



Original article

Cancer-related thrombosis among older patients in a hospital in Vietnam: A retrospective study

The Ha Ngoc Than^{ab}, Lan Phuong Nguyen^c, Tien Ngoc Hoanh My Nguyen^{ab}, Tai Huy Kien Pham^{de}, Tran To Tran Nguyen^{ae*}, Nhan Thanh Vo^a

^aDepartment of Geriatrics, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam;

^bDepartment of Geriatrics-Palliative Care, Ho Chi Minh City University Medical Center, Ho Chi Minh City, Vietnam;

^cKhanh Hoa General Hospital, Khanh Hoa Province, Vietnam;

^dDepartment of Oriental Internal Medicine, University of Medicine and Pharmacy at Ho Chi Minh City, Ho Chi Minh City, Vietnam;

^eDepartment of Geriatrics, Gia Dinh People's Hospital, Ho Chi Minh City, Vietnam.

Received March 01, 2022; Revised April 28, 2022; Accepted May 12, 2022

Abstract: Introduction: Venous thromboembolism (VTE), a highly prevalent complication in cancer patients, causes prolonged hospitalization and mortality. This study aimed to investigate the characteristics of VTE in older patients with cancer. **Methods:** This was a retrospective study. Data were extracted from electronic medical records at the Geriatrics-Palliative Care Department of University Medical Center Ho Chi Minh City. Inclusion criteria included: aged ≥ 60 years, confirmed or newly diagnosed with cancer, and new VTE diagnosis. Exclusion criteria included lacking any information on demographics, laboratories, or treatments. Pulmonary embolism (PE) was confirmed using chest computerized tomography scans, while deep vein thrombosis (DVT), and other types of venous thrombosis were confirmed based on a doppler or abdominal ultrasound. Data were analyzed using Stata 15.0, with $p < 0.05$ signifying statistical significance. **Results:** Data of 151 patients were extracted from 1170 medical records (median age: 67, range 60 to 89 years). The three most frequent types of VTE were portal vein thrombosis (48.3%), PE (30.5%), and DVT (29.1%). Stage IV cancer was found in 74.2% of VTE patients. Leg pain was presented in 59.1% of the patients with DVT, and dyspnea was confirmed in 80.4% of the patients with PE. Anticoagulant therapy was the most common treatment for VTE (33.8%) and no major bleeding was recorded. **Conclusions:** VTE was highly common among older patients with advanced cancer. Leg pain was an indicator of DVT and dyspnea was a warning sign of PE in older patients with cancer. No major bleeding was recorded in those receiving anticoagulants.

Keywords: deep vein thrombosis; portal thrombosis; pulmonary embolism; retrospective; VTE.

1. INTRODUCTION

In individuals with cancer, venous thromboembolism (VTE) including deep venous thrombosis (DVT) and pulmonary embolism (PE) is a highly prevalent complication. Approximately 4-20% of cancer patients will experience VTE

and those with active cancer have a 5 to 7-fold increased risk of developing this [1]. A systematic review in Asian countries reported that the incidence of VTE in individuals with cancer was 1.85–9.88 per 1,000 person-years [2]. In particular, VTE is the second leading cause of death [3], causes frequent and

*Address correspondence to Tran To Tran Nguyen at the Department of Geriatrics, University of Medicine and Pharmacy at Ho Chi Minh City, 217 Hong Bang Street, Ward 11, District 5, Ho Chi Minh City, Vietnam; E-mail: nguyentrantotran@gmail.com or nguyentrantotran@ump.edu.vn

DOI: 10.32895/UMP.MPR.7.1.2

prolonged hospitalization, and decreases the quality of life among individuals with cancer [4].

In Vietnam, cancer is the second leading cause of death in older adults (age ≥ 60 years based on the WHO's definition) [5, 6]. Older adults with cancer have a significantly higher risk of developing VTE than younger ones because of several contributing factors, including older age [7], comorbidities [8], immobility [9], and frailty [10]. A study in Poland reported that older people with cancer experiencing PE had a hospital mortality rate six times higher and a long-term mortality rate three times higher than younger patients with cancer [11]. Moreover, 50% of deaths in older cancer patients with VTE occur within 3 months of the VTE diagnosis [12].

