Evaluation of Deep Venous Thrombosis in Patients with Hemiplegia Caused By a Cerebrovascular Accident

Serebrovasküler Olaya Bağlı Gelişen Hemipleji Olgularında Derin Ven Trombozunun Değerlendirilmesi

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ÖZET Amaç: Akut inmeli olgular, alt ekstremite paralizisi ve immobilite ile birlikte aterosklerotik hastalık, genetik mutasyonlar ya da akut beyin hasarının inflamatuar yanıtına bağlı olarak ortaya çıkan hemostatik faktörlerdeki artış sonucu, derin ven trombozu (DVT) açısından risk altındadırlar. Çalışmamızın amacı; akut-subakut serebrovasküler olaya (SVO) bağlı gelişen hemiplejili olgularda DVT gelişimi ile ilgili risk faktörlerini belirlemekti. Ayrıca bu olgularda DVT insidansını saptamak ve klinik muayene ile Doppler ultrasonografi (USG) arasındaki ilişkiyi araştırmaktı. **Gereç ve Yöntemler:** Çalışmamıza kliniğimizde yatarak rehabilite edilen, SVO'ya bağlı hemipleji gelişen 116 olgu alındı. Hemipleji süresi 90 günü geçen, geçirilmiş DVT öyküsü olan ve antikoagülan tedavi alan olgular çalışma dışı bırakıldı. Klinik muayenede, her iki alt ekstremitede bacak ağrısı, hassasiyet, kızarıklık, ısı farkı, palpapl kord, Homans belirtisi, pretibial ödem ve alt ekstremite çevre ölçümleri değerlendirildi. Olgulara aynı gün alt ekstremite venöz renkli doppler USG uygulandı. **Bulgular:** Akut-subakut hemiplejili olgularda DVT ile yaş, cinsiyet, etkilenen taraf, hastalık ve immobilizasyon süresi, SVO etiyolojisi, ambulasyon düzeyi, alt ekstremite kas gücü ve spastisite değerleri arasında istatistiksel anlamlı bir ilişki saptanmadı ($p > 0.05$). Klinik muayene ile Doppler USG arasında ise anlamlı bir korelasyon bulundu ($p = 0.000$). **Sonuç:** Çalışmamızda SVO'ya bağlı gelişen hemiplejik olgularda, DVT tanısında klinik bulguların tarama testi olarak faydalı olacağı kanısına varılmıştır.

Anahtar Kelimeler: Venöz tromboz; hemipleji

ABSTRACT Objective: The patients with acute stroke are at a risk of deep vein thrombozis (DVT) because of lower extremity paralysis, immobilization, atherosclerotic disorders, genetic mutations, and increasing of the hemostatic factors due to the inflammatory response of the acute cerebrovascular accident (CVA). The aim of the present study was to determine the risk factors for the development of DVT in patients with acute-subacute hemiplegia caused by CVA. In addition, it was also aimed to determine the incidence of DVT among these patients, as well as to investigate the correlation between clinical examination and Doppler ultrasonography (USG). **Material and Methods:** 116 inpatients with hemiplegia due to a CVA and undergoing rehabilitation in our clinic were included in the study. Patients with hemiplegia for more than 90 days, previous DVT history, and received anticoagulant therapy were excluded from the study. On clinical examination, both of the lower extremities were evaluated with regard to pain, tenderness, erythema, temperature difference, sensation, palpable venous cord, Homans' sign, pretibial edema, circumference of the lower extremity was evaluated bilaterally. Lower extremity color Doppler USG was performed in patients on the same day. **Results:** No statistically significant correlation was determined in patients with either acute or subacute hemiplegia between DVT and age, gender, affected side, disease and immobilization period, etiology of CVA, ambulation level, muscle strength of lower extremity, and spasticity ($p > 0.05$). However, statistically moderate agreement was found between clinical examination and Doppler USG ($p = 0.000$). **Conclusion:** In the present study, it was considered that the clinical findings were useful as screening test in the DVT diagnosis in hemiplegic patients due to a CVA.

