INCIDENCE OF DEEP VEIN THROMBOSIS IN LOWER LIMB INJURY FOLLOWING CAST IMMOBILISATION

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For Their Patience, Love and Support

DISCLAIMER

I hereby certify that the work in this dissertation is my own except for the quotations and summaries which have been duly acknowledged.

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Dr. Zairuddin Abdullah Zawawi

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ABSTRACT

Study Design

A cohort prospective study conducted in Hospital Universiti Sains Malaysia (HUSM).

Objectives

1. To determine the incidence of DVT following cast immobilization of the lower limb.
2. To determine whether level of cast causes DVT.
3. To determine possible predisposing factors leading to DVT.

Introduction

Patient who had undergone lower limb immobilization have an increased risk for the development of deep vein thrombosis and subsequent pulmonary embolism, a life threatening situation.

One of the known causes for the development of deep vein thrombosis is by recent cast immobilization of lower extremities.

The purpose of this study is to determine the incidence of deep vein thrombosis following lower limb immobilization by cast and its predisposing factors.

Methods

A total of 40 patients participated in the study where they must be on cast for at least 6 weeks duration.

The incidence of deep vein thrombosis was determined by colour Doppler ultrasound.

Results

From 40 patients assessed during the study period, deep vein thrombosis was identified in only 1 patient after 6 weeks of casting.

This gave the incidence rate of only 2.5%.

Conclusion

The rate of deep vein thrombosis in our community following lower limb immobilization by cast is very low.

Thus, we could conclude that cast application is still a safe mode of treatment in lower limb injury and it is not necessary to start antithrombolytic agent for prophylaxis for DVT.

ABSTRAK

Bentuk Kajian

Kajian prospektif 'cohort' dijalankan di Hospital Universiti Sains Malaysia (HUSM)

Objektif

1. Untuk mengkaji kemungkinan berlakunya penyakit penyumbatan salur darah (DVT) selepas penggunaan simen di anggota bawah.
2. Untuk mengkaji samada takat pemakaian simen boleh menyebabkan DVT.
3. Untuk mengetahui sebab-sebab lain yang boleh mengakibatkan DVT.

Pengenalan

Pesakit yang menjalani rawatan kecederaan pada bahagian kaki dengan pemakaian simen mempunyai risiko yang lebih tinggi untuk mendapat DVT dan seterusnya menyumbang kepada pengaliran darah beku dari bahagian kaki ke paru-paru yang boleh membawa maut.

Tujuan kajian ini adalah untuk mengetahui kadar kejadian salur darah tersumbat yang disebabkan oleh pemakaian simen pada bahagian kaki yang tercedera.

Metodologi

Seramai 40 pesakit mengambil bahagian di dalam kajian ini dimana mereka yang mengalami kecederaan pada bahagian kaki hendaklah menjalani rawatan dipakaikan simen di bahagian kaki sekurang-kurangnya 6 minggu.

Kadar kejadian salur darah tersumbat ditentukan oleh 'colour Doppler Ultrasound'.

Keputusan

Dari 40 pesakit yang menjalani kajian sepanjang tempoh tersebut.hanya seorang dari mereka menunjukkan tanda-tanda salur darah tersumbat selepas 6 minggu pemakaian simen.

Dari pemerhatian dan kajian,didapati kadar risiko adalah 2.5%.

Kesimpulan

Kadar kejadian salur darah tersumbat di kalangan penduduk sekitar selepas pemakaian simen kaki adalah amat rendah.

Kesimpulan dari kajian ini adalah pemakaian simen kaki sebagai salah satu kaedah rawatan untuk kecederaan kaki adalah selamat dan pengambilan ubatan sebagai langkah pencegahan adalah tidak diperlukan.

1.0 INTRODUCTION

Patients who had underwent lower limb immobilization have an increase risk for the development of deep vein thrombosis (DVT) and subsequent pulmonary embolism (PE), which can be a life threatening situation. (Kudsk *et al.*, 1989). In a study by Scarvelis and Wells in 2006, one of the causes for the development of deep vein thrombosis is by recent cast immobilization of lower extremities. In another study done in 1993 by Kujath and Spannagel has recommended prophylaxis with a low molecular weight heparin for all patients with an injury of the lower limb being immobilized by a plaster cast.

