

Ectopic pancreas in the ileum

An unusual condition and our experience

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Abstract

Background: Ectopic pancreas in the ileum, including lesions within Meckel diverticulum, can cause severe manifestations and complications; yet, it was seldom reported in English literature.

Aim: This study aimed to raise awareness and provide information for better clinical management of this rare yet serious condition.

Methods: A total of 1713 cases of small bowel resection were performed in our hospital between 2009 and 2018, among which 10 cases of ileac ectopic pancreas were identified. A comprehensive retrospective review of the 10 cases was taken.

Results: Five lesions were located in the ileum wall and 5 were within Meckel diverticulum. Two lesions within Meckel diverticulum were incidental; the remaining 8 lesions were all associated with abdominal pain, gastrointestinal bleeding, and anemia. Of the 5 patients with lesions in the ileum wall, computed tomography uniformly revealed ileoileal intussusceptions with masses as lead points. Capsule endoscopies were performed in 6 cases, of which 3 showed positive findings. Double-balloon enteroscopy was conducted in one case and revealed an ileal diverticulum. Therapeutically, the offending bowel segments were removed, and intussusceptions were restored except for one case in which diverticulectomy was applied. No relapse or sequela was observed in the follow-up.

Conclusions: Ileac ectopic pancreas can be seen in the ileum wall or Meckel diverticulum. The majority of the lesions found in clinical practice present with abdominal pain, gastrointestinal bleeding, and anemia. Lesions in the ileum wall often cause ileoileal intussusception. Computed tomography, capsule endoscopy, and double-balloon enteroscopy are helpful preoperative examinations. Segmental small bowel resection is the treatment of choice.

Abbreviations: CT = computed tomography, CTA = computed tomography angiography, H&E = Hematoxylin and eosin staining, HGB = Hemoglobin levels.

Keywords: ectopic pancreas, gastrointestinal bleeding, ileum, intussusception, Meckel diverticulum

1. Introduction

Ectopic pancreas, also known as heterotopic pancreas or pancreatic rest, refers to isolated pancreatic tissue found outside the pancreas which has no anatomic or vascular connection to the pancreas, yet possessing histological features of pancreatic acinar formation, duct development, and islets of Langerhans.^[1] It is considered a rather rare benign congenital anomaly with an incidence of 0.2% by laparotomy and 0.55% to 13.7% on autopsies.^[2,3] Ectopic pancreas can occur in various sites of the human body. The stomach and duodenum are widely considered

the two most common sites of ectopic pancreas, which account for 24% to 43% and 9% to 36% of all cases respectively.^[4-7] The jejunum is the third most common site of the lesion and reported accountable for about 0.5% to 35% of the cases, while the ileac ectopic pancreas, including ectopic pancreas within Meckel diverticulum, accounts for 2.8% to 7.5% of the total as the fourth most common site.^[5,7-9] Other reported anatomic sites include colon, appendix, mesentery, esophagus, liver, gallbladder, bile duct, spleen, umbilical cord, retroperitoneal cavity, fallopian tube, lung, mediastinum, etc., but they are all extremely rare, described only in a few case reports.^[10]

While the clinical features of ectopic pancreas in the upper gastrointestinal tract have been widely reported and analyzed, studies on ectopic pancreas in the ileum have rarely been reported in English literature, except for several case reports. However, ectopic pancreas in the ileum can be clinically critical and have severe manifestations and complications such as abdominal pain, gastrointestinal bleeding and intussusception.^[11,12] To raise awareness and provide more information for better management of the condition, we aimed to present a retrospective study of 10 cases of histologically confirmed ileac ectopic pancreatic lesions in our hospital over the past 9 years, including ectopic pancreas within Meckel diverticulum.

2. Materials and methods

From July 2009 to June 2018, a total of 10 patients histologically diagnosed with ileac ectopic pancreatic lesions including lesions

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within Meckel diverticulum were found in the First Affiliated Hospital of Zhejiang University. All medical records available including age, sex, symptoms, preoperative examinations, treatments, follow-ups, were extracted and reevaluated. The histological slices were reviewed by 2 senior pathologists and classified according to Fuentes' classification: type I (all elements of the normal pancreatic tissue), type II (pancreatic ducts only), type III (pancreatic acini only), and type IV (islet cells only).^[10] Telephone follow-ups were made to all patients in July 2018. Patient information was anonymized and de-identified prior to analysis. This study was approved by the Ethics Committee of the First Affiliated Hospital, College of Medicine, Zhejiang University with a waiver of informed consent. We declare no conflict of interest.

