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Editorial
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Reflections on Thromboprophylaxis in Hemophilia B Patients after Total Knee Arthroplasty: Five Points to Ponder for Clinical Nurses

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Editorial

We described a male patient with hemophilia B who developed symptomatic Deep Vein Thrombosis (DVT) after right Total Knee Arthroplasty (TKA) for hemophilic arthropathy. DVT developed in the operated leg while he was receiving coagulation factor IX replacement. This case illustrated the importance of providing thromboprophylaxis and nursing care for all patients with hemophilia B receiving coagulation factor replacement after TKA. In the following, we summarized this case study, and proposed five points to ponder for clinical nurses.

Hemophilic arthropathy is a severe joint complication caused by joint hemorrhage in patients with hemophilia B. Currently, arthroplastic surgery is the most effective and thorough treatment for hemophilic destructive osteoarthropathy. As is well known, the risk of DVT is high in patients after arthroplastic surgery, and recent studies suggest that for hemophilic patients, the incidence of DVT after arthroplasty surgery is 0.5% to 10% [1-3]. However, both thromboembolism risk and bleeding risk are fluctuating during hemophilic patients' disease courses, making it challenging for health professionals to determine when and how to consider thromboprophylaxis.

The patient was a 55-year-old man who was diagnosed with hemophilia B at 3 years of age owing to obvious limb swelling and bruising after blood collection. However, no regular treatment was given. In September 2018, the patient was admitted to our department with a diagnosis of hemophilia arthropathy of the right knee. Right TKA was performed and required 160 min to complete. The preoperative and postoperative imaging data were presented in Supplementary Figure 1. The patient agreed that we publish his case. An approval of an Ethics Committee was not needed for this case report.

Coagulation factor IX, 3600 U, was used preoperatively and 12 h after surgery at the same dose. The coagulation factor dosage was gradually reduced daily according to the patient's condition, and his postoperative recovery was well. On Postoperative Day (POD) 6, the coagulation factor dosage was decreased to 1800 U q12h. That morning, when the nurse in charge makes the rounds of the wards, the patient complained of moderate pain in his right leg, and the Visual Analog Scale (VAS) score was 5. Further physical examination revealed that the patient's right lower limb was swollen, and his right knee motion was limited. The doctor in charge was informed immediately, and lower limb DVT was confirmed after B-mode ultrasonography (Figure 1a). At the same time, the coagulation factor dosage was changed to 1800 U qd.

Following medical, physical therapy and nursing care (Figure 2), B-mode ultrasonography showed no DVT in the right lower limb on POD 12 (Figure 1b). At the same time, the coagulation factor dosage was changed to 800 U qd. No bleeding occurred during hospitalization. Telephone

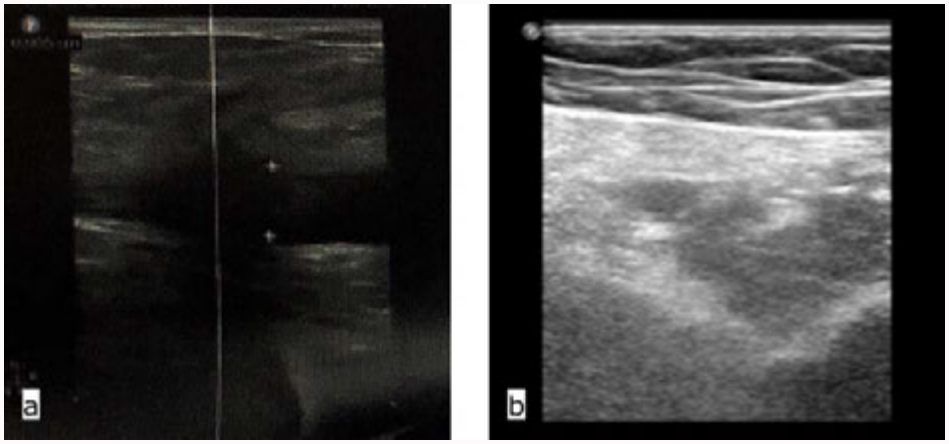

Figure 1: Venous ultrasound scan in the right lower limb.

follow-up revealed that 2 years after the diagnosis of DVT, the patient had returned to his normal life. The DVT resolved, and no Post-Thrombotic Syndrome (PTS) occurred.

