

Endoscopic submucosal dissection for colorectal laterally spreading tumors

Sadettin HÜLAGÜ¹, Ömer ŞENTÜRK¹, Uğur KORKMAZ¹, Göktağ ŞİRİN¹, Ali Erkan DUMAN¹, Gökhan DİNDAR¹, Altay ÇELEBİ¹, Deniz ÖGÜTMEN KOÇ¹, Neslihan BOZKURT¹, Hasan YILMAZ¹, Yeşim GÜRBÜZ², Deniz DUMAN³, Orhan TARÇIN⁴

Departments of ¹Gastroenterology and ²Pathology, Kocaeli University School of Medicine, İzmit

Department of ³Gastroenterology, Marmara University School of Medicine, İstanbul

Department of ⁴Gastroenterology, Acıbadem University School of Medicine, İstanbul

Background/aims: Colorectal laterally spreading tumors are superficial tumors classified into two groups as granular (G-laterally spreading tumor) and non-granular (non-granular-laterally spreading tumor) types. In this study, we aimed to investigate the efficacy and feasibility of endoscopic submucosal dissection in the treatment of laterally spreading tumors. **Materials and Methods:** Forty-four laterally spreading tumors in 40 patients were treated with endoscopic submucosal dissection at a tertiary referral hospital. Patient data were collected retrospectively. In this study, we evaluated tumor size, macroscopic type, lesion location, histology, curative resection, and complications. **Results:** Of the 44 laterally spreading tumors excised by endoscopic submucosal dissection, 29 (65.9%) were G-laterally spreading tumor and 15 (34.1%) were non-granular-laterally spreading tumor. Most of the non-granular-laterally spreading tumors were localized in the right colon, while most G-laterally spreading tumors were localized in the left colon ($p<0.001$). There was also no difference between G-laterally spreading tumors (6/29) and non-granular-laterally spreading tumors (2/15) with regard to exhibiting malignant features ($p=0.69$). Although median size (40 mm vs. 27.5 mm) and procedure time (115 minutes vs. 60 minutes) for G-laterally spreading tumors were bigger and longer respectively, procedure time per cm^2 was not different (8.9 minutes vs. 8.2 minutes) between the two groups. Curative resection rates for laterally spreading tumors were quite high (95.5%), while en bloc resection rates were low (77.3%). The rates of endoscopic submucosal dissection-related complications such as perforation, major and minor bleeding were low (4.5%, 2.3%, 6.8%, respectively). **Conclusion:** Endoscopic submucosal dissection is an effective and safe therapeutic option with high curative rates for early-stage malignant and pre-malignant laterally spreading tumors not having an absolute indication for surgery, regardless of the lesion type and size.

Key words: Endoscopic submucosal dissection, laterally spreading tumors, early colorectal cancer, dysplasia

Kolorektal lateral yayımlı tümörler için endoskopik submukozal diseksiyon

Giriş ve Amaç: Kolorektal lateral yayımlı tümörler, granüler (granüler-lateral yayımlı tümör) ve nongranüler (nongranüler-lateral yayımlı tümör) tip olmak üzere 2 grupta sınıflandırılmaktadır. Bu çalışmanın amacı kolorektal lateral yayımlı tümörlerin tedavisinde endoskopik submukozal diseksiyonun etkinliği ve kullanılabilirliğinin değerlendirilmesidir. **Gereç ve Yöntem:** Üçüncü basamak sağlık hizmeti veren hastanede endoskopik submukozal diseksiyon ile tedavi edilen 40 hastada 44 lezyonun verileri retrospektif olarak toplandı. Bu çalışmada tümör boyutu, makroskopik tipi, lezyon lokalizasyonu, histoloji, küratif rezeksiyon ve komplikasyonlar değerlendirildi. **Bulgular:** Endoskopik submukozal diseksiyon ile çıkarılan 44 lezyonun 29 (65.9%)'u G-lateral yayımlı tümör ve 15 (34.1%)'i nongranüler-lateral yayımlı tümör idi. Nongranüler-lateral yayımlı tümörlerin çoğu sağ kolonda lokalize iken G-lateral yayımlı tümörlerin çoğu sol kolon yerleşimli idi ($p<0.001$). Malignite her 2 lateral yayımlı tümör tipinde de benzer oranlarda gözlemlendi ($p=0.69$). Her ne kadar G-lateral yayımlı tümörlerde ortalama boyut (40 mm'ye karşın 27.5 mm) ve işlem süresi (115 dakikaya karşın 60 dakika) daha uzun olmasına rağmen her cm^2 'ye düşen işlem süresi her 2 tipte de benzerdi (8.9 dakikaya karşın 8.2 dakika). En blok rezeksiyon oranları düşük olmasına rağmen (77.3%), küratif rezeksiyon oranı yüksekti (95.5%). Perforasyon, majör ve minör kanama gibi işleme bağlı komplikasyon oranları düşüktü (4.5%, 2.3%, 6.8%, sırasıyla). **Sonuç:** Endoskopik submukozal diseksiyon, lezyon tipi ve boyutuna bakılmaksızın, cerrahi için tedavi indikasyonları olmayan pre-malign ve erken evre malign kolorektal lateral yayımlı tümörlerde yüksek kür oranları ile güvenli ve etkili bir tedavi seçeneğidir.

