

# World Journal of *Clinical Cases*

*World J Clin Cases* 2022 April 6; 10(10): 2976-3320



**REVIEW**

- 2976 Gut microbiota in gastrointestinal diseases during pregnancy  
*Liu ZZ, Sun JH, Wang WJ*
- 2990 Targeting metabolism: A potential strategy for hematological cancer therapy  
*Tang X, Chen F, Xie LC, Liu SX, Mai HR*

**MINIREVIEWS**

- 3005 Elevated intra-abdominal pressure: A review of current knowledge  
*Łagosz P, Sokolski M, Biegus J, Tycinska A, Zymlinski R*

**ORIGINAL ARTICLE****Case Control Study**

- 3014 Changes in corneal nerve morphology and function in patients with dry eyes having type 2 diabetes  
*Fang W, Lin ZX, Yang HQ, Zhao L, Liu DC, Pan ZQ*
- 3027 Combined sevoflurane-dexmedetomidine and nerve blockade on post-surgical serum oxidative stress biomarker levels in thyroid cancer patients  
*Du D, Qiao Q, Guan Z, Gao YF, Wang Q*

**Retrospective Cohort Study**

- 3035 Early warning prevention and control strategies to reduce perioperative venous thromboembolism in patients with gastrointestinal cancer  
*Lu Y, Chen FY, Cai L, Huang CX, Shen XF, Cai LQ, Li XT, Fu YY, Wei J*
- 3047 Dose-response relationship between risk factors and incidence of COVID-19 in 325 hospitalized patients: A multicenter retrospective cohort study  
*Zhao SC, Yu XQ, Lai XF, Duan R, Guo DL, Zhu Q*

**Retrospective Study**

- 3060 Preventive online and offline health management intervention in polycystic ovary syndrome  
*Liu R, Li M, Wang P, Yu M, Wang Z, Zhang GZ*
- 3069 Evidence-based intervention on postoperative fear, compliance, and self-efficacy in elderly patients with hip fracture  
*Fu Y, Zhu LJ, Li DC, Yan JL, Zhang HT, Xuan YH, Meng CL, Sun YH*
- 3078 Significance of dysplasia in bile duct resection margin in patients with extrahepatic cholangiocarcinoma: A retrospective analysis  
*Choe JW, Kim HJ, Kim JS*

- 3088** Diagnostic value and safety of medical thoracoscopy for pleural effusion of different causes

*Liu XT, Dong XL, Zhang Y, Fang P, Shi HY, Ming ZJ*

### Observational Study

- 3101** Oxaliplatin-induced neuropathy and colo-rectal cancer patient's quality of life: Practical lessons from a prospective cross-sectional, real-world study

*Prutianu I, Alexa-Stratulat T, Cristea EO, Nicolau A, Moisuc DC, Covrig AA, Ivanov K, Croitoru AE, Miron MI, Dinu MI, Ivanov AV, Marinca MV, Radu I, Gafton B*

- 3113** Breast-conserving surgery and sentinel lymph node biopsy for breast cancer and their correlation with the expression of polyligand proteoglycan-1

*Li FM, Xu DY, Xu Q, Yuan Y*

### SYSTEMATIC REVIEWS

- 3121** Clinical significance of aberrant left hepatic artery during gastrectomy: A systematic review

*Tao W, Peng D, Cheng YX, Zhang W*

### META-ANALYSIS

- 3131** Betel quid chewing and oral potential malignant disorders and the impact of smoking and drinking: A meta-analysis

*Lin HJ, Wang XL, Tian MY, Li XL, Tan HZ*

- 3143** Effects of physical exercise on the quality-of-life of patients with haematological malignancies and thrombocytopenia: A systematic review and meta-analysis

*Yang YP, Pan SJ, Qiu SL, Tung TH*

### CASE REPORT

- 3156** Primary malignant peritoneal mesothelioma mimicking tuberculous peritonitis: A case report

*Lin LC, Kuan WY, Shiu BH, Wang YT, Chao WR, Wang CC*

- 3164** Endoscopic submucosal dissection combined with adjuvant chemotherapy for early-stage neuroendocrine carcinoma of the esophagus: A case report

*Tang N, Feng Z*

- 3170** Lymph-node-first presentation of Kawasaki disease in a 12-year-old girl with cervical lymphadenitis caused by *Mycoplasma pneumoniae*: A case report

*Kim N, Choi YJ, Na JY, Oh JW*

- 3178** Tuberculosis-associated hemophagocytic lymphohistiocytosis misdiagnosed as systemic lupus erythematosus: A case report

*Chen WT, Liu ZC, Li MS, Zhou Y, Liang SJ, Yang Y*

- 3188** Migration of a Hem-o-Lok clip to the renal pelvis after laparoscopic partial nephrectomy: A case report

*Sun J, Zhao LW, Wang XL, Huang JG, Fan Y*

- 3194** Ectopic intrauterine device in the bladder causing cystolithiasis: A case report  
*Yu HT, Chen Y, Xie YP, Gan TB, Gou X*
- 3200** Giant tumor resection under ultrasound-guided nerve block in a patient with severe asthma: A case report  
*Liu Q, Zhong Q, Zhou NN, Ye L*
- 3206** Myomatous erythrocytosis syndrome: A case report  
*Shu XY, Chen N, Chen BY, Yang HX, Bi H*
- 3213** Middle thyroid vein tumor thrombus in metastatic papillary thyroid microcarcinoma: A case report and review of literature  
*Gui Y, Wang JY, Wei XD*
- 3222** Severe pneumonia and acute myocardial infarction complicated with pericarditis after percutaneous coronary intervention: A case report  
*Liu WC, Li SB, Zhang CF, Cui XH*
- 3232** IgA nephropathy treatment with traditional Chinese medicine: A case report  
*Zhang YY, Chen YL, Yi L, Gao K*
- 3241** Appendico-vesicocolonic fistula: A case report and review of literature  
*Yan H, Wu YC, Wang X, Liu YC, Zuo S, Wang PY*
- 3251** *Scedosporium apiospermum* infection of the lumbar vertebrae: A case report  
*Shi XW, Li ST, Lou JP, Xu B, Wang J, Wang X, Liu H, Li SK, Zhen P, Zhang T*
- 3261** Woman diagnosed with obsessive-compulsive disorder became delusional after childbirth: A case report  
*Lin SS, Gao JF*
- 3268** Emphysematous pyelonephritis: Six case reports and review of literature  
*Ma LP, Zhou N, Fu Y, Liu Y, Wang C, Zhao B*
- 3278** Atypical infantile-onset Pompe disease with good prognosis from mainland China: A case report  
*Zhang Y, Zhang C, Shu JB, Zhang F*
- 3284** *Mycobacterium tuberculosis* bacteremia in a human immunodeficiency virus-negative patient with liver cirrhosis: A case report  
*Lin ZZ, Chen D, Liu S, Yu JH, Liu SR, Zhu ML*
- 3291** Cervical aortic arch with aneurysm formation and an anomalous right subclavian artery and left vertebral artery: A case report  
*Wu YK, Mao Q, Zhou MT, Liu N, Yu X, Peng JC, Tao YY, Gong XQ, Yang L, Zhang XM*
- 3297** Dedifferentiated chondrosarcoma of the middle finger arising from a solitary enchondroma: A case report  
*Yonezawa H, Yamamoto N, Hayashi K, Takeuchi A, Miwa S, Igarashi K, Morinaga S, Asano Y, Saito S, Tome Y, Ikeda H, Nojima T, Tsuchiya H*

