Original Article Clinics in Orthopedic Surgery 2024;16:34-40 • https://doi.org/10.4055/cios23128

Is the May-Thurner Syndrome a Major Risk Factor for Deep Vein Thrombosis in Total Hip Arthroplasty?

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Background: May-Thurner syndrome (MTS) is iliac vein compression syndrome associated with postoperative deep vein thrombosis (DVT) resulting from chronic compression of the left iliac vein against lumbar vertebrae by the overlying right or left common iliac artery. MTS is not well known as a risk factor for DVT after total hip arthroplasty (THA). We evaluated the incidence of DVT after THA and analyzed if the MTS is a risk factor for DVT after THA. We hypothesized that MTS would be associated with an increased risk of developing DVT after THA.

Methods: All patients > 65 years of age who underwent THA between January 1, 2009, and January 12, 2017, were identified. Among them, the patients who presented for postoperative DVT of the lower extremity were reviewed with medical record data. MTS was diagnosed with computed tomography (CT) angiography of the lower extremity. We analyzed the demographic data, symptoms, diagnoses, and treatment of MTS patients.

Results: A total of 492 consecutive patients aged > 65 years who underwent operation for THA were enrolled. Among them, 5 patients (1.0%) presented for postoperative DVT of the lower extremity. After reviewing the CT angiography of the lower extremity, 4 out of 5 DVT patients (80%) were identified as having MTS. All MTS patients were female and presented with pain and swelling of the left leg. All MTS patients were treated with systemic anticoagulation, aspiration thrombectomy, and percutaneous transluminal angioplasty. Complete resolution of thrombus was observed in all patients.

Conclusions: If the diagnosis of MTS is delayed, the morbidity and mortality rates are significantly increased. Orthopedic surgeons should be aware of MTS as a risk factor for DVT after THA. Moreover, preoperative evaluation with duplex sonography or CT angiography to confirm MTS should be considered. In this regard, this study is considered to have sufficient clinical value for early diagnosis and appropriate treatment of MTS after THA.

Keywords: *May-Thurner syndrome, Deep vein thrombosis, Total hip arthroplasty*

Deep vein thrombosis (DVT) of the lower extremity is a common but feared complication following orthopedic surgery, especially in prolonged immobilization.[1,2] The incidence of DVT after total hip arthroplasty (THA) is reported to range from 0.24% to 0.9% according to the studies.[3-5] It can cause severe pain, delayed rehabilitation, increased length of hospital stay, economic burden on the healthcare system, or life-threatening pulmonary embolism.[3,6] Therefore, this condition should be prevented and treated promptly. Recently, prophylaxis for postoperative DVT, such as low-molecular-weight heparin, unfractionated heparin, intermittent pneumatic compression, graduated compression stocking, or early mobilization,

Received April 25, 2023; Revised September 4, 2023;
Accepted September 7, 2023
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is used after THA.[7,8] There are many risk factors such as family history, old age, obesity, cardiomyopathy, excessive blood loss, transfusion, and prolonged immobilization that increase the risk for DVT after THA.[7] However, May-Thurner syndrome (MTS) is not well known as a risk factor for DVT after THA.

MTS is iliac vein compression syndrome associated with postoperative DVT resulting from chronic compression of the left iliac vein against lumbar vertebrae by the overlying right or left common iliac artery.[9] Repeated stimulation of the iliac vein wall by arterial pulsating causes the endothelial damage and thrombotic states of venous status.[10] It may be one of the potential risk factors for DVT or venous thromboembolism, which develops in the condition of coagulation or vascular predisposition, such as pregnancy of prolonged immobilization.[11] Recently, several studies suggested that MTS may be a risk factor for DVT after hip surgery.[11,12] However, the exact incidence of MTS among DVT patients who underwent THA is not known.

In this study, we evaluated the incidence of DVT after THA and analyzed if the MTS is a risk factor for DVT after THA. We hypothesized that MTS would be associated with an increased risk of developing DVT after THA. MTS should be considered as a risk factor for DVT after THA and preoperative evaluation to confirm the MTS should be considered.

METHODS

This study was approved by the Institutional Review Board of Jeju National University Hospital (No. 2023-04-018). All methods were performed in accordance with the relevant guidelines and regulations (Declaration of Helsinki). The requirement for informed consent was waived by the Institutional Review Board because of the retrospective nature of the study.

