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Original Article

Preoperative Time Required for the Timed "Up and Go" Test in Women with Hip Osteoarthritis Could Predict a Deep Venous Thrombosis Complication after Total Hip Arthroplasty

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We examined whether the preoperative time required for the Timed "Up and Go" (TUG) test could predict the risk for deep venous thrombosis (DVT) in patients with hip osteoarthritis after total hip arthroplasty (THA). Eighteen patients with DVT diagnosed by venography were selected, and 18 without DVT of the same age and sex and with the same operated side as the DVT group were selected as a control group. We evaluated the 5 preoperative factors that might affect the occurrence of DVT complications, as follows: disease duration, body mass index, serum total cholesterol, subjective pain evaluated by the visual analog scale, and TUG. The JOA hip score (pain, range of motion, walking ability, and daily life) was also evaluated before surgery. As a postoperative factor, we checked the postoperative day when weight-bearing was initiated. As a result, TUG (DVT, 18.4 ± 4.0 sec vs. control, 15.0 ± 3.2 sec; $p < 0.01$) was only significantly different between the 2 groups. The ROC curve revealed that the cut-off point of 15.3 sec in preoperative time for TUG was sensitive (83.3%) and specific (61.1%) for DVT after THA (odds ratio = 7.0; 95% confidence interval, 1.6–30.8). These results suggested that low preoperative ambulatory ability in patients with hip osteoarthritis might be associated with DVT after THA. An improvement in TUG before surgery might contribute to a decrease in the occurrence of DVT after THA.

Key words: preoperative Timed "Up and Go" test, deep venous thrombosis, total hip arthroplasty, hip osteoarthritis

Total joint arthroplasty is well-recognized as an effective surgery to decrease impairment and improve ability in the daily life of patients with osteoarthritis by alleviating pain. While this procedure is very successful in clinical practice, deep venous thrombosis (DVT) and pulmonary embolism (PE) are significant complications. The prevalence of DVT in patients receiving total hip arthroplasty (THA), as determined by venography, is reported to be 10.0–40.1% [1–4], and that for PE to be 0.7–30.0% (fatal is 0.05–0.4%) [5]. The risk factors for DVT after THA are as follows: aging [6], female gender [7], body mass index [8, 9], history of DVT [7], the development of coagulation and fibrinolytic markers before [10] or after surgery [11], prolonged bed rest [7, 12], or delayed weight-bearing after the operation [13, 14]. Therefore, early diagnosis and appropriate treatment for DVT are essential

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to prevent subsequent PE.

As a screening test for DVT, D-dimer (Dd) in serum is often evaluated. According to Shiota's study [4], the predictive power of Dd for DVT is highly sensitive (95.5%) and specific (96.9%) when the cut-off is set at 10 μg/ml on the 7th day after THA. We have previously reported that patients with elevated Dd levels, more than 10 μg/ml after THA, require more time for the Timed "Up and Go" test (TUG [15]) before surgery [16]. The purpose of this study was to examine the relationship between preoperative TUG and DVT complications after THA, and to determine the cut-off point of TUG for detecting DVT complications.

Materials and Methods

Participants. One hundred sixty patients with hip osteoarthritis (Hip OA) who received THA in the Department of Orthopaedic Surgery, Okayama University Hospital between 1998 and 2005 were retrospectively reviewed. The criteria for patient selection were as follows: 1) female gender, 2) primary joint replacement, 3) no medical history of heart disease or collagen disease, 4) no smoking in the past or present, 5) no complications other than venous thrombosis (dislocation, vascular problems, arrhythmia requiring treatment, pneumonia, infection, or nerve palsy) during or after surgery, and 6) the ability to walk on admission (with or without a walking aid). As a result, 33 patients with DVT were selected. We next, checked the chart for patients without DVT and identified those having the same age, gender, and operated side as the 33 patients with DVT. As a result, 18 of 33 patients with DVT could be matched to 18 patients without DVT (18 patients with DVT (Group D), another 18 patients without DVT (Group N)). The 2 groups were matched completely for age (average 70.3 ± 5.3 years, range 62–79), gender (all were females), and operated side (9 right and 9 left).

DVT diagnosis. Venography was performed for all 36 patients on postoperative days 14 to 21 (16.0 ± 2.7). Patients in Group D were diagnosed with DVT based on the cut-off sign or filling defect sign.

DVT prophylaxis and physical therapy. None of the patients received prophylactic agents before or after surgery. A foot-pump system was worn on the non-operated foot during surgery and on both feet from postoperative days 1 to 6. Patients were also encouraged to do active motion exercise for the ankle joint (calf pumping) of the operated leg as much as possible during bed rest. Ambulation with weight-bearing began on postoperative day 5 with parallel bars and progressed to gait with a cane until postoperative day 14.

