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WJGE mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal endoscopy and covering a wide range of topics including capsule endoscopy, colonoscopy, double-balloon enteroscopy, duodenoscopy, endoscopic retrograde cholangiopancreatography, endosonography, esophagoscopy, gastrointestinal endoscopy, gastroscopy, laparoscopy, natural orifice endoscopic surgery, proctoscopy, and sigmoidoscopy.

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ORIGINAL ARTICLE

Retrospective Study

Evaluation of appendiceal mucinous neoplasms by curved linear-array echoendoscope: A preliminary study

Jing-Chao Zhang, Yang-Yang Ma, Yong-Zhen Lan, Shuang-Biao Li, Xiao Wang, Jin-Long Hu

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Abstract

BACKGROUND

Preoperative diagnosis of appendiceal mucinous neoplasms is challenging, and there are few reports regarding the endosonographic characteristics of these neoplasms.

AIM

To provide a retrospective assessment of the imaging features of appendiceal mucinous neoplasms using endoscopic ultrasound (EUS) by curved linear-array echoendoscope.

METHODS

A database of all patients with appendiceal mucinous neoplasms who had received EUS examination at our hospital between January 2018 and July 2023 was retrospectively analyzed. The EUS characteristics and patients' clinical data were reviewed.

RESULTS

Twenty-two patients were included in the study. The linear-array echoendoscope successfully reached the ileocecal region in every patient. In the endoscopic view,

we could observe the protrusion in the appendiceal orifice in all patients. A volcano sign was observed in two patients, and an atypical volcano sign was seen in two patients. EUS showed that all 22 lesions were submucosal cystic hypoechoic lesions with clear boundaries. No wall nodules were observed, but an onion-peeling sign was observed in 17 cases.

CONCLUSION
Linear-array echoendoscope is safe to reach the ileocecal region under the guidance of EUS. Image features on endoscopic and echoendosonograhic views could be used to diagnose appendiceal mucinous neoplasms.

Key Words: Appendiceal mucinous neoplasm; Endoscopic ultrasound; Appendix; Endoscopy; Colonoscopy

Core Tip: Appendiceal mucocele is a relatively rare disease. The preoperatively accurate diagnosis is crucial to the treatment strategy. Endoscopy has played an important role in the diagnosis of appendiceal mucocele. Image features on endoscopic and echoendosonograhic views could be used to diagnose appendiceal mucinous neoplasms.

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INTRODUCTION

Appendiceal mucocele is a relatively rare disease. Based on the pathological type, appendiceal mucocele can be classified as mucosal hyperplasia, mucinous cystadenoma, or mucinous cystadenocarcinoma. Even though appendiceal mucocele, expect mucinous cystadenocarcinoma, does not typically show definitive malignant features, it can rupture and lead to the development of pseudomyxoma peritonei, a life-threatening complication with a 10-year survival rate of 45%[1]. Therefore, an accurate diagnosis is crucial to the treatment strategy. However, patients with appendiceal mucocele do not have specific clinical manifestations, delaying diagnosis[2,3]. The patient may have no symptoms or show acute appendicitis-like presentation in the early stages of the disease with right lower quadrant pain secondary to distention of the appendix by mucin[4]. Since the development of endoscopic ultrasound (EUS)[5], endoscopy has played an important role in the diagnosis of appendiceal mucocele. To date, only a few studies have demonstrated the EUS characteristics of appendiceal mucocele using miniprobe catheter EUS. Moreover, miniprobe EUS exhibited limited depth of penetration. In this work, we evaluated the EUS characteristics of appendiceal mucocele by curved linear-array echoendoscope to assess the accurate diagnosis.

MATERIALS AND METHODS

Patients with a pathological diagnosis of appendiceal mucocele who had received EUS examination by linear echoendoscope from January 2018 to July 2023 were reviewed. The patients' general characteristics, EUS results, and surgery method were recorded. This study was approved by the institutional review board of Hebei Cangzhou Hospital of Integrated Traditional Chinese Medicine and Western Medicine.

