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Advances in Risk Factors and Assessment Tools for Perioperative Venous Thrombosis in Colorectal Cancer Patients

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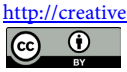

Abstract

This article reviews the current knowledge on venous thromboembolism (VTE) in patients with colorectal cancer during the perioperative period, systematically explores the risk factors influencing the development of VTE before, during, and after surgery, and summarizes the assessment tools, including scoring tables, thromboelastography, and risk prediction models, in order to provide a basis for further identification of high-risk VTE patients during the perioperative period of colorectal cancer. Among them, the risk prediction model provides higher predictive accuracy in identifying high-risk patients.

Keywords

Colorectal Cancer, Perioperative, Venous Thrombosis, Deep Vein Thrombosis, Influencing Factors

1. Introduction

Venous Thromboembolism (VTE), a clinical syndrome caused by venous thrombus formation and detachment leading to vascular obstruction, includes deep vein thrombosis (DVT) and pulmonary embolism (PE). As the second leading cause of cancer-related mortality, the incidence of VTE continues to rise [1], with an estimated prevalence of 20% - 30% [2]. Colorectal cancer (CRC), the third most common cancer globally, ranks second in incidence and fourth in mortality among cancers in China [3]. VTE, a frequent complication of malignancies, occurs in approximately 2.75% - 8.9% of CRC patients [4]. Surgery remains the primary treatment for colorectal cancer, yet VTE—a common and serious postoper-

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ative complication—can prolong hospital stays, hinder subsequent treatments, reduce quality of life, and even pose life-threatening risks. Studies [5] indicate that 82.5% of postoperative CRC patients are at high risk for VTE, with most cases being asymptomatic. However, only 24.3% receive VTE prevention during the perioperative period. VTE is a preventable complication during the perioperative phase, and healthcare professionals' involvement in preoperative, intraoperative, and postoperative VTE risk assessment and intervention can effectively reduce its incidence and mortality. The risk of VTE fluctuates over time, varies with disease progression and treatment, and shows significant individual differences, making dynamic monitoring crucial. However, current assessments of VTE risk factors and evaluation tools for colorectal cancer patients remain inconsistent, with no unified standards established. This review synthesizes perioperative VTE risk factors and assessment tools for colorectal cancer patients worldwide, aiming to provide clinical references for identifying high-risk VTE patients.

2. Perioperative VTE Risk Factors in Colorectal Cancer Patients

Researchers are increasingly focusing on factors influencing the development of venous thromboembolism (VTE) in colorectal cancer patients during the perioperative period. Beyond the tumor itself, multiple perioperative factors also contribute to VTE occurrence. In a study by Schlick *et al*. [6], 51,139 patients undergoing colorectal cancer resection were analyzed to identify preoperative, intraoperative, and postoperative factors associated with VTE. The findings revealed that VTE risk factors vary across different perioperative stages in colorectal cancer patients.

2.1. Preoperative Factors

2.1.1. Age

Multiple studies have demonstrated that age is a key factor influencing the development of VTE (venous thromboembolism) in colorectal cancer patients. Patients aged 60 and older exhibit significantly increased perioperative VTE risks. Research [7] [8] indicates that vascular endothelial cell damage progressively worsens with advancing age in elderly patients, leading to elevated levels of pro-coagulant substances and fibrinogen while reducing plasminogen activator synthesis, thereby maintaining a hypercoagulable state. Furthermore, age-related physiological changes including slowed metabolic rates further reduce blood flow velocity, exacerbating VTE susceptibility [9]. Consequently, patients aged 60 and older with colorectal cancer should be classified as a high-risk group requiring enhanced monitoring and preventive measures during the perioperative period. Additionally, elderly patients often have comorbidities such as hypertension, diabetes, and cardiovascular diseases, which collectively impair vascular endothelial function and blood rheology, indirectly increasing VTE risk [10]. Therefore, comprehensive preoperative evaluations should assess age-related physiological changes and comorbid conditions, utilizing personalized dynamic risk assessment tools to develop targeted prevention strategies that reduce both the incidence and severity of VTE during the perioperative phase.

