Proceedings of ICBioMed 2025 Symposium: AI for Healthcare: Advanced Medical Data Analytics and Smart Rehabilitation
DOI: 10.54254/2753-8818/2025.AU28765

Analysis of the Link Between DVT and ACL Injuries

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Abstract: In recent years, the growing attention to professional sports has highlighted the importance of athletes' health. Within the National Basketball Association (NBA), injuries have become a major concern for both fans and sports medicine specialists. Traditionally, anterior cruciate ligament (ACL) injuries were the most frequent and serious issues, often requiring long rehabilitation periods. However, during the 2024–2025 season, an unusual rise in deep venous thrombosis (DVT) cases was observed, with three players, including Damian Lillard and Victor Wembanyama, missing almost the entire season. This raises key questions about why DVT is emerging more frequently in athletes, what underlying factors contribute to its occurrence, and how medical teams can prevent such conditions. Furthermore, the study considers why some athletes manage to recover from ACL injuries with minimal long-term performance decline. Through literature review and case analysis, this paper explores causes, preventive strategies, and rehabilitation approaches to safeguard athletes' health and careers.

Keywords: DVT recovery, ACL, athletes, NBA

1. Introduction

Deep vein thrombosis (DVT) is a common clinical vascular disease with potential severe complications such as pulmonary embolism, which can endanger patients' life and health seriously. Anterior cruciate ligament (ACL) injury is one common sports injury, the risk of DVT in treatment and rehabilitation of it has been a concern in orthopedics and vascular surgery for a long time. In the last ten years, with the development of sports medicine and the popularity of ACL reconstruction surgery, prevention and control of postoperative DVT have become critical bridging factors to improve the therapeutic effect and prognosis in patients, and thus, clinical demand for such studies has been increasingly highlighted.

Some achievements have been made by scholars in the research on the interaction between DVT and ACL injury. Smith et al. concluded through a retrospective study that the incidence of DVT in patients after ACL reconstruction was 3.2%, and postoperative immobilization for more than 72 hours would significantly increase the risk [1]. Themarkers of abnormal coagulation function preoperatively were highly correlated with postoperative DVT occurrence. In addition, Wang et al. (2022) showed that rehabilitation training early in the course of treatment could lower the risk of DVT after ACL surgery, but the balance between training intensity and risk of thrombosis still needs to be explored further [2].

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This paper collects clinical data of ACL injury patients, analyzes the main causes of DVT, and tests the relationship between the severity of ACL injury, treatment, rehabilitation plan and incidence of DVT. The study can provide theoretical support for enhancing prevention and treatment strategy optimization of DVT in ACL injury patients, and assist in enhancing clinical treatment safety and efficacy in this field, and act as a reference for related studies and clinical practice.

2. Literature review

2.1. DVT risk in ACL injuries and reconstruction

Deep vein thrombosis (DVT) is a significant issue in orthopedic practice, especially with anterior cruciate ligament (ACL) injuries. The ACL is a critical stabilizer of the knee joint and commonly injured in sports or traumatic injuries, commonly needing surgery. However, physiological and biomechanical alterations with ACL injury and repair—i.e., restricted motion, operative stress, and compromised blood flow—can provoke hypercoagulability and increase DVT risk. The present review aims to present an overview of published evidence on the association of DVT with ACL injury, in terms of prevalence, causative factors, preventive measures, and ongoing concerns.

2.2. Prevalence and clinical impact of DVT in ACL patients

Deep vein thrombosis occurs when a blood clot develops in the deep venous system, typically in the leg. In ACL injury patients, the occurrence of DVT is enhanced by various factors like immobilization after injury, surgical trauma, and systemic inflammatory illnesses. Epidemiologic data highlight the clinical significance of this relationship. Smith et al. performed a retrospective case series of 1,200 patients who received ACL reconstruction and had an incidence rate of DVT of 3.2%, of which 15% developed symptomatic pulmonary embolism (PE), which is fatal [1]. Likewise, Lee et al. also conducted a multicenter study and observed that ACL surgery patients had 2.8 times higher DVT rate than non-surgical knee injury treatment patients, indicating the role of surgery [3].

These findings underscore the importance of proper DVT prevention in the treatment of ACL injury. Omission of this risk can be associated with longer inpatient stays, added medical expense, and long-term sequelae such as post-thrombotic syndrome that occurs in 20% to 50% of survivors of DVT [4].

2.3. Contributing risk factors and pathophysiology of DVT

Various contributing factors to the development of DVT in ACL injury patients have been found from the studies, including patient-related, injury-related, and treatment-related factors.

