

Original Research Article

Prevalence and risk factors of deep vein thrombosis with acute stroke: a cross-sectional study

Abstract:

Background: Deep vein thrombosis (DVT) is a serious complication in stroke patients and may lead to the devastating consequences of a pulmonary embolism. The risk factors for DVT in acute stroke are advanced age, high National Institute of Health Stroke Scale (NIHSS) score, hemiparesis, immobility, female gender, atrial fibrillation. The present study is aimed at identifying the prevalence and risk factors for DVT in acute stroke patients to provide a better outcome.

Methods: This was a prospective cross sectional study conducted in of Dhaka Medical College and Hospital from January 2022 to December 2023. Data was collected in a preformed questionnaire. Statistical analysis was performed using IBM SPSS version 26.0. Continuous variables were analyzed in the form of the means with standard deviations (Mean \pm SD). Categorical variables were shown as numbers and proportions. Continuous data were analyzed using the independent samples t-test. Categorical data were analyzed using the chi-squared test. Univariate variables with a p-value of <0.05 were retained in a binary logistic regression model. Receiver operating characteristic (ROC) curve analysis was performed by identifying the area under the ROC curve (AUC) to evaluate the performance of the logistic regression model. Statistical significance was defined as a p-value of < 0.05 .

Results: A total of 106 patients with acute stroke (AS) were included in the study. The included patients were divided into two groups: DVT and non-DVT group. Out of 106 patients, 34(32.07%) patients presented with DVT. Patients with DVT were older than those without DVT (62.7 ± 10.7 vs. 56.5 ± 11.9 years, $p < 0.05$). Females were more affected by DVT (58.88% vs. 26.85%, $p < 0.05$). In the DVT group, the level of D-dimer was significantly higher than that in the non- DVT group (2.2 ± 1.7 vs. 0.45 ± 1.1 , $p < 0.05$). Elevated CRP and low serum albumin level were also observed in DVT group which was statistically significant ($p < 0.05$). Multiple logistic regression analysis showed that age, NIHSS score and D-dimer levels were independent variables for the presence of DVT in acute stroke patients Odds ratio for age, NIHSS score and elevated d-dimer were 1.043(1.000–1.075, $p=0.029$), 1.266(1.168-1.284, $p=0.008$) and 1.446(1.130–1.849, $p=0.003$) respectively. Receiver operating characteristic curves demonstrated that age >60 years, NIHSS score >25 and a D-dimer level of ≥ 1.52 $\mu\text{g/mL}$ were independent factors for the presence of DVT at the time of stroke admission.

Conclusion: The present study has showed that advanced age, high NIHSS score and raised serum D-dimer levels are independent predictors of DVT in stroke patients. A further large multicenter study should be done to provide a better management to the patients of DVT in stroke patients.

Key words: *Prevalence, risk factors, deep vein thrombosis, acute stroke*

Introduction:

Deep vein thrombosis (DVT) is a serious complication in stroke patients and may lead to the devastating consequences of a pulmonary embolism.¹ Though majority of morbidity arises within one week of stroke, complications like pulmonary embolism (PE) occurs between the second to fourth weeks of an ischemic and hemorrhagic stroke which is also the leading cause of mortality in the post stroke period.² PE generally arise from venous thromboembolism that develops in a paralyzed lower extremity or pelvis. It has been reported in studies from Western societies that DVT occurred in up to 80% of patients with ischemic stroke who did not receive prophylactic therapy.³ In general, studies have estimated the overall prevalence of clinically evident DVT after acute stroke to be around 2–20%.⁴ Data from the CLOTS trials, the largest observational report, which evaluated 5632 immobile patients with acute stroke using duplex ultrasound showed detection of DVT within 10 days of enrollment in 11 percent and within 30 days in 15% of patients.⁵ Apart of PE, DVT can lead to chronic venous insufficiency which may lead to further complications

The risk factors for DVT in acute stroke are advanced age, high National Institute of Health Stroke Scale (NIHSS) score, hemiparesis, immobility, female gender, atrial fibrillation.⁶ A recent large prospective study based on a cohort of 30,000 members of a general population in Norway demonstrated that DVT was independent of traditional cardiovascular risk factors, implying that stroke and related conditions mainly immobility are the main contributors to the venous thromboembolism (VTE).⁶ Besides the risk of DVT/pulmonary embolism (PE) may even be higher in patients with sub-arachnoid hemorrhage and intracranial hemorrhage than ischemic stroke.⁷

The initial test of choice for diagnosing peripheral venous thrombosis is duplex ultrasound due to its accuracy, low cost, portability and safety. In addition, Doppler techniques provide direct information regarding flow physiology.⁸ CT or MR venography are also good alternatives to duplex ultrasound.

