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Evaluation of the Efficacy of Endoscopic Submucosal Dissection for the Treatment of ≥ 40 mm Protruding Colorectal Tumors

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Abstract: *Objective:* To explore the effectiveness and safety of endoscopic submucosal dissection (ESD) in the treatment of ≥ 40 mm protruding colorectal tumors. *Methods:* Sixty-five patients with colorectal tumors who underwent surgical treatment in the Department of Anorectal Surgery of a hospital from July 2023 to June 2024 were selected and grouped according to the type of surgery, with 33 cases of **endoscopic mucosal resection (EMR) patients included in the control group, and 32 cases of** E**SD patients included in** the observation group. The surgical characteristics, adverse events, as well as the fasting time, postoperative hospital stay, and hospital costs of the two groups were compared. *Results:* The whole resection rate of the control group and the observation group was 100% and 69.70%, respectively, and the difference was statistically significant ($P < 0.05$); there was no incidence of intraoperative hemorrhage, delayed hemorrhage, and perforation adverse events in the observation group, and the intraoperative hemorrhage rate of the control group was 9.09%, the delayed hemorrhage rate was 6.06%, and the perforation rate was 3.03%, and the difference was statistically significant ($P < 0.05$); postoperative fasting time in the control group and observation group was 1.13 ± 0.32 d vs 1.22 ± 0.33 d, postoperative hospital stay was 4.1 ± 1.3 d vs 4.6 ± 1.5 d, and total hospitalization cost was 9,639.8 ± 1,303.5 yuan vs 9,978.6 ± 1,506.8 yuan, with statistically significant differences ($P > 0.05$). *Conclusion:* The efficacy of endoscopic submucosal dissection for the treatment of ≥ 40 mm protruding colorectal tumors is precise, with a high rate of whole resection, which can significantly reduce the risk of intraoperative bleeding, delayed bleeding, perforation, and other adverse events.

Keywords: Endoscopic submucosal dissection; Protruding colorectal tumor; Resection rate; Adverse events

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1. Introduction

Colorectal tumors are one of the common malignant digestive tumors, and their incidence is increasing year by

year globally. With the rapid development of endoscopic technology, endoscopic submucosal dissection (ESD), as a minimally invasive treatment, has become an important therapeutic option for early colorectal tumors [1]. Compared with traditional endoscopic mucosal resection (EMR), ESD has a higher whole-mount resection rate and a lower incidence of adverse events, and is particularly suitable for the resection of larger lesions [2]. However, the therapeutic efficacy and safety of ESD for protruding colorectal tumors ≥ 40 mm in diameter still need to be further explored [3]. Protruding colorectal tumors usually present morphologically as polypoid or broad-based lesions, and their biological behavior may vary depending on size, location, and pathological type. Tumors ≥ 40 mm in diameter tend to have a higher risk of malignant potential and submucosal infiltration, thus requiring more stringent requirements for complete resection. Traditional surgical resection methods (e.g., EMR) are difficult to achieve complete resection of large lesions due to technical limitations, and often require piecemeal resection, which not only increases the difficulty of pathological assessment, but also leads to local recurrence due to incomplete resection [4]. In addition, segmental resection may also mask the infiltration depth of the lesion, affecting subsequent treatment decisions [5]. In contrast, ESD is able to achieve whole piece resection of large lesions through precise submucosal dissection techniques, providing a more complete specimen for pathological evaluation, and thus determining the depth of infiltration of the tumor and the status of the margins more accurately [6]. Currently, most domestic and international studies on ESD for large colorectal tumors focus on early gastric or esophageal cancers, and clinical data for protruding colorectal tumors with a diameter ≥ 40 mm are relatively limited. Although studies have shown that ESD has a high degree of safety and efficacy in the treatment of colorectal tumors, for large lesions, the technical difficulty and the risk of complications (e.g., perforation, bleeding, etc.) may be significantly increased [7]. Therefore, systematic evaluation of the efficacy and safety of ESD in such patients is important for optimizing clinical treatment strategies. The aim of this study was to investigate the whole resection rate, complete resection rate, and complication rate of ESD for ≥ 40 mm diameter protruding colorectal tumors by retrospective analysis and to compare it with conventional EMR treatment, so as to provide a more reliable evidence-based medical basis for minimally invasive treatment of colorectal tumors by clarifying the value of the clinical application of ESD in such patients.

