Deep Vein Thrombosis in an Ambulatory Hemiparetic Stroke Patient Probably due to Exercise-Related Repetitive Impact: A casereport

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Deep vein thrombosis (DVT) of the lower extremity is a multifactorial and potentially fatal complication following stroke. However, repetitive impact on the lower extremity is a relatively uncommon risk factor for DVT. We report an ambulatory hemiparetic stroke patient who, without classic DVT risk factors, developed a lower extremity DVT probably due to repetitive impact on the popliteal fossa after the inappropriate use of a seated leg flexion machine. This case can remind physiatrists and therapists of the importance of preventing patients from using non-ergonomic postures during training sessions. (Tw J Phys Med Rehabil 2015; 43(2): 121 - 126)

Key Words: deep vein thrombosis, repetitive impact, stroke, rehabilitation

INTRODUCTION

Deep vein thrombosis (DVT) is a multifactorial disease. Virchow proposed that conditions with underlying pathophysiologic processes, including vascular endothelial damage, blood flow stasis, and the hypercoagulability of blood, contribute to the development of DVT.[1] DVT of the lower extremity is associated with pulmonary embolism (PE) and post-thrombotic syndrome (PTS). Overall, DVT increases disease-related cost and impedes the rehabilitation program.

Previous studies have shown that risk factors for DVT include advancing age, obesity, a history of previous thromboembolism, surgery, hypercoagulation state, pregnancy, oral contraceptives usage, hormone replacement therapy, immobilization, and malignancy.[1] Paralytic stroke is also one of the moderate risk factors for DVT due to limb paralysis, prolonged bed rest, and increased prothrombotic activity.[2] Given the significant morbidity and mortality associated with DVT, preventing DVT in stroke patients is of pivotal importance.

Although minor injuries of the lower extremity, such as muscle or ligament rupture, contusion, and sprain, have been shown to be associated with developing DVT,[3] DVT caused by repetitive impact from the seat pan of an exercise machine in hemiparetic stroke patients, without hypercoagulability, has not been reported. We detail a...
case of lower extremity DVT in an Asian hemiparetic stroke patient following repetitive impact on the popliteal fossa due to the use of a non-ergonomic posture while using a seated leg flexion machine.

## CASE REPORT

A 59-year-old man was admitted for right-sided weakness on March 14, 2013. Physical examination revealed muscle strength grades of good (4/5) and fair (3/5) in the right upper and right lower extremities, respectively. A magnetic resonance imaging study revealed left lower pontine infarction. The patient did not have any known risk factors for stroke, such as hypertension, diabetes mellitus, dyslipidemia, hyperuricemia, or smoking. He was overweight, had a body mass index of 27.78 kg/m², and had a history of fatty liver diagnosed by ultrasonography. Clopidogrel was prescribed because the patient had allergy history to aspirin. He was able to stand up with support on the day following the stroke and ambulate using a quadricane after receiving rehabilitation training for two weeks.

The patient has performed six sessions of hamstrings strengthening exercise using a seated leg flexion machine with correct posture, neither pain nor swelling were reported. It took about 10 minutes for the patient to perform hamstrings strengthening exercise in each session. On day 23 post-stroke when he was performing the seventh time of hamstring strengthening exercise using a seated leg flexion machine, the patient presented with right popliteal pain after performing a hamstring contraction (Figure 1-A and 1-B). The impact stress on the right popliteal region against the anterior lower edge of the seat pan increased during deep knee flexion. He reported that he performed the exercise forcefully at the first contraction and discomfort developed afterwards. The patient did not give much attention to it and completed the training session. A few hours later, right popliteal pain without swelling occurred.

Although the popliteal pain improved gradually after applying a hot pack and topical non-steroid anti-inflammatory ointment to the area, progressive swelling of the right lower leg was noted five days after the onset of the popliteal pain. Physical examination revealed localized warmth and swelling with pitting edema of the right lower leg. The right calf circumference was five centimeters greater than that of the left side, which was checked at the level of 10 cm below the tibial tuberosity. Soft tissue ultrasonography of the right leg revealed no structural abnormality, such as muscle or tendon rupture. Although Homan’s sign is negative, a venous doppler ultrasonography, however, revealed thrombus in the right superficial femoral vein, the popliteal vein, and one popliteal vein. After cardiologist consultation, warfarin was prescribed. His clopidogrel was discontinued two days after the use of warfarin.

To evaluate the risk factors for DVT, we conducted a series of blood tests to rule out malignancy (alphafetoprotein, carcinoembryonic antigen, anti-squamous cell carcinoma antigen, and free prostate-specific antigen), thrombophilia (antithrombin III deficiency, protein C deficiency, protein S deficiency, and hyperhomocysteine), autoimmune disease, and vasculitis (anticardiolipin IgG and anti-nuclear antibody). The results of these blood tests were all within normal limits.

