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Comparison of anesthesia quality and postoperative recovery quality of total intravenous anesthesia with ciprofol and propofol in laparoscopic radical resection of elderly patients

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Abstract: Objective To compare the anesthesia quality and postoperative recovery quality between ciprofol and propofol for total intravenous anesthesia in elderly patients with colon cancer undergoing laparoscopic radical resection, and to provide evidences for optimizing clinical anesthesia selection. **Methods** A total of 156 patients scheduled to undergo laparoscopic radical resection of colon cancer in the First People's Hospital of Zhangjiagang from January 2023 to January 2025 were prospectively included. According to the random number table method, they were divided into ciprofol group (group C) and propofol group (group P), with 78 patients in each group. Anesthesia was maintained by pumping ciprofol 0.4-3 mg/(kg·h) and remifentanil 0.05-2 μg/(kg·min) in group C, and propofol 4-12 mg/(kg·h) and remifentanil 0.05-2 μg/(kg·min) in group P, and intermittent intravenous injection of rocuronium as needed to maintain the muscle relaxation effect. Intraoperative mean arterial pressure (MAP) and heart rate (HR) were recorded. Richmond agitation-sedation scale (RASS) scores were assessed in the post-anesthesia care unit (PACU). Anesthesia induction time, extubation time, and PACU stay were recorded. Intraoperative adverse events, including injection pain, hypotension, hypertension, bradycardia, and tachycardia, were observed, as well as adverse events in the PACU. The 15-item quality of recovery scale (QoR-15) was used to evaluate postoperative recovery. **Results** Instant MAP at the time of endotracheal intubation was significantly lower in group P compared to group C (P<0.05). No significant differences were observed in RASS scores after extubation, as well as anesthesia induction time, extubation time, or PACU stay between the two groups (P>0.05). The non-, mild-, moderate-and severe- injection pain were 17, 33, 19 and 9 cases in group P, and 67, 5, 5 and 1 case in group C, respectively. The degree of injection pain in group P was significantly higher than that in group C (Z=7.544, P < 0.01). The incidence of intraoperative hypotension in group P was significantly higher than that in group C (51.3% *vs* 26.9%, χ^2 =9.718, P=0.002). No significant difference was found in the incidence of adverse events in the PACU, and postoperative QoR-15 scores on postoperative days 1, 2, and 3 between the two groups (P>0.05). **Conclusion** In laparoscopic radical resection of colon cancer in the elderly patients, total intravenous anesthesia with ciprofol or propofol can achieve good anesthesia effects and postoperative recovery quality. Compared with propofol, ciprofol has certain advantages in maintaining hemodynamic stability and the injection pain is more mild. Therefore, ciprofol can be used as a safe and effective anesthesia choice in laparoscopic surgery for elderly patients with colon cancer.

Keywords: Ciprofol; Propofol; Total intravenous anesthesia; Laparoscopic radical resection for colon cancer; Anesthesia quality; Postoperative recovery quality; Elderly

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With the acceleration of population aging, the demand for surgery in the elderly population is increasing [1]. Laparoscopic technology has been widely used in the treatment of colon cancer in elderly patients due to its advantages such as minimal trauma and low incidence of complications. Considering the deterioration of physiological functions, comorbidity with multiple chronic underlying diseases, and increased risk of postoperative complications

and delayed recovery in elderly patients, the selection of perioperative anesthetic drugs not only needs to ensure the effectiveness and safety of anesthesia but also pay attention to the quality of postoperative recovery and patient comfort [2-3].

Propofol, as a commonly used drug for total intravenous anesthesia, is widely used in clinical practice due to its favorable pharmacological properties [4]. However, potential adverse reactions of propofol, including hemodynamic instability, dose-related respiratory depression, and injection pain, still require attention [5]. In the process of improving anesthesia quality, how to exert the sedative advantages of propofol while reducing its adverse reactions is the key to current anesthesia management. Ciprofol is a novel γ-aminobutyric acid receptor agonist with higher binding affinity to receptors than propofol, and has certain advantages in pharmacological and physicochemical properties [6-7]. In addition, the metabolites of ciprofol are inactive, which can reduce the risk of drug accumulation in the body [8]. Existing studies have shown that ciprofol can significantly reduce injection pain and help maintain hemodynamic stability, which may provide a safer and more effective anesthetic option for elderly patients [9-10]. However, research on the application of ciprofol in elderly patients undergoing laparoscopic colon cancer surgery is still relatively limited, and especially lacks direct comparative data with propofol in terms of anesthesia quality and postoperative recovery.

Therefore, this study aims to compare the anesthesia quality and postoperative recovery quality of ciprofol and propofol in total intravenous anesthesia for elderly patients undergoing laparoscopic radical resection for colon cancer, so as to provide a basis for the optimal selection of clinical anesthetic drugs.

1 Materials and methods

1.1 Study design

A total of 156 elderly patients scheduled to undergo laparoscopic radical resection of colon cancer at the First People's Hospital of Zhangjiagang from January 2023 to January 2025 were prospectively enrolled. PASS 11.0 software was used to estimate the sample size based on the mean difference in the 15-item quality of recovery score (QoR-15) on the first postoperative day between the two groups. According to the results of the preliminary pilot study, the mean difference in QoR-15 scores on the first postoperative day between group C and group P was 5.1 points, with standard deviations of 11.6 points and 12.6 points in group C and group P, respectively. With α set at 0.05 and 1-β at 0.8, the calculated required sample size was 71 cases per group. Considering a dropout rate (λ) of 0.1, 78 patients were finally included in each group. SPSS 26.0 was used to generate random numbers. With a total sample size of 156 cases and a 1∶1 ratio between the two groups, patients were assigned to either the ciprofol group (group C) or the propofol group (group P) according to the random number table method, with 78 patients planned for each group. This trial was approved by the Ethics Committee of Zhangjiagang First People's Hospital (Ethics Approval No.: ZJGYY-2023019), and all patients agreed to participate in this study and signed the informed consent form. Randomization was performed by a researcher not involved in patient recruitment, anesthesia administration, or data collection, and allocation concealment was implemented using sequentially numbered, sealed, opaque envelopes. Before surgery, an anesthetic nurse not involved in other study procedures opened the envelope and prepared the corresponding drugs. All drugs were numbered and dispensed by this nurse to ensure that anesthesiologists remained blinded to the type of drug during administration. Patients, data collectors, postoperative assessors, and other clinical staff also remained blinded to the group allocation to minimize research bias.

