Letter to the Editor

Adventurous toothpick: the role of ultrasound and contrast-enhanced ultrasound

Cheng Guan[1], Da-Yan Huang[2], Jun Luo[1]

[1]School of Medical and Life Sciences, Chengdu University of Traditional Chinese Medicine, Chengdu, China; [2]Department of Ultrasound, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China

Correspondence to: Jun Luo, MD. Department of Ultrasound, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, 32# W. Sec 2, 1st Ring Rd., Qingyang District, Chengdu 610072, China. Email: milton-lj@hotmail.com.

Submitted Dec 03, 2023. Accepted for publication May 09, 2024. Published online Jun 21, 2024.
doi: 10.21037/qims-23-1726
View this article at: https://dx.doi.org/10.21037/qims-23-1726

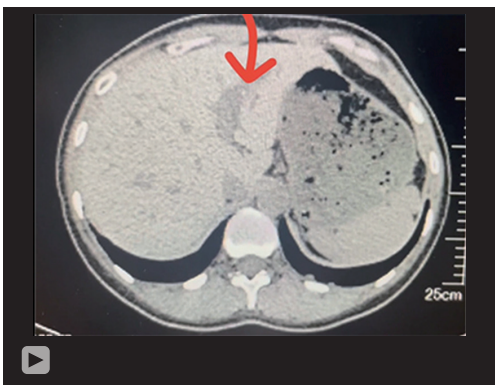
Introduction

Accidental foreign body ingestion is a relatively common occurrence in clinical practice. A survey conducted in the ultrasound (US) department estimated that there were approximately 595,000 emergency department visits related to foreign bodies in the United States in 2021 (https://www.cdc.gov/nchs/data/nhamcs/web_tables/2021-nhamcs-ed-web-tables-508.pdf). Most (80–90%) ingested foreign bodies pass uneventfully through the gastrointestinal tract (1-3). However, some sharp objects, especially chicken/fish bones, as well as wooden/plastic toothpicks, can penetrate the gastrointestinal wall into adjacent tissues and organs leading to serious complications (4,5) such as widespread peritonitis, abscess formation, fatal hemorrhage, and pericardial effusion. Liver abscesses caused by the ingestion foreign bodies are rare, comprising only 1–5% of hepatic abscess cases (6). Early diagnosis remains a challenge because the clinical symptoms are usually delayed and relatively non-specific and few patients remember ingesting a foreign body. Moreover, prior medical treatments from symptom onset to confirmed foreign body diagnosis can obscure initial symptoms or imaging features. We would like to contribute our recent experience with a similar case involving a bamboo toothpick penetrating the anterior gastric wall and becoming lodged in the left lobe of the liver. In this case, where the results of computed tomography (CT) and magnetic resonance imaging (MRI) were inconclusive, contrast-enhanced ultrasonography (CEUS) suggested a foreign body with peripheral inflammatory changes. Eventually, surgery confirmed the CEUS findings, and the patient was discharged in a stable condition after successful surgery.

Case presentation

A 33-year-old female presented to our hospital having experienced pain in her right upper quadrant for 2 months and her CT scan suggested that she might have a liver neoplasm. The attending physician inquired in detail about her condition. She reported that she had experienced persistent, mild pain in her right upper abdomen for 20 days with no discernible cause 2 months prior. The pain was exacerbated by coughing. She had history of fever, although the exact temperature remained unknown. She had experienced no vomiting, diarrhea, dizziness, headache, or xanthochromia of the skin and sclera, among other discomforts. When the patient had presented to a local hospital, a B-US examination had indicated "a hepatic lesion, suggestive of possible a liver abscess or parasitic infectious lesions". The patient was unable to provide any laboratory values collected at the local hospital. After a 3-week course of antibiotics, both her fever and abdominal discomfort had diminished. A subsequent CT (*Video 1*) (*Figure 1*) examination at the local hospital had revealed a heterogenous low-density lesion in the left outer lobe, suspected of a possible neoplasm or hepatic echinococcosis. Consequently, she was advised to attend a higher-level hospital for further treatment. A month later, the patient presented at our hospital for further treatment. Since the onset of the disease, her overall well-being, including

