Incidence of Deep Venous Thrombosis Associated With Proximal Hamstring Rupture

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Background: Rates of deep venous thrombosis (DVT) have been studied for most common orthopaedic injuries. However, rates and risk factors have not been published for proximal hamstring injuries.

Purpose: To determine the incidence of symptomatic DVT associated with proximal hamstring rupture and associations with prophylactic anticoagulation.

Study Design: Case series; Level of evidence, 4.

Methods: Inclusion criteria included all complete and, in a separate cohort, partial proximal hamstring ruptures treated by the senior author from 2007 through 2018 with at least 8 weeks of follow-up. Tendinopathy without tear was excluded. No DVT screening was performed. Charts of patients with symptomatic DVT were reviewed for the treatment method, the presence of imaging-confirmed DVT or pulmonary embolism, and risk factors for DVT. No patients received postinjury DVT prophylaxis. Surgical patients were routinely instructed to take aspirin (325 mg bid) or apixaban (2.5 mg bid) for 4 weeks. Patients with risk factors for DVT received enoxaparin (40 mg daily) for 2 weeks followed by aspirin (325 mg bid) for 2 weeks.

Results: A total of 144 complete proximal hamstring ruptures were included: 132 treated operatively and 12 treated nonoperatively. There were 10 DVTs associated with the injury, for an overall rate of 6.9%. Five of the DVTs were diagnosed preoperatively in patients who had not received DVT prophylaxis; the other 5 were diagnosed postoperatively in patients on DVT prophylaxis. Six of the 10 DVTs had identifiable risk factors. All patients with postoperatively diagnosed DVTs were on prophylactic aspirin or enoxaparin. In the partial proximal hamstring rupture cohort of 114 ruptures, there were no DVTs.

Conclusion: There is a high incidence of DVT associated with complete proximal hamstring ruptures (6.9%) despite many patients receiving DVT prophylaxis. This is substantially higher than that in other lower extremity injuries. Clinicians should have a high index of suspicion for DVT after these injuries, and postinjury DVT prophylaxis may be warranted.

Keywords: proximal hamstring tear; proximal hamstring rupture; deep venous thrombosis; venous thromboembolism; complication

Deep venous thrombosis (DVT) is a concerning complication after lower extremity injury given the potential sequela of life-threatening pulmonary embolism (PE). Surgery, as a well-established risk factor for DVT, may further increase the risk in many patients with such injuries. DVT is seen as a partially preventable complication of injury and surgery given our ability to anticoagulate patients. Discrete and especially preventable complications have come under increased scrutiny in this era of increasing outcome metrics and physician performance tracking. Beyond the clinical impact on the patient, there are financial repercussions on the health care system. Therefore, elucidating the rates of DVT by injury type will help establish a baseline for patient care and performance metrics. In addition, these rates can guide clinical care, allowing surgeons to appropriately anticoagulate patients based on their injury and/or surgery.

Given the prominence of DVT among orthopaedic complications, the rates of DVT have been extensively studied for the most common orthopaedic injuries. Such rates have not been clearly established for proximal hamstring injuries.[1]

Proximal hamstring ruptures or tears are an uncommon diagnosis, often occurring because of eccentric contraction of the hamstring.[1] Diagnosis is made clinically and on magnetic resonance imaging (MRI), which can differentiate partial from complete tears. Either can be treated

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nonoperatively or operatively depending on the patient and injury factors. Operative management is often chosen for complete tears, with evidence suggesting good outcomes[2,3,4,17,31] and possible superiority to nonoperative management.[5,14,24] High-grade partial tears may also benefit from surgery if nonoperative management is unsatisfactory.[5,23]

The purpose of this study was to determine the incidence of clinically apparent DVT associated with both complete and partial proximal hamstring ruptures within a single surgeon's cohort of patients. Our hypothesis was that the rates of DVT would be relatively high compared with rates in other lower extremity injuries.

METHODS

This was a retrospective cohort study to determine the incidence of DVT associated with proximal hamstring injuries. Inclusion criteria consisted of all complete and partial proximal hamstring ruptures treated by the senior author (S.L.M.) between 2007 and 2018 with at least 8 weeks of follow-up. Patients were extracted from the comprehensive personal database of the senior author, who is one of the highest volume surgeons for proximal hamstring repair in the region. Follow-up was calculated from the time of injury if managed nonoperatively or surgery if managed operatively. Diagnosis of complete or partial rupture was made based on MRI. Proximal hamstring tendinopathy without tear was excluded. The surgeon did not screen for DVTs but ordered a diagnostic ultrasound if a patient had calf swelling, erythema, or pain. If shortness of breath or chest pain was present with relevant alteration of vital signs, computed tomography was ordered to evaluate for PE. Charts and the surgeon's database were reviewed for the treatment method, the presence and location of DVT, the presence of PE, and risk factors. Risk factors included age, body mass index, family history of venous thromboembolism (VTE), smoking, use of oral contraceptives, history of cancer, and immobility.

