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Endoscopic submucosal dissection in gastrointestinal lesions: Clinical outcomes from a single center

Huseyin Aykut,[1] Emin Pala,[2] Suleyman Sayar,[3] Oguzhan Ozturk,[4] Resul Kahraman,[5] Kamil Ozdil[6]

[1]Department of Gastroenterology, University of Health Sciences, Umraniye Training and Research Hospital, Istanbul, Turkiye
[2]Department of Gastroenterology, Sancaktepe Sehit Prof. Dr. Ilhan Varank Training and Research Hospital, Istanbul, Turkiye
[3]Department of Gastroenterology, VM Medical Park Pendik Hospital, Istanbul, Turkiye
[4]Department of Gastroenterology, Biruni University Faculty of Medicine Hospital, Istanbul, Turkiye
[5]Department of Gastroenterology, Demiroglu Bilim University Faculty of Medicine, Istanbul, Turkiye
[6]Department of Gastroenterology, Memorial Atasehir Hospital, Istanbul, Turkiye

ABSTRACT

OBJECTIVE: Endoscopic Submucosal Dissection (ESD) is increasingly utilized for en bloc resection of superficial gastrointestinal neoplasms, providing accurate histopathological evaluation and potential curative treatment. Despite its widespread use in Eastern Asia, clinical data from Turkiye remain limited. In this study, we aimed to retrospectively analyze clinical parameters such as technical success, complication rates, histopathological findings and local recurrence rates observed during follow-up in ESD procedures performed at our center.

METHODS: We retrospectively analyzed 147 patients who underwent ESD or hybrid ESD at a tertiary center between January 2020 and January 2025. Demographic characteristics, lesion features, procedural outcomes, complications, and follow-up results were evaluated.

RESULTS: En bloc resection was achieved in 99.3% of cases, with R0 resection in 93.9%. Invasive adenocarcinoma was detected in 7 patients; 3 patients with invasive adenocarcinoma and 1 patient with incomplete resection were referred for surgery. Intra-procedural complications (mainly bleeding) occurred in 3.4%, while post-procedural complications (post-ESD coagulation syndrome or microperforation) occurred in 4.7%. All complications were managed conservatively, and none required surgery. Median hospital stay was 1 day. Recurrence was rare and successfully managed either endoscopically or surgically.

CONCLUSION: ESD is a safe and effective treatment for superficial gastrointestinal neoplasms in appropriately selected patients when performed by an experienced team. High technical success and low complication rates can be achieved in experienced centers. Future prospective, multicenter studies are warranted to establish standardized ESD practice in Turkiye.

Keywords: En bloc resection; endoscopic submucosal dissection; endoscopy; superficial gastrointestinal neoplasms; Turkiye.

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Endoscopic treatment methods are becoming more important in the management of superficial neoplastic lesions in the gastrointestinal tract [1]. Among these approaches, Endoscopic Submucosal Dissection (ESD) stands out for enabling en bloc resection of early-stage malignancies, particularly in the stomach, esoph-

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Correspondence: Huseyin AYKUT, MD. Umraniye Egitim ve Arastirma Hastanesi, Saglik Bilimleri Universitesi, Gastroenteroloji Klinigi, Istanbul, Turkiye.
Tel: +90 505 631 09 18 e-mail: huseyin.ayk@gmail.com

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agus, and colorectal regions, optimizing histopathological staging, and offering potentially curative treatment [2–4]. Initially developed in Japan for the treatment of early gastric cancers, endoscopic submucosal dissection (ESD) has been successfully adapted for esophageal and colon lesions in specialized centers. Nevertheless, ESD has become widely practiced only in a limited number of centers in Western countries, and due to its technical complexity, risk of complications, and long learning curve, it is still being compared with alternative techniques such as endoscopic mucosal resection (EMR) [5, 6].

Although ESD requires more technical expertise than conventional endoscopic mucosal resection (EMR) method, the success rates of ESD have significantly improved with the growing experience of endoscopists [1, 7, 8]. ESD allows for en bloc and R0 resection in lesions that are larger than 20 mm, exhibit lateral spreading, or those that cannot be completely removed through piecemeal resection, thereby enhancing histopathological evaluation and increasing the probability of curative resection [3, 7]. With these features, ESD has become a prominent method in the treatment of premalignant or early-stage malignant epithelial gastrointestinal lesions; it has been adopted as the standard approach in high-volume centers such as Japan and Korea and is applied in selected cases in Europe and America [5, 7].

