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INCIDENCE OF DEEP VEIN THROMBOSIS IN FLOATING KNEE

INCIDÊNCIA DE TROMBOSE VENOSA PROFUNDA EM JOELHO FLUTUANTE

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ABSTRACT

Objective: To report the incidence between Deep Vein Thrombosis (DVT) in ipsilateral femur and tibia fractures (floating knee), considering its relation with hospitalization time, fracture classification, treatment implemented and comorbidities.

Methods: This is a retrospective observational analytical study using the medical charts of thirty patients admitted with floating knee to a trauma hospital between October 2016 and July 2017.

Results: Of the 30 patients assessed, 25 (83%) were men and 5 (17%) women. The most affected age range was between 21 and 30 years (36%). The dominant limb was affected in 17 (57%) patients. A total of 19 (63%) patients were classified as Fraser type I, 18 (60%) had open (compound) fractures, 16 (53%) fractures of the tibia and 8 (26%) of the femur. The most widely used emergency treatment was external fixation of the femur and tibia (25 patients = 83%). Seven patients used a femur plate and external fixator in the tibia as definitive treatment. Of the 30 patients studied, 14 (46%) suffered infectious complications, 9 (30%) superficial and 5 (16%) deep. Deep venous thrombosis was observed in 17% of patients ($p=0.409$).

Conclusion: Despite the use of antithrombotic prophylaxis, there was a high incidence of DVT in the affected limb of patients with floating knee. Fraser I fractures, being male and the non-dominant limb increases the likelihood of developing DVT.

Level of Evidence: Level I

Keywords: vein thrombosis, knee trauma, bone fractures.

RESUMO

Objetivo: Relatar a incidência de trombose venosa profunda (TVP) em fratura ipsilateral de fêmur e tíbia (joelho flutuante), levando-se em conta sua relação com o tempo de internação, com a classificação da fratura, o tempo para fazer o procedimento cirúrgico, o tratamento implementado e com as comorbidades.

Materiais e métodos: Realizado um estudo retrospectivo, observacional e analítico por meio da avaliação de prontuários de trinta pacientes admitidos com joelho flutuante em um hospital de trauma durante o período de outubro de 2016 a julho de 2017.

Resultados: Dos 30 pacientes avaliados, foi observado que 25 (83%) dos pacientes eram do gênero masculino e 5 (17%) dos pacientes eram do gênero feminino. A faixa etária mais acometida foi entre 21 e 30 anos (36%). O acometimento do membro dominante ocorreu em 17 (57%) dos pacientes avaliados. Dezenove (63%) pacientes acometidos foram classificados como Fraser Tipo I. Dezoito (60%) pacientes tiveram fratura exposta, sendo 16 (53%) em tíbia e 8 (26%) em fêmur. O tratamento mais utilizado como urgência foi o de controle de danos com fixador externo em fêmur e tíbia (25 pacientes ou 83%). Sete pacientes utilizaram placa no fêmur e fixador externo na tíbia como tratamento definitivo. Dos 30 pacientes estudados, 14 (46%) tiveram complicações infecciosas, sendo 9 (30%) superficiais e 5 (16%) profundas. Observamos trombose venosa profunda em 17% dos pacientes ($p=0,409$).

Conclusão: Apesar do uso da profilaxia antitrombótica medicamentosa, houve uma grande incidência de TVP no membro acometido em pacientes com joelho flutuante na população estudada. As fraturas classificadas como Fraser I, pacientes do sexo masculino e o membro não dominante levaram ao aumento da probabilidade do surgimento de TVP.

Nível de Evidência: Nível I

Palavras-chave: trombose venosa, traumatismo de joelho, fraturas ósseas.

INTRODUCTION

One of the main complications of lower limb fractures is Deep Vein Thrombosis (DVT)¹, which may result in risk of death, such as pulmonary thromboembolism². DVT has a direct relation with high-energy trauma³.

A number of protocols are used to avoid this complication, the most common being the routine use of anticoagulants in prophylactic doses, such as low molecular weight heparin. Despite the high cost, this measure is effective in preventing DVT, lowering treatment costs and avoiding morbidity with considerable risk of death or permanent sequelae to the patient⁴.