1.2 Comparison of general data

In group C, there were 38 males and 40 females; in group P, 33 males and 45 females. There was no statistically significant difference in gender distribution between the two groups (χ^2=0.646, P=0.421). No statistically significant differences were observed between the two groups in terms of age, American Society of Anesthesiologists (ASA) physical status classification, BMI, history of abdominal surgery, operation duration, frailty grade, duration of fasting, or proportion of patients with hypertension, diabetes mellitus, or coronary heart disease (P>0.05). **[Table 1]**

Tab.1 Comparison of general data between two groups (n=78)

Groups	Age (years, $\bar{x}$ ±s)	ASA classification (II/III，case)	BMI (kg/m², $\bar{x}$ ±s)	History of abdominal surgery [case(%)]	Operation time [min,$M(Q_1,Q_3)$]
Group C	71.3±5.5	26/52	23.6±3.1	27 (34.6)	191.0（179.3, 201.3）
Group P	70.7±5.1	30/48	23.5±3.5	21 (26.9)	188.5（178.8, 197.0）
$t/Z/\chi^2$ value	0.707	0.446	0.178	1.083	1.142
P value	0.481	0.504	0.859	0.298	0.254

Groups	Frailty degree (none/mild/moderate/severe, cases)	Fasting duration [h,$M(Q_1,Q_3)$]	Hypertension [case (%)]	Diabetes [case (%)]	Coronary heart disease[case (%)]
Group C	57/12/7/2	12.0（11.0, 14.3）	37 (47.4)	30 (38.5)	24 (30.8)
Group P	60/11/6/1	12.0（11.0, 15.0）	33 (42.3)	27 (34.6)	19 (24.4)
Z/χ^2 value	0.594	0.577	0.415	0.249	0.803
P value	0.553	0.564	0.520	0.618	0.370

1.3 Study subjects

Researchers conducted evaluations on eligible patients the day before surgery.

Inclusion criteria:

(1) Age ≥ 65 years;

(2) ASA physical status classification II-III;

(3) Body mass index (BMI) 18.5-27.9 kg/m^2;

(4) Scheduled to undergo elective laparoscopic radical resection of colon cancer under total intravenous anesthesia.

Exclusion criteria:

(1)Known allergy to eggs, soy products, or study drugs (e.g., ciprofol, remifentanil, rocuronium, and atropine);

(2)With comorbid central nervous system diseases (e.g., craniocerebral trauma, acute stroke, progressive dementia);

(3)Severe hypertension (defined as preoperative systolic blood pressure ≥ 180 mmHg);

(4)With comorbid psychiatric disorders or alcohol dependence;

(5)Difficulty in airway management;

(6)With language, hearing, or vision impairments that made them unable to complete relevant evaluations;

(7)Severe cardiac insufficiency (e.g., heart failure staging stage C or higher, second-degree or higher atrioventricular block);

(8)Severe hepatic or renal insufficiency (e.g., Child-Pugh classification grade C, requiring dialysis etc.).

Withdrawal criteria:

(1) Converted to open surgery during the operation;

(2) Required conversion to inhalational anesthesia for maintenance during the operation;

(3) Severe adverse events occurred during the operation, requiring discontinuation of study drugs or interruption of surgery;

(4) Loss of key data (e.g., hemodynamic parameters, recovery scores) that made them unable to complete the evaluation of primary outcome measures;

(5) Patients or their families voluntarily requested to withdraw from the study during the research process.

1.4 Anesthesia method

All patients underwent bowel preparation preoperatively and were required to fast from solid food for 8 hours and clear liquids (e.g., plain water, weak tea, clear fruit juice, etc.) for 2 hours before surgery. If patients had delayed gastric emptying or special complications, the fasting time was appropriately prolonged based on individual conditions. All patients received standardized anesthesia management without any preoperative medications. Upon entering the operating room, patients underwent 3-way verification to confirm basic patient information, surgical site, fasting status, and allergy history. Subsequent monitoring parameters include electrocardiogram (ECG), heart rate, non-invasive systolic/diastolic blood pressure, blood oxygen saturation (SpO_2), and bispectral index (BIS). An intravenous access was established in one upper limb, with intravenous infusion of 0.9% sodium chloride injection at 10 mL/(kg·h). Oxygen flow rate was adjusted to 10 L/min with 100% oxygen concentration, and oxygen was administered via a face mask. Radial artery puncture was performed under local anesthesia for invasive blood pressure monitoring, with dynamic recording of invasive mean arterial pressure (MAP).

For anesthesia induction, group C received an intravenous injection of ciprofol (Manufacturer: Liaoning Haisco Pharmaceutical Co., Ltd.; Batch No.: 20220808) at a dose of 0.2–0.5 mg/kg, while group P received propofol (Manufacturer: Xi'an Libang Pharmaceutical Co., Ltd.; Batch No.: 22205311) at 1–2 mg/kg. Both groups were then given slow intravenous injections of sufentanil (Manufacturer: Yichang Renfu Pharmaceutical Co., Ltd.; Batch No.: 21A03331) 1 μg/kg and rocuronium (Manufacturer: Guangdong Xinghao Pharmaceutical Co., Ltd.; Batch No.: 139220905) 1 mg/kg for induction. During induction, manual controlled ventilation was performed. Oral visual endotracheal intubation was conducted when the BIS value dropped below 60, complete jaw relaxation was achieved, and the corneal reflex disappeared. The position and depth of the endotracheal tube were confirmed by auscultating breath sounds and observing the numerical value and waveform of end-tidal CO_2 ($ETCO_2$). After confirmation, the endotracheal tube was secured, and mechanical ventilation was initiated with a volume-controlled mode. The ventilator parameters were set as follows: tidal volume 6–8 mL/kg (ideal body weight), respiratory rate 12–18 breaths/min, inspiratory-expiratory ratio 1:1.5, inspired oxygen concentration 40%–60%, and $ETCO_2$ was maintained between 35–45 mmHg.

For anesthesia maintenance, group C received continuous infusion of ciprofol at 0.4–3 mg/(kg•h) and remifentanil (Manufacturer: Yichang Renfu Pharmaceutical Co., Ltd.; Batch No.: 20A05021) at 0.05–2 μg/(kg•min). Group P received continuous infusion of propofol at 4–12 mg/(kg•h) and remifentanil at 0.05–2 μg/(kg•min). Rocuronium was intermittently administered during surgery to maintain muscle relaxation as needed. The doses of anesthetic drugs were dynamically adjusted to keep the BIS value between 40–60 and MAP within ±20% of the baseline value. In case of hemodynamic instability, fluid replacement or vasoactive drugs were administered as appropriate. If MAP was < 65 mmHg or decreased by more than 20% from the baseline for over 1 minute, ephedrine (Manufacturer: Southwest Pharmaceutical Co., Ltd.; Batch No.: 210401) 6 mg or norepinephrine (Manufacturer: Xi'an Lijun Pharmaceutical Co., Ltd.; Batch No.: 2303061) 4–8 μg was intravenously injected. If MAP increased by more than 20% from the baseline, the depth of anesthesia was adjusted (maintaining BIS within the normal range), and urapidil (Manufacturer: Takeda GmbH; Batch No.: 12149173) 5–10 mg was administered if necessary. During surgery, if bradycardia or tachycardia occurred, after excluding causes such as blood loss, inadequate or excessive anesthesia depth, esmolol (Manufacturer: Qilu Pharmaceutical Co., Ltd.; Batch No.: 2B0042C04) or atropine (Manufacturer: Shanghai Hefeng Pharmaceutical Co., Ltd.; Batch No.: 03220701) was intravenously injected.