Intubation of the linear echoendoscope

All cases were performed after a standard bowel preparation, using either a linear echoendoscope (3870UTK, Pentax company, Japan) or linear echoendoscope (EG-580UT, Fujifilm company, Japan). We inserted the linear echoendoscope with the guidance of endoscopic and ultrasound views. During the insertion of the endoscope, if the angle of the colon was too large to display the endoscopic view, we used ultrasound to scan the direction of the proximal colon to assist in inserting the endoscope (Figure 1). Closed intestinal cavities are often difficult to distinguish on ultrasound images. The direction of the intestinal cavity can be easier to identify by injecting water into the cavity.

RESULTS

This study included 22 patients that were diagnosed with appendiceal mucocele and received EUS examination. Among them, there were 9 male and 13 female patients, aged 26-80 years. The average age was 60.9 ± 12.6 years. Clinical symptoms included discomfort in the right lower abdomen in 6 cases, appendicitis in 10 cases, and physical examination

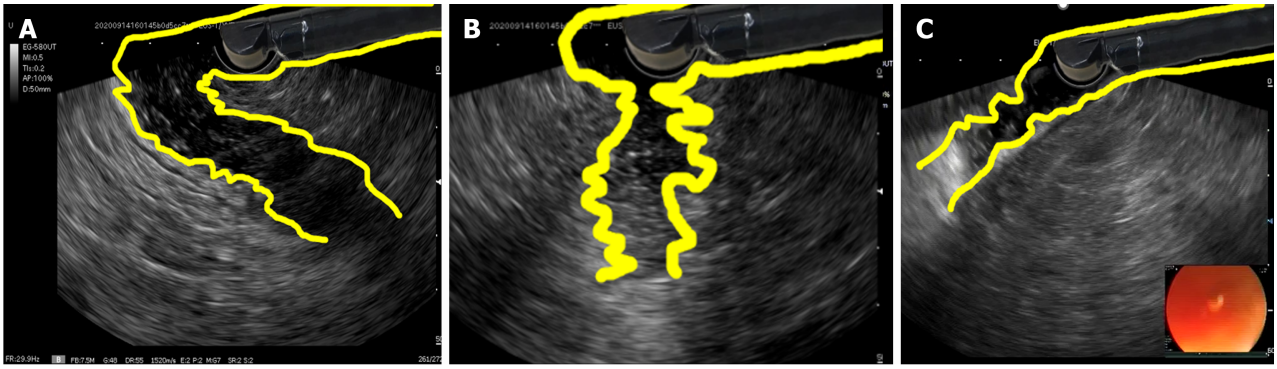

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Figure 1 Using ultrasound to scan the direction of the proximal colon to assist in inserting the endoscope. A: The direction of the proximal colon is at an acute angle; B: The direction of the proximal colon is almost at a right angle; C: The direction of the proximal colon is almost at an obtuse angle.

in 6 cases.

The echoendoscope successfully reached the ileocecal region in all 22 patients. In the endoscopic view, we could observe the protrusion in the appendiceal orifice. The surface of the protrusion was smooth, and no secretion was observed in 20 cases, of which the appendiceal orifice was compressed to one side of the lesion in 18 cases and the appendiceal orifice was located on the surface of the lesion in 2 cases (volcano sign). The appendiceal orifice was located on the surface of the lesion with white secretion in 2 cases (atypical volcano sign) (Figure 2). EUS showed that all 22 lesions were submucosal cystic hypoechoic lesions with clear boundaries and no wall nodules were observed. The size of the lesions ranged from 1.1 cm to 5.7 cm, with the average size being 3.1 ± 1.1 cm. Onion-peeling sign, which was defined as intermittent hyperechoic lines in the hypoechoic lesion, could be observed in 17 cases (Figure 3). Overall, 16 cases underwent appendectomy, 4 cases received ileocecal resection, and 2 cases underwent right hemicolectomy. The surgical process was smooth and there were no complications. Postoperative pathology confirmed 20 cases of appendiceal mucinous adenoma and 2 cases of mucinous adenocarcinoma.