In nonoperative cases, patients were made weightbearing as tolerated and referred to physical therapy without restriction or bracing. Operative patients, whether with complete or partial ruptures, were made toe-touch weightbearing. They were immobilized in a hip brace locked in extension initially, made partial weightbearing at 1 to 2 weeks, and were weaned to weightbearing as tolerated out of the brace at 4 weeks. The only variation in bracing was 1 patient who was placed in a knee brace locked at 90 degrees of flexion instead of a hip brace. Nonoperative patients did not receive DVT prophylaxis. From September 2007 to July 2017, operative patients without the following risk factors were instructed to take prophylactic aspirin 325 mg bid postoperatively for 4 weeks. From July 2017 to September 2018, because of a change in surgeon preference, operative patients without the following risk factors were prescribed prophylactic apixaban 2.5 mg bid postoperatively for 4 weeks if covered by insurance and patients were agreeable. Patients with risk factors for DVT, such as family history of VTE, use of oral contraceptives, obesity, or current smoking, received prophylactic enoxaparin 40 mg daily for 2 weeks followed by aspirin 325 mg bid for 2 weeks.

The incidence of symptomatic DVT and PE was calculated from the extracted data. Risk factors were identified in patient charts in cases of VTE. Further statistical analysis was limited because of the small cohort of DVT cases. This study received institutional review board approval.

RESULTS

A total of 144 complete proximal hamstring ruptures were included: 132 treated operatively and 12 treated nonoperatively. There were 10 DVTs associated with this injury, giving an overall rate of 6.9%. The rates in the operative patients before (7.7%) and after (7.1%) the surgeon switched from prophylactic aspirin to apixaban for patients without the aforementioned risk factors for DVT were similar. Two patients were found to have PEs, both of whom also had DVTs, with a rate of 1.4% within the complete rupture cohort. One was diagnosed preoperatively and 1 was diagnosed postoperatively.

Five of the DVTs (50% of DVT cases) were diagnosed preoperatively. Of these, there was a mean of 15 days (range, 2-42 days) between injury and diagnosis. No patients had been on DVT prophylaxis before diagnosis. Of the postoperatively diagnosed DVTs, there was a mean of 26 days (range, 6-91 days) between surgery and diagnosis and 55 days (range, 24-127 days) between injury and diagnosis. All patients with postoperatively diagnosed DVTs were on prophylactic aspirin or enoxaparin.

Six patients had DVTs only at or below the knee. One had DVTs solely above the knee. One had DVTs both above and below the knee. Two patients had ultrasounds at outside institutions, and the location of DVT could not be established.

Regarding risk factors, all patients with DVT had a body mass index of less than 30 kg/m^2. The mean patient age at the time of DVT diagnosis was 48.3 years (range, 29-64 years). Of the 5 preoperatively diagnosed DVTs, 2 patients had risk factors. One patient was placed in a knee flexion brace by an outside physician for 2.5 weeks before presenting to our institution, and 1 had concomitant rib fractures limiting mobility. Of the 5 postoperatively diagnosed DVTs, 4 patients had risk factors. One was a smoker and was placed in a knee flexion brace postoperatively. This patient was later diagnosed with Factor V Leiden. One patient was taking oral contraceptives, 1 had an immediate family history of DVT, and 1 had a long plane flight 4 days before surgery.

The partial proximal hamstring rupture cohort included 114 ruptures (52 treated operatively and 62 treated nonoperatively). There were no DVTs.

DISCUSSION

We found that the rate of DVT associated with complete proximal hamstring rupture was high at 6.9%. Half were

diagnosed before the initiation of DVT prophylaxis, and half were diagnosed postoperatively after the patients had been on DVT prophylaxis. There were no DVTs among the cohort of partial hamstring ruptures.