Vietnam is a rapidly aging country in Asia with approximately 12 million older people in 2019, and this number is projected to rise to approximately 30 million people in 2050 [13]. There are approximately 165,000 new cancer cases and 115,000 cancer deaths each year in Vietnam [14]. However, when we searched PubMed, Scopus, Web of Science, and Google Scholar using the keywords for thrombosis AND cancer AND Vietnam, no previous studies were available. Early recognition of the signs and symptoms of DVT and PE will help reduce related complications and mortality in older adults with cancer [15, 16]. Previous studies found early and appropriate treatment may reduce approximately 40% of mortality in PE patients [17, 18]. Therefore, we aimed to investigate the characteristics of VTE in older adults with cancer in the Geriatrics-Palliative Care Department of the University Medical Center Ho Chi Minh City, a university hospital.

2. MATERIALS AND METHOD

2.1. Study settings

We conducted this study at the Geriatrics-Palliative Care Department of the University Medical Center Ho Chi Minh City, a university hospital.

2.2. Study design and participants

This was a retrospective study. We extracted data within 5 years, between January 1st, 2016, and December 31st, 2020. Inclusion criteria included: age ≥ 60 years, admission to the Geriatrics-Palliative Care Department during the study period, a new or confirmed diagnosis of cancer, and a new diagnosis of VTE. Exclusion criteria included: lacking any information related to demographics, laboratories, or treatments. Geriatricians collected data based on electronic medical records. Patients received no further follow-up after discharge.

Measurements

Collected data included: (1) demographics including age, sex, and education level; (2) comorbidities; (3) type and stage of cancer; (4) admission diagnosis; (5) laboratory information such as X-rays, chest computerized tomography (CT) scans, ultrasound, and blood tests; (6) immobility; (7) length of hospital stay; and (8) treatment of VTE. Bleeding complications were followed up in patients receiving anticoagulants from the first date of use until the discharge date. Major bleeding complications were defined as fatal bleeding and/or overt bleeding in an area or organ such as bleeding that was intracranial, intraspinal,

retroperitoneal, pericardial or intra-articular, or intramuscular with compartment syndrome and/or bleeding causing hemoglobin decrease of ≥ 2 g/dL or requiring transfusion of ≥ 2 units of red blood cells [19]. Immobility was defined as confinement to bed or chair at least 3 days before VTE diagnosis [20].

DVT and other types of venous thrombosis were confirmed using a doppler or abdominal ultrasound performed by specialists. PE was diagnosed using chest computerized tomography (CT) scans and the results were analyzed by diagnostic image specialists.

Patients aged 60-69 years were grouped as < 70 while those aged 70 years or older were grouped as ≥ 70 since previous studies explored that individuals aged ≥ 70 years tend to present atypical symptoms [21, 22].

Bias

To avoid bias in VTE measurement, the results of the ultrasounds and CT scans in our study were interpreted by diagnostic image specialists of the University Medical Center, who are highly qualified and experienced

2.3. Statistical method

Characteristics of the study participants were presented as mean \pm standard deviation (SD) or median (interquartile range, IQR) for continuous variables, and as frequency (percentages) for categorical variables as appropriate. Differences in characteristics were evaluated using T-tests for continuous variables; and χ^2 or Fisher exact tests for categorical variables by age groups.

Data analysis was carried out in Stata version 15.0 (StataCorp LP, College Station, Texas). Statistically significant levels are set at p values of 0.05.

2.4. Ethical considerations

The study was approved by the Institutional Review Board of the University of Medicine and Pharmacy at Ho Chi Minh City (approval number: 140/HĐĐĐ-ĐHYD). This retrospective study was observational; hence, written informed consent was not obtained from participants.

3. RESULTS

A total of 1170 medical records with various types of cancer were reviewed during the study period, 1016 patients were excluded due to non-VTE diagnoses and 3 were excluded due to missing information. Consequently, data from 151 eligible patients were collected.

The general characteristics of the study population are presented in **Table 1**. The median age of patients who developed VTE was 67 (range 60 to 89). The highest rate of VTE was observed in patients with hepatocellular carcinoma (HCC) (50%), followed by those with lung cancer (14.6%). Approximately three-fourths of the individuals who developed VTE had stage IV cancer, and at the time of VTE diagnosis, nearly half of the patients (47%) were newly diagnosed with cancer. The results showed that 77.3% of patients with VTE had immobility. In our study, 92.1% of patients with VTE received cancer treatment, and the most

frequent comorbidity among them was infection (39.7%, n = 60).

We found that portal vein thrombosis (48.3%) was the most common type of VTE, followed by PE (30.5%) and DVT (29.1%). Details of the VTE types are given in Figure 1.