The options for lowering the risk of DVT has been documented quite extensively in the literature. Early mobilization, administration of antithrombotic agents, and the use of external compression devices are well known methods to prevent DVT. However, in clinical medical practice, VTE prophylaxis in acutely stroke patients has been found to be suboptimal⁹ Several studies have also validated this observation by showing a gap that exists between evidence-based guidelines/recommendations and actual practice in the hospital setting.¹⁰ Besides the National Institute for Health and Clinical Excellence (NICE) guidelines recommend that routine prophylactic anticoagulation should not be used (grade A) for prevention of venous thromboembolism (VTE) after stroke as it may lead to hemorrhagic complications.¹¹ Though Well's criteria is widely used too to diagnose and assess DVT, risk stratification is can be poorly identified in the immediate stroke period.¹² So the present study is aimed at identifying the prevalence and risk factors for DVT in acute stroke patients to provide a better outcome.

Materials and methods:

This was a prospective cross sectional study conducted in of Dhaka Medical College and Hospital from January 2022 to December 2023. The inclusion criteria were as follows:

1. Patient age > 18 years
2. Patient presented with acute onset of stroke (within 7 days)
3. Patient diagnosed with DVT within 14 days of stroke

Following patients were excluded from study

1. Recurrent stroke
2. past history of venous thromboembolism (VTE)
3. Incomplete medical records
4. Age < 18 years

Deep-vein thrombosis was diagnosed according to the findings of lower extremity ultrasonography, performed by trained ultrasound physicians. DVT was defined based on the following ultrasonic findings: the presence of a non-compressible segment or flow impairment on color Doppler imaging.

Demographic variables including age, sex, BMI, history of smoking, co-morbidities (hypertension, hyperlipidemia, diabetes, coronary heart disease, atrial fibrillation, and malignant tumor), and infections (pneumonia and urinary tract infection) were measured. Clinical data like time of onset of stroke, type of stroke, site of stroke, neurological deficit were recorded. The following laboratory data were obtained with blood samples collected within 24 hours after hospitalization: white blood cell (WBC) count, hematocrit, red blood cell (RBC) count, red blood cell volume distribution width (RDW), hemoglobin (Hb), platelet (PLT) count, C-reactive protein (CRP), serum albumin (Alb), triglycerides (TG), total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), glucose, aspartate aminotransferase (AST), alanine aminotransferase (ALT), fibrin degradation product (FDP), D-dimer, activated partial thromboplastin time (APTT), and prothrombin time (PT).

Data was collected in a preformed questionnaire. Statistical analysis was performed using IBM SPSS version 26.0. Continuous variables were analyzed in the form of the means with standard deviations (Mean \pm SD). Categorical variables were shown as numbers and proportions. Continuous data were analyzed using the independent samples t-test. Categorical data were analyzed using the chi-squared test. Univariate variables with a p-value of < 0.05 were retained in a binary logistic regression model. Receiver operating characteristic (ROC) curve analysis was performed by identifying the area under the ROC curve (AUC) to evaluate the performance of the logistic regression model. Statistical significance was defined as a p-value of < 0.05.