Approximately 30 minutes before the end of surgery, parecoxib sodium 40 mg and azasetron 10 mg were intravenously administered to relieve postoperative pain and prevent postoperative nausea and vomiting (PONV). After

surgery, anesthetic infusion was discontinued, and patients were transferred to the post-anesthesia care unit (PACU) with the endotracheal tube in place. If necessary, sugammadex 2–4 mg/kg was intravenously injected for neuromuscular blockade reversal. The endotracheal tube was extubated when patients showed complete recovery of spontaneous breathing (e.g., facial expressions, normal respiratory rate and tidal volume, eye opening, purposeful limb movement, patent airway, and consciousness). If the pain score was ≥4 after extubation, oxycodone 0.1 mg/kg was intravenously administered for rescue analgesia. Patients were closely monitored in the PACU and transferred to the general ward for further observation when their Steward score exceeded 4.

1.5 Outcome measures

Heart rate (HR) and MAP were recorded at four time points: before anesthesia induction (T0), immediately after endotracheal intubation (T1), at the end of anesthesia (T2), and immediately after extubation (T3).

The Richmond Agitation-Sedation Scale (RASS) was assessed immediately after extubation, and at 15, 30, and 45 minutes after extubation. The RASS ranges from +4 to -5, where a higher absolute value indicates more severe disturbance of consciousness: 0 represents an awake state; -1 to -5 indicates drowsiness to unarousable; and +1 to +4 indicates restlessness to aggressive agitation. The following parameters were recorded: anesthesia induction time (from the start of intravenous drug administration to BIS value < 60, complete jaw relaxation, and disappearance of corneal reflex), extubation time (from admission to the PACU to endotracheal tube removal), and PACU stay time. The 4-point scoring system proposed by Ambesh *et al.* [11] was used to assess the pain intensity during ciprofol/propofol injection. Intraoperative adverse events were observed, including intraoperative hypotension, hypertension, bradycardia, and tachycardia. The number of cases of rescue analgesia, hypoxemia, PONV, and incidence of delayed emergence in the PACU were recorded. The quality of postoperative recovery was evaluated using the postoperative QoR-15 [12] on postoperative days 1, 2, and 3.

1.6 Statistical methods

Statistical analysis of data was performed using SPSS 26.0. For measurement data, normality was tested using the Kolmogorov-Smirnov test before statistical analysis. Variables that were normally distributed with homogeneous variance were expressed as $\bar{x}\pm s$ and compared between groups using the independent samples t-test. Variables that were non-normally distributed or with heterogeneous variance were expressed as M (Q_1, Q_3) and analyzed using the nonparametric Mann-Whitney U test. Enumeration data were expressed as case (%) and analyzed using the chi-square test. For ordinal data (e.g., frailty grading), comparisons between groups were performed using the nonparametric rank sum test (Mann-Whitney U test). The log-rank test was used to compare the difference in delirium recovery time between the two groups, and Kaplan-Meier curves were plotted. A P value < 0.05 was considered statistically significant.

2 Results

All patients in both groups successfully completed laparoscopic radical resection of colorectal cancer under total intravenous anesthesia and 3-day postoperative observation. Only at 3 days postoperatively, 1 patient in group C and 2 patients in group P requested transfer to another hospital, resulting in loss to follow-up for QoR-15 assessment.

2.1 Comparison of heart rate, MAP, and RASS

For MAP levels at different time points, there were significant time effect, group effect, and interaction effect between the two groups (P<0.05). For heart rate and RASS, significant time effects were observed (P<0.05). Pairwise comparisons showed that MAP at T1 was significantly lower in group P than in group C (P<0.05), while there were no statistically significant differences in MAP or heart rate between the two groups at other time points (P>0.05). There were no statistically significant differences in RASS scores between the two groups immediately after extubation, or at 15, 30, and 45 minutes after extubation (P>0.05). **[Table 2 & Table 3]**

2.2 Comparison of anesthesia induction time, extubation time, and PACU stay time

There were no statistically significant differences between the two groups in anesthesia induction time, extubation time, or PACU stay time (P>0.05). **[Table 4]**

2.3 Comparison of intraoperative adverse events

The incidence of injection pain and intraoperative hypotension in group P was higher than that in group C, with statistically significant differences (P<0.05). There were no statistically significant differences in the incidence of intraoperative hypertension, bradycardia, or tachycardia between the two groups (P>0.05). **[Table 5]**

2.4 Comparison of rescue analgesia and adverse events in PACU

There were no statistically significant differences in the postoperative rescue analgesia rate, incidence of hypoxemia, PONV, or delayed emergence between the two groups (P>0.05). **[Table 6]**

2.5 QoR-15 Scores

There were no statistically significant differences in QoR-15 scores between the two groups on postoperative days 1, 2, and 3 (P>0.05). **[Table 7]**

Tab. 2 Comparison of hemodynamic indexes between the two groups（n =78, $\bar{x}\pm s$）

Groups	MAP（mmHg）				Heart rate（times/min）			
	T0	T1	T2	T3	T0	T1	T2	T3
Group C	97.1±10.5	90.8±8.3[a]	93.6±9.0	95.5±8.8	75.8±6.7	71.3±7.0	70.4±8.5	77.5±10.3
Group P	95.9±10.0	81.7±9.6	90.4±10.2	93.6±9.7	76.8±7.4	72.1±8.2	72.7±9.3	74.9±9.6
F/P_{group}value	25.415/＜0.001				0.306/0.580			
F/P_{time} value	33.944/＜0.001				15.543/＜0.001			
$F/P_{intercation}$value	5.545/＜0.001				2.383/0.068			

Note: Compared with group P, [a]$P < 0.05$.

