JBUON 2018; 23(2): 500-506
ISSN: 1107-0625, online ISSN: 2241-6293 • www.jbuon.com
E-mail: editorial_office@jbuon.com

ORIGINAL ARTICLE

Incidence and risk assessment of venous thromboembolism in cancer patients admitted to intensive care unit for post-operative care

Jia-Xuan Xu, Jun Dong, Hong Ren, Xiao-Jie Chen, Yong Yang, Ren-Xiong Chen, Guo-Dong Wang, Hong-Zhi Wang

Key Laboratory of Carcinogenesis and Translational Research (Ministry of Education/Beijing), Department of Critical Care Medicine, Peking University Cancer Hospital and Institute, Beijing, China

Summary

Purpose: *Cancer patients undergoing surgery are at high risk of venous thromboembolism (VTE). The occurrence of VTE in Chinese cancer patients admitted to intensive care unit (ICU) for postoperative care is poorly characterized. This study was designed to investigate the incidence of VTE in this population and to evaluate the utility of the Caprini score in risk stratification.*

Methods: *2127 consecutive adult patients admitted to a 10-bed surgical ICU (SICU) in a tertiary care academic hospital during a 4-year period (January 1, 2013 - December 31, 2016) were enrolled. Demographic and VTE data were collected. Data for the Caprini risk assessment model (RAM) was used to stratify patients on their risk of VTE.*

Results: *Of the 2127 patients admitted to ICU after cancer surgery, 66 (3.1%) developed symptomatic VTE. There were a total of 32 patients with pulmonary embolism (PE), 51 patients with deep vein thrombosis (DVT) and 17 patients with both conditions. Based on the original Caprini RAM, 99.5% of the patients scored in the "highest risk" category (score ≥5), all patients with VTE were in the "highest risk" category. Further substratification in the "highest risk" category showed the risk of developing VTE events was significantly higher among patients with Caprini score greater than 10, as compared with patients with Caprini score of 5 to 6 (OR 5.63;95%CI 1.27-24.94), 7 to 8 (OR 2.36;95%CI 1.23-4.52) or 9 to 10 (OR 2.28;95%CI 1.17-4.44). The percentage of patients receiving double prophylaxis was 16.8% (358/2127), 20 of the 66 VTE patients (30.3%) received double prophylaxis before VTE was diagnosed. Patients with higher Caprini score were more likely to receive double thromboprophylaxis than patients with lower Caprini score (23.4% of patients with Caprini score>10 vs 10.8% with Caprini score 5-6).*

Conclusions: *Though accompanied with the subutilizing of chemoprophylaxis, the overall incidence of VTE was relatively low in Chinese cancer patients admitted to ICU for postoperative care. In contrast, the Caprini score was high in this population. The original Caprini RAM was limited to stratify this population, but further substratification of "highest risk" category demonstrated the risk of developing VTE events was significantly higher in patients with Caprini score greater than 10. Future research with high quality evidence should be performed targeting on the accurate risk stratification and optimizing VTE prophylaxis for this population.*

Key words: *cancer surgery, Caprini score, intensive care unit, risk stratification, venous thromboembolism*

Introduction

VTE manifesting as DVT and PE, is the major source of postoperative morbidity and mortality in cancer patients, contributing to prolonged length of hospital stay and incremental hospital costs [1,2]. When cancer patients are admitted to ICU for postoperative care, the risk of VTE is substantially

Correspondence to: Hong-Zhi Wang, MD. Key Laboratory of Carcinogenesis and Translational Research (Ministry of Education/Beijing), Department of Critical Care Medicine, Peking University Cancer Hospital and Institute,Beijing, China, 52 Fucheng Street, Haidian District, 100142 Beijing, China. Tel: +86 013811587782, E-mail: doctorwhz@163.com
Received: 01/09/2017; Accepted: 23/09/2017

higher than other patient population. Administration of chemoprophylaxis can significantly reduce the risk of VTE, but the benefits of chemoprophylaxis may be counterbalanced by the risk of postoperative bleeding and coagulopathy in this population. Risk stratification is urgently needed for physicians to optimize thromboprophylaxis regimen. Well-validated in postsurgical patient population, the Caprini RAM is the most widely used tool for VTE risk prediction and recommended in VTE guidelines for VTE risk stratification [3,4]. Since the occurrence of VTE in Chinese cancer patients admitted to ICU for postoperative care is poorly characterized, we conducted this retrospective study to 1) investigate the incidence of symptomatic VTE in this patient population and 2) to examine the utility of the Caprini RAM for VTE risk stratification.

