Original Article
Predisposing factors and effect of bundle nursing in PICC-related upper extremity deep venous thrombosis in patients with non-Hodgkin's lymphoma undergoing chemotherapy

Hong Qian[1*], Jin Liu[2*], Chunyan Xu[3], Wei Zhu[4], Ling Chen[1]

Departments of [1]Nursing, [2]Integrated Traditional Chinese Medicine & Western Medicine, Cancer Hospital of Xinjiang Uygur Autonomous Region (Affiliated Cancer Hospital of Xinjiang Medical University), Urumqi, Xinjiang Uygur Autonomous Region, China; Departments of [3]Hepatobiliary and Pancreatic Surgery, [4]lymphoma, Cancer Hospital of Xinjiang Uygur Autonomous Region (Affiliated Cancer Hospital of Xinjiang Medical University), Urumqi, Xinjiang Uygur Autonomous Region, China. *Equal contributors and co-first authors.

Abstract: Objective: To explore the effects of bundle nursing on PICC-related upper extremity deep venous thrombosis (PICC-UEDVT) in patients with non-Hodgkin's lymphoma (NHL) who are undergoing chemotherapy, and contributing factors toward PICC-UEDVT. Methods: 370 NHL patients undergoing chemotherapy in the Department of Hematology were selected prospectively and randomized into a control group (receiving routine nursing) and an observation group (receiving bundle nursing) using random number method. There were 185 patients in each group. The incidence of PICC-UEDVT and satisfaction rate towards nursing were calculated and risk factors for PICC-UEDVT were explored in the two groups. Results: The incidence of PICC-UEDVT was lower in the observation group (18 patients, 9.73%) than that of the control group (35 patients, 18.92%; P<0.05); the satisfaction rate towards nursing was higher in the observation group than the control group (P<0.05). Tumor stage, ECOG score >2, hemoglobin <100 g/L, and D-dimer >0.5 mg/L were factors that contributed to the occurrence of PICC-UEDVT in NHL patients (P<0.05). Conclusion: Tumor stage, ECOG score >2, reduced hemoglobin, and increased D-dimer levels are predisposing factors for PICC-UEDVT in NHL patients. However, bundle nursing can reduce the incidence of PICC-UEDVT and increase the satisfaction rate towards nursing.

Keywords: Non-Hodgkin's lymphoma, chemotherapy, PICC intubation, thrombosis, predisposing factors

Introduction

Non-Hodgkin's lymphoma (NHL) is a cancer that originates in the lymph node as well as other lymphatic tissues. With the improvement of diagnostic approaches, the detection rate of NHL is on the rise every year with a relatively high mortality. The 5-year survival rate of NHL patients is only 37.2% [1, 2]. NHL in China accounts for 80% of all lymphomas [3]. According to the statistics, NHL ranks 10th among all causes of tumor death in China [4]. Currently, despite the ability for early diagnosis of NHL and the constant development of new drugs, the 5-year survival rate of NHL patients is still low in China, only 37.2% [5]. Long-term intravenous chemotherapy is still the main treatment for NHL patients [6]. However, owing to the particularity of chemotherapeutic drugs, peripherally inserted central catheter (PICC) is often necessary during clinical treatment [7].

Previous studies have shown that patients with malignant tumors are more susceptible to venous thrombosis than patients with other diseases, with an incidence of 6% in NHL patients, and mainly in the lower extremity and the lung [8-10]. It has also been reported that the risk of venous thrombosis in patients with malignant tumors is increased by about 50% after chemotherapy compared with that before chemotherapy, and these patients are more likely to have upper extremity deep venous thrombosis (UEDVT) owing to the long-term use of PICC

[9, 11]. The incidence of upper extremity thrombosis caused by PICC or intravenous infusion is 12.3% [12].