After receiving warfarin treatment and elastic stockings usage, the patient’s right leg swelling improved gradually and he was able to ambulate without an assistive device one week later. The difference of calf circumference between two legs was less than three centimeters after warfarin treatment for twenty days. The prothrombin time was monitored with the goal of international normalized ratio (INR) between 2.0 and 3.0. A follow-up venous doppler ultrasonography showed organized thrombus at right popliteal vein with partial recanalization after receiving warfarin treatment for four months. The swollen right calf also got much improvement on that time. The warfarin therapy was discontinued after completing a six-month course.

## DISCUSSION

The findings of the present report suggest that repetitive impact with minor injury on a lower extremity due to the inappropriate use of a seated leg flexion machine is probably a precipitating factor for developing
DVT in stroke patients. Although immobilization after stroke is a risk factor for DVT, DVT usually occurs in the paralyzed limb within the first two weeks following the stroke.\(^2\) Since our patient was only hemiparetic, he was able to stand up with support on the day following the stroke and ambulate with a quadricane within two weeks. Immobilization and mild overweight is less likely to explain the occurrence of DVT for this patient.

Because of the temporal relationship between the repetitive impact in improper posture and subsequent calf pain and leg swelling, we propose that repetitive impact to the popliteal vein is a precipitating factor of the DVT in our patient. Veins are tended to be injured by repetitive compressions.\(^4,5\) For example, subclavian vein thrombosis due to repetitive compression of the subclavian vein by adjacent muscle, ligament or bone while performing repetitive hyperabduction of shoulder has been reported in several sports, such as baseball\(^6\), hockey\(^7\) and swimming\(^8\). Moreover, intimal injury post minor trauma of the lower extremity such as contusion and sprain have been shown to be associated with DVT development.\(^3\) The popliteal and posterior tibial veins are vulnerable to intimal injury due to their anatomic positions. It was reported that, in a soccer player, DVT developed ten days

![Figure 1. (A) and (B) The patient reclined on the seat back with his knee joint deeply flexed against the anterior lower edge of the seat pan. (C) and (D) The popliteal fossa should be away from the anterior lower edge of the seat pan, and deep knee flexion should be avoided.](image-url)
after minor “tackle” injury over the popliteal area while performing sudden hyperextension and torsion of the lower extremities.\[^9\]\ We think that the repetitive impact with minor injury in the popliteal fossa in our patient might lead to thrombus formation in the popliteal and posterior tibial vein because of impaired venous backflow and fibrotic transformation of the venous wall, as reported in previous literature.\[^3,10\]\ Considering that there were no changes in his medication, ADL and rehabilitation program, minor injury following repetitive compression caused intimal injury and venous stasis are the most reasonable causes for the occurrence of DVT in our patient.

Regarding the management of DVT, anticoagulation is the mainstay of therapy for patients with acute DVT and is recommended for a minimum of three months.\[^11\]\ PTS develops in about one-third of patients with DVT, which may cause chronic leg pain and may limit activity.\[^12\]\ Conventionally, to prevent PTS, patients with lower extremity DVT were encouraged to continue wearing elastic compressing stockings for two years.\[^1\]\ The effectiveness of compression stocking, however, was not supported by a recent large controlled clinical trial.\[^13\]\ In the past, immobilization has often been recommended for patients with DVT to prevent thrombosis shedding and subsequent PE. However, a recent study has demonstrated that early ambulation does not increase the risk of PE in patients with DVT.\[^14\]\ Ankle range-of-motion exercise and early ambulation are encouraged for patients with DVT to prevent PTS and improve their functional level.\[^15,16\]\ There is no prior case report of DVT caused by the use of a non-ergonomic posture while using exercise equipment. This case report illustrates the importance of providing and adhering to safety instructions during exercise training and when using exercise equipment. To avoid DVT caused by repetitive impact, physiatrists and therapists should remind patients to maintain good posture during exercise training sessions at all times. When using a seated leg flexion machine, one should keep the popliteal fossa away from the anterior lower edge of the seat pan and avoid deep knee flexion (Figure 1-C and 1-D). In addition, ergonomically designed exercise equipment may aid in the prevention of DVT in stroke patients.

CONCLUSION

This case report shows that repetitive impact on the popliteal area while using exercise equipment probably caused a DVT in an ambulatory hemiparetic stroke patient. The importance of maintaining an ergonomic posture during exercise training cannot be overemphasized. Physiatrists, therapists, and manufacturers should cooperate to prevent patients from using non-ergonomic postures during training sessions.

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REFERENCES


具移行能力的中風患者在復健過程中可能因反覆撞擊造成深靜脈血栓：病例報告

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下肢深靜脈血栓對於中風病人是一種多因素和潛在的致命併發症。下肢反覆撞擊對於深靜脈血栓是相對少見的危險因子。我們報告了一個沒有典型深靜脈血栓危險因子的腦中風偏癱患者，可能由於不當使用坐姿曲腿訓練機造成後胭窩反覆撞擊，進而產生下肢深靜脈血栓。這個案例可以提醒復健科醫師和治療師在訓練的過程當中維持正確姿勢以及避免反覆撞擊的重要性。（台灣復健醫誌 2015；43(2): 121 - 126）

關鍵詞：深靜脈血栓(deep vein thrombosis)，反覆撞擊(repetitive impact)，中風(stroke)，復健(rehabilitation)