All patients > 65 years of age who underwent THA between January 1, 2009, and January 12, 2017, were identified. Among them, the patients who presented for postoperative DVT of the lower extremity were reviewed with medical record data. Patients' demographic data including age, sex, body mass index (BMI), medical disease, and anticoagulation medication were reviewed. MTS was diagnosed with computed tomography (CT) angiography of the lower extremity if there was extensive thrombosis from the left common iliac vein to the popliteal vein and compression of the left common iliac vein between the right common iliac artery and the fifth lumbar vertebrae body. The diagnosis and side for THA and prophylaxis for DVT were also reviewed. The signs, symptoms, and side of MTS, time duration from THA to MTS, location of thrombus, modality of treatment for MTS (oral anticoagulation, thrombolysis, thrombectomy, percutaneous transluminal angioplasty [PTA], vascular stent, or inferior vena cava [IVC] filter insertion) were identified. The treatment outcome was defined as complete resolution (no residual thrombus), partial resolution (residual thrombus), or no resolution (complete occlusion of the affected vein) by venography or computed tomographic venography.

Standard statistical methods were used to summarize the data: mean and range for continuous data and frequency and percent for categorical data. Analyses were performed using SPSS for Windows ver. 11.0 (SPSS Inc.).

RESULTS

A total of 492 consecutive patients aged > 65 years who underwent THA were enrolled. Among them, 5 patients (1.0%) presented with postoperative DVT of the lower extremity. After reviewing the CT angiography of the lower extremity, 4 out of the 5 DVT patients (80%) were identified as having MTS. The mean age at operation of the MTS patients was 63.0 ± 8.4 years (range, 54.0–72.0 years). All of the MTS patients were female. The mean BMI was 29.5 ± 4.7 kg/m^2 (range, 21.9–32.7 kg/m^2). Three patients had hypertension and 2 patients had cardiovascular disease. Two patients who had cardiovascular disease were taking anticoagulation medication. The diagnosis for THA was osteoarthritis in 2 patients, femur neck fracture in 1 patient, and septic hip sequelae in 1 patient. All MTS patients wore compression stockings for DVT prophylaxis. All MTS patients presented with pain and swelling of the left leg. Although 2 patients underwent THA in the right hip, they also presented with DVT signs and symptoms in the left leg. The mean time interval from THA to MTS was 35.6 ± 12.8 days (range, 24–54 days). The thrombus was extended from the common iliac vein to the popliteal vein in 1 patient and from the iliofemoral vein to the popliteal vein in 3 patients. All of the MTS patients were treated with systemic anticoagulation, aspiration thrombectomy, and PTA. The IVC filter was placed in 2 patients. After thrombolysis, all patients were given antiplatelet agents and graduated compression stockings for 6 months. After 6 months, complete resolution of thrombus was observed in all patients (Table 1).

Case

A 68-year-old female patient underwent THA due to Crowe type IV developmental dysplasia of the hip in the

Table 1. Patient Characteristics, Treatment, and Outcome

Variable	Case 1	Case 2	Case 3	Case 4	Mean ± SD
Age (yr)	54	58	72	68	63.0 ± 8.4
Sex	F	F	F	F	
BMI (kg/m^2)	32.7	24.5	21.9	24.6	25.9 ± 4.7
Medical disease					-
DM	–	–	–	–	
HTN	+	–	+	+	
CVD	+	–	+		
Stroke	–	–	–	–	
CKD	–	–	–	–	
DVT	–	–	–	–	
Anticoagulation medication	+	–	+	–	-
Diagnosis for THA	OA	OA	Femur neck Fx	Septic hip sequelae	-
Side for THA	Left	Right	Left	Right	-
Prophylaxis for DVT					-
Compression stocking	+	+	+	+	
Anticoagulation medication	+	+	+	+	
Interval form THA to ambulation (day)					
Sign and symptom of MTS	Pain, swelling	Pain, swelling	Pain, swelling	Pain, swelling	
Side of MTS	Left	Left	Left	Left	
Interval form THA to MTS (day)	24	31	54	37	36.5 ± 12.8
Location of thrombus	Iliofemoral to popliteal	Iliofemoral to popliteal	Iliofemoral to popliteal	Common iliac to popliteal	
Treatment for MTS					
Systemic anticoagulation	+	+	+	+	
Thrombectomy	+	+	+	+	
PTA	+	+	+	+	
Vascular stent	–	–	–	–	
IVC filter insertion	–	+	+	–	
Treatment outcome of MTS	Complete resolution	Complete resolution	Complete resolution	Complete resolution	

