



Incidence and Risk Factors Associated with Post Tibial Plateau Fracture Deep Venous Thrombosis: A Prospective Cohort Study

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i38A32092

Editor(s):

(1) Dr. Sirigireddy Sivajothi, College of Veterinary Science, Sri Venkateswara Veterinary University, India.

Reviewers:

(1) Pratik Phansopkar, Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, India.

(2) Stan Gabriel Carol Davila, Elias University Hospital, Romania.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/70136>

Original Research Article

**Received 01 May 2021
Accepted 05 July 2021
Published 26 July 2021**

ABSTRACT

Objective: The purpose behind this study was to determine the incidence and risk factors associated with post tibial plateau fracture deep venous thrombosis (DVT)

Materials and Methods: A prospective study was conducted in a tertiary care hospital, Indus Medical College & Hospital, Tando Muhammad Khan to recruit those patients who were undergoing orthopedic surgeries during the periods of eighteen months. All the adult patients of both gender planned for surgery due to tibial plateau fracture were enrolled under this study. Duplex ultrasound was performed to detect the presence of underlying postoperative DVT. Post-operatively patients were assessed for potential risk factors associated with higher incidence of DVT.

Results: For the final analysis, 344 patients were included among them majority were males (n = 219, 63.66%) with overall mean age and SD was 47.52±12.02 years. The most common cause of fracture was road traffic accident (n = 178, 51.74%). The overall incidence of post-operative DVT

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observed in our study was 9.30% (n = 32). Mean age 40.19±6.10 years, increased mean duration of operation 3.01±.078 hours, increased mean duration of post-hospitalization 18.49±7.37 days, raised mean WBC counts 20.12±5.64, and increased mean D-dimer levels 3.24±3.09 (laboratory cut off value 0.5mg/L) were significantly associated with higher incidence of DVT in patients operated for tibial plateau fractures.

Conclusion: This prospective analysis has identified the potential modifiable risk factors associated with DVT. Consideration should be given to the preventable and treatable risk factors to prevent from the DVT associated complications.

Keywords: Tibial plateau fracture; DVT; Pakistan.

1. INTRODUCTION

Following surgery of lower limb, deep venous thrombosis (DVT) could be the potential reason of pulmonary embolism and associated morbidity and mortality in hospitalized patients especially in patients with trauma. The overall incidence of tibial shaft fracture, 16.9/1000,000/years, tibial diaphyseal fracture accounts for 40%, and tibial plateau fractures accounts for 1-2% of all adult fractures and almost 32% of per-knee fractures [1-4].

After the trauma, certain pathophysiological changes occur which causes hypercoagulation state, systemic inflammatory response, and trauma stress are the major risk factors leads to the development of DVT [5,6]. The risk of DVT further increased when extremity gets elevated after surgical procedure to reduce the mobility. In a study, Knudson et al., [7] proposed risk factors associated with venous thromboembolism particularly in patients with lower extremity fractures using the National Data Trauma Bank (NTDB) using a scoring system called Abbreviated Injury Score (AIS) of more than 3. Another author Shibuya with his colleagues [8] also used the NTDB for determining the incidence of DVT and pulmonary embolism (PE) in patients with fractures only affected foot or ankle and found the incidence rate of 0.28% and 0.21%, respectively. The overall incidence of DVT after tibial fracture is extremely low (6%) hence chemical prophylaxis for routine use is doubtful [9].

Post-surgical DVT prevention is purely dependant of underlying risk factors. By far, most of the previously conducted studies are focused on knee and hip joint arthroplasties, a specific population particularly old age group and patients who are immobilized for

prolonged period. Epidemiological studies focusing on tibial plateau fracture is still lacking. Junyong Li and colleagues [9] have conducted a study but it does not cover the population residing at our region and also their advance health care facilities may be the reason of comparatively low incidence of DVT in their population and incidence of DVT might be high in our area. However, there is no any national database available through which the incidence of DVT can be documented that is why our study will fill the scientific gap present in our area.

