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*CASE REPORT*

# Postoperative encapsulated hemoperitoneum in a patient with gastric stromal tumor treated by exposed endoscopic full-thickness resection: A case report

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## Abstract

### *BACKGROUND*

Gastric stromal tumors, originating from mesenchymal tissues, are one of the most common tumors of the digestive tract. For stromal tumors originating from the muscularis propria, compared with conventional endoscopic submucosal dissection (ESD), endoscopic full-thickness resection (EFTR) can remove deep lesions and digestive tract wall tumors completely. However, this technique has major limitations such as perforation, postoperative bleeding, and post-polypectomy syndrome. Herein, we report a case of postoperative serous surface bleeding which formed an encapsulated hemoperitoneum in a patient with gastric stromal tumor that was treated with exposed EFTR. Feasible treatment options to address this complication are described.

### *CASE SUMMARY*

A 47-year-old male patient had a hemispherical protrusion found during gastric endoscopic ultrasonography, located at the upper gastric curvature adjacent to the stomach fundus, with a smooth surface mucosa and poor mobility. The lesion was 19.3 mm × 16.1 mm in size and originated from the fourth ultrasound layer. Computed tomography (CT) revealed no significant evidence of lymph node enlargement or distant metastasis. Using conventional ESD technology for mucosal pre-resection, exposed EFTR was performed to resect the intact tumor in order to achieve a definitive histopathological diagnosis. Based on its morphology and immunohistochemical expression of CD117 and DOG-1, the lesion was proven to be consistent with a gastric stromal tumor. Six days after exposed EFTR, CT showed a large amount of encapsulated fluid and gas accumulation around the stomach. In addition, gastroscopy suggested intracavitary bleeding and abdominal puncture drainage indicated serosal bleeding. Based on these findings, the patient was diagnosed with serosal bleeding resulting in encapsulated

abdominal hemorrhage after exposed EFTR for a gastric stromal tumor. The patient received combined treatments, such as hemostasis under gastroscopy, gastrointestinal decompression, and abdominal drainage. All examinations were normal within six months of follow-up.

*CONCLUSION*
This patient developed serous surface bleeding in the gastric cavity following exposed EFTR. Serosal bleeding resulting in an encapsulated hemoperitoneum is rare in clinical practice. The combined treatment may replace certain surgical techniques.

**Key Words:** Exposed endoscopic full-thickness resection; Gastric stromal tumors; Hemoperitoneum; Abdominal infection; Complication; Postoperative bleeding; Case report



**Core Tip:** Postoperative bleeding is a common complication after exposed endoscopic full-thickness resection (EFTR), and is most commonly seen in the gastrointestinal tract. In the present case, following exposed EFTR for a gastric stromal tumor, bleeding was noted in both the gastric cavity and the serosal surface, which resulted in an encapsulated hemoperitoneum. The patient subsequently recovered after comprehensive treatment with gastrointestinal decompression, endoscopic hemostasis, B-ultrasound-guided abdominal puncture drainage, and anti-infection therapy.

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## INTRODUCTION

Gastric stromal tumors, which are derived from mesenchymal tissues, are one of the most commonly diagnosed gastrointestinal tumors[1-4]. They typically occur in the gastric fundus, anterior wall of the gastric corpus, and anterior wall of the gastric antrum[5]. On account of their origin in the stomach wall, gastric stromal tumors can be classified into stromal tumors originating from the muscularis mucosa and those originating from the muscularis propria[1,6]. Endoscopic submucosal dissection (ESD) has been extensively performed to treat those tumors derived from the superficial muscularis mucosa[7,8]. By contrast, for gastric stromal tumors derived from the deep layers of the muscularis propria, especially those that grow outside the cavity, ESD may result in perforation and incomplete tumor excision[9].

Thus, muscularis propria-derived gastric stromal tumors are regarded as contraindications to endoscopic resection[10, 11]. Moreover, these tumors are clinically removed by surgical or laparoscopic procedures. Recently, exposed endoscopic full-thickness resection (EFTR) for the treatment of gastric stromal tumors originating from the muscularis propria has obtained satisfactory therapeutic effects[12-14]. This report describes a case of postoperative encapsulated hemoperitoneum in a patient with a gastric stromal tumor treated by exposed EFTR.

