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Research Article

Analysis of Risk Factors for Deep Venous Thrombosis after Emergency Orthopedic Surgery for the Lower Extremity in Elderly Female Patients

Kishida K[1], Nakashima M[2], Onoyama Y[3], Tomi K[4] and Hayashi Y[4]*

[1]Pharmaceutics, Yoka Municipal Hospital, 1878-1 Yoka, Yoka-cho, Yabu, Hyogo, 667-8555, Japan
[2]Clinical Laboratory, Yoka Municipal Hospital, 1878-1 Yoka, Yoka-cho, Yabu, Hyogo, 667-8555, Japan
[3]Rehabilitation, Yoka Municipal Hospital, 1878-1 Yoka, Yoka-cho, Yabu, Hyogo, 667-8555, Japan
[4]Anesthesiology, Yoka Municipal Hospital, 1878-1 Yoka, Yoka-cho, Yabu, Hyogo, 667-8555, Japan

***Corresponding author:** Dr. Yukio Hayashi, Anesthesiology Service, Yoka Municipal Hospital, 1878-1, Yoka, Yoka-cho, Yabu, Hyogo, 667-5555, Japan
Tel: 81-79-662-5555;
Fax: 81-79-662-3134;
Email: yhayashi@anes.med.osaka-u.ac.jp

Abstract

Background: Obesity is one of well-known risk factors for deep venous thrombosis (DVT) in general population. However, our clinical impression in our hospital is not consistent with this idea. Since our hospital locates in a rural area where the aging population is more pronounced than in urban areas. Thus, the risk factors for DVT may be different from the general concepts. In this study, we conducted a multi-variant analysis to identify possible risk factors associated with DVT in elderly female patients undergoing surgical treatment for lower extremity fractures.

Methods: This retrospective study included one hundred and ninety-five female patients aged 65 or older who underwent emergency orthopedic surgery for lower extremity fractures in our hospital between January 2020 and December 2022. The following clinical data were analyzed: patient characteristics (age, height, weight and BMI), anesthesia data (anesthesia method, duration of anesthesia, intraoperative blood loss and intraoperative transfusion), preoperative comorbidities (diabetes, hypertension, atrial fibrillation and dementia), anti-coagulation treatment prior to injury, preoperative administration of selective estrogen receptor modulators, presence of DVT before operation, and bed rest > 3 days after operation. We analyzed these data by logistic regression analysis to identify significant risk factors for developing DVT postoperatively.

Results: DVT was identified in 28 patients which represented 14.4% of the sample. Multivariate analysis identified low BMI and dementia as significant factors for postoperative DVT.

Conclusion: Dementia and emaciation were identified as significant risk factors for DVT in this study population.

Keywords: Complication: Deep Venous Thrombosis; Risk factors; Elderly female patients; Operation: Orthopedic and Emergent; Drugs: Selective Estrogen Receptor Modulators

Abbreviations

DVT: Deep Venous Thrombosis; SERMs: Selective Estrogen Receptor Modulators.

Introduction

Deep venous thrombosis (DVT) in the lower extremities is a serious postoperative complication due to its potential to progress to pulmonary embolism. So far, several risk factors for postoperative DVT were well examined [1]. Obesity is one of well-known risk factors for DVT in general population. However, our clinical impression in our hospital contradicts established literature, that is, emaciation may also represent a significant risk factor for postoperative DVT. Our hospital locates in a rural area where the aging population is more pronounced than in urban areas and the previous review [1] also reported that "Elderly" and "Fracture of lower limb" are risk factors for DVT. On the basis of these facts, we performed a multi-variant analysis to identify possible risk factors associated with DVT in elderly female patients undergoing surgical treatment for lower extremity fractures at a single institution.

Furthermore, in our previous case report [2], we described two elderly female patients who underwent emergency operation while receiving selective estrogen receptor modulators (SERMs) therapy for osteoporosis. One developed new-onset DVT postoperatively, and the other experienced worsening of pre-existing DVT. Since SERMs, clinically applied to osteoporosis in the elderly female patients, share similar pharmacological property with oral contraceptive pills and may increase the risk of DVT [3]. Thus, we also included SERMs use in this multi-variant analysis.

