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ORIGINAL RESEARCH

Comparative Analysis of the Effects of Propofol and Sevoflurane on Coagulation and Immune System Function in Patients Undergoing Radical Surgery for Colon Cancer

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Objective: To compare the effects of intravenous anesthesia with propofol and inhalation anesthesia with sevoflurane on coagulation and immune system function in patients undergoing radical surgery for colon cancer.

Methods: The following were compared between the two groups: blood rheology indicators [plasma viscosity (PV), erythrocyte aggregation index (EAI), erythrocyte deformability index (EDI)], coagulation function indicators [prothrombin time (PT), activated partial thromboplastin time (APTT), D-dimer (D-D), fibrinogen (FIB)], humoral immune function indicators [immunoglobulin A (IgA), immunoglobulin M (IgM), immunoglobulin G (IgG)], cellular immune function indicators [CD4+, CD8+, natural killer cells (NK)], postoperative recovery, and postoperative complications.

Results: ① Blood Rheology Indicators: At 60 minutes after anesthesia induction, PV, EAI, and EDI levels in both groups decreased compared to pre-anesthesia levels ($P < 0.05$), with no significant differences between the two groups at the same time point ($P > 0.05$). ② Coagulation Function Indicators: At 1 day postoperatively, D-D and FIB levels increased compared to 1 day preoperatively, with Group A showing less pronounced changes than Group B ($P < 0.05$). ③ Humoral Immune Function Indicators: In Group A, humoral immune indicators showed no significant changes at 1 day postoperatively compared to 1 day preoperatively ($P > 0.05$). In Group B, IgM and IgG levels decreased at 1 day postoperatively compared to 1 day preoperatively and were lower than those in Group A at the same time point ($P < 0.05$). ④ Cellular Immune Function Indicators: At 1 day postoperatively, CD4+, CD8+, and NK cell levels decreased in both groups compared to 1 day preoperatively.

Conclusion: Propofol and sevoflurane have similar effects on perioperative blood rheology in colon cancer patients. However, propofol has a lesser impact on coagulation and immune function compared to sevoflurane, making it more effective in promoting postoperative recovery and reducing the risk of related postoperative complications.

Keywords: colon cancer, radical surgery, propofol, sevoflurane, coagulation function, immune system function, effects

Introduction

Colon cancer is one of the most common malignancies worldwide, with its incidence and mortality rates second only to gastric and liver cancers among gastrointestinal tumors.[1] According to the latest statistics released by the International Agency for Research on Cancer (IARC), the global annual incidence of colon cancer has exceeded 1.9 million cases and continues to rise annually.[2] The pathogenesis of colon cancer is complex and involves multiple factors, including genetic predisposition, environmental factors, and lifestyle habits. Among these, intestinal microecological imbalances, chronic inflammatory responses, and immune dysfunction are considered critical pathological mechanisms.[3–5] With the continuous advancement of early screening techniques for colon cancer, an increasing number of patients can achieve favorable prognoses through radical surgery.[6] However, perioperative management also plays a significant role in influencing postoperative recovery. Studies[7] have shown that changes in coagulation function during surgery in cancer patients may

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significantly increase the risk of thromboembolism or postoperative bleeding, making it a core objective of perioperative management to maintain stable coagulation function. In addition, surgical trauma can lead to significant suppression of both humoral and cellular immune functions. Reduced immune function not only delays postoperative recovery but also increases the risk of postoperative infections and tumor recurrence or metastasis.[8,9] Therefore, it is of significant clinical importance to explore the specific effects of anesthesia methods on coagulation and immune functions.

Propofol and sevoflurane are two commonly used anesthetics widely applied in general anesthesia for clinical surgeries. Propofol is a short-acting intravenous anesthetic characterized by rapid sedation, quick recovery, and fewer adverse reactions, making it widely used for various types of surgical anesthesia and sedation.[10] Sevoflurane, an inhalation anesthetic, offers advantages such as rapid induction, stable maintenance, and convenient modulation, and is frequently applied in complex surgeries.[11] Although previous studies[12,13] have evaluated the anesthetic effects and safety of propofol and sevoflurane, comparative research on their effects on coagulation and immune system function in patients undergoing radical surgery for colon cancer remains limited. Based on this background, this study retrospectively analyzed the clinical data of 120 patients who underwent radical surgery for colon cancer in our hospital. The aim was to compare the effects of intravenous anesthesia with propofol and inhalation anesthesia with sevoflurane on coagulation and immune system functions, providing new references for clinical practice and contributing to the optimization of perioperative management in colon cancer patients.

