Surgical Endoscopy (2019) 33:4048–4056
https://doi.org/10.1007/s00464-019-06698-x

Clinical outcomes of endoscopic resection for non-ampullary duodenal laterally spreading tumors

Jiale Zou[1] · Ningli Chai[1] · Enqiang Linghu[1] · Yaqi Zhai[1] · Zhenjuan Li[1] · Chen Du[1] · Longsong Li[1]

Received: 15 October 2018 / Accepted: 6 February 2019 / Published online: 12 February 2019

Abstract

Background and aims Non-ampullary duodenal laterally spreading tumors (NAD-LSTs) mimic the morphological features and natural history of colorectal LSTs, even achieving a large size but lacking invasive behavior; thus, they are suited for endoscopic resection (ER). At present, the endoscopic therapeutic approach in NAD-LSTs has not been clearly established. The aim of this study was to evaluate the efficacy and safety of ER for NAD-LSTs and to evaluate the risk factors for delayed perforation after ER of NAD-LSTs.

Patients and methods A total of 54 patients with 54 NAD-LSTs treated with ER at the Chinese PLA General Hospital between January 2007 and January 2018 were retrospectively analyzed. Data on patient demographic, clinicopathological characteristics of the lesions, outcomes of ER, and results of follow-up endoscopies were collected.

Results The mean (SD) lesion size was 26.9 mm (8.5). Endoscopic mucosal resection (EMR) was performed in 21 lesions, and endoscopic submucosal dissection (ESD) was performed in 33 lesions. R0 resection was achieved in 93.9% of the ESD group and 38.1% of the EMR group ($p = 0.000$). Delayed bleeding was noted in two patients. Delayed perforation was identified in four patients. The incidence of delayed perforation showed a significant association with post-ampullary tumor location ($p = 0.030$). Follow-up endoscopy was performed in all cases with a mean (SD) period of 22.1 months (8.2), and local recurrence was identified in four cases after piecemeal EMR.

Conclusions ER of NAD-LSTs is a feasible and less invasive treatment. However, ER of NAD-LSTs is associated with serious adverse events such as delayed perforation, especially in patients with lesions located distal to Vater's ampulla.

Keywords Endoscopic resection · Non-ampullary duodenal laterally spreading tumors · Delayed perforation