2.1.2. Gender

Colorectal cancer predominantly affects middle-aged and elderly male patients. Studies [11] [12] investigating postoperative venous thromboembolism (VTE) risk factors revealed that men are more susceptible to VTE after colorectal cancer surgery compared to women. However, a Japanese retrospective study [13] demonstrated that female gender is an independent risk factor for preoperative VTE, a conclusion corroborated by Chinese researchers Wei *et al*. [5]. This discrepancy may stem from estrogen's dual effects: it elevates coagulation factor levels while reducing fibrinolytic activity, and increases inflammatory cytokines like interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α) in women, which activate the coagulation system and heighten thrombosis risk. Therefore, there is no unified conclusion regarding the impact of gender on the risk of VTE in colorectal cancer. This might be due to differences in the populations involved, cancer stages, or the hormonal factors considered in different studies. Further research is needed.

2.1.3. Obesity and Body Mass Index (BMI)

Obese patients and those with higher BMI levels have a greater postoperative risk of VTE. Multiple studies [14] [15] have demonstrated that obesity is a significant risk factor for long-term VTE. Shen Chenglong *et al*. [16] investigated 140 patients undergoing laparoscopic radical colorectal cancer resection, finding that 26 cases developed venous thromboembolism. Comparative analysis revealed that patients with postoperative VTE had higher BMI levels. This may be attributed to obesity-related comorbidities such as hypertension and hyperlipidemia, reduced physical activity, and slower blood flow leading to increased blood viscosity, which facilitates thrombus formation. In clinical practice, healthcare providers should incorporate BMI into VTE risk stratification as a high-risk indicator and initiate early, continuous, and multidisciplinary interventions.

2.1.4. Disease Characteristics

The disease-related characteristics of colorectal cancer are associated with the occurrence of venous thromboembolism (VTE). Studies have found that factors such as tumor location [14], cancer stage [17], pathological tumor type, and diagnostic procedures can influence VTE risk in colorectal cancer patients. The left side shows a higher tendency for thrombosis compared to the right side, possibly due to increased blood viscosity, slower blood flow velocity, and a higher susceptibility to intestinal inflammation in left-sided colorectal cancer. Patients with advanced metastatic cancer are prone to blood flow stagnation due to increased metabolic burden, systemic inflammatory responses, vascular obstruction or compression, and long-term central venous catheter placement. Pathological tumor types such as mucinous colorectal cancer, which secretes excessive mucin, along with patients undergoing colonoscopy biopsies, are more likely to cause endothelial damage, promoting a thrombosis-prone state and increasing VTE risk.

2.1.5. Basic Diseases

Patients with colorectal cancer exhibit multiple risk factors, including hypertension, diabetes, and a history of thrombosis, all of which correlate with the development of venous thromboembolism (VTE). These comorbidities—cardiovascular diseases, diabetes, and hypertension—are prevalent among middle-aged and elderly populations [7] [9] [15] [18] [19]. Chronic exposure to these conditions leads to vascular endothelial dysfunction, impaired fibrinolysis, reduced elasticity, and slowed blood flow. These changes promote platelet and red blood cell adhesion within blood vessels, creating a hypercoagulable state that significantly elevates VTE risk. Studies show that VTE incidence rates among patients with hypertension (52.50%), diabetes (35.29%), and coronary heart disease (33.33%) are notably higher than those without these conditions (44.90%) [20]. A prior history of venous thrombosis further increases VTE susceptibility, with new VTE cases occurring seven times more frequently than in patients without such history, and a 26.1% recurrence rate within five years [8] [21]. Therefore, comprehensive preoperative cardiac and pulmonary function assessments should be conducted for colorectal cancer patients to implement preventive measures and minimize VTE risks.