Methods

This retrospective cohort study was performed in Peking University Cancer Hospital, a tertiary care academic hospital ranked top 5 in cancer specialty in China. Approval for this study was obtained from the Institutional Review Board. All admissions to a 10-bed SICU, undergoing surgery for malignancy between January 1, 2013 and December 31, 2016 were registered. Patients younger than 18 years old were excluded. The enrolled patients were retrospectively identified with the electronic medical records, data including demographics, malignancy characteristics, concomitant diseases, APACHE II score, and length of ICU and hospital stay were collected.

Data regarding thromboprophylaxis were also recorded. According to the protocol of VTE prevention at Peking University Cancer Hospital, perioperative mechanical prophylaxis such as graduated compression stockings (GCS) and intermittent pneumatic compression (IPC) devices was recommended unless contraindicated. Chemoprophylaxis was not routinely used unless the physicians considered the patient at high risk of VTE and low risk of bleeding.

Originally derived from surgical patients, the Caprini RAM is a convenient method to stratify VTE risk by summing up individual risk factors. In this model, different patient and procedure risk factors are assigned weighted points (ranging from 1 to 5) based on the risk of VTE for each factor as listed in Table 1. A total risk factor score is calculated and stratify patients into 4 risk levels based on reported incidence of VTE: "very low risk" (0 points), "low risk" (1-2 points), "moderate risk" (3-4 points), and "high risk" (≥5 points), leading to stratified prophylaxis. In this study the Caprini score was calculated for individual patient, based on comorbidities and perioperative risk factors immediately on admission to ICU.

The primary outcome of this study was 30-day VTE, occurring after the admission to ICU. As routine screening protocol for VTE was not performed in our hospital, investigation for VTE was at the discretion of the attending physicians if patients got suspected symptoms related to VTE (such as extremity edema, pain, unexplained shortness of breath or hypoxia). DVT was defined as acute thrombosis of lower-extremity veins (iliac, femoral, popliteal or calf veins) or upper-extremity veins (axillary, subclavian, brachial or internal jugular veins) by compression ultrasonography. PE was defined as acute thrombosis within the pulmonary vasculature based on spiral computed tomography.

Table 1. 2005 Caprini risk model

Each risk factor represents 1 point
Age 41–60 years
Swollen legs (current)
Varicose veins
Obesity (BMI >25)
Minor surgery planned
Sepsis (<1 month)
Acute myocardial infarction
Congestive heart failure (<1 month)
Medical patient currently at bed rest
History of prior major surgery (<1 month)
History of inflammatory bowel disease
Abnormal pulmonary function (COPD)
Serious lung disease including pneumonia (<1 month)
Oral contraceptives or hormone replacement therapy
Pregnancy or postpartum (<1 month)
History of unexplained stillborn infant, recurrent spontaneous abortion (>3), premature birth with toxemia or growth-restricted infant
Each risk factor represents 2 points
Age 61–74
Arthroscopic surgery
Malignancy (present or previous)
Laparoscopic surgery (>45 min)
Patient confined to bed (>72 h)
Immobilizing plaster cast (<1 month)
Central venous access
Major surgery (>45 min)
Each risk factor represents 3 points
Age 75 years or older
History of DVT/PE
Positive factor V Leiden
Elevated serum homocysteine
Heparin-induced thrombocytopenia (HIT)
Elevated anticardiolipin antibodies
Positive prothrombin 20210A
Positive lupus anticoagulant
Other congenital or acquired thrombophilia
Each risk factor represents 5 points
Stroke (<1 month)
Multiple trauma (<1 month)
Elective major lower extremity arthroplasty
Hip, pelvis, or leg fracture (<1 month)
Acute spinal cord injury (paralysis) (<1 month)