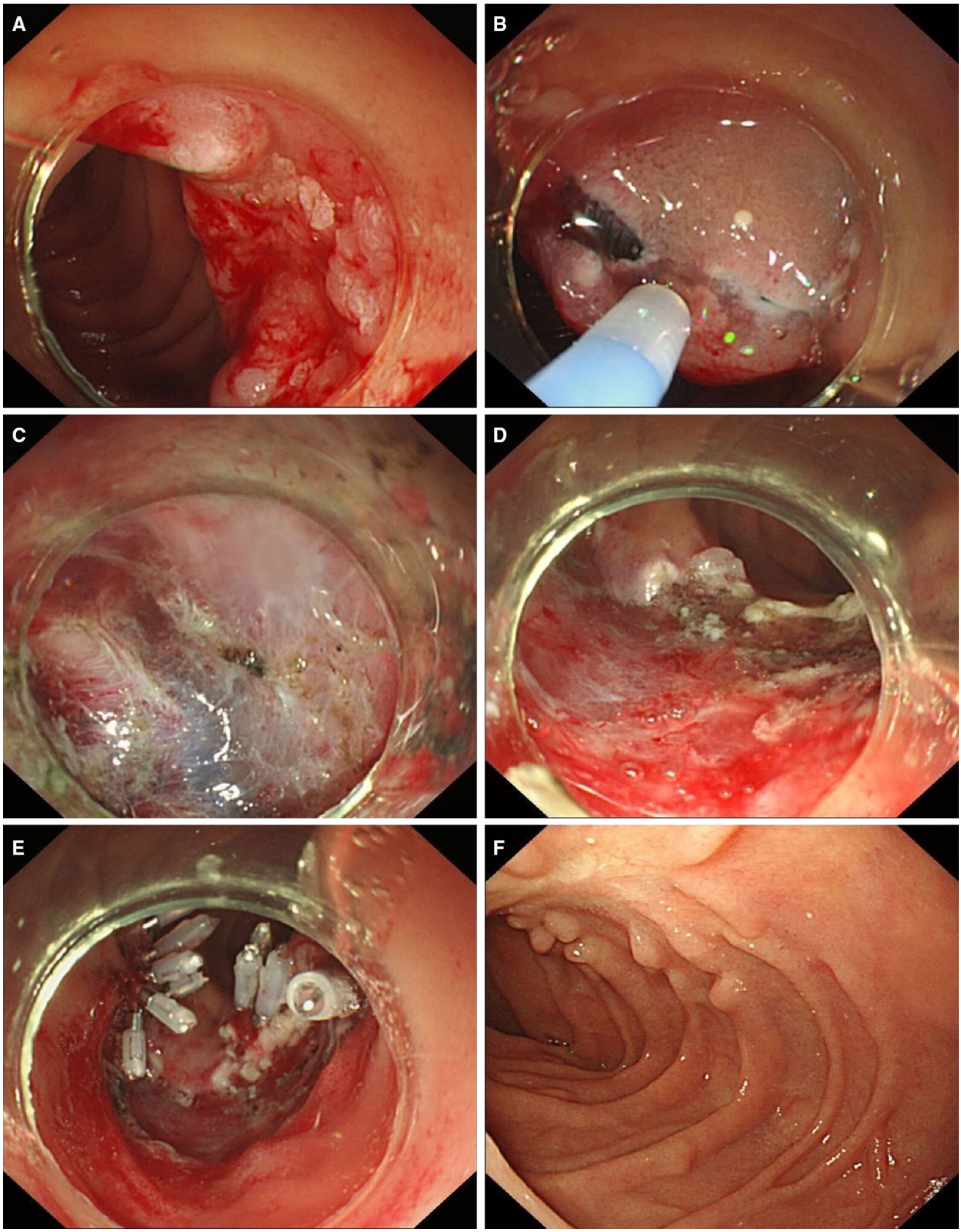
With the increasing use of upper endoscopy, increasingly more non-ampullary superficial duodenal tumors (NASDTs) are found in asymptomatic patients [1, 2]. There are various morphological types of NASDTs, of which a subgroup extends laterally and circumferentially rather than vertically along the lumen [3, 4]. These tumors mimic the morphological features and natural history of colorectal laterally spreading tumors (LSTs), even achieving a large size but lacking invasive behavior; thus, they are suited for less invasive therapies, including endoscopic resection (ER) [3–5]. ER of NASDTs by endoscopic mucosal resection (EMR) is technically easy and with low rates of procedure-related adverse events; however, it is difficult to achieve en bloc resection of lesions > 20 mm [6]. Endoscopic submucosal dissection (ESD) to remove NASDTs can enable en bloc resection regardless of tumor size, allowing accurate pathological evaluation and preventing residual disease and local recurrence. However, ESD is more technically demanding and carries more adverse events in NASDTs [7]. At present, the endoscopic therapeutic approach in non-ampullary duodenal LSTs (NAD-LSTs) has not been clearly established. The aim of this study was to evaluate the efficacy and safety of ER for NAD-LSTs and to evaluate the risk factors for delayed perforation after ER of NAD-LSTs.

Jiale Zou and Ningli Chai have contributed equally to this work.

Jiale Zou and Ningli Chai are co-first authors.

✉ Enqiang Linghu
linghuenqiang@vip.sina.com

[1] Present Address: Department of Gastroenterology, Chinese PLA General Hospital, 28 Fuxing Road, Haidian District, Beijing 100853, China


A
B
C
D
E
F

◂**Fig. 1** **A** A 25 mm × 20 mm laterally spreading adenoma located at the lateral wall of the second part of the duodenum; **B**–**D** the lesion was removed en bloc by endoscopic submucosal dissection (ESD); **E** the margin of mucosal defect after duodenal ESD was closed using multiple clips; **F** follow-up endoscopy after 2 years, showing no evidence of recurrence at the original tumor site

Patients and methods

Patients

This retrospective study was carried out at the Chinese PLA General Hospital. Between January 2007 and January 2018, a total of 54 lesions in 54 patients were diagnosed as NAD-LSTs. They were all treated with ER and enrolled in the study. The selection of ER techniques was determined by the endoscopists during the procedure. In this study, NAD-LSTs were defined as (1) superficial duodenal tumors not involving the papilla; (2) lesions ≥ 10 mm in diameter and extending laterally and circumferentially, rather than vertically, along the interior luminal wall of the duodenum. Patients with ampullary or periampullary tumors as well as familial adenomatous polyposis (FAP) were excluded from the study. Data on patient demographic, clinicopathological characteristics of the lesions, outcomes of ER, and results of follow-up endoscopies were collected. The study was approved by our hospital ethics committee, and written informed consent was obtained from all the patients.