sleep, appetite, and bowel movements, had remained stable, with no significant weight changes. The patient had been in good health in the past and had no history of trauma or other significant medical conditions. Upon admission, the patient was afebrile, and her vital signs were stable. Pertinent initial vital signs were as follows: body temperature 36.7 ℃, heart rate 65 beats per minute, respiratory rate of 20 breaths per minutes, and blood pressure 113/78 mmHg. Physical examination revealed mild tenderness in the right upper quadrant without rebound pain. No skin wounds, masses, or features of jaundice were observed. The laboratory values were as follows: total bilirubin: 7.7 μmol/L; total bile acid: 11.2 μmol/L; alkaline phosphatase: 70 U/L; alanine aminotransferase (ALT): 36 U/L; white blood cell count: 4.18×10^9/L; alpha-fetoprotein (AFP): 3.61 ng/mL; carcinoembryonic antigen (CEA): 1.73 ng/mL; carbohydrate antigen 199 (CA19-9): 3.43 μmol/L; carbohydrate antigen 72-4 (CA72-4): 11.4 μmol/L. Overall, the patient's laboratory tests were basically normal. Only CA72-4 levels were mildly elevated (normal range of CA724 is less than 6.9 μmo/L); however, CA72-4 is a non-specific tumor marker and its elevated value may not be meaningful. Subsequently, to distinguish the patient's condition from a liver neoplasm or parasitic infectious lesion, the clinician scheduled an MRI and CEUS. On the day following admission, CEUS of the liver was conducted, B-mode revealed a 6.5 cm hyperechoic linear lesion in the left outer lobe of the liver. Furthermore, the surrounding liver parenchyma showed an irregular and diminished echo, with the affected area measuring approximately 7.5×2.2 cm. No significant blood flow signal was detected (*Figure 2*). Contrast-enhanced mode indicated a lengthy hyperechoic area in the in the left outer lobe of the liver surrounded by a hypoechoic zone. After injection of contrast medium: [SonoVue elbow vein mass injection: 1.2 mL (SonoVue; Bracco, Milan, Italy)] the hypoechoic area enhanced in the arterial phase in synchrony with the surrounding hepatic parenchyma, began to fade in the late arterial phase, and further faded in the portal phase and the delayed phase, with marked hypo-enhancement. These features suggested the presence of a foreign body associated with infection (*Figure 3*). On the fourth day post-admission, MRI identified circular long T1 and T2 signals in the left outer lobe of the liver. Although an enhanced scan showed



Video 1 Thin linear radiopaque lesion is located in the center of low attenuating lesion in the liver. Speckled hyperdensity may be seen at the edges of the lesions. Toothpick is thinner than the calcification.

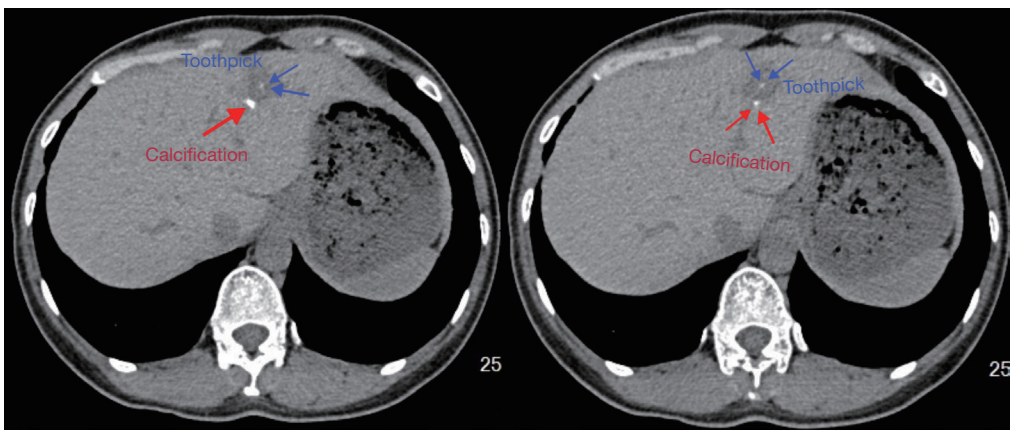


Figure 1 Thin linear radiopaque lesion located in the center of low attenuating lesion in the liver. Speckled hyperdensity may be seen at the edges of the lesions. The toothpick is thinner than the calcification.

