

Intraoperative Submucosal Injection of Triamcinolone Acetonide Combined with Oral Prednisone for Prevention of Esophageal Stricture after ESD for Circumferential Superficial Tumors: A Retrospective Pilot Study

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Abstract

Objective

To retrospectively evaluate the efficacy and safety of intraoperative submucosal injection of triamcinolone acetonide (TA) combined with sequential short-term oral prednisone in preventing esophageal stricture after Endoscopic Submucosal Dissection (ESD) for circumferential superficial esophageal neoplasms.

Methods

Clinical data of patients who underwent ESD for circumferential esophageal lesions at our institution from Jan 2021 to Dec 2024 were reviewed. All patients received submucosal lifting and dissection using a solution containing TA, followed by an 8-week course of oral prednisone. The primary endpoints were the incidence of clinically significant stricture and the number of endoscopic balloon dilations (EBD). Secondary endpoints included procedure time, total TA dosage, and mucosal healing rate at 1 month.

Results

A total of 11 patients (8 males, 3 females; mean age 75.1 ± 4.2 years) with circumferential lesions were included. All procedures achieved 100% R0 resection without intraoperative perforation. No delayed perforation, postoperative infection, or major bleeding occurred. During a median follow-up of 12 (6–24) months, clinically significant stricture occurred in only 1 patient (9.1%), who developed dysphagia post-ESD and required 2 sessions of EBD to resolve. The remaining 10 patients experienced no dysphagia or stricture requiring intervention. No severe systemic steroid-related adverse events requiring special intervention were observed.

Conclusion

In this single-center retrospective pilot study, the combination of intraoperative TA submucosal injection and oral prednisone showed a promisingly low stricture rate and a favorable safety profile for circumferential esophageal ESD. This strategy is simple, cost-effective, and minimizes the need for repeated invasive procedures. Further validation in larger prospective studies is warranted.

Background

Endoscopic submucosal dissection (ESD) has become the standard curative treatment for early esophageal neoplasms. However, post-ESD esophageal stricture remains a major adverse event, particularly when the mucosal defect involves a large circumference or extends to the entire circumference of the esophagus. The incidence of stricture in such cases is notoriously high, reported to range from 70% to 90% without prophylactic intervention ^[1, 2]. Severe strictures significantly impair patients' quality of life and often necessitate repeated endoscopic balloon dilation (EBD), creating a substantial burden on both patients and healthcare systems.

Current strategies to prevent post-ESD strictures primarily include local injection or gel application of corticosteroids, long-term oral corticosteroids, placement of self-expanding metal or plastic stents, and autologous mucosal transplantation^[3]. Although these methods have reduced the stricture rate to varying degrees, they are associated with limitations. For instance, local injections can be technically demanding and carry risks of perforation or bleeding, while

stents may migrate or cause tissue overgrowth. Furthermore, long-term systemic corticosteroid therapy raises concerns regarding adverse events such as infection, diabetes, and osteoporosis [4].

To address these challenges, we modified the prophylaxis strategy with two key innovations. First, instead of the conventional postoperative injection into the ulcer bed, we utilized a submucosal injection solution containing triamcinolone acetonide (TA) throughout the entire ESD procedure. This approach ensures that the corticosteroid covers the submucosal layer evenly from the oral to the anal side of the lesion during lifting and dissection. Second, we adopted a sequential, short-term (8-week) course of oral prednisone to maintain anti-inflammatory and anti-fibrotic effects while minimizing the systemic side effects associated with high-dose or long-term steroid use.

In this study, we retrospectively analyzed the efficacy and safety of this novel combination strategy in patients who underwent ESD for circumferential superficial esophageal neoplasms at our center from January 2021 to December 2024. Our aim is to provide preliminary evidence for a simpler, safer, and more cost-effective prophylactic protocol for this challenging clinical condition.

Materials and Methods

1. Study Design and Patient Selection

This was a retrospective study that analyzed the clinical data of 11 consecutive patients with circumferential esophageal lesions who underwent endoscopic submucosal dissection (ESD) at the Gastroenterology Center, Subei People's Hospital of Jiangsu Province, between January 2021 and December 2024. All patients successfully completed endoscopic treatment according to the protocol. The study protocol was approved by the Ethics Committee of Subei People's Hospital of Jiangsu Province (Approval No.2026KY160). Due to the retrospective nature of the study, the requirement for individual informed consent was waived.

