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Feasibility and predictors of same-day discharge following endoscopic submucosal dissection for early esophageal cancer

Yu-ping Yuan[1], Chi-chao Wang[2] and Yuan-liang Zheng[2*]

Abstract

Background Endoscopic submucosal dissection (ESD) is a common treatment for early esophageal cancer. Although ESD is considered safe, same-day discharge (SDD) is only feasible in selected patients. Therefore, identifying factors associated with the likelihood of SDD is crucial for optimizing patient selection and clinical management.

Methods We conducted a retrospective analysis of patients with early esophageal cancer treated with ESD between August 2020 and July 2024. Patients were divided into SDD and non-SDD groups. Preoperative clinical features were compared between the groups. Univariate and multivariate logistic regression analyses were performed to identify independent predictors associated with the feasibility of SDD.

Results Among 146 patients, 42 (28.8%) were discharged on the same day. Multivariate analysis identified larger lesion size (OR = 2.152, 95% CI: 2.037–2.280, $p = 0.008$), history of alcohol abuse (OR = 6.507, 95% CI: 3.169–11.211, $p = 0.032$), and tumor location in the upper esophagus (OR = 7.827, 95% CI: 5.481–14.547, $p = 0.023$) as significant factors negatively associated with SDD feasibility. Notably, larger lesions were associated with a lower likelihood of SDD.

Conclusion Tumor size, upper esophageal location, and a history of alcohol abuse were identified as independent predictors associated with reduced feasibility of same-day discharge following ESD.

Keywords Endoscopic submucosal dissection, Esophageal Cancer, Same-Day discharge, Risk factors

Introduction

Early esophageal cancer features malignant tumors, with cancer cells confined to the esophageal mucosa or submucosal layer and without deeper tissue or lymph node invasion [1]. Recent medical advancements have led to endoscopic submucosal dissection (ESD) becoming a leading treatment for early esophageal cancer [2–4]. This method allows complete lesion removal and preservation of esophageal function, thus minimizing postoperative complications.

The average length of stay for ESD has decreased from 10 days to 3 days and is considered a safe duration [5, 6]. With the growing acceptance of the same-day discharge

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(SDD) model, numerous studies have confirmed its safety and viability in patients with early esophageal cancer after ESD [7–10]. This approach not only reduces medical expenses and enhances patient contentment but also reduces the risk of hospital infections. Furthermore, it improves hospital bed utilization, reduces patient waiting times, and meets the modern medical needs.

In this study, we aimed to assess clinical predictors of SDD following ESD in patients with early esophageal cancer and to identify the risk factors influencing SDD. The insights gleaned will guide clinicians in promptly identifying high-risk patients, selecting suitable candidates for early esophageal cancer ESD and potentially enhancing medical cost efficiency and patient satisfaction.

Methods

Patients and study design

Using the clinical database at Wenzhou Central Hospital, we conducted a retrospective analysis of patients who underwent endoscopic resection for esophageal cancer between August 2020 and July 2024. This study adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Wenzhou Central Hospital (IRB number: L2024-03-050). No patient interest or privacy was involved, all participants provided written informed consent or oral consent.

The inclusion criteria were as follows: pathologically confirmed superficial esophageal squamous cell carcinoma or precancerous lesions, Endoscopic submucosal dissection, patient age > 18 years, tumor infiltration depth M/SM1, performance status of 0 or 1, good cardiopulmonary function, and ASA score < 4. The exclusion criteria were history of untreated primary malignant tumors, tumor infiltration depth exceeding SM1 during surgery, prior esophageal disease radiation therapy, and incomplete record information.

Endoscopic procedure and postoperative management All ESD procedures were performed under conscious sedation with midazolam and/or propofol, with CO_2 insufflation, The dose of propofol was adjusted based on patient response to maintain adequate sedation, typically ranging from 1.5 to 3.0 mg/kg/hr. No opioids or benzodiazepines were used as premedication. A standard ESD technique was applied, including lesion marking, submucosal injection, mucosal incision, and submucosal dissection using an IT knife or dual knife. Hemostasis was achieved as necessary using hemostatic forceps. After the procedure, patients were instructed to remain nil by mouth for the first 4–6 h. If no signs of perforation, severe pain, or bleeding were observed, they were allowed to begin sipping water. A soft or liquid diet was typically resumed the next day based on tolerance. All patients received oral esomeprazole at a dose of 20 mg twice daily for 4–6 weeks to promote mucosal healing and reduce acid exposure. Prophylactic antibiotics were not administered routinely but were considered in cases with intraoperative perforation, suspected bacteremia, or prolonged operative time due to submucosal fibrosis. Vital signs and clinical symptoms were closely monitored during the postoperative observation period prior to discharge.

