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Venous Thromboembolism after Orthopaedic Surgery – How Long is the Patient at Risk?

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Abstract

Aim: Venous thromboembolism (VTE) is a leading cause of morbidity and mortality in hospital with orthopaedic surgery already an established risk factor. This study aims to establish the length of time that a patient is at risk of sustaining a VTE post orthopaedic surgery.

Method: A retrospective case series of all patients who underwent orthopaedic surgery between 2010 and 2014 whom re-presented with a VTE within one year of their initial operation. Demographic, operative and clinical information was obtained in order to identify potential risk factors.

Results: 53 patients were identified as having a VTE within one year of discharge. The majority (63.4%) underwent lower limb arthroplasty. 29% of the cohort had either a family or personal history of VTE, 79% had ischaemic heart disease (IHD), hypertension or both. The average body mass index (BMI) of the cohort was 31.4; above the UK national average. 56.6% of the cohort developed a pulmonary embolism (PE) and 49% developed a deep vein thrombosis (DVT). Co-occurring DVT and PE was diagnosed in 5.6% of patients. The average length of time for readmission for patients to re-present at hospital with a PE was 122 days (range 4-361) and 107 days (range 7 – 360) with a DVT.

Conclusion: This study confirms the existence of pre-established risk factors for developing VTE including obesity, personal and family history of DVT, cardiovascular disease and lower limb arthroplasty. These risk factors are recognised despite patients receiving post-operative thromboprophylaxis.

The findings of this study extend the current research by suggesting that patients presenting with known risk factors of developing VTE may be at risk for longer than the current guidelines cover for the administration of thromboprophylaxis. We propose further studies are needed to identify any potential requirements for more extensive VTE prophylaxis in this population.

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Introduction

Venous thromboembolism (VTE) is a collective term referring to the diagnosis of deep vein thrombosis (DVT) or pulmonary embolism (PE). VTE is a commonly encountered diagnosis that can result in serious morbidity and a reported mortality of 10.6% within 30 days and 23% at one year1. VTE can present in numerous different ways. Classically a patient with DVT will present with pain and swelling of the leg. A patient with PE is likely to present with symptoms such as chest pain, tachycardia, dyspnoea and haemoptysis2.

In 2005, the House of Commons Health Committee reported that 25,000 people in the UK die from preventable VTE each year3 and NICE guidelines were introduced to facilitate an early reproducible process, which would allow prompt diagnosis and management of these patients.4 The guidance is predominantly based around the 2 level Wells score for both DVT5 (Figure 1) and PE6 (Figure 2) with the outcome of the score determining which subsequent investigation is performed. Even with the use of scoring systems such as this, it is down to the clinician to have a high index of suspicion for VTE where appropriate.

Previously established significant risk factors for VTE include trauma, cancer, advanced age, obesity, family/personal history, cardiovascular disease, race[15] and surgery[7]. Within surgery, orthopaedic procedures carry the highest risk, (1 in 45 after hip or knee replacement) second only to oncology[8]. Prior to discharge from a surgical unit, the index of suspicion for VTE is high. It is known that certain orthopaedic operations such as arthroplasty, pelvic fracture fixation and lower limb casts following foot & ankle surgery carry an increased risk of developing a VTE; therefore these patients commonly receive prolonged post-operative VTE prophylaxis for 28 days following total knee arthroplasty and 35 following total hip arthroplasty; according to NICE guidance CG92 or local trust policy.

Clinical Feature	Points
Active cancer (on treatment, treated in the last 6 months or palliative)	1
Paralysis, paresis or plaster immobilisation of the lower limb	1
Bedridden for 3 days or more, or major surgery in the past 12 weeks requiring general or regional anaesthesia	1
Localised tenderness along the distribution of the deep venous system	1
Entire leg swollen	1
Calf Swelling 3 cm larger than the symptomatic side	1
Pitting oedema confined to the symptomatic leg	1
Collateral superficial veins (non-varicose)	1
Previous DVT	1
Alternative diagnosis is at least as likely as DVT	-2
Clinical probability simplified score	Points
DVT likely	2 points or more
DVT unlikely	1 point or less

Figure 1: Two level DVT Wells score

Clinical Feature	Points
Clinical signs and symptoms of DVT (minimum of leg swelling and pain with palpation of the deep veins)	3
Alternative diagnosis is less likely then PE	3
Heart rate >100 beats per minute	1.5
Immobilisation for more than 3 days or surgery in the previous 4 weeks	1.2
Haemoptysis	1
Malignancy (on treatment, treated in the last 6 months or palliative)	1
Previous DVT / PE	1.5
Clinical probability simplified score	Points
PE likely	More than 4 points
PE unlikely	4 points or less

Figure 2: Two level PE Wells score

time increases the likelihood of a VTE post-operatively[9]. This heightens the risk of VTE in some orthopaedic procedures due to the nature of surgery and length of operative time required. Despite following guidance it is well evidenced that some patients continue to present with VTE following the cessation of prophylaxis[10,11]

Method

The objectives of this study were to determine: what risk factors for VTE were present in patients who underwent orthopaedic surgery in specialised trauma unit and to establish the length of time that a patient is at risk of sustaining a VTE post orthopaedic surgery including the interval between their initial operative procedure and the subsequent presentation of VTE.