Anahtar kelimeler: Endoskopik submukozal diseksiyon, lateral yayımlı tümörler, erken kolorektal kanser, displazi

Address for correspondence: Sadettin HÜLAGÜ
 Kocaeli University School of Medicine,
 Department of Gastroenterology, İzmit, Turkey
 E-mail: shulagu@hotmail.com

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INTRODUCTION

Colorectal laterally spreading tumors (LSTs) typically extend laterally and circumferentially rather than vertically along the colonic wall (1), and the frequency of invasive carcinoma is lower than that of polypoid lesions of similar size. LSTs are usually removed by endoscopic mucosal resection (EMR), however, larger tumors may require piecemeal resection (2-5). Adenomas, mucosal cancers, and superficial submucosal cancers, which have a very low incidence of lymph node metastasis, are histopathologically potential candidates for endoscopic treatment (6,7).

LSTs are defined as lesions greater than 10 mm in diameter which have a low vertical axis and extend laterally along the luminal wall. They are usually classified into two types according to their surface morphology: the granular type (G-LST) and the non-granular type (NG-LST). The granular type consists of collecting nodules that form uneven granular surfaces, whereas the non-granular type exhibits smooth surface (1,8).

Literature studies reveal that G-LSTs are associated with a low incidence of submucosal invasion, which usually occurs under the largest nodule in the majority of such tumors. Consequently, piecemeal resection is a reasonable option for accurate histological assessment if the largest nodule is not partially included in one piece. On the other hand, NG-LSTs show a higher incidence of submucosal invasion, which is often multifocal, and this endoscopically causes difficulty in estimating the deepest point of invasion. Therefore, piecemeal resection is not suitable in NG-LSTs because the deepest point of invasion is likely to be missed, or lymphovascular involvement may occur if the lesion is divided at these significant points. As a result, en bloc resection should be performed for NG-LSTs to adequately evaluate the resected specimen (4,9).

Conventional EMR techniques, however, are inadequate for en bloc resection of LSTs larger than 20 mm, because there can be incomplete removal and local recurrence occasionally after a piecemeal EMR (2,10). EMR depends on the diameter of the lesions; if the neoplasm is larger than 2 cm, the method cannot always be feasible and is associated with high recurrence rate ranging between 2% and 35% (11). As a result, open surgeries, laparoscopic surgeries, and lymph node dissections, have been performed in the past on large LSTs li-

mitted to mucosal or submucosal (SM) invasion less than 1000 μ m from the muscularis mucosae (SM1) despite the negligible risk of lymph node metastasis (7), thus resulting in a considerably lower patient quality of life after surgery compared with EMR (12).

Endoscopic submucosal dissection (ESD) is a new development in therapeutic endoscopy, which allows for en bloc resection of sessile lesions regardless of the diameter, using special "devices" (13,14). ESD was shown to be effective in histopathological evaluation of gastrointestinal premalignant or early-stage malignant lesions, allowing higher complete en block and curative resection compared to EMR (2,15-20).

High en bloc resection rate and reduced rate of recurrence of gastric cancer are major achievements of ESD, however, only experienced endoscopist can perform ESD for colorectal and esophageal cancers - technical difficulty and a high complication rate are the major concerns (15,17).