SD: standard deviation, BMI: body mass index, DM: diabetes mellitus, HTN: hypertension, CVD: cardiovascular disease, CKD: chronic kidney disease, DVT: deep vein thrombosis, THA: total hip arthroplasty, OA: osteoarthritis, Fx: fracture, MTS: May-Thurner syndrome, PTA: percutaneous transluminal angioplasty, IVC: inferior vena cava.

left hip joint (Fig. 1). The patient received intermittent pneumatic compression on both lower extremities for the purpose of preventing thrombosis. Delayed ambulation was started 4 weeks after operation due to femoral shortening osteotomy. The patient experienced swelling and pain in the left thigh at 37 days after operation. The symptoms occurred suddenly and worsened rapidly. CT angiography indicated thrombosis of the left common iliac vein, femoral vein and popliteal vein, and stenosis due to compression of the left common iliac vein between

the right common iliac artery and fifth lumbar vertebrae body (Fig. 2). MTS with DVT was diagnosed. The patient accepted continuous infusion of heparin for anticoagulant therapy. Then the patient received a popliteal vein puncture for venography of the left lower extremity. Complete occlusion was observed from the left common iliac vein to the popliteal vein. Moreover, severe stenosis was also observed in the common iliac vein, a finding appropriate for MTS. Aspiration thrombectomy was performed by inserting an aspiration catheter through the puncture site of the popliteal vein. A large amount of blood clots was aspirated out. After the thrombectomy, severe stenosis was still observed in the common iliac vein. The PTA balloon was used to expand the common iliac vein. Normal venous flow was observed without stenosis after recanalization with balloon PTA (Fig. 3). Vascular stent was not inserted because the thrombolytic therapy and PTA were satisfactory. Three days later, venography showed that the thrombus was completely dissolved and the stenosis of the left iliac vein was exposed. After thrombolysis, the patient received a subcutaneous injection of enoxaparin 60 mg twice a day for 2 weeks until discharge. The symptoms gradually

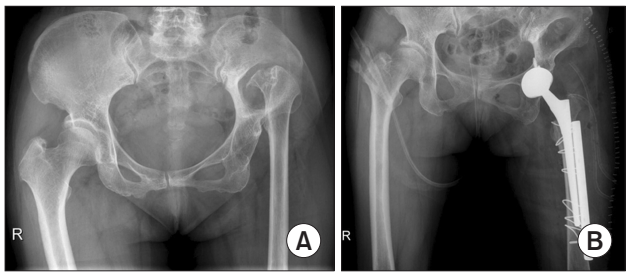

Fig. 1. (A) Preoperative hip anteroposterior radiograph showed Crowe type IV developmental dysplasia of the hip in the left hip joint. (B) Postoperative hip anteroposterior radiograph after total hip arthroplasty.

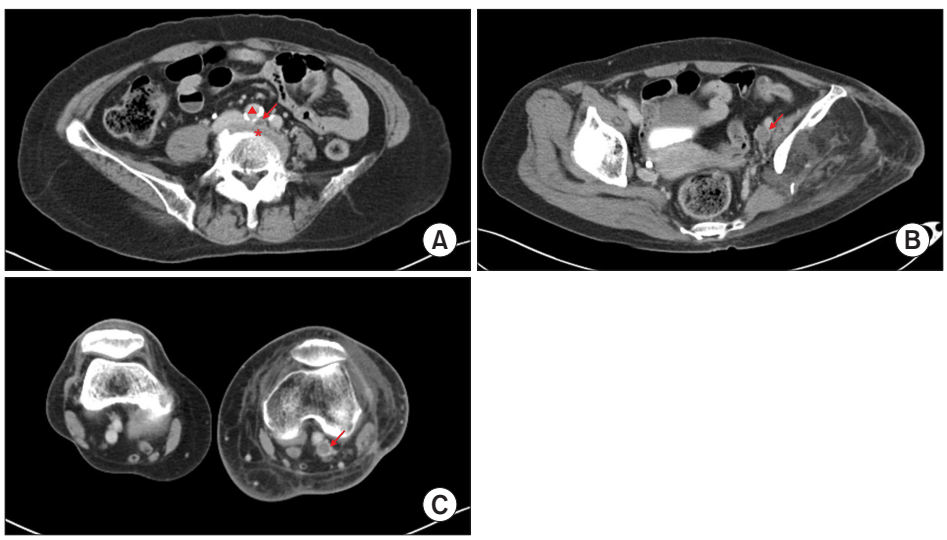

Fig. 2. (A) Computed tomography (CT) angiography showed the compression of the left common iliac vein (arrow) between the right common iliac artery (arrowhead) and fifth lumbar vertebral body (asterisk). (B) CT angiography showing thrombosis of the femoral vein (arrow). (C) CT angiography showing thrombosis of the popliteal vein (arrow).