3. Results

From July 2009 to June 2018, a total of 1713 cases of small bowel (jejunum and ileum) resection were performed in our hospital, and all removed parts were examined for pathology. Among them, 38 ectopic pancreatic lesions were identified, including 28 lesions in the jejunum and 10 lesions (0.58%) in the ileum. In the same time period, 171 cases of ectopic pancreatic lesions in the digestive tract were pathologically confirmed in our hospital, which means that ileac lesions account for 5.8% of all ectopic pancreatic lesions in the digestive tract.

3.1. Age and sex distribution

Of all the 10 patients reviewed, 8 (80%) were men and 2 (20%) were women. The ages ranged from 17 to 72 years, with an average age of 40 years, and no adult age group was exempted. The main characteristics of all patients enrolled are listed in Table 1.

3.2. Location and size

Among the 10 cases enrolled, 5 lesions were located in the ileum wall and the other 5 were within Meckel diverticulum. Notably, a total of 75 Meckel diverticulum were surgically excised during the study period in our hospital. The distances to the ileocecal valve of the former lesions ranged from 80 cm to 140 cm with an average of 104 cm, while the distances to the ileocecal valve of the later ones ranged from 30 cm to 90 cm with an average of 57 cm (Table 1). The size (length) of the lesions in the ileum wall ranged from 2 cm to 5 cm, and the size (length) of Meckel diverticulum ranged from 4 cm to 8 cm (Table 1). The size of the ectopic pancreatic lesions within Meckel diverticulum, however, was not recorded. Notably, the size of these lesions has not been accurately measured, but only roughly estimated during surgery.

3.3. Symptoms and physical examination

In this series, only 2 incidental lesions (cases 9 and 10) had no ectopic pancreas related symptoms and were clinically insignificant, which were found and removed during abdominal surgery due to other diseases. The remaining 8 lesions (80%) were all associated with abdominal pain and gastrointestinal bleeding or melena. Other symptoms included syncope (2), distention (2), vomiting (1) and diarrhea (1). The abdominal pain and gastrointestinal bleeding or melena can be subacute (1–3 months: cases 3, 4, 5, and 7) or chronic and recurrent (more than

3 months: cases 1, 2, 6, and 8), but no duration of symptoms was shorter than 1 month. Slight abdominal tenderness was seen in 5 patients without Blumberg sign. No other prominent abdominal sign was recorded.

3.4. Laboratory findings

Laboratory investigations revealed varied degrees of anemia in all the 8 clinically significant cases, whose hemoglobin levels (HGB) at the time of admission were 75, 96, 83, 71, 85, 91, 115, and 97 g/L, respectively. The red blood cells were microcytic and hypochromic, which indicated iron deficiency anemia. Fecal occult blood tests were strongly positive in all the 8 patients (cases 1 to 8). Increased C-reactive protein levels were detected in cases 3, 6, and 7. There was no significant increase in white blood cell counts and tumor marker levels. Unfortunately, no record of serum amylase level was found.

3.5. Image findings

All 10 patients had enhanced computed tomography (CT) of the abdomen. No lesion-related change was found in the 2 incidental cases and reviews after surgery did not make any new discovery. Of the 5 patients with lesions in the ileum wall, CT scans uniformly revealed ileoileal intussusceptions with intestinal masses as the lead points (Fig. 1); however, the intestinal masses were all misdiagnosed as lipomas by our radiologists. CT scans of the other 3 patients with lesions within Meckel diverticulum may be characterized by arterial malformation in the ileac intestinal wall, inhomogeneous thickening of the intestinal wall, and gas accumulation in the intestine with slight pelvic effusion respectively (Fig. 1). In addition, small intestinal barium X-ray examination was conducted in case 2 and showed an expansion of the small intestinal lumen and thickening of mucosal folds at the end of the ileum. Abdominal computed tomography angiography (CTA) was conducted in case 3 with no positive discovery. Additionally, 6 patients (cases 1–4, 6, and 8) underwent ^{99m}Tc-Perchnetate imaging and no positive discovery was made.

3.6. Endoscopic views

Capsule endoscopies were performed in 6 of the 8 clinically significant cases, and the results are listed in Table 1. Diverticulum and multiple ulcers in the small bowel were found in case 2 (Fig. 2). Swelling and purpling of ileal mucosa, submucosal vascular tortuosity, and small intestinal hemorrhage were seen in case 3 (Fig. 2). Moreover, case 6 showed distal ileum lumen distortion with mucosal congestion and small intestinal hemorrhage (Fig. 2). Double-balloon enteroscopy was conducted after obtaining negative result in capsule endoscopy in case 8, which discovered a diverticulum in the lower ileum (Fig. 2). The 6 patients also received gastroscopies and colonoscopies before the capsule endoscopies, yet no positive discovery was made except for blood in the colon of case 6.