Several studies have been done to find out the incidence of deep vein thrombosis in patients underwent joint replacement operations and have been proven that despite the use of effective prophylaxis against deep vein thrombosis, some of the patients still at the risk of developing asymptomatic deep vein thrombosis.(J. Kelly, 2001)

As being described by several studies, the goal standard for deep vein thrombosis evaluation is by venogram study but the ultrasonography is still the most accurate non invasive test for the detection of deep vein thrombosis .The effectiveness of Duplex ultrasonogram for the detection of deep vein thrombosis of lower extremities in non orthopaedic patients have been well established. (Agnelli and Becattini, 2007, B.Roger, 2001)

A prospective study done in 1993 of which a comparison was made between the use of duplex ultrasonography and ascending contrast venography has concluded that even though venogram is a gold standard for detection of venous thrombosis, duplex ultrasonogram is still a preferable non invasive technique.(Montefusco-von Kleist *et al.*, 1993)

Over the past two decades, Doppler ultrasound has fast becoming a standard primary imaging technique for the initial evaluation of patient with a clinical suspicion of developing DVT in the lower extremities.(Ulrike M. Hamper MD, 2007).

The purpose of this study is to detect the incidence of either symptomatic or asymptomatic deep vein thrombosis in lower extremities following cast immobilization by using the non invasive technique that is Doppler ultrasonography. Therefore the treatment for clinical and sub clinical deep vein thrombosis can be proposed for our future management.

Until this moment, there is no specific study about the incidence of DVT in lower extremities following cast immobilization done in our local situation.

2. 0 LITERATURE REVIEW

2.1 Deep vein thrombosis in lower limb injury

2.1.1 Overview of DVT

Thromboembolism is the most common complication of lower limb injury. It comprises of three associated disorders:

i. Deep vein thrombosis (DVT)
ii. Pulmonary embolism (PE)
iii. Chronic venous insufficiency

Venous thrombosis in the lower limb can involve the superficial leg veins, the deep veins of the calf (calf vein thrombosis), and the more proximal veins, including popliteal veins, the superficial femoral, common femoral and iliac veins. Less commonly, thrombosis involves other veins in the body.

Thrombosis of the superficial veins of the legs usually occurs in varicosities and is benign and self-limiting. Occasionally, however, the thrombi in superficial veins extend into the deep veins and give rise to major PE. Deep calf vein thrombosis is a less

serious disorder than proximal vein thrombosis because thrombi in calf veins are generally small and therefore not usually associated with clinical disability or major complications.

Most calf vein thrombi are asymptomatic but these thrombi can extend proximally and become dangerous. Venous thrombi produce symptoms because they obstruct venous outflow, cause inflammation of the vein wall or perivascular tissue, or embolise into the pulmonary circulation. Extension of thrombosis is more likely if the original thrombogenic stimulus persists.

Complete spontaneous lysis of large venous thrombi is uncommon, and even when patients with venous thrombosis are treated with heparin, complete lysis occurs in fewer than 10% of case. (Anand SS.; 1998) In contrast, complete dissolution of small, asymptomatic calf vein thrombi occurs quite frequently.

There is a strong association between DVT and PE. Pulmonary emboli are detected by perfusion lung scanning in 50% of patients with symptomatic DVT. Asymptomatic venous thrombosis is found in 70% of patients with confirmed clinically symptomatic PE (Girard *et al.*, 2001)

If the thrombus that embolise is small (when the thrombus is located in the calf), the embolus is usually asymptomatic and clinically insignificant, although the cumulative

effect, if there are repeated showers of small emboli, can cause cor pulmonale.If the thrombus is large and involves the proximal veins, it often produces clinical manifestations; if it is very large or if the patient has a compromised cardio respiratory system, it can be fatal. Most clinically significant and virtually all fatal emboli arise from thrombi in the proximal veins.