Statistics

Statistical analyses were carried out with SPSS software version 22. Continuous variables with a normal distribution were described as means with standard deviations, while continuous variables with skewed distribution were presented as median values with interquartile ranges. Comparisons between two groups were performed with 2-tailed Student t-test. Discrete variables were presented as frequencies and percentages, and group comparisons were performed using the chi-square or Fisher exact test. Patients were categorized into risk categories based on the calculated Caprini score and the incidence of venous thromboembolism for each risk groups was estimated along with a 95% confidence interval. A p value <0.05 was considered to indicate significance.

Results

A total of 2127 consecutive cancer patients admitted to ICU for postoperative care were included in this study. The baseline characteristics of the included patients are presented in Table 2. Of the total 2127 patients, 1918 patients underwent radical surgery, and 209 palliative or emergency surgery before admission to the ICU. Patients had a median age of 67 years (range 59-75), with most of them being male (64.2%). The majority of the patients in this cohort had colorectal cancer (38.3%), followed by gastric cancer (19.9%), lung cancer (10.4%) and esophageal cancer (8.0%), with median APACHE II score of 8 (range 7-11), ICU length of stay 3 days (range 2-5) and hospital length of stay 17 days (range 12-25).

The observed rate of VTE in ICU was 3.1% (66/2127) (Table 3). There were a total of 32 patients with PE (1.5% of the overall population, 48.5% of the VTE population), 51 patients with DVT (2.4% of the overall population, 77.3% of the VTE population), and 17 (0.8% of the overall population, 25.8% of the VTE population) experienced both PE and DVT. In the 51 patients diagnosed with DVT, there were 6 patients with proximal DVT (2 located in inner jugular vein and 4 in femoral vein), and 45 with distal DVT (thrombus located below the knee in the calf vein). The median time from surgery to VTE development was 3 days (range 1-7). There were 2 postoperative sudden deaths recorded. Unfortunately, the autopsies were refused to be performed. Both DVT and severe right ventricular enlargement were detected on bedside echocardiography in these 2 cases, so DVT with PE were diagnosed based on indirect evidence and the attending physician's clinical judgment.

According to the original Caprini RAM (also recommended in ACCP guidelines), patients were classified into different risk groups by their Caprini scores in this study (Table 4). As a result, only 10 patients (0.5% of the overall population) were classified into low to moderate risk and the remaining 99.5% were high risk (score ≥5). Given the majority of patients classified into the high risk group, this group was substratified by Caprini score and the VTE incidence was calculated for each subgroup. Patients with Caprini score of 10 or greater were significantly more likely to develop VTE events compared with those with Caprini score of 5 to 6 (odds ratio, 5.63; 95%CI 1.27-24.94; p=0.01), 7 to

Table 2. Demographic and clinical characteristics of enrolled patients

Characteristics	*n (%)*
Gender,male	1366 (64.2)
Age,years (range)	67 (59-75)
Site of malignancy	
Esophagus	170 (8.0)
Gastric	423 (19.9)
Colorectal	814 (38.3)
Pancreatic	62 (2.9)
Hepatobiliary	90 (4.3)
Genital urinary tract	64 (3.0)
Lung	222 (10.4)
Breast	47 (2.2)
Gynecologic	52 (2.5)
Sarcoma	66 (3.1)
Medical co-morbidity	
Hypertension	872 (41.0)
Arrhythmia	277 (13.0)
Coronary heart disease	406 (19.1)
COPD	133 (6.3)
Diabetes	367 (17.3)
Cerebrovascular disease	184 (8.7)
APACHE II score*	8 (7-11)
Length of ICU stay (days)§	3 (2-5)
Length of hospital stay (days)†	17 (12-25)

*APACHE II score: Acute physiology and chronic health evaluation II score, median (range), §median (range), †median (range)