3.7. Treatment and follow-up

In our group, all the 8 clinically significant cases received open abdominal surgeries. The two incidental cases were meant to receive Whipple procedure and radical resection of sigmoid colon cancer respectively. The specific procedures performed

Table 1

Main patient characteristics.

Patient	Sex	Age	Location	Size (length)	Main symptoms	Hemoglobin levels	Computed tomography findings	Capsule endoscopy findings	Treatment
Case 1	Female	31y	Meckel's diverticulum, 40 cm above the ileocecal valve	4 cm (diverticulum)	Abdominal pain and gastrointestinal bleeding	75g/L	Arterial malformation in the ileac intestinal wall	No abnormal discovery	Diverticulectomy
Case 2	Male	52y	Meckel's diverticulum, 30 cm above the ileocecal valve	5 cm (diverticulum)	Abdominal pain and gastrointestinal bleeding	96g/L	Inhomogeneous thickening of the intestinal wall	Diverticulum and multiple ulcers in small bowel	Segmental small bowel resection
Case 3	Male	47y	Ileum, 80 cm above the ileocecal valve	5 cm	Abdominal pain and gastrointestinal bleeding	83g/L	Ileoleal intussusception with a possible lipoma	Swelling and purpling of ileal mucosa, submucosal vascular tortuosity and small intestinal hemorrhage	Reduction of intussusception and segmental small bowel resection
Case 4	Male	17y	Ileum, 80 cm above the ileocecal valve	5 cm	Abdominal pain and gastrointestinal bleeding	71g/L	Ileoleal intussusception with a possible lipoma	No abnormal discovery	Reduction of intussusception and segmental small bowel resection
Case 5	Female	43y	Ileum, 130 cm above the ileocecal valve	5 cm	Abdominal pain and gastrointestinal bleeding	85g/L	Ileoleal intussusception with a possible lipoma	/	Segmental small bowel resection
Case 6	Male	28y	Ileum, 140 cm above the ileocecal valve	2 cm	Abdominal pain and gastrointestinal bleeding	91 g/L	Ileoleal intussusception with a possible lipoma	Distal ileum distortion with mucosal congestion and small intestinal hemorrhage	Reduction of intussusception and segmental small bowel resection
Case 7	Male	26y	Ileum, 90 cm above the ileocecal valve	5 cm	Abdominal pain and gastrointestinal bleeding	115g/L	Ileoleal intussusception with a possible lipoma	/	Reduction of intussusception and segmental small bowel resection
Case 8	Male	17y	Meckel's diverticulum, 90 cm above the ileocecal valve	6 cm (diverticulum)	Abdominal pain and gastrointestinal bleeding	97g/L	Gas accumulation in the intestine and slight pelvic effusion	No abnormal discovery (diverticulum found under double-balloon enteroscopy)	Segmental small bowel resection
Case 9	Male	67y	Meckel's diverticulum, 85 cm above the ileocecal valve	8 cm (diverticulum)	Incidental finding during surgery	/	No Meckel's diverticulum or ectopic pancreas related finding	/	Segmental small bowel resection
Case 10	Male	72y	Meckel's diverticulum, 40 cm above the ileocecal valve	No record	Incidental finding during surgery	/	No Meckel's diverticulum or ectopic pancreas related finding	/	Segmental small bowel resection

"/" stands for "no data" or "meaningless data".