Observation indicators The collected demographic information and clinical characteristics included age, sex, ASA classification, smoking status, history of alcohol abuse, preoperative comorbidities (such as hypertension, diabetes, and chronic obstructive pulmonary disease (COPD)), lesion attributes (size, location, number, and infiltration depth), range of circumferential resection, intraoperative complications (bleeding and perforation), and surgical time.

Intraoperative bleeding was defined as hemorrhage during ESD that required active endoscopic hemostatic intervention, such as coagulation, clipping, or injection therapy [11]. Minor oozing that resolved spontaneously or with minimal contact was not considered bleeding. Perforation was defined as visible transmural defect with or without the presence of mediastinal emphysema, confirmed either during the procedure or postoperatively on imaging [12]. SDD was defined as the completion of both admission and discharge within 24 h. The discharge criteria included the absence of a need for supplemental oxygen or intravenous analgesics during postoperative observation, along with stable vital signs (heart rate, blood pressure, and oxygen saturation) [8–9]. The instructions advised patients to contact the team physician through a designated WeChat group if they experienced symptoms such as persistent pain, bleeding, or fever, and to seek immediate emergency care when necessary. During the first week after discharge, at least one adult family member was required to assist the patient at home and be familiar with the emergency contact procedures for reaching the medical team.

Statistical analysis

Data were analyzed using the SPSS software (v 23.0). The comparison of all variables between the SDD and non-SDD groups utilized descriptive statistics, as in a retrospective cohort study. Categorical variables were denoted by frequency, normally distributed continuous variables by mean ± standard deviation, and non-normally distributed variables by median (IQR). To test differences between groups, Student's t-test, $\chi 2$ test, Fisher's exact test, or Mann-Whitney U test was applied as needed. Subsequently, a multivariate logistic regression analysis was conducted on variables with $p < 0.1$ in univariate analysis to identify preoperative risk factors for SDD.

Differences were considered statistically significant at $p < 0.05$.

Results

Of the 168 patients with early esophageal cancer, 6 were excluded for Endoscopic Mucosal Resection (EMR), 2 for ASA = 4 level, 6 for incomplete data, and 8 for tumor invasion depth exceeding SM1 (Fig. 1). Among the remaining 146 patients, a total of 164 lesions were detected. The majority of patients were male (71.4%), with a median age of 56 years (IQR: 50.5–65.5). The average tumor size was 25.6 mm (SD: 9.7), with 79.5% of tumors located in the middle or lower third of the esophagus. Multiple lesions were found in 18 patients (12.3%). Intraoperative bleeding occurred in 8 patients (5.5%) and was successfully managed using hemostatic forceps and electrocoagulation. Perforation occurred in 6 patients (4.1%) and was treated with endoscopic clipping and prophylactic antibiotics. In the SDD group, no patients reported severe post-discharge symptoms such as chest pain, hematemesis, fever, or signs of aspiration. There were no emergency department visits or hospital readmissions within 7 days after discharge. No cases of delayed postoperative bleeding were reported (Table 1).

