J. Phys. Ther. Sci.
23: 145–147, 2011

Can Clinical Findings Predict the Complications Associated with Acute-phase Deep Venous Thrombosis after Total Hip Arthroplasty?

KENTARO SASAKI, RPT[1)], MASUO SENDA, MD[2)], YOSHIYUKI MATSUYAMA, OTR[2)], HARUYUKI OTA, RPT[2)]

[1)]*Department of Physical Therapy, Kinjo University: 1200 Kasamamachi, Hakusan city, Ishikawa 924-8511, Japan. TEL: +81 76-276-4400, FAX: +81 76-275-4316*
[2)]*Division of Physical Medicine and Rehabilitation, Okayama University Hospital*

Abstract. [Purpose] The purpose of this study was to investigate whether clinical findings can be used to predict lower extremity complications associated with deep venous thrombosis (DVT) after total hip arthroplasty (THA). [Subjects and Methods] In all, 37 female patients (mean age, 63.4 ± 10.2 years) with osteoarthritis of the hip who had undergone THA were included in this study. We evaluated pain (Homans sign or tenderness) and edema on the postoperative day when physical therapy was restarted. [Results] Venography revealed that 12 patients had DVT (group D) and 25 patients did not (group N). The intensity of calf pain was significantly higher in group D than in group N. The positive predictive value of pain for DVT was 62.5%, and the negative predictive value of pain was 75.9% (sensitivity, 41.7%; specificity, 88.0%). Patients with proximal DVT tended to have fewer clinical findings than those with distal DVT. [Conclusion] These results suggest that clinical findings are more apparent in patients with DVT; however, proximal DVT would be overlooked because it has few clinical findings.
Key words: Deep venous thrombosis, Total hip arthroplasty, Clinical findings

(This article was submitted Apr. 27, 2010, and was accepted Aug. 27, 2010)

INTRODUCTION

Deep venous thrombosis (DVT) is one of the major complications of orthopedic surgery. In our hospital, 40.1% of the patients who undergo total hip arthroplasty (THA) develop DVT, which is diagnosed by venography[1)]. In the clinical setting, DVT needs to be detected as soon as possible to prevent its progression to pulmonary embolism (PE), which is a life-threatening condition. The prevalence of PE developing subsequent to DVT is approximately 30%[2)]. Early ambulation is recommended for the prophylaxis of DVT[3)]; however, in the case of patients who already have DVT, PE might be induced by muscle contraction. Thus, a physical therapist should be consulted to determine whether patients have DVT, before starting ambulation. Furthermore, clinical examinations of the extremities need to be conducted to find any signs or symptoms of DVT. The following are typical symptoms of DVT: pain, edema, warmth, redness, and varicose veins of the extremities[4)]. Because clinical findings might vary, especially in the acute phase, careful observation or examinations are required. Previously, few studies have investigated the predictive power of clinical findings of acute-phase DVT in patients undergoing THA. The aim of this study was to assess the predictive power of these clinical findings.

SUBJECTS AND METHODS

Subjects

The subjects of this study were 37 female patients (mean age, 63.4 ± 10.2 years) with osteoarthritis of the hip who had undergone THA (right hip, 19 patients; left hip, 18 patients). None of the patients had a history of DVT, were taking medication that could affect the coagulo-fibrinolytic system, or developed complications (dislocation, nerve palsy, etc.) after THA. All surgeries was performed via the lateral approach, and the procedure required less than 2 hours. All patients were ordered to perform physical therapy for post-operative rehabilitation, and they all agreed to use of their data in this study.

Methods

On average 7 days after the operation, physical therapy was restarted, and the clinical findings with regard to pain and edema in the operated leg were evaluated. In this study, we selected pain and edema as the clinical parameters because patients can objectively differentiate between the pain experienced before and after the operation (none of the patients complained of pain in the calf before undergoing

Table 1. Predictive parameters of calf pain

	group D (n=12)	group N (n=25)	PPV	NPV
positive	5 (41.7%)*	3 (12.0%)*	62.5%	–
negative	7 (58.3%)	22 (88.0%)	–	75.9%

*p<0.05. PPV: postive predictive value. NPV: negative predictive value.

Table 2. Predictive parameters of edema

	group D (n=12)	group N (n=25)	PPV	NPV
positive	6 (50.0%)	6 (24.0%)	50.0%	–
negative	6 (50.0%)	19 (76.0%)	–	76.0%

PPV: postive predictive value. NPV: negative predictive value.