Study Design

A retrospective case series of patients who underwent an orthopaedic procedure at Sheffield Teaching Hospitals NHS Foundation Trust – (Northern General Hospital) and re-presented to the trust with a subsequent VTE within one year of their initial operation. The study period was from 1/1/2010 to 31/12/2014. In order to be included patients must:

1. Have undergone an orthopaedic opertation recorded on ORMIS within the study period
2. Have undergone any imaging with coded as positive for VTE on PACS (electronic imaging software)

Any patients whom did not meet the inclusion criteria above were excluded from the study.

All eligible patients were identified and matched using an electronic patient database. Paper notes were requested for each patient who fulfilled the inclusion criteria and a team of two orthopaedic trainees then examined the notes using a 24-question proforma.

Proforma

The proforma was a 3 page, A4 document that included:

- Patient demographics; age, height, weight, BMI and gender.
- Operative and anaesthetic information: Name of procedure, length of surgery, site of surgery and type of anaesthesia
- Post-operative information: Intensive care transfer, time to mobilise, physiotherapy, thromboprophylaxis used both immediate post operatively and extended VTE if indicated
- Past Medical history: Significant co-morbidities, Family/Personal history of VTE
- Biochemistry: Creatinine, Urea, INR
- VTE information; PE, DVT, site of DVT, timing of DVT from operation

Analysis

The data was converted from the proforma into a computerised spreadsheet and analysed to determine any trends within the study population. The study population was then split into sub-groups for further statistical analysis

Sheffield teaching hospitals VTE guidance

All patients included in this study received care based on local inpatient guidelines for extended VTE prophylaxis. All patients are risk assessed on admission to hospital using local clerking document to establish risk factors(Table 1). Subcutaneous Dalteparin is the low molecular weight heparin (LMWH) recommended for use in inpatients at Sheffield teaching hospitals for the prevention of VTE. The recommended dosing of Dalteparin is summarised in Table 2. According to local guidelines, a proportion of orthopaedic patients will be offered extended thromboprophylaxis post discharge from hospital as shown in Table 3.