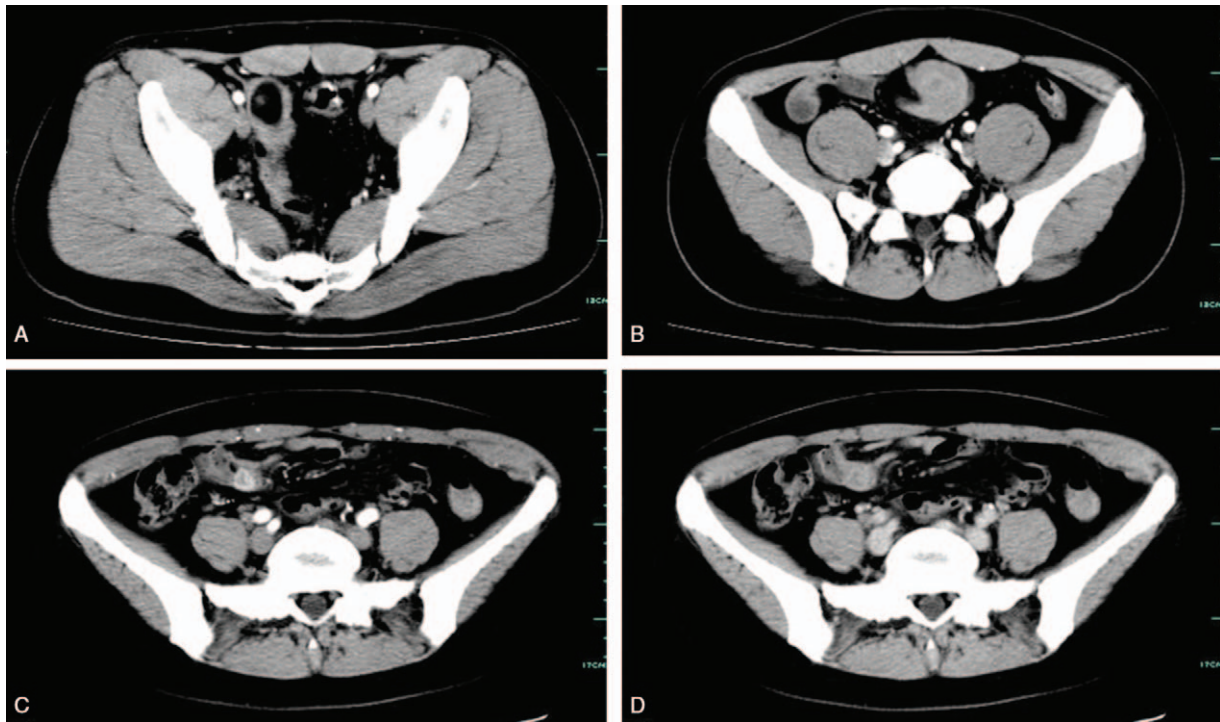


Figure 1. A&B: Ileoileal intussusception and lead point revealed by CT in case 6; C&D: arterial malformation in the ileac intestinal wall revealed by CT in case 1.