Ipsilateral femur and tibia fractures, described by Blake and McBryde in 1975 as floating knee⁵, are associated with high-energy mechanisms⁶ and as such, a greater relation with DVT is expected.

Fraser classified floating knee into 2 types. Type I is characterized by diaphyseal femur and tibia fractures, while type II affects the knee joint and is subdivided into type IIA; diaphyseal femur and intra-articular tibia fractures; IIB: intra-articular fractures of the femur and diaphyseal of the tibia and IIC: intra-articular femur and tibia fractures⁷.

The aim of the study is to retrospectively relate the association between deep vein thrombosis (DVT) and ipsilateral fracture of the femur and tibia (floating knee) in patients under antithrombotic therapy.

MATERIALS AND METHODS

This is a retrospective cross-sectional analytical study of patients treated in Fortaleza Ceará state (CE) Brazil, at a tertiary trauma referral hospital, between October 2016 and July 2017. During this time, 37 floating knee patients were treated.

All the patients diagnosed with floating knee and admitted to the hospital during the aforementioned period were included in the study. Diagnosis was conducted using anteroposterior radiographs (AR) and a profile of leg and femur bones of the affected limb.

Exclusion criteria were patients with pre-fracture clinical comorbidities that could interfere in the incidence of complications (diabetes, thrombophilia, hemophilia, smoking), and prior history of thromboembolic events.

A total of 30 patients who met the inclusion criteria participated in the study.

The following data were collected from the patients' medical charts: age, sex, side affected, Fraser's classification of fractures, trauma mechanism, type of fracture (open or closed), treatment used for fractures in urgent care, definitive treatment of fractures and complications (superficial infection, deep infection and DVT).

Subcutaneous antithromboembolic prophylaxis was performed on all the patients, using enoxaparin (40mg/day) (30 patients) during hospitalization since the day of admission and maintained for 2 months, if the patient does not present any complications, according to the institution's protocol. DVT diagnosis was considered after clinical complaints (pain and rigidity) and confirmed with direct visualization of the venous thrombosis by Doppler ultrasound.

The data were stored in the Statistical Package for the Social Sciences program (SPSS, NY, USA) version 18.0 and tabulated in Microsoft Excel 2007 (Microsoft, WA,

USA), calculating the percentage frequency for the categorical variables. Associations between the variables were carried out using Pearson's chi-squared test. A p-value < 0.05 was considered statistically significant in all the analyses.

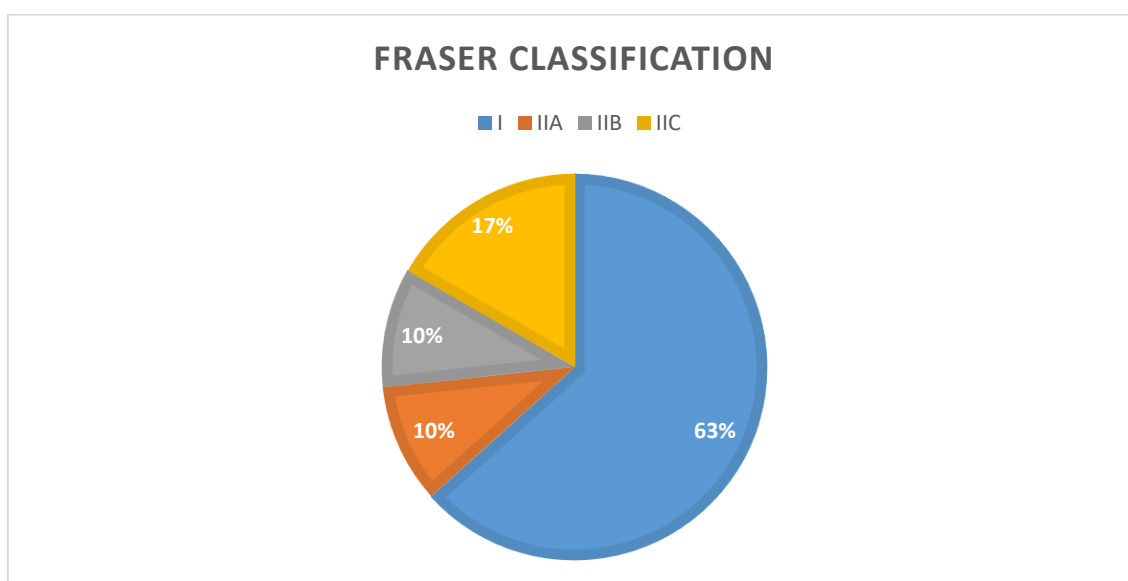
The study was approved by the Research Ethics Committee under protocol number 2.259.144 and written informed consent was obtained from the Medical Chart sector of the institution.