Data and Methods

Basic Information

A retrospective analysis was conducted on the clinical data of 120 patients with colon cancer who underwent radical resection at our hospital between January 2023 and August 2024. Inclusion criteria: ① Diagnosed with colon cancer through relevant clinical examinations and confirmed diagnosis;[14] ② Met surgical indications and underwent elective radical surgery at our hospital; ③ Had not received prior immunotherapy, chemotherapy, or radiotherapy; ④ Met the indications for propofol or sevoflurane anesthesia; ⑤ Provided informed consent for participation in this study, with consent forms signed by patients and their families; ⑥ Had complete and authentic clinical data available for analysis. Exclusion criteria: ① Presence of other malignant tumors; ② Severe immune system disorders or hematological diseases; ③ Severe organ dysfunction; ④ History of prior abdominal surgery; ⑤ Cognitive, communication, or psychiatric disorders; and/or ⑥ Intolerance or allergy to procedures or drugs used in this study. Based on the type of anesthesia received during surgery, patients were divided into Group A and Group B, with 60 cases in each group. This study was approved by the Medical Ethics Committee of Suzhou Ninth People's Hospital (Approval No.: MZ-2024-XH-0012), and it strictly adheres to ethical standards throughout the research process. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Methods

All patients underwent radical colorectal cancer surgery, with surgical procedures and anesthesia management performed by the same medical team to ensure standardization and comparability of outcomes. Before entering the operating room, patients received preoperative pharmacological pretreatment, including intramuscular injections of sodium phenobarbital injection (Harbin Pharmaceutical Group Sanjing Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H23021167) 0.1 g and scopolamine injection (Henan Furun Huaiqing Tang Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H19994038) 0.3 mg. Upon entering the operating room, a peripheral venous access was established, and a multiparameter monitor was connected to comprehensively monitor vital signs, including heart rate, blood pressure, oxygen saturation, and respiratory rate, ensuring intraoperative safety.

Anesthesia induction followed standardized protocols: Midazolam injection (Jiangsu Enhua Pharmaceutical Group Co., Ltd., Approval No.: National Drug Standard H19990027) 3 mg for sedation. Fentanyl injection (Yichang Renfu Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H42022076) 4 μg/kg for analgesia.

Vecuronium bromide for injection (Zhejiang Xianju Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H19991172) 0.1 mg/kg as a muscle relaxant for tracheal intubation. Lidocaine injection (Shanxi Jinxin Shuanghe

Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H11022295) 50 mg to reduce intubation stimulation. Propofol injection (Sichuan Guorui Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H20030114) 2 mg/kg as the primary anesthetic induction agent. After completing the above steps, tracheal intubation was performed, and mechanical ventilation was initiated. Ventilation parameters were adjusted to maintain optimal oxygenation during surgery.

Anesthesia maintenance varied by group: Group A: Propofol injection 4–10 mg/(kg·h) + remifentanil hydrochloride for injection (Yichang Renfu Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H20030197) 0.1–0.4 μg/(kg·min). Group B: Inhalation of 1.0–2.5% sevoflurane (Lunan Better Pharmaceutical Co., Ltd., Approval No.: National Drug Standard H20080681) + remifentanil hydrochloride for injection 0.1–0.4 μg/(kg·min). The Bispectral Index (BIS) was monitored in all patients during surgery, and drug dosages were adjusted based on the monitoring results to maintain adequate anesthesia depth. If the BIS remained at 40–60, the anesthetic dosage was maintained. If the BIS exceeded 60, the anesthetic dosage was increased; if it dropped below 40, the dosage was reduced. At the end of the surgery, propofol or sevoflurane administration was stopped immediately, and vital signs were closely monitored to ensure the prompt recovery of spontaneous respiration and consciousness.