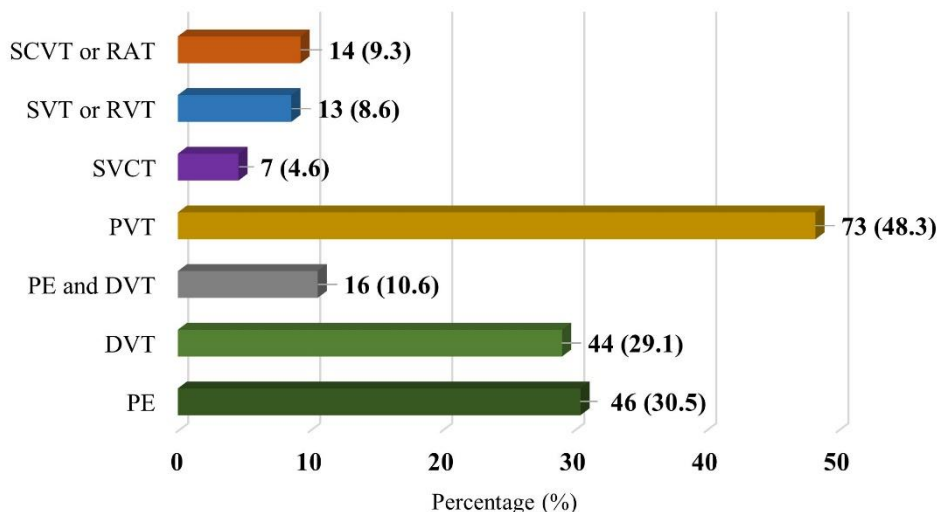


Figure 1. Sites of venous thromboembolism (n = 151)

Abbreviations: SVCT = Super vena cava thrombosis; DVT = Deep venous thrombosis; SVT = Splenic vein thrombosis; SCVT = Subclavian vein thrombosis; RAT = Right atrial thrombosis; RVT = Renal vein thrombosis; PE = pulmonary embolism; PVT = portal vein thrombosis.

Table 1. Characteristics of 151 cancer patients with VTE by age groups, admitted to the department between January 2016 and December 2020

Variable	Total (n = 151)	Age <70 (n = 83)	Age ≥70 (n = 68)	p value
Age, median [range]	67 [60-89]			
Gender, n (%)				0.937
Female	55 (36.4)	30 (36.1)	25 (36.8)	
Male	96 (63.6)	53 (63.8)	43 (63.2)	
City residence, n (%)	57 (37.6)	29 (34.9)	28 (41.2)	0.432
Body mass index, kg/m ² , mean ± SD	21.0 ± 3.3	21.2 ± 3.4	20.8 ± 3.1	0.476
High fall risk (%)	116 (76.8)	66 (79.5)	50 (73.5)	0.386
Comorbidities, n (%)				
Heart failure	3 (2.0)	0 (0.0)	3 (4.4)	0.091 [§]
Atrial fibrillation	6 (4.0)	2 (2.4)	4 (5.9)	0.412 [§]
Gastrointestinal bleeding	7 (4.6)	6 (7.2)	1 (1.5)	0.129 [§]
History of stroke	9 (6.0)	4 (4.8)	5 (7.4)	0.732 [§]
Ischemic heart disease	14 (9.9)	4 (4.8)	14 (9.9)	0.054 [§]
Diabetes	28 (18.5)	21 (25.3)	7 (10.3)	0.021 [§]
Chronic kidney failure	39 (25.8)	10 (12.0)	29 (42.7)	<0.001
Hypertension	52 (34.4)	24 (28.9)	28 (41.2)	0.115
Primary cancer site, n (%)				
Liver (Hepatocarcinoma)	76 (50.0)	43 (51.8)	33 (48.5)	
Lung	22 (14.6)	11 (13.8)	11 (16.2)	
Colon or rectum	9 (6.0)	6 (6.3)	3 (4.4)	
Stomach or esophagus	8 (5.3)	5 (6.3)	3 (4.4)	
Pancreas	6 (4.0)	5 (6.3)	1 (1.5)	
Gallbladder or biliary tract	6 (4.0)	4 (5.0)	2 (2.9)	
Ovary and uterine	4 (2.7)	3 (3.8)	1 (1.5)	
Lymphoma	4 (2.7)	0 (0.0)	4 (5.8)	
Prostate	2 (1.4)	0 (0.0)	2 (2.9)	
Breast	2 (1.4)	1 (1.3)	1 (1.5)	
Kidney	2 (1.4)	0 (0.0)	2 (2.9)	
Others	10 (6.5)	4 (5.4)	6 (7.5)	

Table 1. (continue)