Key Words: Venous thrombosis; hemiplegia

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Many local and systemic factors play a role in the pathogenesis of DVT. Venous stasis, hypercoagulopathy and endothelial injury are known as "Virchow's triad". A minimum of 2 of these factors are required for DVT development.[1,2] Risk for DVT is increased in patients with either acute or subacute hemiplegia caused by a CVA due to immobility, atherosclerotic disease, genetic mutations or increase in haemostatic factors. These patients should be under close follow-up with regard to DVT risk, since it may lead to fatal events, such as pulmonary embolus, and may prolong the rehabilitation process.[3,4] As pulmonary embolism is a major cause of death after acute stroke, the prevention of this complication is of crucial importance.[5]

MATERIAL AND METHODS

A total of 116 patients that had either acute or subacute hemiplegia due to a CVA were hospitalized for 3 months in our clinic for rehabilitation were included in the study. The age, duration of the disease, gender, hemiplegic side, as well as CVA etiology determined by computerized cranial tomography (CT) and immobilization duration were recorded. Hypertension, diabetes mellitus, myocardial infarction, chronic venous insufficiency, hypercholesterolemia, aspirin usage and trauma history were investigated. On clinical examination, both of the lower extremities were evaluated with regard to pain, tenderness, erythema, temperature difference, sensation, palpable venous cord, Homans' sign,[6] pretibial edema, as well as circumference differences in 3 cm above medial malleolus, femur (10 cm above patella) and cruris (10 cm below patella). Lower extremity Brunnstrom (Br) recovery stage was used to evaluate the motor capacity of the patients (Appendix 1).[7,8] Spasticity was also grouped according to Br stage. Patients with lower extremity in Br stage I were placed in the first group (flaccid tonus), patients with Br stage III were placed in the second group (maximum spasticity), and patients with Br stages II, IV, V were placed in the third group (minimum-moderate spasticity). Four-point scale was used to evaluate the dorsiflexion and plantar flexion of the ankle (Appendix 2).[9] The ambulation potential was evaluated through the Functional Ambulation Scale (FAS) (Appendix 3).[10,11] Patients with FAS 4 and 5 were considered as ambulated, whereas patients with FAS 0, 1, 2, 3 were considered as non-ambulated. Patients were divided into two groups according to immobilization period; those with a period of 0-14 days and those with a period of 15 days or over. On the same day of physical examination, bilateral lower extremity venous system color Doppler ultrasonography (USG) (by ATL 1500 HDI, 5-12 Mega-Hertz linear probe) was performed on each patient by the same radiologists. On this examina-

APPENDIX 1: Brunnstrom stages of motor recovery of the arm and leg.

Stage	Characteristics
Stage 1	No activite movement present.
Stage 2	Basic limb synergies either appear as weak associated reactions or appear on attempted voluntary movement. Spasticity begins to develop.
Stage 3	Basic limb synergies or components of these synergies are performed voluntarily and show definite joint movements. Spasticity is marked.
Stage 4	Movement combinations begin to deviate from basic limb synergies.
Stage 5	There is relative independence from the basic limb synergies and the patient has the ability to mix difficult extensor synergy with flexor synergy movements. Spasticity is decreases further.
Stage 6	Isolated joint movements are performed in a well-coordinated manner.

APPENDIX 2: A four-point scale.

1. Flaccid paralysis…no leg movement; some muscle contraction
2. Minimal movement…full range of function with/without gravity
3. Full range of motion aganist gravity with moderate resistance but still weak (must still remain in whelchair)
4. Full ambulatory… full range of function aganist gravity with resistance

APPENDIX 3: Functional Ambulation Scale (FAS).

Functional Ambulation Scale (FAS) is evaluated between 0 and 5 within 6 categories. 0 indicates bed level, 5 indicates complete independence at ambulation. FAS is a scale which shows the human assistance rather than equipment assistance provided.

tion, the two of the main femoral veins, deep and superficial femoral veins, popliteal vein, anterior and posterior tibial vein, and peroneal veins were visualized. The loss of compressibility, calibration changes, and non-responsiveness to Valsalva maneuver were considered as diagnostic criteria for DVT.[12] The correlation between clinical examination and Doppler USG in diagnosis was evaluated. The statistical relationship between demographic data and findings, that were considered risk factors, was investigated. Patients with hemiplegia duration longer than 90 days, previous DVT history, and had been receiving anticoagulant therapy were excluded from the study.

Fischer's exact test and odd's ratio were used for the statistical analysis of qualitative data. Agreement of clinical findings and Doppler USG were investigated with Kappa coefficient.

RESULTS

Demographic characteristics of 116 hemiplegic patients are shown in Table 1 and Table 2. DVT was detected by clinical examination in 22 (19.0%) patients, and by Doppler USG in 8 (6.9%). DVT symptoms were present at hemiplegic side in all of the patients. The moderate agreement between clinical examination and USG was found (Kappa= 0.481, p= 0.000).