Inclusion Criteria: Patients were included if they met the following criteria: (1) Histologically confirmed esophageal squamous high-grade intraepithelial neoplasia or squamous cell carcinoma by preoperative gastroscopy and biopsy. (2) Endoscopic ultrasound (EUS) indicating tumor confined to the mucosal layer, or magnified endoscopy showing type B1 or B2 intrapapillary capillary loop (IPCL) patterns. (3) No evidence of local or distant lymph node metastasis by CT scan. (4) Preoperative Lugol's iodine staining or narrow-band imaging (NBI) demonstrating a circumferential esophageal mucosal lesion.

Exclusion Criteria: Patients were excluded if they met any of the following criteria: (1) Requiring additional surgery or radiotherapy after ESD. (2) Contraindications to corticosteroid use, such as active peptic ulcer, tuberculosis, severe osteoporosis, poorly controlled diabetes mellitus, corticosteroid allergy, or severe psychiatric disorders. (3) Severe cardiopulmonary dysfunction.

2. Endoscopic Procedure

All ESD procedures were performed by experienced endoscopists. Preoperative assessment of lesion extent and depth was routinely conducted using conventional endoscopy, magnified endoscopy, or endoscopic ultrasound. All patients underwent the procedure under general anesthesia with endotracheal intubation.

For submucosal injection, triamcinolone acetonide (TA, Shanghai General Pharmaceutical Co., Ltd.) was diluted with normal saline containing indigo carmine to a final concentration of 1 mg/mL. A disposable injection needle (Nanjing Micro-Tech, model IN02-22423180) was used. A Dual knife (Olympus, model: KD-650Q) was employed for dissection.

The procedure involved marking the proximal and distal margins of the lesion. An initial submucosal cushion was created by injecting normal saline. Subsequently, the TA-containing solution was injected sequentially at the distal edge of the initial cushion to further elevate the lesion, with careful attention to avoid injection into or beyond the muscularis propria. Circumferential incision of the proximal and distal margins was then performed, followed by the creation of a submucosal tunnel. During the gradual submucosal dissection, the TA-containing solution was continuously and evenly injected into the remaining submucosal layer to ensure comprehensive corticosteroid coverage. After complete dissection, the resected specimen was retrieved. Following resection, meticulous hemostasis was achieved using coagulation forceps or hemoclips if necessary, particularly in areas where the muscularis propria was exposed. (Fig. 1).

3. Postoperative Management and Follow-up

Postoperatively, patients received routine intravenous fluids and gastric acid suppression with proton pump inhibitors (PPIs). Close monitoring for delayed complications such as bleeding or perforation was performed. Oral fluid intake was permitted 24 hours after ESD if no discomfort was reported. Subsequently, an 8-week course of oral prednisone was initiated with a tapering regimen: 30 mg/day for weeks 1–2, 25 mg/day for weeks 3–4, 20 mg/day for week 5, 15 mg/day for week 6, 10 mg/day for week 7, and 5 mg/day for week 8. For diabetic patients, hypoglycemic treatment was adjusted under the guidance of an endocrinologist, with close blood glucose monitoring. Patients with a history of peptic ulcer received prophylactic PPI therapy. If infection or other severe adverse events occurred, the prednisone dose was reduced or discontinued as clinically indicated.

Follow-up gastroscopy was performed at 1, 3, and 6 months post-ESD to assess wound healing, the presence of esophageal stricture, and to rule out residual lesions using NBI or Lugol's iodine staining. Before each endoscopic examination, patients' dysphagia was graded using the Stooler dysphagia grading scale (0–4 points):

Grade 0: No dysphagia; food passes smoothly through the mouth, pharynx, and esophagus into the stomach.

Grade 1: Mild dysphagia; food passes through the mouth and pharynx, but some obstruction occurs in the esophagus, requiring extra effort to swallow.

Grade 2: Moderate dysphagia; food encounters obstruction in both the pharynx and esophagus, requiring extra effort to swallow.

Grade 3: Complete inability to eat; unable to pass anything, including liquids, through the mouth and pharynx.

Grade 4: Severe dysphagia; complete inability to swallow anything, including liquids, through the mouth and pharynx.

