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Incidence of VTE in the First Postoperative 24 Hours after Abdominopelvic Surgery: A Single-Centre Observational Study

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1. Abstract

1.1. Background: A good number of research reports the incidence of postoperative venous thromboembolism (VTE) mostly looks at longer postoperative duration, usually days after surgery.

1.2. Objective: We investigated the incidence of early asymptomatic VTE (24 hours postoperatively) to assess the relevance of generalisation of extended post-hospital discharge chemoprophylaxis.

1.3. Methods: We conducted a single-centre, observational study. Data from patients undergoing surgery were recorded, and the 24 hours post-op VTE incidence was determined primarily by Doppler ultrasound of the lower limbs. Statistical analysis controlling for age, sex, body mass index, laboratory results, medical history, surgery type, and details were performed to determine the risk of VTE.

1.4. Result: The clinical data of 209 patients, including 138 (66.0%) males and 71 (34.0%) females, with a mean age of 58.91±13.48 years, were used for the present study. Post-operative ultrasound revealed VTE findings in 104/209 (49.76%) of the patients, with the majority 61 (29.19%) having bilateral intramuscular venous thrombosis and the least 17 (8.13%) showing right limb intramuscular venous thrombosis. The risk of VTE was associated with age, history of malignant disease (cancer) or chemotherapy, blood loss, duration of surgery, levels of CA-199, and APTT.

1.5. Conclusion: From our findings, a significant number of patients had asymptomatic VTE in the first postoperative 24 hours. The general assumption that the Asian population has a very low incidence of VTE and therefore no extended use of chemoprophylaxis to prevent post-surgery VTE as a routine practise should be revised.

2. Introduction

Venous Thromboembolism (VTE) is an umbrella term that includes deep venous thrombosis (DVT) and pulmonary embolism (PE). Thromboembolism is an underappreciated cause of death. In 2010, VTE accounted for 1 in 4 deaths and was the leading cause of death worldwide [1]. More than 296,000 deaths each year in the United States result from VTE, whereas deaths secondary to VTE per annum in the United Kingdom, are more than five times that of breast cancer, AIDS, and traffic accidents [2]. VTE is one of the most everyday complications after most surgeries, even though it can be somewhat prevented [3]. Knowledge about VTE prophylaxis and treatment has been brought to light; however, VTE remains a worldwide postsurgical problem [4]. Even though relevant, perioperative VTE prophylactic practices and knowledge is not enforced amongst most general surgery practitioners, unlike their orthopedic colleagues [5]. Several studies have demonstrated an increased risk of VTE in special populations, including cancer patients, post-operative patients, and pregnant women, among sev-

eral others. Zabrocka et al. [6] reported an increased risk of VTE in advanced cancer patients due to age, late staging of the disease, and immobility. The hideous and fatal nature of VTE accounts for its high incidence of in- hospital mortality [7]. A very high asymptomatic VTE prevalence among palliative care patients is 50%, while clinically overt disease accounts for only 10% [6]. This is quite worrying as many VTE's will go undetected nonetheless, its associated risk, including death, remains significantly high. Several studies with subsequent adoption of VTE prophylaxis guidelines have been implemented, yet the morbidity of VTE has remained relatively unchanged in the past two decades [8]. Though obvious that current screening and VTE prophylaxis protocols are not enough, many surgeons do not thoroughly screen patients for VTE in the pre-operative period and in-hospital stay. Whereas using more potent anticoagulants may decrease VTE incidence, most surgeons are reluctant to use thromboprophylaxis due to an associated increased risk of bleeding and infection [8]. The unknown effect on Quality of Life (QoL), vague risks of its discontinuation, associated conditions such as malnutrition renal or liver insufficiency that further increase the risk of bleeding make VTE prophylaxis even more challenging [6]. An enormous amount of evidence suggests that major abdominal and pelvic surgeries are associated with a significantly high risk of VTE incidence [9]; however, the likelihood of all patients undergoing such surgeries differs. The need to employ precision medicine for better-individualized assessment and predictive tools for VTE risk is quite clear. The practice of extended prophylaxis or not remains unclear as different studies support either approach. Balachandran et al. [10] report a low incidence of VTE among patients undergoing major emergency abdominal surgery compared to the incidence after elective surgery. A good number of research reports on the incidence of postoperative VTE among major abdominal surgeries, mainly in a more extended postoperative duration setting (usually days after surgery). Subsequently, various studies have implemented guidelines supporting extended post-discharge chemoprophylaxis to prevent post-operative VTE incidence and some chemoprophylaxis only during the in-hospital stay. There have been reports of a low incidence of VTE amongst the Asian population. Most centres in Asia, including mine, do not practice extended post-hospital VTE thromboprophylaxis after surgery as a general routine. We, therefore, sought to investigate the incidence of early VTE (24 hours postoperatively) in an Asian population to assess the relevance of extended post-hospital discharge chemoprophylaxis at a single center (gastrointestinal/ hernia and abdominal wall surgery department).