Results:

A total of 106 patients with acute stroke (AS) were included in the study. The included patients were divided into two groups: DVT and non-DVT group. Out of 106 patients, 34(32.07%) patients presented with DVT. The general characteristics of the patients are demonstrated in Table 1. There was no significant difference in BMI, smoking, history of surgery, comorbidities, and infections between the two groups. Patients with DVT were older than those without DVT (62.7 ± 10.7 vs. 56.5 ± 11.9 years, $p < 0.05$). Females were more affected by DVT (58.88% vs. 26.85%, $p < 0.05$)

Characteristics	Non-DVT(n=72)	DVT(n=34)	P-value
Age (years)	56.5 ± 11.9	62.7 ± 10.7	0.004
Male n (%)	54(75.00%)	14(41.12%)	0.118
Female n (%)	18(25.00%)	20(58.88%)	0.002
BMI (kg/m ²)	24 ± 1.2	26 ± 3.2	0.125
Smoking, n (%)	65(90.72%)	32(94.11%)	0.43
Comorbidities			
Hypertension, n (%)	68(94.44%)	30(88.23%)	0.085
Hyperlipidemia, n(%)	58(80.55%)	30(88.23%)	0.664
Diabetes, n (%)	71(98.86%)	32(94.11%)	0.862
Coronary heart disease n(%)	45(62.50%)	28(82.35%)	0.068
Atrial fibrillation n(%)	6(.8.33%)	2(5.88%)	0.488
Malignant tumor n (%)	4(5.55%)	2(5.88%)	0.269
Infections			
Pneumonia, n (%)	23(31.94%)	6(17.64%)	0.182
Urinary tract infection, n(%)	18(25.00%)	11(32.35%)	0.218
NIHSS score	18 ± 4.2	34 ± 8.2	0.003

Table-1 showing demographic characteristics of patients

Variable	DVT	Non-DVT	P value
Onset-to-admission time (days)	2±1.6	1.6±2.1	0.165
Site of stroke			
Cerebral hemisphere n (%)	30(88.23%)	56(77.77%)	0.983
Brainstem, n (%)	4(11.76%)	13(18.05%)	0.335
Both, n (%)	0	3(4.16%)	0.467
Type of stroke			
Ischemic n(%)	28(82.35%)	60(83.33%)	0.076
Haemorrhagic n(%)	6 (17.64%)	12(16.66%)	0.087

Table-2 showing pattern of stroke of study population

Parameter	DVT	Without DVT	p-value
WBC (10 ⁹ /L)	8.6 ± 3.6	7.8 ± 4.6	0.178
Hematocrit (%)	43.7 ± 3.9	42.6 ± 4.8	0.351
RBC (10 ¹² /L)	4.5 ± 0.5	4.8 ± 1.2	0.243
RDW (%)	11.7 ± 0.5	12.6 ± 1.4	0.115
Hb (g/L)	12.6±0.78	12.6±0.32	0.285
PLT (10 ⁹ /L)	254.2 ±84.0	236.7 ±76.2	0.182
Alb (g/L)	29.3 ± 3.9	38.5 ± 3.5	0.004
TG (mmol/L)	1.4 ± 0.7	1.6 ± 0.6	0.814
Total cholesterol (mmol/L)	3.6 ± 0.8	3.8 ± 0.7	0.367
HDL-C (mmol/L)	0.8 ± 0.2	0.7 ± 0.2	0.590
LDL-C (mmol/L)	1.8± 0.6	1.6 ± 0.4	0.329
Random Blood glucose (mmol/L)	8.8 ± 1.9	7.45 ± 2.4	0.729
CRP	16±4.3	10±1.6	0.047
AST (IU/L)	30.8 ±14.3	28.4 ±12.1	0.638
ALT (IU/L)	36.2 ±12.4	35.6 ±18.0	0.470
D-dimer (ug/mL)	2.2 ± 1.7	0.45 ± 1.1	0.002
FDP	11.3 ± 1.2	9.0 ± 1.3	0.068
APTT (s)	38.6 ± 4.3	36.6 ± 4.6	0.764

PT (s)	12.4 ± 0.6	12.2 ± 0.5	0.675
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Table-3 showing laboratory variables of the patients

Table 3 shows the results of laboratory factors in patients with DVT vs. those without DVT. In the DVT group, the level of D-dimer was significantly higher than that in the non- DVT group (2.2 ± 1.7 vs. 0.45 ± 1.1 , $p < 0.05$). Elevated CRP and low serum albumin level were also observed in DVT group which was statistically significant ($p < 0.05$).