This is notably higher than the rates of symptomatic DVT associated with many other lower extremity orthopaedic injuries. Published injuries and their associated DVT rates include foot and ankle trauma at 0.28%,[25] foot and ankle surgery at 0.22% to 1.9%,[9,15,19] operatively treated ankle fracture at 2.66%,[22] Achilles tendon rupture at 0.43% to 7%,[9,16,21,32] and quadriceps tendon rupture at 2.5% (risk of DVT or PE).[10] A Cochrane review of 8 randomized controlled trials of patients with at least 1 week of lower extremity immobilization showed rates of symptomatic VTE of 0.8% on low-molecular-weight heparin and 2.1% without anticoagulation.[34]

The reason for the high rate of DVT seen in complete proximal hamstring ruptures is unclear, and further research is warranted. Comparing it with similar operatively managed injuries may yield insight. Anterior cruciate ligament (ACL) reconstruction, with a 0.33% to 0.5% rate of DVT,[7,12] also addresses a soft tissue injury with postoperative bracing and limited mobility, but it generally allows for weightbearing as tolerated postoperatively. Our operative cohort was initially made toe-touch weightbearing. Nonweightbearing or limited weightbearing is seen in multiligament knee reconstruction, where a 2% rate of DVT has been found.[8] Hip arthroscopy is proximal in the lower extremity like hamstring ruptures, may have a similar patient population, and may involve restricted weightbearing; DVT rates have been shown at 0.1% to 0.79%.[18,29] These patients tend not to be immobilized, and the preceding injury is less traumatic. Immobilization has been shown to strongly increase the risk of VTE.[30] Operatively treated ankle fractures are similarly nonweightbearing and immobilized below the knee, but the rate of DVT (2.66%) is much lower than that in our cohort.[22] They are a more distal injury. Achilles tendon rupture and quadriceps tendon repair may be the best correlate, given that they are also tendon repairs initially made nonweightbearing with joint immobilization, yet even these rates are lower at 0.43% to 7% for Achilles rupture[9,16,21,32] and 2.5% (risk of DVT or PE) for quadriceps tendon repair.[10]

There may be a constellation of factors that contribute to the high rates of DVT seen in complete proximal hamstring ruptures—the nonweightbearing postoperatively alongside a hip extension brace, combined with more proximal trauma and surgery. Factors that we have not specifically examined, such as the difficulty with ambulating in a hip extension brace postoperatively and associated decreased mobility, may play a role as well. The presence of DVTs only in the complete rupture cohort and not in the partial rupture cohort may relate to the degree of pathology and trauma alongside the increased rate of operative management in the former group.

Aspirin is often prescribed for 4 weeks postoperatively as DVT prophylaxis for operative repair of proximal hamstring ruptures.[1] Most of our patients were managed with aspirin as well, unless there was a risk factor for DVT. Owing to the high rate of DVT anecdotally noted by the surgeon in 2017, she switched to apixaban for DVT prophylaxis. The rates of DVT in operatively managed patients over those time frames did not appreciably change, although there is a limited sample size.

Of note, when discussing the rates of DVT, it is important to differentiate DVTs diagnosed clinically via symptoms or via screening tests. The former rates will be much lower, perhaps capturing only clinically relevant events. The latter can be much higher, although the clinical importance of many of these DVTs is debatable. Achilles tendon ruptures illustrate this discrepancy well. Studies based on symptomatic DVT show rates of 0.43% to 7%,[9,16,21,32] while screening for DVT produces rates of 34% to 35%.[9,20] ACL reconstruction studies show a 0.33% to 0.5% rate of DVT[7,12] in symptomatic patients and 8.4% to 14% in screened patients.[11,27,33] Studies of knee arthroscopy show that only 25% to 27% of DVTs found on screening are symptomatic.[11,28] We captured only symptomatic DVTs. Symptomatic DVTs may be more clinically important, warranting study and intervention. Unless otherwise specified, the referenced studies in this manuscript only examined symptomatic DVT. Screening studies were excluded.

A review of our DVT cases showed possible risk factors for thrombosis. Six of the 10 DVTs had an identifiable risk factor. These factors were wide-ranging, from preoperative immobilization to oral contraceptives to a family history of DVT. Studies have shown obesity[25] and older age[13,25] to be risk factors for DVT in lower extremity injuries, although some studies have found no risk factors.[21] None of our patients with DVTs were obese, and only 1 was older than 60 years.

There are limitations to this study. Owing to the absolute infrequency of DVT, our population did not capture enough patients to merit meaningful statistical analysis on rates or risk factors. This is an unfortunate reality in the study of uncommon events. Large database studies are better equipped to evaluate such rates given their large sample sizes, but they have limitations as well.[6,26] This study was not designed to identify and statistically analyze the risk factors of DVT in that only the charts of patients with DVT were reviewed for specific risk factors. The retrospective design may introduce selection bias, overestimating the risk of DVT. Because we did not use screening tests and only examined symptomatic DVTs, our data may underestimate the true incidence of DVT.

CONCLUSION

There is a high incidence of DVT associated with complete proximal hamstring ruptures (6.9%) despite many patients receiving DVT prophylaxis. This is substantially higher than that in other lower extremity injuries. Clinicians should have a high index of suspicion for DVT after these injuries, and postinjury DVT prophylaxis may be warranted.

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