2.1.6. D-Dimer Levels and Others

Several studies indicate that preoperative D-dimer levels, plasma viscosity [16] [19], intestinal obstruction, bloody stools [5], chemotherapy, serum folate and homocysteine levels [22], and the frequency of venipuncture may increase the risk of venous thromboembolism (VTE) in colorectal cancer patients. Multiple studies [16] [19] [23] [24] have shown that elevated D-dimer levels correlate with inflammatory responses, indicating a hypercoagulable state in patients. Both preoperative and postoperative D-dimer levels significantly influence VTE risk in colorectal cancer [25] [26]. Clinically, dynamic monitoring of these levels is essential to assess VTE risk changes and adjust preventive measures accordingly. Excessive venipuncture can damage vascular walls, disrupt endothelial function, cause cellular injury, and lead to localized thrombus formation [9] [12]. Preoperative chemotherapy, radiotherapy, and other anti-tumor interventions cause vascular damage comparable to repeated venipuncture [14], compromising endothelial integrity and reducing anti-thrombotic properties. Additionally, researchers [27] found that patients with interrupted VTE prevention protocols exhibited higher VTE incidence rates compared to those with uninterrupted protocols.

2.2. Intraoperative Factors

2.2.1. Duration and Surgical Approach

Research [6] [9] [11] [16] [28] indicates a correlation between surgical duration and VTE incidence. Prolonged operations increase VTE risk, with procedures lasting ≥3 hours affecting the coagulation system, where extended duration correlates with greater trauma. Different researchers have reached different conclusions regarding the impact of various surgical methods on VTE. This might be

due to differences in the duration of the surgery, surgical techniques, or selection criteria for patients. A study [12] identified open surgery as an independent risk factor for VTE in colorectal cancer patients, showing higher VTE rates than laparoscopic procedures. Li Ge *et al*. [28] noted that laparoscopic colorectal cancer surgery, though longer than open surgery, significantly impacts functional recovery and increases venous thrombosis risk. Conversely, another study [29] suggested laparoscopic surgery has minimal effects on coagulation function and lower VTE risks.

2.2.2. Intraoperative Blood Loss and Transfusion

Excessive intraoperative blood loss and blood transfusions can significantly increase the risk of venous thromboembolism (VTE) [9] [12] [28]. Prolonged surgical procedures subject tissue factors to continuous exposure, keeping the coagulation system in a prolonged activated state. Following massive blood loss, insufficient blood volume leads to a marked decrease in blood flow velocity. During storage, blood products gradually release micro-particles, free hemoglobin, and inflammatory mediators—micro-aggregates that directly damage vascular endothelial cells, further elevating VTE risks. Therefore, for patients with anticipated prolonged surgeries or significant bleeding tendencies, multidisciplinary consultations should be initiated preoperatively to comprehensively evaluate the thrombo-hemostatic balance.

2.2.3. Others

Risk factors such as anesthesia duration ≥180 minutes [5], surgical positioning variations [7], elevated white blood cell (WBC) count, and vascular involvement [20] may contribute to VTD formation. Additionally, positions like prone or lithotomy positions that obstruct iliac vein return and prolonged hypotension causing low shear stress can further amplify thrombotic risk. However, these factors require validation through large-scale studies. During the perioperative period, dynamic monitoring of WBC, D-dimer, and lower extremity venous flow velocity should be implemented, with early initiation of mechanical or pharmacological prophylaxis for patients with multiple risk factors.

2.3. Postoperative Factors

2.3.1. Postoperative Immobilization Time

The duration of postoperative bed rest and immobilization also influences the risk of venous thromboembolism (VTE) in colorectal cancer patients [14] [16] [19] [24] [28] [30]. Patients unable to engage in early ambulation and functional exercises experience blood concentration, slowed circulation, and significant local blood stasis, creating a conducive environment for thrombus formation. A multicenter retrospective analysis [31] of 881 radical colorectal cancer patients demonstrated that those remaining bedridden for ≥3 days had a VTE incidence rate of 12.1%, compared to merely 3.4% among those initiating ambulation within 24 hours postoperatively. Additionally, a study [32] on advanced-stage colorectal

cancer revealed that patients with prolonged bed rest—often due to incision pain, multiple drainage tubes, or physical debilitation—experienced 2.29 times higher VTE risks than early ambulation patients.