2. PATIENTS AND METHODS

A prospective study was conducted in a tertiary care hospital, Indus Medical College & Hospital, Tando Muhammad Khan to recruit those patients who are undergoing orthopedic surgeries between 1st May 2019 to 31st November 2020 with a aim to detect post surgical complication including deep venous thrombosis.

2.1 Inclusion and Exclusion Criteria

Data collection was started after patients meet the following inclusion criteria: age more than 16 years and less than 60 years (as the chances of DVT increases after the age of 60 years due to comorbid conditions such as lack of mobility, CVA, or diabetes mellitus), undergoing surgery of tibial plateau fracture, and with no previous history of any type of lower limb surgery. Patients with metastatic fracture or having fracture of more than 4 weeks, concurrent fractures in other locations, patients with known coagulopathy, prehospitalization or preoperative presence of DVT, patients on anticoagulation were excluded from the study.

2.2 Methodology

As per the recommended management, all the patients with tibial plateau fracture were

managed as per the protocol and treatment started with placement of inflatable tourniquet of affected limb after that subcutaneously Low molecular weight heparin (LMWH) with dose strength of 2500-4100IU was administered once daily in all admitted patients along with elevation of extremity of affected limb. Prevention of DVT was also followed postoperatively with LMWH and elevation of limb when diagnosed using Doppler ultrasound.

Tibial plateau fracture was diagnosed based on the history, presentation, clinical examination and confirmed on the basis of radiographic findings suggestive of tibial plateau fracture. A gold standard treatment, open reduction and internal fixation ((ORIF) was performed on all these patients. The diagnosis of DVT was made in accordance with the Guideline for the Diagnosis and Treatment of Deep Vein Thrombosis (3rd edition), proposed by the Chinese medical association. Patients were followed postoperatively for the development of DVT. Duplex ultrasonography (DUS) was performed on day one and on alternate days till discharge of patients. After the diagnosis, presence of DVT was categorized into two groups, proximal DVT (DVT localized in popliteal vein or proximally and/or presence of DVT proximally and distally) and distal DVT (distal to popliteal vein).

2.3 Data Collection and Analysis

Data were collected for demographic characteristics (age, gender, and area of residence), comorbidities (hypertension, diabetes mellitus, chronic liver or kidney disease), trauma (type of fracture either it was closed or open, and etiology of trauma), operative details like post-operative duration of hospital stay, and laboratory parameters (random blood sugar, hemoglobin levels, lactate dehydrogenase (LDH), white blood cell count (WBC), platelets count, and D-dimer level). Independent t-test and chi-square test were applied to determine the risk factors associated with DVT and a p value <0.05 was considered as statistically significant.

3. RESULTS

For the final analysis of patients, 344 patients were included among them majority were males (n = 219, 63.66%) and 36.33% (n = 125) were females with overall mean age and SD was 47.52±12.02 years. The age range was 16 years to 60 years with median age was 40.0 years. Majority of the patients operated were belongs to

urban area as compared to rural, 58.7% (n = 202) and 41.27% (n = 142), respectively.

The most common cause of fracture was road traffic accident (n = 178, 51.74%) followed by fall from height (n = 118, 34.30%), and blunt trauma (n = 48, 13.39%), respectively. Based on the Schatzker classification system most of the fractures were classified as type I-IV (n = 230, 66.86%) while 33.13% (n = 114) fractures were classified as type V-IV.

The overall incidence of post-operative DVT observed in our study was 9.30% (n = 32). Chart No. 01. Most commonly DVT observed in distal vein (n = 19, 59.37%) while DVT involved in proximal vein in 13 patients (40.62%) with an incidence rate of 1.9% and 1.3%, respectively.

Variables like mean age 40.19±6.10 years, increased mean duration of operation 3.01±0.78 hours, increased mean duration of post-hospitalization 18.49±7.37 days, raised mean WBC counts 20.12±5.64, presence of diabetes mellitus, and increased mean D-dimer levels 3.24±3.09 (laboratory cut off value 0.5mg/L) were significantly associated with higher incidence of DVT in patients operated for tibial plateau fractures. Chart No. 01.