DISCUSSION

Appendiceal mucocele, caused by dilation of the lumen because of an accumulation of mucus, is a relatively uncommon disease. Appendiceal mucinous cystadenoma can secrete mucin and present in a malignant fashion, resulting in the development of life-threatening pseudomyxoma peritonei. However, it is difficult to make the diagnosis of appendiceal mucocele. The presentation of appendiceal mucocele is quite variable, and the clinical symptoms are vague and non-specific. For asymptomatic patients, appendiceal mucocele may be incidentally detected on imaging examination or during a colonoscopy. For symptomatic patients, appendiceal mucocele has an overlap of symptoms with acute appendicitis, frequently leading to a preoperative misdiagnosis. Therefore, sufficient preoperative examinations are necessary to make an accurate diagnosis. For multiphase computed tomography images, appendiceal mucocele should be considered when a focal well-defined cystic mass with slightly higher water attenuation, thickened cystic wall with ring mural enhancement, and a characteristic progressive contrast enhancement in imaging, especially in older females with non-specific symptoms that are similar to appendicitis[6].

During colonoscopy, the classical appearance of appendiceal mucocele is a ''volcano sign'', with the appendiceal orifice seen at the center of the mound[7,8]. Colonoscopic biopsy is not recommended because the overlying mucosa is not involved, and biopsy carries the potential risk of rupturing the appendiceal mucocele. The author described an atypical "volcano sign" with mucus spewing out of the appendicular orifice and the final diagnosis was appendiceal mucinous adenocarcinoma[9]. Our study also found two mucinous adenocarcinomas that presented as an atypical "volcano sign", which may be caused when the tumor ruptured into the lumen of the colon, releasing mucus. Overall, an atypical "volcano sign" might be the sign of mucinous adenocarcinoma.

EUS can be useful in confirming the nature of the lesion, thereby ruling out solid lesions such as carcinoid, lipoma, or gastrointestinal stromal tumor[10,11]. Due to the maneuverability of the linear array echoendoscope, it was widely used to evaluate lesions in left colon and rectum[12,13]. Using a linear array echoendoscope to evaluate the proximal colon has been reported in only a few studies. For more proximal areas of the colon, forward-viewing echocolonoscopes and through-the-scope miniprobe catheter ultrasound were typically used, but these methods have limitations. In this study, we used a linear array echoendoscope to evaluate the appendiceal lesions. Advancement of a conventional curved linear echoendoscope beyond the sigmoid colon usually requires previous placement of an overtube or a guidewire[14]. In this study, we inserted the linear echoendoscope just with the guidance of endoscopic and ultrasound views. If the intestinal lumen could not be seen under endoscopic view, we injected water into the intestinal lumen to help identify the direction of the intestinal lumen using ultrasound view. We passed through the sigmoid and descending colon without loop and maintained a good freedom of scope. If the scope is difficult to pass, we could use a guidewire method. Appendiceal mucocele is a hypoechoic lesion with clear boundaries and is without mural nodes. In addition, we found that the "onion-peeling sign" could be seen in most cases, which may be due to the different timing of mucus secretion. The "onion-