A total of 42 patients (28.8%) completed SDD, and we analyzed the risk factors in both the SDD group ($n = 42$) and the non-SDD group ($n = 104$). No significant differences were observed between the two groups in terms of age, sex, operation time, ASA classification, smoking status, preoperative comorbidities (hypertension or diabetes), tumor infiltration depth, tumor location, lesion number, and intraoperative complications (bleeding or perforation) ($p > 0.05$). However, statistical differences were noted in tumor size, alcohol abuse history,

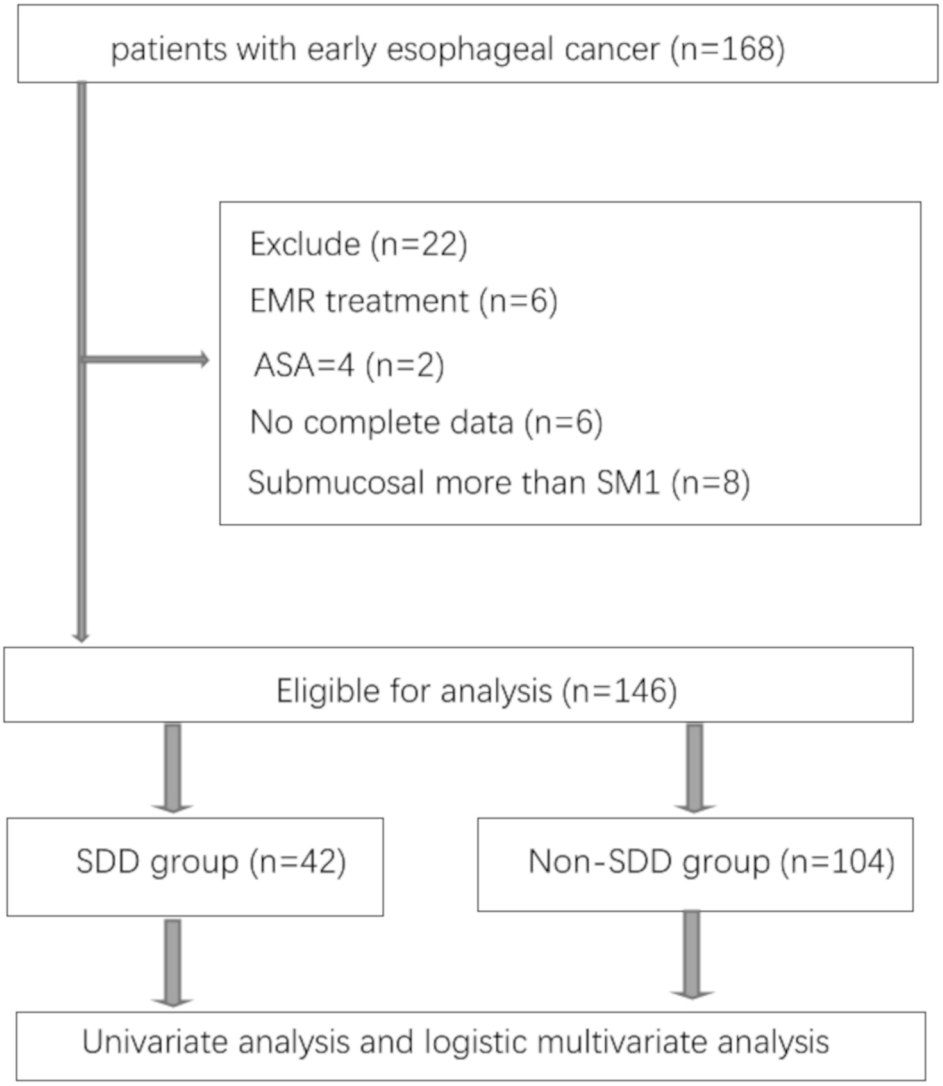

Fig. 1 Details of the study enrollment

Table 1 Baseline characteristic of patients

Characteristics	Value (*n* = 146)
Age, years, median (IQR)	56(50.5,65.5)
Male, Sex, *n* (%)	98(67.1)
Intraoperative bleeding, *n* (%)	10(6.8)
Intraoperative perforation, *n* (%)	6(4.1)
Lesion size, mm, mean (SD)	25.6(9.7)
Localization, *n* (%)	
Upper esophagus	30(20.6)
Mid-esophagus	58(39.7)
Lower esophagus	58(39.7)
Lesion number, multiple, *n* (%)	18(12.3)

SD = standard deviation; IQR = interquartile range

circumferential resection range, and COPD ($p < 0.05$) (Table 2).