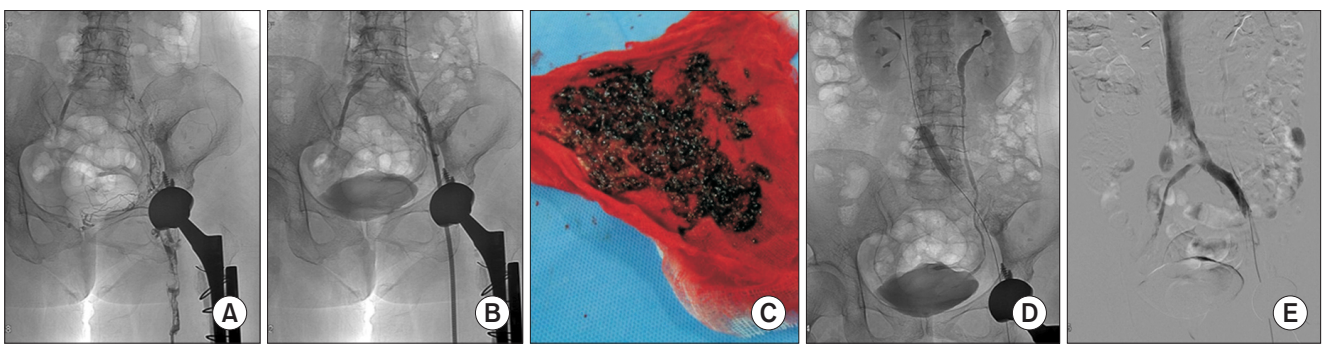

Fig. 3. (A) Venography showed complete occlusion and severe stenosis of the left common iliac vein to the popliteal vein. (B) Aspiration thrombectomy was performed by inserting an aspiration catheter through the puncture site of the popliteal vein. (C) Many blood clots were aspirated out. (D) The percutaneous transluminal angioplasty balloon was used to expand the common iliac vein. (E) Venous flow was observed normally without stenosis after recanalization with balloon percutaneous transluminal angioplasty.

improved and the patient was discharged 2 weeks after the thrombolytic therapy. The patient was given rivaroxaban (15 mg twice a day for 3 months) and graduated compression stockings for 6 months. There were no symptoms at the outpatient visit at 6 months after the operation.

DISCUSSION

In this study, we reported the incidence of DVT after THA and analyzed the demographic data, diagnosis, treatment, and outcome of MTS patients. The incidence of DVT after THA was 1.0%, and 80% of the DVT patients were identified as having MTS. We confirmed that MTS were associated with an increased risk of developing postoperative DVT after THA. Although symptomatic MTS is rare, MTS should be suspected as a risk factor in case of DVT occurring after hip arthroplasty.

DVT is a major risk factor for increased length of hospital stay, worsened outcome, morbidity, or mortality.[3] In addition to worsened outcome to patients, the healthcare cost for DVT is a considerable economic burden on the healthcare system.[6] As a part of an effort to decrease the burden of this complication, strategies for DVT management have been developed.[3] DVT prophylaxis including intravenous thrombosis, elastic compression stockings, or early mobilization significantly reduced the incidence of DVT after THA.[7] DVT incidence after THA was reported to range from 0.24% to 0.9%.[3-5] In the current study, we confirmed that the DVT incidence after THA was 1.0%. This result was not significantly different from other studies that applied DVT prophylaxis.

The risk factors for DVT as a Virchow's triad are venous stasis, endothelial injury, and hypercoagulable state. Venous stasis occurs during prolonged immobilization after THA.[13] The soft-tissue dissection and manipulation result in endothelial injury.[14] The systemic inflammatory response due to soft-tissue injury causes the hypercoagulable state in THA.[3] Other factors such as family history, old age, obesity, cardiomyopathy, excessive blood loss, and transfusion increase the risk of DVT.[7] Recently, several studies recognized that MTS may be a risk factor for DVT after hip surgery. Liu et al.[12] reported that left common iliac vein compression was significantly associated with DVT following hip fracture. Bergen et al.[11] showed that left common iliac vein compression significantly increased the risk of DVT following THA. This study is the first to confirm the exact incidence of MTS (80%) among DVT patients who underwent THA. However, the precise mechanism by which MTS causes DVT after THA is still unknown. It is thought that relative pelvic immobilization may synergize with left common iliac vein compression to increase the risk of DVT following THA.[11] The chronic pulsating compression of the common iliac artery leads to endothelial change and fibrosis of the intimal layer of the left common iliac vein.[10] Future study is needed to figure out the exact mechanism by which MTS causes DVT after THA.