Measures. We reviewed 1 postoperative and 5 preoperative factors that might influence the occurrence of DVT, including disease duration before surgery (duration), body mass index (BMI), serum total cholesterol, visual analog scale (VAS) for the intensity of subjective pain, the time required for TUG [15] as ambulatory ability, and the postoperative day when weight-bearing was initiated. TUG consisted of standing up from a chair (seat height 45 cm) and walking straight for 3 m, turning, returning to the chair, and sitting down. Subjects performed the tasks as naturally as possible (speed and/or walking device). We measured the performance time in seconds and adopted the faster time from the 2 tests. After performing TUG, patients expressed subjective pain when moving using the VAS scale [17]. We also evaluated the JOA hip score before surgery. This consisted of 4 items (pain, range of motion in the operated hip, walking ability, and daily life ability); a perfect score was 100 and the worst 0. To focalize ability, we also evaluated the sum scores (walking and daily life ability, perfect score was 40, worst 0).

Data analysis. Six factors and JOA hip score (total score and ability score) were compared between the 2 groups using the unpaired t-test. To determine whether TUG would be a significant factor between the 2 groups, multiple regression analysis was used to show that TUG was an independent factor. If TUG was independent from other factors, the cut-off point to predict DVT complication after THA was chosen based on optimal sensitivity and specificity. For all tests, a p value < 0.05 was considered statistically significant.

Results

To compare between the 2 groups, only TUG was statistically different. Patients in Group D required more time to complete TUG than patients in Group N (18.4 ± 4.0 sec v.s. 15.0 ± 3.2 sec, $p < 0.01$) (Table

Table 1 Pre and postoperative subject characteristics in 2 groups

	Group D (N = 18)	Group N (N = 18)	*P* Value
Age (years)	70.3 ± 5.3	70.3 ± 5.3	
Sex (male/female)	0/18	0/18	
Operated side (r/l)	9/9	9/9	
Duration (years)	8.1 ± 9.5	9.0 ± 6.4	>0.05
BMI (kg/m^2)	25.0 ± 3.1	23.2 ± 3.2	>0.05
Total cholesterol (mg/dl)	214.6 ± 44.3	219.2 ± 17.3	>0.05
VAS (mm)	61.9 ± 21.0	55.3 ± 26.1	>0.05
TUG (s)	18.4 ± 4.0	15.0 ± 3.2	<0.01
JOA total hip score (point)	35.8 ± 5.4	36.4 ± 7.0	>0.05
JOA ability score (point)	10.0 ± 2.7	10.3 ± 2.1	>0.05
FWB (days)	6.7 ± 1.0	6.7 ± 1.1	>0.05

Each value represents the mean ± SD.
Duration, Duration from the onset of osteoarthritis to operation; BMI, Body mass index; VAS, Visual analogue scale; TUG, The Timed "Up and Go" test; FWB, postoperative days starting full weight-bearing.

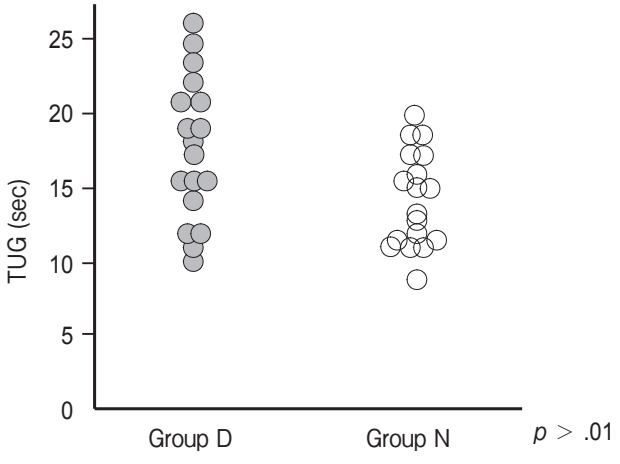

Fig. 1 Group D had less ambulatory ability in TUG than Group N before THA.

1) (Fig. 1). The multiple regression analysis showed that TUG was not affected by another factors (age, duration, BMI, VAS, T-cho, JOA hip score). A ROC curve showed that the optimal cut-off point with TUG before THA for predicting a DVT complication was 15.3 sec, with an 83.3% sensitivity and 61.1% specificity (odds ratio = 7.0; 95% confidence interval, 1.6–30.8) (Fig. 2).

