

## IMAGING CHARACTERISTICS AND PREDICTIVE FACTORS OF COMPLICATED GASTROINTESTINAL FOREIGN BODIES IN COMPUTED TOMOGRAPHY

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### ABSTRACT

**Background:** Gastrointestinal foreign body is a frequently encountered problem in daily practice at the Emergency Department. The majority of gastrointestinal foreign bodies will pass spontaneously, but in several cases, severe or even fatal complications can happen. X-rays, endoscopy, and computed tomography are the most common imaging modalities to diagnose gastrointestinal foreign bodies. **Method:** In our study, twenty-five patients who were diagnosed by CT and treated for gastrointestinal foreign bodies were reviewed retrospectively. The predictive risk factors for complications after foreign body ingestion or insertion were analyzed by multivariate logistic regression, including age, sex, type of gastrointestinal foreign body, and imaging characteristics in CT (location, size, thickening and enhancing bowel wall, fat infiltration, collection, and free gas). **Results:** All foreign bodies were sharp-pointed, and the average length was  $30.56 \pm 10.03$  mm (11-54 mm). Bones accounted for 64% of cases, toothpicks followed with 16%. The most common location for foreign bodies in digestive tract was the small intestine, followed by the stomach, esophagus, and colon. Thickening and enhancing bowel wall, fat infiltration were both seen in most cases of 84%. Transmural foreign bodies accounted for 56% and perforation, abscess were more frequent complications with

64%, and 16% of cases, respectively. Multivariate analysis showed that size ( $p < 0.014$ ) and type ( $p < 0.035$ ) were significant independent risk factors associated with the development of complications in patients with gastrointestinal foreign bodies. **Conclusion:** CT plays a crucial role in the detection and diagnosis of gastrointestinal foreign bodies and its complications. In patients with gastrointestinal foreign bodies, the risk of complications was increased with bone type and larger size of foreign bodies.

**Keywords:** *gastrointestinal foreign bodies, foreign bodies, complications of foreign bodies, sharp-pointed foreign bodies, ingested foreign bodies.*

### I. INTRODUCTION

Foreign body ingestion or insertion occurs frequently. Several studies have shown that 80–90% of foreign objects will likely pass without the need for intervention, endoscopy was performed in 10–20% of cases, and 1% of patients need surgical intervention [1]. Although the majority of gastrointestinal foreign bodies will pass spontaneously, several complications can happen, such as perforation, bowel obstruction, fistula, and even death [1–3].

Apart from history and physical examination, chest or abdominal radiographs and computed tomography may be performed to diagnose gastrointestinal foreign bodies.

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Even when chest or abdominal radiographs seem like an appropriate first step, CT is considered superior due to its higher accuracy in the evaluation of the location, size, and complications of gastrointestinal foreign bodies. In cases of esophageal foreign bodies, the sensitivity and specificity of CT were 100% and 70.6%, respectively, and radiography was 25.3% and 86.3%, respectively [4–6]. With the diagnosis of a sharp-pointed foreign body in the gastrointestinal tract, the sensitivity and specificity of CT were up to 100% and 93.7%, respectively [7].

Endoscopy is a practical approach to diagnosing and evaluating foreign bodies, but it is also an invasive technique and difficult to assess foreign bodies in the small bowel.

Recently, CT has become more widely indicated to improve the efficiency of diagnosing gastrointestinal foreign bodies and limit the indications for endoscopy or unnecessary surgery.

## II. MATERIALS AND METHODS

This study was approved by the scientific review board of Hanoi Medical University (2675/QĐ-ĐHYHN).

*Patient Population:* 25 patients were treated for gastrointestinal foreign bodies at Hanoi Medical University Hospital from July 2019 to July 2022, had CT scans and medical records.