Table 3. Venous thromboembolism data

Variables	*No. of patients (%)*
Total VTE events	66 (3.1)
VTE location	
PE	32 (1.5)
PE+DVT	17 (0.8)
PE only	15 (0.7)
DVT	51 (2.4)
Proximal extremity	6 (0.3)
Distal extremity	51 (2.1)

For abbreviations see text

Table 4. Observed VTE incidence for each group substratified by Caprini score

Caprini score	*No. of patients(%)*	*Observed VTE rate n(%)*	*95%CI*
Low risk (0-1)	0 (0)		
Moderate risk (2)	1 (0.1)		
High risk (3-4)	9 (0.4)		
Highest risk (≥5)	2117 (99.5)		
Caprini 5-6	167 (7.9)	2/167 (1.20)	0.21-4.71
Caprini 7-8	924 (43.4)	26/924 (2.81)	1.75-3.87
Caprini 9-10	791 (37.2)	23/791 (2.91)	1.74-4.08
Caprini>10	235 (11.0)	15/235 (6.38)	3.26-9.50

Table 5. Odds for VTE substratified by Caprini score

	Caprini 7-8	*Caprini 9-10*	*Caprini>10*
Caprini 5-6	2.39 (0.56-10.16) p=0.29	2.47 (0.58-10.58) p=0.29	5.63 (1.27-24.94) p=0.01
Caprini 7-8		1.034 (0.59-1.83) p>0.99	2.36 (1.23-4.52) p=0.02
Caprini 9-10			2.28 (1.17-4.44) p=0.02

Data are presented as odds ratios (95% CI)

8 (odds ratio, 2.36; 95%CI 1.23-4.52; p=0.02) or 9 to 10 (odds ratio, 2.28; 95%CI 1.17-4.44; p=0.02). However, there was no significant difference between 5 to 6, 7 to 8 and 9 to 10 group (Table 5).

Of the enrolled patients 14.8% (315/2127) received preoperative double thromboprophylaxis (pharmacological combined with mechanical prophylaxis), and this proportion increased to 16.8% (358/2127) after admission to ICU; 20 of the 66 VTE patients (30.3%) received double prophylaxis before VTE was diagnosed. As shown in Figure 1, patients with greater Caprini score were more likely to receive double prophylaxis (23.4% of patients with Caprini score >10, 19.1% with Caprini score 9-10, 14.5% with Caprini score7-8, and 10.8% with Caprini score 5-6).

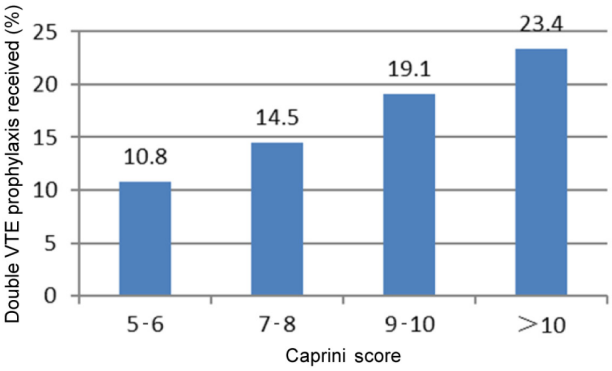

Figure 1. Double VTE prophylaxis received according to Caprini score.

Discussion

VTE is a frequent complication in patients with cancer and is associated with significant morbidity and mortality. Published data confirmed that the risk of VTE is increased up to 6-7 fold in cancer patients compared to the general population, and if undergoing surgical operation, the risk will go even higher [5]. Hence, thromboprophylaxis for cancer patients after major surgery was strongly recommended according to the VTE risk assessment [6].