Tab.3 Comparison of RASS between the two groups [n=78，piont，$M(Q_1,Q_3)$]

Groups	Immediately after extubation	15 min after extubation	30 min after extubation	45 min after extubation
Group C	0 (-1.3, 1.0)	0 (-1.0, 1.0)	0 (-1.0, 1.0)	0 (0, 0)
Group P	-0.5 (-2.0, 1.0)	-0.5 (-1.0, 1.0)	0 (-1.0, 1.0)	0 (0, 1.0)
***F/P*$_{group}$ value**	1.518/0.209			
***F/P*$_{time}$ value**	4.554/0.033			
***F/P*$_{intercation}$ value**	1.518/0.209			

Tab.4 Comparison of anesthesia induction time, extubation time and PACU stay between the two groups (n =78, $\bar{x}\pm s$)

Groups	Cases	Anesthesia induction time（s）	Extubation time, （min）	PACU stay time（min）
Group C	78	252.6±21.7	8.1±2.0	55.0±8.3
Group P	78	247.9±20.5	8.5±1.7	56.5±10.1
***t* value**		1.391	1.346	1.013
***P* value**		0.166	0.180	0.313

Tab. 5 Comparison of intraoperative adverse reactions between the two groups [n=78, case (%)]

Groups	Injection pain (none/mild/moderate/severe, cases)	Hypotension	Hypertension	Bradycardia	Tachycardia
Group C	67/5/5/1	21 (26.9)	16 (20.5)	19 (24.4)	6 (7.7)
Group P	17/33/19/9	40 (51.3)	20 (25.6)	14 (17.9)	9 (11.5)
Z /χ^2 value	7.544	9.718	0.578	0.961	0.664
***P* value**	＜0.001	0.002	0.447	0.327	0.415

Tab.6 Comparison of salvage analgesia and adverse reactions in PACU between two groups [n=78, case (%)]

Groups	Postoperative rescue analgesia [case (%)]	Hypoxemia [case (%)]	PONV [case (%)]	Delayed emergence [case (%)]
Group C	22 (28.2)	12 (15.4)	5 (6.4)	2 (2.6)
Group P	25 (32.1)	17 (21.8)	7 (9.0)	2 (2.6)
χ^2 value	0.274	1.059	0.361	0.260
***P* value**	0.601	0.303	0.548	0.612

Tab.7 Comparison of QoR-15 scores between the two groups ($\bar{x}\pm s$)

Groups	Cases	1 day after surgery [a]	2 days after surgery [a]	3 days after surgery [b]
Group C	78	95.9±9.3	104.0±11.1	116.4±13.2
Group P	78	94.4±9.9	104.7±10.7	119.9±14.5
***t* value**		0.975	0.401	1.562
***P* value**		0.331	0.689	0.121

Note: [a] indicates 78 cases in both group C and group P; [b] indicates 77 cases in group C and 76 cases in group P, respectively, and the reasons for dropout are as previously described.

3 Discussion

With the accelerated aging of the population, the demand for laparoscopic radical resection for colorectal cancer in elderly patients is increasing. This population is often accompanied by physiological function degradation and multiple chronic underlying diseases, making perioperative management, especially the selection of anesthesia regimens, crucial for the quality of postoperative recovery [13]. This study compared the clinical performance of ciprofol and propofol in total intravenous anesthesia for elderly patients based on the QoR-15, aiming to provide new evidence for optimizing anesthesia strategies in elderly patients.

The results of this study showed that the QoR-15 scores in the ciprofol group were comparable to those in the propofol group at 1, 2, and 3 days after surgery, suggesting that the two drugs are comparable in terms of postoperative recovery quality in elderly patients, meeting the requirements of the current enhanced recovery after surgery (ERAS) concept. This indicates that ciprofol can be a safe and effective alternative to propofol. A study by Shi *et al.* [14] compared the postoperative recovery quality of ciprofol and propofol in ureteroscopic surgery, and the results showed that ciprofol achieved early postoperative recovery effects comparable to propofol. In addition, there were no significant differences between the two groups in indicators such as anesthesia induction time, extubation time, and PACU stay time, further indicating that both drugs can provide good anesthesia depth and postoperative recovery process, with similar clinical application value. Gan *et al.* [15] evaluated the difference in the success rate of general anesthesia induction between ciprofol and propofol, and the results showed that ciprofol was similar to propofol in terms of anesthesia induction success rate. Good postoperative awakening quality helps reduce complications, improve patient prognosis, and

enhance patient satisfaction. In this study, the RASS was used for dynamic assessment of sedation-agitation status during awakening. The results showed no statistically significant difference in RASS scores between the two groups at different time points after extubation, suggesting that ciprofol and propofol have comparable effects in terms of postoperative awakening quality. In addition, the PACU stay time was similar between the two groups, further confirming the good performance of ciprofol in promoting patient awakening and stabilizing the awakening state.

In terms of safety, the incidence of intraoperative hypotension and injection pain in the ciprofol group was significantly lower than that in the propofol group, indicating that ciprofol has certain advantages in hemodynamic stability and injection comfort. A latest meta-analysis by Cheng *et al.* [16] showed that ciprofol exhibits higher safety in different age groups undergoing gastrointestinal endoscopy, mainly reflected in higher hemodynamic stability. Due to its strong vasodilatory effect, propofol is more likely to cause blood pressure reduction during the induction and maintenance phases, especially in the elderly population with higher risks. In contrast, ciprofol has a higher affinity for γ-aminobutyric acid receptors, thus showing better hemodynamic stability [17]. In addition, injection pain is a common adverse reaction of propofol, which may cause patient discomfort and sympathetic excitatory response during the induction phase [18]. However, due to its lower aqueous phase concentration and lipophilicity, ciprofol stimulates blood vessels less during intravenous injection and has better tolerability [19]. There were no significant differences between the two groups in other intraoperative adverse reactions (such as hypertension, bradycardia, tachycardia) and adverse events in the PACU (hypoxemia, PONV, delayed awakening, rescue analgesia), suggesting that both drugs are relatively reliable in terms of overall perioperative safety. A meta-analysis by Chen *et al.* [20] evaluated the efficacy and safety of ciprofol and propofol in perioperative management of elderly patients, and the results showed that ciprofol is comparable to propofol in efficacy and has a better safety profile in general anesthesia for elderly patients.

This study has the following limitations. First, although the two groups of patients were balanced in most baseline characteristics, due to research conditions, this study did not collect patients' educational level, which may have a potential impact on postoperative subjective scores (such as QoR-15). Second, this study only included medium to large-scale elective laparoscopic surgeries, and whether the conclusions are applicable to short surgeries remains unclear. Finally, this study did not use a neuromuscular transmission monitor to monitor intraoperative muscle relaxation effects, which may limit the comprehensive assessment of the impact of muscle relaxants. More multicenter clinical studies in different population backgrounds are needed for validation in the future.

In conclusion, in elderly patients undergoing laparoscopic radical resection for colorectal cancer, total intravenous anesthesia with either ciprofol or propofol can achieve good anesthetic efficacy and postoperative recovery quality. Compared with propofol, ciprofol has certain advantages in maintaining hemodynamic stability and causes milder injection pain. Therefore, ciprofol can be a safe and effective anesthetic option for elderly patients with colorectal cancer undergoing laparoscopic surgery.