Bundle nursing, a series of evidence-based treatment or nursing approaches for refractory diseases, was proposed by the American Institute for Healthcare Improvement to assist medical staff in providing the best possible nursing services or outcomes for patients. It is composed of a series of related and effective operation, treatment and nursing approaches, that have led to good efficacy in the prevention of venous thrombosis after orthopedic surgery and gynecologic malignant tumor surgery [13]. This manuscript aims to explore whether patients with non-Hodgkin's lymphoma (NHL) who have undergone chemotherapy and need PICC could develop PICC-related upper extremity deep venous thrombosis (PICC-UEDVT) with the use of bundle nursing and show the predisposing factors that result in PICC-UEDVT.

Materials and methods

General data

A total of 370 NHL patients undergoing chemotherapy in the Department of lymphoma of our hospital between January 2018 and June 2020 were selected prospectively and randomized into a control group (receiving routine nursing) and an observation group (receiving bundle nursing) using random number method, with 185 patients in each group. The patients were aged between 22 and 74 years, with an average age of 41.3±7.6 years. Informed consent was obtained from all patients. The study was approved by the Ethics Committee.

Inclusion and exclusion criteria

Patients were included if they were pathologically confirmed with NHL, older than 18 years, had undergone chemotherapy for a long time (longer than 4 months) and needed PICC [3]. Patients were excluded if their clinical data were incomplete, had severe coagulation dysfunction before chemotherapy, had acute thrombosis before, were not available for follow-up, had other cancers, or had participated in other trials.

Methods

General data and other information collection: The general data and other relevant information of the patients, including gender, age, tumor stage, chemotherapy regimen, and PICC duration, were collected by questionnaire.

Randomization: Patients were randomized into a control group receiving routine nursing and an observation group receiving all the interventions in the control group plus bundle nursing.

In the control group, the conditions of patients' veins were evaluated. The indications and complications after PICC intubation were strictly monitored; the site for intubation was disinfected and the intubation process was conducted in intubation room under a sterile environment. The basilic vein in the right upper extremity was selected for puncture under B-ultrasound monitoring, and the pointed end of the catheter was located with X-ray films after puncture. Routine care was given within 24 hours after intubation and once a week thereafter, for unexpected events such as bleeding, catheter sliding-out and local infection, corresponding treatment was delivered. Patients were asked to move their extremity on the operating side with fist clenching 200 times a day (longer than 5 s for each time) 24 hours after intubation. Patients were asked not to carry heavy stuff (>5 kg) with the operated extremity; patients was asked to use water-proof films to cover the intubation site while taking a shower.

In the observation group, regular care was given after intubation and 7 steps for disinfecting hands were strictly followed to ensure sterile operations. A small amount of blood was withdrawn at the beginning of infusion to ensure that the catheter was not blocked. Patients were asked to take a shower before intubation and to drink more than 2000 mL water daily. Wechat messages were sent or telephone calls made to urge patients to move their upper extremity often. Patients and their families were suggested to observe the intubation site for redness, swelling, pain, or skin color change around the site.

Outcome measures: The incidence of UEDVT was calculated in the two groups before and after intervention. Satisfaction with nursing

Table 1. Comparison of general data between the two groups

| Item	Observation group (n=185)	Control group (n=185)	χ^2/t	P
Gender (male/female)	100:85	97:88	0.098	0.775
Age (years)	42.1±7.9	40.9±7.1	1.537	0.125
Chemotherapy regimen			0.300	0.584
Palliative chemotherapy	124	119		
Eradicative chemotherapy	61	66		
Tumor stage (n)			0.796	0.372
Stage I-II	130	122		
Stage III-IV	55	63		
Pathologic type (n)			0.174	0.676
Diffuse large B-cell lymphoma	102	98		
Follicular lymphoma	83	87		
Complications (n)				
Coronary heart disease	10	12	0.193	0.660
Diabetes	19	18	0.030	0.862
Renal disease	4	6	0.411	0.521
With a history of surgery or trauma (n)	24	21	0.228	0.633
ECOG scores (n)			0.143	0.285
0-2	119	109		
3-4	66	76		
Lab Measures before intervention (n)				
Hemoglobin <100 g/L	30	26	0.337	0.562
Blood platelet >350*10^9/L	14	15	0.037	0.847
White blood cell count >11*10^9/L	34	32	0.074	0.786
D-dimer >0.5 mg/L	41	45	0.242	0.622
Albumin <40 g/L	142	137	0.478	0.489

was rated as 5 grades (very satisfied, satisfied, just so-so, unsatisfied, extremely unsatisfied) in accordance with Likert 5 grading method, which was then compared between the two groups [14]. Satisfaction rate (%) = very satisfied (%) + satisfied (%); contributing factors to PICC-UEDVT were compared before and after intervention and analyzed with the use of one-way analysis of variance and multivariate logistic regression.