In the current study we found the incidence of VTE events in Chinese cancer patients admitted to ICU for postoperative care was 3.1%. Due to lack of results from high quality studies, the real VTE incidence of cancer patients in Asia is still controversial [7,8]. Data from retrospective studies based on Asian patients undergoing major cancer surgery showed a VTE incidence of 0.06-0.85% [9,10]. Even with the genetic inhomogeneity, a recent published review including Chinese, Koreans, Japanese, Malaysians and Indians, demonstrated no significant differences in VTE risk between studies from different regions in Asia [11]. One of the study from Taiwan, which is comparable to the population in our study, indicated the VTE rate was lower than Caucasian cancer patients [12]. Certainly the possibility of underdiagnosis due to the limitation of retrospective studies should be noticed. When

we look at the data from prospective studies, the incidence varied greatly up to 42% [7,13]. These studies were likely to overestimate the VTE risk as DVT scan were routinely performed even in asymptomatic patients in all these studies and two studies which observed VTE incidence at 38 and 42% had a very small sample size. A recent prospective observational study by Lee et al. included 548 Korean colorectal patients undergoing major abdominopelvic surgery with only mechanical prophylaxis, and revealed a postoperative DVT incidence of 3.0% in the screening group compared with 0.7% in the non-screening group [7]. Based on these observations, it is reasonable to conclude the VTE rate in Asian cancer patients undergoing major surgery is about 2-3%, equal to the VTE incidence at moderate risk (about3%) according to the American College of Chest Physicians (ACCP) VTE guideline risk categories. All these results above indicated differences in the epidemiologic profile of VTE in Asian compared with western population, and a proportion of cancer patients may be exposed to possibly unnecessary costs and risk of bleeding. This highlights the importance of appropriate risk stratification in Asian cancer populations undergoing major surgery.

The Caprini score is the most widely used VTE RAM developed from a large retrospective study, with a database including a representative sample of general, vascular, and urological operated patients. Taking into account the total number of risk factors which are associated with the patient's condition and the nature of the surgery performed, the Caprini VTE RAM is validated in western surgical patient populations and is recommended in guidelines for VTE prevention [4]. However, in our study we found the original Caprini score was limited in its ability to discriminate the VTE risk among Chinese cancer patients admitted to ICU for postoperative care, since the majority (99.5%) of the enrolled patients were categorized into the highest risk group (Caprini score ≥5), which means we couldn't distinguish between different risk levels. This is consistent with the results on patients with gynecologic malignancy [14]. This can be partially explained when we put the risk factors of cancer patients according to the original Caprini score, a score of 4 by the 2 factors alone (2 points for major surgery and malignancy each) would be calculated. If any additional risk factors such as advanced age, central lines and other complications exist, which are quite common in ICU patients compared with patients in general care wards, the patients would be classified into the highest-risk category.

One solution is increasing the cutoff point for stratifying cancer patients. Bahl et al. modified the Caprini RAM and added a separate "super high risk" group (>8) and recommended an extended duration of chemoprophylaxis for this group [15]. Similar to cancer patients, a raised cutoff point of 8 had already been used in the risk stratification in patients undergoing plastic and orthopedic surgery [16]. In the current study, substratification of the "highest risk" category showed the risk of developing VTE events was significantly higher among patients with Caprini score greater than 10, as compared with patients with Caprini score of 5 to 6 (odds ratio 5.63; 95%CI 1.27-24.94), 7 to 8 (odds ratio 2.36; 95%CI 1.23-4.52) or 9 to 10 (odds ratio 2.28; 95%CI 1.17-4.44). This suggests if the cutoff points are elevated, the Caprini score may be more effective in discriminating the relative risk of VTE between different cancer patients.

Risk assessment tools customized for cancer patients may be another way out. The current Caprini RAM considers malignancy as a single risk factor regardless of the primary cancer, while the risk of VTE may have great variations in different cancers (thinking about the VTE risk of a patient with early stage colorectal cancer *in situ* compared with a pancreatic cancer patient with distant metastasis). One universal VTE RAM cannot solve all the problems just like one size cannot fit all. More tumor-specific factors should be considered in VTE risk stratification for cancer patients. For example, Khorana score is a tumor-specific RAM recommended in National Comprehensive Cancer Network (NCCN) guideline [17]. Unfortunately, this RAM was only verified in cancer patients receiving chemotherapy, and there are no similar RAMs recommended for cancer patients undergoing surgery. Future development of RAMs customized for cancer patients could allow us to tailor our VTE prophylaxis regimen.