3. Methods

3.1. Study design, setting and participants

We conducted a single-centre observational study at the First Affiliated Hospital of Zhengzhou University, China, from November 1, 2020, to April 30, 2021. The study protocol was reviewed and approved by the First Affiliated Hospital of Zhengzhou University ethics committee (2021KY-0374－002). The study was designed and conducted in compliance with the principles of the Declaration of Helsinki and all other local and international ethical protocols. The study has been reported by STROBE guidelines [11]. The inclusion criteria were as follows: patients (≥18 years of age) who were receiving surgery requiring general anesthesia in our hospital's gastrointestinal/hernia and abdominal wall surgery department within the said duration. Patients who were not on VTE chemoprophylaxis at least seven days before surgery were included in the study. Exclusion criteria were as follows: the second data of patients who received surgery twice or more in the exact center within the duration of the study were excluded, but data from their first surgery were included in the study. Emergency patients who could not do a DVT evaluation by a Doppler ultrasound before surgery were excluded. Patients who underwent minor procedures such as venous port insertion, wound debridement, or any other procedure with local anesthesia were also excluded from the study. Patients who passed the inclusion criteria for the study were invited to participate in the study without any selection bias.

3.2. Study procedures, variables and outcomes

Data on baseline demographics (such as age, height, weight and body mass index [BMI]), comorbidities, relevant medical history and preoperative laboratory findings, including coagulation profile, tumour markers and blood routine, were recorded. The Caprini VTE assessment score [12] was used to classify patients according to their various risks. The Color Doppler ultrasound was used to assess lower limbs for DVT 1-2 days before surgery and repeated within 24 hours post- surgery. The study's primary outcome was VTE incidence in the first postoperative 24 hours. A positive VTE outcome was defined by an abnormal finding on Doppler ultrasound (bilateral, right or left intramuscular venous thrombosis) or PE on Computed tomography angiography (CTA).

3.3. Statistical analyses

Due to the observational and descriptive design of the study, calculation of the sample size was not performed, being defined by the number of patients fulfilling inclusion criteria with complete data operated on during the study periods. A total of 209 patients were enrolled in this study. Categorical variables were described as numbers and percentages (%), and continuous variables were defined as the mean and standard deviation (SD) and stratified by the incidence of 24hr VTE event. The Shapiro–Wilk test was used to verify normality. A 2-sample t-test assessed differences between the VTE and non-VTE groups for normally distributed continuous variables, the Mann- Whitney U test for non-normally distributed continuous variables, and the $\chi 2$ or Fisher exact test for categorical variables. Logistic regression models were used to examine the significant crude and adjusted (using age, sex, body mass index, laboratory results, medical history, the surgery type and details as covariates) risk factors associated with 24hr VTE of the

characteristics identified to be statistically significant ($p < 0.05$) or approaching significance. Data was first collected into Microsoft Excel and analysed using SPSS version 26.0 (Statistical Package for the Social Sciences, Chicago, IL USA), with Graph Pad Prism 8 being used to generate figures. All statistical tests were 2-tailed; $P < 0.05$ was considered statistically significant in all analyses.