Venous thrombi usually organize slowly and can be complicated by the post thrombotic syndrome. The residual abnormality can also act as a nidus for recurrent thrombosis, which occurs in approximately one third of patients over an 8-year follow-up period.(Jack Hirsh, 1996)

2.1.2 Venous system of lower limb

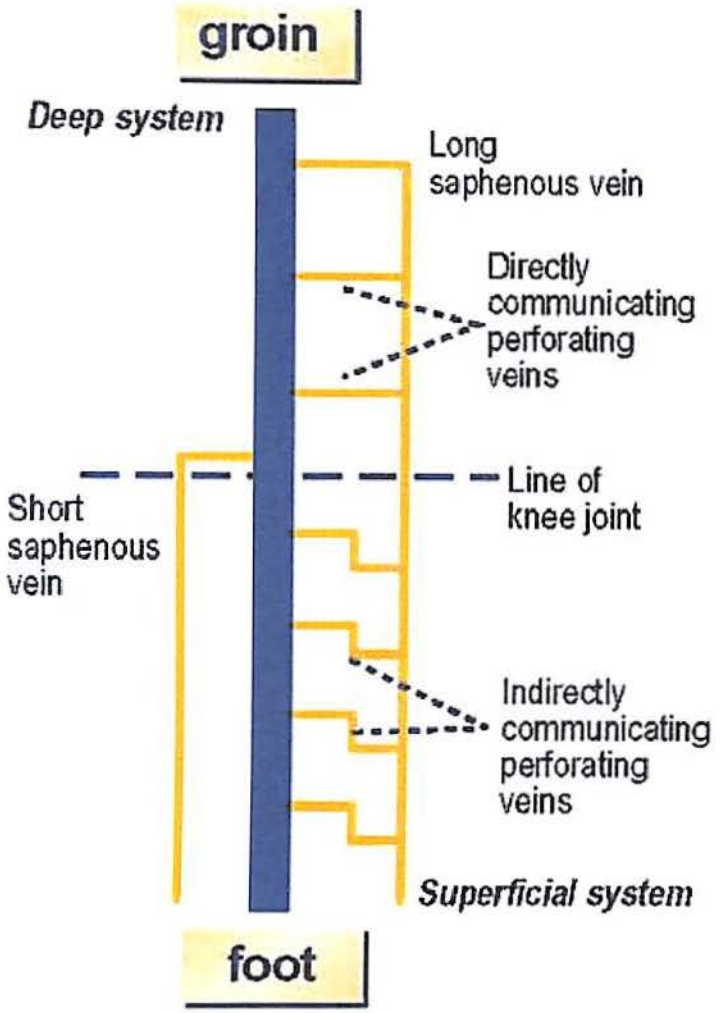

Figure 2.1 Diagram showing lower limb deep vein system

The long saphenous vein is the longest vein, commencing from the medial side of the foot passing anterior to the medial malleolus, up the medial side of the leg and terminating in the femoral vein in the groin. There are normally 4-6 tributaries joining the vein at the groin – unfortunately there are numerous variations. The saphenous branch of the femoral nerve joins the long saphenous vein at the level of the knee. It lies posterior, in close relationship to the vein. The short saphenous vein arises at the outer border of the foot behind the lateral malleolus. It ascends up the middle of the calf to empty into the popliteal vein in about 60% of cases, the long saphenous vein in about 20% and elsewhere in the remainder. In the lower third of the leg the sural nerve is in close proximity.(Galanaud *et al.*, 2007)

The perforator veins join the deep and superficial systems. Their function is to carry blood from the superficial to the deep system. Dissection studies have shown that there are over 50 points of communication between the superficial and deep system. The number of perforators decreases as one move up the leg. In the thigh, the perforators tend to communicate directly with the deep veins while below the knee this communication tends to be indirect via venous plexuses.

The three arteries below the knee are accompanied by paired veins lying on each side of the artery up to the knee joint. In most cases these veins join together to form the popliteal vein which lies superficial and posterior to the popliteal artery. The popliteal vein becomes the superficial femoral vein at the adductor hiatus and passes round the

artery to lie deep to it in the thigh. It then passes round to lie on the artery's medial side at the level of the groin where it is joined by the profunda vein which drains the thigh.

2.2 Incidence and prevalence

Venous thromboembolism has an estimated annual incidence in developed countries of one in 1000 people.(Charles Court Brown, 2006a) In a prospective study, the incidence of deep venous thrombosis documented by venography is between 35% and 63% in patients with major trauma. In this study also, five independent risk factors for deep vein thrombosis have been identified i.e. older age, fracture of the femur or tibia, surgery, spinal cord injury and blood transfusion(Verstraete, 1999)

Kujath et.al in his study in 1993 found that the incidence of DVT was low in patients given prophylaxis compared to the patients without prophylaxis. All of his patients that were involved in his study were cast immobilized after lower limb injury.