In this study, we retrospectively examined the data of ESD procedures for colorectal LSTs. In addition, we investigated the safety and effectiveness of ESD for colorectal LST.

MATERIALS and METHODS

Between October 2006 and June 2011, 44 colorectal LST measuring ≥ 20 mm in 40 patients were resected endoscopically in the Kocaeli University Faculty of Medicine. The medical charts were collected and analyzed retrospectively. We defined LSTs as lesions having a low vertical axis and extending laterally along the interior luminal wall and subdivided them into two subtypes based on endoscopic findings. The G-LST was defined as a lesion with even or uneven nodules on the surface, and the NG-LST as a lesion with a smooth surface.

Indication Criteria for ESD

For endoscopic evaluation, pit pattern was inspected after application of 1% indigo carmine. Granular and non-granular lesions ≥ 20 mm were selected. Patients with villous adenoma, tubulovillous adenoma, intramucosal carcinoma, dysplasia, and recurrent lesions were included in the study. Lesions carrying invasive carcinoma risk at the endoscopic inspection were evaluated with endoscopic ultrasonography (O.T, MD; D.D, MD) and/or computed tomography for lymph node metastasis. Patients who had invasive carcinoma, lymph node

metastasis, type V pit pattern with no increase in pit size (loss of pit pattern) after submucosal injection were sent for surgery. Patients who had advanced colorectal cancer, familial adenomatous polyposis, or inflammatory bowel disease were excluded from this study.

Equipment and Procedure

All procedures were performed by a single operator (S.H.) who was highly experienced in ESD.

Prior to an ESD attempt, all lesions were examined with an optical magnifying endoscope (EG-450 ZW5; Fujinon) and colonoscope (EC-590 Z/WL; Fujinon), with 1% indigo carmine used as an adjunct to magnification. The invasion depth of the lesions was examined by echoendoscopes (GF-UE 160-AL5; Olympus) depending on the size and location of the lesion. Then, submucosal injection was performed to lift the lesion. For the injection, a special mixture (1 unit of 2% sodium hyaluronic acid, 3 units of saline, 0.5 mL of epinephrine (1/10 000) and 0.5% of indigo carmine) was used. After sufficient lifting, a flush knife (DK2618JN 20; Fujinon), insulated-tip knife (KD-610L; Olympus) or needle knife (KD-11Q-1) was used to create incision around the lesion, extending into the submucosa. After circumferential incision, a submucosal dissection was performed to remove the lesion in an en bloc fashion.

A semi-circumferential incision was performed initially. After submucosal dissection, circumferential incision was completed. A few cases were accomplished with snare resection, but only after 80% of ESDs were completed.

All of the ESD procedures were performed under deep sedation. A combination of propofol and fentanyl was provided by an anesthesiologist. Patients were continuously monitored with an electrocardiogram, and blood pressure and oxygen saturation were monitored. This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and in compliance with good clinical practice.

Histopathological Examination

Resected specimens were fixed in a 10% buffered formalin solution, embedded on paraffin and then cut into 2–3 mm slices. Each section was stained with hematoxylin-eosin and then histopathologically diagnosed by a highly experienced pathologist. The tumor size, the depth of invasion, lymphatic and vascular involvement, and tumor

invasion to the lateral and basal margins were assessed. Histologic criteria for cure were well-differentiated adenocarcinoma, loss of lymphatic and/or vascular metastasis, intramucosal carcinoma, and loss of neoplastic cells at the lateral and vertical borders. In the cases of invasive carcinoma with massive submucosal invasion ($>1000\ \mu\text{m}$ below the muscularis mucosae), undifferentiated adenocarcinoma, and/or vessel infiltration by cancer cells, additional surgical intervention with removal of regional lymph nodes was recommended.

Definitions and Follow-up Strategy

All the specimens were examined by a single pathologist specialized in gastrointestinal pathology. En bloc resection was defined as the removal of a lesion in a single piece. Piecemeal resection was defined as the removal of a lesion in more than one piece. A recurrent disease was defined as the reappearance of neoplastic tissue at the site of initial ESD at the 6th-month follow-up endoscopy.