Results

Demographics

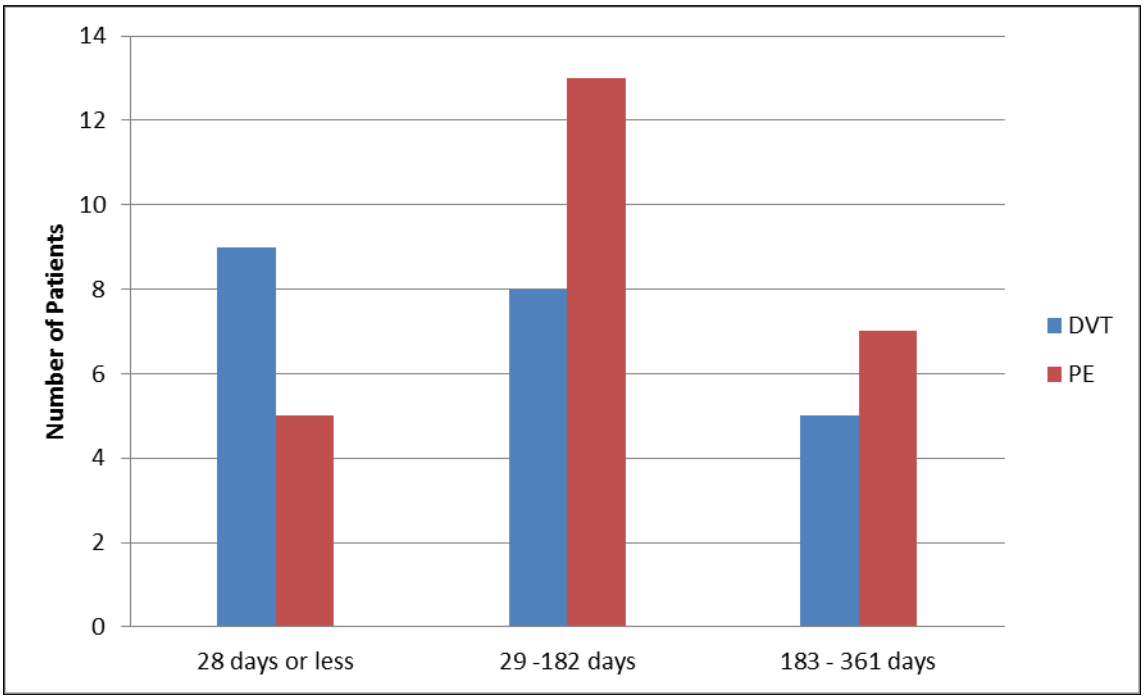

Figure 3: Average time lapsed from operation to redmission with VTE.

53 patients from the hospital database were identified who had sustained a VTE confirmed on imaging within 12 months of having an orthopaedic operation. Of whom 24 were male and 29 were female, with a sex ratio of 1:1.2 (M:F).

The mean age of patients was 67.3 years (range 31-89 years). The mean BMI was 32.2 for Females (range 20-48) and 30.6 for Males (range 20-42) with an overall average of 31.4; higher than the UK average of 24.78[12]

Past Medical History

29% of patients included in the study had either a family or personal history of VTE. Co-morbidity data (Table 4) showed that 85.6% of the cohort had one or more existing medical conditions. Only 14% had no other diagnosed conditions. Of those with co-morbidities, 79% had ischaemic heart disease (IHD), hypertension or both.

Operative and Anaesthetic information

64% of patients underwent either primary or revision arthroplasty (Table 5). The mean surgical time for the cohort was 101 minutes (20-260 minutes). Surgical time data was similar for the arthroplasty patients with a mean time of 105 minutes (76-240 minutes). Anaesthetic data showed that 69% received a spinal anaesthetic, 39% of patients had a general anaesthetic and 2% had local anaesthetic.

VTE information

Thromboprophylaxis was given in accordance with local trust policy and based on patient specific risk assessments. All patients' received the recommended VTE prophylaxis by mechanical intervention (TED stockings), pharmacological intervention (LMWH) or both. 30 of the 53 patients had a PE and 26 had a DVT. 3 patients had both DVT and PE

Table 1: Risk factors for (VTE):

Patient-related risks	Admission-related risks
Active cancer or cancer treatment	Significantly reduced mobility for 3 day or more (relative to normal state)
Age greater than 60 years	Hip or knee replacement
Dehydration	Hip fracture
Known thrombophilia's	Total anaesthetic plus surgical time over 90 minutes
One or more significant medical	Surgery involving pelvis or lower limb with a total an-aesthetic plus surgical time over 60 minutes
co-morbidities e.g. heart disease, metabolic, endocrine or respiratory pathologies; acute infectious diseases; inflammatory conditions	
Obesity (body mass index over 30kg/m^2)	Acute surgical admission with inflammatory or intra-abdominal condition
Personal history or first-degree relative with a history of VTE	Critical care admission
Use of hormone replacement therapy	Surgery with significant reduction in mobility
Use of the combined oral contraceptive	
Varicose veins with phlebitis	
Pregnancy or puerperium (up to 6 weeks after delivery)	

Risk factors for bleeding include the following:

Patient-related risks	Admission-related risks
Active bleeding	Neurosurgery, spinal surgery or eye surgery
Acquired bleeding disorders (such as acute liver failure)	Other surgical procedure with a high bleeding risk
Concurrent use of anticoagulants known to increase the risk of bleeding	Lumbar puncture/ epidural/ spinal anaesthesia expected within the next 12 hours
Acute stroke	Lumbar puncture/ epidural/ spinal anaesthesia within the previous 4 hours
Thrombocytopenia (platelets less than 75 x 10^9/L)	
Uncontrolled hypertension (greater than or equal to 230mmHg systolic or 120 mmHg diastolic)	
Untreated inherited bleeding disorders (such as haemophilia and von Willebrand's disease)	

Table 2: Recommendations for dosing of Dalteparin according to STH guidelines

Patient's weight to nearest	eGFR greater than or equal to	eGFR less than
kilogram	20 mL/min/1.73m^2	20 mL/min/1.73m^2
Less than 45kg	2,500 units once daily	2500 units once daily
45-99kg	5,000 units once daily	
100-149kg	7,500 units once daily	
150kg and greater	5,000 units twice a day	