Technique

All the ER procedures were performed with the patient under general anesthesia with endotracheal intubation. Intravenous hyoscine (10–20 mg) was given during the ER procedure to limit intestinal contraction. Lesion size was assessed by an open polypectomy snare placed adjacent to the lesion. All duodenal ER procedures were performed by 2 experienced interventional endoscopists. We used a duodenoscope (TJF-260V, Olympus, Tokyo, Japan) for lesions located at the anteromedial wall of the duodenum and a therapeutic gastroscope with a water-jet system (GIF-Q260J, Olympus, Tokyo, Japan) for lesions located on the lateral or posterior wall. Normal saline solution with dilute epinephrine (1 in 10,000) and indigo carmine was usually added as the submucosal injection solution to elevate the lesion, and sodium hyaluronate was added to the injection solution when mucosal elevation was insufficient.

For the EMR procedure, submucosal injection solution was injected into the underlying submucosal layer to elevate the lesion. The lifted lesion was then isolated using a snare (ASM-1-S, COOK, USA). Before resection, the endoscopists should confirm that the muscularis propria and deeper layers had not been ensnared.

For the ESD procedure, a transparent hood (D-201-11802, Olympus, Tokyo, Japan) was placed on the tip of the endoscope to obtain a satisfactory view during ESD. The circumferential submucosal incision was performed using an electrosurgical knife after submucosal injection. After mucosal incision, direct dissection of the submucosal layer in direct vision was performed. In duodenal ESD, we prefer a short needle-type electrosurgical knife, such as the Dual knife (KD-650U, Olympus, Tokyo, Japan), which facilitates easy mucosal incision and submucosal dissection processes in the duodenum (Fig. 1).

After removing the lesion, electrosurgical hemostatic forceps (FD-410LR, Olympus, Tokyo, Japan) were used on the mucosal defect to prevent and control bleeding. The hemostatic forceps should be slightly pulled away from the muscle layer before coagulation to prevent electrical injury of the thin muscle layer. Conventional clips were used to attempt to close the mucosal defect to prevent postoperative bleeding and perforation.

Histopathological evaluation

All the resected specimens were fixed in 10% buffered formalin. Histopathologic type, lesion size, depth of invasion, tumor involvement in the lateral and vertical margins and lymphovascular invasion were evaluated.

Postoperative treatment and follow-up

All patients were fasted and administered an intravenous proton pump inhibitor (PPI) and octreotide for 72 h. During hospitalization, endoscopy was not routinely performed to check for the formation of ulcers after ER. The patients were closely observed for the prevention of delayed bleeding or perforation by the evaluation of factors such as stool color and abdominal signs and symptoms. If the patients were healthy at this stage, they were discharged with a high dose of oral PPI for 8–10 weeks. Follow-up endoscopy with biopsy were performed 3, 6, and 12 months following ER and every year thereafter to evaluate local recurrence.

Definition of terms

En bloc resection was defined as a lesion resected in a single piece and not piecemeal. R0 resection was defined as en bloc resection with the lateral and vertical margins free of tumor. Delayed bleeding was defined as bleeding requiring

blood transfusion or an emergency endoscopic hemostatic procedure after the ER procedure. Delayed perforation was defined as free air detected on a plain radiograph or computed tomography (CT) performed after the ER procedure. Local recurrence was defined as identifying regrowth at the original tumor site during the follow-up period. The follow-up period was defined as the interval between the date of resection and the most recent endoscopic examinations.

Statistical analyses

Statistical analysis was performed using SPSS software (version 25; IBM, Armonk, NY). Quantitative data are expressed as the means ± standard deviations (SDs) or medians with ranges. Qualitative data are presented as proportions. Continuous variables were compared using Student's *t* test or the Mann–Whitney *U* test. Categorical variables were compared using the Chi-square test or Fisher's exact test. Two-sided *p* values < 0.05 were considered statistically significant.