The main factors affecting the success and complication rates in ESD include the endoscopist's expertise, the location and size of the lesion, the extent of submucosal fibrosis, and patient-specific comorbidities [9, 10]. As experience increases, both en bloc and R0 resection rates rise, while complication rates fall substantially [11–13]. Procedure-related complications include bleeding (2–8%), perforation (1–10%), post-ESD coagulation syndrome (PECS), and stricture development [14, 15]. The risk of stricture and perforation is reported to be higher in lesions located in the esophagus and colon [16, 17]. Proper patient selection, careful anatomical evaluation, use of advanced endoscopic equipment, and an experienced operator have a key role in minimizing these complications [10].

Although an increasing number of studies on the efficacy and safety of ESD are being published worldwide, data obtained from centers in Turkiye are limited in number and largely reflect experiences in relatively small patient groups [18–22].

In this study, we aimed to retrospectively analyze clinical parameters such as technical success (en bloc and R0 resection rates), complication rates (bleeding, perforation, PECS, stricture), histopathological findings, and local recurrence rates observed during follow-up in ESD procedures performed at our center.

Highlight key points

- ESD enables en bloc resection of superficial GI neoplasms, allowing accurate histopathological evaluation and potential curative treatment.
- High technical success rates are consistently reported in experienced centers. Outcomes tend to improve with increasing experience.
- Complication rates are low (~8%) and mostly managed conservatively without need for surgery.

MATERIALS AND METHODS

Study Design and Population

This retrospective observational study was carried out at the Gastroenterology Clinic of Umraniye Training and Research Hospital. The study included eligible patients who underwent ESD or hybrid ESD for superficial neoplastic lesions detected in the esophagus, stomach, duodenum, or colon between January 2020 and January 2025. The indication for ESD was determined based on compliance with the criteria of the ESGE and the Japanese Gastrointestinal Endoscopy Society (JGES). Patients' demographic characteristics (age, gender), comorbidities, lesion location, size, surface pattern, morphological type, histopathological diagnosis, equipment used, and postoperative complications (bleeding, perforation, PECS, stricture) were comprehensively assessed. Clinical data were acquired from the hospital's electronic record system and endoscopy archive.

Definition of Post-procedural Events

Postprocedural adverse events were recorded based on clinical, laboratory, endoscopic, and radiological findings. PECS was defined as the presence of abdominal pain and localized tenderness after ESD, accompanied by mild inflammatory markers (elevated WBC and/or CRP) in the absence of radiologic evidence of perforation. Clinical improvement with conservative management (analgesia, intravenous fluids, and empiric antibiotics) was required for diagnosis confirmation.

Microperforation was defined as a subtle mural defect or minimal extraluminal air detected radiologically without endoscopic evidence of full-thickness perforation, hemodynamic instability, or the need for emergency surgery, and

was managed conservatively. Bleeding was classified as either intraoperative or delayed. Intraoperative bleeding was defined as hemorrhage requiring endoscopic hemostatic intervention (coagulation or clipping) during the procedure. Delayed bleeding was defined as hematemesis, melena, or a ≥2 g/dL drop in hemoglobin level that required endoscopic intervention after the procedure.

Endoscopic Procedure

All patients provided informed consent prior to the procedure, and the necessary preoperative preparations (blood tests, imaging, cessation of antiaggregant or anticoagulants and fasting period) were completed. The sedation protocol was determined by an experienced anesthesiologist based on the location of the lesion and the duration of the procedure. Propofol-based deep sedation was predominantly favored for gastric and colonic lesions.

Endoscopic procedures were performed using Pentax EPK-i7010 (EC-3890LZi, EG-2990Zi endoscopes) and Fujifilm BL7000 (EC-760R, EG-760R endoscopes) systems. The Olympus ESG-300 electrocautery device was used for coagulation and dissection.

Lesions were classified morphologically according to the Paris classification, and the vascular pattern of colorectal lesions was evaluated based on the Japanese NBI Expert Team (JNET) classification [23, 24]. After adequate bowel preparation, high-resolution endoscopes equipped with electronic chromoendoscopy feature and a transparent cap (distal cap) attached to the tip were used to evaluate the lesion margins in detail, after which 0.4% indigo carmine dye and hydroxyethyl starch solution (Voluhes; Polifarma, Tekirdag, Turkiye) were injected into the submucosa to achieve mucosal elevation.