A lesion was considered to be completely removed when the vertical and lateral surgical margins were 2 mm away from the lesion. The presence of neoplastic cells at the surgical margins was considered as an incomplete resection. Patients were hospitalized for observation after the procedure and underwent follow-up endoscopies at 6 and 12 months. After a normal endoscopy at the 12th month, annual follow-up was offered.

Statistical Analysis

All calculations were conducted using the SPSS statistical software package version 16.0 (SPSS, Chicago, IL, USA). Descriptive analyses were performed using mean $\pm$ standard deviation (SD) for normally distributed variables, and using medians and interquartile range for the non-normally distributed variables. Comparisons were made with the Fisher's exact and Mann-Whitney U-tests. Differences at $p < 0.05$ were considered statistically significant.

RESULTS

The clinical and pathologic characteristics of the study population are shown in Table 1.

A total of 44 ESD procedures were performed in 40 patients with a median age of 61.5 years. A patient who had been operated for sigmoid colon cancer and who had had an ESD procedure for adenoma with high-grade dysplasia-adenoma (HGD-A) (G-LST) at the anastomosis site, had a second

ESD procedure due to HGD-A (NG-LST) in the rectum although only scar tissue was present in the previous ESD area. A patient who had been operated for sigmoid and transverse colon cancer had ESD procedure due to three low-grade dysplasia-adenoma (LGD-A) (NG-LST) in the caecum. The median size of the lesions was 30 mm (range

20-100 mm). The places of resection were rectum in 27 (61.3%), sigmoid colon in 4 (9%), descending colon in 2 (4.5%), transverse colon in 2 (4.5%), ascending colon in 1 (2.3%), and caecum in 8 (18.2%) lesions, respectively. Comparison between NG-LST and G-LST regarding anatomic site revealed that 9 of the lesions (60%) in the right colon were NG-LST and 2 (7%) of them were G-LST, whereas in the left colon and the rectum, 6 (40%) of them were NG-LST and 27 of them (93%) were G-LST, respectively ($p < 0.001$).

The numbers of early colonic cancer (ECC) in the left and right colon were 1 to 7, whereas 10 lesions in the right colon and 26 lesions in the left colon were premalignant. Histopathological results were similar ($p = 0.65$). On the other hand, six of the G-LST-type tumors were ECC, and the rest were premalignant (HGD-A) (Figure 1A-F), whereas 13 of 15 NG-LST were premalignant (LGD-A or HGD-A) (Figure 2A-F) ($p = 0.69$). Patients who had a non-lifting sign with submucosal injection or type VN pattern were sent for surgery. Possible characteristics of malignancy according to the endoscopic inspection were mild irregular pit pattern (Tip Vi) and presence of a depressed area. Altho-

Table 1. Clinical and pathologic characteristics of the study population

Female / Male	19 (47.5%) / 21 (52.5%)
Age (mean$\pm$SD)	62 $\pm$ 10
Macroscopic view	
Granular type	29 (65.9%)
Non-granular type	15 (34.1%)
Location	
Rectum	27 (61.4%)
Left colon (except rectum)	6 (13%)
Right colon	11 (25.6%)
Lesion size [cm², median (range)]	9 (2-60)
Histopathology	
Adenoma with high grade dysplasia	33 (75%)
Adenoma with low grade dysplasia	3 (6.8%)
Early carcinoma (intramucosal)	8 (18.2%)