Variable	Total (n = 151)	Age <70 (n = 83)	Age ≥70 (n = 68)	p value
Clinical stage, n (%)				0.048 [§]
I	0	0	0	
II	9 (5.9)	4 (4.8)	5 (7.4)	
III	30 (19.9)	11 (13.3)	19 (27.9)	
IV	112 (74.2)	68 (81.9)	44 (64.7)	
Cancer at the time of VTE, n (%)				0.993
Before	0 (0)	0 (0)	0 (0)	
Simultaneous	71 (47.0)	39 (47.0)	32 (47.1)	
After	80 (53.0)	44 (53.0)	36 (52.9)	
Metastatic, (%)	112 (74.2)	68 (81.9)	44 (64.7)	
Risk factors of VTE				
Any infection, n (%)	60 (39.7)	33 (39.8)	27 (39.7)	0.411
Immobility, n (%)	117 (77.3)	63 (76.8)	53 (77.9)	<0.001
Recent surgery, n (%)	67 (45.0)	35 (42.7)	32 (47.8)	0.535
Hospital stay, day, mean ± SD	11.6 ± 8.6	10.7 ± 7.4	12.8 ± 9.9	0.144
Time to VTE diagnosis, median [range]	2 [0; 60]	2 [0; 55]	3.5 [0; 60]	
Laboratory findings, mean ± SD				
White blood cells, K/μL	11.4 ± 6.4	11.5 ± 5.8	11.3 ± 7.1	0.820
Red blood cells, T/L	3.9 ± 0.9	4.1 ± 0.9	3.7 ± 1.0	0.013
Hemoglobin, g/L	113.7 ± 24.5	116.4 ± 22.6	110.3 ± 26.4	0.127
Platelet, Giga/L	237.3 ± 125.6	247.7 ± 127.9	224.5 ± 122.6	0.266
C-reactive protein, mg/L	76.3 ± 68.9	75.9 ± 68.3	76.8 ± 70.4	0.944
Urea, mg/dL	46.6 ± 47.2	40.7 ± 48.3	53.7 ± 45.0	0.096
Creatinine, μmol/L	94.3 ± 48.1	84.3 ± 42.5	106.5 ± 51.9	0.004
ALT, UI/L	63.6 ± 69.1	66.5 ± 65.5	60.1 ± 73.7	0.574
Treatment for cancer, n (%)				
Surgery for cancer	67 (44.4)	35 (42.7)	32 (47.8)	0.535
Chemotherapy	56 (37.1)	34 (41.5)	22 (32.4)	0.251
Radiation	16 (10.6)	10 (12.1)	6 (8.8)	0.522
Treatment for VTE, n (%)				0.921 [§]
Anticoagulation drugs	51 (33.8)	30 (36.1)	21 (30.9)	
IVC filters	2 (1.3)	1 (1.2)	1 (1.5)	
Anticoagulant + IVC filters	2 (1.3)	1 (1.2)	1 (1.5)	
No treatment	96 (63.6)	51 (61.5)	45 (66.2)	

The p-value for the difference between age groups was calculated with the independent samples t-test for continuous data and Chi-squared for categorical data

[§] Non-parametric test: Wilcoxon rank-sum test or Fisher's exact test applied.

Abbreviations: ALT = Alanine aminotransferase; IVC = inferior vena cava; CFS = Clinical Frailty Scale; SD = standard deviation

Table 2. Clinical characteristics of 44 patients with deep venous thrombosis

	Total n = 44 (%)	Age < 70 n = 25 (%)	Age ≥ 70 n = 19 (%)	p value
Edema	27 (61.4)	13 (52.0)	14 (73.7)	0.143
Pain	26 (59.1)	13 (52.0)	13 (68.4)	0.272
Cellulitis	0 (0)	0 (0)	0 (0)	-
Duplex ultrasonography findings				
Lower extremity				0.512
Left	25 (56.8)	13 (52.0)	12 (63.2)	
Right	8 (18.2)	6 (24.0)	2 (10.5)	
Both	11 (25.0)	6 (24.0)	5 (26.3)	
Thrombosis site				0.766 [§]
Distal	22 (50.0)	14 (56.0)	8 (42.1)	
Proximal	2 (4.6)	1 (4.0)	1 (5.3)	
Distal and proximal	20 (45.4)	10 (40.0)	10 (52.6)	
Thrombotic type				
Stable	44 (100.0)	25 (100.0)	19 (100.0)	-
Occlusive	43 (97.7)	25 (100.0)	18 (94.7)	0.246

The p-value for the difference between age groups was calculated by the Chi-squared test.