*Research Method:* a retrospective descriptive study

*The records were reviewed for the following data:* Patients' demographic characteristics including age and sex were

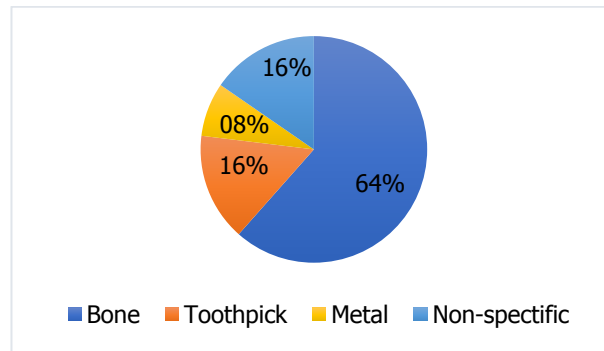
obtained. The types of foreign bodies were categorized into bones, toothpicks, metal, batteries and non-specific. In CT, the evaluation of foreign body combined length, shape (sharp-pointed or round, obtuse), anatomic locations (esophagus, stomach, duodenum, small intestine, colon and rectal), correlation with mural (intramural, transmural, extramural), thickening and enhancing bowel wall, free gas, collection, associated complications (perforation, fistula, abscess, peritonitis, bowel obstruction). Patients were categorized into one of two groups (complicated vs uncomplicated) and the following data were analyzed: gender and age of the patients; type; and CT characteristics of foreign bodies.

*Statistical analysis:* Categorical variables were analyzed using the chi-square or Fisher's exact test, as appropriate. Significant variables identified by the univariate analysis were further analysed by logistic regression modeling using SPSS software (version 16.0; SPSS, Inc., Chicago, IL, USA). P-Values <0.05 were considered statistically significant.

## III. RESULTS

Twenty-five patients with the average age was  $49.76 \pm 14.89$  years old (26 - 82 years old), had sharp-pointed foreign body with an average length was  $30.56 \pm 10.03$  mm (11-54 mm).

The most common foreign bodies were bones (20 of 25 cases, 64%), followed by toothpicks (4 of 25 cases, 16%), metallic foreign bodies (2 case, 8%) [Figure 1].



**Figure 1: Types of foreign body**

The location of foreign bodies were showed in [Table 1]. Small intestine was the most accounted location of foreign body with 36%, stomach with 32%, esophagus with 20%, and colon with 8%.

**Table 1: Location of gastrointestinal foreign bodies**

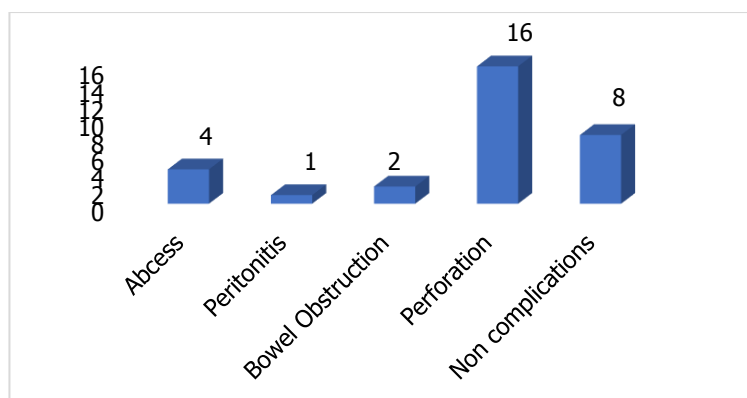
Location	Number	Percentage
Esophagus	5	20%
Stomach	8	32%
Duodenum	1	4%
Small Intestine	9	36%
Colon	2	8%
<b>Total</b>	<b>25</b>	<b>100%</b>

In the correlation with murals, 56% of patients had transmural foreign bodies, intramural and extramural foreign bodies were seen in 38% and 16%, respectively.

Luminal and periluminal lesions associated with foreign bodies were thickening and enhancing bowel wall (84%), fat infiltration (84%), collection (12%), and free gas (12%).

Complications of foreign bodies were

shown in [Figure 2]. In our study, 8/25 cases (32%) had no complications. Among the common complications, perforation was the most common complication with 16/25 cases, accounting for 64%, followed by abscess (mediastinal or abdominal cavity) accounted for 04/25 cases, equivalent to 16%. Bowel obstruction and peritonitis were encountered in 02 and 01 cases, respectively, no fistula was recorded.