Observational Indicators

Hemorheological Parameters

5 mL of radial arterial blood was collected before anesthesia and 60 minutes after anesthesia induction to measure plasma viscosity (PV), erythrocyte aggregation index (EAI), and erythrocyte deformability index (EDI) using a hemorheological analyzer.

Coagulation Function Parameters

5 mL of fasting elbow venous blood was collected on the morning of the day before surgery and the first day after surgery to measure prothrombin time (PT), activated partial thromboplastin time (APTT), D-dimer (D-D), and fibrinogen (FIB) levels using an automatic coagulation analyzer.

Humoral Immune Function Indicators

Blood samples collected as above were analyzed using immunoturbidimetry to measure levels of immunoglobulin A (IgA), immunoglobulin M (IgM), and immunoglobulin G (IgG).

Cellular Immune Function Indicators

Blood samples collected as above were analyzed using flow cytometry to measure levels of CD4+, CD8+, and natural killer (NK) cells.

Postoperative Recovery

Indicators included the time to first postoperative flatus, time to first ambulation, and length of hospital stay, recorded uniformly by hospital medical staff.

Postoperative Complications

Complications included bleeding, infection, airway reactions, gastrointestinal reactions, blood pressure abnormalities, anastomotic leakage, and embolism formation, all recorded uniformly by hospital medical staff.

Statistical Analysis

GraphPad Prism 8 was used for plotting, and SPSS 22.0 was employed for data analysis. Measurement data were described using (mean ± SD), with independent sample t-tests for between-group comparisons and paired t-tests for within-group comparisons. Count data were described using n (%), and chi-square tests were used for analysis. A p-value of <0.05 was considered statistically significant.

Results

Comparison of Basic Information

There was no significant difference between the two groups in terms of gender, age, lesion diameter, and lesion location ($P > 0.05$), indicating comparability. See Table 1.

Table 1 Comparison of Basic Information (Mean ± SD, n [%])

	Group A (n=60)	Group B (n=60)	t/x^2	P
Gender	–	–	0.392	0.531
Male	35 (58.33)	37 (61.67)	–	–
Female	25 (41.67)	23 (38.33)	–	–
Age (years)	61.54±9.15	61.23±9.47	0.182	0.855
Lesion diameter (cm)	4.65±0.72	4.73±0.79	0.242	0.808
Lesion location	–	–	0.562	0.453
Ascending colon	20 (33.33)	21 (35.00)	–	–
Transverse colon	11 (18.33)	8 (13.33)	–	–
Descending colon	17 (28.33)	19 (31.67)	–	–
Sigmoid colon	12 (20.00)	12 (20.00)	–	–

Comparison of Hemorheological Index Levels

The levels of PV, EAI, and EDI in both groups decreased at 60 minutes after anesthesia induction compared to pre-anesthesia levels ($P < 0.05$). No significant differences were found in PV, EAI, and EDI levels between the two groups at the same time points ($P > 0.05$). See Table 2.

Comparison of Coagulation Function Indicators

Levels of D-D and FIB at 1 day post-operation were elevated compared to 1 day pre-operation in both groups, with Group A showing smaller changes compared to Group B ($P < 0.05$). See Figure 1 and Table 3.

Comparison of Humoral Immune Function Indicators

The humoral immune function indicators in Group A showed no significant changes at 1 day post-operation compared to 1 day pre-operation ($P > 0.05$). In Group B, levels of IgM and IgG decreased at 1 day post-operation and were lower than those in Group A at the same time point ($P < 0.05$). See Figure 2 and Table 4.

Comparison of Cellular Immune Function Indicators

Levels of CD4+, CD8+, and NK cells decreased at 1 day post-operation compared to 1 day pre-operation in both groups, with Group A showing smaller changes compared to Group B ($P < 0.05$). See Figure 3 and Table 5.

Comparison of Postoperative Recovery

Group A had shorter times to first postoperative flatus, first postoperative ambulation, and hospital stay compared to Group B ($P < 0.05$). See Figure 4 and Table 6.