4. Results

4.1. Patient Characteristics

The clinical data of 209 patients, including 138 (66.0%) males and 71 (34.0%) females, with a mean age of 58.91±13.48 years (range, 18-81 years), were used for the present study. There was no significant difference in age between males and females (59.79±13.70 vs 57.21±12.96, $p = 0.191$) used in the study. Before surgery, 22/209 (10.5%) of patients had VTE upon clinical examination. This number increased exponentially to 104/209 (49.8%) 24 hours post-surgery, with 1 patient progressing from bilateral intramuscular thrombosis to PE. Of the 22 with pre-op VTE, 11 had bilateral intramuscular venous thrombosis, 5 had left limb intramuscular venous thrombosis, and 6 had right intramuscular venous thrombosis. Of the 6 who had pre-op right thrombus findings, 5 converted to bilateral thrombus findings post-op, and 2 of those who had pre-op left intramuscular venous thrombosis findings converted to bilateral findings post-op findings with one converting to no obvious finding and another pre-op bilateral thrombus finding converting to no obvious findings post-op possibly due to operator error. There was no significant difference in the number of males and females (69/138 vs 35/71, $p = 0.923$) who experienced VTE post-surgery. However, patients who experienced VTE post-surgery were significantly older than those who did not experience VTE (63.73±10.23 vs 54.14±14.61, $p < 0.001$). (Table 1) summarises the demographic and clinical data of patients whose clinical data were used for the study. Values are presented as mean±-standard deviation for continuous variables and as frequency (percentage) for categorical variables. *Comorbidities identified were stroke, A-fib and chronic heart disease (CHD). BMI, Body mass index; VTE, venous thromboembolism. aComparison of the non-VTE group vs 24hr VTE group using a two-sample t-test, $\chi 2$ test or Fisher's exact test. P values < 0.05 are considered statistically significant.

Table 1: Demographics, Clinical Characteristics and History of patients stratified by the occurrence of 24hr Venous Thromboembolism (VTE)

Parameters	**Post-Op VTE Findings**		**Total (n=209)**	**P-value[a]**
	24hr VTE	No VTE (n=104)	(n=105)	
Mean age	63.73±10.23	54.14±14.61	58.91±13.48	<0.001
Mean height	165.60±7.36	164.22±12.11	164.90±10.03	0.322
Mean weight	67.90±13.79	66.47±12.60	67.19±13.19	0.434
Mean BMI	24.81±4.96	25.41±11.57	25.11±8.90	0.622
Gender				
Male	69 (66.3)	69 (65.7)	138 (66.0)	0.923
Female	35 (33.7)	36 (34.3)	71 (34.0)	
Age category				<0.001
≤ 45	5 (4.8)	26 (24.8)	31 (14.8)	
46 to 55	15 (14.4)	23 (21.9)	38 (18.2)	
56 o 65	30 (28.8)	32 (30.5)	62 (29.7)	
> 65	54 (51.9)	24 (22.9)	78 (37.3)	
History				
Smoking	28 (58.3)	20 (41.7)	48 (23.0)	0.176
Drinking	24 (51.1)	23 (48.9)	47 (22.5)	0.839
Hypertension	25 (51.0)	24 (49.0)	49 (23.4)	0.84
Diabetes	7 (31.8)	15 (68.2)	22 (10.5)	0.075
Malignant Disease	85 (55.6)	68 (44.4)	153 (73.2)	0.006
Immobility	1 (100.0)	0 (0.0)	1 (0.5)	0.498
Fracture	1 (25.0)	3 (75.0)	4 (1.9)	0.621
Chemotherapy	3 (16.7)	15 (83.3)	18 (8.6)	0.003
Varicose Veins	3 (75.0)	1 (25.0)	4 (1.9)	0.369
Thrombotic Disease	1 (100.0)	0 (0.0)	1 (0.5)	0.498
Surgical History	39 (42.9)	52 (57.1)	91 (43.5)	0.08
DVTE/PE	2 (100.0)	0 (0.0)	2 (1.0)	0.246
Co-morbidity*	13 (54.2)	11 (45.8)	24 (11.5)	0.69
VTE Risk				0.29
High	74 (71.2)	64 (61.0)	138 (66.0)	
Intermediate	25 (24.0)	35 (33.3)	60 (28.7)	
Low	5 (4.8)	6 (5.7)	11 (5.3)	