RESULTS

Of the 30 patients assessed, 25 (83%) were men and 5 (17%) women. The most affected age range was between 21 and 30 years (36%). The dominant limb was affected in 17 (57%) patients.

Fraser's classification showed that most patients were classified as type I, that is, extra articular femur and tibia fractures (Graph 1).

Graph 1: Fraser classification for the patients studied



A total of 18 (60%) patients had open fractures, 16 (53%) in the tibia and 8 (26%) in the femur. Of the open tibia fractures, five were grade I Gustillo & Anderson⁸, seven grade II and six Grade IIIa. Five of the open femur fractures were grade II and 3 grade IIIa.

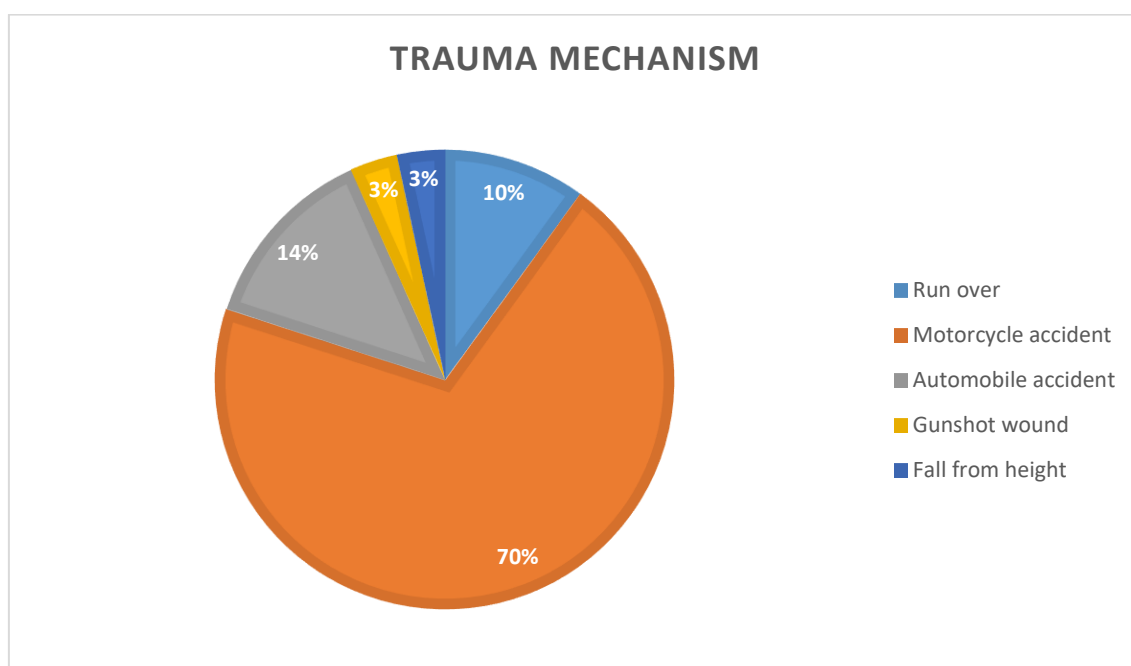
The most widely used emergency treatment was external fixation of the femur and tibia (25 patients = 83%). The most frequently used definitive treatment was a femur plate and external fixator in the tibia of 7 patients (23%) (Table 1). One of the patients

suffered clinical complications due to severe infection and soft tissue necrosis, requiring suprapatellar amputation after venous Doppler ultrasound (negative for DVT).