**Figure 2: Complications of foreign bodies**

Factors that were significant based on univariate analysis included advanced age, the type of bone foreign bodies, location, size  $\geq 3$  cm, thickening and enhancing bowel wall, fat infiltration, collection, free gas. The results of the logistic regression analysis are shown in [Table 2]. There was no significant difference between the two groups with

respect to gender, age ( $p = 0.407$ ), location of foreign bodies (0.853) [Table 2]. Multivariate analysis showed that the type ( $p = 0.035$ ), and size of the foreign bodies ( $p = 0.014$ ) were significant independent risk factors associated with the development of complications in patients with gastrointestinal foreign bodies.

**Table 2: Patients characteristics associated with complications**

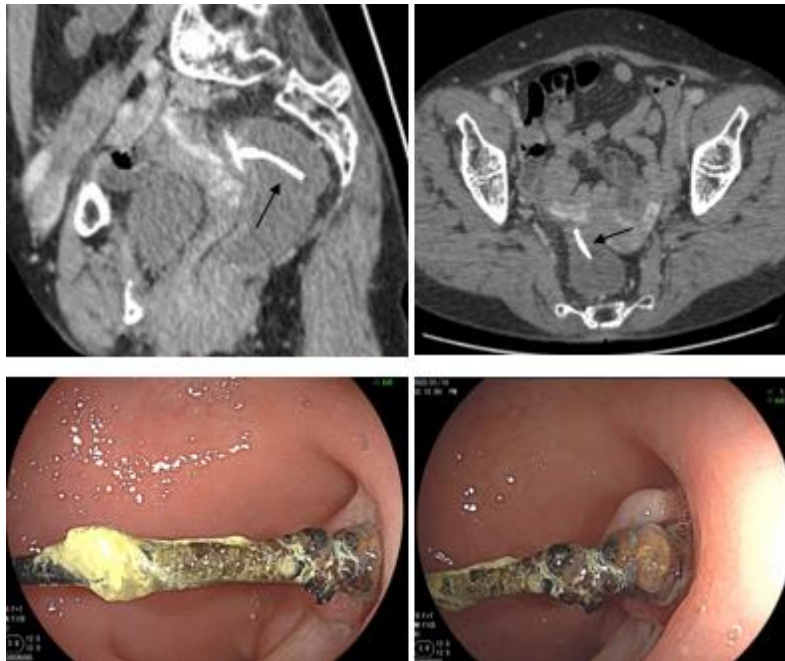
		Complications		P-value
		Present	Absent	
Sex	Male	9	5	0.407
	Female	9	2	
Age (years)	$\leq 15$	0	0	0.407
	15-29	1	1	
	30-44	1	3	
	45-59	9	2	
	$\geq 60$	4	2	
Type of foreign bodies	Bone	13	3	0.035*
	Toothpicks	3	1	
	Metal	2	0	
	Unspecified	0	3	
CT findings	Anatomical location of foreign bodies		0.853	
	Esophagus	3		2
	Stomach	6		2
	Duodenum	1		0
	Small Intestine	7		2
	Colon	1		1
	Size of foreign bodies		0.014*	
	$\leq 3$ cm	5		6
	$> 3$ cm	13		1
	Thickening and enhancing bowel wall		0.307	
	Yes	16		5
	No	2		2
	Fat infiltration		0.307	
Yes	16	5		
No	2	2		
Collection		0.355		
Yes	3		0	
No	15		7	
Free gas		0.355		
Yes	3		0	
No	15		7	
* Fisher's exact test. P<0.05				

## IV. DISCUSSION

In two years, we have studied 25 cases of gastrointestinal foreign bodies. The mean age of patients in our study was  $49.76 \pm 14.89$  years old, ranging from 26-82 years old, with no patients under the age of 15. The average age of our study was consistent with the study of Ismail Okan et al. in 2018, which evaluated 122 adult patients, but differed statistically significantly from the study by Sung Il Kim et al. in 2017, which evaluated 201 patients, showing a mean age in both studies of  $46.68 \pm 18.64$  years old ( $p = 0.233$ ) and  $44.6 \pm 16.60$  years old, respectively [8, 9].