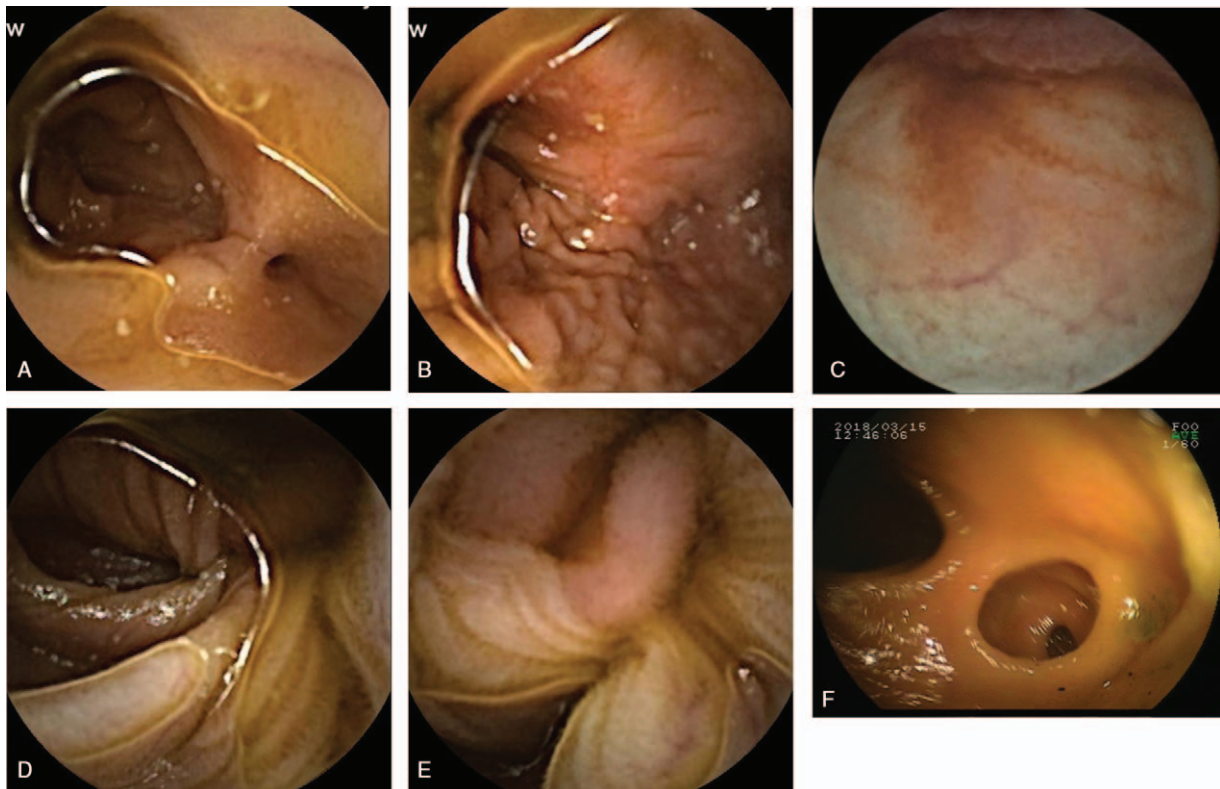


Figure 2. A&B: Diverticulum and multiple ulcers in small bowel revealed by capsule endoscopy in case 2. C: Swelling and purpling of ileal mucosa (or possible ectopic pancreatic lesion) revealed by capsule endoscopy in case 3. D&E: Distal ileum lumen distortion with mucosal congestion and small intestinal hemorrhage revealed by capsule endoscopy in case 6. F: Double-balloon enteroscopy revealed a diverticulum in the lower ileum in case 8.

Table 2
Histopathological features of the ectopic pancreatic lesions.

Patient	Fuentes' classification	Intestinal wall layer the lesion located in	Inflammation of the ectopic pancreas	Condition of the overlying mucosa	Adipose tissue/fat infiltration	Ectopic gastric mucosa
Case 1	Type I	Submucosa	Slight lymphocyte infiltration	Ectopic duodenal mucosa	(-)	(-)
Case 2	Type I	Muscular layer and serosa	(-)	Erosion	Fat infiltration	(-)
Case 3	Type I	Submucosa	(-)	Erosion	Tumor-like adipose tissue in the serosa	(-)
Case 4	Type I	Submucosa	(-)	Normal	(-)	(-)
Case 5	Type I	Muscular layer	(-)	Erosion	Fat infiltration	(-)
Case 6	Slices damaged	/	/	/	/	/
Case 7	Type I	Serosa	Slight neutrophil infiltration	Ulceration	Adipose tissue around the ectopic lesion	(-)
Case 8	Type I	Serosa	(-)	Normal	(-)	(-)
Case 9	Type I	Muscular layer	(-)	Normal	(-)	(-)
Case 10	Slices damaged	/	/	/	/	/

"/" stands for "no data" or "meaningless data". "(-)" stands for "negative".

in each case are shown in Table 1. Generally, the offending bowel segments were removed and intussusceptions were restored except for case 1 in which diverticulectomy was applied. Conservative medical management was given before the operation in all the 8 clinically significant cases, but the measures were unable to stop the bleeding effectively. The operations went smoothly with no serious complication recorded, and all patients were discharged uneventfully within a maximum of 11 days after the surgery. After a follow-up of 4 to 92 months in the 8 clinically significant cases, no recurrence or sequela was observed. The exact time of follow-up for cases 1–8 (clinically significant cases) are 53 months, 66 months, 92 months, 53 months, 57 months, 43 months, 35 months, and 4 months, respectively.

3.8. Histopathological features

The histopathological features of the lesions are listed in Table 2. Eight set of slices were retrieved while two were unfortunately damaged. The 8 ectopic pancreatic lesions all consisted of pancreatic ducts, acini, and islet cells and therefore were classified as type I according to Fuentes' classification (Fig. 3). Three lesions were located in the submucosa, 2 lesions were located in the muscular layer, 2 lesions were located in the serosa, and 1 lesion involved both muscular layer and serosa. No inflammation of the ectopic lesion was observed except for a very slight lymphocyte infiltration in case 1 and a slight neutrophil infiltration in case 7 (Fig. 3). Erosion of the overlying mucosa was seen in 3 cases, and ulceration was found in case 7 (Fig. 3). Fat infiltration was

observed in 2 cases, tumor-like adipose tissue in the serosa was found in case 3, and adipose tissue around the ectopic lesion was found in case 7; these conditions may be related with the lipoma-like imaging features on CT. No ectopic gastric mucosa was found in these slices.