2.3.2. Postoperative Complications

Postoperative infections also serve as an independent risk factor for venous thromboembolism (VTE). This occurs when infections trigger the release of inflammatory mediators that activate monocytes and tumor cells, disrupting blood flow dynamics and upsetting the balance between coagulation and fibrinolytic systems, ultimately leading to venous thrombosis. Complications such as postoperative hemorrhage, anastomotic leakage, and pulmonary infections significantly increase the risk of VTE. The more severe and numerous these complications are, the higher the likelihood of VTE development. Importantly, postoperative complications represent an independent, intervenable risk factor.

2.3.3. Others

Postoperative complications such as abdominal distension, intestinal paralysis, and semi-recumbent positions may impede venous return in the lower limbs. Delayed gastric decompression, fasting, and inadequate fluid replacement can lead to hypovolemia and increased blood viscosity. Additionally, postoperative hemostatic medications and repeated venipuncture at the same site further elevate the risk of venous thrombosis.

3. Perioperative VTE Risk Assessment Tool for Colorectal Cancer Patients

3.1. Scoring Scale and Thromboelastogram

3.1.1. Caprini Score Sheet

The Caprini Scorecard, developed by American researchers Caprini *et al.* [33] in 1991, remains one of the most widely used clinical tools for individualized perioperative venous thromboembolism (VTE) risk assessment. This comprehensive instrument comprises 40 items covering patient demographics, medical history, and laboratory tests, each scored on a 1 - 5 scale. Patients are categorized into four risk levels (low risk 0 - 1, moderate risk 2, high risk 3 - 4, and very high risk ≥5), with corresponding preventive recommendations provided. While its detailed content offers valuable guidance for patient management, the scorecard's extensive items and complex application process, combined with the high probability of patients being classified as high-risk, currently limit its effectiveness in achieving precise patient stratification [25].

3.1.2. Khorana Score Sheet

The Khorana Score, developed in 2008 by Khorana *et al.* [34], is a venous thromboembolism (VTE) risk assessment tool specifically designed for ambulatory chemotherapy patients. It enables rapid identification of high-risk individuals before chemotherapy. The scale evaluates five key parameters: tumor type, platelet count, hemoglobin levels, and leukocyte count. Scoring ranges from low risk (0

points) to high risk (≥3 points). With its concise design and reliance on clinical and laboratory data, the scale is particularly suitable for cancer patients undergoing outpatient treatment. However, it lacks consideration of critical risk factors such as chemotherapy regimens and prior VTE history, resulting in limited predictive power for high-risk thrombosis and reduced effectiveness in assessing patients receiving targeted or immunotherapy.

3.1.3. Hemotensography

The Thromboelastography (TEG) test evaluates patients' overall coagulation function through parameters such as clotting time and blood clot formation rate. With advantages including short testing duration, accurate data, and simple operation, it has been widely adopted in clinical practice [35]. However, due to its limited detection of risk factors, it is often combined with other thrombosis risk assessment tools. Integrating conventional coagulation indicators with TEG enables a comprehensive evaluation of colorectal cancer patients during initial diagnosis, providing evidence for prognosis assessment and effective anticoagulation strategies [36]. The combination of TEG with the Caprini model offers a more precise evaluation of postoperative venous thromboembolism (VTE) risks in colorectal cancer patients compared to standalone assessments [37]. Researchers including Guo Fangyu [38] have also demonstrated that combining TEG with TCM syndrome screening in early postoperative stages can identify high-risk thrombosis patients, thereby reducing deep vein thrombosis incidence through TCM techniques.

