Endoscopic transcecal appendectomy: a new endotherapy for appendiceal orifice lesions

Background

Endoscopic transcecal appendectomy (ETA) has been reported as a minimally invasive alternative procedure for lesions involving the appendiceal orifice. The aim of this case series study was to evaluate the feasibility, safety, and effectiveness of ETA for lesions at the appendiceal orifice.

Methods

This retrospective study included consecutive patients with appendiceal orifice lesions who underwent ETA between December 2018 and March 2021. The primary

Fig. 1

Supplementary material is available under https://doi.org/10.1055/a-1675-2625

Introduction

The advancement in endoscopic instruments has allowed endoscopic treatment to become the primary choice for treatment of various colorectal lesions such as polyps, laterally spreading tumors (LSTs), and submucosal lesions (SMLs) [1]. Endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) have become the most commonly used methods for these colorectal lesions [2–4]. However, for lesions involving the appendiceal orifice, especially for lesions that invade deeply into the appendiceal lumen, complete resection with EMR or ESD is technically challenging because the distal margin cannot be fully visualized [2–4]. These types of lesions often require surgical interventions [5].

In recent years, endoscopic full-thickness resection (EFTR) using a specially designed EFTR device (FTRD; Ovesco Endoscopy, Tübingen, Germany) has been introduced to dissect lesions involving the appendiceal orifice [6–8]. Although it is a single-step and non-exposure procedure, the EFTR still cannot ensure complete resection of lesions with deep invasion into the appendiceal lumen, and may lead to a higher incidence of postoperative appendicitis [6–8]. Surgery may be needed for some of these patients owing to postoperative perforation or intrabdominal abscess [6–8]. In 2018, Liu et al. reported the first description of full-thickness resection of lesions involving the appendiceal orifice and simultaneous dissection of the appendix [9], known as the endoscopic transcecal appendectomy (ETA) technique. The ETA technique allows the appendiceal lesion to be completely resected regardless of its extension into the appendiceal orifice, and prevents the possibility for development of postoperative appendicitis. To date, the ETA technique has been applied to various appendiceal orifice lesions including colonic sessile serrated lesions, appendiceal retention cysts, appendiceal polyps, and chronic appendicitis [9–12]. However, previous studies on ETA have been generally small (four cases at most) [9–12].

The present retrospective case series study was designed to evaluate the feasibility, safety, and effectiveness of ETA in the management of lesions at the appendiceal orifice, including polypoid lesions, LSTs, and SMLs.

Methods

Study design

This retrospective case series study was conducted in a tertiary hospital (West China Hospital, Sichuan University, Chengdu, China). The study protocol was reviewed and approved by the Biomedical Research Ethics Committee of West China Hospital, Sichuan University.

Patients

Consecutive patients with appendiceal orifice lesions who underwent ETA in our hospital between December 2018 and March 2021 were retrospectively reviewed from our database of prospectively collected data. Patients with advanced carcinoma or with previous appendectomy were excluded. All patients received a preoperative consultation with detailed explanation of the pros and cons of different approaches including surgery, ESD, EFTR, and the novel ETA procedure. Informed consent to undergo the ETA procedure was obtained from all included patients.

Procedures

All ETA procedures were performed by an advanced endoscopist (B.H.), who had performed ≥400 colorectal ESD procedures prior to the current study. All patients underwent strict bowel preparation to reduce intestinal contents and were treated under general anesthesia with intubation. Before the procedures, the enteric cavities were cleaned using sterilized water. All ETA procedures were performed using Olympus endoscopes (PCF-Q260L; Olympus, Tokyo, Japan) and routine ESD instruments: insulated-tip knife (IT knife), dual knife, hook knife, a straight 4-mm clear cap, metal clips, and endoloop. A 20-ml syringe with 18-G needle was also available for abdominal decompression when the endoscope was introduced into the abdomen.