- 3306** Endoscopic-catheter-directed infusion of diluted (-)-noradrenaline for atypical hemobilia caused by liver abscess: A case report  
*Zou H, Wen Y, Pang Y, Zhang H, Zhang L, Tang LJ, Wu H*
- 3313** *Pneumocystis jiroveci* pneumonia after total hip arthroplasty in a dermatomyositis patient: A case report  
*Hong M, Zhang ZY, Sun XW, Wang WG, Zhang QD, Guo WS*

**ABOUT COVER**

Editorial Board Member of *World Journal of Clinical Cases*, Hui-Jeong Hwang, MD, PhD, Associate Professor, Department of Cardiology, Kyung Hee University Hospital at Gangdong, Kyung Hee University College of Medicine, Seoul 05278, South Korea. [neonic7749@hanmail.net](mailto:neonic7749@hanmail.net)

**AIMS AND SCOPE**

The primary aim of *World Journal of Clinical Cases* (*WJCC*, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

*WJCC* mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

**INDEXING/ABSTRACTING**

The *WJCC* is now indexed in Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports/Science Edition, Scopus, PubMed, and PubMed Central. The 2021 Edition of Journal Citation Reports® cites the 2020 impact factor (IF) for *WJCC* as 1.337; IF without journal self cites: 1.301; 5-year IF: 1.742; Journal Citation Indicator: 0.33; Ranking: 119 among 169 journals in medicine, general and internal; and Quartile category: Q3. The *WJCC*'s CiteScore for 2020 is 0.8 and Scopus CiteScore rank 2020: General Medicine is 493/793.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: *Xu Guo*; Production Department Director: *Xiang Li*; Editorial Office Director: *Jin-Lei Wang*.

**NAME OF JOURNAL**

*World Journal of Clinical Cases*

**ISSN**

ISSN 2307-8960 (online)

**LAUNCH DATE**

April 16, 2013

**FREQUENCY**

Thrice Monthly

**EDITORS-IN-CHIEF**

Bao-Gan Peng, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati, Ja Hyeon Ku

**EDITORIAL BOARD MEMBERS**

<https://www.wjgnet.com/2307-8960/editorialboard.htm>

**PUBLICATION DATE**

April 6, 2022

**COPYRIGHT**

© 2022 Baishideng Publishing Group Inc

**INSTRUCTIONS TO AUTHORS**

<https://www.wjgnet.com/bpg/gerinfo/204>

**GUIDELINES FOR ETHICS DOCUMENTS**

<https://www.wjgnet.com/bpg/GerInfo/287>

**GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH**

<https://www.wjgnet.com/bpg/gerinfo/240>

**PUBLICATION ETHICS**

<https://www.wjgnet.com/bpg/GerInfo/288>

**PUBLICATION MISCONDUCT**

<https://www.wjgnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjgnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjgnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>

## Retrospective Cohort Study

# Early warning prevention and control strategies to reduce perioperative venous thromboembolism in patients with gastrointestinal cancer

Yun Lu, Feng-Ying Chen, Lan Cai, Chun-Xia Huang, Xue-Fang Shen, Li-Qin Cai, Xiao-Ting Li, Yong-Yan Fu, Juan Wei

**Specialty type:** Gastroenterology and hepatology

**Provenance and peer review:** Unsolicited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review report's scientific quality classification**

Grade A (Excellent): 0  
Grade B (Very good): B  
Grade C (Good): 0  
Grade D (Fair): 0  
Grade E (Poor): 0

**P-Reviewer:** Serban ED

**Received:** September 3, 2021

**Peer-review started:** September 3, 2021

**First decision:** December 1, 2021

**Revised:** December 23, 2021

**Accepted:** February 20, 2022

**Article in press:** February 20, 2022

**Published online:** April 6, 2022



**Yun Lu, Xue-Fang Shen, Juan Wei**, The Fifth Ward of Surgery, Kunshan Hospital of Traditional Chinese Medicine, Kunshan 215300, Jiangsu Province, China

**Feng-Ying Chen, Lan Cai, Chun-Xia Huang, Xiao-Ting Li, Yong-Yan Fu**, Department of Nursing, Traditional Chinese Medicine Hospital of Kunshan, Kunshan 215300, Jiangsu Province, China

**Li-Qin Cai**, The Fourth Ward of Surgery, Traditional Chinese Medicine Hospital of Kunshan, Kunshan 215300, Jiangsu Province, China

**Corresponding author:** Xue-Fang Shen, MBBS, Doctor, The Fifth Ward of Surgery, Kunshan Hospital of Traditional Chinese Medicine, No. 189 Chaoyang Road, Kunshan 215300, Jiangsu Province, China. [13913262392@163.com](mailto:13913262392@163.com)

## Abstract

### BACKGROUND

Venous thromboembolism (VTE) is a major cause of unexpected and perioperative in-hospital deaths. It is characterized by high morbidity, high mortality, high misdiagnosis rate, and high missed diagnosis rates. VTE is a common postoperative complication in cancer patients. VTE is preventable, and early identification of risk factors leading to VTE and appropriate early preventive actions can reduce its occurrence and mortality. Presently, there is no uniform standard for the prevention and control of VTE in clinical practice, and hospitals in China lack mature and effective protocols for the assessment, prevention, and treatment of VTE.

### AIM

To explore whether an early warning program could influence the occurrence of deep vein thrombosis (DVT) postoperatively.

### METHODS

This is a comparative retrospective cohort study, which enrolled patients who underwent laparotomic or laparoscopic gastrointestinal tumor resection for gastrointestinal cancer between January 2016 and December 2019. Patients were divided into a control group and an early warning group depending on whether or not the early warning program was implemented. A venous thromboembolism

prevention and control team was established. The outcomes included the occurrence of DVT, the correct rate of VTE assessment, the coagulation indicators, and the mastery of VTE knowledge by the nurses.

## RESULTS

A total of 264 patients were included in this study, with 128 patients in the control group and 136 patients in the early warning group. The occurrence rate of DVT in the early warning group was 6.6% (9/136), compared with 14.1% (18/128) in the control group ( $P < 0.05$ ). The correct rates of VTE risk assessment by the nurses and standard implementation rate of VTE preventive measures were 86.8% *vs* 65.6% and 80.2% *vs* 57.8% in early warning and control groups, respectively (all  $P < 0.001$ ). The independent factors associated with postoperative DVT occurrence were age (OR = 1.083, 95%CI: 1.070-3.265,  $P = 0.032$ ), Hyperlipidemia (OR = 1.127, 95%CI: 1.139-2.564,  $P = 0.042$ ), preoperative high VTE risk (OR = 2.131, 95%CI: 1.085-5.178,  $P = 0.001$ ), time of operation (OR = 2.268, 95%CI: 2.005-5.546,  $P = 0.026$ ) and not adoption of early warning prevention (OR = 3.747, 95%CI: 1.523-6.956,  $P = 0.017$ ).