In 8 (36.4%) of the 22 patients initially diagnosed by clinical examination, DVT was also detected by Doppler USG. DVT was not detected by Doppler USG in any of the patients in whom it was not detected by clinical examination. Considering Doppler USG as base, the sensitivity, specificity and the accuracy of indicators for DVT diagnosis on clinical examination were determined as 100%, 87% and 87.9%, respectively. This result revealed that DVT criteria, which were taken into consideration during clinical examination, can be used in diagnosis (Table 3).

Of 116 patients, 82.8% had hypertension, 29.3% had diabetes, 18.1% had hypercholesterolemia, 17.2% had chronic venous insufficiency, and 4.3% had myocardial infarction. Considering the relationship between DVT and demographic characteristics and systemic diseases, no statistically significant relationship was verified by Fisher's test between DVT and gender, age, hemiplegic side, etiology, ambulation level, immobilization and hemiplegia duration ($p > 0.05$). No statistically significant relationship between DVT and hypertension, diabetes mellitus and aspirin usage was detected by Fisher's exact test either ($p > 0.05$).

The frequency and percent distribution of dorsiflexion and plantar flexion of the ankle were similar among patients in whom DVT was either detected or not detected according to the four-point scale. According to the lower extremity Br stage; 1 patient was stage I, 31 patients were stage II, 30 patients were stage III, 22 patients were stage IV, and 32 patients were stage V. Stages were similar in patients with or without DVT ($p= 0.224$). No statistically significant difference was detected between DVT distribution and the level of spasticity ($p > 0.05$).

TABLE 1: Features of patients.

Patient (n= 116)	n	%
Gender (female/male)	59/57	50.9/49.1
Hemiplegic side (right/left)	59/57	50.9/49.1
Etiology (thromboembolus/hemorrhagic)	90/26	77.6/22.4
Ambulation (present/absent)	46/70	39.7/60.3

TABLE 2: Demographic characteristics of patients.

Patient (n=116)	Mean ± standard deviation	Minimum	Maximum
Age (year)	65.70 ± 10.51	24	85
Duration of hemiplegia (day)	57.35 ± 15.8	17	89
Duration of immobilization (day)	22.89 ± 41.16	1	89

TABLE 3: DVT findings by either clinical examination or Doppler USG.

DVT (determined by clinical examination)	DVT (determined by Doppler USG) Positive	%	Negative	%	Total	%
Positive	8	36.4	14	63.6	22	100.0
Negative	0	0.0	94	100.0	94	100.0
Total	8	6.9	108	93.1	116	100.0

Sensitivity= 100.0% (8/8); Specificity =87% (94/108); Accuracy= 87.9% [((8 + 94)/].116)

TABLE 4: Odds ratio of certain factors for DVT.

Risk factors	Odds ratio (OR)	95% confidence Interval
Aspirin usage	0.565	0.13-2.39
Etiology (thromboembolus/hemorrhagic)	2.108	0.25-17.97
Duration of immobility	0.326	1.70-277
Hypertension	1.494	0.17-12.87
Diabetes mellitus	0.792	0.15-4.13
Myocardial infarction	3.714	0.37-37.84
Chronic venous insufficiency	1.648	0.31-8.83
Hypercholesterolemia	1.561	0.29-8.34
Age	1.232	0.23-6.51

In addition, 9 factors that could be risk for DVT were identified in the present study, and their effect on DVT was investigated by using the odd's ratio. It was observed that none of the 9 factors represented a significant risk for DVT. Immobilization period of less than 2 weeks decreased DVT risk to a lesser extent. However, no significant decrease was observed. Furthermore, myocardial infarction and the presence of thromboembolic CVA as an etiologic factor increased the risk of DVT to a lesser extent compared to other factors (Table 4). Evaluating all of these variables and their probable influences, there was no possible risk for DVT.