Table 2 Comparison of Hemorheological Index Levels (Mean ± SD)

	Group A (n=60)	Group B (n=60)	t	P
PV (mPa·s)	–	–	–	–
Pre-anesthesia	1.66±0.10	1.65±0.11	0.521	0.603
60 min after induction	1.34±0.07#	1.33±0.09#	0.679	0.498
EAI	-	-	-	-
Pre-anesthesia	8.53±0.35	8.48±0.347	0.793	0.429
60 min after induction	7.72±0.48#	7.68±0.43#	0.480	0.631
EDI	-	-	-	-
Pre-anesthesia	0.68±0.11	0.67±0.13	0.454	0.650
60 min after induction	0.57±0.12#	0.54±0.11#	1.427	0.156

Note: Compared with pre-anesthesia in the same group, #P < 0.05.

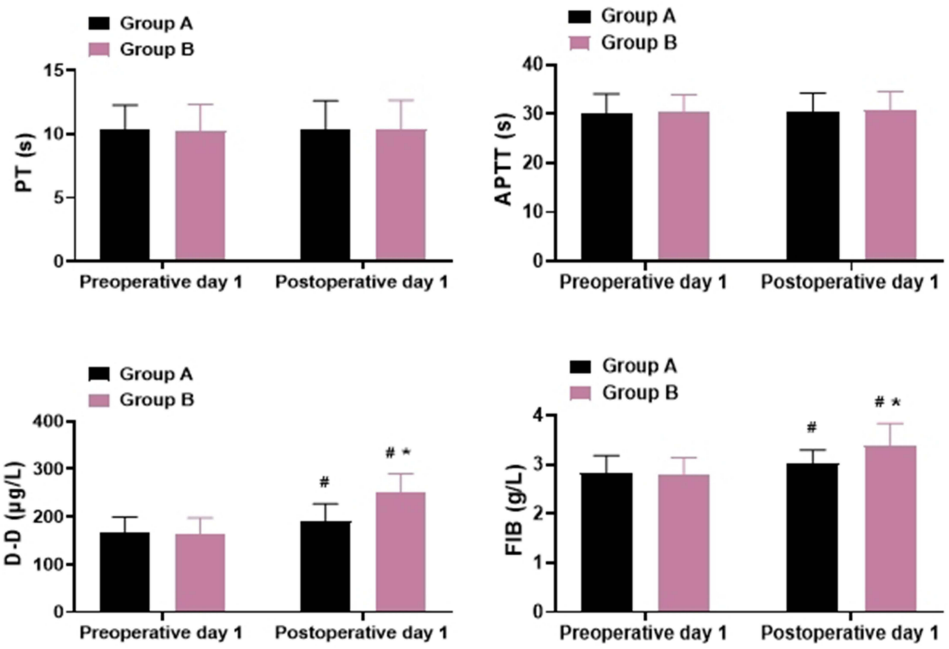

Figure 1 Comparison of Coagulation Function Indicators (mean ± SD).
Note: Compared with 1 day pre-operation in the same group, #P < 0.05; compared between groups, *P < 0.05.

Comparison of Postoperative Complications

The incidence of postoperative complications in Group A (8.33%) was lower than that in Group B (21.67%) (P < 0.05). See Table 7.

Discussion

Radical colectomy is the preferred treatment for colon cancer patients with clear surgical indications, as it effectively removes lesions and significantly improves patient prognosis.[15] In recent years, with advancements in minimally invasive surgical techniques, particularly the widespread application of laparoscopic surgery, the degree of surgical trauma has been significantly reduced. However, beyond surgical trauma itself, the impact of anesthetic methods on postoperative recovery has drawn considerable attention.[16,17] Studies[18] have suggested that intraoperative stress responses, inflammatory reactions, and the choice of anesthetic agents may play critical roles in postoperative complications, recovery processes, and overall prognosis. Since stress and inflammatory responses are often unavoidable, optimizing anesthetic strategies has become an essential means of regulating patients' intraoperative physiological states and improving postoperative recovery quality. Surgical Site Infections (SSI) are among the most common and concerning postoperative complications following colorectal surgeries, particularly radical colectomy. SSI not only affects patient recovery but also contributes significantly to prolonged hospital stays, increased morbidity, and even mortality. Studies have shown that SSIs can lead to further complications such as sepsis and longer postoperative recovery times, making it a crucial aspect of postoperative care.[19] Furthermore, the incidence of SSIs can result in additional healthcare costs, adding a financial burden on both healthcare systems and patients. Preventing and managing SSIs effectively is therefore paramount to improving surgical outcomes and reducing patient suffering. Given the immunosuppressive effects of surgery and anesthesia, careful management is necessary to mitigate the risk of infection. The role of anesthetic agents, particularly the choice between sevoflurane and propofol, may influence the likelihood of SSIs, with some studies suggesting that certain agents may enhance immune responses and thus reduce the risk of infection.