## CONCLUSION

The early warning strategy was independently associated with the decreasing occurrence of VTE, and it might be suitable for protection from VTE in patients undergoing gastrointestinal cancer surgery.

**Key Words:** Venous thromboembolism; Gastrointestinal cancer; Perioperative period; Early warning; Prevention and control

©The Author(s) 2022. Published by Baishideng Publishing Group Inc. All rights reserved.

**Core Tip:** Presently, there is no uniform standard for the prevention and control of venous thromboembolism (VTE) in clinical practice, and hospitals in China lack mature and effective protocols for the assessment, prevention, and treatment of VTE. An early warning strategy was independently associated with the decreasing occurrence of VTE, and it might be suitable for protection from VTE in patients undergoing gastrointestinal cancer surgery.

**Citation:** Lu Y, Chen FY, Cai L, Huang CX, Shen XF, Cai LQ, Li XT, Fu YY, Wei J. Early warning prevention and control strategies to reduce perioperative venous thromboembolism in patients with gastrointestinal cancer. *World J Clin Cases* 2022; 10(10): 3035-3046

**URL:** <https://www.wjgnet.com/2307-8960/full/v10/i10/3035.htm>

**DOI:** <https://dx.doi.org/10.12998/wjcc.v10.i10.3035>

## INTRODUCTION

Venous thromboembolism (VTE) includes deep vein thrombosis and pulmonary thromboembolism[1]. It refers to a thrombus in a vein, making blood vessels completely or incompletely obstructed, leading to venous reflux disorder[2]. VTE is one of the major causes of unexpected and perioperative in-hospital deaths, and is characterized by high morbidity, high mortality, high misdiagnosis rate, and high missed diagnosis rates[3].

VTE is the third most common vascular disease after coronary syndrome and stroke. Patients with malignant tumors have a 4-7 times higher risk of VTE compared to healthy individuals [4]. Such patients can have a VTE incidence as high as 15%-20% [5]. Surgical treatment is the first choice of treatment for cancers, but the surgical trauma itself also increases the incidence of VTE in patients[6,7], and lower limb DVT incidence can be as high as 10%-40% when no prophylaxis is given[8]. VTE occurrence in patients with cancer can increase the treatment costs, mortality, and lead to a material and spiritual burden for both cancer patients as well as their families, and often leads to medical disputes[6, 7,9].

VTE is a preventable disease. The early identification of risk factors leading to VTE and appropriate early preventive actions can reduce the occurrence and mortality of VTE[10]. Although consensus and guidelines for the prevention and treatment of VTE have recently been introduced in various countries [11-17], recognizing the early warning signs and taking effective preventive actions remain essential. Presently, there is no uniform standard for the prevention and control of VTE in clinical practice, and hospitals in China lack mature and effective protocols for the assessment, prevention, and treatment of VTE.

Therefore, the present study explored whether the integration of early warning prevention strategies could reduce the occurrence of VTE in patients with gastrointestinal cancer during the perioperative period. The results of this study might provide clues into changes in hospital policies and hold potential to improve the outcomes of gastrointestinal cancer patients undergoing surgery.

## MATERIALS AND METHODS

### Patients

This was a retrospective comparative cohort study of patients who underwent gastrointestinal surgery for a gastrointestinal cancer at Kunshan Hospital of Traditional Chinese Medicine, China, between January 2016 and December 2019. The surgical oncology department of this hospital has 160 beds, and about 150 patients with gastrointestinal cancer are treated each year. This study was approved by the Medical Ethics Committee of our hospital (#2017063). Written informed consent was obtained from the patients. This study was registered at the China Clinical Trial Registry (registration number: ChiCTR2100044555).

The inclusion criteria were as follows: (1) Patients  $\geq$  18 years of age; (2) Those who underwent laparotomic or laparoscopic gastrointestinal tumor resection under general anesthesia; (3) Patients with complete data, including pathological or cytological diagnosis of malignant tumor; (4) TNM stages I-III; (5) No history of anticoagulation therapy during the 3 mo before surgery; (6) No neoadjuvant chemoradiotherapy; and (7) Patients had the ability to communicate normally.

The exclusion criteria were as follows: (1) Patients with cardiopulmonary diseases or nerve, muscle, or joint diseases, or any condition that affected mobility; (2) Mental illness or severe cognitive disorders or defects in language expression; (3) Postoperative cardiac, cerebrovascular, or other severe complications; (4) VTE before surgery; (5) Contraindications to drugs or physical VTE prevention; (6) Patients who were using heparin, low-molecular-weight heparin, or oral anticoagulants; (7) Patients who were discharged from hospital after surgery against medical advice or were lost to follow-up; or (8) Were transferred to a local hospital for additional treatments after surgery.

### Grouping

An early warning and management strategy was devised on the basis of extant knowledge of cancer-associated VTE[16]. During the study period, patients who had matched the eligibility criteria were placed either into an early warning group or a control group depending on the time of their surgery. The control group included patients who underwent surgery before the program was implemented between January 2016 and December 2017, while the early warning group included patients who underwent surgery after the program was implemented, *i.e.*, between January 2018 and November 2019.

### Control group

The patients in the control group were evaluated using the Caprini thrombus risk factor assessment form[18] to assess VTE risk during hospitalization. The nurses routinely used a paper scoring form to report the results. The doctor reviewed and issued their orders. VTE risk was divided into three levels, namely, low (0-2 points), moderate (3-4 points), and high ( $\geq$  5 points). Preventive actions were undertaken on the basis of the result of the risk assessment. Patients who were found to be at low risk underwent dietary guidance, lower limb elevation, ankle pump exercise, early mobilization, and the use of gradient compression stockings and intermittent inflation pressure devices. Patients who were found to be at moderate risk were given physical prevention and anticoagulants. Those with bleeding risk were given physical prevention as the first choice. Patients who were found to be at high or extremely high risk were given anticoagulants and physical prevention.

### Early warning group

Integrated strategies for VTE early warning prevention and control were adopted for the early warning group. We established a multimode information system for early VTE prevention, and standardized the procedures used in the implementation of VTE prevention and control.

A VTE prevention and control team was established. The deputy chief of the department was designated the team leader, and the medical director was the deputy team leader. The medical, nursing, clinical, pharmacy, and ultrasound departments each had two key members on the team. All the members on the team had senior deputy titles or above. The team included a VTE quality monitoring group and a VTE prevention and control multidisciplinary cooperation group. All the team members had at least 5 years of professional experience and had received the latest VTE-related knowledge training. The team developed a perioperative VTE prevention and control system on the basis of VTE-related guidelines and related research along with taking into account the actual situation encountered in the hospital.