3.2. Risk Prediction Model

3.2.1. ABAD Prediction Model

The ABAD prediction model, developed by Tan *et al*. [39] for preoperative screening of high-risk patients undergoing radical colorectal cancer surgery, identified four risk factors closely associated with venous thromboembolism (VTE) in 528 Chinese colorectal cancer patients: age, body mass index (BMI), activated partial thromboplastin time (aPTT), and D-dimer levels. Built on logistic regression, the model ultimately produced a nomogram with high predictive performance and usability. However, as the data were retrospectively collected without prospective validation or external verification, further validation with larger sample sizes is required.

3.2.2. KDS Prediction Model

The Kagoshima Deep Vein Thrombosis (Kagoshima-DVT) Score, a predictive model developed by Japanese researchers Shibata *et al*. [40], evaluates preoperative DVT risk in gastrointestinal cancer patients. It assesses six risk factors: D-dimer ≥1.5 mg/L, age ≥60 years, female gender, ongoing glucocorticoid use, cancers with high/very high DVT risk, and prolonged immobility. Scores are categorized into three risk levels: low-risk (0 - 2 points), moderate-risk (3 - 4 points), and high-risk (5 - 7 points). All included criteria are routine hospital admission tests, avoiding additional financial burden. Currently a single-center retrospective

study with limited sample size, the model overestimates risks due to high D-dimer weighting. Notably, it excludes critical risk factors like tumor staging and central venous catheterization. While applicable for preoperative patients, it is not suitable for postoperative bedridden patients or chemotherapy-associated thrombosis risk assessment.

3.2.3. COMPASS-CAT Prediction Model

The COMPASS-CAT (Cancer-Associated Thrombosis) prediction model, developed in 2017 by Gerotziafas *et al*. [41] based on a multinational prospective cohort study of 1,355 outpatients with solid tumors, serves as a VTE risk assessment tool for patients with breast cancer, colorectal cancer, lung cancer, and other malignancies. This model can be evaluated before or during chemotherapy and includes 11 risk factors such as prior thrombosis history, tumor stage, chemotherapy status, and cancer type. Chinese researchers Wang Wenjun *et al*. [42] validated this model in colorectal cancer patients, incorporating D-dimer into the prediction model through logistic regression analysis to develop a localized Chinese combined prediction model. The updated model showed improved AUC values, incorporating three major risk factors: prior VTE history, central venous catheterization, and D-dimer levels. With higher sensitivity, the revised model demonstrates significantly enhanced predictive performance compared to the original COMPASS-CAT model.

3.2.4. Sir Run Run Shaw VTE Risk Prediction Model (SRSV)

The Sir-Run-Run-Shaw VTE RAM, a venous thromboembolic risk prediction model proposed by the team of Sir Run Run Shaw Hospital affiliated to Zhejiang University School of Medicine [26] in 2025, was specifically designed for postoperative patients with Chinese colorectal cancer (CRC). It includes four risk factors: age ≥69 years, tumor stage, preoperative plasma D-dimer, and blood transfusion, categorized into three levels: low risk (0 points), medium risk (1 point), and high risk (≥2 points). As the first localized VTE risk tool, it uses only four variables—routine admission data. Scholars found statistically significant differences between the model and the concurrent Caprini scoring system, indicating the model's greater applicability to Chinese colorectal cancer surgery patients. However, this study was a single-center retrospective analysis involving 541 cases, with external validation on 287 cases, necessitating multi-center verification.

3.2.5. Machine Learning (ML) Models

Qin *et al*. [43] developed a VTE prediction model using multiple machine learning methods for 1,191 colorectal cancer patients, evaluating postoperative VTE occurrence within 30 days by incorporating patient-level factors, cancer-level factors, and laboratory test results. The postoperative VTE incidence rate was 10.8%, with ten significant predictors including lymph node metastasis, C-reactive protein, tumor grade, anemia, primary tumor location, gender, age, and D-dimer. The XGBoost model demonstrated superior performance across all machine learning models, providing additional potential risk factors for VTE in colorectal

cancer patients and offering valuable references for clinical VTE prevention decisions.