Sevoflurane, a widely used inhalation halogenated anesthetic, is characterized by rapid induction, fast recovery, and excellent controllability, with minimal impact on the cardiovascular and respiratory systems.[20] Research has shown that sevoflurane can maintain stable anesthetic depth during surgery and reduce the incidence of adverse events during the

Table 3 Comparison of Coagulation Function Indicators (Mean ± SD)

Group	PT (s)		APTT (s)		D-D (μg/L)		FIB (g/L)	
	Preoperative Day 1	Postoperative Day 1	Preoperative Day 1	Postoperative Day 1	Preoperative Day 1	Postoperative Day 1	Preoperative Day 1	Postoperative Day 1
Group A (n=60)	10.32 ± 1.95	10.43 ± 2.18	30.26 ± 3.82	30.57 ± 3.68	166.05 ± 33.21	191.46 ± 35.27$^{\#}$	2.84 ± 0.35	3.03 ± 0.27$^{\#}$
Group B (n=60)	10.28 ± 2.06	10.38 ± 2.27	30.32 ± 3.61	30.76 ± 3.83	165.41 ± 32.17	252.27 ± 38.16$^{\#*}$	2.81 ± 0.33	3.38 ± 0.46$^{\#*}$

Note: Compared with 1 day pre-operation in the same group, #P < 0.05; compared between groups, *P < 0.05.

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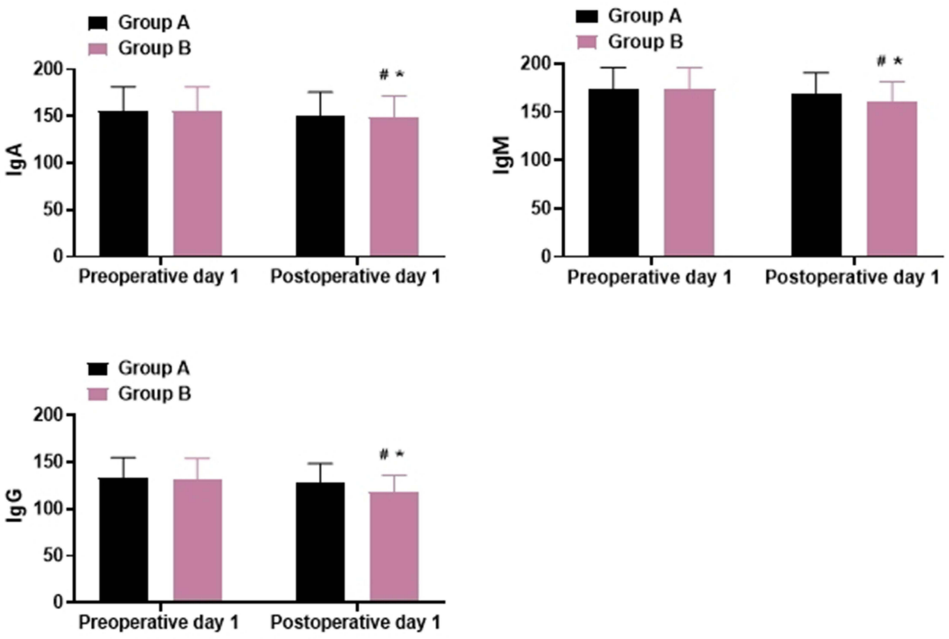

Figure 2 Comparison of Humoral Immune Function Indicators (mean ± SD, U/mL).
Note: Compared with 1 day pre-operation in the same group, #P < 0.05; compared between groups, *P < 0.05.

surgical process.[21] In this study, patients who received sevoflurane for maintenance anesthesia exhibited relatively stable hemodynamics intraoperatively, highlighting the advantages of sevoflurane in maintaining physiological stability during surgery. However, on postoperative day 1, the D-D and FIB levels of patients in the sevoflurane group were significantly elevated compared to preoperative day 1, which is speculated to be associated with stress responses induced by surgical trauma and intraoperative blood loss. This finding suggests that sevoflurane may have limited efficacy in modulating postoperative coagulation function. Additionally, although sevoflurane possesses a degree of muscle-relaxing effect,[22] its effectiveness in reducing sensitivity to intraoperative pain stimuli and enhancing recovery speed remains constrained.