Results

Patient and lesion characteristics

There were 54 NAD-LSTs from 54 patients in the study. The mean (SD) age was 54.1 years (12.4). The number of male and female patients was 29 and 25. The mean (SD) lesion size was 26.9 mm (8.5). Lesions were principally located at the second portion of the duodenum (70.4%). The most common Paris classification was 0-IIa (53.7%). The distribution of histological types was as follows: adenoma, 9 cases (16.7%); low grade intraepithelial neoplasia (LGIN), 15 cases (27.8%); high grade intraepithelial neoplasia (HGIN), 28 cases (51.8%); intramucosal adenocarcinoma, 2 cases (3.7%) (Table 1).

Table 1 Baseline characteristics of 54 non-ampullary duodenal laterally spreading tumors in 54 patients who underwent endoscopic resection, and clinicopathological characteristics of the tumors

Age, years, mean ± SD	54.1 ± 12.4
Gender (male/female)	29/25
Lesion size, mm, mean ± SD	26.9 ± 8.5
Lesion location, *n* (%)	
D1	16 (29.6%)
D2	38 (70.4%)
Paris classification, *n* (%)	
0-IIa	29 (53.7%)
0-IIa + Is	15 (27.8%)
0-IIa + IIc	10 (18.5%)
Histological classification, *n* (%)	
Adenoma	9 (16.7%)
LGIN	15 (27.8%)
HGIN	28 (51.8%)
Intramucosal adenocarcinoma	2 (3.7%)
Treatment methods, *n* (%)	
EMR	21 (38.9%)
ESD	33 (61.1%)

D1 the first portion of the duodenum, *D2* the second portion of the duodenum, *LGIN* low grade intraepithelial neoplasia, *HGIN* high-grade intraepithelial neoplasia, *EMR* endoscopic mucosal resection, *ESD* endoscopic submucosal dissection

Outcome of EMR and ESD

EMR was performed in 21 lesions, and ESD was performed in 33 lesions. There was no difference between the groups in terms of the baseline characteristics. R0 resection was achieved in 93.9% of the ESD group and 38.1% of the EMR group ($p = 0.000$). The procedure time was significantly shorter in the EMR group than in the ESD group ($p = 0.000$). Delayed bleeding was noted in one EMR patient (4.8%) and one ESD patient (3.0%), and they were all successfully treated by endoscopic clipping and electronic coagulation. No intraoperative perforation occurred. Delayed perforation was identified in four patients (7.4%), and there was no significant difference between EMR group and ESD group in terms of delayed perforation rate (4.8% vs. 9.1%, $p = 0.953$) (Table 2). The four delayed perforations were all detected within 24 h after the procedure. One lesion that was resected into four pieces by piecemeal EMR and three lesions that were removed en bloc by ESD. The mean (SD) size of the four lesions was 28.8 mm (11.8). All four lesions were located distal to Vater's ampulla. Prophylactic endoscopic closure of the mucosal defect by conventional clips was performed in two cases. Finally, the four cases were all successfully treated with local closure by over-the-scope clip (OTSC) (Ovesco Endoscopy AG, Tubingen, Germany) (Fig. 2), fasting, nasogastric tube placement and broad-spectrum antibiotics (Table 3). In addition, the incidence of delayed perforation showed a significant association with post-ampullary tumor location ($p = 0.030$) (Table 4).

Follow-up

Follow-up endoscopy was performed in all cases with a mean (SD) period of 22.1 months (8.2). Local recurrence was identified in four cases, and they were treated by further endoscopic intervention, such as ER or argon plasma

Table 2 Outcomes of EMR and ESD

	EMR ($n=21$)	ESD ($n=33$)	p value
Lesion size, mm, mean ± SD	26.8 ± 8.2	26.9 ± 9.0	0.659
Procedure time, minutes, median (range)	29.0 (24.0–45.0)	39.0 (29.0–67.0)	0.000
En bloc resection, *n* (%)	11 (52.4%)	32 (97.0%)	0.000
R0 resection, *n* (%)	8 (38.1%)	31 (93.9%)	0.000
Delayed bleeding, *n* (%)	1 (4.8%)	1 (3.0%)	1.000
Delayed perforation, *n* (%)	1 (4.8%)	3 (9.1%)	0.953
Hospital stay, days, median (range)	7.0 (5.0–14.0)	6.0 (4.0–16.0)	0.000
Follow-up, months, mean ± SD	26.8 ± 12.3	19.2 ± 7.3	0.001
Local recurrence, *n* (%)	4 (19.0%)	0	0.038

EMR endoscopic mucosal resection, *ESD* endoscopic submucosal dissection

coagulation (APC) ablation. Compare the outcomes between recurrence group and non-recurrence group, the lesion size was significantly larger in the recurrence group than in the non-recurrence group ($p=0.005$). Besides, the four cases were all removed by piecemeal EMR (Table 5).