Methods

This retrospective study was approved by the IRB of Yoka Municipal Hospital (Yoka Municipal Hospital IRB ID: 202201-R01, approval date: 7/18/2023) and was registered in the UMIN Clinical Trial Registry (UMIN 47975). Informed consent was waived due to the retrospective design. We included two hundreds and one female patient aged 65 or older who underwent emergency orthopedic surgery for lower extremity in our hospital between January 2020 and December

2022. All patients were managed according to a standardized clinical pathway. This included mechanical thromboprophylaxis involving intermittent pneumatic compression pumps and thromboembolic deterrent open toe keen-length compression stockings, chemical prophylaxis (heparin or edoxaban) initiated on the first postoperative day and routine ultrasound examination of the lower extremities preoperatively and on 7th postoperative day.

The following data were extracted from electrical medical records to identify significant risk factors for postoperative DVT: patient characteristics (age, height, weight and BMI); anesthesia data (anesthesia method, duration of anesthesia, intraoperative blood loss and intraoperative transfusion); preoperative comorbidities including diabetes, hypertension, atrial fibrillation and dementia; anti-coagulation treatment prior to injury; preoperative SERM administration; presence of DVT before operation; and bed rest > 3 days after operation.

In this study, DVT(+) was defined as either new development or progression of DVT by postoperative routine ultrasound examination on day 7 compared with preoperative imaging findings.

The study period was set from January 2020 onward, corresponding to the new implementation of the hospital's electronic medical record system. A previous similar retrospective study [4] included 228 patients, so we planned to collect about 200 subjects, to analyzed the data and to perform the power of analysis, if needed. At first, we collected 201 subjects for three years (January 2020 to December 2022) and analyzed these data. As shown in "Results" we identified significant factors in this patient population, so we described these results in this report.

Statistical Analysis

Data were expressed as mean ± SD. The data were analyzed by logistic regression analysis (SPSS ver. 29, Chicago, IL, USA) to determine the significant risk factors associated with postoperative DVT (+). Factors included in the multivariate regression analysis were selected among variables yielding $P < 0.2$ by univariate analysis. $P < 0.05$ was considered statistically significant.

Results

Of the 201 female patients initially identified, 6 were excluded due to incomplete lower extremity ultrasonography, either preoperatively or postoperatively. Thus, 195 patients were included in this study. The patient's demographic data is presented in Table 1, with the mean age of 84.1 years (SD: 10.1). DVT (+) was identified in 28 patients which represented 14.4% of the sample. Variables with P<0.2 in the univariate analysis including BMI, hypertension, dementia and atrial fibrillation were considered for inclusion in the multivariate models (Table 2). Due to significant correlation between age and hypertension (r = 0.265; P < 0.01) and between age and dementia (r = 0.417; P < 0.01). Thus, age (P = 0.020; in univariate analysis) was excluded from the multivariate analysis. Similarly, BMI was included, while weight was excluded.

The multivariate analysis identified low BMI and dementia as significant risk factors for DVT (+) (Table 3). SERM had an odds ratio of 2.064, but the associated P value was 0.39. Thus, it was not included in the multivariate analysis (Table 2).

Table 1: Demographic data of 195 patients.

Demographic data of the patients	
Age (year)	84.1 ± 10.1
Height (cm)	148 ± 6.5
Weight (kg)	45.2 ± 9.8
BMI	20.4 ± 3.6
Preoperative administration	
Anticoagulants or antiplatelets	52 (26.7)
SERM	8 (4.1)
Anesthesia data	
General anesthesia/Spinal anesthesia	125/70
Duration of anesthesia (min)	109 ± 49
Intraoperative blood loss (ml)	127± 160
Intraoperative blood transfusion (ml)	46 ± 125
Comorbidities before the operation	
Hypertension	125 (64.1)
Diabetes	34 (17.0)
Dementia	97 (49.7)
Atrial fibrillation	17 (8.8)
DVT before the operation	28 (14.4)
Postoperative factor	
Bed rest > 3 days	43 (22)
Routine ultrasound examination after the operation	
DVT (+)	28 (14.4)

SERM: Selective Estrogen Receptor Modulator, DVT: Deep Venous Thrombosis, DVT (+) indicates cases in which DVT either newly developed or worsened postoperatively. Data were expressed as mean ± SD or the number of patients (%).