The experiences from this case can be summarized as follows:

Firstly, patients with hemophilia arthritis are prone to bleeding after joint replacement owing to coagulation dysfunction, but it does not mean that these patients are not at risk of postoperative thrombosis. Studies have shown that hemophilia patients have a lower risk of DVT complications because of their coagulation factor deficiency (ies). In fact, because large volumes of coagulation factors may be administered perioperatively, the coagulation function of hemophilia patients during this period may be corrected to a relatively normal or even high coagulation state. Therefore, DVT events may occur perioperatively. In particular, for hemophilia arthritis patients with one or more DVT risk factors, perioperative DVT prevention should receive more attention. Although this patient had no other DVT risk factors, he did have a history of several blood transfusions and activity disorder. As a consequence, DVT prevention was worthy of our attention. We should comprehensively assess the risk of DVT according to the specific conditions of patients with hemophilic arthritis during the perioperative period, prevent it in advance and find it in time.

Secondly, nurses should assess the specific DVT risk to ensure patients safety. The Caprini risk assessment model is commonly used clinically to assess DVT risk in surgical patients. We assessed the DVT risk in our patient carefully (Supplementary Table 1); Nonetheless, we found that the Caprini scale lacks specific indicators for hemophilia patients, which increases the difficulty of DVT prevention for hemophilia arthritis patients after joint replacement. For example, "blood transfusion(s) (within one month)" in the Caprini scale is a sub-item, but there is no option for infusing coagulation factors. Thus, it is very important to know the specificity of hemophilia arthritis patients according to the existing theories and perform targeted assessment to identify the DVT risk early.

Thirdly, nurses should develop patient-personalized early activity plans. Early activity is significant to shorten the time to discharge after joint replacement in patients with hemophilia arthritis. Particularly, the Ankle Pump Exercise (APE) not only prevents thrombosis, but also conductive to functional rehabilitation. Hence postoperative active APE is recommended for patients with hemophilia arthritis [4]. For this patient, Continuous Passive Motion (CPM) was used for functional exercise from POD 1, beginning at 50 degrees and gradually increasing the angle according to the patient's condition. Regarding active exercise, patients with hemophilia arthritis should be encouraged to perform leg activities during bed rest combined with postoperative functional exercise. Teaching patients APE and straight leg raises, when they have recovered sufficiently, assists patients in achieving early mobilization. However, our patient had ankle hemophilic arthropathy and ankylosis, which directly affected postoperative lower extremity functional exercise. In addition to the knee hemophilic arthropathy, our patient had right quadriceps muscle atrophy and poor muscle strength, which also increased the difficulty of performing functional exercise. Thereby, clinical nurses should comprehensively evaluate a patient's ability and the effect of postoperative functional exercise to select an optimal activity plan to prevent DVT while promoting functional recovery.

Additionally, clinical nurses should accurately identify patients' DVT symptoms and find out the discomfort of patients timely, combining with clinical examination to diagnose early. The patient recovered well after TKA. However, on POD 6, the patient developed symptoms of DVT, and this diagnosis was confirmed. Through careful observation and risk prevention, nurses identify DVT in patients as early as possible and begin interventions quickly to minimize detrimental effects. This suggests that clinical nurses should be familiar with the symptoms of DVT and that they must recognize symptoms related to DVT as soon as a patient develops them. The department should formulate a regular training plan to improve nurses' awareness. This ensures patient safety and reflects nurses' value.

Finally, clinical nurses should pay more attention to markers such as leg circumference and D-dimer to monitor changes in the patient's condition. From POD 6, the patient developed lower limb swelling and pain, and the responsible nurse monitored changed in his lower leg circumference daily until he was discharged. Thigh circumference was measured 10 cm above the patella, and calf circumference was measured 10 cm below the tibial tubercle. These measurements are performed to monitor the effect of DVT anticoagulation therapy and to prevent DVT progression. As shown in Supplementary Figure 2, the patient's thigh and calf circumference on the healthy side leg (left) showed no significant changes during hospitalization. When the patient has DVT, the circumference of the right leg is the