Statistical analysis

Data were analyzed using SPSS 17.0 software. Continuous variables are expressed as mean ± standard deviation ($\bar{x}$±sd). Whether the data conform to normal distribution as well as the homogeneity of variance were analyzed using independent sample t-test and expressed as t. Independent sample t-test was also used for between-group comparison and paired sample t-test for within-group comparison. One-way analysis of variance combined with post-hoc Bonferroni test was applied for comparison among multiple groups, and Pearson chi-square test was used to analyze enumeration data, which was expressed as chi-square. Pearson correlation analysis was used for the correlations between two variables. Logistic regression analysis was applied to identify the risk factors of PICC-UEDVT in NHL patients with age, percentage of stage III-IV tumor, cases complicated by diabetes and cases with history of surgery or trauma, ECOG score, D-dimer levels as independent variables and occurrence of UEDVT as a dependent variable. Variables with differences by one-way analysis of variance were selected, and were screened with Ward's method, with inclusion level equivalent to 0.05 and exclusion level to 0.1. Odds ratio value (OR value) was used to express the increased risk of PICC-UEDVT occurrence. P< 0.05 was considered significant.
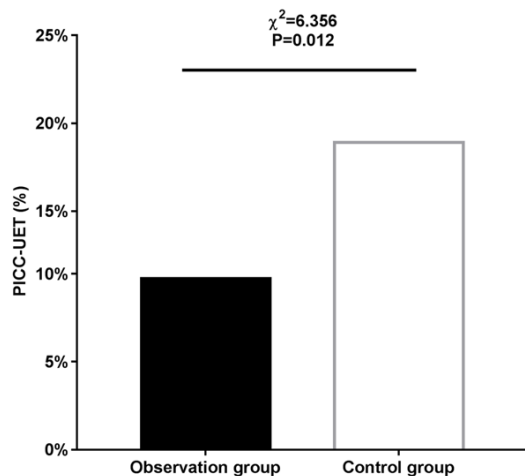
Figure 1. Incidence of PICC-UEDVT during PICC intubation in the two groups PICC-UEDVT: peripherally inserted central catheter-related upper extremity deep venous thrombosis.

Results

Comparison of general data in the two groups

There was no difference in the comparison of general data in the two groups (all P>0.05), see **Table 1**.

Incidence of PICC-UEDVT in the two groups

The incidence of PICC-UEDVT was lower in the observation group (18 cases, 9.73%) than that of the control group (35 cases, 18.92%; P< 0.05), see **Figure 1**.

Comparison of satisfaction rate between the two groups

The total satisfaction rate towards nursing was higher in the observation group (84.32%) than that of the control group (72.97%; P<0.01), see **Table 2**.

Comparison of general data in patients with or without thrombosis between the two groups

Patients were divided into different groups according to the presence or absence of thrombosis. Statistical comparison showed that age, percentage of stage III-IV tumor, the number of patients with diabetes and with a history of surgery or trauma, ECOG score, and D-dimer level were higher in the thrombosis group than those in the non-thrombosis group, while hemoglobin

level was lower in the thrombosis group than that in the non-thrombosis group (P<0.05), see **Table 3**.

Multivariate logistic regression analysis of PICC-UEDVT

It was found by multivariate logistic regression analysis that tumor stage, ECOG score >2, reduced hemoglobin and increased D-dimer levels were factors predisposing to PICC-UEDVT in NHL patients (P<0.05), see **Tables 4**, **5**.