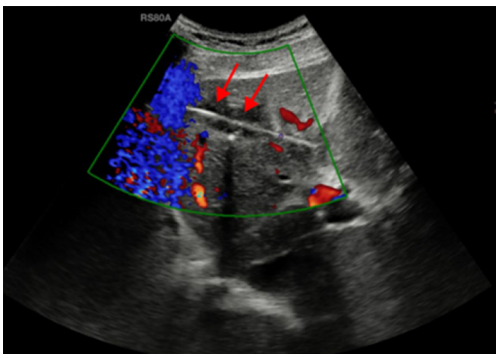


Figure 2 The red arrows point to the lesion. The peripheral liver parenchyma showed irregular and diminished echo, with the affected area measuring approximately 7.5×2.2 cm. No evident blood flow signal was observed.

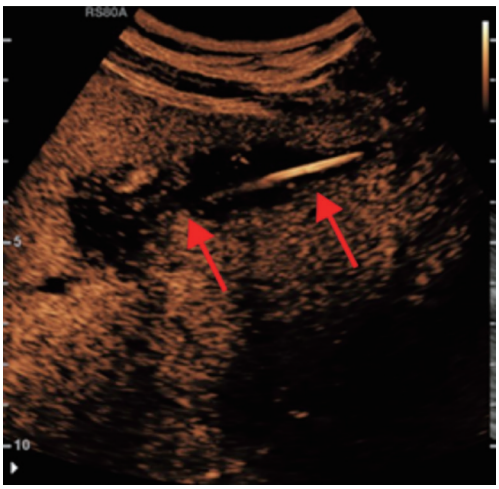


Figure 3 The red arrows point to the lesion. Contrast-enhanced ultrasonography indicated a lengthy hyperechoic area in the left outer lobe of the liver, surrounded by a hypoechoic zone, suggesting the presence of a foreign body associated with infection.

no further enhancement, nodular and patchy long T1 and T2 signal shadows were observed in the adjacent area. Moreover, the enhanced scan also depicted a ring-shaped delayed enhancement shadow along the bile duct and thickening of the adjacent bile duct wall. These findings were suggestive of the likelihood of cholangiopathy, leading the radiologists to consider possible intrahepatic cholangiocarcinoma (ICC) or cholangitis lesions (*Figure 4*). The patient's imaging had shown liver lesions, which were unclear in nature; there was a high possibility of foreign bodies, but the possibility of neoplasm had not been ruled out. To confirm the diagnosis and guide further treatment, the doctors planned to perform laparoscopic exploratory surgery. On the fifth day, the patient underwent fluorescence laparoscopic intrahepatic foreign body removal under general anesthesia, together with gastric repair and intraoperative US exploration. During the operation, dense adhesions between the lesser curvature side of the stomach and the left outer lobe of the liver were observed, as well as adhesions between the left outer lobe of the liver and the abdominal wall. A toothpick-shaped bamboo object, approximately 6.5 cm in length, was found to be obliquely inserted into the second porta hepatis in the liver (*Figure 5*), which indicated foreign body penetration from the lesser curvature side of the stomach to liver. No further abnormalities were detected in the abdominal cavity. No liver abscess was found during surgery. The patient had been administered antibiotics for 3 weeks at her local hospital, which may have caused the abscess to disappear. Postoperatively, the patient was administered antibiotics for 3 days. When questioned, the patient did not recall ingesting the foreign body. The patient was discharged on the third day following surgery, with completely resolved symptoms and signs.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this article and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