20 of the 25 cases were bone, accounting for 64% [Figure 1]. The superiority of bone in our study was similar to the results of

Sung Il Kim et al. (57.71%), Sang Hun Sung et al. (47.78%), and Yu-Hui Chiu et al. (44.03%) [9–11]. Toothpicks were found in 4/25 cases, accounting for 16%, higher than the study of Yu-Hui Chiu et al. (1.89%) [11]. The reason for the similarity was that studies were performed on Asian patients, who had a common culture such as keeping toothpicks at bedtime and eating fish or chicken bones. Two metal foreign bodies were both intrauterine devices. Intrauterine devices are among the most common contraceptive methods, especially in Asia. Although this method was confirmed to be safe and highly effective, several complications can happen [12]. Transmigration of the IUD, consequently leading to bowel perforation, is a more infrequent complication [Figure 3].



**Figure 3:** NECT, axial plane: revealed a T-shaped foreign body (arrows) consistent with an IUD penetrating the sigmoid wall with surrounding inflammation. Multiple attempts were made but failed to remove the IUD colonoscopically so she was moved to operation bloc. The patient's operative and postoperative course was unremarkable and she was discharged to home on postoperative day 5 without complications. Her follow-up examination in the outpatient clinic was also without complication.

The average length of the foreign body in the study was  $30.56 \pm 10.03$  mm, similar to the study of Kyong Hee Hong et al. in 2015, which was  $26.2 \pm 16.7$  mm ( $p = 0.46$ ) [13]. The mean length in cases with complications was  $33.44 \pm 9.02$  mm.

In CT, 9/25 cases of foreign bodies were stuck in the small intestine, accounting for 36%. Foreign bodies in the stomach, colon, and esophagus were recorded in 08/25, 05/25, and 02/25 cases, respectively. The duodenum recorded one case; no case recorded foreign bodies in the rectum. The distribution of gastrointestinal foreign body locations in our study was different from published studies. In most studies, esophageal foreign bodies accounted for the highest percentage; for example, according to Meihong Yu et al., 1432/2030 cases (70.54%) or according to Roura et al., 181/242 cases (74.79%) [14, 15]. In the study of Roura et al., the number of jejunal and gastric foreign bodies was 19/242 and 03/242, respectively (7.85% and 1.24%). The explanation for this difference is that in the previous study, patients with symptoms, a

history of swallowing, or suspected swallowing were directly evaluated through endoscopy without a CT scan, while in our study, the majority of patients were admitted to the hospital because of nonspecific abdominal pain symptoms and failed to obtain a history of swallowing foreign bodies; therefore, diagnostic endoscopy was not indicated in the first place.

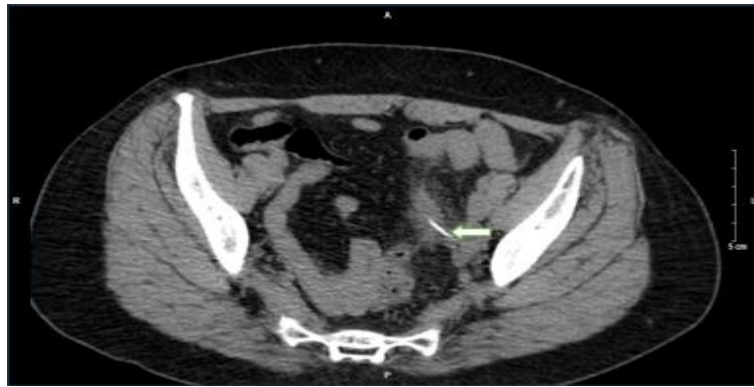
Regarding the mural and foreign body correlation, transmural foreign bodies accounted for the highest frequency with 56%, higher than the study of Meihong et al. with 5/21 cases (23.8%) [14]. There is one case where a foreign body was in a dangerous position because it penetrated the esophagus wall and was close to the aortic arch [Figure 4]. Of the total of 14 cases of transmural foreign bodies, there were 5 cases causing perforation, 3 cases causing abscess, and 1 case causing peritonitis. Foreign bodies outside the gastrointestinal tract accounted for 4/5 cases (16%), most of which were located in the mesenteric, of which 1 case caused abscesses and 3 cases without complications.