This team also developed training content of the risk assessment prediction and strategies for the prevention and management of VTE and decided on the training frequency. Risk prediction model

updates and multiple training methods were adopted, using a variety of media such as video, WeChat, lectures, and ward rounds. Nurses at different levels were trained using different training methods according to a previous study[19]. Younger nurses received collective training and video education for VTE prevention and control training. Senior nurses used the discussion after the morning rounds to assess their knowledge, and targeted supplementary education was provided when necessary. The department conducted teaching rounds, and case discussions on VTE in patients with gastrointestinal tumors were conducted to analyze the shortcomings of VTE prevention and control measures in the department and how to make corrections. Team members from the nursing department organized and produced VTE-related videos and a manual. Contents of the video included ankle pump exercise, early mobilization activities, clexane injection, and air pump treatment. The manual included the causes, symptoms, prevention, and nursing responsibilities associated with VTE.

VTE risk was scored within 24 h of admission, within 6 h after surgery, at first mobilization, and at any change in condition. The Caprini thrombus risk factor assessment form was used for risk assessment [18]. This form was incorporated into the hospital medical record system. The items were entered into the system electronically. The primary nurse conducted the Caprini scoring and selected the corresponding indicators. Scores and grades were automatically provided by the system and reviewed by the attending physician to determine the final scores. A card containing the warning signs was placed at the bedside of all the patients who were identified as high risk. Patients undergoing drug prophylaxis for VTE underwent risk assessment of bleeding and other factors that might affect prevention[2]. When the Caprini score of the patients reached high risk, notes were marked on a blackboard at the nurses' station to ensure the implementation of the prevention and control measures of VTE by the clinical nurses and to raise their risk awareness of VTE.

The VTE prevention and control guidelines for surgical patients were regularly reviewed. The physical and drug prophylaxis methods, including thrombus risk assessment, ankle pump exercise, gradient compression stockings, intermittent inflatable pressure devices, early mobilization, clexane injections, and bleeding assessment, were the same as for the control group according to the risk level. Health education materials were made from patients' perspective, including the causes and risks of VTE during gastrointestinal surgery, the impact of VTE on postoperative rehabilitation, the advantages and effects of VTE prevention and control, and how to manage postsurgical abdominal incision pain during rehabilitation. The desired surgical effect of the program on the patient was evaluated, the factors affecting the patient's adherence to exercise were examined, and the effect of drugs on bleeding risk was evaluated. Measures for VTE prevention were formulated into a target entry form using the goal achievement theory, and it covered the entire perioperative period and the follow-up after patient discharge. The primary nurse completed the VTE prevention and control form daily. VTE quality control standards were established. Responsible nurses conducted random spot checks every week, and the supervisor of nursing care conducted random spot checks every month.

### Outcomes

The outcomes included the occurrence of DVT, the correct rate of VTE assessment, the coagulation indicators, and the mastery of VTE knowledge by the nurses.

As VTE most commonly occurs on day 3 after surgery, color Doppler examinations of the lower limbs were performed before surgery and on days 1, 3, and 7 after the surgery. The color Doppler examinations were performed by one of five radiologists, including two attending radiologists and three deputy chief radiologists with at least 6 years of lower limb venous thrombosis screening experience, according to the work schedule. The same LogiqE9 color Doppler ultrasound diagnostic apparatus (GE Healthcare, Waukesha, WI, United States) was used. The external iliac vein, popliteal vein, deep femoral vein, posterior tibial vein, calf muscle veins, and other lower limb veins were examined. According to the diagnostic standard of DVT[1,20], the occurrence rate was defined as the number of cases of lower limb DVT divided by the total number of cases in this group.

Re-evaluation times and preventive measures of VTE among patients were checked by consulting the nursing record sheet. Combined with information from medical records, the Caprini score assessment was rechecked. The rate of correct Caprini score assessment was the number of correctly evaluated cases divided by the total number of cases  $\times 100\%$ . The standard implementation rate of VTE preventive measures was the number of cases with correct VTE prevention divided by the total number of cases  $\times 100\%$ .

The coagulation indicators included plasma d-dimer, prothrombin time (PT), activated partial thromboplastin time (APTT), and fibrinogen degradation products. These indicators were measured in blood samples obtained on the mornings of days 1, 3, and 7 after the operation. The blood samples were tested within 3 h, and all tests were completed by the hospital's central laboratory.

A self-designed VTE knowledge survey questionnaire was designed for the nurses. Fifteen nurses were surveyed before the training. The issues that occurred during the survey were discussed with experts, and the results were then used to revise and improve the questionnaire. The overall Cronbach's  $\alpha$  coefficient of the questionnaire was 0.84 and the content validity index was 0.92. The questionnaire covered three dimensions, namely, basic knowledge of VTE, VTE risk assessment, and VTE prevention, with a total of 45 mixed questions. There were 30 points for each dimension, with a total score of 90 points. As part of the implementation process of the early warning program, 2-3 nurses, senior nurses,

supervisor nurses, and deputy chief nurses were selected using a randomization system from each surgical ward to participate in the questionnaire survey before and at 6 mo after training. The questionnaires were dispatched and retrieved on-site, and the respondents completed the questionnaires independently within 30 min.

### Data collection

All the data were extracted from the medical charts and from the documentation of the implementation of the early warning program.

### Statistical analysis

SPSS 22.0 (IBM, Armonk, NY, United States) was used for data analysis. Categorical data were expressed as frequencies and percentages and analyzed using the chi-square test. Continuous data were expressed as means  $\pm$  SD and analyzed using the Student's *t* test. Univariate and multivariate logistic regression analyses were used to explore the associated factors with the occurrence of postoperative DVT. The variates that  $P < 0.05$  in univariate analysis were included in the multivariable analysis with stepwise method.  $P$  values  $< 0.05$  were considered statistically significant.

## RESULTS

### Patient characteristics

A total of 264 patients were included in the study with 128 patients in control group and 136 patients in early warning group. There were no significant differences in the age, sex, education levels, marital status, disease diagnosis, tumor staging, surgical method, VTE risk classification, comorbidities, and postoperative bedtime between the two groups (all  $P > 0.05$ ; [Table 1](#)).

### Occurrence of DVT

The occurrence rate of DVT was 6.6% and 14.1% in the early warning group and control group, respectively ( $P < 0.05$ ). The correct rates of VTE risk assessment by the nurses were 65.6% and 86.8% ( $P < 0.001$ ), at same time standard implementation rate of VTE preventive measures were 57.8% and 80.2% ( $P < 0.001$ ) in control and early warning groups, respectively ([Table 2](#)).

### Coagulation indicators

The d-dimer levels were lower in the early warning group than in the control group at 7 d ( $1.52 \pm 1.03$  vs  $2.75 \pm 1.82$   $\mu\text{g/mL}$ ,  $P < 0.001$ ). The levels of fibrinogen degradation products were lower in the early warning group than in controls on day 3 ( $5.62 \pm 2.11$  vs  $7.69 \pm 2.27$ ,  $P < 0.001$ ) and day 7 ( $4.38 \pm 3.04$  vs  $8.16 \pm 4.26$ ,  $P < 0.001$ ). There were no differences in the PT and APTT between the two groups (all  $P > 0.05$ ; [Table 3](#)).