4.2. Clinical laboratory assessment

(Table 2) summarises clinical data of patients who experienced 24hr post-surgery VTE and those who did not. These measurements were taken before surgery. Patients who experienced VTE post- surgery had significantly higher levels of APTT (27.79±3.51 vs 29.56±6.44, p = 0.041) before surgery compared to patients who did not experience VTE. However, the WBC, HGB, ALB, D- Dimer, and CEA levels were not significantly different among both groups. Values are presented as mean±standard deviation. WBC, white blood cells; HGB, haemoglobin; ALB, serum albumin; CEA, carcinoembryonic antigen; CA, cancer antigen; PT, prothrombin time; INR, International Normalized Ration; APTT, activated partial thromboplastin time; BT, bleeding time. P values < 0.05 are considered statistically significant.

Table 2: Clinical Laboratory Findings of patients

	Post-Op VT	**E Findings**		
Parameter	**24hr VTE**	**No VTE**	**Total**	**P-value**
WBC Count x109/L	6.00±2.32	5.96±2.75 5.98±2.54		0.899
HGB (g/L)	114.72±22.96	116.42±30.00	115.58±26.68	0.646
ALB (g/L)	37.87±5.58	42.72±36.95	40.31±26.53	0.188
CEA (ug/L)	8.39±25.22	3.16±7.73	5.99±19.38	0.08
CA-199 (U/mL)	71.37±280.47	12.48±9.47	44.28±207.71	0.063
CA-125 (U/mL)	25.94±88.82	13.62±12.13	20.27±65.88	0.221
PT (seconds)	11.51±9.22	10.37±1.49	10.94±6.60	0.213
INR	0.96±0.14	0.95±0.12	0.95±0.13	0.615
APTT (seconds)	27.79±3.51	29.56±6.44	28.68±5.26	0.014
D-Dimer (µg/mL)	1.27±3.75	0.64±1.14	0.95±2.78	0.101
BT (seconds)	17.24±16.50	15.30±2.25	16.27±11.76	0.236

4.3. Details of surgery

The clinical details surrounding surgery performed for patients were recorded and presented in (Table 3). The period spent for surgery, mode and type of surgery was not significantly different among patients who experienced VTE 24 post-operation. However, patients who experienced VTE post-operation were people who lost a considerably higher amount of blood during surgery (119.97±107.39 vs 80.83±90.10, p = 0.005). The highest rate of VTE occurred after Gastrectomy (65.4%), followed by Hernia (42.9%), Values are presented as mean±standard deviation for continuous variables and as frequency (percentage) for categorical variables. VTE = Venous thromboembolism. P values < 0.05 are considered statistically significant.

Table 3: Details surrounding surgeries conducted for patients

Parameters	**Post-Op VTE Findings**	**Total (n=209)**	**P-value[a]**	
24hr VTE No VTE				
Duration Of Surgery (Minutes) Intra-Op Blood Loss (mL)	206.50±84.04	169.65±104.25	187.99±96.29	0.005
	119.97±107.39	80.83±90.10	100.31±100.77	0.005
Mode of Surgery				0.228
Open	8 (7.7)	18 (17.1)	26 (12.4)	
Laparoscopic	90 (86.5)	82 (78.1)	172 (82.3)	
Robotic	5 (4.8)	4 (3.8)	9 (4.3)	
Changed mode	1 (1.0)	1 (1.0)	2 (1.0)	
Type of Surgery				0.062
Appendectomy	3 (2.9)	11 (10.5)	14 (6.7)	
Colon Resection	9 (8.7)	11 (10.5)	20 (9.6)	
Exploratory	3 (2.9)	4 (3.8)	7 (3.3)	