A history of foreign body ingestion is important, but if the patient cannot recall any related event, imaging is crucial to achieving a correct diagnosis. Various imaging modalities, such as conventional plain radiographs, CT, ultrasonography, and endoscopy are the most commonly used methods to determine the presence and location of a foreign body. Conventional plain radiography is usually the preferred imaging method for detecting foreign bodies, but false-negative rates are as high as 47% (7). Most foreign bodies can be identified by radiographs; however, thin metal objects, wood, plastic, and glass, and fish or chicken bones are not readily seen (8-10). Moreover, its spatial resolution is limited, and it is often difficult to evaluate the specific location and relationship between foreign bodies and surrounding structures. CT is a significant method

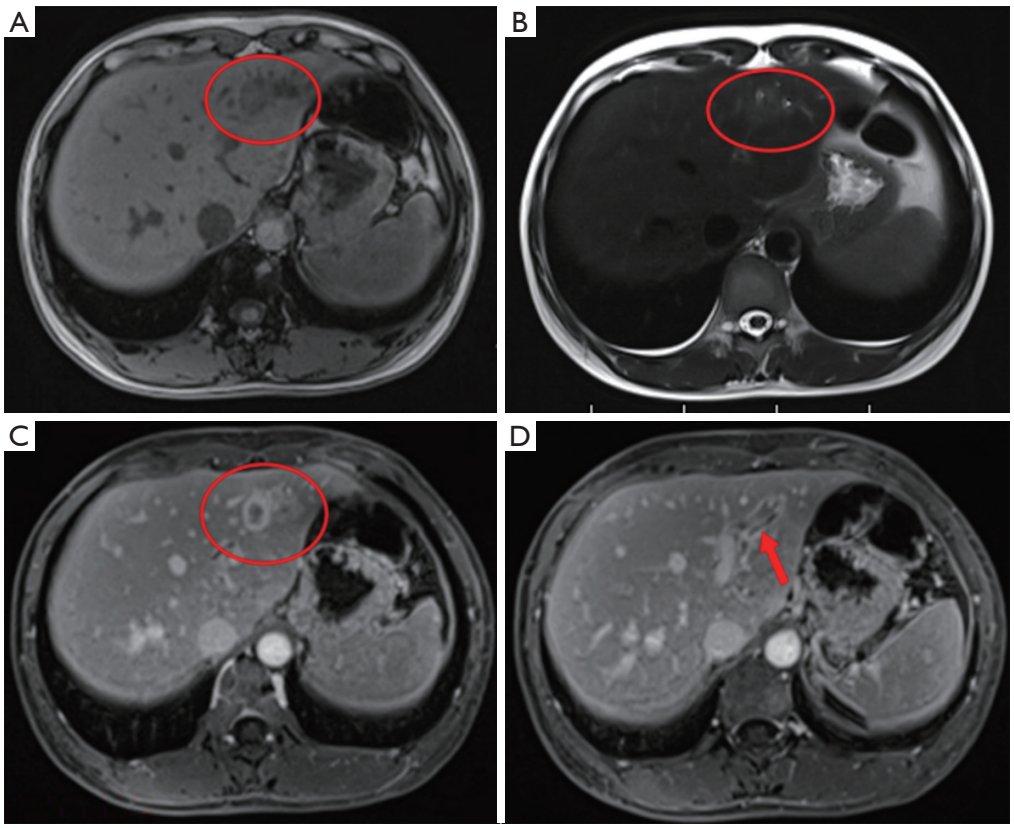


Figure 4 The red circles are lesions. MRI identified circular long T1 and T2 signals in the left outer lobe of the liver. The red arrow points to the lesion. The enhanced scan also depicts a ring-shaped delayed enhancement shadow along the bile duct and thickening of the adjacent bile duct wall. (A) T1WI; (B) T2WI; (C) T1WI+ contrast; (D) T1WI+ contrast. MRI, magnetic resonance imaging; T1WI, T1-weighted imaging; T2WI, T2-weighted imaging.