### Independent associated factors with the occurrence of postoperative DVT

After adjusted hypertension, age (OR = 1.083, 95%CI: 1.070-3.265,  $P = 0.032$ ), hyperlipidemia (OR = 1.127, 95%CI: 1.139-2.564,  $P = 0.042$ ), preoperative high VTE risk (OR = 2.131, 95%CI: 1.085-5.178,  $P = 0.001$ ), time of operation (OR = 2.268, 95%CI: 2.005-5.546,  $P = 0.026$ ) and not adoption of early warning prevention (OR = 3.747, 95%CI: 1.523-6.956,  $P = 0.017$ ) were independently associated with the occurrence of postoperative DVT of patients with gastrointestinal cancer ([Table 4](#)).

### Mastery of VTE-related knowledge by the nurses

The basic knowledge of VTE, VTE risk assessment, VTE prevention scores, and total score were increased after implementation (all  $P < 0.001$ ; [Table 5](#)).

## DISCUSSION

VTE is a common postoperative complication in patients with cancer[5-7]. Early identification of the risk factors leading to VTE and active early preventive actions can reduce its occurrence. Therefore, this study aimed to evaluate the effects of early warning prevention and control strategies for perioperative VTE in patients undergoing surgery for gastrointestinal cancer. The results of our study suggest that an early warning strategy reduced the occurrence of VTE and improved the application of the appropriate methods against VTE in patients who underwent surgery for gastrointestinal cancer.

Under normal physiological conditions, the coagulation and fibrinolytic systems are mutually restrained and balanced to maintain blood flow. "Hypercoagulability of blood, stasis of venous blood flow, and damage to vascular endothelial cells" are the basis of thrombosis[21]. VTE has been shown to have a significantly higher rate of occurrence in patients with malignant tumors than in patients without

**Table 1** Characteristics of the patients in two groups

Item	Control (n = 128)	Early warning (n = 136)	P value
Sex, n (%)			
Male	72 (56.3)	69 (50.7)	0.369
Female	56 (43.8)	67 (49.3)	
Age (years), mean ± SD	65.9 ± 11.3	63.4 ± 12.7	0.096
BMI (kg/m <sup>2</sup> ), mean ± SD	21.6 ± 3.3	22.3 ± 4.2	0.108
Education, n (%)			0.263
Junior middle school and below	36 (28.1)	41 (30.2)	
Senior high school and technical secondary school	59 (40.1)	50 (36.8)	
Junior college and undergraduate and above	33 (25.8)	45 (33.1)	
Marital status, n (%)			0.736
Living with a spouse	86 (67.2)	94 (66.9)	
Unmarried, widowed or divorced	42 (32.8)	42 (30.9)	
Hypertension, n (%)	23 (17.9)	19 (14.0)	0.375
Diabetes, n (%)	18 (14.1)	24 (17.6)	0.402
Hyperlipemia, n (%)	15 (11.7)	18 (13.2)	0.710
Preoperative VTE risk classification, n (%)			0.488
Moderate risk	52 (40.6)	61 (44.9)	
High risk	76 (59.4)	75 (55.2)	
TNM, n (%)			0.928
I	34 (26.6)	39 (28.7)	
II	51 (39.9)	53 (39.0)	
III	43 (33.6)	44 (32.4)	
Surgical method, n (%)			0.524
Radical resection of gastric cancer	68 (53.1)	70 (51.5)	
Radical resection of rectal cancer	42 (32.8)	40 (29.4)	
Radical resection of colon cancer	18 (14.1)	26 (19.12)	
Operation time (min), mean ± SD	118.5 ± 45.7	121.8 ± 51.9	0.247
Intraoperative blood loss (mL), mean ± SD	85.3 ± 21.6	89.7 ± 23.6	0.076
Length of hospital stay (day), mean ± SD	15.27 ± 2.68	14.69 ± 2.35	0.062

SD: Standard deviation; VTE: Venous thromboembolism; BMI: Body mass index.

cancer due to cancer-related hypercoagulability, gene mutation, and anti-tumor treatments[22,23]. The trauma of surgery itself can cause an increase in the release of tissue factors, consequently activating of the endogenous coagulation pathways and inhibition of the fibrinolytic system, resulting in local blood coagulation and the occurrence of DVT. In addition to these factors, as patients are bedridden after the operation, the slow venous blood flow in the lower limbs further contributes to the high risk of postoperative thrombosis in cancer patients[22,23]. Therefore, it is crucial to establish a comprehensive prevention and management system for VTE in cancer patients.

Previous studies have stated that in the cancer population, VTE can occur in three different settings: hospitalized cancer patients, surgery and the extended postsurgical period, and outpatient chemotherapy. It is well-documented that patients undergoing cancer surgery are at very high risk of VTE[24]. Therefore, it is vital to understand the VTE risk in specific cancer patient groups and settings so that staff and patients can adopt and implement effective prophylactic measures and consequently

**Table 2 Comparison of deep vein thrombosis occurrence rate, venous thromboembolism risk assessment rate by nurses, and implementation rate of VTE preventive measures between the two groups**

	Control (n = 128)	Early warning (n = 136)	P value
Occurrence of DVT, n (%)	18 (14.1)	9 (6.6)	0.046
Correct rates of VTE risk assessment of nurse evaluation, n (%)	84 (65.6)	118 (86.8)	< 0.001
Standard implementation rate of VTE preventive measures of patients, n (%)	74 (57.8)	109 (80.2)	< 0.001

DVT: Deep vein thrombosis; VTE: Venous thromboembolism.

**Table 3 Comparison of coagulation indicators between two groups at different points in time**

	Control (n = 128)	Early warning (n = 136)	P value
d-dimer (μg/mL), mean ± SD			
Before	0.46 ± 0.20	0.44 ± 0.24	0.473
1 d	1.86 ± 0.96	2.04 ± 1.27	0.197
3 d	3.27 ± 1.85	2.68 ± 1.74	0.008
7 d	2.75 ± 1.82	1.52 ± 1.03	0.000
Prothrombin time (s), mean ± SD			
Before	11.3 ± 1.4	11.1 ± 1.0	0.061
1 d	11.5 ± 1.1	11.3 ± 1.2	0.359
3 d	11.7 ± 1.0	11.5 ± 0.9	0.057
7 d	11.2 ± 1.2	11.3 ± 1.0	0.648
Fibrinogen degradation product, mean ± SD			
Before	2.54 ± 1.52	2.67 ± 1.36	0.464
1 d	7.26 ± 3.21	6.82 ± 3.29	0.273
3 d	7.69 ± 2.27	5.62 ± 2.11	0.000
7 d	8.16 ± 4.26	4.38 ± 3.04	0.000
Activated partial thromboplastin time (s), mean ± SD			
Before	33.1 ± 6.4	32.2 ± 5.7	0.242
1 d	35.6 ± 7.3	35.7 ± 6.6	0.925
3 d	34.6 ± 6.6	32.8 ± 7.3	0.523
7 d	62.3 ± 6.3	32.3 ± 6.6	0.247

SD: Standard deviation.

reduce the rate of VTE occurrence. The National Comprehensive Cancer Network (NCCN) clinical practice guidelines in oncology state that high-risk abdominal/pelvic cancer surgery patients include patients undergoing surgery for gastrointestinal cancer, those with previous history of VTE, those who were under anesthesia for ≥ 2 h, with a bed rest of > 4 d, those with advanced stage disease, and those who are > 60 years of age[25]. Therefore, the results of this study make an important contribution towards reducing the VTE risk in these vulnerable gastrointestinal cancer patients.