**Figure 4:** Thoracic CT post-contrast, axial plane, venous phase: esophageal foreign body with length about 14mm (white arrow) with thickening of the esophageal wall, small air bubbles encircling (black arrow), mild fatty infiltration of adjacent soft tissue.

Thickening and enhancing bowel wall, fat infiltration were both seen in most cases with 84%, there were signs of focal inflammation of the damaged bowel due to foreign body [Figure 5]. Free gas was seen in 12% of patients, only in 18.75% of cases of gastrointestinal perforation in the study.

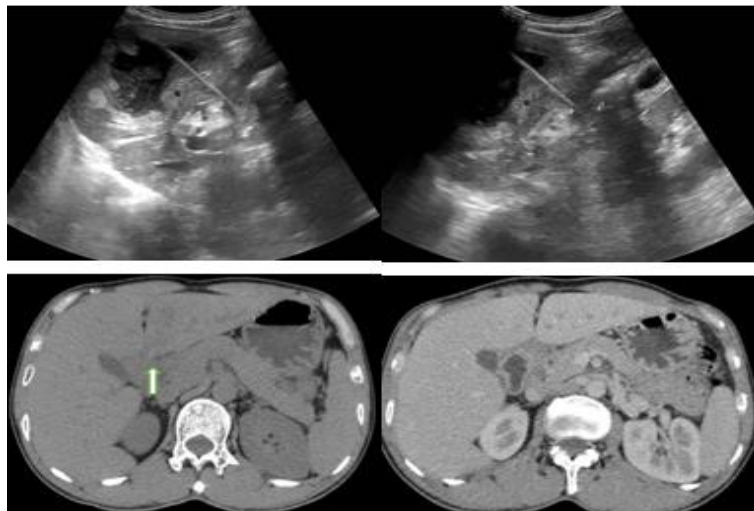




**Figure 5: NECT, axial plane: 01 strip-like, sharp-pointed foreign body ~ 25 mm long (arrow) penetrated the intestinal loop wall to the surrounding mesentery with fatty infiltration with thin fluid but not forming an abscess.**

Regarding complications of gastrointestinal foreign bodies, 8/25 cases were uncomplicated, equivalent to 32%, lower than the study of Kyong Hee Hong et al. with 73.02% [13]. Among the complications group, perforation was the most common with 16/25 cases (64%), higher than the previous study of 15–35% [1, 2]. The next most common complication was abscess, with 4/25 cases (16%), higher than the study of Kyong Hee Hong et al. (0.5%)

[13] [Figure 6]. Peritonitis was observed in 1/25 cases, and no fistula complications were recorded on CT. Intestinal obstruction was found in 2/25 cases, accounting for 8%. Gastrointestinal foreign bodies causing intestinal obstruction are rare in clinical practice, presented mainly in the form of clinical cases and a few single studies, such as the study of Fangbin Shao et al. in 2020 with 9/78 cases, accounting for 11.5% [16].



**Figure 6: Ultrasound and CT of a left liver abscess caused by a foreign body (arrow) penetrating the gastric antrum into the liver parenchyma, with localized wall thickening of the corresponding gastric segment. Mild dilatation and thickening of the left hepatic biliary tract. The patient had an intervention to remove the foreign body, and one bamboo toothpick was removed.**

Recently, there have been reports on the risk factors associated with complications due to foreign body ingestion or insertion [9–11]. In this study, the type and size of the foreign bodies were significant independent risk factors associated with the development of complications in patients with gastrointestinal foreign bodies. Unlike prior studies, location and age were not significantly associated as risk factors for complications of foreign bodies in the digestive tract [10, 13]. The size of foreign bodies was shown to be an independent predictive risk factor for complications of gastrointestinal foreign bodies, unlike previous reports.

#### V. CONCLUSION

CT has an important role in detecting, diagnosing gastrointestinal foreign bodies and evaluating associated complications. In patients with gastrointestinal foreign bodies, the risk of complications was increased with a bone type, and larger size.