Gastrectomy	68 (65.4)	48 (45.7)	116 (55.5)	
Hernia	9 (42.9)	12 (11.4)	21 (10.0)	
Peritoneal Mass	3 (2.9)	4 (3.8)	7 (3.3)	
Rectal	7 (6.7)	6 (5.7)	13 (6.2)	
Small Bowel Resection	2 (1.9)	9 (8.6)	11 (5.3)	
Intra-Op Blood Transfusion				0.036
Yes	12 (11.5)	4 (3.8)	16 (7.7)	
No	92 (88.5)	101 (96.2)	193 (92.3)	
Intra-Op Complication			0.318	
Yes	0 (0.0)	1 (1.0)	1 (0.5)	
No	104 (100.0)	104 (99.0)	208 (99.5)	
Pulmonary Embolism				0.314
Positive	1 (1.0)	0 (0.0)	1 (0.5)	
Negative	103 (99.0)	105 (100.0)	208 (99.5)	

4.4. Ultrasound findings

Ultrasound findings of patients are summarised in (Figure 1). Pre-operation ultrasound findings revealed that the majority of 187 (89.47%) of patients did not have any obvious abnormality, with 22 (10.53%) having VTE. Of those who had VTE before surgery, the majority, 11 (5.26%), had bilateral intramuscular venous thrombosis (BIVT). Post-operation ultrasound findings revealed an abnormality in 104/209 (49.76%) of the patients, with the majority 61 (29.19%) having bilateral intramuscular venous thrombosis and the least 17 (8.13%) showing right limb intramuscular venous thrombosis.

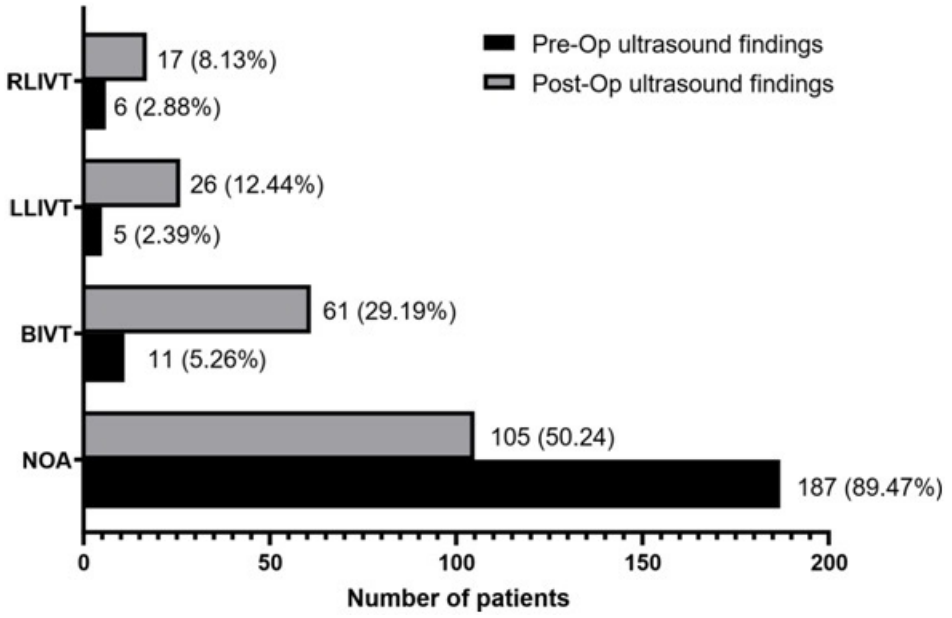

Figure 1: Results of Pre-operation and post-operation ultrasound findings. Bars represent the number of patients. NOA, no obvious abnormality; BIVT, bilateral intramuscular venous thrombosis; LLIVT, right limb intramuscular venous thrombosis; RLIVT, right limb intramuscularvenous thrombosis

4.5. Risk factors for the incidence of venous thromboembolism in patients

Univariate and multivariable logistic regression analysis was performed considering the patient's demographic characteristics, clinical history, surgery details and laboratory findings to identify potential risk factors for venous thromboembolism among cancer patients undergoing surgery. The results of univariate and multivariate logistic regression models are summarised in (Table 4). The results showed that the risk of VTE increased with age: in comparison with patients under 45 years, the OR of VTE increased exponentially by age and was 11.70 (95% CI: 4.01-34.15, $p < 0.001$) in those over 60 years. Similarly, a previous history of malignant disease (OR = 2.43; 95% CI: 1.29-4.61, p = 0.006), history of chemotherapy (OR = 5.61; 95% CI: 1.5720.02, p = 0.008), increased loss of blood during surgery (OR = 1.00; 95% CI: 1.00-1.01), increased duration of surgery (OR = 1.00; 95% CI: 1.00-1.01), and an increased CA-199 (OR = 1.03; 95% CI: 1.00-1.05, p = 0.023) all appeared to increase the risk of experiencing 24hr VTE. Surprisingly, increased APTT (OR = 0.92, 95% CI: 0.85-0.98) was associated with a lower odd of VTE. The multivariate logistic regression model found that increased age and history of chemotherapy and surgery were associated with increased odds of 24hr VTE in patients with gastric cancer.