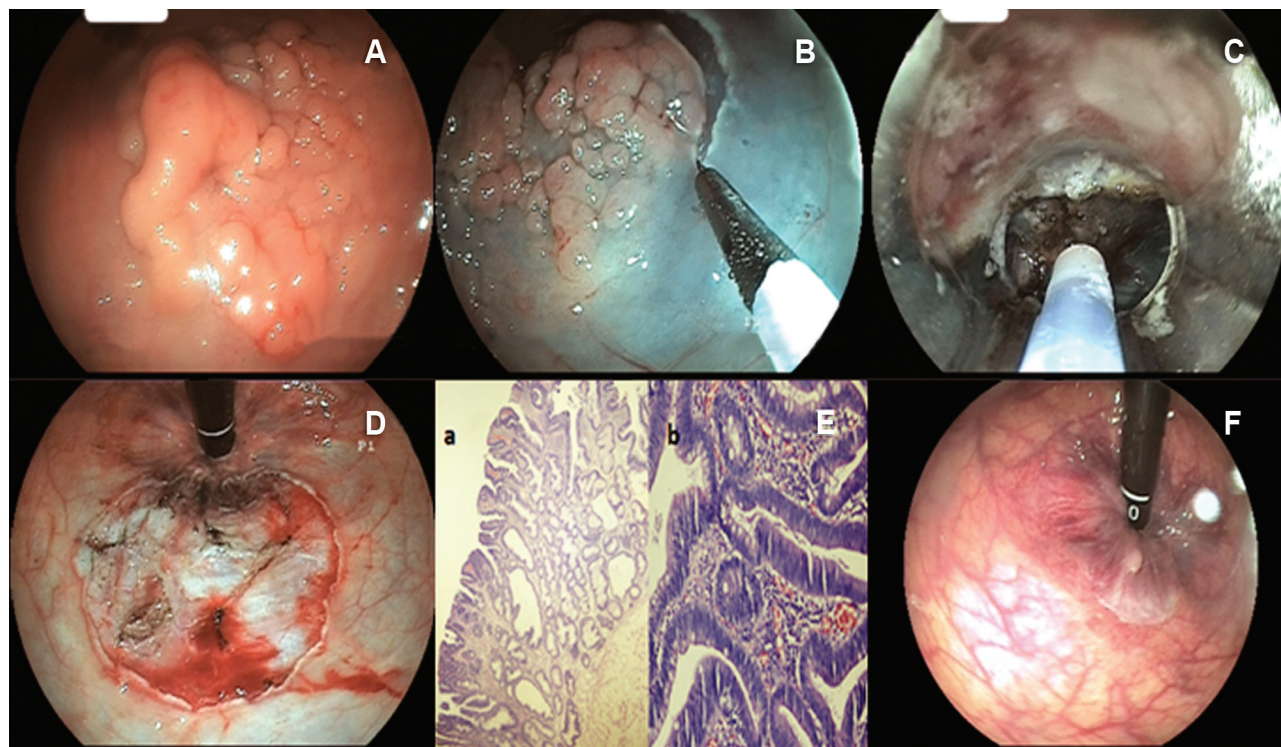


Figure 1. Endoscopic submucosal dissection of granular-type laterally spreading tumor in the rectum. **A.** Granular-type laterally spreading tumor in the rectum; **B.** Cutting the lesion circumferentially with endo-cut; **C.** Endoscopic view completed cutting the lesion circumferentially with endo-cut; **D.** Appearance of the mucosa after the lesion being extracted; **E.** Histology: **a).** Villous adenoma (HEX40); **b).** Villous adenoma with high-grade dysplasia (HEX200); **F.** Endoscopic view eight months after the procedure.