A clinically significant esophageal stricture was defined as Stooler Grade ≥ 1 dysphagia combined with the inability to pass a standard endoscope (outer diameter 8.9 mm, Olympus GIF-H290, Japan) through the narrowed segment during follow-up gastroscopy, necessitating endoscopic balloon dilation (EBD). Stricture resolution was defined as the absence of dysphagia and successful passage of the 8.9 mm endoscope. Patients who developed stricture were followed up until 6 months after their last EBD session, after which they entered routine follow-up for early esophageal cancer after ESD.

4. Outcome Measures

Clinical data including sex, age, lesion length and location, postoperative pathology, and complications related to ESD and EBD were recorded. The primary endpoints were the incidence of post-ESD esophageal stricture (defined as

above), Stooler dysphagia grade, the total number of EBD sessions, and the number of EBD sessions per patient. Secondary endpoints included procedure time (from marking to endoscope withdrawal after ESD), total triamcinolone acetonide dosage, and the 1-month wound healing rate (calculated as the number of patients with complete wound healing divided by the total number of patients $\times$ 100%).

5. Statistical Analysis

Statistical analysis was performed using SPSS software (version 26.0, IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean $\pm$ standard deviation (SD) or median (interquartile range [IQR]), and categorical variables were presented as counts and percentages. Given the small sample size and the retrospective nature of this single-center study, descriptive statistics were primarily used. For comparative analyses, if applicable in future expanded studies, continuous variables would be analyzed using the Student's t-test or Mann-Whitney U test, and categorical variables using Fisher's exact test. A two-sided P-value < 0.05 was considered statistically significant.

Results

1. Baseline Characteristics

A total of 11 patients with circumferential superficial esophageal neoplasms were included in this retrospective study. The cohort consisted of 8 males (72.7%) and 3 females (27.3%), with a mean age of 75.1 ± 4.2 years (range: 69-81 years). Regarding tumor location, the lesions were distributed as follows: 1 case (9.1%) in the upper thoracic esophagus, 7 cases (63.6%) in the middle thoracic esophagus, and 3 cases (27.3%) in the lower thoracic esophagus. Histopathologically, 9 patients (81.8%) were diagnosed with high-grade intraepithelial neoplasia (HGIN), and 2 patients (18.2%) had intramucosal carcinoma (IMC) with focal invasion into the muscularis mucosae. The mean longitudinal length of the lesions was 4.8 ± 1.2 cm (range: 3.5-7.5 cm). (Table 1)

2. Intraoperative Findings

All 11 patients successfully underwent en bloc ESD resection. Intraoperative submucosal injection of triamcinolone acetonide (TA) was performed smoothly in all cases. The mean total dosage of TA used was 47.3 ± 11.7 mg (range: 40-80 mg). No intraoperative perforation or massive bleeding occurred. (Table 1)

3. Efficacy in Stricture Prevention

During the follow-up period (median 12 months), clinically significant esophageal stricture occurred in only 1 patient (9.1%, Case 4). (Table 1)

Case 4 Analysis: A 74-year-old male with a high-grade lesion in the middle esophagus. Notably, this patient had the longest longitudinal lesion length (7.5 cm) in the cohort and received the highest dose of TA (80 mg) due to the extensive dissection area. He developed dysphagia postoperatively (Stooler score 2) and required 2 sessions of endoscopic balloon dilation (EBD) at 3 months and 5 months post-ESD, respectively. His symptoms resolved completely after the interventions.

The remaining 10 patients (90.9%) showed excellent outcomes without stricture formation:

8 patients (72.7%) maintained a Stooler dysphagia score of 0.

2 patients (18.2%, Case 5 and Case 11) reported mild dysphagia (Stooler score 1) but did not require endoscopic treatment. Follow-up gastroscopy confirmed good epithelialization without significant narrowing in these 10 patients.

4. Safety Profile

All surgical procedures were successfully completed, and no major complications such as intraoperative perforation, postoperative infection, or delayed major bleeding were observed. Throughout the 8-week course of oral prednisone, no severe systemic adverse events (e.g., severe infection, gastrointestinal bleeding, ketoacidosis, or osteoporotic fracture) were observed.