DISCUSSION

The first 14 days of hemiplegia caused by a CVA comprise high risk for the development of DVT.[7] DVT is encountered in 11-75% of the patients in acute phase.[13] Subclinical DVT is more common than clinically apparent DVT.[14] It is difficult to clinically reach a DVT diagnosis in hemiplegic patients. This is because edema can occur in the paralyzed extremity, even in the absence of thrombosis, but there may not be any symptom in the extremity with thrombosis.[13] In a study by Wells et al.,[15] the diagnosis was confirmed by Doppler USG in 85% of the patients in whom DVT was suspected by clinical examination. In a study conducted by Yagci et al[16] that evaluated the correlation of clinical examination and Doppler USG among hemiplegic patients after a CVA, no significant correlation was detected between DVT and pain, local tenderness and leg edema, whereas a significant correlation was detected between DVT and Homan's sign, local temperature and erythema. Moreover, at least one clinical sign concordant with the Doppler USG findings was observed in 58.3% of the hemiplegic patients with DVT, and DVT diagnosis was reached by Doppler USG in 41.7% of those without any clinical sign. In the present study, the incidence of DVT was determined as 6.9% by Doppler USG, whereas it was determined as 19% by clinical examination. The moderate agreement between Doppler USG findings and clinical findings were found.

In a study conducted by Kontos[17] on 123 patients with hemiplegia caused by a CVA, it was observed that DVT development was more prevalent among females. Similarly, Kawase et al[18] observed female sex was strongly associated with DVT formation. Gregory et al[19] evaluated the relationship between DVT and gender, age and ethnic distributions of patients with hemiplegia caused by a CVA, and found no significant difference. Similarly, Yagci et al[20] did not determine a significant correlation between DVT and age or gender. In the present study as well, there was no significant correlation between DVT and gender or age distribution of patients with hemiplegia caused by a CVA.

Cope et al[21] observed that DVT incidence increased on the hemiplegic side, and considered that this increase was due to the loss of the venous muscles' pump-effect on valves, as well as recurrent minor traumas. In the present study, all of the DVTs were observed in the paralyzed extremity.

Considering the relationship between DVT and CVA etiology among hemiplegic patients, some studies reported that the hemorrhagic type caused DVT more frequently than the thromboembolic type. This was considered to relate to the short hospitalization period of the thromboembolic type.[20,22] However, in a study conducted by Harvey et al.,[23] no correlation was found between these two types of etiology with regard to

DVT. In the present study, DVT incidence was higher in the thromboembolic type; however, this difference was not statistically significant ($p > 0.05$).

Immobilization is an important risk factor for DVT among hemiplegic patients.[17,24] In the present study, it was observed that the incidence of DVT increased as the hospitalization period prolonged. Nevertheless, there was no significant relationship between immobilization period and DVT. As this period less than 2 weeks, it reduced the risk of DVT to a lesser extent.

In many studies, it was reported that there was a negative correlation between ambulation level and DVT.[17,23,24,25] In the present study, no significant correlation was determined between ambulation level and DVT.

Desmukh et al.[26] screened 503 hemiplegic patients. Hypertension was present in 81% of the patients concomitantly to DVT, and this was found to be statistically significant. Contrarily to this study, other authors reported no relationship between DVT and hypertension, and neither between DVT and diabetes mellitus and myocardial infarction history.[7,22,27] In the present study, the presence of hypertension and myocardial infarction slightly increased the risk of DVT.

Although several studies[17,25] reported that aspirin usage reduced the risk for DVT, no statistically significant effect was determined in the present study.

As a result, in patients who was not diagnosed as DVT in clinical examination, also had no diagnosis of DVT in Doppler USG. This article shows that clinicial examination having high sensitivity and specivity can be used as screening test.