There was also a study done to establish the rate of DVT in orthopaedic trauma patients in Tianjin Hospital, identify DVT risk factors and to support the use of prophylaxis. The prevalence of deep vein thrombosis (DVT) in Asian countries is considered to be less than in Western countries. In this study, all of the patients admitted with lower limb injury immobilized by cast were assessed for DVT using duplex ultrasound. It was found that DVT developed in 12.4% of the patients. In conclusion, this

study showed that the incidence of DVT in Chinese orthopaedic trauma patients approaches that in Western countries. They had then recommended that DVT prophylaxis should be applied in China as in Western countries.(Lu *et al.*, 2007)

Although few trauma patients sustain fatal pulmonary embolism, a large population is at risk from nonfatal embolism due to unrecognized DVT. In one of a published case reports stated that even a rare incidence, soft tissue injury such as tendoachilles injury can still pose a treat for the development of acute pulmonary embolism(Yusof, 2007).

Mechanical antithrombotic methods and low-dose unfractionated heparin administered subcutaneously moderately decrease the risk of venous thromboembolism but are less effective than a fixed dose of subcutaneous unmonitored low molecular weight heparin.

Prophylaxis with oral anticoagulants is also effective but is much less used because of the bleeding risk. This is particularly the case in patients with intracranial neurosurgery and acute spinal cord injury.

2.3 Pathophysiology

The Virchow triad, as first formulated (i.e. venous stasis, vessel wall injury, hypercoagulable state), is still the primary mechanism for the development of venous thrombosis. The relative importance of each factor is still debated. The formation, propagation, and dissolution of venous thrombi represent a balance between thrombogenesis and the body's protective mechanisms, specifically the circulating inhibitors of coagulation and the fibrinolytic system.

In practical terms, the development of venous thrombosis is best understood as the activation of coagulation in areas of reduced blood flow. This explains why the most successful prophylactic regimens are anticoagulation and minimizing venous stasis. DVT of the lower extremity usually begins in the deep veins of the calf around the valve cusps or within the soleal plexus. A minority of cases arise primarily in the ileofemoral system as a result of direct vessel wall injury, as seen with hip surgery or catheter-induced DVT. The vast majority of calf vein thrombi dissolve completely without therapy. Approximately 20% propagate proximally. (Anand SS, 1998) Propagation usually occurs before embolization. The process of adherence and organization of the venous thrombus does not begin until 5-10 days after thrombus formation. Until this process has been established fully, the non adherent disorganized thrombus may propagate and/or embolise.