This study strongly suggests that implementing an evidence-based prevention management system, formulating standardized VTE prevention procedures, combining information systems, performing early VTE screening, and implementing standardized graded interventions could effectively reduce the occurrence rate of VTE in patients operated for gastrointestinal cancer. The program implemented in the current study included hospital-level VTE prevention and control teams; improved VTE early warning prevention; an improved knowledge of control in the hospital; multimode training methods including centralized training, case discussions, and video teaching. After implementing all these aspects, the

**Table 4 Univariate and Multivariate logistic regression analysis of the occurrence of postoperative deep vein thrombosis of patients with gastrointestinal cancer**

	DVT Group (n = 27)	Non-DVT Group (n = 237)	Univariate			Multivariate		
			OR	95%CI	P value	OR	95%CI	P value
Age	70.81 ± 7.95	60.17 ± 8.36	1.03	1.04-1.35	0.026	1.083	1.070-3.265	0.032
Gender								
Male	16 (59.26)	125 (52.74)	1					
Female	11 (40.74)	112 (47.26)	1.30	0.58-2.93	0.52			
BMI	22.56 ± 1.92	21.83 ± 2.51	1.09	0.96-1.23	0.145			
Education background								
Junior secondary and below	5 (18.52)	72 (30.38)	1					
Above junior secondary	22 (81.48)	165 (69.62)	0.52	0.19-1.43	0.371			
Marital status								
Having a spouse	17 (62.96)	163 (68.78)	1					
Unmarried, widowed, or divorced	10 (37.04)	74 (31.22)	0.77	0.33-1.76	0.539			
Hypertension, no	17 (62.96)	205 (84.50)	3.77	1.58-8.95	0.002			
Diabetes, no	22 (81.48)	200 (84.39)	1.23	0.43-3.45	0.78			
Hyperlipidemia, yes	8 (29.63)	25 (10.55)	3.57	1.41-8.99	0.005	1.127	1.139-2.564	0.042
TNM								
I, II	6 (22.22)	67 (28.27)	1					
III	12 (44.45)	75 (31.65)	0.56	0.25-1.26	0.18			
Surgery method								
Radical gastrectomy	13 (48.15)	125 (52.74)	1					
Radical resection of colorectal cancer	9 (33.33)	73 (30.80)	0.832	0.37-1.81	0.651			
Preoperative VTE risk grade								
Medium-risk	6 (22.22)	107 (45.15)	1					
High risk	21 (77.78)	130 (54.85)	1.12	0.13-0.89	0.023	2.131	1.085-5.178	0.001
Time of operation (min)	128.4 ± 29.47	112.2 ± 35.76	1.07	1.13-1.37	0.024	2.268	2.005-5.546	0.026
Intraoperative bleeding volume (mL)	91.46 ± 17.38	85.25 ± 20.26	1.06	0.48-1.26	0.127			
Adoption of early warning prevention, no	18 (66.67)	110 (46.41)	1.28	0.18-1.0	0.046	3.747	1.523-6.956	0.017

OR: Odds ratio; CI: Confidence interval; DVT: Deep vein thrombosis; BMI: Body mass index; VTE: Venous thromboembolism; BMI: Body mass index.

VTE-related knowledge of the nurses increased. Additionally, standardizing the VTE early warning prevention and control procedures for surgical patients, doctors, and nurses led to improved compliance of the patients and nurses and decreased the occurrence rate of VTE. Establishing VTE quality control standards and procedures and continuously conducting quality supervision can ensure the effective implementation of VTE early warning prevention and control strategies[26]. We recommend that in patients who undergo surgery for gastrointestinal cancer, long-term prophylaxis should be carried out by regular monitoring in the postoperative period after discharge from the hospital.

With the renewal of the concepts of clinically relevant personnel and research on VTE, VTE management has begun to receive increasing attention in China[27]. Multidisciplinary teams for VTE prevention and treatment have been established across major medical centers globally, and VTE prevention and control practices has been gradually introduced in these centers[28-30]. Nevertheless, no relevant guidelines or studies are available for gastrointestinal tumors. This study was based on the application of guidelines for VTE prevention, standardized the criteria of VTE prevention, and

**Table 5 Comparison of venous thromboembolism knowledge in nurses before and after implementation**

	Before implementation (n = 86)	After implementation (n = 86)	P value
VTE basic knowledge, mean ± SD	20.0 ± 3.7	23.6 ± 4.3	< 0.001
VTE evaluation knowledge, mean ± SD	18.2 ± 4.0	23.4 ± 4.2	< 0.001
VTE prevention knowledge, mean ± SD	22.3 ± 3.4	25.4 ± 2.5	< 0.001
Total score, mean ± SD	62.4 ± 10.1	71.3 ± 11.4	< 0.001

SD: Standard deviation; VTE: Venous thromboembolism.

establishing a more scientific and objective system for the monitoring of VTE preventive nursing quality for patients with gastrointestinal cancer.

## CONCLUSION

An early warning strategy might reduce the occurrence of VTE and improve the application of the appropriate methods against VTE in patients who undergo surgery for gastrointestinal cancer. The results provide clues that can be used to implement changes in hospital policies to improve the outcomes of patients with cancer.

## ARTICLE HIGHLIGHTS

### Research background

Venous thromboembolism (VTE) is a major cause of unexpected and perioperative in-hospital deaths. It is characterized by high morbidity, high mortality, high misdiagnosis rate, and high missed diagnosis rates. Presently, there is no uniform standard for the prevention and control of VTE in clinical practice, and hospitals in China lack mature and effective protocols for the assessment, prevention, and treatment of VTE.

### Research motivation

Early identification of the risk factors leading to VTE and active early preventive actions can reduce its occurrence. This study aimed to evaluate the effects of early warning prevention and control strategies for perioperative VTE in patients undergoing surgery for gastrointestinal cancer.

### Research objectives

This study aimed to explore whether an early warning program could influence the occurrence of deep vein thrombosis (DVT) postoperatively.