3.2.6. Nomogram Prediction Model

The nomogram model is widely used to predict venous thromboembolism (VTE) in orthopedic surgeries, oncology cases, and critical patients. It transforms complex regression equations into intuitive visual representations, enabling healthcare professionals to assess disease probability and predict patient outcomes through graphical analysis [44]. In a study by Du Runsen *et al*. [45], the nomogram model was applied to 225 colorectal cancer patients, incorporating five key predictors: age ≥60 years, hematochezia, neoadjuvant chemotherapy, surgical duration, and blood transfusion. When compared with the Caprini score, this model demonstrated superior simplicity, efficiency, and precision in evaluating deep vein thrombosis (DVT) risk within 24 hours postoperatively.

3.2.7. CRC-VTE Model

The CRC-VTE model, developed from a large cohort study involving 1836 patients across 46 centers in 17 provinces of China, was designed to predict VTE risk within 30 days after colorectal cancer surgery. Seven independent risk factors were identified, including age ≥70 years, female gender, history of lower limb varicose veins, and heart failure [5]. Compared to the Caprini score, the CRC-VTE score demonstrates superior predictive performance for VTE. However, this model is currently limited to predicting VTE within 30 days post-surgery. For patients undergoing chemotherapy or other adjuvant therapies, alternative prediction models should be used. The model excludes variables such as tumor location, surgical approach, and intraoperative bleeding, which may influence VTE. Additionally, the model is primarily validated for the Chinese population and cannot be generalized to other patient groups or countries.

3.2.8. Column Chart Model

In a single-center study of 982 patients undergoing radical colorectal cancer resection, Wu *et al*. [31] employed logistic regression analysis to identify risk factors, establish a predictive model, and create a nomogram. The independent postoperative VTE risk factors included: postoperative hemoglobin < 10 g/L, postoperative D-dimer ≥ 3.5 μg/mL, BMI ≥ 25 kg/m^2, operative time ≥ 4 hours, lower extremity varicose veins, postoperative intestinal obstruction, and postoperative hypoxemia. These seven factors were used to construct a VTE risk prediction model for CRC radical resection patients, forming the CRSPOT nomogram with an AUC of 0.826, demonstrating reliable predictive capacity to identify high-risk patients early and implement anti-thrombotic strategies promptly. However, the model excluded other factors such as hyperlipidemia and Crohn's disease, and the small sample size without external validation limits its generalizability.

This article mainly summarizes the eight prediction models applied to the VTE risk of patients with colorectal cancer during the perioperative period. Among them, ABAD and KDS are commonly used for preoperative screening to deter-

mine whether patients have VTE risk. COMPASS-CAT is used for hospitalized patients with colorectal cancer. The Sir-Run-Run-Shaw VTE RAM and the nomogram are used for postoperative patients. The Nomogram model, ML, and CRC-VTE can be used within 24 hours after surgery to assess the risk of VTE occurrence within 30 days after colorectal cancer surgery. The specific contents of the models are detailed in Table 1.

Table 1. Predictive model for venous thromboembolism (VTE) risk in colorectal cancer patients during the perioperative period.

