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Effectiveness of High-Frequency Electrosurgical Knife Surgery Under Painless Digestive Endoscopy in Elderly Patients with Gastrointestinal Polyps

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Abstract: *Objective:* To analyze the therapeutic effect of high-frequency electrosurgical knife surgery guided by painless digestive endoscopy (PDE) in elderly patients with gastrointestinal polyps (GP). *Methods:* A total of 100 elderly GP patients admitted between June 2021 and December 2022 were selected. Patients were randomly divided into two groups: the painless group (50 cases) underwent high-frequency electrosurgical knife surgery guided by PDE, while the conventional group (50 cases) underwent the same surgery guided by traditional digestive endoscopy (DE). The total treatment efficacy, perioperative indicators, gastrointestinal hormone levels, oxidative stress (OS) markers, and complication rates were compared between the two groups. *Results:* The total treatment efficacy in the painless group was higher than that in the conventional group, and perioperative indicators were superior in the painless group ($P < 0.05$). One week after treatment, the gastrointestinal hormone levels and OS-related markers in the painless group were better than those in the conventional group ($P < 0.05$). The complication rate in the painless group was lower than in the conventional group ($P < 0.05$). *Conclusion:* High-frequency electrosurgical knife surgery guided by PDE improves the effectiveness of polyp removal in elderly GP patients and accelerates postoperative recovery. It also protects gastrointestinal function, reduces postoperative OS, and ensures higher surgical safety.

Keywords: Painless digestive endoscopy; High-frequency electrosurgical knife surgery; Elderly gastrointestinal polyps

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1. Introduction

Gastrointestinal polyps (GP) are benign tumors located on the mucosa of the digestive tract, characterized by epithelial tissue protrusions. GP has a high incidence rate and, if left untreated, can progress and increase the risk of malignancy, affecting prognosis. Currently, digestive endoscopy (DE) is the standard diagnostic and therapeutic technology for GP, allowing precise control of the observation range, clear visualization of polyp status, and guidance for removal procedures [1,2]. High-frequency electrosurgical knife surgery guided by DE utilizes high-

frequency currents and voltage to precisely separate tissues and completely excise polyps. This approach is simple, minimally invasive, and effective. However, traditional endoscopy often causes significant discomfort during insertion, such as nausea or palpitations, reducing patient cooperation. In contrast, PDE can alleviate the discomfort of endoscope insertion with the use of analgesics, thus improving surgical efficiency [3]. This study evaluated the efficacy of high-frequency electrosurgical knife surgery guided by PDE in 100 elderly GP patients.

2. Materials and methods

2.1. General information

A total of 100 elderly patients with GP treated in the hospital from June 2021 to December 2022 were included. The patients were randomly divided into two groups using a random number table:

(1) Painless group: 50 cases, including 27 males and 23 females; ages ranged from 62 to 88 years, with a mean of (71.26 ± 3.12) years; polyp diameters ranged from 1.1 to 3.6 cm, with a mean of (1.95 ± 0.43) cm; 19 cases had multiple polyps, and 31 cases had single polyps.

(2) Conventional group: 50 cases, including 29 males and 21 females; ages ranged from 63 to 89 years, with a mean of (71.37 ± 3.20) years; polyp diameters ranged from 1.2 to 3.8 cm, with a mean of (1.97 ± 0.59) cm; 20 cases had multiple polyps, and 30 cases had single polyps.

There was no significant difference in baseline data between the two groups ($P > 0.05$).

Inclusion criteria: Diagnosis of GP confirmed by gastroscopic pathology; age > 60 years; clear consciousness; complete clinical data; informed consent to participate.

Exclusion criteria: Presence of gastric perforation; primary diseases such as gastroesophageal bleeding; malignancies; history of open abdominal surgery; withdrawal during the study.

2.2. Methods

Before surgery, routine examinations of cardiac and liver functions were performed. Patients fasted for 8 hours and consumed compound polyethylene glycol electrolyte powder (137.15 g), dissolved in 2 L of warm water, and taken in divided doses.

2.2.1. Painless group

High-frequency electrosurgical knife surgery was performed under painless digestive endoscopy (PDE) guidance. Patients were positioned in the lateral decubitus position. Propofol emulsion injection (1.0 μg/kg) was administered intravenously 5 minutes before surgery. Fentanyl citrate injection (0.5 μg/kg) was also administered intravenously. After anesthesia onset (disappearance of eyelash reflex), the digestive endoscope (DE) was slowly inserted to observe the location, number, and morphology of the polyps. Surrounding fluids were suctioned to ensure a clear surgical field. The high-frequency electrosurgical knife was set at a coagulation power of 40 W, a current index of 4.0, and a power-on duration of 2 seconds per application. Polyps were lifted completely using non-damaging forceps and excised using the electrosurgical knife for coagulation and cutting.