To include all relevant variables, those with $p < 0.1$ in univariate analysis were incorporated into the multivariate regression analysis, encompassing tumor size, ASA classification, alcohol abuse history, circumferential resection range, COPD, and tumor location. This analysis revealed three independent risk factors for SDD: tumor size (OR = 2.152, 95%CI:2.037–2.280, $p = 0.008$), alcohol abuse history (OR = 6.507, 95%CI:3.169–11.211, $p = 0.032$), and tumors located in the upper esophagus (OR = 7.827, 95%CI:5.481–14.547, $p = 0.023$), as shown in Table 3. Following the multivariate regression analysis, predictive probabilities were assessed under various conditions. An ROC curve was created based on these probabilities (Fig. 2) with an area under the curve of 0.913.

Table 2 Clinical characteristic between two groups

Characteristic	SDD group (*n* = 42)	Non-SDD group (*n* = 104)	*p* value
Age, years, median (IQR)	59.5(49.5,67)	55(51,61)	0.206
Male, Sex, *n* (%)	30(71.4)	68(65.4)	0.482
Lesion size, mm, mean (SD)	21.9(6.0)	27.2(10.6)	0.009
Operative time, min, median (IQR)	77.5(66.5,91.3)	82(68,89)	0.833
ASA Class, *n* (%)			0.065
1/2	42(100.0)	93(89.4)	
3	0	11(10.6)	
Smoking status, *n* (%)			0.880
Never/former	32(76.2)	78(75.0)	
Current	10(23.8)	26(25.0)	
Alcohol abuse, *n* (%)			0.015
Yes	11(26.2)	50(48.1)	
No	31(73.8)	54(51.9)	
CRR, *n* (%)			0.024
< 1/2	20(47.6)	34(32.7)	
1/2–3/4	22(52.4)	56(53.8)	
≥ 3/4	0	14(13.5)	
Preoperative comorbidity, *n* (%)			
Hypertension	14(33.3)	20(19.2)	0.068
Diabetes	10(23.8)	24(23.1)	0.924
COPD	0	13(12.5)	0.038
Depth of infiltration, *n* (%)			0.880
M	18(42.9)	46(44.2)	
SM1	24(57.1)	58(55.8)	
Localization, *n* (%)			0.056
Upper esophagus	2(4.8)	8(5.8)	
Mid-esophagus	19(45.2)	66(63.5)	
Lower esophagus	21(50.0)	30(28.7)	
Lesion number, *n* (%)			0.648
Simple	36(85.7)	92(88.5)	
Multiple	6(14.3)	12(11.5)	
Intraoperative complication, *n* (%)			
Bleeding	0	8(7.7)	0.148
Perforation	0	6(5.8)	0.182

SDD = same-day discharge; SD = standard deviation; IQR = interquartile range; ASA = American society of anesthesiologists; COPD = chronic obstructive pulmonary disease; CRR = circumferential resection range

Table 3 Independent predictors of same-day discharge by multivariate analysis

Variable	OR	95% CI	*P*
Lesion size	2.152	2.037–2.280	0.008
Alcohol abuse	6.507	3.169–11.211	0.032
Localization			
Lower third (Ref)			
Middle third	1.012	0.243–4.217	0.987
Upper third	7.827	5.481–14.547	0.023

OR = Odds ratio; CI = Confidence interval; Ref = reference

This observation suggests that the identified risk factors may serve as reliable predictors for assessing the feasibility of SDD after ESD.

Discussion

ESD and EMR are two techniques employed in the endoscopic treatment of early esophageal cancer. Compared with EMR, ESD is not limited by tumor size and is associated with a higher rate of complete resection, as demonstrated in previous studies [4, 13]. ESD is currently favored for the treatment of early esophageal cancers. However, complications such as perforation and bleeding during the procedure can prolong postoperative hospital stay. Previous studies have reported SDD rates ranging from 58.1–71% [7–10]; however, only 28.8% of patients in our study achieved SDD, which is notably lower. This discrepancy may be attributed to eligible patients opting for continued hospitalization due to limited acceptance or understanding of SDD. This underscores the need for better communication and patient education by healthcare providers. Additionally, determining whether early esophageal cancer patients can undergo SDD after ESD necessitates a thorough assessment of their preoperative health status, tumor characteristics, and surgical factors. Extended hospital observation and treatment may be required for certain high-risk groups. Post-discharge follow-up further confirmed the safety of SDD. During the first week after discharge, no patients in the SDD group required emergency medical care or were readmitted to