Discussion

NHL is a hematologic malignant tumor. At present, long-term chemotherapy is still the main treatment for NHL patients owing to the high-relapse rate of NHL; however, PICC intubation effectively addresses the problems appearing during long-term chemotherapy [15]. But with the increased use of PICC, the adverse events and complications have substantially increased, too. PICC-UEDVT is one of these adverse events.

Our results showed that the incidence of UEDVT was 14.32% in NHL patients undergoing PICC intubation in this study. A previous study reported that the incidence of PICC-UEDVT was 25.42%, among which 5.08% of the patients presented with significant clinical symptoms [16]. A study at home showed that the incidence of PICC-UEDVT in patients with tumor undergoing PICC intubation was from 5.56% to 17.39% [17, 18], which conformed to our result.

This manuscript reported that bundle nursing for NHL patients undergoing PICC intubation could reduce the risk of thrombosis. It comprised a series of related nursing measures that had been proven to be effective in clinical settings. Bundle nursing, a type of evidence-based medical care, was advantageous in the prevention of thrombosis [19, 20]. It was also found that bundle nursing could reduce the occurrence of deep venous thrombosis in patients undergoing orthopedic surgery (0.00% VS. 13.33%). Another study applied bundle nursing in patients with malignant tumor for the prevention of thrombosis included 14 RCT 1560 patients, with its result being analyzed by Meta-analysis [21]. The results showed that the incidence of deep venous thrombosis (OR= 0.26, 95% CI (0.18, 0.39), P=0.000), D-dimer

Table 2. Comparison of satisfaction rate between the two groups

Group	Very satisfied	Satisfied	Just so-so	Unsatisfied	Extremely unsatisfied	Total satisfaction rate
Observation group (n=185)	112	44	12	15	6	156 (84.32)
Control group (n=185)	77	58	19	19	12	135 (72.97)
χ^2	12.413					7.098
P	0.015					0.008

Table 3. General data of patients with or without thrombosis

Item	Thrombosis group (n=53)	Non-thrombosis group (n=317)	χ^2/t	P
Gender (male/female)	29:24	168:149	0.054	0.816
Age (years)	43.2±8.2	40.2±6.9	2.761	0.006
Chemotherapy regimen (n)			0.995	0.318
Palliative chemotherapy	38	205		
Eradicative chemotherapy	15	112		
Tumor stage (n)			26.272	<0.001
Stage I-II	20	232		
Stage III-IV	33	85		
Pathologic type (n)			0.011	0.917
Diffuse large B-cell lymphoma	29	171		
Follicular lymphoma	24	146		
Complications (n)				
Coronary heart disease	5	17	1.346	0.246
Diabetes	15	22	12.376	<0.001
Renal disease	2	8	0.270	0.603
With history of surgery or trauma (n)	14	31	4.512	0.034
ECOG score (n)			24.834	<0.001
0-2	16	210		
3-4	37	107		
Lab measures before intervention (n)				
Hemoglobin <100 g/L	25	31	49.452	<0.001
Blood platelets >350*10^9/L	6	23	1.010	0.315
White blood cell count >11*10^9/L	12	54	0.974	0.324
D-dimer >0.5 mg/L	40	46	94.584	<0.001
Albumin <40 g/L	38	241	0.458	0.498

level (WMD=-1.22, 95% CI (-1.47, 0.97), P= 0.000) and the satisfaction rate towards nursing (OR=5.88, 95% CI (3.72, 9.31), P=0.000) were all better in the bundle nursing group than those in the routine nursing group, indicating the application of bundle nursing led to effective outcomes for the prevention of venous thrombosis, which was consistent with our study [13].