[§] Non-parametric test: Fisher's exact test applied

Table 3. Characteristics of 46 patients with pulmonary embolism

	Total n = 46 (%)	Age < 70 n = 26 (%)	Age ≥ 70 n = 20 (%)	<i>p</i> value
Symptoms or signs				
Shock	0 (0)	0 (0)	0 (0)	-
Syncope	0 (0)	0 (0)	0 (0)	-
Low blood pressure	1 (2.2)	0 (0)	1 (5.0)	-
Hemoptysis	5 (10.9)	4 (15.4)	1 (5.0)	0.262 [§]
Wheezing	21 (45.7)	13 (50.0)	12 (60.0)	0.500
Chest pain	26 (56.5)	19 (73.1)	7 (35.0)	0.010
Rale	32 (69.6)	20 (76.9)	12 (60.0)	0.216
Tachypnea	33 (71.7)	21 (80.7)	12 (60.0)	0.121
Dyspnea	36 (80.4)	21 (80.7)	16 (80.0)	0.880
Location of pulmonary embolism				
Unilateral	33 (71.7)	20 (76.9)	13 (65.0)	0.373
Bilateral	13 (28.3)	6 (23.1)	7 (35.0)	
Chest X ray findings				
Normal	10 (22.7)	4 (15.4)	6 (30.0)	0.097 [§]
Westermarck sign	0 (0)	0 (0)	0 (0)	
Hampton hump	1 (2.3)	0 (0)	1 (5.0)	
Fleischner sign	0 (0)	0 (0)	0 (0)	
Pleural effusions or infiltrates	23 (52.3)	17 (65.4)	6 (30.0)	
Calcification	12 (27.3)	5 (19.2)	7 (35.0)	
Chest CT-scans findings				
Lobar	37 (80.4)	22 (84.6)	15 (75.0)	0.415 [§]
Central	0 (0)	0 (0)	0 (0)	
Lobar + central	9 (19.6)	4 (15.4)	5 (25.0)	

The *p*-value for the difference between age groups was calculated by Chi-squared test.

[§] Non-parametric test: Fisher's exact test applied.

Abbreviations: CT = computed tomography

Table 4. Characteristics of 53 patients receiving anticoagulation therapy

	n = 53 (%)
Type of anticoagulant, n (%)	
LMWH	44 (83.0)
UFH followed by oral vitamin K antagonists	4 (7.6)
UFH followed by DOAC	4 (7.6)
DOAC (Rivaroxaban)	1 (1.8)
Withholding, n (%)	14 (26.2)
Reasons for withholding, n (%)	
Major bleeding	0 (0)
Minor bleeding	2 (3.8)
Thrombocytopenia	3 (5.7)
Patient's preference	9 (17.0)

Abbreviations: DOAC = direct oral anticoagulant; LMWH = low molecular weight heparin; UFH = unfractionated heparin

Table 2 presents the clinical characteristics of patients with DVT. Leg edema was the most frequent symptom (61.4%) in patients with DVT and thrombosis occurred more often in the left extremity than in the right. Meanwhile, dyspnea was the most frequent symptom (80.4%) in those with PE of all ages. For patients aged < 70 years, it appears that dyspnea and tachypnea were found at the same rate (**Table 3**).

Of the 151 patients who developed VTE, 51 (33.8%) patients were receiving anticoagulant therapy, 2 (1.3%) were receiving inferior vena cava filter therapy and 2 (1.3%) were receiving both therapies. The remainders did not receive VTE treatment due to contraindication, patients' preference, or their diagnosis being asymptomatic portal vein thrombosis. Most of the patients (83%) received low molecular weight heparin (LMWH) (Enoxaparin 1mg/kg/12h) while 8 (15.2%)

patients received unfractionated heparin (Heparin 80 UI/kg IV bolus, then continuous infusion of 18 UI/kg/h) followed by either warfarin or direct oral anticoagulant (DOAC) as the longer-term treatment. One patient was treated only with DOAC (Rivaroxaban 15 mg twice daily) for his VTE since he had atrial fibrillation and used daily DOAC. No major bleeding was recorded in this study (Table 4).

Table 5. Number of patients receiving anticoagulation therapy by the sites of venous thromboembolism

Site of venous thromboembolism	Total patients	Patients on anticoagulation therapy n (%)
Subclavian vein thrombosis or Right atrial thrombosis	14	7 (50.0)
Splenic vein thrombosis or Renal vein thrombosis	13	12 (92.3)
Super vena cava thrombosis	7	4 (57.1)
Portal vein thrombosis	73	6 (8.2)
Pulmonary embolism and Deep vein thrombosis	16	4 (25.0)
Deep vein thrombosis	44	23 (53.3)
Pulmonary embolism	46	35 (76.1)

4. DISCUSSION

This study aimed to identify the characteristics of VTE among older patients with cancer with the data collected within 5 years (2016-2020). We found that 151 older patients with cancer experienced VTE, and the three most frequent types were portal vein thrombosis, PE, and DVT. At the time of VTE diagnosis, approximately 50% of patients had newly diagnosed cancer. This could suggest that cancer screening should be performed in older adults with a new VTE diagnosis.