In our study, the observed ratio of chemoprophylaxis in ICU was at a relatively low level of 16.8%, although patients with higher Caprini score were more likely to receive double prophylaxis (23.4% of patients with Caprini score>10, 19.1% with Caprini score 9-10, 14.5% with Caprini score 7-8, 10.8% with Caprini score 5-6), which was still not concordant with guideline recommendations. Actually, subutilizing the coagulant agent is not uncommon in Asia. In a survey of opinions and practices of surgical and intensive care specialists towards perioperative VTE prophylaxis from 191 responses in 8 Asian countries, only half of the respondents practised routine thromboprophylaxis in moderate and high risk surgical operations [18]. In a study including 2967 patients in 52 hospitals from Michigan, US, Krell et al. found that only 40.4 % of eligible patients had perioperative

pharmacologic thromboprophylaxis for abdominal cancer surgery, and 25.3 % of the highest-risk patients had inadequate postoperative prophylaxis [19]. On the hand, cancer patients receive chemoprophylaxis under the risk of bleeding. A recent meta-analysis provided evidence that for cancer patients undergoing surgery, pharmacological thromboprophylaxis had limited impact on VTE-related fatal events (RR 1.77, 95% CI 0.76-4.14; p=0.19) and could lead to a significantly increased incidence of bleeding events (RR 2.51, 95% CI 1.79-3.51; p<0.0001) despite a relatively reduced incidence of DVT [20]. A retrospective study using the database of RIETE (an international, prospective registry on patients treated for VTE) observed that the 30-day cumulative incidence of major bleeding and fatal bleeding in cancer patients receiving anticoagulant therapy was 1.8% and 0.74%, respectively, suggesting a substantial proportion of cancer patients may be exposed to a possibly unnecessary risk of bleeding [21]. Challenging of counterbalancing risks of VTE and bleeding is still the main concern before physicians make the decision. Therefore, the benefits and risks of VTE prophylaxis should be weighed for the individual patient to get the optimal prophylactic regimen. VTE prevention should be tailored to patients individually based on appropriate risk assessment.

Limitations

Several limitations of our study should be noted. First, despite a sizeable patient population enrolled, the current study was limited to a mono-center retrospective design. Inherent limitations of a retrospective study involve medical data missing results, potential underscoring or inclusion bias. Second, we observed the VTE incidence only for 30 days after the surgery. Though it was reported the VTE incidence was at its peak in the first 4 to 6 weeks after the surgery, it may, to a certain extent, underestimate the VTE risk in this population without long time follow-up [22]. In our study, colorectal and gastric cancer patients accounted for a major proportion of all enrolled patients. Actually, colorectal and gastric cancer patients did represent those undergoing major surgery with perioperative risk factors for VTE development. In NCCN guideline for VTE prevention and treatment, abdominal/pelvic cancer surgery patients with anesthesia time greater than 2 hrs are defined as VTE high risk population, for whom an extended VTE prophylaxis for up to 4-6 weeks is recommended [6]. However, patient distribution is certainly a potential source of bias. Further, well-designed, prospective, multicenter investigations are desired to estimate the real incidence of VTE among this population and optimize their VTE risk stratification.

Conclusions

Though accompanied with subutilizing chemoprophylaxis, the overall incidence of VTE was relatively low in Chinese cancer patients admitted to ICU for postoperative care.

In contrast, the Caprini score was high in this population. The original Caprini RAM was limited to stratify this population, but further substratification of "highest risk" category demonstrated the risk of developing VTE events was significantly higher in patients with Caprini score greater than 10. Future research with high quality evidence should be performed targeting on the accurate risk stratification and optimizing VTE prophylaxis for this population.

Conflict of interests

The authors declare no conflict of interests.