#### REFERENCES

1. **Webb WA.** Management of foreign bodies of the upper gastrointestinal tract: Update. *Gastrointest Endosc.* 1995;41(1):39-51. doi:10.1016/S0016-5107(95)70274-1
2. **Ikenberry SO, Jue TL, Anderson MA, et al.** Management of gastrointestinal foreign bodies and food impactions. *Gastrointest Endosc.* 2011;73(6):1085-1091. doi:10.1016/j.gie.2010.11.010
3. **Schwartz JT, Graham DY.** Toothpick perforation of the intestines. *Ann Surg.* 1977;185(1):64-66.
4. **Loh WS, Eu DKC, Loh SRH, Chao SS.** Efficacy of computed tomographic scans in the evaluation of patients with esophageal foreign bodies. *Ann Otol Rhinol Laryngol.* 2012;121(10):678-681. doi:10.1177/000348941212101010
5. **Ngan JH, Fok PJ, Lai EC, Branicki FJ, Wong J.** A prospective study on fish bone ingestion. Experience of 358 patients. *Ann Surg.* 1990;211(4):459-462. doi:10.1097/0000658-199004000-00012
6. **Evans RM, Ahuja A, Rhys Williams S, Van Hasselt CA.** The lateral neck radiograph in suspected impacted fish bones--does it have a role? *Clin Radiol.* 1992;46(2):121-123. doi:10.1016/s0009-9260(05)80316-2
7. **Marco De Lucas E, Sádaba P, Lastra García-Barón P, et al.** Value of helical computed tomography in the management of upper esophageal foreign bodies. *Acta Radiol Stockh Swed* 1987. 2004;45(4):369-374. doi:10.1080/02841850410005516
8. **Okan İ, Akbaş A, Küpeli M, et al.** Management of foreign body ingestion and food impaction in adults: A cross-sectional study. *Ulus Travma Ve Acil Cerrahi Derg Turk J Trauma Emerg Surg TJTES.* 2019;25(2):159-166. doi:10.5505/tjtes.2018.67240
9. **Kim SI, Lee KM, Choi YH, Lee DH.** Predictive parameters of retained foreign body presence after foreign body swallowing. *Am J Emerg Med.* 2017;35(8):1090-1094. doi:10.1016/j.ajem.2017.03.002
10. **Sung SH, Jeon SW, Son HS, et al.** Factors predictive of risk for complications in patients with oesophageal foreign bodies. *Dig Liver Dis Off J Ital Soc Gastroenterol Ital Assoc Study Liver.* 2011;43(8):632-635. doi:10.1016/j.dld.2011.02.018
11. **Chiu YH, Hou SK, Chen SC, et al.** Diagnosis and endoscopic management of upper gastrointestinal foreign bodies. *Am J Med Sci.* 2012;343(3):192-195. doi:10.1097/MAJ.0b013e3182263035
12. **Toumi O, Ammar H, Ghdira A, Chhaidar A, Trimech W, Gupta R, Salem R, Saad J, Korbi I, Nasr M, Noomen F, Golli M, Zouari K.** Pelvic abscess complicating sigmoid colon perforation by migrating intrauterine device: A case report and review of the literature. *Int J Surg Case Rep.* 2018;42:60-63. doi:10.1016/j.ijscr.2017.10.038.



13. **Hong KH, Kim YJ, Kim JH, Chun SW, Kim HM, Cho JH.** Risk factors for complications associated with upper gastrointestinal foreign bodies. *World J Gastroenterol WJG.* 2015;21(26):8125-8131. doi:10.3748/wjg.v21.i26.8125
14. **Yu M, Li K, Zhou S, et al.** Endoscopic Removal of Sharp-Pointed Foreign Bodies with Both Sides Embedded into the Duodenal Wall in Adults: A Retrospective Cohort Study. *Int J Gen Med.* 2021;14:9361-9369. doi:10.2147/IJGM.S338643
15. **Roura J, Morelló A, Comas J, Ferrán F, Colomé M, Traserra J.** Esophageal foreign bodies in adults. *ORL J Oto-Rhino-Laryngol Its Relat Spec.* 1990;52(1):51-56. doi:10.1159/000276103
16. **Shao F, Shen N, Hong Z, Chen X, Lin X.** Injuries due to foreign body ingestion and insertion in children: 10 years of experience at a single institution. *J Paediatr Child Health.* 2020;56(4):537-541. doi:10.1111/jpc.14677