Table 1

Table 1. Baseline Characteristics and Clinical Outcomes of the 11 Patients

Case No.	Sex	Age (years)	Tumor Location	Longitudinal Length (cm)	Pathology	Total TA Dosage (mg)	Stooler Score	Stricture	EBD Sessions
1	Male	75	Middle	6.0	HGIN	50	0	No	-
2	Male	79	Middle	4.5	IMC	45	0	No	-
3	Female	78	Upper	3.5	HGIN	40	0	No	-
4	Male	74	Middle	7.5	HGIN	80	2	Yes	2
5	Male	81	Lower	4.5	HGIN	40	1	No	-
6	Male	69	Middle	5.0	HGIN	50	0	No	-
7	Female	77	Lower	4.0	IMC	40	0	No	-
8	Male	73	Lower	5.5	HGIN	40	0	No	-
9	Female	75	Middle	4.0	HGIN	40	0	No	-
10	Male	81	Middle	3.5	HGIN	40	0	No	-
11	Male	69	Middle	5.5	HGIN	55	1	No	-

Abbreviations: TA, Triamcinolone Acetonide; HGIN, High-Grade Intraepithelial Neoplasia; IMC, Intramucosal Carcinoma; EBD, Endoscopic Balloon Dilation.

Discussion

Previous studies have demonstrated that without intervention, the incidence of stricture after total circumferential esophageal endoscopic submucosal dissection (ESD) is remarkably high, reaching 70%–90% or even approaching 100% [1, 2]. Such severe strictures not only lead to profound dysphagia and significantly diminish patients' quality of life but also frequently necessitate repeated endoscopic balloon dilation (EBD)[3]. This further increases the risks of complications like perforation and bleeding, alongside a substantial medical and economic burden. Therefore, there is a pressing clinical need to explore effective, safe, and simplified prophylactic strategies.

Systemic oral corticosteroids are one of the current mainstream strategies for preventing such strictures, acting primarily by inhibiting inflammatory cell infiltration and collagen synthesis. Research by Sato et al. [5] confirmed that postoperative oral prednisolone (starting at 30 mg/day, gradually tapered over 8 weeks) could reduce the stricture rate to approximately 12.5%. However, long-term (typically 8–16 weeks) systemic corticosteroid therapy is associated with

considerable adverse effects, including opportunistic infections, steroid-induced hyperglycemia, gastrointestinal ulcers, osteoporosis, and hypothalamic-pituitary-adrenal axis suppression^[6]. Yamashina et al. reported that the incidence of adverse events exceeded 20% in cohorts receiving long-term oral corticosteroids for stricture prevention^[7]. Moreover, while repeated EBD remains the standard salvage therapy for established strictures, it often requires multiple sessions (averaging around 4.5 times) to maintain luminal patency. Simple dilation, however, does not alter the underlying pathological process of fibrotic scar formation, leading to high recurrence rates and an associated perforation risk of approximately 0.5%–5%^[7,8].

In recent years, local drug delivery strategies have also shown promising results. Triamcinolone acetonide (TA) has been widely used due to its potent local anti-inflammatory and anti-fibrotic effects. Hanaoka et al.^[9] demonstrated that TA injection into the ulcer bed after ESD for mucosal defects involving more than 3/4 but less than full circumference significantly reduced the stricture rate compared to controls (10% vs. 66%). However, for esophageal lesions exceeding 3/4 or 7/8 of the circumference, the efficacy of postoperative TA injection in preventing stricture is limited, and for full circumferential mucosal defects, the stricture rate following postoperative TA injection can still be as high as 100%^[10,11]. Furthermore, due to the thin or even absent submucosal layer of the ulcer bed post-ESD, it is challenging to ensure uniform drug distribution, and repeated deep punctures significantly increase the risks of delayed perforation and mediastinal abscess^[12].

Against this backdrop, our study investigated a comprehensive prophylactic strategy combining "intraoperative full-course submucosal TA injection with short-term oral corticosteroids." This approach aims to optimize both local and systemic drug delivery to maintain anti-fibrotic efficacy while minimizing complication risks. In our cohort of 11 high-risk patients, only one patient (9.1%) developed a clinically significant stricture (Stooler dysphagia grade ≥ 2) requiring two EBD sessions. The remaining 10 patients reported no significant dysphagia (Stooler grade 0–1) during follow-up, and none experienced severe systemic steroid-related adverse events such as severe infection or uncontrolled hyperglycemia.

A distinctive feature of our study is the continuous intraoperative application of TA-containing submucosal injection solution throughout the ESD procedure. This ensured a more abundant and uniform distribution of TA across the entire wound bed, likely delivering a higher effective dose compared to localized postoperative TA injections. The sequential short-term oral prednisone further contributed to sustained anti-fibrotic effects while substantially reducing the systemic side effects associated with long-term steroid use.

