



Preoperative Deep Vein Thrombosis following Acute Anterior Cruciate Ligament Tear: Report of Three Cases

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ABSTRACT

Case report: We report 3 cases of preoperative deep vein thrombosis (DVT) following anterior cruciate ligament (ACL) injury in a 20-year-old female volleyball player (C1), a 22-year-old female snowboarder (C2), and a 36-year-old male recreational basketball player (C3). In all three cases, the patients presented with hypersensitivity in the injured knee and guarded significantly on physical examination. The patients were all placed on anticoagulation prior to operative intervention. C1 underwent repair 45 days after her injury and C2 delayed repair until completion of a 6 month course of warfarin. C3 did not undergo repair of the ACL; he developed significant stiffness and had diagnostic arthroscopy with lysis of adhesions and synovectomy 5 months following his injury.

Conclusion: Data is limited regarding the risk of DVT after nonmajor orthopaedic injury, such as ACL injury. Recognition and immediate treatment of the DVT is essential in minimizing the risk of additional complications. Duration of anticoagulation and delay in surgical intervention should be determined based on individual patient goals and risk factors.

Keywords: Anterior cruciate ligament, Deep venous thrombosis, Preoperative.

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INTRODUCTION

Anterior cruciate ligament (ACL) injury is common in the athletic population. Recent studies report 150,000 ACL tears occurring each year in the United States.^{1,2} The resulting instability can lead to recurrent injuries, chronic instability, and early-onset osteoarthritis.²⁻⁶

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Given the short- and long-term consequences of activity on an unstable knee, surgical reconstruction has become the treatment of choice for most active individuals. Over 100,000 ACL reconstructions are performed every year in the United States^{2,5} and precautions are taken to ensure the patient is prepared for surgery. Evidence has shown that the preoperative state of the knee, including range of motion (ROM) and swelling, can affect overall outcomes of surgical reconstruction. Surgery should be delayed until full extension is obtained and any significant swelling and inflammation has resolved. Preoperative deep vein thrombosis (DVT) events have been previously described in trauma-related cases. However, to our knowledge, this occurrence following ACL injury has not been described. We present three cases of preoperative DVT following injury to the ACL and their treatment outcomes.

CASE REPORT

Case 1

A 20-year-old Division I volleyball player sustained a twisting injury to her left knee during a competition. She was unable to continue to play and was iced and placed on crutches. Initial examination by the athletic trainer was consistent with an ACL tear. The team had a second game out of town the next day, so she did not fly home until Sunday, 2 days after her injury. She was examined by the team physician upon her return home, 3 days after her injury, and at that time complained of left knee pain and swelling although her most significant complaint was left calf pain, which began during the plane flight home. The patient's surgical history was significant for a right knee ACL reconstruction using bone-patellar tendon-bone autograft and medial meniscus repair 4 years prior. She had no other relevant medical history but was taking oral contraceptive pills. The patient denied use of alcohol and tobacco.

Her physical examination demonstrated a moderate left knee effusion and medial joint line tenderness as well as along the medial collateral ligament (MCL). Her ROM was 0° of extension to 120° of flexion. She demonstrated a grade II Lachman's test and 1+ opening to valgus stress. Her history and physical examination were consistent with an ACL tear, MCL sprain, medial meniscus tear, and a DVT. The patient underwent X-ray, magnetic resonance imaging (MRI), and venous duplex scan assessments

on her left lower extremity. The MRI demonstrated a horizontal tear through the medial meniscal posterior horn and body and a tear of the left ACL, as well as moderate-sized knee joint effusion with mild synovitis and a small hemorrhagic popliteal cyst. The venous duplex scan demonstrated occlusion of the soleal vein and one of the paired posterior tibial veins. The patient was diagnosed with a left calf DVT and was prescribed fondaparinux 7.5 mg subcutaneous daily to be taken until reparative surgery. The patient was followed closely by hematology and orthopaedic surgery. After the patient was anticoagulated for 45 days, she underwent ACL reconstruction with bone-patellar tendon-bone autograft and medial meniscus repair. No complications occurred during the surgery. Postoperative ACL rehabilitation protocol was not altered. Follow-up by Duplex Doppler 5 months following her surgery demonstrated no evidence of DVT and normal venous compression.

Case 2

A 22-year-old female sustained an injury to her left knee after landing awkwardly from a jump while snowboarding out of state. She felt immediate pain and swelling. She was evaluated by the medical team at the ski resort and advised to go to the local emergency department. X-rays were taken and she was told her radiographs showed no fracture or other abnormality. She was given crutches and advised to keep a tight wrap on her knee and flew approximately 700 miles home. Three days following the injury, she began to experience calf pain that mimicked an overuse muscle strain, but then progressed to very intense and sharp pain in the calf. The patient followed up with a local physician 5 days after her injury, who obtained an MRI revealing an ACL tear. In addition, he ordered an ultrasound revealing a left calf DVT involving paired gastrocnemius veins extending to the mid-popliteal vein. The patient was started on a course of warfarin bridged with enoxaparin.

The patient denied any history of a hypercoagulable state. She also denied smoking, alcohol use, or recreational drug use. At the time of her injury she was on oral contraceptives.

On examination, the left knee revealed restricted ROM from 30 to 130°. No significant effusion was noted. Mild calf swelling and tenderness was found. Lachman's test was positive and the remaining ligamentous examination was negative. Neurovascular examination in the left foot was intact.

The patient's primary care physician recommended a 6-month course of warfarin therapy. She delayed ACL repair until completion of the anticoagulation therapy.