Submucosal dissection procedures were performed using DualKnife J® (Olympus), Clutch Cutter® (Fujifilm), or Coagrasper Hemostatic Forceps® (Olympus), depending on the characteristics of the lesion. After the procedure was completed, the area where dissection was performed was evaluated for a possible perforation (According to Sydney Classification) and for bleeding. Bleeding control was achieved using electrocautery or metallic clips when necessary; hemoclips were applied to close large post-ESD mucosal defects.

In cases where submucosal dissection was incomplete due to technical limitations (e.g., extensive submucosal fibrosis or prolonged procedure duration), excision was completed using a snare, and these cases were defined as "hybrid ESD". The excised lesion specimens were measured for size at the end of the procedure and sent to the pathology laboratory in formalin for histopathological examination.

Table 1. Patients characteristics (n=147)

Variables	
Number of patients	147
Mean age (years) ±SD	64.1±10.8
Gender (%)	
Female	53.7
Male	46.3
Smoking (%)	15.6
History of malignancy (n=27) (%)	
GI	29.6
Non - GI	66.7
GI+Non-GI	3.7
History of polypectomy (%)	32.7
Drugs (%)	
Anti-aggregants	22.4
Anticoagulants	5.4

SD: Standard deviation; GI: Gastrointestinal.

All patients were monitored for 24–48 hours postoperatively for early complications (bleeding, perforation, PECS); follow-up endoscopy was scheduled at 1 and 12 months post-discharge.

Data Collection and Statistical Analysis

Demographic data (age, sex), lesion-related characteristics (location, size, morphological type, histopathological diagnosis), procedural parameters (duration, technique applied, devices utilized), procedural success (en bloc and R0 resection rates), procedure-related complications (bleeding, perforation, PECS, stricture formation), and post-procedure follow-up findings were retrospectively obtained from the hospital's electronic medical records and endoscopy archive.

Data were analyzed using SPSS software (IBM SPSS Statistics, version 29). Continuous variables were reported as mean±standard deviation or median (minimum–maximum), while categorical variables were given as frequency and percentage. Fisher's Exact (for categorical variables) and Mann Whitney U (for non-normal distributed continuous variable) tests were used for statistical analysis. A p-value of <0.05 was considered statistically significant.

Ethics Approval and Patient Consent

This study was approved by the Ethics Committee of Umraniye Training and Research Hospital (Ethics Committee Decision no: 502, date: 16.01.2025) and conducted in accordance with the 1964 Declaration of Helsinki. All personal information of patients was kept confidential and anonymity was ensured.

RESULTS

This study included a total of 147 patients who underwent ESD or hybrid ESD between January 2020 and January 2025. The demographic characteristics of the patients are summarized in Table 1, and the lesion characteristics are summarized in Table 2.

Complete excision was achieved in 99.3% of cases, while incomplete excision occurred in only one case. When all patients were evaluated, the excision site was closed with hemoclips in 63.3% (n=93) of cases, whilst no closure method was performed in 36.7% (n=54) of cases. The clipping rate was 70.6% in upper gastrointestinal ESD procedures and 61.1% in lower gastrointestinal procedures. However, this difference was not statistically significant (p=0.312).

The analysis of the resection specimens revealed a median lesion diameter of 22 mm (7–110 mm) for the long axis and 15 mm (3–95 mm) for the short axis. The specimen dimensions were determined to be 32 mm (10–135 mm) for the long axis and 25 mm (3–125 mm) for the short axis.

The most common histological diagnosis in lesions excised from the lower gastrointestinal tract was adenoma (81.4%), whereas the majority of lesions in the upper gastrointestinal tract had hyperplastic characteristics (35.3%). Intramucosal carcinoma (Tis) was identified in 12 patients, while invasive adenocarcinoma (T1) was found in 7 patients within the lower gastrointestinal tract. Intramucosal cancer was identified in only one patient within the upper gastrointestinal tract. In all cases of invasive adenocarcinoma, the lesions were sessile, and based on the Kikuchi classification, three lesions were categorized as SM1, two as SM2, and two as SM3. The comprehensive histological assessment findings are presented in Table 3.