A recent study by Zhan et al.^[13] proposed an intensified regimen that shares some commonalities with ours, notably the intraoperative use of TA-containing submucosal injection solution. However, Zhan et al.'s strategy involved multiple additional local TA injections postoperatively, which differs from our approach in two key aspects:

Firstly, intraoperative full-course coverage and margin protection. Our method integrates TA directly into the submucosal injection solution used throughout the ESD. Since repeated submucosal injections are inherently required during ESD to maintain lifting, our approach allows for a "carpet-like" infiltration of the entire lesion base with TA-mixed solution without adding extra procedural steps. Crucially, unlike strategies focusing on oral and anal mucosal incisions, our strategy ensures that the proximal and distal cut margins of the lesion are continuously exposed to TA solution during the entire incision and dissection process. These margins are often the starting points for scar contracture. This continuous intraoperative drug coverage might deposit sufficient TA in the submucosal layer of these margins, exerting potent inhibitory effects at the earliest stages of scar formation, which could be a key mechanism behind the low stricture rate observed in our cohort. Compared to injecting into a fragile ulcer bed postoperatively, this intraoperative delivery is more uniform and minimizes the risk of muscularis propria injury and subsequent perforation.

Secondly, short-term oral steroids replacing multiple postoperative injections. Zhan et al.'s regimen^[13] emphasizes multiple endoscopic re-injections postoperatively, which invariably increases the number of endoscopic procedures, hospital stay, and medical costs for patients, while also carrying the risk of perforation from repeated interventions. Our study adopted an 8-week short-term oral prednisone course to substitute these additional local injections. Compared to long-term systemic steroids, our short-term regimen significantly reduced the risk of systemic adverse effects. Compared to multiple postoperative endoscopic procedures, oral administration is extremely convenient and cost-effective, substantially alleviating patients' physical discomfort and economic burden. The results of our study demonstrate that this "local + short-term systemic" combined approach effectively addresses the issue of short drug retention time associated with purely local injections, while simultaneously circumventing the high risks of long-term systemic therapy, achieving a win-win outcome in terms of efficacy and safety.

Other preventive measures, such as fully covered self-expandable metallic stents or biodegradable stents, can temporarily support the lumen but face challenging issues like migration, tissue embedment, restenosis, and difficulty in removal^[14,15]. Autologous tissue transplantation techniques, while promising, are complex and require high technical expertise, making them difficult to implement in general practice^[16]. In contrast, the strategy proposed in this study does not require specialized equipment, has a low technical threshold, and is easily generalizable.

In conclusion, preventing stricture after circumferential esophageal ESD requires balancing efficacy, safety, and health economics. Long-term systemic corticosteroids carry significant side effects, stent placement and transplantation techniques are complex, and single local injections have limitations. The preliminary results of this study suggest that intraoperative full-course TA submucosal injection combined with short-term oral corticosteroids can effectively reduce the incidence of stricture after circumferential esophageal ESD (only 9.1% in our cohort), which is significantly superior to historical data without prophylaxis. This strategy is simple to perform (no additional procedural steps), highly safe (no perforations or severe infections), and cost-effective, thus possessing high clinical application value. Nevertheless, this study is limited by its retrospective design and small sample size. Future multi-center, large-scale prospective randomized controlled trials are warranted to further validate the optimal concentration of TA in the submucosal injection solution and the precise dosage adjustment for oral corticosteroids.

Declarations

Author Contribution

Dr. Xiufan Ni, Zhen Zhu, Xijing Shi, Jian Yin, Sujun Gao and Li Zhang: participate in the patient management, draft the manuscript; Dr. Lei Chen: in charge of the patient diagnosis and management, revise the manuscript for important intellectual content and final approval.

Data Availability

All data supporting this study are included in the article.

References

1. Ono S, Fujishiro M, Niimi K, et al. Predictors of postoperative stricture after esophageal endoscopic submucosal dissection for superficial esophageal cancer. *Endoscopy*. 2009;41:661–5.
2. Katada C, Muto M, Momma K, et al. Clinical outcomes of endoscopic submucosal dissection in superficial esophageal squamous cell carcinoma. *Gastrointest Endosc*. 2010;72:912–20.