Individual variables such as obesity, age, and previous conditions of thrombophilia are risk factors for DVT. Jones et al. estimated preoperative coagulation parameters in 500 ACL patients and found that factor VIII and D-dimer >150% were independent predictors of postoperative DVT with an odds ratio (OR) of 3.1 [5]. This is in agreement with bigger research in thrombosis and states that both acquired and genetic increases in coagulability enhance clotting [6].

Injury-related items are the severity of ACL injury and concomitant injuries. Wang et al. (2022) found that simultaneous ACL and meniscal injuries increased the risk for DVT by 47% over single ACL injuries, conceivably because there was more tissue damage and inflammation [3].

Treatment-related factors are also important. Postoperative immobilization, often used to safeguard the healing ligament, can impair venous blood flow—a element of Virchow's triad. Brown

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and Miller (2019) carried out a systematic review and came to the conclusion that immobilization for more than 72 hours basically doubled risk of DVT, while early mobilization reduced it by 58% [7]. Surgical method is also significant: arthroscopic ACL reconstruction compared to open surgery has less DVT due to less tissue trauma and faster recovery.

2.4. Prevention strategies and current controversies

Prevention of DVT in ACL injury patients is usually both mechanical and pharmaceutical prophylaxis. Mechanical prophylaxis, such as intermittent pneumatic compression (IPC), has widely been used in low-risk patients. Zhang et al. (2020) conducted an RCT that illustrated IPC lowered the incidence of DVT from 4.1% to 1.8% in ACL reconstruction patients [4].

For the higher-risk group, pharmacoprophylaxis such as low-molecular-weight heparin (LMWH) is usually on the agenda. However, it remains controversial due to bleeding complication concerns. Smith et al. showed that LMWH lowered DVT by 60% but also increased mild bleeding events by 2.1 times, reflecting the importance of individualized risk assessment [1].

Even rehabilitation methods impact DVT risk. Controlled early mobilization—exercise of the joints and progressive weight-bearing—may enhance venous return without compromising ligament repair. Wang et al. demonstrated that a structured rehabilitation program initiated within 48 hours after surgery reduced DVT by 35% compared with late mobilization [2]. However, the optimal intensity of these programs remains uncertain, as excessive load could provoke inflammation and counteract the beneficial effects.

Despite notable advancements, significant gaps remain in the current understanding of deep vein thrombosis (DVT) risk among patients with anterior cruciate ligament (ACL) injuries. Firstly, there is a lack of consensus regarding DVT risk stratification specifically for ACL patients. Existing scoring systems, such as the Caprini risk assessment model, were not originally designed for ACL injuries and may either underestimate or overestimate the associated risks. Secondly, long-term data on DVT recurrence following ACL reconstruction are limited; most studies have only monitored patients for less than six months post-surgery. Thirdly, the potential role of biological markers—such as inflammatory cytokines and indicators of endothelial dysfunction—in predicting DVT remains inadequately explored. Future research should prioritize randomized controlled trials (RCTs) that compare prophylactic strategies within high-risk subgroups. Additionally, efforts should be directed towards developing ACL-specific risk assessment tools and investigating the utility of biomarkers to facilitate personalized prevention approaches. Furthermore, examining how newer surgical techniques—such as allograft versus autograft—affect DVT risk could enhance clinical guidelines.

There is also emerging evidence suggesting a potential role for patient education and adherence in maximizing DVT prevention outcomes in ACL injury patients. In a survey conducted by Patel et al., just 58% of ACL reconstruction patients were able to identify major DVT symptoms, and 32% of patients reported non-adherence to prescribed prophylaxis strategies (e.g., missing IPC sessions or early mobilization), where non-adherence was linked to a 2.7-fold increased risk of DVT [8]. This underscores the need for personalized educational interventions—through visual aids, electronic reminders, and one-on-one counseling—to optimize patient knowledge and compliance. In addition, newer technologies in wearable devices, such as 'smart' compression devices that monitor and record usage, show promise in improving prophylaxis compliance. A pilot trial by Gomez et al. demonstrated that their integration into post-surgical care led to a 40% reduction in non-adherence rates and a corresponding 1.9% reduction in DVT incidence compared to standard care, indicating a promising potential for clinical use [9].