Conflict of interest None

Reference

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·论　著·

环泊酚与丙泊酚全凭静脉麻醉在老年腹腔镜结肠癌根治术中的麻醉质量及术后恢复质量比较

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摘要：目的　比较环泊酚与丙泊酚全凭静脉麻醉在老年腹腔镜结肠癌根治术中的麻醉质量及术后恢复质量，为临床麻醉药物的优化选择提供依据。**方法**　前瞻性纳入2023年1月至2025年1月拟于张家港市第一人民医院行腹腔镜结肠癌根治术的老年患者156例。依照随机数字表分为环泊酚组（C组）或丙泊酚组（P组），每组纳入78例患者。麻醉维持给予C组泵注环泊酚0.4~3 mg/（kg·h）及瑞芬太尼0.05~2 μg/（kg·min），P组泵注丙泊酚4~12 mg/（kg·h）及瑞芬太尼0.05~2 μg/（kg·min），并根据需要间断静脉注射罗库溴铵维持肌松效果。记录术中平均动脉压（MAP）、心率。于麻醉复苏室（PACU）内评估Richmond躁动-镇静量表（RASS）评分。记录患者麻醉诱导时间、拔管时间、PACU停留时间。观察术中不良事件（注射痛、术中低血压、高血压、心动过缓和心动过速）和PACU内不良反应发生率。使用术后15项恢复质量量表（QoR-15）评估患者术后恢复质量。**结果**　P组患者气管插管后即刻MAP显著低于C组患者（$P<0.05$）。两组患者拔管后RASS评分以及两组患者麻醉诱导时间、拔管时间、PACU停留时间比较差异均无统计学意义（$P>0.05$）。注射痛无、轻、中、重在P组分别为17、33、19、9例，在C组分别为67、5、5、1例，P组注射痛程度显著高于C组（$Z=7.544$，$P<0.01$）；术中低血压发生率P组显著高于C组（51.3% *vs* 26.9%，$\chi^2=9.718$，$P<0.01$）。两组患者PACU内不良反应发生率以及两组患者术后1 d、2 d、3 d QoR-15比较差异均无统计学意义（$P>0.05$）。**结论**　在老年腹腔镜结肠癌根治术中，使用环泊酚或丙泊酚进行全凭静脉麻醉均可实现良好的麻醉效果与术后恢复质量。与丙泊酚相比，环泊酚在维持血流动力学稳定性方面具有一定优势且注射痛更加轻微。因此，环泊酚可作为老年结肠癌患者腹腔镜手术中一种安全、有效的麻醉选择。

关键词：环泊酚；丙泊酚；全凭静脉麻醉；腹腔镜结肠癌根治术；麻醉质量；术后恢复质量；老年
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Comparison of anesthesia quality and postoperative recovery quality of total intravenous anesthesia with ciprofol and propofol in laparoscopic radical resection of elderly patients

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Abstract: Objective　To compare the anesthesia quality and postoperative recovery quality between ciprofol and propofol for total intravenous anesthesia in elderly patients with colon cancer undergoing laparoscopic radical resection, and to provide evidences for optimizing clinical anesthesia selection. **Methods**　A total of 156 patients scheduled to undergo laparoscopic radical resection of colon cancer in the First People's Hospital of Zhangjiagang from January 2023 to January 2025 were prospectively included. According to the random number table method, they were divided into

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ciprofol group (group C) and propofol group (group P), with 78 patients in each group. Anesthesia was maintained by pumping ciprofol 0.4-3 mg/(kg·h) and remifentanil 0.05-2 μg/(kg·min) in group C, and propofol 4-12 mg/(kg·h) and remifentanil 0.05-2 μg/(kg·min) in group P, and intermittent intravenous injection of rocuronium as needed to maintain the muscle relaxation effect. Intraoperative mean arterial pressure (MAP) and heart rate (HR) were recorded. Richmond agitation-sedation scale (RASS) scores were assessed in the post-anesthesia care unit (PACU). Anesthesia induction time, extubation time, and PACU stay were recorded. Intraoperative adverse events, including injection pain, hypotension, hypertension, bradycardia, and tachycardia, were observed, as well as adverse events in the PACU. The 15-item quality of recovery scale (QoR-15) was used to evaluate postoperative recovery. **Results** Instant MAP at the time of endotracheal intubation was significantly lower in group P compared to group C (P<0.05). No significant differences were observed in RASS scores after extubation, as well as anesthesia induction time, extubation time, or PACU stay between the two groups (P>0.05). The non-, mild-, moderate- and severe-injection pain were 17, 33, 19 and 9 cases in group P, and 67, 5, 5 and 1 case in group C, respectively. The degree of injection pain in group P was significantly higher than that in group C (Z=7.544, P < 0.01). The incidence of intraoperative hypotension in group P was significantly higher than that in group C (51.3% *vs* 26.9%, χ^2=9.718, P < 0.01). No significant difference was found in the incidence of adverse events in the PACU, and postoperative QoR-15 scores on postoperative days 1, 2, and 3 between the two groups (P>0.05). **Conclusion** In laparoscopic radical resection of colon cancer in the elderly patients, total intravenous anesthesia with ciprofol or propofol can achieve good anesthesia effects and postoperative recovery quality. Compared with propofol, ciprofol has certain advantages in maintaining hemodynamic stability and the injection pain is more mild. Therefore, ciprofol can be used as a safe and effective anesthesia choice in laparoscopic surgery for elderly patients with colon cancer.

Keywords: Ciprofol; Propofol; Total intravenous anesthesia; Laparoscopic radical resection for colon cancer; Anesthesia quality; Postoperative recovery quality; Elderly

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随着人口老龄化的加剧，老年人群接受手术的需求不断增加[1]。腹腔镜技术因其创伤小、并发症发生率低等优势，已被广泛应用于老年患者结肠癌的治疗。考虑到老年患者的生理功能退化、合并多种慢性基础疾病以及术后并发症和恢复延迟的风险增加，围手术期麻醉药物的选择不仅需要保证麻醉的有效性和安全性，还需关注术后恢复质量与患者舒适度[2-3]。

丙泊酚作为全凭静脉麻醉的常用药物，因其良好的药理特性被广泛应用于临床[4]。然而，丙泊酚的潜在不良反应，包括血流动力学不稳定、剂量相关的呼吸抑制以及注射痛仍需引起重视[5]。在提升麻醉质量的过程中，如何在发挥丙泊酚镇静优势的同时减少其不良反应，是当前麻醉管理的关键。环泊酚是一种新型γ-氨基丁酸受体激动剂，与受体结合的亲和力高于丙泊酚，且在药理学及理化性质方面具有一定优势[6-7]。此外，环泊酚的代谢产物无活性，可降低体内药物蓄积风险[8]。现有研究表明，环泊酚可显著减轻注射痛，并有助于维持血流动力学稳定，或许能为老年患者提供一种更安全、有效的麻醉选择[9-10]。然而，关于环泊酚在老年患者腹腔镜结肠癌手术中的应用研究仍相对有限，尤其缺乏与丙泊酚在麻醉质量及术后恢复方面的直接对比数据。