3. Duan Y, Jia W, Liang Y, et al. Progress in the treatment and prevention of esophageal stenosis after endoscopic submucosal dissection. *Clin Res Hepatol Gastroenterol*. 2024;48(3):102290. doi: 10.1016/j.clinre.2024.102290. PMID: 38311060.
4. Zhou S, Chen X, Feng M, et al. Efficacy of different steroid therapies in preventing esophageal stricture after endoscopic submucosal dissection: a comparative meta-analysis. *Gastrointest Endosc*. 2024;100(6):1020–33.e3. doi: 10.1016/j.gie.2024.08.017. PMID: 39173780.
5. Sato H, Inoue H, Kobayashi Y, et al. Oral prednisolone to prevent esophageal stricture after endoscopic submucosal dissection for superficial esophageal cancer. *Endoscopy*. 2014;46:341–6.
6. Li X, Chen M, Li B, et al. Oral steroid versus local steroid injection for prevention of stricture after endoscopic submucosal dissection in esophagus: a systematic review and meta-analysis. *Dig Dis Sci*. 2018;63:2603–13.
7. Yamashina T, Ishihara R, Nagai K, et al. Long-term outcomes of oral steroid administration after esophageal endoscopic submucosal dissection. *Dig Endosc*. 2015;27:254–61.
8. Yang F, Hu Y, Shi Z, et al. The occurrence and development mechanisms of esophageal stricture: state of the art review. *J Transl Med*. 2024;22(1):123. doi: 10.1186/s12967-024-04932-2. PMID: 38297325; PMCID: PMC10832115.
9. Hanaoka N, Ishihara R, Takeuchi Y, et al. Intralesional steroid injection to prevent stricture after endoscopic submucosal dissection for esophageal cancer. *Endoscopy*. 2012;44:1007–11.
10. Hanaoka N, Ishihara R, Uedo N, et al. Refractory strictures despite steroid injection after esophageal endoscopic resection. *Endosc Int Open*. 2016;4(3):E354–9. doi: 10.1055/s-0042-100903.
11. Abe S, Iyer PG, Oda I, et al. Approaches for stricture prevention after esophageal endoscopic resection. *Gastrointest Endosc*. 2017;86(5):779–91. doi: 10.1016/j.gie.2017.06.025.
12. Tsujii Y, Hayashi Y, Kawai N, et al. Risk of perforation in balloon dilation associated with steroid injection for preventing esophageal stricture after endoscopic submucosal dissection. *Endosc Int Open*. 2017;5(7):E573–9. doi: 10.1055/s-0043-110077. PMID: 28670613; PMCID: PMC5482748.
13. Zhan T, Wen J, Kang X, et al. Submucosal steroid pre-injection strategy to prevent oesophageal stricture after circumferential endoscopic submucosal dissection. *Gut*. 2023;72:1833–5.
14. Shi KD, Ji F. Prophylactic stenting for esophageal stricture prevention after endoscopic submucosal dissection. *World J Gastroenterol*. 2017;23(6):931–4. doi: 10.3748/wjg.v23.i6.931.
15. Ohki T, Yamato M, Ota M, et al. Application of regenerative medical technology using tissue-engineered cell sheets for endoscopic submucosal dissection of esophageal neoplasms. *Dig Endosc*. 2015;27(2):182–8. doi: 10.1111/den.12354.
16. Chai N, Zou J, Linghu E, et al. Autologous Skin-Grafting Surgery to Prevent Esophageal Stenosis After Complete Circular Endoscopic Submucosal Tunnel Dissection for Superficial Esophageal Neoplasms. *Am J Gastroenterol*. 2019;114(5):822–5. doi: 10.14309/ajg.000000000000169. PMID: 30882422.