Further analysis for contributing factors of PICC-UEDVT suggested that tumor stage, ECOG score >2, reduced hemoglobin, and increased D-dimer levels were all factors resulting in PICC-UEDVT in NHL patients. Previous studies on the risk factors of venous thrombosis in NHL patients found that cardiovascular diseases and the use of carmustine drugs could lead to an increased incidence of venous thrombosis [22]. In our study, the incidence of cardiovascular disease was low and was not found to be associated with the occurrence of venous thrombosis. Also, patients were not administered any carmustine drugs. Therefore, these

Table 4. Independent variable assignment for contributing factors to PICC-UEDVT

Contributing factor	Independent factor	Assigned value
Age (years)	X1	>40 years old=1, ≤40 years old=0
Tumor stage (n)	X2	Stage III-IV=1, stage I-II=0
Whether complicated with diabetes	X3	Yes=1, No=0
Whether with history of surgery or trauma	X4	Yes=1, No=0
ECOG score	X5	3-5 points=1, 0-2 points=0
Hemoglobin level	X6	<100 g/L=1, ≥100 g/L=0
D-dimer level	X7	>0.5 mg/L=1, 0.5 mg/L=0

Note: PICC-UEDVT: peripherally inserted central catheter-related upper extremity deep venous thrombosis.

Table 5. Multivariate logistic regression analysis of PICC-UEDVT

Contributing factor	β	SE	Wald value	OR value (95% CI)	P
Age (years)	0.192	0.734	0.069	0.842 (0.193-3.263)	0.731
Tumor stage	0.322	0.834	12.123	6.923 (1.221-8.231)	<0.001
Whether complicated with diabetes	0.821	0.782	1.082	2.291 (0.526-9.923)	0.289
Whether with history of surgery or trauma	1.145	0.732	2.701	3.110 (0.821-10.231)	0.124
ECOG scores	1.712	0.743	5.922	5.143 (1.416-21.932)	0.021
Hemoglobin level	1.934	0.823	6.812	0.176 (0.081 -0.689)	0.012
D-dimer level	0.322	0.834	12.123	6.923 (1.221-8.231)	<0.001

Note: PICC-UEDVT: peripherally inserted central catheter-related upper extremity deep venous thrombosis.

two factors were excluded from our study. Another study showed that the occurrence of systemic venous thrombosis in NHL patients was closely associated with tumor stage, with higher stages indicating higher risks of thrombosis, suggesting that risk of thrombosis was higher in patients with relatively high-stage tumor than in those with relatively low-stage tumor [23]. Thrombosis often occurred after surgery, during diagnosis, and chemotherapy [24, 25]. A domestic study reported that the occurrence of thrombosis in NHL patients was associated with patients' age, low hemoglobin level, and ECOG score [26]. It was also found that the increased incidence of thrombosis in NHL patients might be associated with the fact that chemotherapeutic drugs led to hematologic depression, thus rendering patients' blood in a hypercoagulable state [27]. A study also showed that an increased level of D-dimer led to increased incidence of PICC-UEDVT in patients with malignant tumor [28, 29].

However, this is a study with small sample size. Multi-center studies with more samples are needed, to further explore the risk factors of PICC-UEDVT in NHL patients as well as the clinical significance and value of bundle nursing.

In summary, tumor stage, ECOG score >2, reduced hemoglobin, and increased D-dimer are factors contributing to the occurrence of PICC-UEDVT in NHL patients. However, bundle nursing can reduce the incidence of PICC-UEDVT and increase the satisfaction rate towards nursing.

Disclosure of conflict of interest

None.

Address correspondence to: Ling Chen, Department of Nursing, Cancer Hospital of Xinjiang Uygur Autonomous Region (Affiliated Cancer Hospital of Xinjiang Medical University), No. 789 Suzhou East Street, Urumqi 830011, Xinjiang Uygur Autonomous Region, China. Tel: +86-0991-7968030; Fax: +86-0991-7819371; E-mail: cl365796@126.com; Wei Zhu, Department of Lymphoma, Cancer Hospital of

Xinjiang Uygur Autonomous Region (Affiliated Cancer Hospital of Xinjiang Medical University), No. 789 Suzhou East Street, Urumqi 830011, Xinjiang Uygur Autonomous Region, China. Tel: +86-0991-7819-371; Fax: +86-0991-7819371; E-mail: zhwei322@163.com

References

[1] Kosari F and Ghaffari F. The comparison between microwave and autoclave as antigen retrieval methods for immunohistochemical detection of CD15 and CD30 in hodgkin's lymphoma. Iran J Pathol 2018; 13: 390-396.