REFERENCES

1. Coronan JJ. Venous thromboembolic disease: the role of US. Radiology 1993; 186(3):619-30.
2. Kurtoglu M, Yanar H, Özkan Gürdal S. [Diagnosis, treatment and the prophylaxy of venous thromboembolism]. Turkiye Klinikleri J Surg Med Sci 2006;2(25):8-21.
3. Samama MM, Desnoyers PC, Conard J, Bousser MG. Acute ischemic stroke and heparin treatments. Thromb Haemost 1997; 78(1):173-9.
4. CLOTS Trials Collaboration, Dennis M, Sandercock PA, Reid J, Graham C, Murray G, Venables G, et al. Effectiveness of thigh-length graduated compression stockings to reduce the risk of deep vein thrombosis after stroke (CLOTS trial 1): a multicentre, randomised controlled trial. Lancet 2009; 373(9679):1958-65.
5. Kamphuisen PW, Agnelli G, Sebastianelli M. Prevention of venous thromboembolism after acute ischemic stroke. J Thromb Haemost 2005;3(6):1187-94.
6. Henriet JP. [Pain in venous thrombosis of the leg]. [Article in French]. Phlebologie 1992; 45(1):67-76.
7. Brunnstrom S. Recovery stages and evaluation procedures. Movement Therapy in Hemiplegia; A Neurophysiological Approach. 1st ed. New York: Harper and Row Publishers; 1970. p.34-55.
8. Gowland C. Recovery of motor function following stroke: profile and predictors. Physiotherapy Canada 1982;34(2):77-84.
9. Pambianco G, Orchard T, Landau P. Deep vein thrombosis: prevention in stroke patients during rehabilitation. Arch Phys Med Rehabil 1995;76(4):324-30.
10. Collen FM, Wade DT, Bradshaw CM. Mobility after stroke: reliability of measures of impairment and disability. Int Disabil Stud 1990;12(1):6-9.
11. Holden MK, Kathleen MG. Clinical gait assesment in the neurologically impaired. Rehability and meaningfulness. Phys Ther 1986;66: 1530-9.
12. Zwiebel WJ. Venous thrombosis and other pathology. Introduction to Vascular Ultrasonography. 3rd ed. Philadelphia, Pa: WB Saunders Co.; 1992. p. 305-21.
13. Hillbom M, Erilä T, Sotaniemi K, Tatlisumak T, Sarna S, Kaste M. Enoxaparin vs. heparin for prevention of deep-vein thrombosis in acute ischaemic stroke: a randomized, double-blind study. Acta Neurol Scand 2002;106(2):84-92.
14. Zubkov AY, Wijdicks EF. Deep venous thrombosis prophylaxis in cerebral hemorrhage. Rev Neurol Dis 2009;6(1):21-5.
15. Wells PS, Hirsh J, Anderson DR, Lensing AW, Foster G, Kearon C, et al. Accuracy of clinical assessment of deep-vein thrombosis. Lancet 1995;345(8961):1326-30.
16. Yagcı H, Yagcı I, Ozel S. Deep-vein thrombosis in the rehabilitation phase of stroke: the risk factors and effect of anticoagulation. J Rheum Med Rehab 2004;15:149-55.
17. Kontos HA. Vascular disease of limbs. In: Wyngaarden JB, Smith LH, eds. Cecil Textbook of Medicine. 17th ed. Philadelphia, Pa: WB Saunders Co., 1985. p.353-66.
18. Kawase K, Okazaki S, Toyoda K, Toratani N, Yoshimura S, Kawano H, et al. Sex difference in the prevalence of deep-vein thrombosis in Japanese patients with acute intracerebral hemorrhage. Cerebrovasc Dis 2009;27(4): 313-9.
19. Gregory PC, Kuhlemeier KV. Prevalence of venous thromboembolism in acute hemorrhagic and thromboembolic stroke. Am J Phys Med Rehabil 2003;82(5):364-9.
20. Turpie AG. Prophylaxis of venous thromboembolism in stroke patients. Semin Thromb Hemost 1997;23(2):155-7.
21. Cope C, Reyes TM, Skversky NJ. Phlebographic analysis of the incidence of thrombosis in hemiplegia. Radiology 1973;109(3): 581-4.

22. Bamford J, Dennis M, Sandercock P, Burn J, Warlow C. The frequency, causes and timing of death within 30 days of a first stroke: the Oxfordshire Community Stroke Project. J Neurol Neurosurg Psychiatry 1990;53(10): 824-9.

23. Harvey RL, Lovell LL, Belanger N, Roth EJ. The effectiveness of anticoagulant and antiplatelet agents in preventing venous thromboembolism during stroke rehabilitation: a historical cohort study. Arch Phys Med Rehabil 2004;85(7):1070-5.

24. Roth EJ, Lovell L, Harvey RL, Heinemann AW, Semik P, Diaz S. Incidence of and risk factors for medical complications during stroke rehabilitation. Stroke 2001;32(2):523-9.

25. Muir KW, Watt A, Baxter G, Grosset DG, Lees KR. Randomized trial of graded compression stockings for prevention of deep-vein thrombosis after acute stroke. QJM 2000;93(6): 359-64.

26. Desmukh M, Bisignani M, Landau P, Orchard TJ. Deep vein thrombosis in rehabilitating stroke patients. Incidence, risk factors and prophylaxis. Am J Phys Med Rehabil 1991;70(6):313-6.

27. Kelly J, Rudd A, Lewis RR, Coshall C, Moody A, Hunt BJ. Venous thromboembolism after acute ischemic stroke: a prospective study using magnetic resonance direct thrombus imaging. Stroke 2004;35(10):2320-5.