4. DISCUSSION

Tibial plateau fracture is rare and associated with low complication rate but occurrence of deep venous thrombosis in these patients although is not common but may sometime poses management challenge on clinicians and DVT associated complications like pulmonary embolism despite surgical treatment. The overall burden of tibial plateau fracture is less than 1% of all fractures and 8% of fractures occurring in elder population [10]. In our study, the overall incidence of post-operative DVT observed was 9.30%. A study conducted by Abelseth G and colleagues have observed the incidence of clinically occult DVT was 28%, of the represented fractures, 40% were of the femoral shaft (eight of 20), 43% of the tibial plateau (12 of 28), 22% of the tibial shaft (12 of 54), and 12.5% of the tibial plateau (one of eight) [11]. Another study conducted in china has shown quite higher incidence of DVT (46.43%) in postoperative patients with tibial plateau fractures [10]. The most common and logical reason behind this difference is could be due to their increased age causing higher incidence of DVT in patients operated for tibial plateau fracture as compared

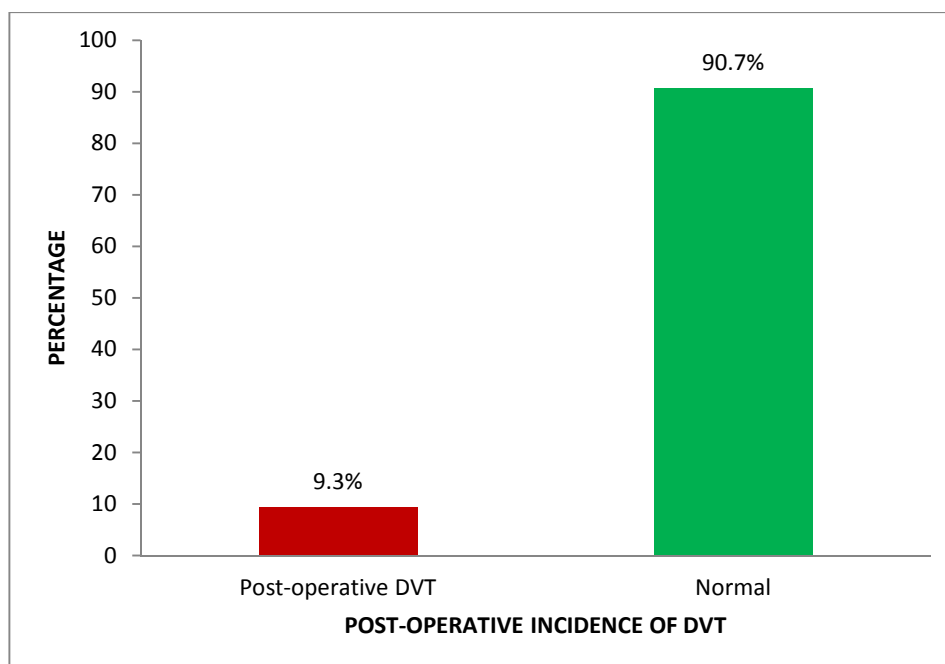


Chart 1. Incidence of deep vein thrombosis after Tibial plateau fracture surgery (N = 344)

Table 1. Risk factors associated with increased incidence of dvt after tibial plateau surgery (N = 344)