Multiple logistic regression analysis showed that age, NIHSS score and D-dimer levels were independent variables for the presence of DVT in acute stroke patients.

Variable	Odd ratio	95% CI	P value
Age	1.043	1.000–1.075	0.029
Female sex	0.852	0.713–0.993	0.071
D dimer	1.446	1.130–1.849	0.003
NIHSS	1.266	1.168-1.284	0.008
CRP	0.882	0.778-0.912	0.213
Serum Albumin	0.654	0.613-0.734	0.084

Table-4 showing Multivariate logistic regression model correlated to DVT

Odds ratio for age, NIHSS score and elevated d-dimer were 1.043(1.000–1.075, $p=0.029$), 1.266(1.168-1.284, $p=0.008$) and 1.446(1.130–1.849, $p=0.003$) respectively. (Table-4) Receiver operating characteristic curves demonstrated that age > 60 years, NIHSS score > 25 and a D-dimer level of $\geq 1.52 \mu\text{g/mL}$ were independent factors for the presence of DVT at the time of stroke admission. (Fig-1) Sensitivity for age > 60 years, D-dimer > 1.52 $\mu\text{g/mL}$ and NIHSS score > 25 were 86.04%, 88.09% and 92.17% respectively. Besides, specificity of these parameters were 87.45%, 85.02% and 78.04% respectively. (Table-5)

variable	Cut-off	Sensitivity	specificity	Area under curve(AUC) of ROC	95%CI
D-dimer($\mu\text{g/mL}$)	1.52	88.09%	85.02%	0.618	0.510–0.726
NIHSS score	25	92.17%	78.04%	0.730	0.643–0.818
Age(years)	60	86.04%	87.45%	0.819	0.744–0.894

Table-5 Predictive values of D-dimer, NIHSS score and age for development of DVT in stroke patients