The average time to convert to the definitive treatment was 8.14 days, with a maximum and minimum of 22 and 2 days, respectively.

The vast majority of patients (70%) suffered high-energy motorcycle accident trauma. (Graph 2) (Table 1).

Graph 2: Floating knee patients according to trauma mechanism



In the 30 cases, the average consolidation time was 19.4 (16-25) weeks for the femur and 16.2 (13-20) weeks for the tibia. There were 2 cases of pseudoarthrosis of the femur, 1 treated with an autologous graft of the iliac crest and 1 with bone transport, and 3 cases of pseudoarthrosis of the tibia, all treated with autologous graft and subsequent consolidation.

Of the 30 patients studied, 14 (46%) suffered infectious complications, 9 (30%) superficial and 5 (16%) deep. Oral antibiotic treatment and local care were implemented

for cases of superficial infection, while for deep infection, the procedure consisted of surgical debridement when *S. aureus* was identified in culture. Endovenous antibiotic therapy was applied for 4 weeks and oral for a further 2, guided by the antibiogram.

One of the patients suffered vascular lesion of the popliteal artery at the moment of trauma, which was submitted to revascularization 3 hours after trauma. The same patient exhibited DVT and deep infection.

Four patients presented with neurological lesion within the territory of the deep fibular nerve and recovered spontaneously after expectant treatment during outpatient follow-up. All were Fraser type IIC.

Of the patients analyzed, Doppler ultrasound detected DVT in 5 of them (17%), cases 3,5,7,11,22 in Table 1 ($p = 0.409$). Of these, four cases were in a deep leg vein and one in a deep thigh vein. All the DVT cases were diagnosed between the second and fourth week post-trauma.

All five patients affected by DVT were men ($p = 0.209$), traffic accident victims ($p = 0.372$) and treated in emergency with an external fixator ($p = 0.570$). In two of these patients, conversion to internal synthesis was precluded due to the severity of the skin injury (cases 3 and 22) and an external fixator was used as definitive treatment. The definitive treatment applied in three cases was plate/screw in the femur and external fixator in the tibia; osteosynthesis with retrograde intramedullary nail in the femur; and plate/screw in the tibia and external fixator, respectively.

Of the patients with DVT, 80% were classified as Fraser I and 20% Fraser IIC ($p=0.480$). All of these patients suffered high-energy trauma, and 60% and 40% of the cases were motorcycle and automobile accident victims, respectively ($p = 0.372$).

Clinical treatment in four of the cases consisted of full heparinization (60mg/day) and one was submitted to vena cava filter placement. In the converted cases for internal synthesis, surgery was performed after DVT diagnosis and treatment, and authorization by the vascular surgery team of the institution.

DISCUSSION:

We demonstrated that male patients classified as Fraser I are more likely to develop DVT and exhibit high indices of associated injury, primarily other fractures. These are uncommon injuries of unknown incidence. In addition, there is greater chance of other associated injuries in these patients, such as organ damage with possible risk of death⁹.

In the present study, most of the patients were men in their 30s. This was also observed in another study, which found 238 cases of floating knee, and a predominance of men (85%) in their 30s (45%).

The present study showed that most patients were victims of high-energy traffic accident trauma, primarily involving motorcycles. These data corroborate those of Rethnam et al.¹¹, who found that 27 of 29 cases of floating knee were also traffic accident victims.

In another retrospective study with 172 cases of floating knee, 71.5% were Fraser type I, 8.2% IIA, 11.2% IIB and 8.7% IIC¹². A similar relation was found in the present study since most of the cases were classified as Fraser type I (63%).

The emergency treatment used here in the vast majority of patients was external fixation, which may be due to the severity on arrival of the patient, since most were victims of high-energy trauma (Table 1). Similar findings were reported by Marco et al.¹³, in which 64.71% of patients with floating knee were treated with external fixation to stabilize fractures on arrival at the hospital.