### Research methods

This is a comparative retrospective cohort study, which enrolled patients who underwent laparotomic or laparoscopic gastrointestinal tumor resection for gastrointestinal cancer between January 2016 and December 2019. Patients were divided into a control group and an early warning group depending on whether or not the early warning program was implemented. A venous thromboembolism prevention and control team was established. The outcomes included the occurrence of DVT, the correct rate of VTE assessment, the coagulation indicators, and the mastery of VTE knowledge by the nurses.

### Research results

A total of 264 patients were included in this study, with 128 patients in the control group and 136 patients in the early warning group. The occurrence rate of DVT in the early warning group was 6.6% (9/136), compared with 14.1% (18/128) in the control group ( $P < 0.05$ ). The correct rates of VTE risk assessment by the nurses and standard implementation rate of VTE preventive measures were 86.8% *vs* 65.6% and 80.2% *vs* 57.8% in early warning and control groups, respectively (all  $P < 0.001$ ). The independent factors associated with postoperative DVT occurrence were age (OR = 1.083, 95%CI: 1.070-3.265,  $P = 0.032$ ), Hyperlipidemia (OR = 1.127, 95%CI: 1.139-2.564,  $P = 0.042$ ), preoperative high VTE risk (OR = 2.131, 95%CI: 1.085-5.178,  $P = 0.001$ ), time of operation (OR = 2.268, 95%CI: 2.005-5.546,  $P = 0.026$ ) and not adoption of early warning prevention (OR = 3.747, 95%CI: 1.523-6.956,  $P = 0.017$ ).

### Research conclusions

The early warning strategy was independently associated with the decreasing occurrence of VTE, and it might be suitable for protection from VTE in patients undergoing gastrointestinal cancer surgery.

### Research perspectives

Subsequent studies should include the group unit to further validate the results of the present research.

---

## ACKNOWLEDGEMENTS

The authors are grateful to Jin Qing, Chief Physician of the Ultrasound Department, Kunshan Hospital of Traditional Chinese Medicine, China.

---

## FOOTNOTES

**Author contributions:** Lu Y and Chen FY and Shen XF carried out the studies, participated in collecting data, and drafted the manuscript; Li XT and Cai LQ and Fu YY performed the statistical analysis and critically for important intellectual content; Huang CX, Li XT, and Lu Y participated in acquisition, analysis, or interpretation of data and drafted the manuscript; All authors read and approved the final manuscript.

**Institutional review board statement:** This study was approved by the Medical Ethics Committee of Kunshan Traditional Chinese Medicine Hospital of Jiangsu Province Affiliated to Nanjing University of Traditional Chinese Medicine (#2017063).

**Informed consent statement:** All study participants or their legal guardian provided informed written consent about personal and medical data collection prior to study enrolment.

**Conflict-of-interest statement:** All the Authors have no conflict of interest related to the manuscript.

**Data sharing statement:** This study was registered at the China Clinical Trial Registry (registration number: ChiCTR2100044555).

**STROBE statement:** The authors have read the STROBE Statement – checklist of items, and the manuscript was prepared and revised according to the STROBE Statement – checklist of items.

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

**Country/Territory of origin:** China

**ORCID number:** Yun Lu 0000-0003-0478-1396; Feng-Ying Chen 0000-0002-9446-3908; Lan Cai 0000-0002-1175-1040; Chun-Xia Huang 0000-0003-3085-6574; Xue-Fang Shen 0000-0003-4474-1356; Li-Qin Cai 0000-0003-3177-4108; Xiao-Ting Li 0000-0002-0293-0936; Yong-Yan Fu 0000-0002-9739-4661; Juan Wei 0000-0001-7003-3957.

**S-Editor:** Liu JH

**L-Editor:** A

**P-Editor:** Liu JH

---

## REFERENCES

- 1 Di Nisio M, van Es N, Büller HR. Deep vein thrombosis and pulmonary embolism. *Lancet* 2016; **388**: 3060-3073 [PMID: 27375038 DOI: 10.1016/S0140-6736(16)30514-1]
- 2 Kearon C, Akl EA, Ornelas J, Blaivas A, Jimenez D, Bounameaux H, Huisman M, King CS, Morris TA, Sood N, Stevens SM, Vintch JRE, Wells P, Woller SC, Moores L. Antithrombotic Therapy for VTE Disease: CHEST Guideline and Expert Panel Report. *Chest* 2016; **149**: 315-352 [PMID: 26867832 DOI: 10.1016/j.chest.2015.11.026]
- 3 Elisha S, Heiner J, Nagelhout J, Gabot M. Venous Thromboembolism: New Concepts in Perioperative Management. *AANA J* 2015; **83**: 211-221 [PMID: 26137764]
- 4 Khorana AA, Francis CW, Culakova E, Kuderer NM, Lyman GH. Thromboembolism is a leading cause of death in cancer patients receiving outpatient chemotherapy. *J Thromb Haemost* 2007; **5**: 632-634 [PMID: 17319909 DOI: 10.1111/j.1538-7836.2007.02374.x]