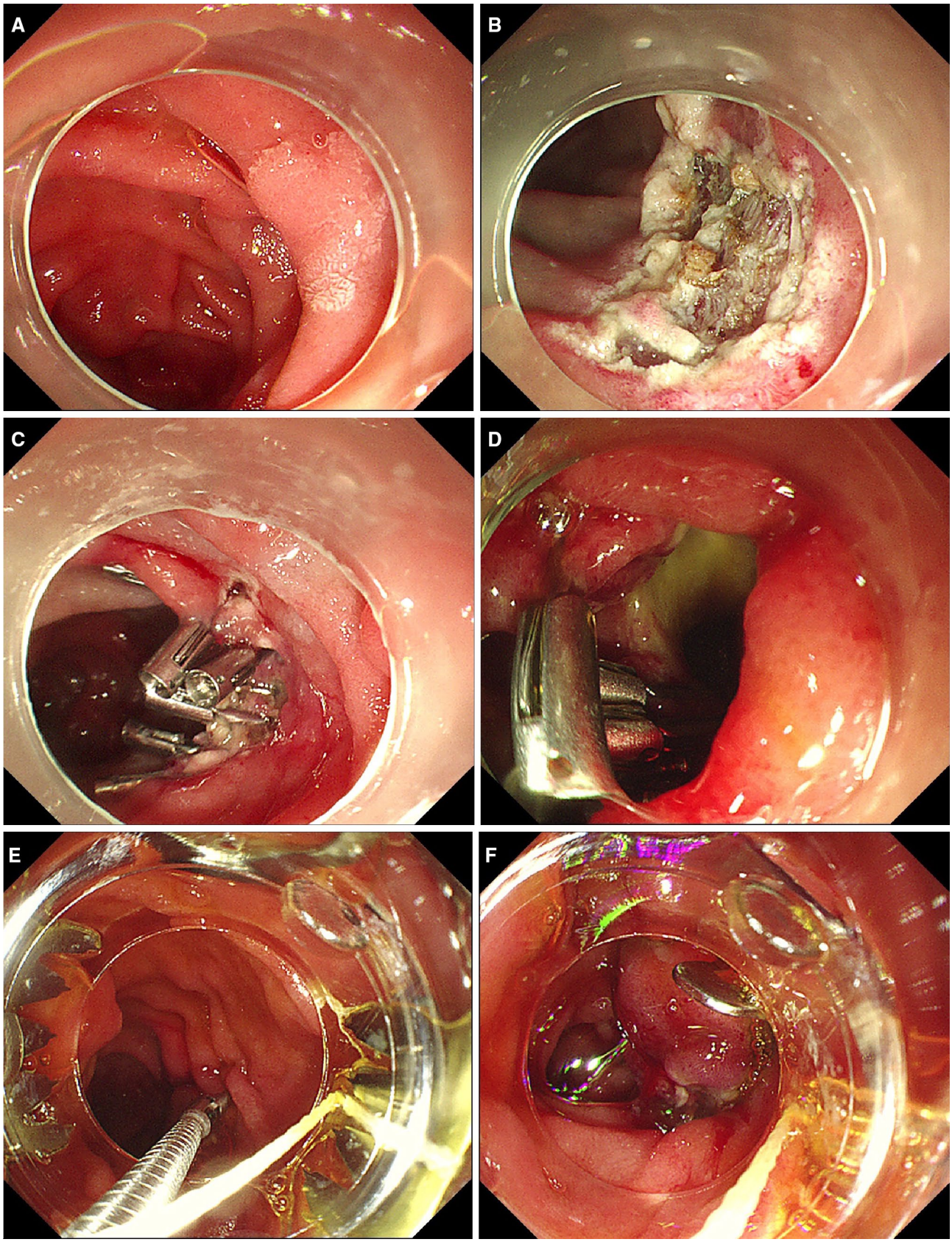
Discussion

This retrospective study examined the outcomes after ER of NAD-LSTs in a Chinese tertiary referral center during a 11-year period. A total of 54 lesions were included in this study, indicating that these lesions are uncommon. Traditionally, NAD-LSTs were managed surgically, including extensive segmental resection and Whipple's pancreatectomy, associated with high perioperative morbidity and mortality rates [8–10]. In addition, endoscopists regarded ER for NAD-LSTs as "hot potatoes" because of the technical challenge and high risk of adverse events and therefore showed reluctance toward performing the procedure. However, with increasing enrichment of endoscopist experience in duodenal ER, and with improvement in the associated tools and peripheral devices, ER has gained acceptance for the treatment of duodenal large lesions with good overall results.