Propofol, a short-acting intravenous anesthetic, primarily exerts its effects by enhancing gamma-aminobutyric acid (GABA)-mediated central inhibitory neurotransmission.[23] Compared to sevoflurane, propofol not only induces sedation rapidly but also more effectively suppresses intraoperative pain transmission and stress responses.[24] This study demonstrated that the changes in coagulation function on postoperative day 1 were less pronounced in patients who received propofol compared to those who received sevoflurane ($P < 0.05$), indicating that propofol has certain advantages in reducing postoperative hypercoagulable states. Furthermore, propofol has been reported to improve intraoperative microcirculation,[25] thereby potentially reducing the risk of complications such as postoperative bleeding and thrombosis. Regarding safety, the results of this study showed that the incidence of postoperative complications in patients receiving

Table 4 Comparison of Humoral Immune Function Indicators (Mean ± SD, U/mL)

Group	IgA		IgM		IgG	
	Preoperative Day 1	Postoperative Day 1	Preoperative Day 1	Postoperative Day 1	Preoperative Day 1	Postoperative Day 1
Group A (n=60)	155.64 ± 25.68	150.87 ± 24.73	174.16 ± 21.53	168.84 ± 21.65	133.49 ± 21.25	127.58 ± 20.83
Group B (n=60)	156.13 ± 24.87	148.79 ± 22.91#*	173.96 ± 22.08	161.27 ± 19.84#*	132.41 ± 21.65	118.42 ± 17.43#*

Note: Compared with 1 day pre-operation in the same group, #P < 0.05; compared between groups, *P < 0.05.

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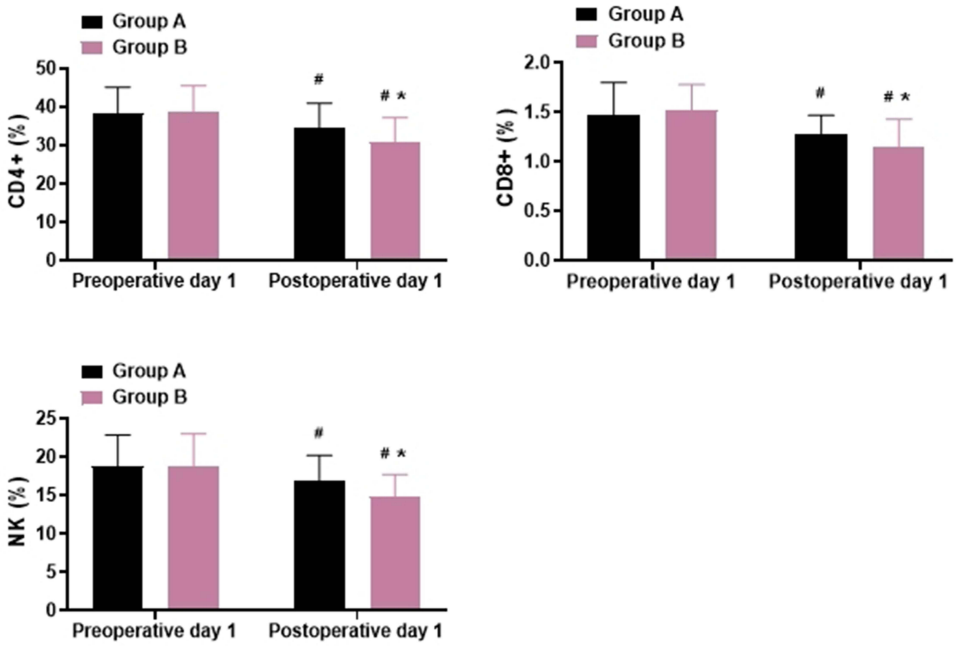

Figure 3 Comparison of Cellular Immune Function Indicators (mean ± SD).
Note: Compared with 1 day pre-operation in the same group, #P < 0.05; compared between groups, *P < 0.05.

propofol anesthesia was 8.22%, significantly lower than the 27.40% observed in patients receiving sevoflurane anesthesia. This disparity underscores the clinical value of propofol.