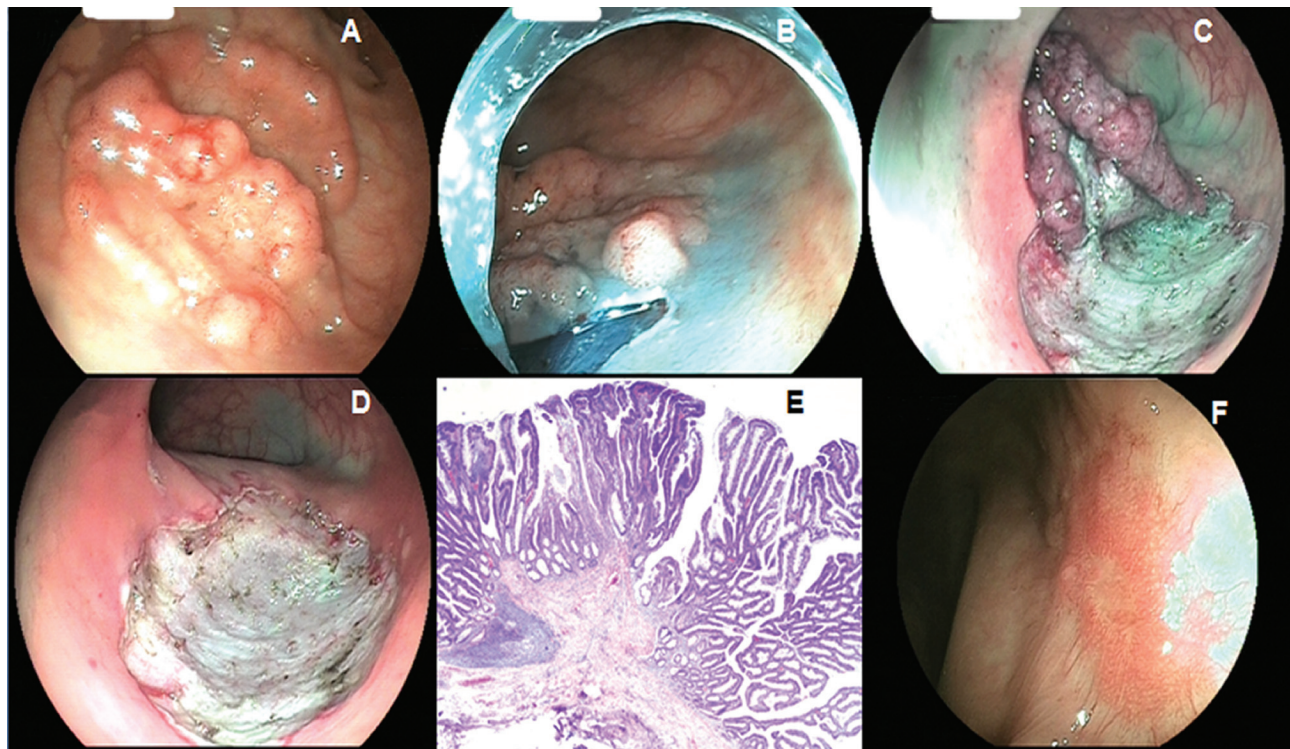


Figure 2. Endoscopic submucosal dissection of non-granular-type laterally spreading tumor in the rectum. **A.** Non-granular-type laterally spreading tumor in the rectum; **B.** Cutting the lesion circumferentially with endo-cut; **C.** Endoscopic view just before completing the submucosal dissection; **D.** Appearance of the mucosa after the lesion being extracted; **E.** Histology: tubulovillous adenoma including fields of focal pattern loss and dysplasia (HEX40); **F.** Endoscopic view ten weeks after the procedure.

Table 2. Characteristics of malignancy of the lesions

	Malignant (n=8) (%)	Pre-malignant (n=36) (%)	<i>p</i> -value
Presence of depressed areas	7 (87.5%)	2 (5.6%)	<0.001*
Mild irregular pit pattern	7 (87.5%)	3 (8.3%)	<0.001*
Lesion diameter [median (min-max)] (mm)	40 (30-80)	30 (20-100)	0.051 ^p

* Fischer's exact test, ^p Mann-Whitney U-test

ugh the malignant lesions were larger, the difference was not statistically significant (Table 2). Lesion type had no effect on the potential for malignancy. Seventy-five percent of the carcinomas were ≥ 40 mm. The sensitivity, specificity, positive and negative predictive values for the presence of depressed area, and the irregular pit pattern are shown in Table 3. The clinical outcome of the 44 ESD procedures is shown in Table 4.

Lesion diameter and procedure duration in patients with G-LST were higher compared to those in patients with NG-LST. However, unit time for cm^2 resection was similar in both groups (Table 5).

Thirty-four lesions were resected en block with ESD, while piecemeal resection was applied in the

Table 3. Sensitivity, specificity, positive and negative predictive values of characteristics for malignancy

	Positive depressed area (%) (%)	Positive mild irregular pit pattern (%)
Sensitivity	87.5	87.5
Specificity	94.4	91.6
Positive predictive value	77.7	70
Negative predictive value	97	97
Overall accuracy	93.1	91

remaining ten lesions, eight of which were G-LST. It is important to note that six patients with G-LST and one with NG-LST lesions who underwent

Table 4. Clinical results and outcome

En bloc resection / Piecemeal resection	34 (77.3%) / 10 (22.7%)
Complete resection / Incomplete resection	43 (97.7%) / 1 (2.3%)
Curative resection rate	42/44 (95.5%)
Recurrence rate	2 (4.5%)
Complications	
Perforation	2 (4.5%)
Major bleeding	1 (2.3%)
Minor bleeding	3 (6.8%)
Procedure time (mean±SD, min)	
Total time min/cm ²	101±73 / 10±6
Endoscopic follow-up period (mean±SD, month)	18±14

piecemeal resection had scar tissue and a history of endoscopic evaluation. Complete resection was possible in 43 of the 44 lesions. A single patient had incomplete resection. A NG-LST patient with en bloc resection, who was diagnosed as carcinoma through histopathological examination, underwent surgery for possible microinvasion. However, the resected tissue had no malignancy. On the other hand, two patients with G-LST and HGD-A showed a recurrence at the sixth month of follow-up. These tumors were elevated by submucosal injection and a second ESD for one of these was applied.