In this study, we carried out EMR for 21 lesions and ESD for 33 lesions. The rates of en bloc and R0 resection by EMR were significantly lower than by ESD. Besides, we noted 4 cases developed local recurrences were all managed by piecemeal EMR, which highlighted the need for careful follow-up assessment after piecemeal EMR to ensure that recurrence can be detected at an early stage. Therefore, based on the evidence of the present study, we considered suitable therapeutic strategy for NAD-LSTs was to achieve R0 resection to prevent local recurrence. Endoscopists can select EMR for NAD-LSTs when R0 resection can be achieved. Otherwise, we recommend ESD for NAD-LSTs which can achieve high R0 resection rate to prevent local recurrence.

ER of NAD-LSTs is technically challenging and is associated with a high incidence rate of adverse events owing to duodenal anatomical peculiarities [6, 11]. The duodenal wall is thinnest in the gastrointestinal tract. ER ulcers are exposed to bile acids and pancreatic juices in the lumen, and the extensive second-order arterial blood supply of the duodenum may increase the risk of adverse events. In this study, delayed diffuse oozing from duodenal ER sites was noted in one EMR patient and one ESD patient, and they were all successfully treated by soft coagulation with hemostatic forceps and endoscopic clipping. As the duodenal wall is too thin, coagulation may cause transmural burns and increase the risk of perforation. Thus, we cautiously use coagulating forceps by slightly pulling away from the muscle layer before coagulation.

Delayed perforation occurred in 7.4% of patients after ER of NAD-LSTs. In our analysis, one case that was removed by piecemeal EMR and three cases that were removed by ESD, however, it was not statistically significant. A likely mechanistic explanation in this case is that ESD is associated with electrical cautery during submucosal dissection or repeated coagulation, resulting in delayed perforation. In addition, the incidence of delayed perforation showed a significant association with post-ampullary tumor location. A likely mechanistic explanation in this case is that ER ulcers distal to Vater's ampulla are fully exposed to bile acids and pancreatic juices, which caused delayed perforation with digestion


A
B
C
D
E
F

◂**Fig. 2** **A** A 15 mm × 12 mm laterally spreading adenoma located at the lateral wall of the second part of the duodenum; **B, C** the mucosal defeat after duodenal endoscopic submucosal dissection (ESD) was closed by clips; **D** the mucosal defect occurred delayed perforation 17 h later after the ESD procedure; **E, F** the perforation was successfully closed with the over-the-scope clip (OTSC)

of the muscle layer. We attempted several interventions to close ER ulcer to prevent delayed perforation. However, each approach carries advantages and disadvantages. We attempted spraying porcine fibrin sealant onto the ER ulcer to prevent delayed perforation, which was safe and easy to perform, especially for large mucosal defects that the size of the conventional clips was insufficient. However, it was tended to fall because of gravitational influence and frequent intestinal contractions. We also perform prophylactic endoscopic closure of the mucosal defect by conventional clips to prevent delayed perforation. However, in the present study, delayed perforation was identified in two patients despite carrying out prophylactic clipping. We believe the following explanations may apply: first, the application of conventional clips may be technically challenging in the duodenum. For example, the second portion of the duodenum lies tangential to the endoscope, making it difficult to completely close the ulcer using conventional clips. Second, as the duodenal tract frequent intestinal contractions, combined with conventional clips' lack of grasping power, detachment of some of the clips may result. Third, as the duodenal wall is too thin, transmural injury may occur by the clip itself. This is especially the case for large mucosal defects of NAD-LSTs after ER in which the size of the conventional clip is insufficient and cannot be anchored by normal mucosa adjacent to a resection defect. Thus, the application of conventional clips to close ER defect in the duodenum may be technically challenging and their role in the duodenum is less clear. An ideal closure of mucosal defect should be effective, safe, and easy to perform. The OTSC is an effective and safe endoscopic method for closure of perforation, fistulas, leaks, and nonvariceal gastrointestinal bleeding, allowing compression of larger amounts of tissue [12, 13]. In the duodenum, it can easily and precisely close large mucosal defects with the assistance of a Twin grasper [14, 15]. In the present study, we successfully applied OTSC to address four patients with delayed perforations.