In terms of promoting postoperative recovery, propofol also exhibited superiority. The study found that patients in the propofol group had shorter times to first postoperative flatus, first ambulation, and hospital discharge compared to those in the sevoflurane group ($P < 0.05$). This is likely attributable to the pharmacological properties of propofol, which include rapid metabolism and a shorter recovery time. These features not only reduce the inhibitory effects of residual anesthetics on gastrointestinal function but also facilitate early postoperative mobilization, thereby enhancing overall recovery efficiency.[26,27] Additionally, immune function changes serve as crucial indicators for evaluating the quality of postoperative recovery. Colon cancer patients often experience immune function decline due to the disease itself and surgical stress,[28] and the immunosuppressive effects of different anesthetic agents also vary.[29,30] This study revealed that both sevoflurane and propofol resulted in some degree of postoperative impairment in humoral and cellular immunity. However, the fluctuations in immune function on postoperative day 1 were less pronounced in patients who received propofol compared to those who received sevoflurane ($P < 0.05$). This finding aligns with previous research,[31,32] suggesting that propofol has a smaller impact on early postoperative immune function, potentially reducing the risk of complications such as postoperative infections. Thus, propofol not only maintains anesthetic depth during surgery but also better preserves postoperative immune function, creating favorable conditions for rapid recovery.

Table 5 Comparison of Cellular Immune Function Indicators (Mean ± SD)

Group	CD4+ (%)		CD8+ (%)		NK (%)	
	Preoperative Day 1	Postoperative Day 1	Preoperative Day 1	Postoperative Day 1	Preoperative Day 1	Postoperative Day 1
Group A (n=60)	38.52 ± 6.68	34.80 ± 6.23#	1.48 ± 0.32	1.28 ± 0.19#	18.82 ± 4.07	17.05 ± 3.18#
Group B (n=60)	38.84 ± 6.72	31.08 ± 6.14#*	1.52 ± 0.26	1.16 ± 0.27#*	18.87 ± 4.19	14.94 ± 2.83#*

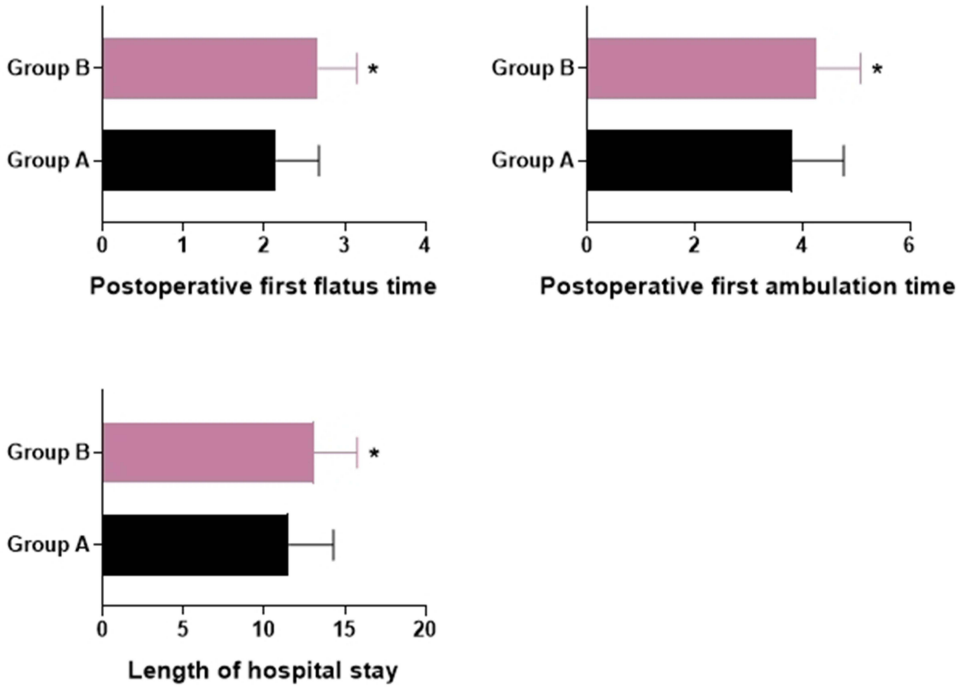

Figure 4 Comparison of Postoperative Recovery (mean ± SD).
Note: Compared between groups, *P < 0.05.