Complications

During the 44 procedures in 40 patients with LST, two microperforations occurred: one in a case with a 25 mm NG-LST HGD-A in the transverse colon, and the other – in a patient with a 60 mm G-LST HGD-A in the rectum. Both patients had scar tissue due to previous endoscopic interventions. Both perforations were encountered in the initial sites. The rectal microperforation was completely cured after application of hemoclip, whereas the perforation in the transverse colon could not be comple-

tely surged. Both patients did not have any problems (recurrence or residual tumor) during the follow-up period.

Major hemorrhage, defined as the need for >2 units of blood transfusion, was observed in a patient with NG-LST ECC. The patient was again treated with hemoclip application and was followed-up conservatively. Minor hemorrhage was defined as hemorrhage lasting for more than one minute and requiring procedures such as hemoclip. No patients with minor hemorrhages needed any transfusions.

DISCUSSION

Colorectal ESD has become the treatment of choice in patients with LST-NG-type tumors >20 mm in size and who were previously surgically treated (12,21). The present study also showed that ESD is effective and reliable in patients with LST. Most of the lesions in the right colon were NG-LST. In our series, G-LSTs were larger and had a tendency to localize in the left colon. There was no difference in the frequency of malignancy although 75% of the malignant lesions were G-LSTs. Endoscopic submucosal dissection showed a very high rate (95.5%) of complete curative resection. Generally, lesions ≥20 mm in size are difficult to resect en bloc by conventional EMR, whereas ESD has no size limitation if the operation is performed by a highly experienced surgeon. Since its introduction, ESD has provided specimens suitable for accurate histological assessment, and it is also predicted to lead to the reduction of local recurrence.

Comparison between G and NG-LSTs according to lesion dimensions showed that G-LSTs were larger. Hurlstone et al (5) demonstrated that G-LSTs tended to localize in the left colon and had a mean diameter of >42 mm, whereas NG-LSTs were seen in the right colon more frequently and had a mean diameter of 24 mm. Toyonaga et al. (22) reported

Table 5. Comparison of continuous variables in patients with granular type laterally spreading tumor [(Median (Min-Max))]

	G-LST (n=29)	NG-LST (n=15)	p-value
Age (year)	61.5 (40-87)	62.5 (41-85)	0.896
Lesion size (mm)	40 (20-100)	27.5 (20-50)	0.001
Lesion size (cm ²)	11 (4-60)	5.5 (2-20)	0.003
Procedure time (total, min)	115 (30-420)	60 (10-120)	<0.001
Procedure time (cm ² , min)	8.9 (1.7-30)	8.2 (2.5-16.6)	0.909

Mann-Whitney U-test, G-LST: Granular type laterally spreading tumor. NG-LST: Non-granular type laterally spreading tumor.

similar findings (more G-LSTs in the left colon with a mean diameter of 36 mm and NG-LSTs in the right colon with a mean diameter of 28 mm). Our series also showed similar findings (more G-LSTs in the left colon with a mean diameter of 40 mm and NG-LSTs in the right colon with a mean diameter of 27.5 mm).

The rate of malignancy in large colorectal lesions was reported to be 5-15% (22). In a large single-center experience, the rate of malignancy was 10.4% for lesions of 16-20 mm and 22.1% for lesions of greater than 20 mm (23). Kudo *et al.* (24) showed that malignancy rate was 24% in LSTs >20 mm in diameter. In another investigation, 11 of the 158 LSTs (7%) were adenocarcinomas (25). Consistent with the literature, the rate of carcinoma in LSTs >20 mm was 18.2% (8/44) in the present study. En bloc resection of LST-type tumors is difficult by conventional EMR and the malignancy risk increases (10,26), especially for lesions ≥ 30 mm in size; ESD should be the intervention of choice for its higher cure rate. The rate of recurrence was only 4.5% in the present study.