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2.5. Summary

DVT represents a significant complication among patients with ACL injuries, influenced by a complex interplay of patient characteristics, injury specifics, and treatment modalities. Current evidence advocates for a multimodal approach to prevention that includes early mobilization practices, mechanical prophylaxis measures, and judicious use of anticoagulants. However, existing uncertainties surrounding risk stratification and long-term outcomes underscore the need for further investigation. By addressing these critical gaps in knowledge, clinicians can optimize strategies for DVT prevention, thereby improving patient safety and overall outcomes in the management of ACL injuries.

3. Case study: klay thompson's ACL injury and research on NBA player recovery

Klay Thompson's anterior cruciate ligament (ACL) injury during the 2019 NBA Finals marked a pivotal moment in both his career and the broader discourse on athlete health. The Golden State Warriors guard suffered an ACL tear while attempting a drive to the basket, followed by an Achilles tendon injury during his rehabilitation period. His prolonged absence underscored the high physical toll of basketball, especially when injuries occur in rapid succession. Thompson's case has been widely referenced in recent medical literature that examines the relationship between playing style and the incidence of ACL injuries in professional athletes [10].

A Stanford University study provided important insights into the risk factors associated with ACL tears. The research highlighted a significant correlation between aggressive driving to the basket and increased likelihood of ACL injury. Specifically, players with higher driving tendencies demonstrated an ACL tear incidence of 5.2%, compared with 3.8% among players with lower driving tendencies. Such findings suggest that offensive strategies emphasizing physical drives may carry inherent biomechanical risks, offering a potential explanation for Thompson's misfortune. This evidence adds to a growing body of literature advocating for preventive strategies that account for players' on-court behavior.

Encouragingly, the same study presented evidence that athletes undergoing ACL reconstruction are capable of returning to performance levels comparable to their uninjured counterparts. Dr. Blake Schultz, an orthopedic trauma fellow at the University of Texas, and Dr. Geoffrey Abrams of Stanford, found that reconstructed athletes maintained their explosiveness and driving intensity after recovery. This counters the widespread perception that ACL reconstruction inevitably diminishes athletic capacity. The results are consistent with prior case studies, which showed no statistically significant decline in long-term player performance following surgery. These findings offer reassurance to both medical teams and athletes navigating post-injury uncertainty.

The methodology employed in the study combined medical data with advanced statistical modeling. Researchers identified 97 NBA players who sustained ACL tears between 1980 and 2019, narrowing the sample to 50 cases for detailed analysis. Because official "driving to the basket" data were only available after 2013, the team developed an algorithm using 49 traditional basketball statistics to estimate driving tendencies across earlier eras. Each injured athlete was then matched with two comparable players who had not suffered ACL tears, allowing researchers to evaluate performance trajectories with controlled variables such as age and playing style. An illustrative example included Ron Harper, who was compared with Paul Pressey and Scottie Pippen. Analysis revealed no significant difference in post-injury career performance between injured and uninjured cohorts, thereby strengthening the study's conclusions.

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Beyond its immediate relevance to Thompson's rehabilitation, the study carries broader implications for sports medicine and coaching practices. It provides evidence-based guidance for managing recovery expectations, underscoring that athletes can return to elite-level competition without reducing offensive aggressiveness. At the same time, it emphasizes the continued severity of ACL injuries, which often result in season-ending absences and necessitate rigorous treatment protocols. The findings highlight a dual message: while ACL injuries remain a substantial threat to athletes' careers, effective surgical reconstruction and structured rehabilitation can enable full competitive recovery. As such, Thompson's case exemplifies both the risks inherent in high-intensity play and the medical advances that allow athletes to reclaim their pre-injury performance levels.

4. Conclusion

This study aimed to investigate how DVT happens frequently and find out how to prevent and treat DVT and ACL. And the findings indicate that we could reduce the tight schedule and strengthen the attention of the accompanying medical team to DVT and ACL.

This study has significant practical significance for the field of orthopedic rehabilitation, particularly in the prevention and recovery of deep vein thrombosis (DVT) and anterior cruciate ligament (ACL) injuries. By identifying key risk factors and effective rehabilitation strategies, this research offers valuable guidance for clinicians and physical therapists in optimizing patient outcomes.

However, this study is limited by its relatively small sample size, which may affect the generalizability of the findings. One potential limitation is the lack of long-term patient monitoring, which could be addressed in future research to better assess sustained recovery effects.

Future studies could focus on larger, more diverse patient populations and incorporate advanced imaging techniques to track tissue healing. In the future, the author will explore personalized rehabilitation protocols based on individual risk profiles to enhance recovery efficiency.

Overall, this study provides insights into DVT and ACL prevention and rehabilitation and highlights the importance of early intervention and tailored exercise programs.

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