In our study, older patients with HCC accounted for half of the individuals with VTE. Hence, this is the reason why portal vein thrombosis was the most common type in our study (48.3%). Another study has shown that approximately 40% of patients with HCC developed portal vein thrombosis [23]. We explored that only 8.2% of patients with portal vein thrombosis received treatment since most of them were asymptomatic and incidentally diagnosed after routine abdominal ultrasounds. Indeed, there are no recent specific recommendations for asymptomatic chronic portal vein thrombosis treatment [24]. Therefore, more than 90% of individuals with portal vein thrombosis in our study did not receive treatment.

The results showed that approximately 60% of older patients with DVT presented with leg edema or leg pain. This finding is similar to the result of the author Piazza's study, which found lower extremity symptoms were met in about 50% of older patients with DVT [25]. When patients get older, the symptoms will be more atypical due to geriatric syndromes [22]. Therefore, apart from leg edema, leg pain should also be considered a warning sign of DVT in older patients with cancer [26].

We also found that all individuals with PE presented with at least one of these symptoms and signs, including dyspnea, tachypnea, chest pain, or wheezing. These findings are in line with previous studies. Dyspnea and tachypnea are the most frequent manifestations in older patients with PE [27]. We revealed that the rate of dyspnea in older individuals with PE in our study is similar to the result of author Luca (80.4% vs 88%) [28], but the rate of tachypnea in our study is relatively

higher than that in Luca's study (71.7% vs 50%). Hence, a complaint of dyspnea in older patients with cancer should be considered a warning sign of PE and should not be overlooked in clinical practice.

Table 5 presents the numbers of patients receiving treatment according to the sites of VTE. The patients with portal vein thrombosis had the lowest rate of receiving treatment.

Chest pain is another symptom of note, as our study observed the rate of chest pain in patients aged < 70 years were more than twice in those aged ≥ 70 years (73.1% vs 35%, $p = 0.010$). This is echoed by the author Ramos [29], who also reported that chest pain was reported in approximately 30% of patients aged ≥ 66 years with PE, which is significantly lower than in younger patients (53%).

In this study, 33.8% of patients with VTE received anticoagulant therapy, LMWH being the most common type. Although a higher age increases the risk of bleeding [30], our study recorded no major bleeding where patients received the recommended doses of anticoagulants. Previous studies showed that people aged 90 years or older are at a mildly increased risk of bleeding [30], and this age group only accounted for a small proportion of our study population.

However, our study also has several limitations. First, we did not conduct routine image screening to detect VTE in all cancer patients; thus, we have been underestimating the number of patients with cancer-related thrombosis. Second, we did not explore the risk factors of VTE in older patients with cancer. Third, this is a single-center study, which also excluded younger patients; hence, the data may not be representative of a more diverse population. However, to the best of our knowledge, this is the first study addressing the characteristics of VTE among older patients with cancer in Vietnam. It provides some implications in assisting physicians in the early recognition of DVT and PE in older adults with cancer, to help reduce the mortality rate and prolonged hospitalization among these patients. Moreover, our study will be the first step to developing a larger multicenter study, which will include a larger population and identify risk factors for developing VTE in Vietnamese patients.

Conclusion

VTE was highly common among older patients with stage IV cancer. At the time of VTE diagnosis, approximately 50% of cases had newly diagnosed cancer. Leg pain may be an indicator of DVT in older patients. More than 80% of patients with PE experienced dyspnea although five other symptoms and signs may be met, including tachypnea, chest pain, wheezing, rales, and hemoptysis. Patients aged ≥ 70 years were less likely to have dyspnea than patients aged < 70 years. No major bleeding was recorded in VTE patients receiving the recommended doses of anticoagulants.


FUNDING


The authors received no financial support for the research, authorship, and/or publication of this article.

CONFLICT OF INTEREST


The authors declare that there is no conflict of interest.