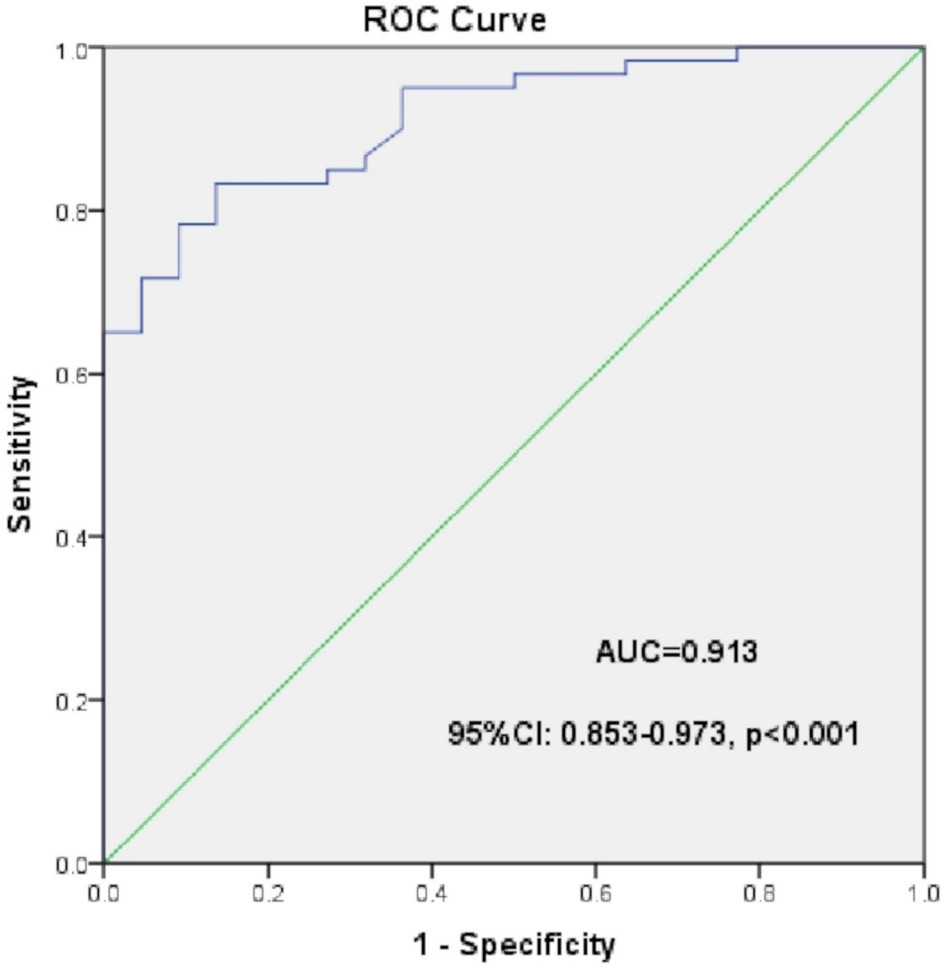

Fig. 2 Receiver operating characteristic curve for prediction probabilities of same-day discharge following endoscopic submucosal dissection for early esophageal cancer

the hospital. There were also no reported cases of aspiration pneumonia or delayed bleeding. These observations support the feasibility of SDD following ESD.