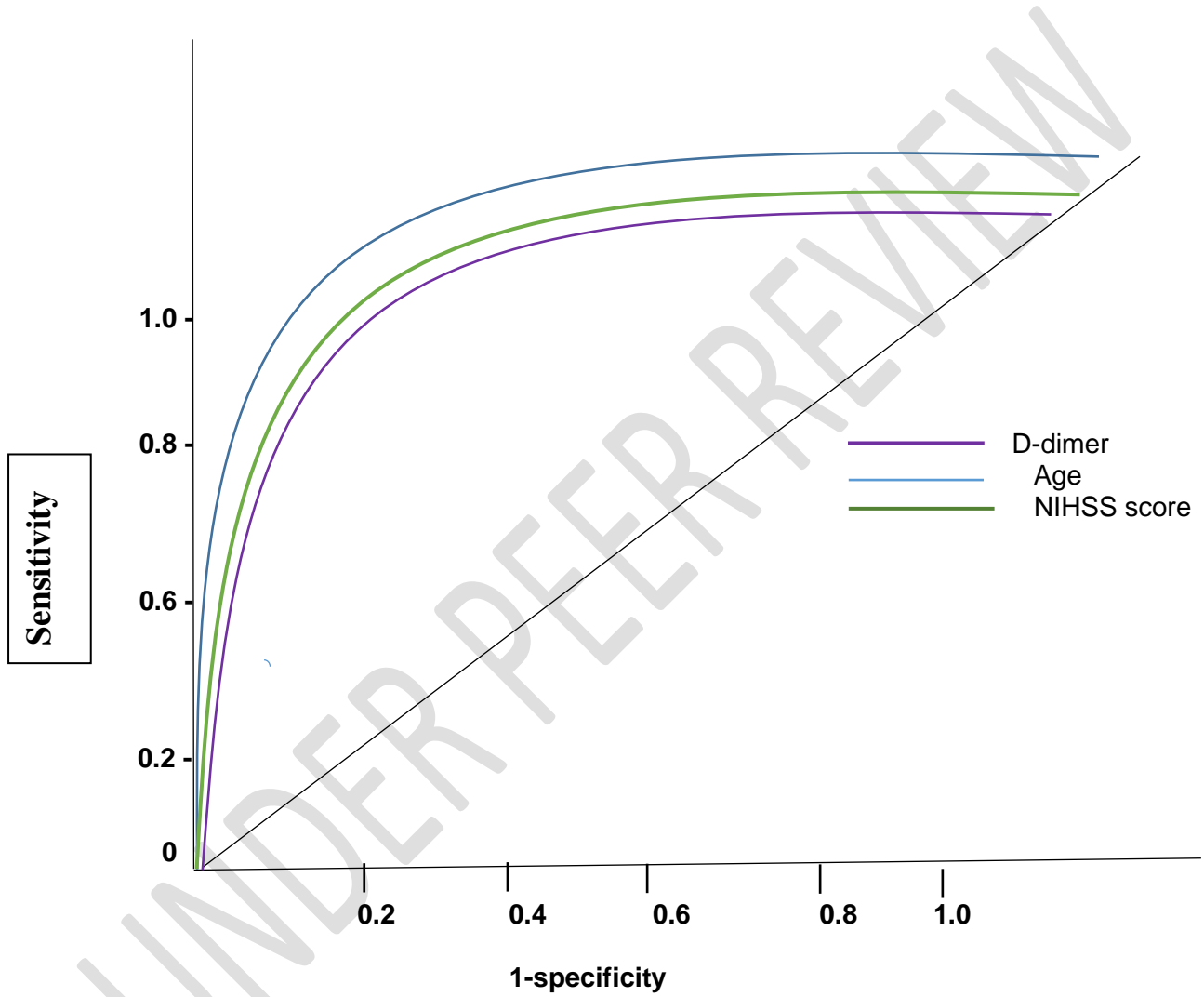


Fig 1 : Graphical presentation showing variation in sensitivity against specificity

Discussion:

Different studies had showed different risk factors for DVT in patients after AS. In our study, older age, higher NIHSS score, and higher D-dimer were identified as independent factors associated with the occurrence of DVT in patients with AS.

The present study showed 32.04% presented with DVT in AS patients which is higher than other studies.¹³ In another study, stroke patients admitted to a rehabilitation unit in Singapore was 9%, which was lower than ours.¹⁴ The higher rate of DVT may be due to delayed presentation and lack of proper guideline for rehabilitation after AS. Besides de-ambulation by physiotherapists and use of compression therapy by intermittent pneumatic compression is not routinely advised in the current centre for stroke patients.

Previous studies have shown that advanced age was significantly associated with DVT ,Particularly, the age ≥ 65 years was closely related to the occurrence of DVT.¹⁵ In the present study, age at a cutoff of ≥ 60 years should raise clinical suspicion and could be used as an independent factor to predict DVT risk.

High level of D-dimer is risk factor of DVT. Previous studies reported that D-dimer had a sensitivity of 85–95% and a specificity of 25–50% for DVT in patients with AS during hospitalization.¹⁶ Our study showed similar findings indicating routinely d-dimer should be advocated for early detection of DVT on the background of AS.

The National Institutes of Health Stroke Scale (NIHSS) is a tool to objectively quantify the impairment caused by a stroke. The NIHSS is composed of 11 items, each item is scored between a 0 and 4. The maximum possible score is 42 with the minimum score being a 0.¹⁷In the present study a higher NIHSS score has demonstrated to be a significant risk factor for developing DVT. So NIHSS score should be analyzed to predict DVT development in stroke patients.

Our study has several limitations. First, this study was a single- center study with a small sample size. Second, this study did not distinguish between newly developed DVT and asymptomatic DVT that had not been found prior to stroke .Third, the study period was very short.

Conclusion:

The present study has showed that advanced age, high NIHSS score and raised serum D-dimer levels are independent predictors of DVT in stroke patients. Besides routine physiotherapy and compression therapy should be administered to reduce the burden of DVT in stroke patients in our country. A further large multicenter study should be done to provide a better management to the patients of DVT in stroke patients.

CONSENT:

Patient's informed written consent was taken to publish her case for academic purpose.

ETHICAL APPROVAL:

As per international standards or university standards written ethical approval has been collected and preserved by the authors.

Disclaimer (AI tool):

No AI tool has been used for preparation of manuscript.

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