- 5 **Lee AY**, Levine MN. Venous thromboembolism and cancer: risks and outcomes. *Circulation* 2003; **107**: 117-121 [PMID: 12814981 DOI: 10.1161/01.CIR.0000078466.72504.AC]
- 6 **Easaw JC**, Shea-Budgell MA, Wu CM, Czaykowski PM, Kassis J, Kuehl B, Lim HJ, MacNeil M, Martinusen D, McFarlane PA, Meek E, Moodley O, Shivakumar S, Tagalakis V, Welch S, Kavan P. Canadian consensus recommendations on the management of venous thromboembolism in patients with cancer. Part 2: treatment. *Curr Oncol* 2015; **22**: 144-155 [PMID: 25908913 DOI: 10.3747/co.22.2587]
- 7 **Easaw JC**, Shea-Budgell MA, Wu CM, Czaykowski PM, Kassis J, Kuehl B, Lim HJ, MacNeil M, Martinusen D, McFarlane PA, Meek E, Moodley O, Shivakumar S, Tagalakis V, Welch S, Kavan P. Canadian consensus recommendations on the management of venous thromboembolism in patients with cancer. Part 1: prophylaxis. *Curr Oncol* 2015; **22**: 133-143 [PMID: 25908912 DOI: 10.3747/co.22.2586]
- 8 **Geerts WH**, Bergqvist D, Pineo GF, Heit JA, Samama CM, Lassen MR, Colwell CW. Prevention of venous thromboembolism: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition). *Chest* 2008; **133**: 381S-453S [PMID: 18574271 DOI: 10.1378/chest.08-0656]
- 9 **Park BY**, Kim MJ, Kang SR, Hong SE. Legal issues related to postoperative pulmonary thromboembolism in Korea. *Ann Surg Treat Res* 2016; **91**: 316-322 [PMID: 27904854 DOI: 10.4174/ast.2016.91.6.316]
- 10 **Bhutiani N**, Quinn SA, Mercer MK, Hong YK, Stevenson M, Egger ME, Philips P, McMasters KM, Martin RCG 2nd, Scoggins CR. Identifying risk factor for development of perioperative venous thromboembolism in patients with gastrointestinal malignancy. *Am J Surg* 2019; **218**: 311-314 [PMID: 30795857 DOI: 10.1016/j.amjsurg.2019.02.008]
- 11 NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines). Cancer-Associated Venous Thromboembolic Disease. Version 1. 2019. Fort Washington: National Comprehensive Cancer Network. 2019 [DOI: 10.1111/j.1759-7714.2010.00016.x]
- 12 **Al-Hameed F**, Al-Dorzi HM, AlMomen A, Algahtani F, AlZahrani H, AlSaleh K, AlSheef M, Owaidah T, Alhazzani W, Neumann I, Wiercioch W, Brozek J, Schünemann H, Akl EA. Prophylaxis and treatment of venous thromboembolism in patients with cancer: the Saudi clinical practice guideline. *Ann Saudi Med* 2015; **35**: 95-106 [PMID: 26336014 DOI: 10.5144/0256-4947.2015.95]
- 13 **Farge D**, Bounameaux H, Brenner B, Cajfinger F, Debourdeau P, Khorana AA, Pabinger I, Solymoss S, Douketis J, Kakkar A. International clinical practice guidelines including guidance for direct oral anticoagulants in the treatment and prophylaxis of venous thromboembolism in patients with cancer. *Lancet Oncol* 2016; **17**: e452-e466 [PMID: 27733271 DOI: 10.1016/S1470-2045(16)30369-2]
- 14 **Afshari A**, Ageno W, Ahmed A, Duranteau J, Faraoni D, Kozek-Langenecker S, Llau J, Nizard J, Solca M, Stensballe J, Thienpont E, Tsiridis E, Venclauskas L, Samama CM; ESA VTE Guidelines Task Force. European Guidelines on perioperative venous thromboembolism prophylaxis: Executive summary. *Eur J Anaesthesiol* 2018; **35**: 77-83 [PMID: 29112553 DOI: 10.1097/EJA.0000000000000729]
- 15 Venous thromboembolism in over 16s: reducing the risk of hospital-acquired deep vein thrombosis or pulmonary embolism. London: National Institute for Health and Care Excellence (NICE); 2019-Aug-13 [PMID: 32924386]
- 16 Cancer and Thrombosis Expert Committee of Chinese Society of Clinical Oncology. Guidelines for the prevention and treatment of tumor-related venous thromboembolism (2019 edition). *Chin J Clin Oncol* 2019; **46**: 653-660 [DOI: 10.1016/s0049-3848(10)70029-3]
- 17 **Professional Committee on Nursing Care CCoIUoATSoE**; Chinese Medical Doctor Association. Expert consensus on the application of graduated compression Stockings for prevention and treatment of venous thromboembolism. *J Intervent Radiol* 2019; **28**: 811-818 [DOI: 10.1097/00000446-200602000-00039]
- 18 **Caprini JA**. Risk assessment as a guide for the prevention of the many faces of venous thromboembolism. *Am J Surg* 2010; **199**: S3-10 [PMID: 20103082 DOI: 10.1016/j.amjsurg.2009.10.006]
- 19 **Shen XF**, Lu Y, Liu YY. Investigation and analysis on the prevention of venous thromboembolism among surgical patients from county-level hospitals. *Nurs Integr Trad Chin West Med* 2019; **5**: 84-87 [DOI: 10.1182/blood.v110.11.1865.1865]
- 20 **Useche JN**, de Castro AM, Galvis GE, Mantilla RA, Ariza A. Use of US in the evaluation of patients with symptoms of deep venous thrombosis of the lower extremities. *Radiographics* 2008; **28**: 1785-1797 [PMID: 18936036 DOI: 10.1148/rg.286085513]
- 21 **Furie B**, Furie BC. Mechanisms of thrombus formation. *N Engl J Med* 2008; **359**: 938-949 [PMID: 18753650 DOI: 10.1056/NEJMra0801082]
- 22 **Piatek C**, O'Connell CL, Liebman HA. Treating venous thromboembolism in patients with cancer. *Expert Rev Hematol* 2012; **5**: 201-209 [PMID: 22475288 DOI: 10.1586/ehm.11.86]
- 23 **Khorana AA**, Carrier M, Garcia DA, Lee AY. Guidance for the prevention and treatment of cancer-associated venous thromboembolism. *J Thromb Thrombolysis* 2016; **41**: 81-91 [PMID: 26780740 DOI: 10.1007/s11239-015-1313-4]
- 24 **Khorana AA**. Risk assessment and prophylaxis for VTE in cancer patients. *J Natl Compr Canc Netw* 2011; **9**: 789-797 [PMID: 21715725 DOI: 10.6004/jnccn.2011.0064]
- 25 **Streiff MB**, Holmstrom B, Angelini D, Ashrani A, Elshoury A, Fanikos J, Fertrin KY, Fogerty AE, Gao S, Goldhaber SZ, Gundabolu K, Ibrahim I, Kraut E, Leavitt AD, Lee A, Lee JT, Lim M, Mann J, Martin K, McMahon B, Moriarty J, Morton C, Ortel TL, Paschal R, Schaefer J, Shattil S, Siddiqi T, Sudheendra D, Williams E, Hollinger L, Nguyen MQ. Associated Venous Thromboembolic Disease, Version 2.2021, NCCN Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw* 2021; **19**: 1181-1201 [DOI: 10.6004/jnccn.2021.0047]
- 26 **Zhang J**, Liu ZY. Interventional practice of hospital venous thromboembolism. *Chin J Hosp Admin* 2017; **33**: 51-53 [DOI: 10.12788/jhm.3029]
- 27 **Gong JN**, Yang YH. Current Clinical Management Status of Pulmonary Embolism in China. *Chin Med J (Engl)* 2017; **130**: 379-381 [PMID: 28218208 DOI: 10.4103/0366-6999.199841]
- 28 **Pillet A**, Minne F, Belhadj Chaidi R, Chapelle G, Ferru A. Management of venous thromboembolism in cancer patients according to guidelines after educative measures. *Bull Cancer* 2018; **105**: 486-492 [PMID: 29680153 DOI: 10.1016/j.bulcan.2018.01.019]
- 29 **Falck-Ytter Y**, Francis CW, Johanson NA, Curley C, Dahl OE, Schulman S, Ortel TL, Pauker SG, Colwell CW Jr.

Prevention of VTE in orthopedic surgery patients: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest* 2012; **141**: e278S-e325S [PMID: [22315265](#) DOI: [10.1378/chest.11-2404](#)]

- 30 **Klaassen Z**, Wallis CJD, Lavallée LT, Violette PD. Perioperative venous thromboembolism prophylaxis in prostate cancer surgery. *World J Urol* 2020; **38**: 593-600 [PMID: [30840115](#) DOI: [10.1007/s00345-019-02705-x](#)]



Published by **Baishideng Publishing Group Inc**  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA  
**Telephone:** +1-925-3991568  
**E-mail:** [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)  
**Help Desk:** <https://www.f6publishing.com/helpdesk>  
<https://www.wjgnet.com>