RISK FACTORS	DVT	Normal	p value
	(n = 32)	(n = 312)	
Continuous variables	Mean ± SD		
Age – years	40.19±6.10	32.18±5.24	0.011
Duration of operation - hours	3.01±0.78	1.51±0.81	0.013
Duration of post-operative hospitalization – days	18.49±7.37	9.72±2.90	0.001
Hemoglobin - gm/dL	13.44±2.02	11.11±1.90	0.170
Platelets - / mcl	200.36±2.90	230.52±19.20	0.32
WBC - x109/L	20.12±5.64	12.00±1.68	0.041
RBS - mg/dL	195.74±22.06	201.15±12.84	0.11
LDH - U/L	230±19.41	198±20.89	0.37
D-dimer - mg/L	3.24±3.09	1.03±0.54	0.002
Categorical variables	(%)	(%)	
Gender			
Male	17 (53.12)	202 (64.74)	0.52
Female	15 (46.87)	110 (35.25)	
Area of Residence			
Urban	19 (59.37)	183 (58.65)	0.23
Rural	13 (40.62)	129 (41.34)	
Comorbids			
Hypertension	21 (65.62)	116 (37.17)	0.27
Diabetes Mellitus	23 (71.87)	115 (36.85)	0.034
CKD	9 (28.12)	38 (12.17)	0.07
CLD	6 (18.75)	18 (5.76)	0.08
Injury			
Open fracture	4 (12.5)	30 (9.61)	0.058
Fracture type (Schatzker)			
I-IV	27 (84.37)	203 (65.06)	0.77
V-VI	5 (15.62)	109 (34.93)	

WBC = White Blood Cell, RBS = Random Blood Sugar, LDH = Lactate Dehydrogenase, CKD = Chronic Kidney Disease, CLD = Chronic Liver Disease.

to ours (mean age and SD 40.19±6.10 years). Secondly, the reason of quite high incidence of DVT among these patients could be due to their selection criteria in which they have enrolled patients with underlying malignancies which we did not. Another possible reason could be the difference in mechanism of injury, the most common cause of tibial plateau fracture in our study was RTA while in their study it was high energy trauma with comparatively along with raised d-dimer levels as compare to our study. It is well established that high energy trauma is associated with systemic body stress response which results in a hypercoagulable state and also causes intimal damage and leads to the development of DVT.

In our study, more than 50% of the tibial plateau fractured occurred due to road traffic accident because tibial plateau fracture usually occurs due to high-energy trauma. Our findings are in favor with the previously conducted studies [12-14]. On the other hands, there are certain factors which contribute significantly for the development and higher incidence of DVT. In our study increased age more than 40.19±6.10 years, increased mean duration of operation 3.01±0.78 hours, increased mean duration of post-hospitalization 18.49±7.37 days, raised mean WBC counts 20.12±5.64, and increased mean d-dimer levels 3.24±3.09 (laboratory cut off value 0.5mg/L) were significantly associated with higher incidence of DVT in patients operated for tibial plateau fractures. Increasing age is a significant risk factor for the development of DVT in a study conducted by Auer R and colleague [15] age and increased D-dimer levels are also shown significant risk factor in a study conducted by Junyong Li [9]. There are certain studies that have shown delay in intervention is also associated with increased incidence of DVT [16,17] which we were unable to study.

Besides we tried to included most of the variables that are associated with increased risk of DVT but due to lack of resources and follow-up we were unable to included those such as assessment of immobilization of injured extremity pre and post intervention, presence of underlying malignancy, use of oral contraceptive pills in women, use of blood thinners, and transfusion of blood after the injury. Future studies needs to be focused on such areas so that these potential risk factors can be indentified and managed accordingly.

5. CONCLUSION

The incidence of DVT in our study is although not higher than other studies but the potential complications associated with DVT may put the patients into threatening situation and may be challenging to deal. The risk factors which we have identified through this study may also be associated with increased postoperative hospitalization, postoperative morbidity, and mortality.