The ETA procedure involved the following steps (Fig. 1, Fig. 2, Video 1): 1) circumferential marking of the lesion border using a dual knife with soft coagulation ERBE setting; 2) near-circumferential full-thickness resection around the lesion using dual knife and IT knife with Endocut setting; 3) introduction of the endoscope into the peritoneal cavity through the incision in order to dissect and cut off the mesoappendix and appendicular artery using the IT knife or hook knife; 4) snare-assisted traction of the partially dissected appendix for con tin—

Guo Linjie et al. Endoscopic transcecal appendectomy: ... Endoscopy | © 2021. The Author(s).
uous dissection; 5) closure of the defect using double endoscopic suture technique after repeated cleansing of the resected area. A nasogastric tube was inserted into the rectum for anal decompression and removed after 2–3 days. After the procedure, patients remained fasted for at least 3 days and received intravenous antibiotics during this period.

Outcomes and definitions
The primary outcome of the study was technical success of ETA. Secondary outcomes included postoperative adverse events, postoperative hospital stay, and recurrence. Technical success was defined as successful en bloc resection and R0 resection of neoplastic lesions, and successful en bloc resection of non-neoplastic lesions. En bloc resection was defined as resection of the lesion and the appendix. R0 resection was defined as complete resection with negative margins. Postoperative adverse events included postoperative bleeding, perforation, and intra-abdominal abscess (IAA). Postoperative bleeding was defined as hemorrhage with clinical symptoms and confirmed by emergency endoscopy from the time of procedure completion to postoperative day 28 [13]. Postoperative perforation was defined as perforation of the cecum. IAA was defined as abscess collection inside the abdominal cavity confirmed by abdominal ultrasound or computed tomography scan. Recurrence was defined as neoplastic lesions recurring in the same location [14]. All cases were followed until April 2021.

Statistical analysis
Statistical analyses were conducted using SPSS version 25.0 (IBM Corp., Armonk, New York, USA). Continuous variables were expressed as median and range. Categorical variables were expressed as counts and percentages.

Results
A total of 13 patients with lesions at the appendiceal orifice underwent ETA during the study period. The characteristics of patients, lesions, and outcomes are shown in Table 1. There were six male and seven female patients. Ages ranged from 33 to 87 years, with a median age of 64 years. Six patients had comorbidities and three patients had previous history of abdominal surgery. Under colonoscopy, five lesions manifested as polyloid lesions, four lesions were LSTs, and four lesions were SMLs (see Fig. 1 in the online-only Supplementary material). The median lesion size was 20 mm (range 8–50). Histopathological analysis showed four adenomas, two serrated lesions, four lesions were LSTs, and four lesions were SMLs (see Fig. 1 in the online-only Supplementary material). The median lesion size was 20 mm (range 8–50). Histopathological analysis showed four adenomas, two serrated lesions, four lesions were LSTs, and four lesions were SMLs (see Fig. 1 in the online-only Supplementary material)
(range 3–13) and 8 days (range 6–18), respectively. There were no cases of postoperative bleeding, perforation, or IAA. The median medical cost during the whole hospitalization was 37,219 yuan (range 31,206–53,450). During a median follow-up of 17 months (range 1–28), no recurrence was detected.

**Discussion**

This retrospective case series study showed that all 13 appendiceal orifice lesions were successfully resected using the ETA technique, without postoperative bleeding, perforation, or IAA, demonstrating that ETA is a feasible, safe, and effective technique for the treatment of appendiceal orifice lesions.

With increased colon cancer screening, appendiceal and/or cecal lesions involving the appendiceal orifice are becoming more frequently encountered [15]. Surgery, including right hemicolectomy and partial cecectomy, has often been used as the standard therapy for these lesions. However, right hemicolectomy is associated with relatively high postoperative complications and may be considered excessive for relatively benign lesions such as adenomas, serrated lesions, and low grade appendiceal mucinous neoplasms [5,16]. Partial cecectomy can be less invasive than hemicolectomy, but it is difficult for the surgeon to visualize the lesion margins, thus extended resection or even right hemicolectomy may be performed in certain cases to ensure negative margins are obtained [5]. In addition, conversion from laparoscopic to open surgery may be needed in some cases, which further increases medical costs and surgical trauma [17]. Compared with surgery, ETA has several potential advantages. First, endoscopists can directly visualize the extent of the appendiceal orifice lesion, which could allow maximum preservation of the ileocecal valve and intestine. Second, endoscopists have more direct access to the appendiceal orifice lesion and the appendix, which could facilitate the identification of the appendix and reduce potential injuries to surrounding tissues, especially in patients with previous abdominal surgery. Third, the ETA technique leaves no scar on the abdomen and has no complications associated with surgical incision, such as incisional hernia and wound infection [18].