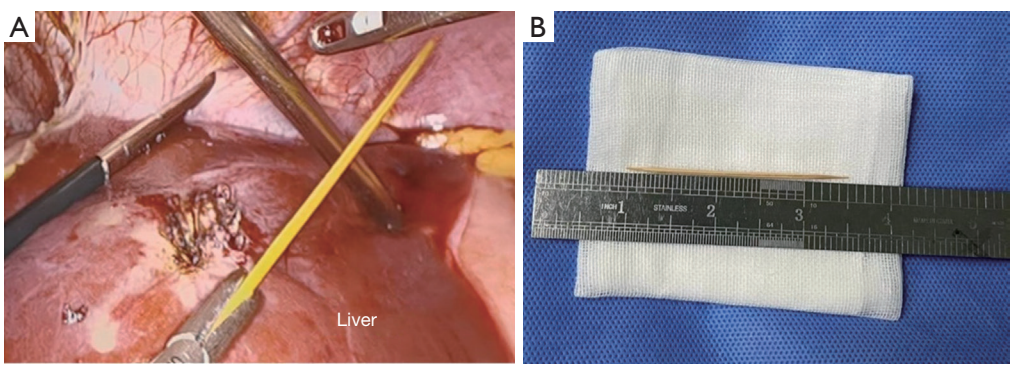


Figure 5 Laparoscopic extraction of the foreign body: a toothpick-shaped bamboo object, approximately 6.5 cm in length, was found to be obliquely inserted into the second porta hepatis in the liver.

for imaging and localizing foreign bodies. CT not only provides better anatomic information, but can also detect other complications such as abscess formation, mediastinitis, or aortic/tracheal fistulas (10,11). However, the image of CT is a tomography scan of a certain thickness, which has a fixed scanning section. Standard coronal and sagittal

scans may fail to detect the overall shape of the foreign body due to the different shapes of the foreign body and the random disordered spatial position of the surrounding adjacent organs, and the display of a certain section of the foreign body may be easily confused with calcification, soft tissue structure, and so on. Contrast-enhanced CT is expensive; CT 3-dimensional (3D) reconstruction may require additional costs and is not performed on every patient, especially during the initial screening. In this case, the toothpick appeared only as a discontinuous speckled high-density shadow on conventional CT (*Figure 1*), which was ignored because the shape of the toothpick in the liver parenchyma was not parallel to the CT scan section, and the cross-section of the toothpick was very narrow, so it showed a similar appearance to intrahepatic calcification. Additionally, hepatocellular carcinoma, ICC, and hepatic echinococcus can appear as a heterogenous low-density lesion with calcifications on conventional axial CT. In this case, the patient is from an endemic area (Ganzi Tibetan Autonomous Prefecture in Sichuan Province), which is a predisposing factor for hepatic echinococcosis. These factors may make it difficult to diagnose liver abscess and hepatic echinococcosis with CT.

In this case, the patient underwent further CEUS and MRI because CT suggested the possibility of a liver neoplasm or hepatic echinococcosis, but the patient's other clinical information did not fully support the diagnosis of neoplasm, such as the tumor markers not being high. So, the clinicians endeavored to gather more information to determine the diagnosis. The utility of MRI in the work-up for foreign body lies not with detection/identification of the foreign body itself, but rather in evaluating for the presence and extent of associated infection or granulomatous reaction (12). MRI requires an extended acquisition time and may cause delays in disease evaluation. Furthermore, during MRI examinations, internal metallic foreign objects can potentially become dislodged, posing additional injury risks. In this case, neoplastic lesions and infectious lesions could not be excluded on MRI, and ICC was suspected. The occurrence of ICC is often insidious in absence of high-risk factors such as chronic liver disease, it can be easily ignored, and early ICC non-contrast imaging may be confused with other benign liver lesions, such as hepatic hemangioma and hepatitis pseudotumor. In addition, when ICC is accompanied by abscess formation, it can also be easily confused with simple liver abscess.