In recent years, deep learning algorithms have emerged as a promising tool in the diagnosis and classification of colorectal cancer (CRC). These advanced algorithms are capable of analyzing histopathological images with remarkable precision, potentially improving the accuracy and speed of CRC diagnosis. Several studies have demonstrated that deep learning models can assist pathologists in distinguishing between malignant and benign tissues with higher sensitivity and specificity than traditional methods.[33,34] As such, the integration of deep learning into clinical practice could lead to earlier detection of CRC, thereby improving patient outcomes through timely interventions. Although this technology is

Table 6 Comparison of Postoperative Recovery (Mean ± SD)

Group	Postoperative First Flatus Time	Postoperative First Ambulation Time	Length of Hospital Stay
Group A (n=60)	2.15 ± 0.53	3.82 ± 0.95	11.54 ± 2.76
Group B (n=60)	2.67± 0.48*	4.27 ± 0.81*	13.08 ± 2.69*

Note: Compared with 1 day pre-operation in the same group, #P < 0.05; compared between groups, *P < 0.05.

Table 7 Comparison of Postoperative Complications [n (%)]

Complications	Group A (n=60)	Group B (n=60)	x^2	*P*
Bleeding	1 (1.67)	3 (5.00)	–	–
Infection	1 (1.67)	2 (3.33)	–	–
Airway reaction	0 (0.00)	2 (3.33)	–	–
Gastrointestinal reaction	1 (1.67)	1 (1.67)	–	–
Blood pressure abnormalities	1 (1.67)	1 (1.67)	–	–
Anastomotic leak	1 (1.67)	2 (3.33)	–	–
Embolism formation	0 (0.00)	2 (3.33)	–	–
Total incidence	5 (8.33)	13 (21.67)	4.183	0.040

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still in the early stages, it holds significant potential to enhance diagnostic capabilities and may become an essential component of CRC diagnostic workflows in the near future. Another emerging area of research involves the use of biomarkers to predict postoperative complications following colorectal surgery. One such biomarker is Butyrylcholinesterase (BuChE), which has shown promise in predicting complications like infection and poor wound healing. BuChE levels have been found to correlate with postoperative recovery and the occurrence of complications, suggesting that it may serve as a valuable predictive marker in clinical settings. A recent study by Verras[35] demonstrated that lower BuChE levels in patients were associated with a higher incidence of postoperative complications. The integration of BuChE testing into routine perioperative management could help identify high-risk patients and tailor interventions more effectively, thus improving recovery outcomes and reducing the risk of adverse events.

Although this study confirmed the advantages of propofol in reducing postoperative complications, improving coagulation function, and supporting immune function recovery, certain limitations remain. Firstly, as a single-center retrospective analysis, the sample size was relatively small, potentially affecting the generalizability of the results. Secondly, the mechanisms underlying postoperative changes in immune and coagulation function are complex and require larger-scale prospective studies to elucidate the specific impacts of different anesthetic agents. Additionally, incorporating biomarker analysis and multidimensional imaging assessments could provide a more comprehensive understanding of the mechanisms of anesthetic agents in perioperative management. In summary, propofol demonstrates greater clinical potential in reducing postoperative complications, regulating coagulation function, and promoting immune function recovery. In clinical practice, anesthetic plans should be tailored to individual patient characteristics and surgical needs to provide precise perioperative management, ultimately improving postoperative recovery quality and patient quality of life.

Conclusion

In conclusion, propofol demonstrates better postoperative recovery, coagulation function regulation, and immune protection in colon cancer radical surgery. It is recommended to prioritize propofol as the anesthetic agent in clinical practice to improve postoperative recovery quality and reduce the risk of related complications.

Disclosure

The authors report no conflicts of interest in this work.

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