) a nodular filling defect larger and more varied in shape than lymphoid hyperplasia; (b) a discrete polyp that may be the lead point of an intussusception (c) a long, distensible infiltrating lesion with ill-defined, thick walls with or without aneurismal dilatation of the lumen; or (d) a large exocentric mass extending into adjacent tissues
Traumatic hematoma	In unenhanced CT, hyperattenuating hematoma is seen within the bowel. Active bleeding is better assessed in contrast enhanced CT or CT angiogram, where it is seen as linear, pooled or swirled focal collection of hyper dense intraluminal contrast extravasation.
NSAIDs-induced ulceration	These lesions are very difficult to detect radiologically because they resemble normal plicate circulars and usually do not manifest as a complete obstruction.
Cohn's disease	In the acute phase, CT shows stratified wall thickening of discontinuous small bowel segments with "comb sign" and proliferation of mesenteric fat and lymphadenopathy. In the chronic phase, CT shows luminal narrowing, loss of mural stratification, abscesses, fistulas, sinus tracts, mesenteric fibrofatty proliferation and mildly enlarged lymph nodes.

Table 3: Differential diagnosis table for fishbone induced perforated appendicitis.

ABBREVIATIONS

AXR = Abdominal radiograph
CT = Computed tomography
ED = Emergency Department
IV = Intravenous

KEYWORDS

Fishbone; foreign body; perforation; appendix; intestine; computed tomography

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