4. Discussion

Jean Schultz described a case of pancreatic-gland-like tissue at the base of the ileal diverticulum in 1727, which is commonly believed to be the first case of ectopic pancreas recorded in literature.^[13] The lesion has since been reported in various parts of the human body, but the true incidence of ectopic pancreas remains undetermined as most cases are asymptomatic. Existing data indicates a prevalence of 0.2% at laparotomy and 0.55% to 13.7% on autopsies as mentioned before.^[2,3]

Most of the lesions were found in the upper gastrointestinal tract and proximal jejunum, while lesions in the ileum were relatively rare, and when seen, they were usually associated with Meckel diverticulum.^[14] Pearson reviewed 589 cases of ectopic pancreas and found that only 3% of the lesions were located in the ileum and 6% in Meckel diverticulum.^[15] Another large sample study of 212 cases conducted by Dolan RV found only 3 cases (1.4%) in the ileum wall and 11 cases (5.2%) in Meckel diverticulum.^[4] The data from our hospital revealed only 5 cases (2.9%) in the ileum wall and 5 cases in Meckel diverticulum out of a total of 171 ectopic pancreatic cases in recent 9 years. However, a retrospective study by Chen revealed a 12.8% proportion of ectopic pancreas in the ileum wall and a 7.7%

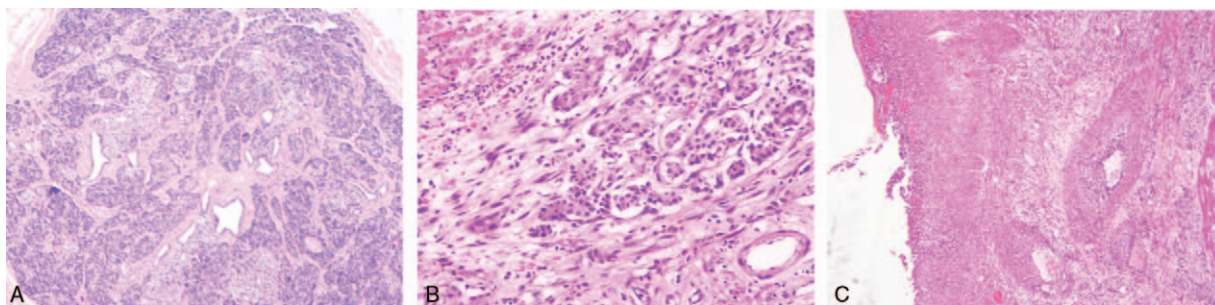


Figure 3. A: Ectopic pancreas consists of pancreatic ducts, acini, and islet cells; Hematoxylin and eosin staining (H&E) stain, original magnification, $\times 50$; B: Neutrophil infiltration in the pancreatic tissue (pancreatic ducts and acini); H&E stain, original magnification, $\times 200$. C: Ulceration of the overlying mucosa; H&E stain, original magnification, $\times 50$.

proportion of ectopic pancreas in Meckel diverticulum, which is a surprisingly high incidence.^[16]

Studies focused on ectopic pancreas in the ileum including Meckel diverticulum are few. Traditionally, most of the lesions were considered asymptomatic and therefore clinically insignificant, and diagnoses were mainly made during abdominal radiological examinations or surgical explorations motivated by other diseases.^[10,17,18] According to Armstrong, approximately half of the cases of small intestinal ectopic pancreas are asymptomatic.^[19] Some researchers even claim that ectopic pancreas in the ileum is almost always asymptomatic.^[20] When symptoms do occur, abdominal pain and gastrointestinal bleeding are most common.^[21] On the contrary, based on the limited number of case reports and several literature reviews we found, ectopic pancreatic tissues in the ileum can be quite symptomatic and may cause severe clinical manifestations and complications. According to a literature review by Kilius, most cases (5 of 7) represent ectopic pancreas in Meckel diverticulum with gastrointestinal bleeding.^[22] Abdominal pain and gastrointestinal bleeding were also frequently seen in case reports of ectopic pancreas in the ileum wall, often along with ulceration or intussusception.^[11,18,20,23–25] In our study, the majority of the lesions found in clinical practice present with abdominal pain, gastrointestinal bleeding and anemia, and lesions in the ileum wall can often present as ileoileal intussusception, which is consistent with previous studies.

Generally, ectopic pancreas related symptoms can be divided into 2 categories: those possible in any mass, and those specific to pancreatic tissue.^[26] The former ones, which are mainly comprised of bowel or biliary obstruction, intussusception, and ulceration, are largely determined by the size and location of the masses.^[26] Pancreatic-tissue-specific complications are mostly pancreatitis and pancreatic neoplasm, which includes adenocarcinoma, neuroendocrine tumor, intraductal papillary mucinous neoplasm, etc. And as in the normal pancreas, ectopic pancreatitis is far more common than ectopic pancreatic neoplasm.^[10] Besides, the pancreatic juice secreted by the ectopic pancreatic tissue also may cause abdominal pain, bleeding, or perforation due to its corrosive effect.^[27] In clinical practice, however, affirmative pancreatic-tissue-specific complications are very rare, found only in a few case reports; most of the symptoms and complications are caused by the mass effect of the lesion instead. In our cases, no inflammation or neoplasm of the ectopic lesion was observed, except for a very slight lymphocyte infiltration in case 1 and a slight neutrophil infiltration in case 7.