CONSENT AND ETHICAL APPROVAL

Before commencement of study, hospital ethical review committee has approved the protocol and informed consent was taken from all patients before collection of data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Vollans S, Chaturvedi A, Sivasankaran K, Madhu T, Hadland Y, Allgar V, et al. Symptomatic venous thromboembolism following circular frame treatment for tibial fractures. *Injury* 2015;46(6):1108-11.
2. Choufani C, Aguir S, Barbier O. Thromboembolic risk in repatriated patients with traumatic lower-limb injuries. *J Med Vasc.* 2018;43(6):342-6.
3. Sun ML, Feng YP, Huang J, Wang Y. Clinical features of hospitalized patients with deep venous thrombosis. *Zhonghua Nei Ke Za Zhi.* 2017;56(12):914-8.
4. Van Gent JM, Calvo RY, Zander AL, Olson EJ, Sise CB, Sise MJ, et al. Risk factors for deep vein thrombosis and pulmonary embolism after traumatic injury: A competing risks analysis. *J Trauma Acute Care Surg.* 2017;83(6):1154-60.
5. Tran HA, Gibbs H, Merriman E, Curnow JL, Young L, Bennett A, et al. New guidelines from the Thrombosis and Haemostasis Society of Australia and New Zealand for the diagnosis and management of venous thromboembolism. *Med J Aust.* 2019;210(5):227-35.
6. Grabo DJ, Seery JM, Bradley M, Zakaluzny S, Kearns MJ, Fernandez N, et al. Prevention of Deep Venous Thromboembolism. *Mil Med.* 2018;183(suppl_2):133-6.

7. Knudson MM, Ikossi DG, Khaw L, Morabito D, Speetzen LS. Thromboembolism after trauma: an analysis of 1602 episodes from the American College of Surgeons National Trauma Data Bank. *Ann Surg.* 2004;240(3):490-6.
8. Shibuya N, Frost CH, Campbell JD, Davis ML, Jupiter DC. Incidence of acute deep vein thrombosis and pulmonary embolism in foot and ankle trauma: analysis of the National Trauma Data Bank. *J Foot Ankle Surg.* 2012;51(1):63-8.
9. Li J, Zhu Y, Chen W, Zhao K, Zhang J, Meng H, et al. Incidence and locations of deep venous thrombosis of the lower extremity following surgeries of tibial plateau fractures: a prospective cohort study. *J Orthop Surg Res* 2020;15(1):605.
10. Jiahao L, Kun Z, Binfei Z, Yan Z, Hanzhong X, Shuangwei Q, et al. Relationship Between the Incidence of Deep Vein Thrombosis During Hospitalization and the Energy of Injury in Tibial Plateau Fractures. *Clin Appl Thromb Hemost* 2020;26:1076029620913948.
11. Abelseth G, Buckley RE, Pineo GE, Hull R, Rose MS. Incidence of deep-vein thrombosis in patients with fractures of the lower extremity distal to the hip. *J Orthop Trauma.* 1996;10(4):230-5.
12. Junior MK, Fogagnolo F, Bitar RC, Freitas RL, Salim R, Jansen Paccola CA. TIBIAL plateau fractures. *Rev Bras Ortop.* 2009;44(6):468-74.
13. Mustonen AO, Koivikko MP, Kiuru MJ, Salo J, Koskinen SK. Postoperative MDCT of tibial plateau fractures. *AJR Am J Roentgenol* 2009 Nov;193(5):1354-60.
14. Vasanad GH, Antin SM, Akkimaradi RC, Policepatil P, Naikawadi G. "Surgical management of tibial plateau fractures - a clinical study". *J Clin Diagn Res.* 2013;7(12):3128-30.
15. Auer R, Riehl J. The incidence of deep vein thrombosis and pulmonary embolism after fracture of the tibia: An analysis of the National Trauma Databank. *J Clin Orthop Trauma.* 2017;8(1):38-44.
16. Wang H, Kandemir U, Liu P, Zhang H, Wang PF, Zhang BF, et al. Perioperative incidence and locations of deep vein thrombosis following specific isolated lower extremity fractures. *Injury.* 2018;49(7):1353-7.
17. Hefley FG, Jr., Nelson CL, Puskarich-May CL. Effect of delayed admission to the hospital on the preoperative prevalence of deep-vein thrombosis associated with fractures about the hip. *J Bone Joint Surg Am.* 1996;78(4):581-3.

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