2.2.2. Conventional group

High-frequency electrosurgical knife surgery was performed under traditional DE guidance. No anesthesia was administered before surgery. The digestive endoscope was slowly inserted to observe the polyps, followed by

coagulation and excision using the high-frequency electrosurgical knife. The procedure followed the same steps as in the painless group.

2.3. Observation indicators

(1) Perioperative indicators: Observations included intraoperative blood loss, surgery duration, postoperative pain at 2 hours (measured using a visual analog scale, with scores ranging from 0 to 10, where higher scores indicate greater pain), postoperative exhaust time, and length of hospital stay.

(2) Gastrointestinal hormones: Four milliliters of fasting venous blood was drawn, centrifuged for 12 minutes at 4,000 r/min to extract serum, and used to measure vasoactive intestinal peptide (VIP), gastrin (GAS), and motilin (MOT) levels using radioimmunoassay.

(3) Oxidative stress (OS) markers: Fasting venous blood was processed similarly to measure 5-hydroxytryptamine (5-HT) and malondialdehyde (MDA) using enzyme-linked immunosorbent assay (ELISA). Glutathione peroxidase (GSH-Px) and total antioxidant capacity (T-AOC) were measured using a chemical colorimetry method.

(4) Complication rate: Observed complications included gastrointestinal bloating, wound infection, gastric perforation, and gastric bleeding.

2.4. Efficacy evaluation criteria

(1) Significant effect: Complete removal of polyps in one session with total symptom resolution.

(2) Effective: Residual polyps with significant symptom alleviation.

(3) Ineffective: Large residual polyps with no symptom relief.

2.5. Statistical analysis

Data were analyzed using SPSS 28.0. Measurement data were expressed as mean ± standard deviation (SD) and compared using the *t*-test. Count data were expressed as [*n* (%)] and compared using the χ^2 test. Statistical significance was set at $P < 0.05$.

3. Results

3.1. Comparison of overall treatment effectiveness between groups

Table 1 shows that the overall treatment effectiveness rate in the painless group was significantly higher than that in the conventional group ($P < 0.05$).

Table 1. Comparison of overall treatment effectiveness between groups [*n* (%)]

Group	*n*	Significant effect	Effective	Ineffective	Total effectiveness
Painless	50	26 (52.0)	22 (44.0)	2 (4.0)	48 (96.0)
Conventional	50	21 (42.0)	20 (40.0)	9 (18.0)	41 (82.0)
χ^2	-	-	-	-	5.005
P	-	-	-	-	0.025

3.2. Comparison of perioperative indicators between groups

Table 2 shows that the perioperative indicators in the painless group were significantly better than those in the conventional group ($P < 0.05$).

Table 2. Comparison of perioperative indicators between groups (mean ± SD)

Group	*n*	Blood loss (mL)	Surgery time (min)	Postoperative pain at 2 h (score)	Postoperative exhaust time (h)	Hospital stay (days)
Painless	50	15.62 ± 2.34	27.11 ± 4.03	1.85 ± 0.56	24.10 ± 3.56	6.61 ± 1.58
Conventional	50	21.27 ± 3.41	36.91 ± 4.37	3.01 ± 0.79	33.15 ± 3.97	8.40 ± 1.79
t	-	9.660	11.657	8.471	12.001	5.301
P	-	0.000	0.000	0.000	0.000	0.000

3.3. Comparison of gastrointestinal hormones between groups

Before treatment, there were no significant differences in gastrointestinal hormone levels between the groups ($P > 0.05$). After one week of treatment, the gastrointestinal hormone levels in the painless group were significantly better than those in the conventional group ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of gastrointestinal hormones between groups before and after treatment (mean ± SD, pg/mL)

Group	*n*	VIP		GAS		MOT	
		Before	After	Before	After	Before	After
Painless	50	36.15 ± 4.19	40.15 ± 5.98	150.36 ± 18.74	130.52 ± 15.39	262.64 ± 19.85	240.56 ± 18.02
Conventional	50	36.09 ± 4.22	45.91 ± 5.77	151.32 ± 17.53	115.92 ± 14.70	263.05 ± 18.78	214.66 ± 17.90
t	-	0.071	4.901	0.265	4.851	0.106	7.210
P	-	0.943	0.000	0.792	0.000	0.916	0.000

3.4. Comparison of oxidative stress markers between groups

Before treatment, there were no significant differences in OS markers between the groups ($P > 0.05$). After one week of treatment, the OS markers in the painless group were significantly better than those in the conventional group ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of OS markers between groups before and after treatment (mean ± SD)

Group	*n*	5-HT (ng/mL)		MDA (mmol/L)		GSH-Px (U/mL)		T-AOC (U/mL)	
		Before	After	Before	After	Before	After	Before	After
Painless	50	250.65 ± 20.41	375.02 ± 34.11	4.46 ± 0.39	5.01 ± 0.58	1,925.84 ± 97.63	1,768.32 ± 80.57	5.25 ± 0.64	3.75 ± 0.40
Conventional	50	250.31 ± 21.47	470.12 ± 39.52	4.48 ± 0.40	6.42 ± 0.63	1,924.33 ± 98.06	1,620.53 ± 77.32	5.28 ± 0.69	2.89 ± 0.37
t	-	0.081	12.881	0.253	11.643	0.077	9.358	0.225	11.160
P	-	0.935	0.000	0.801	0.000	0.939	0.000	0.822	0.000

3.5. Comparison of complication rates between groups

Table 5 shows the complication rate in the painless group was significantly lower than that in the conventional group ($P < 0.05$).