## CASE PRESENTATION

### *Chief complaints*

A 47-year-old male patient was first admitted to our department for further evaluation and treatment of a gastric mass incidentally discovered by gastroscopy during a routine health check-up. One week after undergoing exposed EFTR, the patient was re-admitted to our department due to fatigue and anorexia for 2 d.

### *History of present illness*

The patient did not have symptoms such as abdominal pain, diarrhea, nausea, or vomiting.

### *History of past illness*

The patient had a history of hypertension and took medication regularly.

### *Personal and family history*

The patient was a non-smoker and did not drink alcohol. He had no significant family history.

### *Physical examination*

Both during the first and second hospitalization, physical examination revealed no obvious abnormalities, and his abdomen was soft without tenderness and no palpable mass.

### *Laboratory examinations*

Before exposed EFTR in the first hospitalization, laboratory tests demonstrated normal routine blood tests, coagulative function, liver function, and renal function. Moreover, common serum tumor markers, including alpha-fetoprotein, carcinoembryonic antigen, and carbohydrate antigen 19-9, were normal.

Following exposed EFTR in the first hospitalization, on the day after surgery, the patient's temperature was 37.5 °C, and routine blood tests showed the following: White blood cell (WBC) count: 14.5 × $10^9$/L; neutrophil/granulocyte (NE) ratio: 85.6%; hemoglobin (HB): 127 g/L; and hypersensitive C reactive protein (hsCRP): 25.89 mg/L, which suggested post-polypectomy syndrome with fever and signs of inflammation. On the third day after surgery, all laboratory examinations showed normal results.

During the second hospitalization, laboratory examinations showed WBC count: 19.7 × $10^9$/L; NE ratio: 82.9%; HB: 134 g/L; and hsCRP: 206.06 mg/L. Blood chemistry tests demonstrated signs of inflammation/infection. On the second day, laboratory examinations revealed WBC count: 12.3 × $10^9$/L; NE ratio: 87.6%; HB: 114 g/L; and hsCRP: 161.16 mg/L. Blood tests indicated inflammatory and infectious complications; therefore, abdominal puncture fluid culture and blood culture were performed. Both aerobic and anaerobic cultures of the puncture fluid indicated infection with *Klebsiella pneumoniae* and *Streptococcus parahaemolyticus*, sensitivity to carbapenems, and negative blood culture.

### *Imaging examinations*

Prior to exposed EFTR, endoscopic examination revealed a hemispherical protrusion, approximately 16 mm in diameter, located at the upper gastric curvature adjacent to the stomach fundus, with a smooth surface mucosa and poor mobility (Figure 1A). Gastric endoscopic ultrasonography (EUS) examination revealed a mass 19.3 mm × 16.1 mm in size, derived from the muscularis propria, which grew outside the cavity. The echo pattern of the mass was uniform and at a low level (Figure 1B); however, the results of EUS were insufficient for diagnosis. Gastric computed tomography (CT) illustrated a well-demarcated mass 16 mm × 15 mm in size, demonstrating mild enhancement, with an intact mucosal line. Additionally, the CT scan showed no significant evidence of lymph node enlargement or distant metastasis (Figure 2A).

Following exposed EFTR, abdominal CT illustrated that titanium endoclips remained in the stomach, with a large amount of encapsulated fluid and gas accumulation around the stomach (Figure 2B). Emergency gastroscopy also revealed a small amount of dark red bloody liquid in the lower part of the stomach and duodenum. After surgery, multiple metal endoclips were observed on the surface of the wound, with obvious swelling of the anal mucosa and a small amount of bleeding on the surface. The wound was cauterized with hemostatic forceps and re-clamped with metal endoclips. Ultrasound examination showed that a mixed mass of gas and liquid was detected around the upper abdominal cavity and stomach, which was approximately 80 mm × 151 mm in size with an alveolate-like shape inside. These imaging features guided treatment by abdominal puncture drainage and gastrointestinal decompression.

## FINAL DIAGNOSIS

After preliminary examinations, exposed EFTR was performed to complete tumor excision and obtain histopathological results (Figure 3). On gross examination, the tumor was a well-shaped firm mass, white and yellow in color. Histopathological results illustrated that the tumor was located in the muscularis propria and was a spindle cell tumor, arranged in a bundle-like interweaving pattern with mild nuclear atypia (Figure 3A and B). Immunohistochemical staining was performed to determine tumor diagnosis, which displayed positive CD117 and DOG1 (Figure 3C and D). Due to these results, the histopathological diagnosis was in accordance with a gastric stromal tumor.