The symptoms of the 5 cases with intussusception in our series are clearly caused by the mass effect. We believe that the bleeding in most intussusception cases was not directly from the ectopic pancreatic lesions, but from the invaginated intestine instead. The incidence of a localized pathological lead point for intussusception varies from 2% to 10%, while most cases of intussusception are idiopathic.^[20,28] Several conditions, such as polyps, leiomyomas, hamartomas, neurofibromas, adenomas, inflammatory fibrous polyps, tuberculosis, lipomas, Meckel diverticulum, adhesions, and ectopic pancreas, have been reported as the lead point for intussusception.^[29] Intussusception secondary to isolated ectopic pancreas in the ileum, even though extremely rare, has been reported in multiple studies.^[11,14,18,25,29] The vast majority of these reported cases occurred in children or infants, which is in line with the well-known fact that intussusceptions primarily happen in pediatric cases with only 5% of intussusceptions occur in adults.^[29] However, unlike the pediatric

situations, merely 10% of intussusceptions are idiopathic in adults, and in the small intestine, they are almost always associated with benign masses.^[30] Of all the 10 patients reviewed in our study, patient age ranged from 17 to 72 years with an average of 40 years. This may be mainly due to the fact that our hospital rarely treats pediatric patients.

The pathophysiological mechanisms of symptomatic cases in Meckel diverticulum are difficult to determine. It may due to inflammation, diverticulitis, or ulcerations caused by alkaline secretions of ectopic pancreatic tissue.^[31] However, it is still hard to tell whether the bleeding was ectopic-pancreas-related or not for certain in our cases. About half of resected Meckel diverticulum contain ectopic tissues, and gastric heterotopia is the most common, reported in 23% to 50% of the cases, while ectopic pancreatic tissue is found in 5% to 16% of the cases.^[32] The main cause of bleeding from Meckel diverticulum is considered to be the acid secretion from the ectopic gastric mucosa, which then leads to ulceration and hemorrhage.^[32] However, no ectopic gastric mucosa was found in our series; therefore, 99mTc-Perchnetate imaging made no positive discovery. Some scholars proposed that the main clinical presentation of Meckel diverticulum with ectopic pancreatic tissue is intussusception, in which case the lesions are usually located in the distal end of the diverticulum and serve as a lead point.^[31] A number of case reports backed the proposal.^[33,34] Indeed, Meckel diverticulum is considered the most common pathologic lesion that acts as a lead point for intussusception.^[28] Nevertheless, more reports of symptomatic Meckel diverticulum with ectopic pancreatic tissue are intussusception-free, which are congruent with our study.^[12,22,35] In fact, Meckel diverticulum without pancreas ectopia can cause similar symptoms too, so it is possible that the bleeding was not related to the ectopic pancreas lesions.

There is no reliable laboratory marker for the existence of ectopic pancreatic tissue.^[10,36,37] When ectopic pancreatitis or ectopic pancreatic neoplasm occurs, which is very unusual, there may be a corresponding elevation in amylase level or tumor markers. But the elevation is usually quite mild, owing to the small size of the lesion.^[38,39] Unfortunately, no assay of serum amylase level was made in our series. When gastrointestinal bleeding occurs, a decrease in hemoglobin levels can be detected. The hemoglobin level is very helpful to estimate the severity of the condition and may serve as an indicator for the necessity and urgency of surgery and other treatments such as blood transfusion. C-reactive protein and full blood count may be useful to provide information about the inflammation.

Computed tomography (CT) is one of the most important imageological examinations of small bowel diseases, and it has been extensively reported for evaluation of ectopic pancreas. Typically, CT images of ectopic pancreas in the gastrointestinal tract show a round or oval intramural soft tissue mass with smooth or microlobulated margins.^[10] The attenuation and enhancement features of the lesion reflect its microscopic composition: ectopic tissue that is predominantly composed of acini shows homogeneous avid enhancement that is greater than or equal to that of the orthotopic pancreas; hypoenhancing lesions are dominated by ductal structures and sometimes surrounded by hypertrophied muscle.^[37] A central umbilication, which fills with contrast, is a diagnostic feature thought to represent a rudimentary duct, but this feature is only found in a minority of cases.^[10] With all these characteristics theoretically summarized, it is still very difficult to make the diagnosis of