Although the majority of procedures were performed using standard ESD, a small subset of patients (13.6%) underwent hybrid ESD owing to technical limitations, such as fibrosis or challenging lesion positioning. In this subgroup, the lesion and specimen sizes were smaller than those treated with conventional ESD, which is consistent with the selective use of the hybrid technique. Importantly, there were no statistically significant differences between the hybrid ESD and standard ESD groups

Table 2. Lesion characteristics (n=147)

Variables	%
Lesion location	
Colon	76.9
Stomach	20.3
Duodenum	2.1
Esophagus	0.7
Most common colon location	
Rectum	31
Most common stomach location	
Antrum	63.3
Morphological evaluation	
Paris classification	
Paris type 0 - 2a	37.4
Paris type Is	27.9
Paris type 0 - 2a+Is	16.3
Paris type Isp	7.5
Others	10.9
JNET classification (n=111)	
JNET type 2A	71.2
JNET type 2B	27
JNET type 1	1.8
Intubation	
All procedures	55.1
Upper GI lesions	94.1
Lower GI lesions	43.4
Technique used	
ESD	86.4
Hybrid ESD	13.6
Lesion excision	
Complete	99.3
Incomplete	0.7
ESD defect closure	63.3
Upper GI lesions	70.6
Lower GI lesions	61.1

JNET: Japan Narrow Band Imaging Expert Team; GI: Gastrointestinal; ESD: Endoscopic Submucosal Dissection.

Table 3. Outcomes and complications (n=147)

Variables	
Lesion size (mm) (median, min–max)	
Short axis	15 (3–95)
Long axis	22 (7–110)
Specimen size (mm) (median, min–max)	
Short axis	25 (3–125)
Long axis	32 (10–135)
Surgical margin, n (%)	
R0 (negative margin)	138 (93.9%)
R1 (positive margin)*	9 (6.1%)
Histopathological diagnosis, n (%)	
Adenoma	100 (68%)
Tubulovillous	38 (38%)
Tubular	33 (33%)
Serrated	13 (13%)
Villous	5 (5%)
Gastric	7 (7%)
Mixed (Tubulovillous+Serrated)	4 (4%)
Hyperplastic	14 (9.5%)
Intramucosal adenocarcinoma (Tis)	12 (8.2%)
Invasive adenocarcinoma (T1)	7 (4.8%)
SM1	3 (42.8%)
SM2	2 (28.6%)
SM3	2 (28.6%)
Others**	14 (9.5%)
Dysplasia (Adenoma), n (%)	100 (68%)
High grade	56 (56%)
Low grade	44 (44%)
Intraoperative complication, n (%)	5 (3.4%)
Bleeding	4 (80%)
Mallory–Weiss tear	1 (20%)
Postoperative complication, n (%)	7 (4.7%)
PECS	4 (57.2%)
Microperforation	3 (42.8%)
Hospital stay (days) (median, min–max)	1 (1–10)
Post–op maximum leukocyte (x10^3/μL)	10.43 (3.35–21.17)
Postoperative maximum CRP (mg/L)	19.5 (1–186)

SM: Submucosa; PECS: Post–ESD coagulation syndrome; CRP: C reactive protein; *: 7 cases of adenoma, 2 invasive adenocarcinoma; **: 4 cases of neuroendocrine cell hyperplasia, 3 neuroendocrine tumors, 1 intestinal metaplasia, 1 heterotopic pancreas, 1 granular cell tumor, 1 inflammatory fibroid polyp, 1 fundic gland polyp, 1 arteriovenous malformation, and 1 lipoma.

in terms of key clinical outcomes, including the R0 resection rate, complication profile, and histopathological features ($p>0.05$) (Table 4).

During follow-up, a total of four patients were referred for surgery: two with SM3 lesions (one with a positive lateral surgical margin), one with a SM2 lesion (also with a positive lateral surgical margin), and one with adenoma (high grade dysplasia) who had incomplete resection. In one of SM3 patients who underwent surgery, no recurrent lesion was found; nevertheless, adenocarcinoma metastasis was present in one lymph node. In the other patient, no residual malignancy was observed. In the two cases (one SM2 lesion with a positive lateral surgical margin and one with incomplete resection), invasive adenocarcinoma was found.