According to these examinations, during the second hospitalization, the patient was treated for postoperative complications including delayed bleeding, encapsulated hemoperitoneum, and abdominal infection following exposed EFTR for a gastric stromal tumor.

## TREATMENT

During the first hospitalization, the patient underwent exposed EFTR without laparoscopic assistance under general anesthesia during tracheal intubation on November 11, 2022. Following complete resection of the tumor, a metal clamp was applied to the defect wound in the gastric wall under endoscopy, with gradual clamping of the wound from both sides to the center. During the operation, close observation of changes in the abdomen was of vital significance, with the application of a 20G needle to puncture the right upper abdomen to alleviate pneumoperitoneum.

Postoperative treatment included maintaining a semi-reclined position, fasting, gastrointestinal decompression, intravenous infusion of 1.0 g cefotiam for anti-infection, intravenous infusion of omeprazole for acid suppression, and fluid replacement to maintain electrolyte balance. On the first and second day, 150 mL and 400 mL of yellow green liquid was drained by gastrointestinal decompression, respectively. On the third day, the gastrointestinal decompression tube was removed, followed by intake of a liquid diet and then a semi-liquid diet. After drinking and eating, the patient had no abnormal abdominal signs, and all laboratory examinations were normal. He was discharged on the 4$^{th}$ d after surgery.

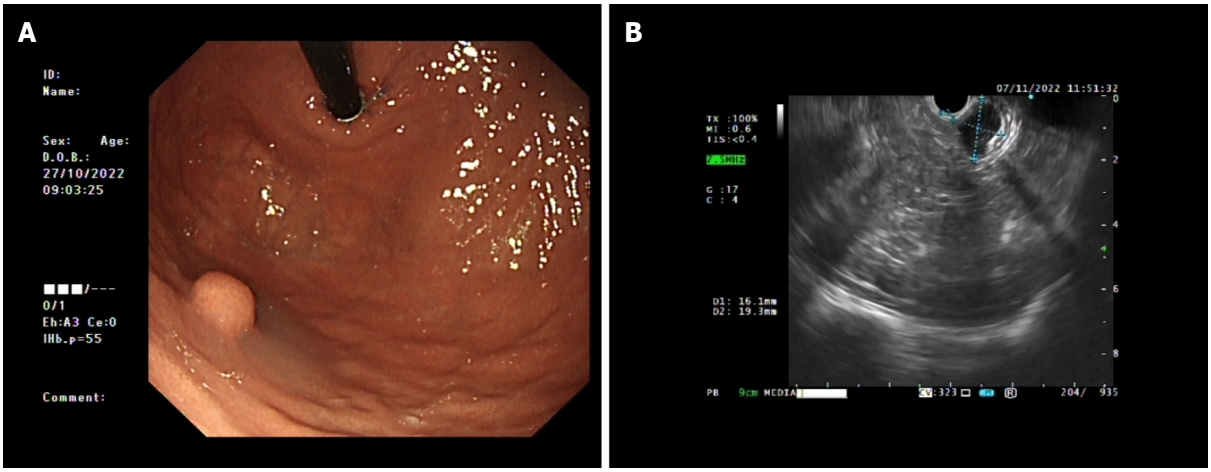


**Figure 1 Preoperative endoscopic examination results.** A: Endoscopic image showing a hemispherical protrusion, approximately 16 mm in diameter, located at the upper gastric curvature adjacent to the stomach fundus, with a smooth surface mucosa and poor mobility; B: Endoscopic ultrasound image showing a mass 19.3 mm × 16.1 mm in size, derived from the muscularis propria, which partly grew outside the cavity. The echo pattern of the mass was uniform and at a low level.