[2] Anderson C and Nichols HB. Trends in late mortality among adolescent and young adult cancer survivors. J Natl Cancer Inst 2020; 112: 994-1002.

[3] Hematological Oncology Committee of Chinese Anti-Cancer Association, Leukemia and Lymphoma Group of Hematological Society of Chinese Medical Association and Anti-Lymphoma Alliance of Chinese Society of Clinical Oncology. The Chinese expert consensus on hematopoietic stem cell transplantation for malignant lymphoma (2018). Zhonghua Zhong Liu Za Zhi 2018; 40: 927-934.

[4] Zheng RS, Sun KX, Zhang SW, Zeng HM, Zou XN, Chen R, Gu XY, Wei WW and He J. Report of cancer epidemiology in China, 2015. Zhonghua Zhong Liu Za Zhi 2019; 41: 19-28.

[5] Zeng H, Chen W, Zheng R, Zhang S, Ji JS, Zou X, Xia C, Sun K, Yang Z, Li H, Wang N, Han R, Liu S, Li H, Mu H, He Y, Xu Y, Fu Z, Zhou Y, Jiang J, Yang Y, Chen J, Wei K, Fan D, Wang J, Fu F, Zhao D, Song G, Chen J, Jiang C, Zhou X, Gu X, Jin F, Li Q, Li Y, Wu T, Yan C, Dong J, Hua Z, Baade P, Bray F, Jemal A, Yu XQ and He J. Changing cancer survival in China during 2003-15: a pooled analysis of 17 population-based cancer registries. Lancet Glob Health 2018; 6: e555-e567.

[6] Zhu J, Huang H, Chen H, Zhang X, Li Z, Wu D, Zhou D, Song Y, Hu Y, Liang Y, Ren H, Huang H, Li N, Chen H, Hu J, Li J, Meng R, Wu J, Yu D and Huang X. Plerixafor and granulocyte-colony-stimulating factor for mobilization of hematopoietic stem cells for autologous transplantation in Chinese patients with non-hodgkin's lymphoma: a randomized phase 3 study. Transfusion 2018; 58: 81-87.

[7] Nezami N, Xing M, Groenwald M, Silin D, Kokabi N and Latich I. Risk factors of infection and role of antibiotic prophylaxis in totally implantable venous access port placement: propensity score matching. Cardiovasc Intervent Radiol 2019; 42: 1302-1310.

[8] Raskob GE, van Es N, Verhamme P, Carrier M, Di Nisio M, Garcia D, Grosso MA, Kakkar AK, Kovacs MJ, Mercuri MF, Meyer G, Segers A, Shi M, Wang TF, Yeo E, Zhang G, Zwicker JI, Weitz JI and Büller HR. Edoxaban for the treatment of cancer-associated venous thromboembolism. N Engl J Med 2018; 378: 615-624.

[9] Bakalov V, Tang A, Yellala A, Kaplan R, Lister J and Sadashiv S. Risk factors for venous thromboembolism in hospitalized patients with hematological malignancy: an analysis of the national inpatient sample, 2011-2015. Leuk Lymphoma 2020; 61: 370-376.

[10] Rungjirajittranon T, Owattanapanich W, Ungprasert P, Siritanaratkul N and Ruchutrakool T. A systematic review and meta-analysis of the prevalence of thrombosis and bleeding at diagnosis of philadelphia-negative myeloproliferative neoplasms. BMC Cancer 2019; 19: 184.

[11] Langer F and Bokemeyer C. Crosstalk between Cancer and Haemostasis. Implications for cancer biology and cancer-associated thrombosis with focus on tissue factor. Hamostaseologie 2012; 32: 95-104.

[12] Liu Q. Analysis of risk factors of thrombosis related to implantable intravenous port in patients with lymphoma. Chin Gen Prac 2020; 18: 2241-2243.

[13] Qiu WW, Li HH, Ding XH, Liu YY, Long Y and Li XJ. Meta-analysis of the effect of cluster nursing intervention in preventing postoperative deep vein thrombosis in patients with gynecological malignant tumors. Intern Med Deo 2020; v.15: 61-65.