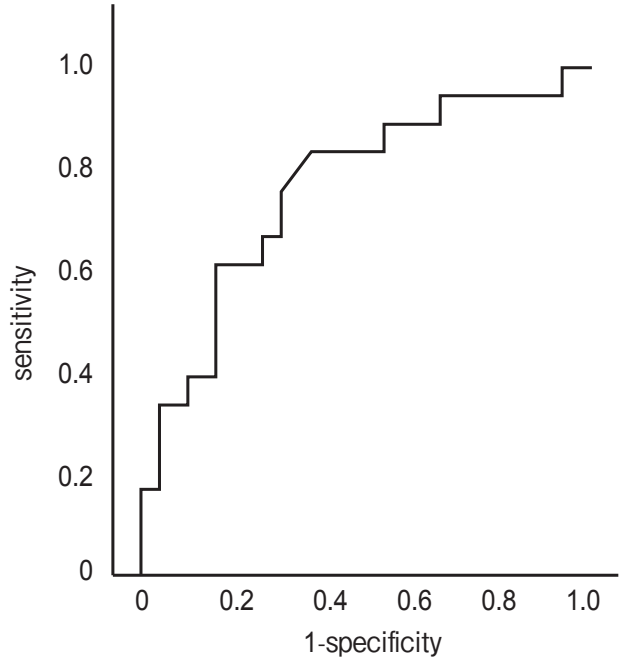

Fig. 2 The ROC curve revealed that the preoperative cut-off time of 15.3 sec for the Timed "Up and Go" (TUG) test was sensitive (83.3%) and specific (61.1%) for a deep venous thrombosis complication after total hip arthroplasty.

Discussion

We have previously reported that preoperative TUG is an important factor for the elevation of Dd after THA in patients with Hip OA in over 60 s [16]. However, Dd was an indirect marker for DVT and could not determine the existence of DVT with cer-

tainty. Thus, venography was performed in the current study, which is the gold standard for detecting DVT. The results show that the preoperative time required for TUG would affect DVT complications after THA and is an independent factor. Furthermore, we determined that the cut-off point was 15.3 sec before THA (sensitivity 83.3%, specificity 61.1%). Arnold *et al.* [18] have used TUG for the evaluation of patients with Hip OA, and concluded that patients with longer TUG times are older and less mobile. Groot *et al.* [19] have investigated physical activity in patients with end-stage hip or knee OA with an activity monitor. They showed that Hip OA patients are less active (time spent upright, walking or carrying out activity) per day than gender- and age-matched healthy controls. Half of all patients with DVT were inactive or mildly active before onset of the complication [20]. McNally *et al.* [12] have shown that a leg with DVT after THA has potentially decreased venous capacitance and outflow before surgery. Their results would suggest that the decrease in physical activity would lead to venous stasis due to a lack of muscle contraction. Including our results, osteoarthritis itself would be a risk factor for DVT.

We also evaluated the JOA hip score in 2 ability items reflecting individual ability in daily life, but it was not different between the 2 groups. In contrast, the time required for TUG is correlated to a range of individual activity [21]. TUG has already been reported to measure performance ability or activity in patients with osteoarthritis [22]. Therefore, TUG would be better than the JOA hip score in predicting the DVT complications induced by a sedentary state.

There have been no reports of whether preoperative exercise therapy can prevent DVT after THA. Westrich *et al.* [23] have examined the effects of active contraction in the calf muscle to peak venous velocity and mean venous volume after THA. Above the saphenofemoral junction, active ankle dorsal to planter flexion was found to enhance peak venous velocity by 158%, and there was an average 9.2 ml increase in mean venous volume per contraction compared with rest. Because most patients with Hip OA have pain, they are not able to increase their activity levels or prolong walking time in daily life. We therefore recommend regular calf muscle exercise with or without slight weight-bearing.

Limitation. There were 2 major limitations to the current study. First, we did not examine DVT complication before surgery by venography due to an ethical problem. We could not distinguish postoperative DVT from preexisting DVT in Group D. We excluded patients with remarkable clinical symptoms or signs (swelling, edema, varicose, tenderness, and heat), with a past history of DVT, and those taking medications that might affect the coagulation system. Second, we could not match operative factors (implant type, operation time, use of cement). In particular, it is well known that the use of cement affects the amount of bleeding. Unfortunately, we could not check the details of each surgery. However, none of our patients had any complications excluding DVT, and there were no differences in the progress of postoperative physical therapy between the 2 groups.

Conclusion. Ambulatory ability reflected by TUG before surgery was found to be associated with DVT after THA, and the cut-off point for TUG to increase the prevalence rate of DVT was determined to be 15.3 sec. Further study is required to determine whether improving the time required for TUG before surgery decreases the prevalence of DVT.

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