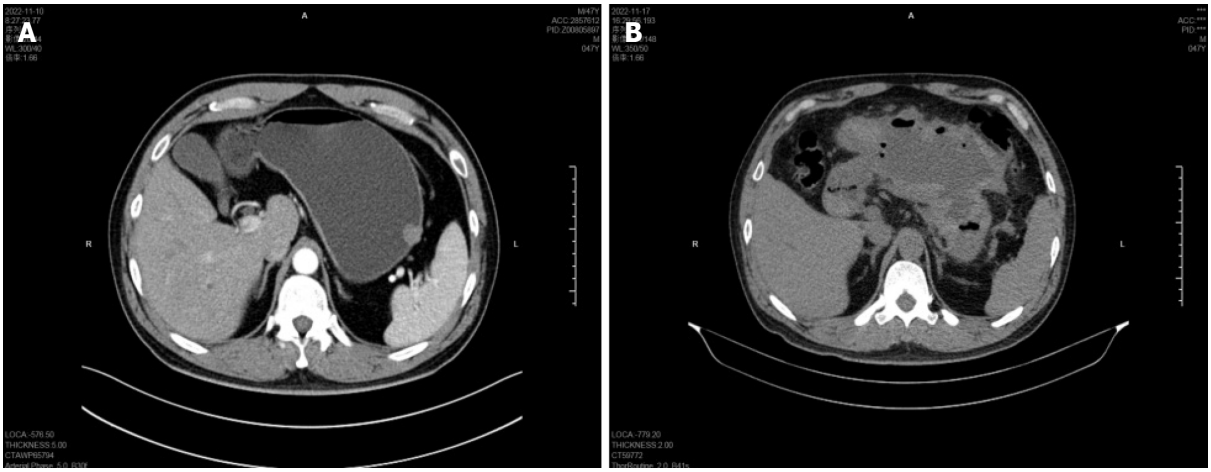


**Figure 2 Abdominal computed tomography examination.** A: Gastric computed tomography (CT) illustrated a well-demarcated mass, 16 mm × 15 mm in size, demonstrating mild enhancement, with an intact mucosal line; B: Abdominal CT revealed a large amount of encapsulated fluid and gas accumulation around the stomach.

During the second hospitalization, according to the blood chemistry tests, the patient received treatment with cefoperazone sodium and sulbactam sodium for injection to control infection. An intravenous infusion of omeprazole for acid suppression was also given, and other therapies were adopted to maintain electrolyte balance. Additionally, based on the endoscopic and imaging results, the patient received gastrointestinal decompression, and 210 mL of dark red bloody liquid was intermittently drained over 12 h. The patient was given norepinephrine nasal feeding and hemostasis treatment intermittently. On the second day of hospitalization, the antibiotic was upgraded to meropenem for anti-infection treatment. The subsequent findings of abdominal puncture fluid culture and blood culture demonstrated the correctness of changing the medication. Under ultrasound guidance, a puncture tube was placed to drain abdominal fluid, and dark red bloody liquid was extracted, which further confirmed the diagnosis of postoperative bleeding both in the gastric cavity and on the serosal surface after exposed EFTR, which formed an encapsulated hemoperitoneum in the abdominal cavity. The amount of encapsulated fluid in the abdominal cavity was reduced by gastrointestinal decompression drainage and abdominal puncture drainage, during which 0.9% physiological saline was used for intermittent flushing and drainage.

## OUTCOME AND FOLLOW-UP

After comprehensive treatment by endoscopic hemostasis, abdominal puncture and drainage, and anti-infection, this treatment regimen was considered efficacious. The patient gradually recovered following bleeding and abdominal infection caused by exposed EFTR and was ultimately discharged on the 13$^{th}$ d after admission.