Table 4: Significant Crude and Adjusted Risk Factors for 24hr VTE among Patients Based on Logistic Regression

	Univariate Unadjusted Risk of 24hr VTE	**Multivariate Adjusted Risk of 24hr VTE**		
	OR (95% CI)	P value	OR (95% CI)	P value
Demographics				
Age	1.07 (1.04-1.09	<0.001	1.07 (1.03-1.10)	<0.001
Age Category				
≤ 45	1 (REF)		1 (REF)	
46 to 55	3.39 (1.07-10.79)	0.039	1.52 (0.21-10.86)	0.676
56 to 65	4.88 (1.66-14.34)	0.004	1.77 (0.13-23.56)	0.666
> 65	11.70 (4.01-34.15)	<0.001	3.01 (0.10-93.83)	0.53
Male gender	1.03 (0.58-1.82)	0.923	0.78 (0.40-1.52)	0.468
Clinical history History of Malignant				
Disease	2.43 (1.29-4.61)	0.006	0.24 (0.02-3.79)	0.31
History of Diabetes	0.43 (0.17-1.11)	0.082	0.35 (0.12-1.05)	0.061
History of Chemotherapy	5.61 (1.57-20.02)	0.008	0.11 (0.03-0.44)	0.002
History of Surgery	0.61 (0.35-1.06)	0.08	0.49 (0.25-0.98)	0.044
Clinical Results				
CEA	1.03 (0.99-1.07)	0.178	1.02 (0.98-1.07)	0.335
CA199	1.03 (1.00-1.05)	0.023	1.03 (0.99-1.06)	0.129
D-DIMER	1.14 (0.94-1.38)	0.177	1.03 (0.88-1.21)	0.719
APTT	0.92 (0.85-0.98)	0.015	0.94 (0.86-1.02)	0.146
Surgery characteristics				
Duration Of Surgery	1.00 (1.00-1.01)	0.007	1.00 (1.00-1.01)	0.791
Intra-Op Blood Loss	1.00 (1.00-1.01)	0.007	1.00 (1.00-1.01)	0.206
Surgery mode				
Open	1 (REF)	1 (REF)		
Laparoscopic	2.47 (1.02-5.98)	0.045	2.02 (0.72-5.63)	0.181
Robotic	2.81 (0.59-13.34)	0.193	2.24 (0.38-13.13)	0.373
Changed mode	2.25 (0.13-40.66)	0.583	3.86 (0.16-93.76)	0.407
Type of Surgery				
Appendectomy	1 (REF)	1 (REF)		
Colon Resection	3.00 (0.64-14.15)	0.165	1.23 (0.22-6.90)	0.811
Exploratory	2.75 (0.39-19.67)	0.314	2.09 (0.22-19.98)	0.521
Exploratory	5.19 (1.38-19.62)	0.015	2.73 (0.63-11.85)	0.179
Hernia	2.75 (0.59-12.85)	0.198	1.52 (0.27-8.41)	0.634
Peritoneal Mass	2.75 (0.39-19.67)	0.314	3.13 (0.32-30.28)	0.324

Rectal	4.28 (0.80-22.93)	0.09	1.80 (0.29-11.10)	0.526
Small Bowel Resection IntraOP blood	0.82 (0.11-5.99)	0.84	0.81 (0.09-7.01)	0.848
Transfusion	3.29 (1.03-10.57)	0.045	2.31 (0.66-8.04)	0.189