2. Information and methodology

2.1. General information

Sixty-five patients with colorectal tumors who underwent surgical treatment in the Department of Anorectal Surgery of a hospital from July 2023 to June 2024 were selected and grouped according to the type of surgery, with 33 patients who underwent EMR included in the control group, and 32 patients who underwent ESD included in the observation group. In the control group, there were 20 males and 13 females, aged 55–69 years old, with an average of 60.25 ± 2.46 years old; the lesion sites were: the right half of the colon in 21 cases, the left half of the colon and the rectum in 12 cases; the maximum diameter of the tumor was 41.12 ± 3.15 mm. In the observation group, there were 22 males and 10 females, aged 56–70 years old, with an average of 61.05 ± 2.17 years old; the lesion sites were: the right half of the colon in 19 cases, the left half of the colon and the rectum in 13 cases; and the maximum diameter of the tumor was 40.72 ± 3.00 mm. The general data of the two groups of patients were compared, the difference was not statistically significant ($P > 0.05$). The study protocol was approved by the Medical Ethics Committee of our hospital, and all patients voluntarily signed a written informed consent.

Inclusion criteria: (1) single protruding (polypoid or broad-based) colorectal tumor with a diameter of

≥ 40mm confirmed by endoscopy or imaging; (2) high-grade intraepithelial neoplasia (HGIN), intramucosal carcinoma (Tis/T1a), or superficial submucosal infiltration (SM1, with an infiltration depth of < 1000 μm); (3) no lymph node metastasis confirmed by ultrasonic endoscopy/EUS, CT/MRI (cN0) and distant metastasis (cM0); (4) patients signed informed consent and tolerated general anesthesia and ESD surgery (without severe cardiopulmonary dysfunction).

Exclusion criteria: (1) pathologically confirmed T1b (SM2/3, infiltration depth ≥ 1000 μm) or more advanced (≥ T2); (2) imaging or pathological confirmation of the presence of lymph node metastasis (pN+) or distant metastasis (M1); (3) lesions combined with ulceration, scarring, or deep infiltration signs (e.g., submucosal fibrosis, negative elevation sign); (4) combined with uncorrectable coagulation abnormalities (INR > 1.5, platelets < 50×10^9/L) or inability to suspend anticoagulant drugs; (5) concomitant contraindications to pregnancy, active inflammatory bowel disease, and history of previous colorectal surgery resulting in anatomical abnormalities.

2.2. Methodology

2.2.1. Control group

Endoscopic mucosal resection (EMR) was performed in the control group. Preoperatively, the extent of the lesion was accurately assessed, and the lesion was augmented by submucosal injection of glycerol fructose-indigo carmine mixture (containing epinephrine). For pedunculated polyps, direct electrodes were used with a loop device, while broad-based lesions were resected in pieces by the "injection-loop" method; the trauma was treated with electrocoagulation to stop hemorrhage, and metal clips were used to close the defects if necessary, and close follow-up was required after the operation.

2.2.2. Observation group

Endoscopic submucosal dissection (ESD) was performed in the observation group. The surgery was performed in strict accordance with the standard operating procedures: (1) mucosal marking: a high-frequency electric knife was used to mark the edge of the lesion at 0.5 cm with electrocoagulation; (2) submucosal injection: a mixture of indigo carmine-glycerol fructose-adrenaline was used for multiple injections, so as to make the submucosal layer rise sufficiently and form a stable "liquid cushion"; (3) marginal preincision: an IT knife or Dual knife was used to circumferentially incise the mucosa along the lateral side of the marked point; (4) submucosal dissection: the submucosal layer was gradually separated, keeping the field clear, and completely peeling off the lesion, and electrocoagulation was used during the operation to prevent bleeding; (5) wound treatment: metal clips were used to close the exposed muscular layer or electrocoagulation, and closely monitoring the complications such as delayed hemorrhage and perforation in the postoperative period.

2.3. Observation indicators

Statistical analysis of surgical characteristics (whole or segmental resection), adverse events (intraoperative hemorrhage, postoperative hemorrhage, perforation), as well as indicators of duration of fasting, postoperative hospital stay, and hospital costs.

2.4. Statistical methods

SPSS23.0 software was applied for statistical analysis, and the measurement information was expressed as mean ± standard deviation (SD), and *t*-test was used for comparison, and the count information was expressed as rate (%),

and χ^2 test was used for comparison, and $P < 0.05$ was considered statistically significant difference.

3. Results

The whole block resection rate of the control group and observation group was 100% and 69.70%, and the R0 resection rate was 93.75% and 63.64%, respectively, with statistically significant differences ($P < 0.05$); the incidence of intraoperative bleeding, delayed hemorrhage, and perforation adverse events in the observation group was 0, while the intraoperative bleeding rate of the control group was 9.09%, the rate of delayed hemorrhage was 6.06%, and the rate of perforation was 3.03%, the difference was statistically significant ($P < 0.05$); the postoperative fasting time, postoperative hospitalization time, and total hospitalization cost of the two groups were compared, the difference was not statistically significant ($P > 0.05$). See **Table 1**.