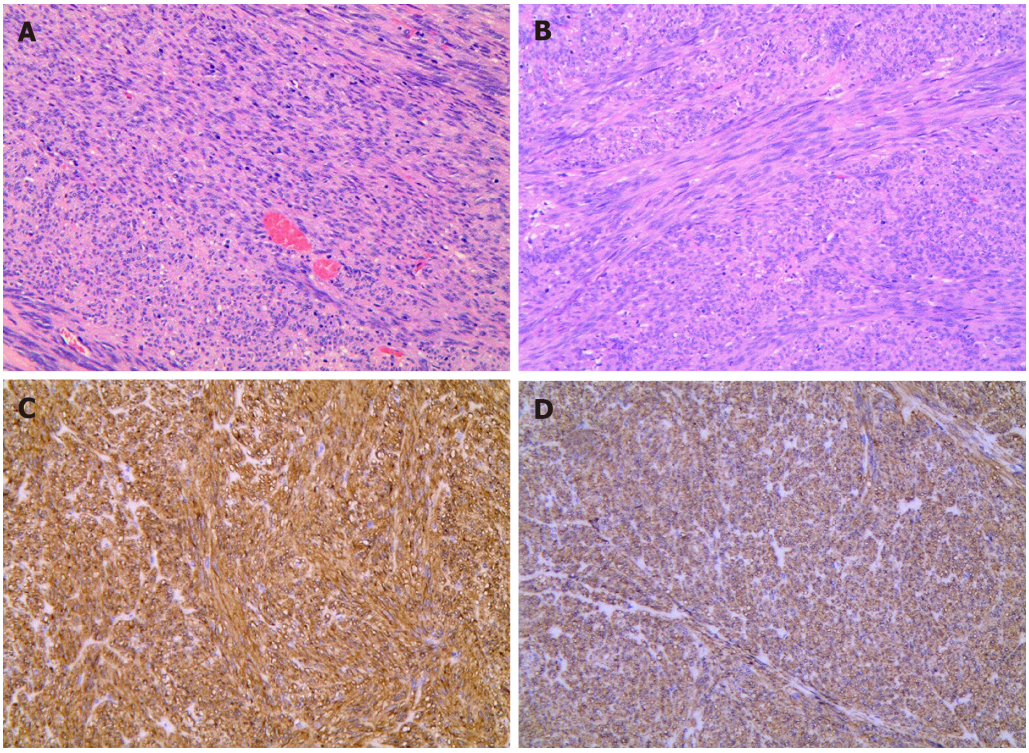


**Figure 3 Postoperative pathological examination results.** A and B: The tumor was located in the muscularis propria and was a spindle cell tumor, arranged in a bundle-like interweaving pattern with mild nuclear atypia (H&E, original magnification × 100); C and D: Immunohistochemical staining of tumor cells showed diffuse positivity for CD117 (C) and DOG1 (D), which were diffusely expressed on the surface of cell membranes.

Based on the Chinese expert consensus on the endoscopic diagnosis and treatment of gastrointestinal stromal tumor (2020, Beijing), it is recommended that such patients undergo endoscopic examination within 1 year after endoscopic treatment, to evaluate wound healing and tumor recurrence at 3 mo, 6 mo, and 12 mo after surgery. CT scans can be performed every 6-12 mo within 5 years after surgery, but our patient's compliance was poor. The most recent gastroscopy review at 11 mo after surgery did not show tumor recurrence, and routine blood examinations indicated that hsCRP was completely normal. Additionally, abdominal ultrasound indicated that there was no obvious mass echo or liquid in the abdominal cavity.

## DISCUSSION

For gastric stromal tumors originating from the muscularis propria that grow in an extraluminal manner or are closely connected to the serosal layer, routine ESD is prone to perforation and incomplete tumor resection[9,15-17]. Instead, exposed EFTR without laparoscopic assistance is capable of completely removing the tumor and reducing the recurrence rate[18,19]. Therefore, exposed EFTR, as a new minimally invasive technology, has therapeutic potential for patients with gastrointestinal submucosal tumors[20-23]. In addition, compared with surgical procedures, exposed EFTR has advantages such as less trauma and maintains the original anatomy and function of the stomach to an extent[24,25]. However, the most crucial issue for exposed EFTR is ensuring the complete closure of the gastric resection site in order to decrease the probability of complications, such as delayed hemorrhage, perforation, infections, and abdominal abscesses [26-29]. Furthermore, serious complications may be life-threatening[30]. Thus, the prevention and treatment of complications are of vital significance.

Postoperative hemorrhage is one of the most common complications following exposed EFTR[31,32]. In clinical practice, hemorrhage is divided into intraoperative bleeding and delayed bleeding based on the time of bleeding[33-35]. Moreover, according to the bleeding location, it can be classified into intracavitary bleeding and serosal bleeding[36]. Postoperative bleeding has a close association with the location of the lesion, and patients with tumors located at the junction of the gastric fundus are prone to delayed bleeding after exposed EFTR[37]. In this case, the lesion was located at the junction of the gastric fundus. After surgery, the gastric wall defect was completely clamped from both sides of the wound to the center with metal clips under direct vision *via* the endoscope, and postoperative hemorrhage subsequently occurred.