Table 5. Comparison of complication rates between groups [*n* (%)]

Group	*n*	Gastrointestinal bloating	Wound infection	Gastric perforation	Gastric bleeding	Total complications
Painless	50	1 (2.0)	0	0	0	1 (2.0)
Conventional	50	4 (8.0)	1 (2.0)	1 (2.0)	1 (2.0)	7 (14.0)
χ^2	-	-	-	-	-	4.891
P	-	-	-	-	-	0.027

4. Discussion

The development process of GP involves poor dietary habits and weakened gastrointestinal function, leading to inflammatory responses in the gastric mucosa. This results in the mucosal epithelium protruding and forming polyps [4]. Elderly individuals have a higher likelihood of developing this condition due to their declining physical functions, prolonged dietary irregularities, preference for high-salt foods, and frequent constipation. These factors contribute to intestinal mucosal lesions, thereby triggering GP. Traditional diagnostic endoscopy (DE) can comprehensively diagnose GP and guide polyp removal. However, elderly patients remain conscious during the procedure, leading to significant stress reactions such as emotional tension, increased heart rate, and elevated blood pressure, which can hinder the smooth execution of the procedure [5,6]. Additionally, in a conscious state, elderly patients experience faster gastrointestinal motility, delaying wound healing and prolonging postoperative recovery.

In contrast, PDE offers advantages such as ease of operation, rapid cutting, and efficient hemostasis. PDE allows patients to undergo endoscopy in a state resembling natural sleep, improving their tolerance to the endoscopic process and polyp removal. It also slows gastrointestinal motility and efficiently detects and removes small polyps [7].

The results of this study indicate that the painless group had a higher overall treatment effectiveness rate and significantly better perioperative indicators compared to the conventional group ($P < 0.05$). The underlying reasons include the following: Local anesthesia administered 5 minutes before the procedure for elderly patients provided both analgesic and sedative effects, alleviating preoperative anxiety. This improved patient compliance and ensured the smooth and effective execution of the procedure, enhancing the reliability and safety of the surgery [8]. PDE prevents reactions like tremors during the procedure, avoiding damage to healthy tissues and minimizing intraoperative blood loss. Additionally, PDE eliminates the risk factors associated with electrosurgical polypectomy and shortens the duration of the surgery. Consequently, the surgical outcomes are favorable, and postoperative recovery is quicker. Furthermore, anesthetic drugs reduce postoperative pain perception and provide prolonged analgesic effects, resulting in milder postoperative pain [9].

VIP is produced by intestinal neurons and has dual biological effects. GAS, found in the duodenum and stomach and produced by pancreatic D cells, promotes gastrointestinal motility and enhances gastric contractions. MOT, located in the small intestine, stimulates phase III muscle contractions and accelerates gastric emptying. In this study, the gastrointestinal hormone levels in the painless group were more stable one week after treatment

compared to before treatment and showed less fluctuation [10]. PDE alleviates pain and psychological distress, enabling patients to undergo endoscopy in a painless state, reducing excessive gastrointestinal motility, and stabilizing gastrointestinal hormone secretion.

Serotonin and MDA are common OS markers used to assess stress levels and evaluate surgical stability. In this study, the OS-related indicators in the painless group were significantly better one week after treatment compared to the conventional group ($P < 0.05$). This is attributed to the use of anesthetic agents like propofol in PDE, which act quickly to provide stable sedative and analgesic effects, stabilize hemodynamics, and reduce stress responses [11]. Furthermore, the complication rate in the painless group was lower than in the conventional group ($P < 0.05$). PDE reduces the invasiveness of high-frequency electrosurgical procedures, improves resection precision, and prevents unnecessary damage, enhancing safety [12]. The side effects of anesthetic drugs are minimal, primarily targeting the central nervous system, and they rarely cause residual drug accumulation, demonstrating higher anesthesia reliability.

5. Conclusion

In conclusion, high-frequency electrosurgical procedures guided by PDE demonstrate high success rates and facilitate postoperative recovery in elderly GP patients. This approach protects gastrointestinal function, reduces perioperative stress responses, and ensures high surgical safety, making it the preferred treatment option for elderly GP patients.

Disclosure statement

The author declares no conflict of interest.

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