The incidence of carcinoma was shown to be higher (28% vs. 10%) in patients with NG-LST in numerous studies (2,22). Uraoka *et al.* (9) showed similar findings. However, Niimi *et al.* (27) reported a malignancy rate of 47% in NG-LST and of 53% in G-LST cases. In the present study, the rate was not significantly different between the two types (20.7% for G-LST and 13.3% for NG-LST).

In a previously published study, en bloc and complete resection rates were found to be 63% vs. 60% for ESD and 55.8% vs. 35% for EMR (28). En bloc resection success rate by ESD ranged between 84% and 99.2% in the literature; piecemeal resection rates ranged between 1% and 16%, complete resection rate ranged between 74.6% and 98.1%, whereas incomplete resection rate ranged between 2% and 25% (18,22,27,29). Although the en bloc resection rate in the current study was among the lowest (77.3%), the complete resection rate was among the highest in the literature (97.7%). We think that the reason for the lower rate of en bloc resection is the higher rate of partial endoscopic resections (polypectomy) and scar tissue formation. At the same time, piecemeal resections were found to be performed especially for big lesions. High curative resection rates despite low rates of en bloc resection are associated with the absence of submucosal invasion. Furthermore, we have detected recurrence at the 6th-month follow-up in a

patient with G-LST treated by piecemeal ESD and in a patient with G-LST treated by en bloc ESD. The first patient was treated with a second ESD procedure. The second patient was planned for second ESD procedure.

Perforation rates due to ESD in patients with LST ranged between 3.5% and 10% in the literature (20,27,29-31). Kim *et al.* (32) found the highest rate as 24.6% (20/81) in their series and reported that fibrosis, tumor dimensions, and duration of the procedure were the predictors of this complication. The perforation rate in the present study was consistent with the literature (2/44; 4.5%). Both perforations were encountered in the initial sites. This shows the importance of experience. On the other hand, bleedings related to ESD procedures ranged between 0.3% (1/268) and 2% (4/200) in the literature (16,22,29). In our patient series, there was a major hemorrhage in a single patient (1/44; 2.3%).

Most of the time, en bloc resection is impossible with conventional EMR because G-LSTs are too large to resect en bloc, and NG-LSTs tend to have multifocal submucosal invasion. ESD has the advantage to resect the largest amount of tissue possible from the deepest point of invasion or lymphovascular involvement, and therefore is the most reliable intervention for the most reliable pathological examination.

Although high en bloc resection rates correlate to low local recurrence rate (10), long-term outcome data, including not only local recurrence but additional treatment, are necessary to prove the superiority of ESD. A direct comparison between ESD and surgical colectomy regarding reliability, efficacy, and cost affectivity has not yet been published.

One of the most important messages of our series is the finding of scar formation due to previous insufficient endoscopic interventions. These parts became partially elevated during the submucosal injection of ESD evaluation. Scar formation was the most influencing factor of unsuccessful en bloc resection. Furthermore, in a patient with G-LST and HGD-A treated with piecemeal resection, recurrence was detected at the sixth month of follow-up. According to the literature, the location of the tumor (near the anal canal) and the piecemeal resection were the two major reasons for this recurrence.

Pit patterns of the lesions significantly correlated with the histopathological results (33). Irregular

pit pattern structure or loss of the pit pattern shows the presence of a carcinoma with 90% sensitivity. The presence of a depressed area also increases the incidence of malignancy (34). Kanao et al. showed that type VN and severe irregular type Vi pit pattern was associated with high levels of deep submucosal invasion (95.7% and 56.1%; respectively) (35). Furthermore, mild irregular type Vi pit pattern was associated with low levels of submucosal invasion. In the present study, we found that

mild irregular pit pattern and depressed areas showed malignancy with a high overall accuracy rate (91% and 93.1%, respectively). Seven of the lesions with mild irregular pit pattern were intramucosal carcinoma and three of them were HGD-A.

In conclusion, ESD is an effective and safe therapeutic option with high curative rates for early-stage malignant and pre-malignant LSTs with no absolute indication for surgery, regardless of the lesion type and size.

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