US has excellent resolution in homogeneous echogenic parenchymal organs. It can be used for multi-angle multi-section scanning without the limitation of fixed scan sections, so the overall shape of the foreign body can be well visualized. In this example, 2-dimensional (2D) US provided a good representation of the long axis of the toothpick, showing a unique imaging advantage compared to CT and MRI.

The role of CEUS was mainly to preliminarily exclude the diagnosis of hepatic malignancy and hepatic echinococcosis prior to surgery. CEUS has improved the role of US in the diagnosis of focal liver lesions (FLLs). Some International guidelines recommend CEUS as the first-line imaging modality for the characterization of incidentally detected, indeterminate FLLs without a background of cirrhosis and a history or clinical suspicion of malignancy. CEUS is recommended for patients with a non-cirrhotic liver who have inconclusive CT or MRI findings (13). CEUS has superior temporal resolution to contrast-enhanced CT or MRI. Contrast-enhanced CT or MRI acquire arterial-phase images at a single time or a few time points, whereas CEUS enables monitoring of the entire blood perfusion process of liver lesions (including arterial phase, portal venous phase, the late phase) in real time and can be viewed repeatedly. In this case of typical contrast enhancement pattern and no history of carcinoma, CEUS can more accurately reveal whether FLLs are benign or malignant. Typical hepatic malignancies are characterized by features such as rim enhancement, hyper-enhancement, or rim-like hyper-enhancement and central hypo-enhancement. They present with enhancement earlier than the surrounding liver parenchyma, then wash out rapidly. ICCs commonly exhibit earlier washout (≤60 s). As inflammation progresses, the CEUS manifestations are variable. In the early stages of infection, lesions tend to appear hyper-enhancing, whereas mature lesions develop non-enhancing lesions as liquefaction progresses. Mature liver abscesses on CEUS exhibit enhancement of the margins and septum in the arterial phase. Hepatic echinococcosis generally exhibits no enhancement in any temporal phase, neither within nor around the lesion. In this case, the hypoechoic area enhanced in synchrony with the adjacent liver parenchyma and showed a slow washout, which largely excluded the diagnosis of hepatic malignancy and hepatic echinococcosis. A recent meta-analysis indicated that the pooled sensitivity and specificity for CEUS in characterization of FLLs were 92%, 87%, respectively (14). From a safety viewpoint, US contrast agents are considered

safe with a very low incidence of side effects. There is no cardio-, hepato-, or nephro-toxic effects. Microbubble US contrast agents can be used multiple times during the same examination (15).

Admittedly, the results of an ultrasonographic examination are greatly influenced by the operator. B-mode US clearly visualized a linear hyperechoic structure in our hospital, yet an initial US examination only aroused suspicion of liver abscess or parasitic infectious lesions at the local hospital, and ordinary CT examination raised suspicion of a liver neoplasm or hepatic echinococcus at the local hospital. Further CT examinations (such as contrast-enhanced CT and/or 3D reconstruction) were not conducted. Clinicians and patients have to be more cautious when facing the possibility of malignant tumors, especially tumors with a high degree of malignancy and poor prognosis such as ICC. These factors lead to confusion and suspicion among clinicians in diagnosis, prompting the search for more information to make an accurate diagnosis. Although US had clearly shown the presence of a foreign body, and there was a high suspicion of a foreign body with peripheral liver parenchymal inflammation and no abscess formation after the findings were combined with those of CEUS (because the absence of enhancement due to abscess formation was not detected by CEUS), it was not 100% certain that there was no neoplasm in the area until the final pathological evidence had been obtained, and the necessity of surgical removal of the foreign body also provided the possibility of further histological pathological examination, rather than just medical anti-inflammatory therapy. Eventually, the patient's surgical results confirmed the diagnosis of US and CEUS. CEUS is a complementary method after 2D ultrasonography, especially when CT and MRI examinations are inconsistent with clinical information and cannot support a diagnosis, which is of great help in the differential diagnosis of FLLs. At the same time, if CEUS shows that an abscess has formed, the abscess can be drained by US guidance, which is also a consideration for further evaluation with CEUS. Questions remain regarding how to improve diagnostic efficiency in patients with unexplained abdominal pain and which imaging tests should be used to diagnose a foreign body in the gastrointestinal tract. We should consider not only accuracy, but also ionized radiation and economic effects.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-23-1726/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this article and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