Endoscopic procedures such as EMR, ESD, and EFTR are also alternative treatments for appendiceal orifice lesions [2–4,6–8]. However, it is not appropriate to perform EMR if the lesion margin inside the appendiceal orifice cannot be visualized or if more than 50% of the circumference of the appendiceal orifice is involved [2]. R0 resection is often not achievable using the conventional ESD technique if the lesion extends deeply into the appendiceal orifice or if the lesion involves more than 75% of the appendiceal orifice circumference [3,4]. Traction-assisted ESD can achieve higher R0 resection rates (more than 80%) for lesions extending into the appendiceal orifice, with short procedure times and length of stay, but additional surgery is required in some of these patients, especially for patients with deep invasion without previous appendectomy (27.3%, 3/11) [19]. Recently reported single-step, non-exposure EFTR allows only partial resection of the appendix [6–8], and thus residual lesion tissue may remain. Reported rates of R0 resection using EFTR ranged from 64% to 93% [6–8]. In addition, postoperative appendicitis may develop when using ESD or EFTR for appendiceal orifice lesions [3,6–8]. In contrast, ETA can achieve complete resection of the lesion and the appendix simultaneously, avoiding residual lesion tissue and postoperative appendicitis. In the present study, complete resection was achieved in all cases.
Male 6 (46)
High grade intraepithelial neoplasia 2 (15)
Submucosal lesion 4 (31)
Polypoid lesion 5 (38)
Sessile serrated lesion 2 (15)
Low grade appendiceal mucinous neoplasm (Tis) 1 (8)
Low grade intraepithelial neoplasia 1 (8)
Laterally spreading tumor 4 (31)
Appendicitis with abscess or cyst 3 (23)

Female 7 (54)
Adenoma 4 (31)
Sessile serrated lesion 2 (15)
High grade intraepithelial neoplasia 2 (15)
Low grade intraepithelial neoplasia 1 (8)
Low grade appendiceal mucinous neoplasm (Tis) 1 (8)
Appendicitis with abscess or cyst 3 (23)

Technical success, n (%) 13 (100)
Postoperative adverse events, n (%) 0 (0)
Procedure time, median (range), minutes 167 (90–220)
Fasting time, median (range), days 4 (3–13)
Postoperative hospital stays, median (range), days 8 (6–18)

Technical success, n (%) 13 (100)
Postoperative adverse events, n (%) 0 (0)
Procedure time, median (range), minutes 167 (90–220)
Fasting time, median (range), days 4 (3–13)
Postoperative hospital stays, median (range), days 8 (6–18)

Medical cost, median (range), yuan 37 219 (31 206–53 450)
Follow-up, median (range), months 17 (1–28)
Recurrence, n (%) 0 (0)

1 Comorbidity including hypertension, coronary heart disease, asthma, hyperthyroidism, and diabetes.
2 Previous surgery including surgery for rectal cancer and sigmoid colon cancer.

In conclusion, ETA was shown to be feasible, safe, and effective in the management of appendiceal orifice lesions. Large, multicenter, prospective studies are needed to further assess this technique.

Acknowledgment
This research was funded by National Natural Science Foundation of China (Grant No: 82170675) and 1·3·5 project for disciplines of excellence, West China Hospital, Sichuan University (Grant No: ZYJC21011).
Competing interests

The authors declare that they have no conflict of interest.

Funding

1·3·5 project for disciplines of excellence, West China Hospital, Sichuan University ZYJC21011
National Natural Science Foundation of China 82170675

References

[2] Tate DJ, Desomer L, Awadie H et al. EMR of laterally spreading lesions around or involving the appendiceal orifice: technique, risk factors for failure, and outcomes of a tertiary referral cohort (with video). Gastrointest Endosc 2018; 87: 1279–1288