The limitations of our study were that it was a single-center, retrospective study with a small sample size. Selection of duodenal EMR and ESD without established criteria in this study. Besides, the number of cases with delayed perforation was too small to draw reliable conclusions. Further multicenter studies with larger sample sizes will

Table 3 Clinical features and outcomes of patients with delayed perforation after endoscopic resection

Patient No.	Age, sex	Tumor characteristics					Method	En bloc	Procedure time (min)	Clipping	Time until perforation (h)	Treatment	Hospital stay (days)
		Size (mm)	Location	Pairs	Histology	Depth							
1	Male/71	23	Post-ampulla	IIa + Is	Tubulovillous	M	ESD	Yes	54	Yes	8	OTSC	15
2	Female/63	37	Post-ampulla	IIa + IIc	Tubular	M	ESD	Yes	63	No	13	OTSC	13
3	Female/53	15	Post-ampulla	IIa	Tubulovillous	M	ESD	Yes	32	Yes	17	OTSC	12
4	Female/57	40	Post-ampulla	IIa + IIc	Tubular	M	EPMR	No (4 pieces)	33	No	10	OTSC	14

EPMR piecemeal endoscopic mucosal resection, *ESD* endoscopic submucosal dissection, *OTSC* over-the-scope clip

Table 4 Risk factors for delayed perforation after endoscopic resection for non-ampullary duodenal laterally spreading tumors

	Perforation ($n=4$)	Non-perforation ($n=50$)	p value
Age, years, mean ± SD	61.0 ± 7.8	53.6 ± 12.6	0.253
Gender (male/female)	1/3	28/22	0.499
Lesion size, mm, mean ± SD	28.8 ± 11.8	26.8 ± 8.3	0.659
Lesion location, *n* (%)			0.030
Pre-ampulla	0	34	
Post-ampulla	4	16	
Paris classification, *n* (%)			0.212
0-IIa	1	28	
0-IIa + Is	1	14	
0-IIa + IIc	2	8	
Histological classification, *n* (%)			0.316
Adenoma	2	7	
LGIN	1	14	
HGIN	1	27	
Intramucosal adenocarcinoma	0	2	
Procedure time, minutes, median (range)	43.5 (32–63)	36.5 (24–67)	0.363
Treatment methods, *n* (%)			0.953
EMR	1	20	
ESD	3	30	
Prophylactic clipping			1.000
Not applied	2	20	
Applied	2	30	

LGIN low-grade intraepithelial neoplasia, *HGIN* high-grade intraepithelial neoplasia, *EMR* endoscopic mucosal resection, *ESD* endoscopic submucosal dissection

Table 5 Comparison of outcomes between recurrence group and non-recurrence group

	Recurrence ($n=4$)	Non-recurrence ($n=50$)	p value
Age, years, mean ± SD	52.3 ± 5.1	54.3 ± 12.8	0.756
Gender (male/female)	2/2	27/23	1.000
Lesion size, mm, mean ± SD	38.0 ± 6.8	26.0 ± 8.0	0.005
Lesion location, *n* (%)			1.000
D1	1	15	
D2	3	35	
Paris classification, *n* (%)			1.000
0-IIa	2	27	
0-IIa + Is	1	14	
0-IIa + IIc	1	9	
Histological classification, *n* (%)			0.268
Adenoma	2	7	
LGIN	0	15	
HGIN	2	26	
Intramucosal adenocarcinoma	0	2	
Procedure time, min, median (range)	36.5 (29.0–39.0)	36.5 (24.0–67.0)	0.766
Treatment methods, *n* (%)			0.001
Piecemeal EMR	4	6	
En bloc EMR	0	11	
ESD	0	33	
Follow-up, months, mean ± SD	27.5 ± 5.7	21.6 ± 8.2	0.167

D1 the first portion of the duodenum, *D2* the second portion of the duodenum, *LGIN* low-grade intraepithelial neoplasia, *HGIN* high-grade intraepithelial neoplasia, *EMR* endoscopic mucosal resection, *ESD* endoscopic submucosal dissection

be necessary to establish suitable endoscopic therapeutic approach and obtain reliable conclusions.