References

1. Ambe P, Weber SA, Schauer M, Knoefel WT. Swallowed foreign bodies in adults. Dtsch Arztebl Int 2012;109:869-75.
2. Antoniou D, Christopoulos-Geroulanos G. Management of foreign body ingestion and food bolus impaction in children: a retrospective analysis of 675 cases. Turk J Pediatr 2011;53:381-7.
3. Dray X, Cattan P. Foreign bodies and caustic lesions. Best Pract Res Clin Gastroenterol 2013;27:679-89.
4. Caete ID, Nuez IG, Rodriguez ZG, Cristia YG, Santos AP. Absceso hepático, una forma de presentación infrecuente de la fasciolosis en Cuba. Rev Panam Infectol 2011;13:53-6.
5. Matrella F, Lhuaire M, Piardi T, Dokmak S, Bruno O, Maestraggi Q, Kianmanesh R, Sommacale D. Liver hilar abscesses secondary to gastrointestinal perforation by ingested fish bones: surgical management of two cases. Hepatobiliary Surg Nutr 2014;3:156-62.

6. Pérez Saborido B, Bailón Cuadrado M, Velasco López R. A liver abscess secondary to a toothpick: a rare complication of accidental foreign body ingestion. Rev Esp Enferm Dig 2019;111:167-8.
7. Kpemissi E, Agbere ARD, Ndakena K, Kessie K. Ingested foreign objects: Etiology and treatment. Experience of the Teaching Hospital (Lome, Togo) 1997;7:338-40.
8. Chiu YH, Hou SK, Chen SC, How CK, Lam C, Kao WF, Yen DH, Huang MS. Diagnosis and endoscopic management of upper gastrointestinal foreign bodies. Am J Med Sci 2012;343:192-5.
9. Lee JH, Kim HC, Yang DM, Kim SW, Jin W, Park SJ, Kim HJ. What is the role of plain radiography in patients with foreign bodies in the gastrointestinal tract? Clin Imaging 2012;36:447-54.
10. Liew CJ, Poh AC, Tan TY. Finding nemo: imaging findings, pitfalls, and complications of ingested fish bones in the alimentary canal. Emerg Radiol 2013;20:311-22.
11. Erbil B, Karaca MA, Aslaner MA, Ibrahimov Z, Kunt MM, Akpinar E, Özmen MM. Emergency admissions due to swallowed foreign bodies in adults. World J Gastroenterol 2013;19:6447-52.
12. Martin S, Petraszko AM, Tandon YK. A case of liver abscesses and porto-enteric fistula caused by an ingested toothpick: A review of the distinctive clinical and imaging features. Radiol Case Rep 2020;15:273-6.
13. Dietrich CF, Nolsøe CP, Barr RG, et al. Guidelines and Good Clinical Practice Recommendations for Contrast Enhanced Ultrasound (CEUS) in the Liver - Update 2020 - WFUMB in Cooperation with EFSUMB, AFSUMB, AIUM, and FLAUS. Ultraschall Med 2020;41:562-85.
14. Wu M, Li L, Wang J, Zhang Y, Guo Q, Li X, Zhang X. Contrast-enhanced US for characterization of focal liver lesions: a comprehensive meta-analysis. Eur Radiol 2018;28:2077-88.
15. Wilson SR, Feinstein SB. Introduction: 4th Guidelines and Good Clinical Practice Recommendations for Contrast Enhanced Ultrasound (CEUS) in the Liver-Update 2020 WFUMB in Cooperation with EFSUMB, AFSUMB, AIUM and FLAUS. Ultrasound Med Biol 2020;46:3483-4.

Cite this article as: Guan C, Huang DY, Luo J. Adventurous toothpick: the role of ultrasound and contrast-enhanced ultrasound. Quant Imaging Med Surg 2024;14(10):7768-7774. doi: 10.21037/qims-23-1726