Case 3

A 36-year-old male sustained a right knee injury while playing basketball. He felt his knee "slip-out" and spontaneously reduce. He was seen at urgent care later that day and was prescribed physical therapy. Seven days later he was seen by an orthopaedic surgeon and was diagnosed with a tear of his right ACL. His MRI demonstrated an ACL tear, bone contusion, and a possible right meniscus tear.

Twenty-nine days after his injury and prior to reconstruction surgery, the patient developed a DVT in his right calf. The patient denied tobacco use and had no documented risk factors for development of a DVT. He was anticoagulated on warfarin for 6 months and was followed by a local hematologist. The patient underwent physical therapy with emphasis on regaining full ROM. Delay of any elective surgery for two additional months after completing the 6-month course of warfarin was recommended.

The patient presented with right knee pain and stiffness 5 months following his initial knee injury. He was still taking warfarin. The patient denied use of tobacco and denied use of alcohol. Physical examination was notable for right knee active ROM from 29 to 112° of flexion. He had trace effusion, retropatellar tenderness and crepitus, and quadriceps atrophy.

Due to significant and persistent stiffness in his right knee, the patient underwent right knee diagnostic arthroscopy with lysis of adhesions, and synovectomy, and manipulation under anesthesia. The patient continued warfarin treatment until 7 days presurgery and was then started on enoxaparin injections for 2 days. He was restarted on warfarin 1 day following surgery. The patient was stable postsurgery with no complications and was referred to physical therapy with home exercises. Anticoagulation was fully discontinued at the end approximately 1 month postsurgery.

DISCUSSION

The reported cases present three patients diagnosed with ACL tears who were diagnosed with concurrent DVTs in the preoperative setting. Extensive research and recommendations regarding DVT prophylaxis are available for cases of trauma and for orthopaedic patients undergoing knee or hip arthroplasty not related to trauma. However, recommendations do not currently exist for patients with acute ACL tears. The American Society of Hematology acknowledges that there exist significant gaps in knowledge regarding orthopaedics and thromboembolism, particularly with regard to nonmajor conditions, such as injuries distal to the knee, conditions requiring knee arthroscopy, and elective spine

surgery.⁷ Important issues that are yet unresolved include the timing of surgery and the length of preoperative and postoperative anticoagulation. The question of initiating preoperative physical therapy in the setting of a DVT is also controversial.

When considering the timing of surgery in patients with an ACL tear and a DVT, important outcomes to consider are similar to those for any patient with an ACL tear including risk of further injury to articular cartilage or menisci, time to return to activities, risk of postoperative arthrofibrosis, and postoperative wound complications. However, anticoagulation will usually necessitate a delay in surgical treatment and some sort of prophylaxis should be considered perioperatively to minimize the risk for repeated thromboembolic events. The degree of irritation of the knee joint and preoperative ROM are significant factors in determining the risk of arthrofibrosis.⁸ Furthermore, due to the strong association between DVT and inflammation, it is reasonable to delay surgery in patients with ACL tears and DVT to decrease the risk for arthrofibrosis.⁹

In terms of the length of recommended preoperative anticoagulation, the American Association of Orthopaedic Surgeons (AAOS) does not prescribe a precise length of anticoagulation in their guidelines for patients undergoing total knee or hip arthroplasty.¹⁰ In patients with an ACL tear and a history of DVT, the more significant factor determining the duration of anticoagulation is most likely the length of anticoagulation which is usually determined by another physician. According to the AAOS, the precise prophylactic agent and the duration of prophylaxis should be modulated based on the perceived bleeding risk in an individual patient. However, this factor may be less significant in patients with ACL tears as compared with those receiving total knee or hip arthroplasty due to the fact that bleeding risks during and after ACL reconstruction are significantly less than arthroplasty.¹⁰

Questions also remain regarding preoperative physical therapy recommendations in the setting of a DVT, with the primary negative outcome being pulmonary embolism (PE) with early physical therapy and the development of postthrombotic syndrome as the negative outcome for delaying physical therapy. One study suggests that aggressive mobilization and physical therapy within 48 to 72 hours following the diagnosis of a DVT increases the risk of PE.¹¹ Conversely, evidence supports that early walking following DVT diagnosis does not increase risk of PE.¹² Early walking also reduces the risk of extension of a proximal DVT and does not increase acute DVT symptoms. It may also decrease long-term postthrombotic syndrome. Vigorous exercise has not been shown to worsen acute DVT symptoms but

it is not clear to what extent vigorous exercise decreases the incidence of postthrombotic syndrome.¹²

In our case series, there were a few interesting observations in each of our patients that are worth noting. Anecdotally, on initial presentation, their affected knees seemed hypersensitive compared with patients presenting with ACL injuries without suspicion of DVT. During the examination, they guarded significantly more and they struggled to regain their knee ROM compared with ACL-injured patients without DVT. Also, we found it interesting that two of the three patients flew soon after injuring their ACL. It is recognized that air travel increases one's risk for DVT.¹³ Even in healthy patients, the overall risk of DVT is increased twofold in flights greater than 8 hours. Furthermore, the relative hypoxia experienced by individuals on a flight corresponds to living 7,000 to 8,000 feet above sea level. Hypoxic conditions likely play a role in activating the coagulation cascade. Dehydration, secondary to circumstances on the plane, may also increase the risk of DVT by inducing hemoconcentration.¹³

Although cases of ACL tear with concurrent DVT do not occur with high frequency, it is important to recognize this diagnosis to minimize the risk of further complications. According to the AAOS guidelines, duration of anticoagulation should be tailored to the time required to increase ROM and decrease inflammation on an individual basis. Mobilization and physical therapy should be delayed at least 72 hours, but early walking and exercise appear to impart no negative impacts and may decrease the incidence of postthrombotic syndrome. Further research and attention to DVT diagnosed following ACL injury will allow for more accurate recommendations and better outcomes for this group of patients.

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