Figures

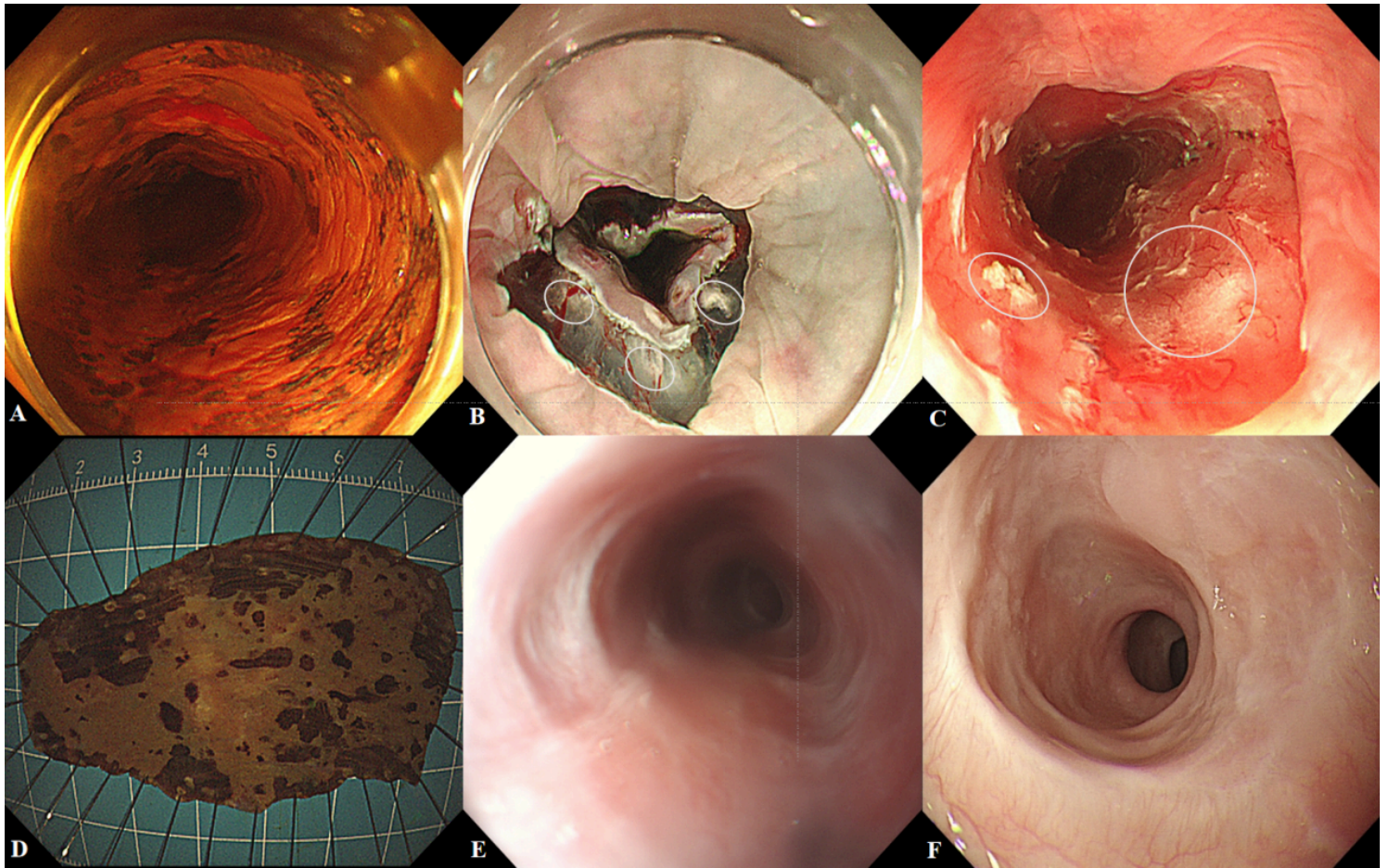


Figure 1

Endoscopic submucosal dissection (ESD) procedure and follow-up of a representative case (Case 10) with circumferential superficial esophageal neoplasm. (A) Preoperative chromoendoscopy with Lugol's iodine staining reveals a circumferential unstained lesion in the middle esophagus. (B) Intraoperative view after circumferential mucosal incision of the proximal and distal margins. Submucosal injection with a solution containing triamcinolone acetonide (TA) is performed, showing the whitish TA solution aggregating within the submucosal layer (indicated by the white box). (C) The ulcer bed immediately after tumor removal, showing significant deposition of the whitish TA solution on the exposed muscle layer and remaining submucosa. (D) The resected specimen, confirming en bloc resection of the circumferential lesion. (E) Follow-up endoscopy at 3 months post-ESD shows good mucosal healing with no evidence of stricture. (F) Follow-up endoscopy at 1 year post-ESD demonstrates a well-epithelialized esophagus without stricture or tumor recurrence. Abbreviations: ESD, endoscopic submucosal dissection; TA, triamcinolone acetonide.