[14] Fan L and Xi SH. Research on construction of evaluation index system for core competence of emergency Nurses. Chin J Nurs 2011; 46: 144-147.

[15] Choeyprasert W, Anurathapan U, Pakakasama S, Sirachainan N, Songdej D, Lertthammakiat S and Hongeng S. Pediatric non-hodgkin lymphoma: characteristics, stratification, and treatment at a single institute in Thailand. Pediatr Int 2019; 61: 49-57.

[16] Ahn DH, Illum HB, Wang DH, Sharma A and Dowell JE. Upper extremity venous thrombosis in patients with cancer with peripherally inserted central venous catheters: a retrospective analysis of risk factors. J Oncol Pract 2013; 9: e8-12.

[17] Zhang F. Interventional nursing method for tumor patients with venous thrombosis after peripherally inserted central venous catheter. Shanxi Med J 2019; 048: 125-127.

[18] Lv Y, Wang L, Duan TT and Pan R. Preventive nursing of venous thrombosis after PICC catheterization in patients with hematological tumors. Tianjin J Nurs 2018; 26: 702-704.

[19] Gurevitch J, Koricheva J, Nakagawa S and Stewart G. Meta-analysis and the science of research synthesis. Nature 2018; 555: 175-182.

[20] Shi J, Ye J, Zhuang X, Cheng X, Fu R and Zhao A. Application value of caprini risk assessment model and elevated tumor-specific D-dimer level in predicting postoperative venous thromboembolism for patients undergoing surgery of gynecologic malignancies. J Obstet Gynaecol Res 2019; 45: 657-664.

[21] Ding JQ and Liao L. Study on the effect of evidence-based clustered nursing on the prevention of deep vein thrombosis after major orthopedic surgery. Nursing Prac Res 2020; 17: 72-75.

[22] Gangaraju R, Chen Y, Hageman L, Wu J, Francisco L, Kung M, Ness E, Parman M, Weisdorf DJ, Forman SJ, Arora M, Armenian SH and Bhatia S. Risk of venous thromboembolism in patients with non-hodgkin lymphoma surviving blood or marrow transplantation. Cancer 2019; 125: 4498-4508.

[23] Borg IH, Bendtsen MD, Bøgsted M, Madsen J and Severinsen MT. Incidence of venous thromboembolism in patients with diffuse large B-cell lymphoma. Leuk Lymphoma 2016; 57: 2771-2776.

[24] Santi RM, Ceccarelli M, Bernocco E, Monagheddu C, Evangelista A, Valeri F, Monaco F, Vitolo U, Cortelazzo S and Cabras MG. Khorana score and histotype predicts incidence of early venous thromboembolism in non-hodgkin lymphomas. Thromb Haemost 2017; 117: 1615-1621.

[25] Sanfilippo KM, Wang TF, Gage BF, Luo S, Riedell P and Carson KR. Incidence of venous thromboembolism in patients with non-hodgkin lymphoma. Thromb Res 2016; 143: 86-90.

[26] Byun JM, Hong J, Yoon SS, Koh Y, Ock CY, Kim TM, Lee JH, Kim SH, Lee JO, Bang SM, Yhim HY, Bae SH, Mun YC and Oh D. Incidence and characteristics of venous thromboembolism in Asian patients with primary central nervous system lymphoma undergoing chemotherapy. Thromb Res 2019; 183: 131-135.

[27] Antic D, Jelicic J, Vukovic V, Nikolovski S and Mihaljevic B. Venous thromboembolic events in lymphoma patients: actual relationships between epidemiology, mechanisms, clinical profile and treatment. Blood Rev 2018; 32: 144-158.

[28] Yang J and Jiang LM. Study on the correlation between PICC catheter venous thrombosis and D-2 polymer in patients with malignant tumors. Clin J Chin Med 2014; 100-102.

[29] Zhao S, Hui W, Li L, Yang W, Yi Y and Xu Q. The influence of PICC on plasma D-dimer level in cancer patients. J Mod Oncol 2016; 20: 3273-3276.