Table 3. Predictive parameters of pain and edema

	group D (n=12)	group N (n=25)	PPV	NPV
positive	3 (25.0%)	1 (4.0%)	75.0%	–
either or neither	9 (75.0%)	24 (96.0%)	–	72.7%

PPV: postive predictive value. NPV: negative predictive value.

Table 4. The comparison of clinical findings between groups P and C

	group P (n=5)	group C (n=7)
pain	1 (20.0%)	4 (57.1%)
edema	1 (20.0%)	4 (57.1%)

THA) and edema can be evaluated quantitatively. All the patients underwent physical examination before surgery, and we assessed the differences in the findings obtained before and after the operation.

"Pain" was evaluated according to the appearance of the "Homans sign" [4] or depending on the tenderness of the calf on the operated side. Homans sign is the stretching of the veins in the calf during dorsal flexion of the ankle joint with the knee extended. Patients were defined as "positive" if they complained of pain at the proximal calf due to either Homans sign or tenderness.

"Edema" was evaluated according to the difference in the maximum circumference of both the lower legs and the degree of pitting edema. The patients were defined as "positive" if the difference in the circumference of both the lower legs was more than 1 cm (operated side > contralateral side) and had distinguishable pitting marks on the dorsum foot.

A foot-pump system was used for the non-operated foot during the operation and for both the feet after the operation. Patients were not administered any prophylactic agents before and after the operation, and were encouraged to start ambulating if the D-dimer level, which reflects the presence of DVT, was not more than 10 μg/ml.

We divided the patients into 2 groups depending on whether their condition was complicated by DVT or not, as diagnosed by venography. The clinical findings were compared between the 2 groups using the χ^2 test. Intergroup comparisons with respect to age and body mass index (BMI) were made by the unpaired t-test. The results were considered significant at $p<0.05$.

RESULTS

Venography revealed that 12 patients had DVT (group D) whereas 25 patients did not (group N). There were no differences between the 2 groups with respect to the postoperative day on which physical therapy was restarted (group D, 7.5 ± 1.7; group N, 7.6 ± 3.1) and with respect to the day venography was performed (group D, 12.2 ± 2.8; group N, 14.2 ± 2.1). Patients in group D were older ($p<0.01$) and had higher BMI than those in group N ($P = 0.05$).

The frequency of pain was significantly higher in group D than in group N ($p<0.05$). In patients who experienced pain, the positive predictive value (PPV) of pain for DVT was 62.5%, and the negative predictive value (NPV) was 75.9% (sensitivity, 41.7%; specificity, 88.0%) when compared with those who did not experience pain (Table 1). Edema was not significantly different between two groups, though it tended to be more apparent in group D patients (Table 2).

The prevalence of pain and edema was higher in group D patients than in group N patients ($p=0.06$). The PPV and NPV of pain and edema for DVT were 75.0% and 72.7%, respectively (sensitivity, 25.0%; specificity, 96.0%) when compared with neither or either finding (Table 3).

Of the 12 patients in group D, 5 (group P) showed proximal DVT (DVT in the femoral vein), and their clinical findings on the lower extremity were fewer than those in patients with distal DVT (DVT in the distal vein) (group C) (Table 4).

DISCUSSION

Because thrombosis can induce inflammation and subsequently might lead to hypertrophy of the surrounding vessel wall, the distensibility of a thrombotic vein is reduced by it, causing pain in patients while stretching[5]. A thrombus blocks venous return leading to edema. In this study, we found that calf pain was a significant predictor of DVT in addition to well-known risk factors for DVT, higher age and BMI. Because the specificity of the NPV of pain was high, a lack of calf pain can be considered as a predictor of absence of DVT after THA. However, the false negative value (1-NPV) was 24.1%, indicating that the possibility of overlooking DVT would be high. Coexistence of pain and edema yielded a similar result, i.e., the sensitivity of the PPV was low. Diamond et al.[6] also reported that clinical findings (swelling, warmth, fever, difference in the circumference of extremities) had high specificity but low sensitivity for rehabilitation inpatients evaluated by ultrasonography. Therefore, the diagnosis of DVT cannot be made only on the basis of clinical findings.