Previous reports have shown that postoperative bleeding after exposed EFTR is mainly manifested as hematemesis, melena, hematochezia, and decreased blood pressure[32,37]. However, in this patient, poor appetite and fatigue were the main symptoms, with bleeding in both the gastric cavity and the serous surface. Additionally, serous surface bleeding led to an encapsulated hemoperitoneum in the abdominal cavity, which is relatively rare in clinical practice. The postoperative bleeding in this patient may have been the result of the abundant blood supply to the gastric body and the

large diameter of the arteries. The large wound surface in exposed EFTR can easily cause extra-serous blood vessel injury and slow recovery of the full-layer defect of the stomach wall, and the wound surface of the stomach body can easily cause blood vessel exposure or even blood vessel destruction after overeating. All these reasons could have led to postoperative hemorrhage in this patient.

In this case, gastrointestinal decompression drainage of bright red bloody fluid illustrated intracavitary bleeding. Thus, we achieved cessation of bleeding under endoscopy. With regard to a treatment strategy for serous surface bleeding forming an encapsulated hemoperitoneum in the abdominal cavity after exposed EFTR, to date, there is no relevant literature on this issue. Based on clinical experience, we carried out intraperitoneal puncture drainage to drain dark red bloody fluid *via* abdominal ultrasound. In addition, we adopted intermittent postoperative saline irrigation, clamping, or opening of drainage tubes to monitor bleeding and reduce infection. The encapsulated effusion sac gradually shrank and then disappeared completely.

The combination therapy approach involving abdominal puncture and drainage under ultrasound guidance combined with antibiotics for anti-infection treatment proved to be effective in this patient. There are potential effects when adopting ultrasound-guided puncture and drainage for intra-abdominal hemorrhage. First, it can clarify the nature of intra-abdominal effusion and monitor bleeding. Second, intermittent drainage and flushing can reduce the incidence of infection and facilitate the absorption of intra-abdominal hemorrhage. Third, puncture fluid culture is capable of determining the source of infection and providing guidance for the utilization of sensitive antibiotics. However, reducing postoperative bleeding at the origin is of vital importance. The adoption of closure techniques is capable of achieving a full-thickness post-EFTR defect closure for the purpose of reducing EFTR-related complications[38]. To date, the closure of transmural defects after exposed EFTR is largely achieved through through-the-scope (TTS) clips or clips combined with endoloops. However, owing to the superficial bite of the clips, full thickness defect closure is difficult to achieve by these techniques. Thus, an appropriate closure approach is crucial for exposed EFTR to promote its effectiveness and safety. Compared with both TTS clips and endoloops, the Ovesco over-the-scope clip system and OverStitch endoscopic suturing system have the significant advantages of realizing full-thickness closure and incorporating the muscularis propria layer, but the main limitation of these techniques is their high cost. However, the cost-effectiveness of post-EFTR defect closure using endosuturing requires further investigation in light of its potential capability of reducing complications, hospitalization, and the need for surgery.

## CONCLUSION

Hemorrhage is a common complication after exposed EFTR. In this case, both the gastric cavity and the serosal surface showed bleeding, and the serosal surface bleeding formed an encapsulated hemoperitoneum in the abdominal cavity, which is rare in clinical practice. Clinical diagnosis and treatment require timely gastrointestinal decompression and gastroscopy examination. Early identification and diagnosis of delayed bleeding after exposed EFTR are crucial. While there are no obvious symptoms in the early stage, abdominal CT scan is crucial to identify specific complications. In addition, timely abdominal ultrasound examination and abdominal puncture and drainage under ultrasound guidance in combination with antibiotics for anti-infection are necessary. Our patient experienced delayed bleeding, encapsulated hemoperitoneum, and abdominal infection after exposed EFTR, which resolved after non-surgical treatment.

## FOOTNOTES

**Author contributions:** Lu HF wrote the manuscript; Li JJ performed the endoscopy and endoscopic ultrasound, and made the clinical diagnosis and treatment plan; Zhu DB and Xu LF supervised the diagnosis and treatment of this patient; Mao LQ and Yu J collected the clinical data and performed the follow-up; Yao LH revised the manuscript; all authors have read and approved the final manuscript.

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