ectopic pancreas effectively based on CT examination in clinical practice. Unfortunately, there is currently a lack of ideal imageological examination for the effective diagnosis of the ectopic pancreas in the ileum. However, just as this study as well as other studies demonstrated, CT is actually very effective in diagnosing intussusception with a high sensitivity, and it was considered the most useful examination for diagnosing intussusception, even though the ectopic pancreatic lesions that acted as a lead point were misdiagnosed as lipoma preoperatively in our series.^[39,40] On the contrary, Meckel diverticulum, especially the ones smaller than 3 cm, may be difficult to distinguish from normal small bowel loops on CT.^[41] Typically, it appears as a blind-ending gas or fluid-filled structure that may also contain foreign bodies or enteroliths, and the neoplasms within a Meckel diverticulum, which is quite rare, can appear as a sessile or lobulated mass that often enhances with contrast and may infiltrate and thicken the adjacent intestinal wall.^[41] In our series, our radiologists were unable to identify Meckel diverticulum on CT preoperatively, and the diverticulum remained elusive under postoperative review. Still, CT plays an important role in the diagnosis and differential diagnosis of Meckel diverticulum and Meckel diverticulum-related complications.^[41,42] Modern multi-detector CT, which offers improved spatial resolution and image reconstruction in coronal and sagittal planes, may help raise the efficacy.^[41]

The use of capsule endoscopy or double-balloon enteroscopy for detecting ectopic pancreas in the ileum is seldom reported in literature. Huan-Lin Chen presented a case of ectopic pancreas in the ileum identified by capsule endoscopy in 2007, and we have not found any other similar report in English literature.^[23] They performed capsule endoscopy for a patient who had noted intermittent dark bloody stool for 2 months, and the examination revealed a red polyp with a stalk located in the ileum, while other examinations like abdominal CT and small intestinal barium X-ray failed to provide any ponderable clue. In our patients, capsule endoscopy revealed anomalies in half of the cases (3 of 6 cases). In fact, capsule endoscopy is currently widely used for detecting the bleeding source in patients with obscure gastrointestinal bleeding and is proved to have high sensitivity and specificity.^[43] Of course, being unable to perform biopsy and more clear observation, capsule endoscopy cannot bear accurate preoperative diagnosis, but it still provides valuable information for better management of the disease. Despite our effort, we found only 2 case reports on the use of double-balloon enteroscopy for detecting ectopic pancreas in the small bowel, and both lesions were in the jejunum.^[44,45] Ectopic pancreas found under double-balloon enteroscopy was extremely uncommon indeed. The use of double-balloon enteroscopy for the diagnosis of Meckel diverticulum, however, was widely reported, and it was considered a safe, effective, and reliable method for diagnosis before surgery.^[46,47] In our cases, we found a diverticulum by double-balloon enteroscopy in the lower ileum, but the diverticulum is too deep and we were unable to make further in-depth observation. Generally, double-balloon enteroscopy was suggested to be used complementarily to other less invasive examinations including capsule endoscopy and CT when needed to confirm or establish the diagnosis.^[46]

Indubitably, symptomatic cases of ectopic pancreas in the ileum should be treated aggressively.^[48,49] Segmental small bowel resection and reduction of intussusception (if found) are the treatments of choice. Diverticulectomy can be adopted if the lesion is found inside a diverticulum and the adjacent bowel is

intact. The management of asymptomatic cases is still under debate.^[48,49] Some argue that all cases of ectopic pancreas, symptomatic or not, should be treated, but others claim that conservative management should be adopted for asymptomatic cases. In our opinion, segmental small bowel resection or diverticulectomy should be performed for large lesions and lesions inside the diverticulum, while small asymptomatic lesions in the ileum wall can be surgically treated or not. The surgical treatment is safe and effective in most cases.

There are several limitations of this study. First, this study is a retrospective study, and some data were not well recorded or preserved. Second, only a small number of patients were enrolled. Thirdly, we only described the histopathological features of the ectopic pancreas lesions instead of the whole resected parts. Finally, we are unable to clarify the pathophysiological mechanisms of symptomatic cases in Meckel diverticulum.

In summary, ileac ectopic pancreas can be seen in the ileum wall or Meckel diverticulum. The majority of the lesions found in clinical practice present with abdominal pain, gastrointestinal bleeding, and anemia. Lesions in the ileum wall can often present as ileoileal intussusception. CT, capsule endoscopy, and double-balloon enteroscopy can be helpful as preoperative examinations, but despite these advanced diagnostic tools, the preoperative diagnosis of an ectopic pancreas remains challenging, and the final diagnosis still depends on the postoperative histological examination. Segmental small bowel resection and reduction of intussusception (if found) are the treatments of choice.

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