Model name (Author, year)	Country	Research type	Modeling Method	Sample capacity	Target audience	Model parameter	Classification of risks	Model prediction performance
ABAD Prediction Model (Tan, 2023) [39]	China	Single-center retrospective	logistic regression, column chart	528	Screening high-risk populations for DVT before surgery is recommended.	Age, BMI, activated partial thromboplastin time, and D-dimer level	/	AUC = 0.705
KDS Prediction Model (Shibata, 2023) [40]	Japan	Single-center retrospective	/	250	Assess preoperative DVT risk in patients with gastrointestinal cancer.	Patients with a body mass index (BMI) ≥1.5 mg/m^2, aged ≥60 years, female, on long-term glucocorticoid therapy, with cancer at high or very high risk of deep vein thrombosis (DVT), or those with prolonged immobility	Low risk (0-2), medium risk (3-4), high risk (5-7)	AUC = 0.653
COMPASS-CAT Prediction Model (Wang Wenjun, 2023) [42]	China	Single-center retrospective	logistic regression	213	Hospitalized colorectal cancer patients	Pre-existing thrombosis, central venous catheterization, 22 cardiovascular risk factors, recent hospitalization, tumor stage, chemotherapy, endocrine therapy, use of cyclines, tumor progression status, limited mobility, cancer type, D-dimer ≥0.55 mg/L	Low to medium risk (0-6 points) and high risk (≥7 points)	AUC = 0.78
Sir-Run-Run-Shaw VTE RAM (Team from Sir Run Run Shaw Hospital, affiliated with Zhejiang University School of Medicine, 2025) [43]	China	Single-center retrospective	logistic regression	541/287 (Modeling/Validation)	Patients after colorectal cancer surgery	Age ≥69 years, tumor stage, preoperative plasma D-dimer, blood transfusion	Low risk (0 points), medium risk (1 point), high risk (≥2 points)	AUC = 0.769
Machine Learning (ML) Models (Qin, 2023) [44]	China	Single-center retrospective	machine learning	1191	The risk of VTE within 30 days after surgery	lymph node metastasis, C-reactive protein, tumor grade, anemia, primary tumor location, gender, age, D-dimer, prothrombin time, tumor stage	/	Training set AUC = 0.990, validation set AUC = 0.908
Nomogram Prediction Model (Du Runsen, 2024) [45]	China	Single-center retrospective	logistic regression	225	Risk of developing deep vein thrombosis (DVT) within 24 hours after colorectal cancer surgery	Age ≥60 years, hematochezia, neoadjuvant chemotherapy, operative time, and blood transfusion	/	AUC = 0.776

Continued

CRC-VTE model (Wei, 2023) [5]	China	Multicenter prospective	logistic regression	1515/321 (Modeling/Validation)	Venous Thromboembolism (VTE) Risk Within 30 Days After Colorectal Cancer Surgery	Age ≥70 years, history of lower extremity varicose veins, heart failure, female, preoperative intestinal obstruction, preoperative bloody/tarry stools, and anesthesia duration of at least 180 minutes	Low risk (0-1), medium risk (2-3), high risk (4-5), or very high risk (≥6)	AUC = 0.71
Line Chart Model (Wu, 2023) [31]	China	Single-center retrospective	logistic regression	982	Patients after colorectal cancer surgery	Postoperative hemoglobin < 10 g/L, postoperative D-dimer ≥ 3.5 μg/mL, BMI ≥25 kg/m^2, operative time ≥4 hours, lower extremity varicose veins, postoperative intestinal obstruction, and postoperative hypoxemia	/	AUC = 0.826

4. Summary

This article reviews the factors influencing the formation of venous thromboembolism (VTE) during the perioperative period of colorectal cancer, detailing key risk factors across three phases: preoperative, intraoperative, and postoperative. Some factors remain unclear and require further validation through research. Early assessment and identification of VTE risk levels are crucial for preventing VTE development. Three commonly used tools in VTE prevention and management for colorectal cancer are the Caprini score, Khorana score, and thromboelastography, each with distinct focuses. The Caprini score is typically used for admission or preoperative evaluation to determine anticoagulation or mechanical prophylaxis. The Khorana score is suitable for pre-chemotherapy outpatient patients, featuring fewer evaluation indicators and simple operation. Thromboelastography provides reference value for assessing thrombotic risk and prognosis by detecting coagulation function, though it is rarely used alone. In recent years, risk prediction models have gained popularity. Researchers worldwide have developed VTE risk prediction models for different time points before and after colorectal cancer surgery, demonstrating higher predictive performance than scoring systems while enabling faster evaluations. However, these models still have limitations: most rely on single-center retrospective data requiring large-sample multicenter validation; and the risk factors incorporated vary across models, lacking unified standards. In conclusion, implementing appropriate scoring systems or risk prediction models for perioperative colorectal cancer patients enables early assessment. By implementing graded preventive measures, this approach effectively reduces VTE incidence, improves patient outcomes and quality of life, shortens hospital stays, lowers medical costs, and achieves personalized, precision thrombosis management.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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