ORCID ID


The Ha Ngoc Than  <https://orcid.org/0000-0003-0731-3045>

Lan Phuong Nguyen  <https://orcid.org/0000-0003-3759-612X>

Tien Ngoc Hoanh My Nguyen  <https://orcid.org/0000-0002-2591-0313>

Tai Huy Kien Pham  <https://orcid.org/0000-0002-2849-5709>

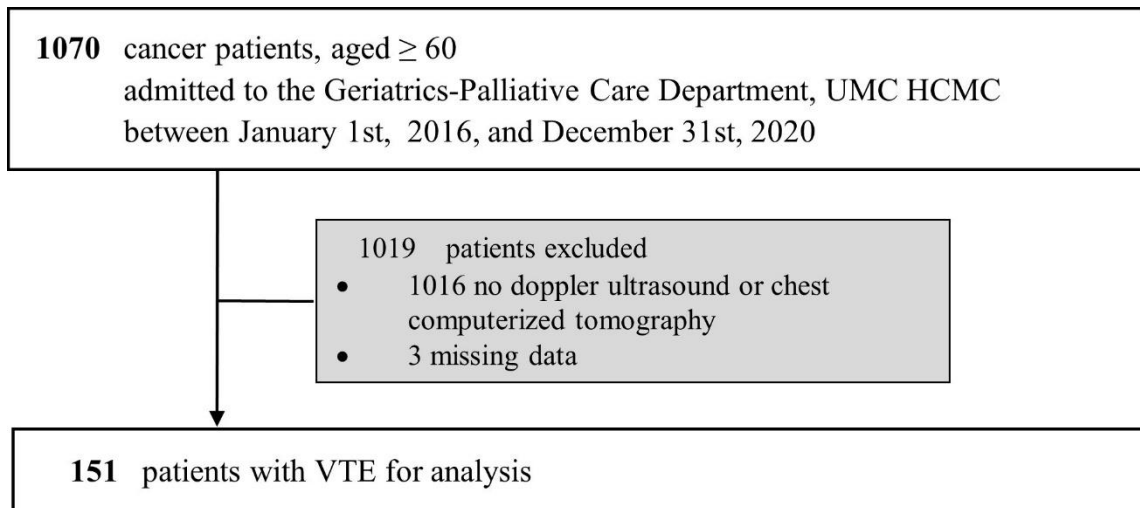
Tran To Tran Nguyen  <https://orcid.org/0000-0001-7225-5430>