Although the exact prevalence of MTS is not known, it is not a rare entity. The prevalence of MTS was reported as 22% of the 430 investigated cadavers.[9] However, most of the MTS are asymptomatic. Only 1 to 3 out of 1,000 MTS patients will represent with a DVT.[10] MTS accounts for only 2% to 3% of the total lower extremity DVT.[15] Although the prevalence of symptomatic MTS after hip surgery is not known, occult common iliac vein compression contributes to DVT after hip fracture or THA. Bergen et al.[11] reported that left common iliac vein compression greater than 50% significantly increased the risk of DVT following THA. Therefore, if DVT occurs after hip arthroplasty, MTS should be suspected as a risk factor. If MTS is conformed through preoperative evaluation with duplex sonography or CT angiography before THA, more aggressive prophylactic treatment will be required.

A symptomatic MTS patient can present with left-side leg pain, swelling, or life-threatening pulmonary embolism.[16] On the laterality of DVT, the prevalence of left-side DVT is higher than right-side DVT.[17] Moreover, MTS may cause left-side DVT by left common iliac vein compression due to the overriding right common iliac artery.[9] After an orthopedic operation, most of the DVT occurs in the ipsilateral lower extremity, but rarely in the contralateral lower extremity.[18] In this study, 2 patients developed left-side DVT after left-side THA. Therefore, MTS should be considered even if the left DVT develops after right-side THA.

Although there is no guideline for the diagnosis of MTS, it follows the general guideline of DVT diagnosis in the lower extremity.[19] In general, postoperative DVT mostly occurs in the leg that underwent operation. However, postoperative DVT can occur on the opposite side in MTS. As a result, if a patient who underwent an operation on the right leg has postoperative DVT in the left leg, MTS should be suspected. A clinical suspicion of lower extremity DVT can be investigated with duplex sonography. It is a simple, convenient, non-invasive, and low-cost method for the diagnosis of DVT.[20] However, duplex sonography may be insufficient for the diagnosis of MTS due to its limitation for iliac vein involvement.[21] CT as well as magnetic resonance venography can clearly show the anatomic relation between the common iliac vein and the common iliac

artery.[22] Although these methods have advantages for the diagnosis of MTS, they are not suitable for patients with renal disease due to radiation and contrast medium.[19] However, since morbidity and mortality can significantly increase if MTS is not diagnosed, imaging studies should be performed on MTS if suspected in DVT patients after THA. Moreover, preoperative evaluation with duplex sonography or CT angiography to confirm the MTS should be considered.

The optimal treatment method for MTS depends on the degree and extent of the thrombosis, including mechanical thrombus aspiration, PTA, stent implantation, and IVC filter.[23,24] Mechanical thrombus aspiration can be used for the removal of venous thrombus caused by iliac vein compression. The effect of thrombolysis can be evaluated by venography.[19] In the case of iliac vein stenosis, PTA or stent implantation is an effective treatment.[23] Stent implantation should be performed when the stenosis exceeds 70%.[25] An IVC filter can be inserted to prevent pulmonary embolism.[19] After mechanical thrombolysis or stent implantation, anticoagulation therapy is necessary for preventing relapse.[26] In this study, after mechanical thrombolysis, PTA, or IVC filter insertion, the patients were treated with anticoagulation therapy.

This study has some limitations. First, the incidence of MTS could not be investigated in all THA patients because of the retrospective nature of this study. Although CT angiography was not routinely performed in this study, in future studies, CT angiography should be performed in all THA patients as MTS is a potential risk factor for DVT. Second, the sample size of this study is very small. Among 492 THA patients, only 5 patients who were diagnosed with DVT were included in this study. A large prospective study should be performed. Third, we did not quantify the DVT prophylaxis regimens of each patient. This limitation may confound the incidence of DVT. In future studies, the DVT prophylaxis regimens should be controlled and quantified.

In this study, we confirmed that MTS could be a major risk for DVT after THA. If the diagnosis of MTS is delayed, the morbidity and mortality rates can be significantly increased. Orthopedic surgeons should be aware of MTS as a risk factor for DVT after THA. Moreover, preoperative evaluation with duplex sonography or CT angiography to confirm MTS should be considered. In this regard, this study is considered to have sufficient clinical value for early diagnosis and appropriate treatment of MTS after THA.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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