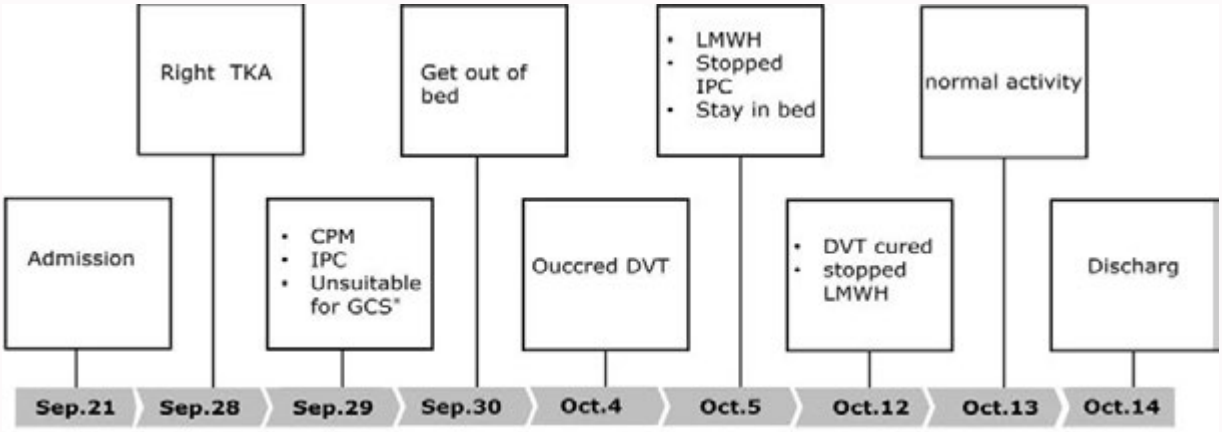

Figure 2: The patient's disease progression.
*Our patient had severe lower extremity malformation and was unsuitable for graduated compression stockings.
TKA: Total Knee Arthroplasty; CPM: Continuous Passive Motion; IPC: Intermittent Pneumatic Compression; GCS: Graduated Compression Stockings; DVT: Deep Vein Thrombosis; LMWH: Low Molecular Weight Heparin

highest, while the right leg is swollen. At that time, the circumference of his right thigh was 45.5 cm and the right calf was 32.5 cm. After 10 days of anticoagulant therapy, his right leg circumference decreased significantly, leg swelling improved significantly. Through B-mode ultrasonography test showed that no new DVT occurred, and the circumference of both legs became similar. These findings suggest that it is necessary for clinical nurses to follow patients' complaints daily, observe patients' symptoms closely, and use quantitative means to monitor changes. Most of all for patients with a high risk of developing DVT, it is necessary to monitor the patient's leg circumference changes perioperatively. The change of the circumference of the swollen limb can reflect the improvement of venous blood flow, which has important reference value for the treatment and prognosis of DVT. The measurement of lower limb circumference is an indispensable part of diagnosis and treatment.

D-dimer has been extensively investigated in the diagnosis of DVT and as an aid in identifying medical patients at high risk for DVT [5]. Changes in D-dimer concentrations perioperatively in our patient are shown in Supplementary Figure 3, which indicates that perioperative D-dimer concentrations over time appear as a parabola. Postoperative D-dimer concentrations showed a continuous increase and peaked at 27.36 mg/dL on POD 5. The peak in D-dimer concentration occurred the day before the patient was diagnosed with DVT, which is considered the pre-thrombotic state. This increase in D-dimer concentration suggests that patients may develop DVT and require further intervention. Clinical nurses are able to observe patients for symptoms and signs of DVT, but also take the initiative to understand the changes in D-dimer concentrations, which are closely related to developing DVT. Continuously increasing D-dimer concentrations indicate that patients may be at a high risk of developing DVT, and high vigilance must be maintained regarding DVT.

Unfortunately, our hemophilia arthritis patient developed DVT after right TKA. However, with multidisciplinary team effort, balanced thrombosis treatment, hemostasis, and coagulation factor replacement therapy, the patient was discharged from hospital without further complications. After a 2-year follow-up, the patient had no repeat DVT and no PTS. But ideal DVT prevention and treatment in similar patients remains unclear. Consequently, it is necessary to summarize actual clinical experience and improve procedures, and to use scientific methods to provide the most basic and safest care for perioperative DVT prevention in hemophilia arthritis patients. The above is our five points to ponder on this case, hoping to provide reference value for future nursing improvement.

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