Nhan Thanh Vo  <https://orcid.org/0000-0002-7690-444X>

REFERENCES

- Abdol Razak NB, Jones G, Bhandari M, Berndt MC, Metharom P. Cancer-Associated Thrombosis: An Overview of Mechanisms, Risk Factors, and Treatment. *Cancers (Basel)*. 2018;10(10):380.
- Lee LH, Nagarajan C, Tan CW, Ng HJ. Epidemiology of Cancer-Associated Thrombosis in Asia: A Systematic Review. *Frontiers in Cardiovascular Medicine*. 2021;8(435).
- Khorana AA. Venous thromboembolism and prognosis in cancer. *Thrombosis research*. 2010;125(6):490-493.
- Okushi Y, Kusunose K, Okayama Y, et al. Acute Hospital Mortality of Venous Thromboembolism in Patients With Cancer From Registry Data. *Journal of the American Heart Association*. 2021;10(11):e019373.
- Centers for Disease Control and Prevention. Older Persons' Health. Age Groups 2019; Available at <https://www.cdc.gov/nchs/fastats/older-american-health.htm>. Accessed January 4th, 2022.
- Statista. Main causes of deaths based on the number of deaths in Vietnam in 2017. State of Health 2017; Available at <https://www.statista.com/statistics/1107639/vietnam-number-of-deaths-by-cause/>. Accessed January 4, 2022.
- Bizien N, Noel-Savina E, Tromeur C, et al. Age is a major risk factor of venous thromboembolism (VTE). *European Respiratory Journal*. 2011;38(Suppl 55):p3936.
- Ordning AG, Horváth-Puhó E, Garne JP, et al. Impact of comorbidity on risk of venous thromboembolism in patients with breast cancer: a Danish population-based cohort study. *BMJ Open*. 2014;4(6):e005082.
- Ye F, Stalvey C, Khuddus MA, et al. A systematic review of mobility/immobility in thromboembolism risk assessment models for hospitalized patients. *Journal of thrombosis and thrombolysis*. 2017;44(1):94-103.
- Folsom AR, Boland LL, Cushman M, Heckbert SR, Rosamond WD, Walston JD. Frailty and risk of venous thromboembolism in older adults. *The journals of gerontology Series A, Biological sciences and medical sciences*. 2007;62(1):79-82.
- Kiluk IE, Krajewska A, Kosacka U, et al. Different manifestations of pulmonary embolism in younger compared to older patients: Clinical presentation, prediction rules and long-term outcomes. *Advances in medical sciences*. 2017;62(2):254-258.
- Wang H, Xu X, Pu C, Li L. Clinical characteristics and prognosis of cancer patients with venous thromboembolism. *Journal of cancer research and therapeutics*. 2019;15(2):344-349.
- HelpAge network in Asia Pacific. Vietnam AgeWatch Report Card. Ageing population in Vietnam 2020; Available at <https://ageingasia.org/ageing-population-vietnam/>. Accessed August 18th, 2021.
- World Health Organization. Cancer in Vietnam. *Cancer*. Available at <https://www.who.int/vietnam/health-topics/cancer>. Accessed Nov 25th, 2021.
- Tapson VF. Acute pulmonary embolism. *N Engl J Med*. 2008;358(10):1037-1052.
- Kearon C, Akl EA, Comerota AJ, et al. Antithrombotic therapy for VTE disease: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest*. 2012;141(2 Suppl):e419S-e496S.
- Chatterjee S, Chakraborty A, Weinberg I, et al. Thrombolysis for pulmonary embolism and risk of all-cause mortality, major bleeding, and intracranial hemorrhage: a meta-analysis. *Jama*. 2014;311(23):2414-2421.
- Stein PD, Matta F, Keyes DC, Willyerd GL. Impact of vena cava filters on in-hospital case fatality rate from pulmonary embolism. *The American journal of medicine*. 2012;125(5):478-484.
- Schulman S, Kearon C, the SOCOAOTS, Standardization Committee Of The International Society On T, Haemostasis. Definition of major bleeding in clinical investigations of antihemostatic medicinal products in non-surgical patients. *Journal of Thrombosis and Haemostasis*. 2005;3(4):692-694.
- Hull RD, Schellong SM, Tapson VF, et al. Extended-duration thromboprophylaxis in acutely ill medical patients with recent reduced mobility: methodology for the EXCLAIM study. *Journal of thrombosis and thrombolysis*. 2006;22(1):31-38.
- Hofman MR, van den Hanenberg F, Siersevelt IN, Tulner CR. Elderly patients with an atypical presentation of illness in the emergency department. *The Netherlands journal of medicine*. 2017;75(6):241-246.
- Olde Rikkert MG, Rigaud AS, van Hoeyweghen RJ, de Graaf J. Geriatric syndromes: medical misnomer or progress in geriatrics? *The Netherlands journal of medicine*. 2003;61(3):83-87.
- Mähringer-Kunz A, Steinle V, Düber C, et al. Extent of portal vein tumour thrombosis in patients with hepatocellular carcinoma: The more, the worse? *Liver International*. 2019;39(2):324-331.
- Streff MB, Abutalib SA, Farge D, Murphy M, Connors JM, Piazza G. Update on Guidelines for the Management of Cancer-Associated Thrombosis. *The Oncologist*. 2021;26(1):e24-e40.
- Piazza G, Seddighzadeh A, Goldhaber SZ. Deep-vein thrombosis in the elderly. *Clinical and applied thrombosis/hemostasis : official journal of the International Academy of Clinical and Applied Thrombosis/Hemostasis*. 2008;14(4):393-398.
- Yayan J, Bals R. Relative Risk of Deep Vein Thrombosis in Very Elderly Patients Compared With Elderly Patients. *Clinical and Applied Thrombosis/Hemostasis*. 2014;22(1):77-84.
- Masotti L, Ray P, Righini M, et al. Pulmonary embolism in the elderly: a review on clinical, instrumental and laboratory presentation. *Vasc Health Risk Manag*. 2008;4(3):629-636.
- Masotti L, Ceccarelli E, Cappelli R, Guerrini M, Forconi S. Pulmonary embolism in the elderly: clinical, instrumental and laboratory aspects. *Gerontology*. 2000;46(4):205-211.
- Ramos A, Murillas J, Mascías C, Carretero B, Portero JL. Influence of age on clinical presentation of acute pulmonary embolism. *Arch Gerontol Geriatr*. 2000;30(3):189-198.
- Kooistra HAM, Calf AH, Piersma-Wichers M, et al. Risk of Bleeding and Thrombosis in Patients 70 Years or Older Using Vitamin K Antagonists. *JAMA Internal Medicine*. 2016;176(8):1176-1183.

SUPPLEMENTARY MATERIALS



Supplementary figure 1. Study population

Of the 1167 patients with cancer aged ≥ 60 , 1016 subjects were excluded for the lack of ultrasound and computerized tomography data and 3 subjects were excluded for the lack of other characteristic and clinical information. A total of 151 patients were finally examined in the present study.