Table 2: Univariate analysis of significant risk factors for newly developed or worsened DVT following the operation.

Variable	Odds ration	95 % CI	P value
Age	1.062	1.009 - 1.117	0.020
Height (cm)	0.999	0.939 - 1062	0.964
Weight (kg)	0.947	0.733 – 0.956	0.030
BMI	0.837	0.733 – 0.956	0.009
Anticoagulants or antiplatelets	0.717	0.273 – 1.882	0.500
SERM	2.064	0.395 – 10.781	0.390
Spinal anesthesia	1.184	0.521 – 2.695	0.687
Intraoperative blood loss	0.999	0.996 – 1.002	0.635
Intraoperative blood transfusion	1.001	0.998 – 1.004	0.687
Duration of anesthesia (min)	0.997	0.989 – 1.006	0.546
Hypertension	1.807	0.731 – 4.519	0.199
Diabetes	0.761	0.246 – 2.356	0.636
Dementia	3.592	1.449 – 8.906	0.006
Atrial fibrillation	2.790	0.900 – 8.650	0.076
Bed rest > 3 days	0.932	0.362 – 2.537	0.932
DVT before the operation	1.127	0.394 – 3.225	0.823

SERM: Selective Estrogen Receptor Modulator, DVT: Deep Venous Thrombosis, CI: Confidence Interval.

Table 3: Multivariate analysis of significant risk factors for newly developed or worsened DVT following the operation.

Variable	Odds ration	95 % CI	P value
BMI	0.860	0.748 – 0.990	0.036
Hypertension	1.871	0.724 – 4.838	0.196
Dementia	2.933	1.149 – 7.490	0.024
Arial fibrillation	2.344	0.714 – 7.692	0.160

CI: Confidence Interval.

Discussion

The present multivariate analysis identified low BMI and dementia as significant risk factors for DVT in elderly female patients undergoing surgical treatment for lower extremity fractures.

Our study revealed BMI as an independent risk factor for DVT, although our findings contradict established literature. A previous

review by Pastori et al. [1] identified obesity as a risk factor for DVT. In contrast, our findings suggest that lower BMI may be associated with an increased risk of DVT, as indicated by an odds ratio of less than 1 for BMI (Tables 2 and 3). This result is consistent with our clinical impression and is clinically interesting. We speculate that this discrepancy may be attributed to the characteristics of our patient population. As shown in Table 1, the average BMI in our cohort was 20.4, indicating that most patients in our study were not obese. Thus, our data suggest that emaciation may also represent a significant risk factor for DVT in elderly women.

As shown in Table 2 and 3, dementia emerged as an independent and significant factor for DVT. While previous clinical studies have identified several risk factors for DVT in patients undergoing surgical repair for lower extremity fractures [5-7], to our knowledge, no study has identified dementia as an independent and significant factor. All data in our study were collected from elderly female patients undergoing emergency orthopedic surgery for lower extremity fractures in our hospital. We deduce that our study population may have contributed to the novel finding of dementia as a significant risk factor of DVT. The exact mechanism by which dementia increases DVT risk remain unclear; however, we hypothesize that delayed postoperative rehabilitation due to dementia may be contributing to the development of postoperative DVT. We are now planning to conduct further research to investigate this hypothesis.

In a previous case report, we suggested that SERMs could be a possible risk factor for DVT following orthopedic surgery in elderly female patients. To explore this further we conducted a multi-variant study to assess the association between SERMs and DVT in this population. Despite observing a minor trend, we were unable to demonstrate that SERMs are a significant and independent risk factor for DVT (Table 2). The low number of patients using SERMs in our study -only eight- may represent a limitation.

There are some limitations in this study. First, all the data were obtained from a single community hospital located in a rural area where the aging population is more pronounced than in urban areas. As a result, the generalizability of our findings to other populations may be limited. Second, we did not account for all potential risk factors for DVT. We have to acknowledge that there might be more meaningful factors to predict DVT. Finally, the retrospective nature of this study introduces potential bias, as perioperative management strategies were not standardized, and undetected confounders may have influenced the results.

Conclusion

This study indicate that dementia and emaciation are significant risk factors for DVT after orthopedic surgery for the lower extremity in elderly female patients. In addition, our finding did not support the idea that SERMs are a significant risk factor for DVT in this patient population.

Declarations

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