因此，本研究旨在比较环泊酚与丙泊酚全凭静脉麻醉用于老年腹腔镜结肠癌根治术患者的麻醉质量及术后恢复质量，为临床麻醉药物的优化选择提供依据。

1 资料与方法

1.1 *研究设计* 前瞻性纳入2023年1月至2025年1月拟于张家港市第一人民医院行腹腔镜结肠癌根治术的老年患者共计156例。使用PASS 11.0软件基于两组患者术后第1天15项恢复质量量表(15-item quality of recovery score, QoR-15)的均值差进行样本量估算。根据前期预试验结果，C组与P组的术后第1天QoR-15均值差为5.1分，C组、P组标准差分别为11.6分、12.6分，设定α=0.05、1-β=0.8，计算得出每组所需样本量为71例，设定脱落率λ=0.1，最终每组各纳入78例患者。使用SPSS 26.0生成随机数字，样本总数156例，两组样本比例1∶1，患者依照随机数字表

分别纳入环泊酚组(ciprofol group, C组)或丙泊酚组(propofol group, P组),每组拟纳入78例患者。本试验已获张家港市第一人民医院伦理委员会批准(伦审号:ZJGYY-2023019),所有患者均同意参加本研究并签署知情同意书。随机分组由一名未参与患者招募、麻醉实施及数据收集的研究人员执行,采用编号顺序密封不透明信封的方法进行分配隐藏。术前由一名不参与其他研究环节的麻醉护士开启信封并准备相应药物。所有药物均由该护士进行编号和分装,确保麻醉医生在实施过程中不知道患者具体药物类型。患者、数据收集人员、术后评估人员及其他临床工作人员同样对分组情况保持盲法,以最大限度降低研究偏倚。

1.2 一般资料比较 C组男38例,女40例;P组男33例,女45例,两组性别构成差异无统计学意义(χ^2=0.646,P=0.421);两组患者年龄、ASA分级、BMI、腹部手术史、手术时间、衰弱程度、禁食时长以及合并高血压、糖尿病、冠心病占比比较差异均无统计学意义(P>0.05)。见表1。

1.3 研究对象 研究人员在手术前一天对符合条件的患者进行评估。纳入标准:(1)年龄≥65岁;(2)美国麻醉医师协会(American society of Anesthesiologists, ASA)分级Ⅱ~Ⅲ级;(3)身体质量指数(body mass index, BMI)18.5~27.9 kg/m^2;(4)拟于全凭静脉麻醉下实施择期腹腔镜结肠癌根治术。排除标准:(1)已知对鸡蛋、大豆制品或研究用药(如环泊酚、瑞芬太尼、罗库溴铵、阿托品)过敏者;(2)合并中枢神经系统疾病者(颅脑外伤、急性卒中、进行性痴呆等);(3)重度高血压(定义为术前收缩压≥180 mmHg);(4)合并精神障碍或酒精依赖者;(5)气道管理困难者;(6)因语言、听力、视力障碍,无法完成相关评估者;(7)严重心功能不全者(心力衰竭分期C期以上、房室传导阻滞二度以上等);(8)严重肝、肾功能不全(Child-Pugh分级为C级、需要透析等)。病例退出标准:(1)术中转为开腹手术者;(2)术中需改用吸入麻醉维持者;(3)术中发生严重不良事件,需中止研究用药或中断手术者;(4)丢失关键数据(如血流动力学指标、恢复评分等),无法完成主要结局指标评价者;(5)患者或其家属在研究过程中主动要求退出研究者。

1.4 麻醉方法 患者术前均接受肠道准备,并按照要求术前8 h禁食固体食物,术前2 h禁饮清流质(如白开水、淡茶、透明果汁等)。如患者存在延迟胃排空或特殊并发症,则根据具体情况适当延长禁食时间。所有患者均接受标准化麻醉管理,不使用任何术前药物。患者入室后进行三方核查,确认患者基本信息、手术区域、禁食水情况以及过敏史。随后监测心电图、心率、无创收缩压/舒张压、血氧饱和度(SpO_2)和脑电双频指数(bispectral index, BIS)。开放一侧上肢静脉通路并静脉滴注0.9%氯化钠注射液10 mL/(kg·h)。调整氧流量10 L/min、氧浓度100%,通过面罩给氧。于局部麻醉下实施桡动脉穿刺、置管监测有创血压,动态记录有创平均动脉压(mean arterial pressure, MAP)。

C组静脉注射环泊酚(药品厂家:辽宁海思科制药有限公司;生产批号:20220808)0.2~0.5 mg/kg;P组静脉注射丙泊酚(药品厂家:西安力邦制药有限公司;生产批号:22205311)1~2 mg/kg。随后两组均缓慢静脉注射舒芬太尼(药品厂家:宜昌人福药业有限责任公司;生产批号:21A03331)1 μg/kg及罗库溴铵(药品厂家:广东星昊药业有限公司;生产批号:139220905)1 mg/kg进行麻醉诱导。麻醉诱导期间行手动控制呼吸,待BIS值低于60、下颌完全松弛、睫毛反射消失后实施经口口腔明视气管内插管。通过听诊呼吸音、观察呼气末二氧化碳分压(end-tidal CO_2, $ETCO_2$)数值和波形,确认气管导管位置和深度。确认无误后固定气管导管,并且转为机械通气,模式为容量控制通气。设置麻醉机呼吸参数:潮气量6~8 mL/kg(标准体质量)、呼吸频率12~18次/min、吸呼比1:1.5、吸入氧浓度40%~60%,维持$ETCO_2$在35~45 mmHg。

C组持续泵注环泊酚0.4~3 mg/(kg·h)及瑞芬太尼(药品厂家:宜昌人福药业有限责任公司;生产批号:20A05021)0.05~2 μg/(kg·min);P组持续泵注丙泊酚4~12 mg/(kg·h)及瑞芬太尼0.05~2 μg/(kg·min)。手术过程中根据需要间断给予罗库溴铵维持肌松效果。根据BIS值控制在40~60,MAP维持在基础值±20%的范围内,动态调整麻醉药物剂量。若出现血流动力学不稳定,可根据情况补液或使用血管活性药物。若MAP低于65 mmHg或较基础值下降幅度超20%以上持续超过1 min,则静脉注射麻黄碱(药品厂家:西南药业股份有限公司;生产批号:210401)6 mg或去甲肾上腺素(药品厂家:西安利君制药有限责任公司;生产批号:2303061)4~8 μg;若MAP上升幅度超基础值20%以上,则调整麻醉深度(维持BIS在正常范围内),必要时给予乌拉地尔(药品厂家:Takeda GmbH;生产批号:12149173)5~10 mg。术中若出现心动过缓或心动过速,在排除失血、麻醉过浅或过深等诱因后,静脉注射艾司洛尔(药品厂家:齐鲁制药有限公司;生产批号:2B0042C04)或阿托品(药品厂