The unreliability of the clinical findings can be attributed to proximal DVT. Patients in group P had fewer clinical findings than those in group C. Proximal DVT is also known as "occult DVT" because it yields few clinical findings[7]. This type of DVT is potentially life-threatening, because it is frequently associated with PE[8]. After THA, the prevalence of proximal DVT is 23–36% and that of fatal PE induced by proximal DVT is 3.4–6.0%[4]. Norris et al.[9] reported that 60% of PE induced in patients with thrombosis in the iliofemoral vein was the result of free-floating thrombi (FFT) that do not adhere to the venous wall. Because FFT float in the vessel, they do not induce inflammation in the wall or inhibit venous return. Thus, FFT in the proximal vein would have few clinical findings. According to previous studies, after thrombolytic therapy, 9.2–10.7 days are required for FFT to attach to the venous wall[5,10]. These reports suggest that early ambulation (within 10 days after surgery), which is recommended in clinical settings, presents a risk of PE if patients have FFT. Kizer et al.[11] reported that patients with DVT who return to physical therapy early (within 48 hours from the start of anticoagulation therapy) are more likely to develop PE than those who return later. They also recommended that the affected leg should be immobilized for at least 48–72 hours while patients received anti-coagulation treatments once DVT has been diagnosed. Thus, the presence of DVT needs to be confirmed by venography or other methods before starting physical therapy because FFT, which shows few clinical findings, presents a potential risk of PE.

In contrast, a systematic review confirmed the efficacy of exercise in patients with stable DVT (adhered thrombosis)[12]. A 6-month daily walking exercise was shown to have a similar degree of vein recanalization and improvement in quality of life as was observed in controls[12]. Partsch[13] investigated the efficacy of bed rest or ambulation by reviewing previous studies and found that walking exercises and compression therapy reduced symptoms, whereas bed rest promoted the development of DVT, although it prevented the development of PE. Thus, we suggest that physical therapy program should be changed depending on the type of thrombi, i.e., adherent or free-floating type.

REFERENCES

1) Shiota N, Sato T, Nishida K, et al.: Changes in LPIA D-dimer levels after total hip or knee arthroplasty relevant to deep-vein thrombosis diagnosed by bilateral ascending venography. J Orthop Sci, 2002, 7: 444–450.
2) O'Reilly RF, Burgess IA, ZicatB: The prevalence of venous thromboembolism after hip and knee replacement surgery. Med J Aust, 2005, 182:154–159.
3) Buhler KO, D'Lima D, Petersilge WG, et al.: Late Deep venous thrombosis and delayed weightbearing after total hip arthroplasty. Clin Orthop Rel Res, 1999, 361: 123–130.
4) Kahn SR: The clinical diagnosis of deep venous thrombosis. Integrating incidence, risk factors, and symptoms and signs. Arch Intern Med, 1998, 158: 2315–2323.
5) Carpini JA, Arcelus IJ, Hoffman KN, et al.: Venous duplex imaging follow-up of acute symptomatic deep vein thrombosis of the leg. J Vas Surg, 1995, 21: 472–476.
6) Diamond PT, Macciocchi SN: Predictive power of clinical symptoms in patients with presumptive deep venous thrombosis. Am J Phys Med Rehabil, 1997, 76: 49–51.
7) Sioson ER, Crowe WE, Dawson NV: Occult proximal deep vein thrombosis: Its prevalence among patients admitted to a rehabilitation hospital. Arch Phys Med Rehabil, 1988, 69: 183–185.
8) Moser KM, Lemoine JR: Is embolic risk conditioned by location of deep vein thrombosis? Ann Intern Med, 1981, 94: 439–444.
9) Norris CS, Greenfield LJ,Herrmann JB: Free-floating thrombus. A risk of pulmonary embolism. Arch Surg, 1985, 120: 806–808.
10) Berry RE, George JE, Shaver WA: Free-floating deep venous thrombosis. A retrospective analysis. Ann Surg. 1990, 211: 719–722.
11) Kiser TS, Stefans VA: Pulmonary embolism in rehabilitation patients: Relation to time before return to physical therapy after diagnosis of deep vein thrombosis. Arch Phys Med Rehabil, 1997, 78: 942–945.
12) Kahn SR, Shrier I, Kearon C: Physical activity in patients with deep venous thrombosis: A systematic review. Thrombosis Research, 2008, 122: 763–773.
13) Partsch H, Kaulich M, Mayer W: Immediate mobilization in acute vein thrombosis reduces post-thrombotic syndrome. Int Angiol, 2004, 23: 206–212.