In conclusion, ER of NAD-LSTs is a feasible and less invasive treatment. However, ER of NAD-LSTs is associated with serious adverse events such as delayed perforation, especially in patients with lesions located distal to Vater's ampulla. Further effective preventive measures for adverse events are required to achieve better outcomes for those patients with NAD-LSTs.

Compliance with ethical standards

Disclosures Jiale Zou, Ningli Chai, Enqiang Linghu, Yaqi Zhai, Zhenjuan Li, Chen Du, and Longsong Li have no conflicts of interest or financial ties to disclose.

References

1. Goda K, Kikuchi D, Yamamoto Y, Takimoto K, Kakushima N, Morita Y, Doyama H, Gotoda T, Maehata Y, Abe N (2014) Endoscopic diagnosis of superficial non-ampullary duodenal epithelial tumors in Japan: Multicenter case series. Dig Endosc 26:23–29
2. Takizawa K, Oda I, Gotoda T, Yokoi C, Matsuda T, Saito Y, Saito D, Ono H (2008) Routine coagulation of visible vessels may prevent delayed bleeding after endoscopic submucosal dissection- an analysis of risk factors. Endoscopy 40:179–183
3. Klein A, Tutticci N, Singh R, Bourke MJ (2016) Expanding the boundaries of endoscopic resection: circumferential laterally spreading lesions of the duodenum. Gastroenterology 150:560–563
4. Fanning SB, Bourke MJ, Williams SJ, Chung A, Kariyawasam VC (2012) Giant laterally spreading tumors of the duodenum: endoscopic resection outcomes, limitations, and caveats. Gastrointest Endosc 75:805–812
5. Binmoeller KF, Shah JN, Bhat YM, Kane SD (2013) "Underwater" EMR of sporadic laterally spreading nonampullary duodenal adenomas (with video). Gastrointest Endosc 78:496–502
6. Navaneethan U, Hasan MK, Lourdusamy V, Zhu X, Hawes RH, Varadarajulu S (2016) Efficacy and safety of endoscopic mucosal resection of non-ampullary duodenal polyps: a systematic review. Endosc Int Open 4:E699–E708
7. Yamamoto Y, Yoshizawa N, Tomida H, Fujisaki J, Igarashi M (2014) Therapeutic outcomes of endoscopic resection for superficial non-ampullary duodenal tumor. Dig Endosc 26:50–56
8. Perez A, Saltzman JR, Carr-Locke DL, Brooks DC, Osteen RT, Zinner MJ, Ashley SW, Whang EE (2003) Benign nonampullary duodenal neoplasms. J Gastrointest Surg 7:536–541
9. Mukherjee S, Kocher HM, Hutchins RR, Bhattacharya S, Abraham AT (2009) Impact of hospital volume on outcomes for pancreaticoduodenectomy: a single UK HPB centre experience. Eur J Surg Oncol 35:734–738
10. Cameron JL, Riall TS, Coleman J, Belcher KA (2006) One thousand consecutive pancreaticoduodenectomies. Ann Surg 244:10–15
11. Inoue T, Uedo N, Yamashita T, Yamamoto S, Hanaoka N, Takeuchi Y, Higashino K, Ishihara R, Iishi H, Tatsuta M, Takahashi H, Eguchi H, Ohigashi H (2014) Delayed perforation: A hazardous complication of endoscopic resection for non-ampullary duodenal neoplasm. Dig Endosc 26:220–227
12. Wedi E, Gonzalez S, Menke D, Kruse E, Matthes K, Hochberger J (2016) One hundred and one over-the-scope-clip applicactions for severe gastrointestinal bleeding, leaks and fistulas. World J Gastroenterol 22:1844–1853
13. Kirschniak A, Subotova N, Zieker D, Königsrainer A, Kratt T (2011) The over-the-scope clip (OTSC) for the treatment of gastrointestinal bleeding, perforations, and fistulas. Surg Endosc 25:2901–2905
14. von Renteln D, Rudolph HU, Schmidt A, Vassiliou MC, Caca K (2010) Endoscopic closure of duodenal perforations by using an over-the-scope clip: a randomized, controlled porcine study. Gastrointest Endosc 71:131–138
15. Hochberger J, Wedi E, Tchoumak I, Jung C (2016) Over-the-scope clip placement and endosponge insertion for prevention of pancreatic enzyme-induced duodenal damage after large duodenal endoscopic resection. Endoscopy 48:E401–E402