Complications

Complications arose in five patients (3.4%) during the procedure; bleeding was observed in four of these patients and was managed with endoscopic intervention, whilst one patient experienced a Mallory-Weiss tear but did not require further intervention. During post-procedure follow-up, complications occurred in 7 patients (4.7%). Among these patients, four (2.7%) experienced PECS, and three (2%) developed pneumoperitoneum as a consequence of microperforation. No cases of delayed bleeding were observed after the procedure. In all patients who developed PECS, the lesion was located in the colon. The median maximum leukocyte count after the procedure was 11.9×10^3/μL (range: $11.2–21.1\times10^3$/μL), the median maximum CRP level was 135 mg/L (range: 50.8–186 mg/L), and the median length of hospital stay was 7.5 days (range: 4–9 days) in patients with PECS. CRP levels and length of hospital stay were lower in the hybrid ESD group ($p=0.002$, $p=0.041$).

Among patients who developed microperforation, the lesion was resected from the colon in two cases and from the duodenum in one case. The median maximum leukocyte count after the procedure was 13.1×10^3/μL ($11.9–14.3\times10^3$/μL), the median maximum CRP level was 87.9 mg/L (9.2–121 mg/L), and the median length of stay was 5 days (2–7 days) in patients with microperforation.

In all patients who experienced post-ESD complications, the dissection site was closed with hemoclips at the end of the procedure. All patients recovered with conservative management, and no acute condition requiring surgical intervention was observed postoperatively.

Table 4. Outcomes and complications according to subgroups

Variables	Hybrid ESD (n=20)	ESD (n=127)	p*
Lesion size (mm) (median, min–max)			
Short axis	10 (5–12)	18 (3–95)	**<0.001***
Long axis	13 (10–28)	23 (7–110)	**<0.001***
Specimen size (mm) (median, min–max)			
Short axis	13 (5–60)	25 (3–125)	**0.002***
Long axis	20 (12–80)	34.5 (10–135)	**0.002***
Surgical margin, n (%)			0.353
R0 (negative margin)	18 (90)	120 (94.5)	
R1 (positive margin)	2 (10)	7 (5.5)	
Histopathological diagnosis, n (%)			0.183
Adenoma	16 (80)	84 (66.1)	
Tubulovillous	7 (43.8)	31 (36.9)	
Tubular	4 (25)	29 (34.5)	
Serrated	3 (18.8)	10 (11.9)	
Villous	1 (6.3)	4 (4.8)	
Gastric	1 (6.3)	6 (7.1)	
Mixed (Tubulovillous+Serrated)	–	4 (4.8)	
Hyperplastic	–	14 (11)	
Intramucosal adenocarcinoma (Tis)	3 (15)	9 (7.1)	
Invasive adenocarcinoma (T1)	1 (5)	6 (4.7)	
SM1	–	3	
SM2	–	2	
SM3	1	1	
Others**	–	14 (11)	
Dysplasia (Adenoma), n (%)			0.211
High grade	7 (43.8)	49 (58.3)	
Low grade	9 (56.2)	35 (41.7)	
Intraoperative complication, n (%)	1 (5)	4 (3.1)	0.524
Bleeding	1	3	
Mallory–Weiss tear	–	1	
Postoperative complication, n (%)	1 (5)	6 (4.7)	0.649
PECS	–	4	
Microperforation	1	2	
Hospital stay (days) (median, min–max)	1 (1–5)	1 (1–10)	**0.041***
Post–op maximum leukocyte (x10^3 /μL)	10.71 (5.45–16.2)	10.43 (3.35–21.17)	0.848*
Postoperative maximum CRP (mg/L)	4.28 (0.5–63)	19.5 (1–186)	**0.002***

ESD: Endoscopic Submucosal Dissection; SM: Submucosa; PECS: Post–ESD coagulation syndrome; CRP: C reactive protein; *: Comparisons of categorical variables were performed using the Fisher's exact test, while non–normally distributed continuous variables were analyzed using the Mann–Whitney U test; **: 4 cases of neuroendocrine cell hyperplasia, 3 neuroendocrine tumors, 1 intestinal metaplasia, 1 heterotopic pancreas, 1 granular cell tumor, 1 inflammatory fibroid polyp, 1 fundic gland polyp, 1 arteriovenous malformation, and 1 lipoma.