家:上海禾丰制药有限公司;生产批号:03220701)。

于手术结束前约30 min静脉注射帕瑞昔布钠40 mg、阿扎司琼10 mg,以缓解术后疼痛并预防术后恶心呕吐(postoperative nausea and vomiting, PONV)。手术结束后停止麻醉药物输注,患者在气管插管状态下转入麻醉复苏室(post-anesthesia care unit, PACU)。如有必要静注舒更葡糖钠2~4 mg/kg进行肌松拮抗。当患者表现出自主呼吸完全恢复(如面部表情、呼吸频率和潮气量正常、睁眼、有意识肢体活动、气道通畅且清醒)后拔除气管导管。拔管后若疼痛评分≥4分,则静脉注射羟考酮0.1 mg/kg进行补救镇痛。患者在PACU中密切监测,待Steward评分>4分后转入普通病房继续观察治疗。

1.5 结局指标 记录麻醉诱导前(T0)、气管插管后即刻(T1)、麻醉结束时(T2)和拔管后即刻(T3)的心率、MAP。于拔管后即刻、拔管后15、30和45 min评估Richmond躁动-镇静评分(Richmond agitation and sedation scale, RASS),该评分范围+4~-5,绝对值越高,意识障碍越重;0为清醒状态,-1~-5为昏睡到无法唤醒,+1~+4为不安到攻击性躁动。记录患者麻醉诱导时间(静脉给药开始至BIS值低于60、下颌完全松弛、睫毛反射消失)、拔管时间(入PACU至拔除气管导管)、PACU停留时间。采用Ambesh等[11]提出的四级评分法评估环泊酚/丙泊酚注射时疼痛程度。观察术中不良事件,包括术中低血压、高血压、心动过缓和心动过速。记录患者PACU内补救镇痛例数、低氧血症、PONV、苏醒延迟发生率。于患者术后1、2、3 d使用术后QoR-15[12]评估患者术后恢复质量。

1.6 统计学方法 使用SPSS 26.0软件对数据进行统计。计量资料在进行统计分析前先使用Kolmogorov-Smirnov检验进行正态性检验,对于符合正态分布且方差齐的变量,以$\bar{x}\pm s$表示,采用独立样本t检验进行组间比较;对于不符合正态分布或方差不齐的变量,以$M(Q_1, Q_3)$表示,采用非参数Mann-Whitney U检验;计数资料以例(%)表示,采用χ^2检验分析。对于有序等级资料(如衰弱程度分级),采用非参数秩和检验(Mann-Whitney U检验)进行组间比较。使用log rank检验比较两组间谵妄恢复时间是否存在差异,并绘制Kaplan-Meier曲线。$P<0.05$为差异有统计学意义。

2 结 果

两组患者均顺利完成全凭静脉麻醉下腹腔镜结肠癌根治术及术后3 d的观察,仅在术后3 d C组、P组分别有1例、2例患者强烈要求转至外院治疗,而导致术后3 d QoR-15评分观察脱落。

2.1 心率、MAP、RASS比较 两组不同时点MAP水平具有显著时间效应、组间效应和交互效应($P<0.05$),心率水平、RASS具有显著时间效应($P<0.05$)。两两比较显示,P组患者T1时点MAP明显低于C组患者($P<0.05$),其他时点两组间MAP、心率比较差异均无统计学意义($P>0.05$);拔管后即刻,拔管后15 min、30 min、45 min的RASS两组间比较差异均无统计学意义($P>0.05$)。见表2、表3。

表1 两组患者一般资料的比较 (n=78)

Tab.1 Comparison of general data between two groups (n=78)

组别	年龄(岁, $\bar{x}\pm s$)	ASA分级(Ⅱ/Ⅲ,例)	BMI(kg/m^2, $\bar{x}\pm s$)	腹部手术史[例(%)]	手术时间[min, $M(Q_1, Q_3)$]
C组	71.3±5.5	26/52	23.6±3.1	27 (34.6)	191.0(179.3, 201.3)
P组	70.7±5.1	30/48	23.5±3.5	21 (26.9)	188.5(178.8, 197.0)
$u/Z/\chi^2$值	0.707	0.446	0.178	1.083	1.142
P值	0.481	0.504	0.859	0.298	0.254
组别	衰弱程度(无/轻/中/重,例)	禁食时长[h, $M(Q_1, Q_3)$]	高血压[例(%)]	糖尿病[例(%)]	冠心病[例(%)]
C组	57/12/7/2	12.0(11.0, 14.3)	37 (47.4)	30 (38.5)	24 (30.8)
P组	60/11/6/1	12.0(11.0, 15.0)	33 (42.3)	27 (34.6)	19 (24.4)
Z/χ^2值	0.594	0.577	0.415	0.249	0.803
P值	0.553	0.564	0.520	0.618	0.370

表2 两组血流动力学指标的比较 (n=78, $\bar{x}\pm s$)

Tab.2 Comparison of hemodynamic indexes between the two groups (n=78, $\bar{x}\pm s$)

组别	MAP(mmHg)				心率(次/min)			
	T0	T1	T2	T3	T0	T1	T2	T3
C组	97.1±10.5	90.8±8.3[a]	93.6±9.0	95.5±8.8	75.8±6.7	71.3±7.0	70.4±8.5	77.5±10.3
P组	95.9±10.0	81.7±9.6	90.4±10.2	93.6±9.7	76.8±7.4	72.1±8.2	72.7±9.3	74.9±9.6
$F/P_{组间}$值	25.415/<0.001				0.306/0.580			
$F/P_{时间}$值	33.944/<0.001				15.543/<0.001			
$F/P_{交互}$值	5.545/<0.001				2.383/0.068			

注:与P组比较,[a]$P<0.05$。

2.2　麻醉诱导时间、拔管时间、PACU 停留时间比较　两组患者麻醉诱导时间、拔管时间、PACU 停留时间比较差异均无统计学意义（$P>0.05$）。见表4。

2.3　术中不良反应比较　P组患者注射痛发生率、术中低血压发生率均高于C组患者，差异有统计学意义（$P<0.05$）。两组患者术中高血压、心动过缓、心动过速发生率的比较差异均无统计学意义（$P>0.05$）。见表5。

2.4　补救镇痛、PACU 内不良反应比较　两组患者术后补救镇痛率、低氧血症、PONV、苏醒延迟发生率的比较差异均无统计学意义（$P>0.05$）。见表6。

2.5　QoR-15 评分　两组患者术后 1、2、3 d 的 QoR-15 评分比较差异均无统计学意义（$P>0.05$）。见表7。

表3　两组 RASS 的比较　［n=78，分，$M(Q_1,Q_3)$］

Tab.3　Comparison of RASS between the two groups ［n=78, piont, $M(Q_1,Q_3)$］

组别	拔管后即刻	拔管后 15 min	拔管后 30 min	拔管后 45 min
C组	0(−1.3, 1.0)	0(−1.0, 1.0)	0(−1.0, 1.0)	0(0, 0)
P组	−0.5(−2.0, 1.0)	−0.5(−1.0, 1.0)	0(−1.0, 1.0)	0(0, 1.0)
$F/P_{组间}$值	1.518/0.209			
$F/P_{时间}$值	4.554/0.033			
$F/P_{交互}$值	1.518/0.209			