References

1. Horsted F, West J, Grainge MJ. Risk of venous thromboembolism in patients with cancer: A systematic review and meta-analysis. PLoS Med 2012;9:e1001275.
2. Sallah S, Wan JY, Nguyen NP. Venous thrombosis in patients with solid tumors: Determination of frequency and characteristics. Thromb Haemost 2002;87: 575-9.
3. Yakar A, Yakar F, Ziyade N, Yildiz M, Uzun I. Fatal pulmonary thromboembolism. Eur Rev Med Pharmacol Sci 2016;20:1323-6.
4. Gould MK. Prevention of VTE in Nonorthopedic Surgical Patients: Antithrombotic Therapy and Prevention of Thrombosis (9th Edn). American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (vol 141, pp e227S, 2012). Chest 2012;141:1369.
5. Grudeva-Popova J. Cancer and venous thromboembolism. JBUON 2005;10:483-9.
6. Streiff MB, Holmstrom B, Ashrani A et al. Cancer-Associated Venous Thromboembolic Disease, Version 1.2015. J Natl Compr Canc Netw 2015;13:1079-95.

7. Kim JW, Chun EJ, Choi SI et al. A prospective study on the incidence of postoperative venous thromboembolism in Korean gastric cancer patients: An inquiry into the application of Western guidelines to Asian cancer patients. PLoS One 2013;8:e61968.
8. Sakon M, Maehara Y, Yoshikawa H, Akaza H. Incidence of venous thromboembolism following major abdominal surgery: A multi-center, prospective epidemiological study in Japan. J Thromb Haemost 2006;4:581-6.
9. Yang SS, Yu CS, Yoon YS, Yoon SN, Lim SB, Kim JC. Symptomatic venous thromboembolism in Asian colorectal cancer surgery patients. World J Surg 2011;35:881-7.
10. Lee KW, Bang SM, Kim S et al. The incidence, risk factors and prognostic implications of venous thromboembolism in patients with gastric cancer. J Thromb Haemost 2010;8:540-7.
11. Yeo DX, Junnarkar S, Balasubramaniam S et al. Incidence of venous thromboembolism and its pharmacological prophylaxis in Asian general surgery patients: A systematic review. World J Surg 2015;39:150-7.
12. Chew TW, Gau CS, Wen YW, Shen LJ, Mullins CD, Hsiao FY. Epidemiology, clinical profile and treatment patterns of venous thromboembolism in cancer patients in Taiwan: A population-based study. BMC Cancer 2015;15:298.
13. Lee FY, Chu W, Chan R et al. Incidence of deep vein thrombosis after colorectal surgery in a Chinese population. ANZ J Surg 2001;71:637-40.
14. Barber EL, Clarke-Pearson DL. The limited utility of currently available venous thromboembolism risk assessment tools in gynecological oncology patients. Am J Obstet Gynecol 2016;215:441-5.
15. Bahl V, Hu HM, Henke PK, Wakefield TW, Campbell DJ, Caprini JA. A validation study of a retrospective venous thromboembolism risk scoring method. Ann Surg 2010;251:344-50.
16. Pannucci CJ, Bailey SH, Dreszer G et al. Validation of the Caprini risk assessment model in plastic and reconstructive surgery patients. J Am Coll Surg 2011;212:105-12.
17. Khorana AA, Kuderer NM, Culakova E, Lyman GH, Francis CW. Development and validation of a predictive model for chemotherapy-associated thrombosis. Blood 2008;111:4902-7.
18. Lee L, Liew NC, Gee T. A survey of contemporary opinions and practices of surgical and intensive care specialists towards peri-operative venous thromboembolism prophylaxis in Asia. Int Angiol 2012;31:526-33.
19. Krell RW, Scally CP, Wong SL et al. Variation in hospital thromboprophylaxis practices for abdominal cancer surgery. Ann Surg Oncol 2016;23:1431-9.
20. Guo Q, Huang B, Zhao J et al. Perioperative pharmacological thromboprophylaxis in patients with cancer: A systematic review and meta-analysis. Ann Surg 2017;265:1087-1093.
21. Ageno W, Samperiz A, Caballero R et al. Duration of anticoagulation after venous thromboembolism in real world clinical practice. Thromb Res 2015;135:666-72.
22. Bergqvist D, Agnelli G, Cohen AT et al. Duration of prophylaxis against venous thromboembolism with enoxaparin after surgery for cancer. N Engl J Med 2002;346:975-80.