Follow-up

All patients were advised to have endoscopic follow-up during the first month and the first year following the procedure. 57.1% (84 patients) of the patients participated in these follow-ups. Endoscopic evaluation was performed on 30 (20.4%) patients within the first month and 72 (49%) patients within the first year; 18 (12.2%) patients underwent endoscopic follow-up in both the first month and the first year. In a patient with an excised lesion pathology of intramucosal adenocarcinoma,

recurrence was suspected in the polypectomy area during the first month follow-up, and the lesion was re-excised by ESD and reported as hyperplastic. However, upon detection of SUV_{max} 6.2 in the same location during follow-up PET-CT, surgery was performed based on a multidisciplinary council's decision, and no malignancy was observed in the subtotal gastrectomy specimen.

In another patient, a hyperplastic sessile polyp was excised from the gastric antrum during the first-year follow-up, and recurrence was seen. The lesion was excised through the ESD method. However, because of frequent recurrences and the large size of the recurring lesions, an antrectomy was performed around three years following the initial procedure. Histopathological examination revealed no malignancy, and the excision material was assessed as consistent with hyperplasia.

DISCUSSION

Upon evaluating the technical success of ESD and hybrid ESD procedures performed at our center, it is evident that ESD serves as a highly effective treatment modality for the excision of early-stage or pre-malignant superficial gastrointestinal lesions, achieving en bloc resection rates of 99.3% and R0 resection rates of 93.9%. These results are consistent with the rising technical success rates reported from centers with growing procedural experience in recent years [1, 2, 7, 25–28]. The hybrid ESD technique was used only in selected cases with anatomical or technical challenges in our study, and its outcomes were similar to those of standard ESD, except for CRP levels and length of hospital stay. Lower CRP levels and shorter hospital stays probably reflect a smaller lesion size and a reduced extent of submucosal dissection. R0 resection, complication rates, and pathological results showed no significant differences, indicating that hybrid ESD remains a reliable option when full dissection cannot be performed. It also suggests that the inclusion of hybrid ESD cases did not introduce significant heterogeneity or affect the overall study results.

In terms of complications, bleeding occurred in 4 patients during the procedure, and Mallory-Weiss tear in 1 patient; post-procedure follow-up revealed PECS in 4 patients and microperforation in 3 patients.

The complication rates reported in the literature vary based on the center's expertise and the anatomical-morphological characteristics of the lesions. Recent trends show a decline in complication rates, owing to improved ESD experience and the advancement of procedural techniques and instruments. Our case series shows complication rates that correlate closely with those reported in recent studies involving larger patient populations [26, 28–31]. All complications were successfully managed with conservative methods, and no patient required surgical intervention.

In our study, three patients with invasive adenocarcinoma (despite complete resection performed) and one patient with high-grade dysplastic adenoma (incomplete resection performed) were evaluated according to current guidelines and referred for surgery. Pathological evaluation revealed adenocarcinoma metastasis in a single lymph node in a case with SM3 lesion and invasive adenocarcinoma in another case with high-grade dysplasia adenoma. These cases highlight the critical role of ESD in histopathological staging, risk assessment, and guiding follow-up and treatment strategies.

In cases where R0 resection couldn't be achieved or deep submucosal invasion is present, early treatment of residual or recurrent lesions through endoscopic or surgical intervention, decided upon by multidisciplinary evaluation, further supports the long-term success of ESD.

The retrospective design of the study, involvement of operators with varying levels of experience, heterogeneity caused by the inclusion of benign lesions, short follow-up periods in some patients, and the inability of all patients to attend regular follow-up appointments are main methodological limitations of this research. The relatively low rate of follow-up endoscopy (57.1%) and the short follow-up duration may have limited recurrence detection and should be considered when interpreting the generalizability of the findings. Nevertheless, the positive results obtained in the early stages indicate that complication rates will decrease further and success rates will increase with the widespread adoption of ESD and the accumulation of experience. In this context, our study contributes positively to the literature in our country, where there are still a limited number of studies on ESD.

In conclusion, this study demonstrates that ESD is a reliable method for the treatment of superficial gastrointestinal neoplasms when performed by an experienced team on appropriately selected patients, with high technical success rates and acceptable complication rates. Prospective, multicenter studies involving larger patient populations from different centers are needed to establish national multicenter databases in Türkiye, which are expected to make significant contributions to the standardization and widespread adoption of ESD in our country, as well as to the development of structured training programs enabling more gastroenterologists to perform this procedure.

Ethics Committee Approval: The Umraniye Training and Research Hospital Scientific Research Ethics Committee granted approval for this study (date: 16.01.2025, number: 502).

Informed Consent: Informed consent was not required due to the retrospective nature of this study.

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