6. Discussion

Thromboembolic events are a significant cause of morbidity and mortality in abdominal surgery patients. In the present study, VTE occurred in 104/209 (49.8%) patient's post-op, almost a 5-fold increase from the initial 22/209 (10.5) patients who had VTE before surgery. To the best of our knowledge, our study is the first to assess VTE incidence in the first 24 hours' post-surgery among patients undergoing major abdominopelvic surgeries. However, a variable incidence of VTE in GI surgeries have been reported [13, 14]. The general routine practice of our centre is; no patient is put on thromboprophylaxis before surgery, all patients get thromboprophylaxis after surgery and no extended thromboprophylaxis post-hospital discharge except in a few exceptional cases. Of the 104 post-op VTE cases, only 4 had mild chest pain and dyspnea symptoms. Many guidelines have recommended extended post-hospital discharge prophylaxis after abdominopelvic oncologic resections as a means of preventing VTE. However, our work shows that more than 45% of patients undergoing abdominopelvic surgeries will have asymptomatic VTE in the early postoperative 24 hours. Most abdominopelvic surgeries are major surgeries that require a longer duration; hence more stress on the body may contribute to the release of more tissue factors and procoagulant proteins. Pneumoperitoneum and general anaesthesia in laparoscopic surgeries have also been documented as risk factors for early VTE incidence [15]. Venous blood flow stasis in the inferior vena cava and common iliac veins due to insufflation of the abdominal cavity with carbon dioxide are all potential causes of early post-op VTE [16]. Our results showed that the risk of VTE increased with age, a previous history of malignant disease (cancer), history of chemotherapy, increased loss of blood during surgery, longer duration of surgery, and an increased CA-199. We also found that history of chemotherapy and previous surgery was associated with increased odds of VTE in the first postoperative 24 hours in patients with gastric cancer; however, increased APTT was associated with lower odds of VTE. In a review analysis by Chopard et al. [17], it was reported that old age and malignancy was associated with higher risks of VTE. Similarly, in a study to assess the risk of recurrence of thromboembolic disorders in patients with VTE, it was reported that old age, male gender, proximal location of DVT and obesity are baseline parameters that increase the risk of VTE [18]. Age below 65 years had a positive association with odds of VTE diagnosis, whereas above 65 years had a negative association with the odds of VTE diagnosis in a report by Nastasi et al. [19]. The present study found an increased risk of VTE as age increases, especially among those over 65 years, similar to that earlier reported [20].

The most recent American College of Chest Physicians antithrombotic therapy guidelines suggest that patients with isolated subsegmental PE at low risk of progression or recurrence may not require anticoagulation [21]. They reported a low risk of recurrence (1% after 1 year and 3% after 5 years) in patients with VTE provoked by surgery [21]. Anticoagulation is recommended for only 3 months, as previous randomised trials showed that significant bleeding risk during extended anticoagulant treatment beyond this period outweighed the risk of recurrent VTE [22, 23]. Old age and cancer, amongst others, have been associated with bleeding during anticoagulant treatment. A 3 times case- fatality rate of bleeding, which may affect the quality of life higher than case-fatality rates of recurrent VTE, have also been documented [24]. In a study to determine the outcomes related to VTE in geriatric trauma patients, Prabhakaran et al. [25] reported a male predominance in the VTE group ($P < 0.001$). In another study, Bistervels et al. [26] said that females have an increased insusceptibility to VTE at a younger age than their male counterparts. Different presentations of VTE has been reported in males and females. Women aged 40-69 had a higher proportion of isolated distal DVT (IDDVT), especially between 40 and 49 years, whereas men had more often proximal DVT [27]. They also reported sex and age as dependent factors of presenting the location of an initial acute DVT. In our study, we did not find any significant difference between males and females (69/138 vs 35/71, $p = 0.923$) in VTE incidence in the first 24 hours post-op.