表4　两组麻醉诱导时间、拔管时间、PACU 停留时间比较（n=78，$\bar{x}\pm s$）

Tab.4　Comparison of anesthesia induction time, extubation time and PACU stay between the two groups　（n=78，$\bar{x}\pm s$）

组别	麻醉诱导时间(s)	拔管时间(min)	PACU停留时间(min)
C组	252.6±21.7	8.1±2.0	55.0±8.3
P组	247.9±20.5	8.5±1.7	56.5±10.1
t值	1.391	1.346	1.013
P值	0.166	0.180	0.313

表5　两组术中不良反应的比较　［n=78，例（%）］

Tab.5　Comparison of intraoperative adverse reactions between the two groups　［n=78, case（%）］

组别	注射痛（无/轻/中/重，例）	低血压	高血压	心动过缓	心动过速
C组	67/5/5/1	21（26.9）	16（20.5）	19（24.4）	6（7.7）
P组	17/33/19/9	40（51.3）	20（25.6）	14（17.9）	9（11.5）
Z/χ^2值	7.544	9.718	0.578	0.961	0.664
P值	<0.001	0.002	0.447	0.327	0.415

表6　两组患者补救镇痛、PACU 内不良反应比较　［n=78，例（%）］

Tab.6　Comparison of salvage analgesia and adverse reactions in PACU between two groups　［n=78, case（%）］

组别	补救镇痛［例（%）］	低氧血症［例（%）］	PONV［例（%）］	苏醒延迟［例（%）］
C组	22（28.2）	12（15.4）	5（6.4）	2（2.6）
P组	25（32.1）	17（21.8）	7（9.0）	2（2.6）
χ^2值	0.274	1.059	0.361	0.260
P值	0.601	0.303	0.548	0.612

表7　两组 QoR-15 评分比较　（$\bar{x}\pm s$）

Tab.7　Comparison of QoR-15 scores between the two groups　（$\bar{x}\pm s$）

组别	术后 1 d[a]	术后 2 d[a]	术后 3 d[b]
C组	95.9±9.3	104.0±11.1	116.4±13.2
P组	94.4±9.9	104.7±10.7	119.9±14.5
t值	0.975	0.401	1.562
P值	0.331	0.689	0.121

注：[a]表示C组、P组为78例；[b]表示C组、P组分别为77例、76例，脱落原因如前所述。

3　讨　论

随着人口老龄化加速，老年患者接受腹腔镜结肠癌根治术的需求日益增加。该类人群常伴随生理功能退化及多种慢性基础疾病，围手术期管理尤其是麻醉方案的选择对术后恢复质量至关重要[13]。本研究基于QoR-15比较了环泊酚与丙泊酚在老年患者全凭静脉麻醉中的临床表现，以期为优化老年患者麻醉策略提供新的证据。

本研究结果显示，环泊酚组在术后1、2、3 d QoR-15评分与丙泊酚组相当，提示两种药物在老年患者术后恢复质量方面具有可比性，符合当前术后加速康复理念的要求，提示环泊酚可以作为丙泊酚安全、有效的替代药物。Shi等[14]研究比较了环泊酚与丙泊酚在输尿管镜手术中的术后恢复质量，结果显示环泊酚可实现与丙泊酚相当的早期术后恢复效果。此外，两组在麻醉诱导时间、拔管时间及PACU停留时间等指标上亦无明显差异，进一步说明两种药物均能提供良好的麻醉深度与术后恢复进程，具备相似的临床应用价值。Gan等[15]研究评估了环泊酚与丙泊酚在全身麻醉诱导成功率方面的差异，结果显示环泊酚在麻醉诱导成功率方面与丙泊酚类似。良好的术后苏醒质量有助于减少并发症、改善患者预后并提升患者满意度。本研究通过RASS量表对苏醒过程中的镇静-躁动状态进行动态评估，结果显示两组在拔管后不同时间点的RASS评分差异无统计学意义，提示环泊酚与丙泊酚在术后苏醒质量方面效果相当。此外，两组PACU停留时间亦相似，进一步印证了环泊酚在促进患者清醒、稳定苏醒状态方面的良好表现。

在安全性方面，环泊酚组术中低血压和注射痛的发生率显著低于丙泊酚组，表明其在血流动力学稳定性和注射舒适性方面具有一定优势。Cheng等[16]最新发布的meta分析显示，环泊酚在实施消化道内镜的不同年龄人群中均展现出更高的安全性，主要体现在血流动力学稳定性更高。丙泊酚由于其较强的

血管扩张作用，更容易引发诱导期和维持期的血压下降，尤其在老年人群中风险更高，而环泊酚对γ-氨基丁酸受体具有更高的亲和力，因此表现出更好的血流动力学稳定性[17]。此外，注射痛是丙泊酚常见的不良反应，可能引起患者不适和诱导期的交感神经兴奋反应[18]。而环泊酚因其更低的水相浓度和脂溶性，在静脉注射过程中更少刺激血管，具有更好的耐受性[19]。两组在术中其他不良反应（如高血压、心动过缓、心动过速）以及PACU内不良事件（低氧血症、PONV、苏醒延迟、补救镇痛）方面均未见显著差异，提示两种药物在围手术期整体安全性方面均较为可靠。Chen等[20]通过meta分析评估环泊酚与丙泊酚在老年患者围手术期管理中的有效性与安全性，结果显示在老年患者的全身麻醉中，环泊酚在有效性方面与丙泊酚相当，且具有更好的安全性特征。

本研究尚存在以下局限性。首先，尽管两组患者在大多数基线特征上平衡，但受研究条件所限，本研究并未收集患者教育水平，可能对术后主观评分（如QoR-15）产生潜在影响。其次，本研究仅纳入中大型择期腹腔镜手术，所得结论是否适用于短小手术尚不明确。最后，本研究未使用神经肌肉传导监测仪对术中肌松效果进行监测，可能限制了对肌松药物影响的全面评估。未来尚需更多的多中心、不同人群背景下的临床研究予以验证。

综上所述，在老年腹腔镜结肠癌根治术中，使用环泊酚或丙泊酚进行全凭静脉麻醉均可实现良好的麻醉效果与术后恢复质量。与丙泊酚相比，环泊酚在维持血流动力学稳定性方面具有一定优势且注射痛更加轻微。因此，环泊酚可作为老年结肠癌患者腹腔镜手术中一种安全、有效的麻醉选择。

利益冲突 无

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