Table 1. Comparison of surgical data, adverse events, and postoperative conditions between the two groups

Groups	Block resection [*n* (%)]	Adverse events			Postoperative indicators		
		Intraoperative bleeding	Delayed hemorrhage	Perforation	Fasting time (d)	Length of postoperative stay (d)	Total cost of hospitalization ($)
Control group ($n = 33$)	23 (69.70)	3 (9.09)	2 (6.06)	1 (3.03)	1.13 ± 0.32	4.1 ± 1.3	9639.8 ± 1303.5
Observation group ($n = 32$)	32 (100)	0	0	0	1.22 ± 0.33	4.6 ± 1.5	9978.6 ± 1506.8
χ^2/t	9.2504		4.4235		1.5595	1.4375	0.9704
P	0.0024		0.0354		0.1239	0.1555	0.3355

4. Discussion

With the change of dietary structure and population aging, the incidence of colorectal tumors in China has shown a continuous upward trend. As an important clinical subtype, protruding colorectal tumors usually present as polypoid or broad-based lesions with a clear potential for malignant transformation. The incidence of high-grade intraepithelial neoplasia or early-stage carcinoma can be more than 30% for protruding colorectal tumors ≥ 40 mm in diameter [8]. Meanwhile, because the increase in tumor size is often accompanied by an elevated chance of submucosal infiltration, timely and complete resection is crucial to the prognosis. Although traditional surgery can ensure the extent of resection, it has the disadvantages of high trauma, slow recovery, and many complications. Endoscopic treatment, on the other hand, faces three major technical difficulties: first, the wide extent of the lesion makes complete resection difficult; second, the rich vascularity of the submucosal layer presents a high risk of intraoperative hemorrhage; and third, the thin wall of the colon, especially the right half of the colon, presents a significant increase in the risk of perforation [9]. In addition, the location of the lesion (e.g., distal rectum or hepatic-splenic flexure of the colon) significantly affects the difficulty of the operation, making endoscopic treatment of tumors ≥ 40 mm a major clinical challenge. ESD is an advanced endoscopic minimally invasive treatment technique, the core of which lies in the whole resection of the lesion through precise submucosal dissection, which mainly consists of three key links [10]: (1) formation of sufficient operating space through submucosal injections, and commonly used injections contain sodium hyaluronate, glycerol fructose, etc., which can maintain the

augmentation effect for a longer period of time; (2) circumferential preincision using a special electric knife (e.g., IT knife, Dual knife) to establish a clear resection boundary; (3) layer-by-layer peeling of the submucosal layer, and control of intraoperative bleeding through precise electrocoagulation hemostasis to achieve a true radical resection [11].

In this study, by examining the whole resection rate, intraoperative bleeding rate, delayed bleeding rate, perforation rate, postoperative fasting time, postoperative hospitalization time, total hospitalization cost, and other indexes of the two groups of patients under different surgical protocols, it was found that the whole resection rate of the control group and the observation group was 100% and 69.70%, respectively, and the difference was statistically significant ($P < 0.05$). The incidence of adverse events in the observation group was 0, while the intraoperative bleeding rate of the control group was 9.09%, the delayed bleeding rate was 6.06%, and the perforation rate was 3.03%, and the difference was statistically significant ($P < 0.05$); the postoperative fasting time of the control group and the observation group was 1.13 ± 0.32 d vs 1.22 ± 0.33 d, the postoperative hospital stay was 4.1 ± 1.3 d vs 4.6 ± 1.5 d, and the total hospitalization cost was 9639.8 ± 1303.5 yuan vs 9978.6 ± 1506.8 yuan, the difference was not statistically significant ($P > 0.05$). The reasons for this analysis were mainly attributed to the fact that ESD significantly reduced intraoperative bleeding through fine submucosal dissection techniques and effective hemostatic measures, and the risk of delayed bleeding could be controlled to less than 5% by using techniques such as prophylactic hemostatic clamping [12]; and the systematic submucosal dissection techniques maintained the perforation rate at an acceptable level (about 4–6%), making ESD the minimally invasive treatment of choice for large colorectal tumors.

5. Conclusion

In conclusion, endoscopic submucosal dissection for ≥ 40 mm protruding colorectal tumors is effective with a high rate of complete resection, and significantly reduces the risk of intraoperative hemorrhage, delayed hemorrhage, perforation, and other adverse events.

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Disclosure statement

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