Kapoor et al.¹⁴ studied 125 patients with lower limb fractures, finding DVT positivity in 6 cases. The study consisted of 47 patients with periacetabular fractures, where 4 (8.51%) developed DVT and 8 sustained floating knee, 2 of whom developed

DVT. These patients did not receive antithrombotic prophylaxis. The present study exhibited a DVT incidence of 17% in patients with floating knee, even with the use of antithrombotic prophylaxis.

The variables analyzed (sex, dominant limb affected, Fraser classification, trauma mechanisms and emergency treatment) were not statistically significant as risk factors for developing DVT in patients with floating knee in the sample under study.

Donath et al. reported the use of fondaparinux with a higher number of distal thrombotic events in the context of orthopedic surgery compared to enoxaparin as antithrombotic prophylaxis¹⁵. However, no statistical significance was found for this relation in the present study.

Early diagnosis and treatment of DVT may directly interfere in decreasing complications related to this condition¹⁶. The five patients diagnosed by venous Doppler ultrasound exhibited no symptoms of pulmonary thromboembolism

The main limitation of the investigation was the short follow-up, given that this is a retrospective study. The initial fixation method with an external fixator is also a negative factor due to prolonged restriction and immobilization¹⁷, in addition to not verifying the presence of other associated lesions, such as knee ligament injuries. We also emphasize that the incidence found may be higher, since the Doppler ultrasound was only used in symptomatic cases.

Nevertheless, we presented a large number of cases of an infrequent lesion with a significant amount of data. We plan to conduct a prospective randomized study with a larger number of cases in the near future.

CONCLUSION

Despite the fact that antithrombotic prophylaxis was used in these patients, there was a high incidence of deep vein thrombosis in those with floating knee. Fraser I fractures, being male and the non-dominant limb increases the likelihood of developing DVT.

Declaration of contribution of the authors

AUTHORS' CONTRIBUTIONS: JBAN (0000-0003-3318-5067)* and RSC (0000-0002-5669-3294)* were the main writers of the manuscript. RCAL, FMGCF (0000-0001-6781-789X)*, and FRBM (0000-0001-9511-3769)* collected data and monitored the patients. RAEL, RSC and FMGCF assessed statistical analysis data and performed the bibliographic survey. CJDS (0000-0001-6678-9268)* and RCAL (0000-0001-8593-9460)* and DAL (0000-0002-5702-1529)* contributed with the concept of the study and revised the manuscript.

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TABLE 1 – Demographic profile, injury pattern, fixation method and complications

Variables	Tibia fractures	Femur fractures	All patients	<i>P</i> -value
No. of patients (men/women)			30 (26/4)	0,209
Age			34.7 (\pm 12-72 years)	0.452
Trauma mechanism				0,372
MVA			28	
GSW			1	
Fall from height			1	
Limb affected (R/L)			21/9	
Dominant limb			17	0.412
Associated injuries (patients with associated injury)			31 (19)	
Fractures in other bones			11	
TBI			8	
Pelvic injury			3	
Chest trauma			3	

Abdominal trauma			2	
Facial trauma			2	
Spinal injury			1	
Other injuries			1	
Time from admission to first surgery			1.21 days	
Fracture pattern				0.480
Closed	14	22		
Open	16	8		
Type I	2			
Type II	8	5		
Type III				
A	4	3		
B	1			
C	1			
Fixation method in the emergency room				0.570
Isolated Ex Fix Transarticular Ex Fix	1/25	1/25		
HIM				
Plate	1	1		

Plaster splint	3	3		
Conversion time			8.14 (\pm 2-22 days)	
Definitive fixation method				0.266
External fixator	12	10		
IM Nailing	4	7		
Plate	12	12		
Plaster cast	1			
Amputation	1	1		
Consolidation time	16.2(\pm 13-20 months)	19.4 (\pm 16-25 months)		
Complications				
DVT	4	1	5	0.409
Infection			14	0.193
Superficial			9	
Deep			5	
Pseudoarthrosis	3	2	5	
Vascular lesion			1	
Neurological lesion			4	

MVA= Motor vehicle accident; GSW= Gunshot wound; TBI= Traumatic brain injury;

Ex Fix= External fixator; IM: Intramedullary nail; DVT= Deep vein thrombosis