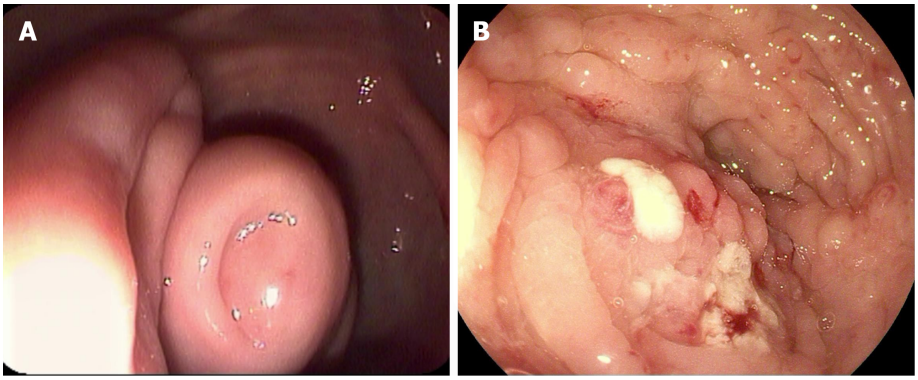

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Figure 2 Endoscopic view of appendiceal mucinous neoplasms. A: A volcano sign that the appendiceal orifice was located on the surface of the protrusion is shown; B: An atypical volcano sign that the appendiceal orifice was located on the surface of the protrusion with white secretion is shown.

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Figure 3 An onion-peeling sign with intermittent hyperechoic lines was seen in the hypoechoic lesion.

peeling sign" could help us to make a differential diagnosis. For unclear lesions, EUS-fine-needle aspiration (FNA) could be performed to confirm the diagnosis[15-17]. However, if appendiceal mucocele is suspected, EUS-FNA is forbidden to avoid the formation of pseudomyxoma peritonei.

Surgery is a standard method for the treatment of appendiceal mucocele. A simple appendectomy could be performed for mucosal hyperplasia and mucinous cystadenoma. In addition, a right hemicolectomy with lymph node dissection is indicated for cystadenocarcinoma. After surgery, patients should be offered follow-up to exclude the subsequent development of pseudomyxoma peritonei[18]. The risk of pseudomyxoma peritonei is related to the pathological finding and is higher if acellular mucin is found beyond the appendiceal serosa[19].

There are limitations in our study. The study was a retrospective study and only a small cohort of patients were included. All the procedures were performed by experienced doctor. For difficult colonoscopy, the safety of intubation of linear echoendoscope into cecum should be further studied.

CONCLUSION

Endoscopy plays an important role in the diagnosis of appendiceal mucocele. We can safely evaluate the lesion in the ileocecal region by using a linear-array echoendoscope. A volcano sign on endoscopic view and EUS features could be used to diagnose appendiceal mucinous neoplasms.

ARTICLE HIGHLIGHTS

Research background

Appendiceal mucinous neoplasms can present in a malignant fashion, but preoperative diagnosis of appendiceal mucinous neoplasms is difficult. Endoscopy plays an important role in the diagnosis of appendiceal mucinous neoplasms. There are limited reports regarding the endosonographic characteristics of these neoplasms.

Research motivation
We evaluated the imaging features of appendiceal mucinous neoplasms using endoscopic ultrasound (EUS) by curved linear-array echoendoscope.

Research objectives
To describe image features on endoscopic and echoendosonograhic views of appendiceal mucinous neoplasms.

Research methods
The EUS characteristics and patients' clinical data were reviewed.

Research results
The appendiceal orifice located on the surface of the lesion in 2 cases (volcano sign) and the appendiceal orifice located on the surface of the lesion with white secretion in 2 cases (atypical volcano sign) were seen. EUS showed that the lesions were submucosal cystic hypoechoic lesions with clear boundaries and no wall nodules were observed. Onion-peeling sign, which was defined as intermittent hyperechoic lines in the hypoechoic lesion, could be observed in part of cases.

Research conclusions
This study demonstrated that we can safely evaluate the lesion in the ileocecal region by using a linear-array echoendoscope. A volcano sign on endoscopic view and EUS features could be used to diagnose appendiceal mucinous neoplasms.

Research perspectives
In the future, for difficult colonoscopy, the safety of intubation of linear echoendoscope into cecum should be studied.

FOOTNOTES

Author contributions: Hu JL, Zhang JC, Ma YY, and Lan YZ designed and performed the research study; Hu JL, Li SB, and Wang X analyzed the data and wrote the manuscript; and all authors have read and approve the final manuscript.

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