Multivariate analysis identified three independent risk factors that influenced SDD following ESD: tumor size, history of alcohol abuse, and tumors situated in the upper esophagus. The first independent risk factor identified was tumor location in the upper esophagus. This finding aligns with previous studies demonstrating that patients with upper esophageal tumors are more prone to intraoperative complications due to the complex anatomy and narrower lumen in this region, which limits the surgical field and increases the technical difficulty [14, 15]. Tumor size also had a significant impact on SDD, consistent with previous literature [14, 16]. Larger tumors may increase procedural complexity and require more extensive dissection. Although our study did not identify operative time or intraoperative complications as independent risk factors for SDD, tumor size itself remained significant. This suggests that larger tumors may reflect an overall greater procedural burden, which could influence clinicians' decisions regarding postoperative monitoring and delay discharge. Another independent risk factor was a history of alcohol abuse. This factor has been inconsistently addressed in previous studies—some excluded it from analysis [8, 9], while others found it clinically insignificant [17]. we hypothesize that alcohol abuse may affect liver function and coagulation status, thereby increasing perceived perioperative risk. Furthermore, alcohol abuse may influence sedation management during ESD. Previous studies have shown that patients with chronic alcohol use often require higher doses of sedatives such as propofol due to increased tolerance [18]. This may lead to delayed postoperative recovery and cautious discharge decisions, possibly explaining the association between alcohol abuse and lower SDD rates observed in our study. Although sedation dosage was not included in our multivariate analysis, this hypothesis merits further investigation in future studies. However, further subgroup analysis is needed to validate this finding given the limited sample size in our study.

Interestingly, the operative time and occurrence of intraoperative complications were not identified as independent risk factors for patients completing SDD, contradicting many research conclusions [19, 20]. We attribute this to the small sample size of SDD in our study, as the occurrence rate of intraoperative bleeding was 5.5%, and the perforation rate was 4.1%, with no cases of delayed bleeding. The intraoperative bleeding rate in our study (5.5%) appeared higher than that in some previous reports [11]. This discrepancy may be attributed to our relatively strict definition of intraoperative bleeding, which included any bleeding that required active endoscopic hemostatic maneuvers. Minor mucosal oozing without intervention was not counted. As such, our definition may have increased the observed incidence compared to studies using more lenient criteria. Additionally, although some reports cite circumferential resection exceeding 3/4 as a critical risk factor for postoperative perforation and stenosis [21, 22], our study found no cases of postoperative perforation in patients with circumferential resection exceeding this amount. It is worth noting that postoperative stenosis, a long-term complication, did not influence the feasibility of SDD in our cohort. A study on colon ESD found that patients with ASA grade 1 or 2 were more likely to qualify for SDD [23]. In contrast, our study revealed that although the proportion of patients with ASA grade 1 or 2 was higher in the SDD group than in the non-SDD group (100% vs. 89.4%), the difference was not statistically significant ($P = 0.065$). Consequently, the preoperative ASA grading did not emerge as a risk factor for SDD following ESD. In our study, multiple lesions had no impact on patients' SDD following ESD; however, other studies have indicated that multiple lesions are associated with a higher incidence of complications and postoperative recurrence than single lesions [24].

Several limitations should be acknowledged in our study. First, the small sample size restricted our ability to control for all potential confounding factors. Second, the nature of this single-center retrospective study introduces the possibility of selection bias, limiting the applicability of the results to other centers. In additional, our study was limited by the lack of systematic, in-person post-discharge follow-up. Although patients were instructed to report symptoms and seek care as needed, the absence of structured surveillance may have led to underreporting of minor post-discharge events. Nevertheless, our findings provide clinically meaningful insights for improving SDD completion rates following ESD. By identifying risk factors, such as tumor size, history of alcohol abuse, and tumor location in advance, and implementing preoperative risk stratification for patients with these risk factors, the allocation of medical resources may become more efficient.

Conclusion

Our findings suggest that factors such as tumor size, a history of alcohol use, and tumor location in the upper esophagus may be associated with an increased risk of SDD failure following ESD for early esophageal cancer. Further research is warranted to explore strategies for identifying patients who may be appropriate candidates for SDD after ESD, taking these potential risk factors into consideration.

Author contributions

Yuan-liang Zheng: original draft, Resources, Methodology, Investigation, Formal analysis, Conceptualization, Funding acquisition. Chi-chao Wang:

Formal analysis, Methodology, Data curation. Yu-ping Yuan: Writing– review & editing, Supervision, Methodology, Investigation.All authors reviewed the manuscript.

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Data availability
Data is provided by corresponding author if a further question for research data will be made available on request.

Declarations

Ethics approval and consent to participate
This study was performed in accordance with the Helsinki Declaration and approved by the Ethics Committee of Wenzhou Central Hospital (IRB number: L2024-03-050). All participants provided written informed consent or oral consent.

Consent for publication
Not applicable.

Conflict of interest
The authors declare no conflicts of interest.

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