To date, the decision to give extended thromboprophylaxis or not remains a challenge, especially in cancer patients. Cancer patients present with both increased risk of VTE as well as bleeding. Gastrointestinal bleeding has been reported as a common adverse effect of chemothromboprophylaxis [19, 28]. It has been reported that tissue factor as a procoagulant protein expressed by cancer cells together with other cancer tissue procoagulant properties highly contributes to the hypercoagulable states of cancer patients [29]. Increased levels of leukocytes, platelets, and tissue factor-positive (TF+) microvesicles (MVs) have all been proposed as potential factors that alone or in combination increase cancer-associated thrombosis [30]. Both hematologic and solid cancer status has been well documented as significant high-risk factors for postoperative VTE. Major abdominal surgeries have high risks of intraoperative and postoperative bleeding hence the reluctance of many general surgeons to employ pharmacological thromboprophylaxis agents in the preoperative period. Fong et al. [31] did not observe a statistically significant difference between patients who received preoperative heparin compared with those who did not (2.6% vs 1.3%, respectively; $p = 0.079$). However, there was an

association with increased VTE rates among patients who received preoperative heparin (OR 2.93, 95% CI 1.10-7.81; p = 0.031) [31].

Even though 104 patients had a postoperative incidence of VTE, only 4 were symptomatic, with one patient progressing to PE. In a study investigating the effectiveness of extended Low molecular weight heparin (LMWH) prophylaxis in high-risk cancer patients by Wright et al. [32], they found no association between the use of extended duration prophylaxis and VTE reduction. They, however, reported an increased risk of postoperative events in those with extended duration prophylaxis after colectomy, following ovarian cancer-directed surgery and hysterectomy for endometrial cancer [32]. In another study to determine the in-hospital and up to 90 days post-op VTE, they found no significant decrease in VTE over time even with a substantial increase in the use of perioperative and in-hospital VTE chemoprophylaxis (31.6% to 86.4% and from 59.6% to 91.4%, respectively) [33]. Vendler et al. [34] investigate the risk of VTE and the cost of preventing VTE by prolonged thromboprophylaxis under ERAS (enhanced recovery after surgery), practice and reported 4 (0.20%) out of 1893 patients, experiencing nonfatal symptomatic VTE with all 4 patients having other postoperative complications before the VTE [34]. Their study concluded that the risk of symptomatic VTE after uncomplicated, elective surgery for colon cancer under ERAS protocol is negligible. In the era of ERAS, most patients are at significantly reduced risk of post-op VTE, and those who do get VTE as triggered by a stressful surgery are primarily asymptomatic and do not progress further to any fatal complications. However, in oncological surgery, most patients will develop subclinical VTE findings on ultrasound in the first 24 postoperative hours. The administration of prolonged pharmacological VTE agents after hospital discharge is very controversial. Many studies support the idea, just as many do not support the concept of extended post-hospital discharge thromboprophylaxis for the general patient population. Our current work did not actively observe patients for post-op VTE incidence beyond 24 hours or the progression of asymptomatic VTE to symptomatic VTE; additional studies are required to investigate the progression of asymptomatic VTE to symptomatic VTE after surgery. Although this study provided some meaningful evidence in clinical practice, it is not without limitations; we did not follow up to study VTE incidence or asymptomatic VTE progression into symptomatic or PE beyond the 24 hours' post-operative hours. Future studies can study incidence within 24 hours, day 7, day 15, day 30 and day 90 to better assess progression from asymptomatic to symptomatic VTE and from DVT to PE to better evaluate the use of extended chemoprophylaxis. A multi-centre extensive study is needed to make more generalized changes to guidelines.

7. Conclusion

Our work showed a 4-fold increase in VTE incidence after surgery in the first postoperative 24 hours. From our findings, a significant number of patients had asymptomatic VTE in the first postoperative 24 hours. The general assumption that the Asian population has a very low incidence of VTE and therefore no extended use of chemoprophylaxis to prevent post-surgery VTE as a routine practise should be revised.

8. Author contribution

Eugene Abbey: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Writing - original draft; Writing - review & editing. Mainprice Akuoko Essuman: Formal analysis, Writing - in the draft; Writing - review & editing. Zhang Zhen: Review. Jiang Jianwu: Review. Liu Qi: Review and editing. Prof Fu Yang: Supervision; Validation.

9. Data Availability

The datasets supporting the conclusions of this article are available from the corresponding author upon reasonable request.

10. Conflicts of interest

The authors declare that they have no conflicts of interest.

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