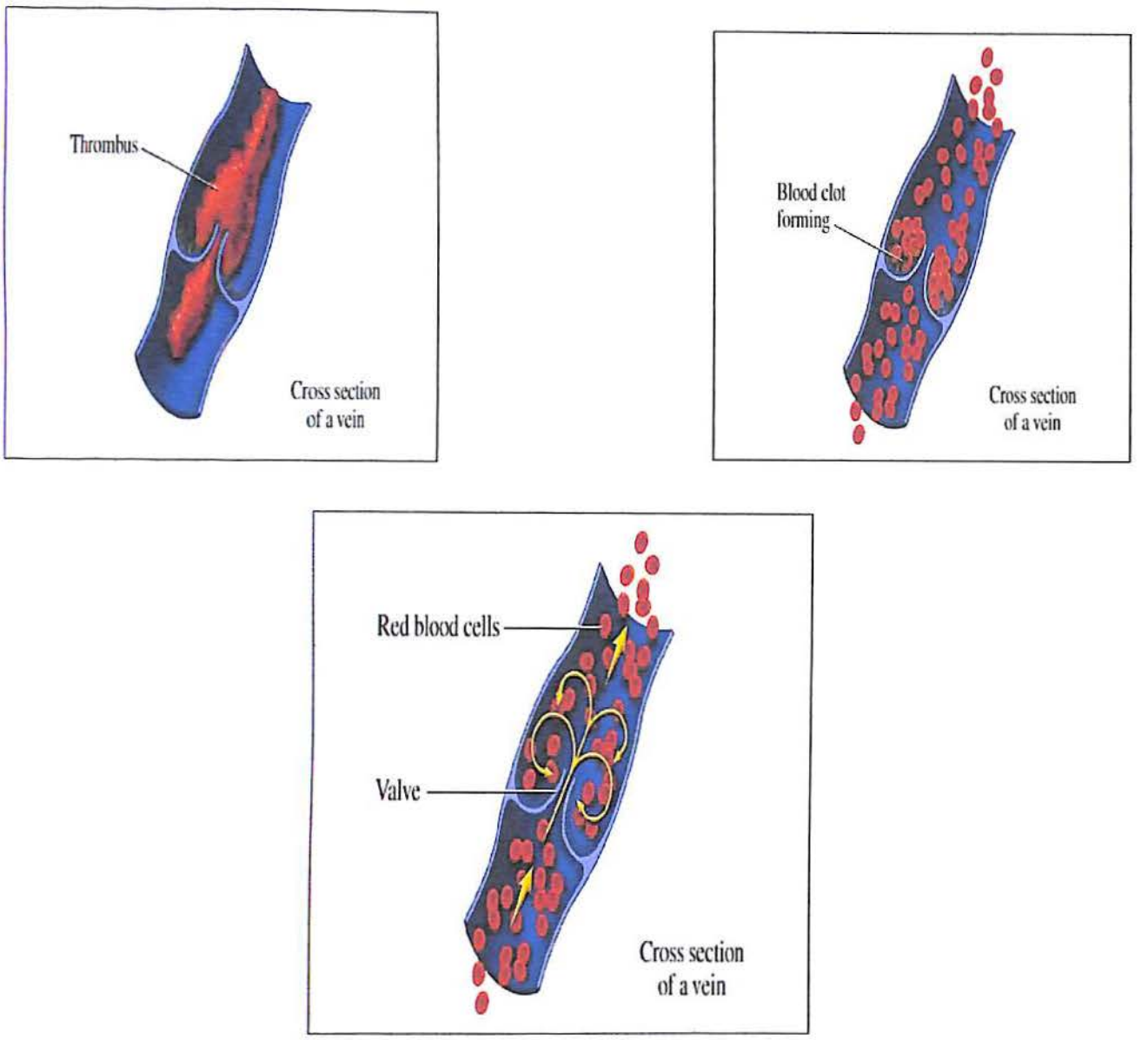

Figure 2.2 Diagrams showing the mechanism of thrombus formation in the vein

Not all venous thrombi pose equal embolic risk. Studies have shown that isolated calf vein thrombi carry a limited risk of PE. Furthermore, studies have suggested that isolated calf vein thrombi are smaller and do not cause significant morbidity or mortality if they embolise. Contradictory evidence from several other studies has indicated that isolated calf vein thrombi do embolise, suggesting that propagation proximally may occur rapidly and that fatal PE arising from isolated calf vein DVT is a significant risk.

The current diagnostic and therapeutic management of DVT are strongly influenced by the different risks assigned to proximal and calf vein thrombi. The propagation and organization of the venous thrombus usually result in destruction of venous valves and produce varying degrees of venous outflow obstruction.

Thromboembolism can occur in vessels in the pelvis, thigh and calf. Most thrombi probably develop in deep veins in the calf and subsequently extend into the thigh but isolated thrombi in the pelvis or deep femoral veins can develop. Approximately 80-90% of DVT occurred in the ipsilateral limb that is injured or surgical limb and only about 10-20% involved contra lateral limb. (Smith *et al.*, 1989).

Thrombi in the calf alone previously were thought to be unlikely to cause pulmonary embolism. However, proximal propagation of calf thromboses occur in as many as 30% of patients and Pellegrini et.al found that 31% of patients with untreated

calf thromboses developed clinically significant pulmonary emboli 3 to 8 weeks post surgery.(Lusiani *et al.*, 1996)

According to Virchow, thrombosis results from an interaction between blood vessel damage, alterations in blood components and venous stasis. Following major orthopaedic operations, there are activation of the coagulation cascade and restricted fibrinolysis lasting for several days.

During hip replacement surgery, femoral vein blood flow is temporarily interrupted when the acetabulum and femoral medulla are exposed. There is also more prolonged stasis as the patient recovers from surgery and begins to mobilize.

2.4 Risk factors in the development of DVT

The important risk factors that are responsible for the development of thromboembolytic disorders are:

i. Prior episodes of thromboembolism
ii. Prior venous surgery and varicose veins
iii. Previous orthopaedics operations
iv. Advanced age
v. Malignancy