Table 3: Extended thromboprophylaxis guidelines according to STH

Operation	Thromboprophylaxis	Dose	Duration
Elective hip arthroplasty	Rivaroxaban	10mg once daily	30 days
Elective knee arthroplasty	Rivaroxaban	10mg once daily	10 days
Pelvic surgery	Warfarin	INR target 2-3	3 months
Patients with lower limb casts	Rivaroxaban	10mg once daily	Until removal of cast

Table 4: Co-morbidity data of patient cohort

Co-morbidity	Number of patients
Hypertension	20
Ischaemic Heart disease	13
No co-morbidity	6
Parkinson's	3
Arrhythmia	2
T2DM	3
Cancer	3
Polycystic ovary syndrome	1

Table 5: Number of patients receiving arthroplasty

Type of arthroplasty performed	Number performed
Primary THR	15
Primary TKR	13
Revision TKR	3
Revision THR	2
Primary total ankle replacement	1

at the time of presentation.

In patients who had developed a PE, the average time between the initial operation and readmission was 122 days (range 4-361) including 8 patients who presented more than 200 days post operatively (figure 3).

In patients who had developed a DVT, the average time between the operation and the admission with DVT was 107 days (range 7 – 360) post op.

In the patients who had operations on the hip and lower limbs, 76% had a DVT on the ipsilateral side and presented at an average of 77 days. Patients with a DVT on the opposite side typically presented later at an average of 147 days.

Discussion

This retrospective study investigated patients who re-presented with a VTE following discharge post orthopaedic surgery at Sheffield Teaching Hospital NHS Foundation Trust (NGH). The study supports the current literature regarding specific risk factors for developing PE such as obesity, arthroplasty surgery and personal or family history of VTE[13]. Over 85% of the study sample had one or more co-morbidities. The most predominant risk factors identified in this cohort were hypertension and IHD, or commonly both.

It could be hypothesised that due to their impaired cardiovascular function, these patients are less mobile and thus at a higher risk of developing a VTE. It should also be considered that vessel wall damage due to hypertension is more likely to lead to thrombus formation and thus a thromboembolic event. This could suggest the need for extended VTE prophylaxis in an already at risk population, with recognised risk factors, compared to patients without risk factors.

This study supports previously established data that VTE can occur despite prophylaxis[14] with one third of re-presentations with were receiving on-going pharmacological prophylaxis at the time of VTE diagnosis.

Up to 6 months post-surgery, the data showed that 76% of DVTs presented on the ipsilateral side following lower limb or hip operations, however following the initial 6 month period, the trend reversed and the contralateral leg was more frequently affected.

It seems likely from study, that in the short term, immobility of the affected leg coupled with local inflammatory factors and probable post-operative vascular disruption increases the likelihood of a DVT occurring on the ipsilateral side. As time passes however, it could be suggested that such local factors have less impact and pre-existing and established risk factors influence the likelihood of a patient having equal chance of developing a DVT in both legs respectively.

When using the Wells score a patient gains one point for 'surgery within 4 weeks' for PE, or 12 weeks for DVT. Within this current cohort, 46% of DVTs and 79% of patients presenting with PE presented after this window and would not have scored a point. It may be the case that later presenting VTE are unrelated to the initial surgery although we feel this may highlight the need for clinical suspicion in patients with risk factors and an orthopaedic surgical history outside the 4 week timeframe.

This study shows that the majority of patients present with VTE following the cessation of the recommended post-operative pharmacological prophylaxis, according to local guidelines. This could suggest that current guidance for thromboprophylaxis is not extensive enough and that patients should be offered prophylaxis for a longer duration if appropriate when considering additional risks and complications.

Limitations

- This study only reviewed patients who re-presented locally. NGH is the regional centre for orthopaedics and patients who were admitted to other hospitals are not included in this study.
- No formal imaging took place prior to operating in any of the patients in this study and it may be the case that they had an undiagnosed VTE before their operation.
- It may be the case that patients who re-presented did not have a VTE confirmed on imaging due to empirical treatment or operator skill and will have therefore not been included in this study.
- A proportion of patients may have developed an asymptomatic VTE and thus not re-presented.
- As this is a retrospective study using patient notes,

co-morbidities, family history and personal history of VTE may not have been recorded and it is likely that this study underestimates the prevalence of these factors

Conclusions

This study supports that previously evidenced risk factors such as obesity, personal and family history of DVT, cardiovascular disease, long operative time and arthroplasty may increase a patient's risk of developing a VTE despite the administration of post-operative VTE prophylaxis.

Current guidance on VTE prophylaxis in arthroplasty, pelvic surgery and patients in lower limb casts suggest extended thromboprophylaxis post-operatively. However this study suggests that patients presenting with risk factors, as outlined in this study, may be at an increased risk of developing VTE for a prolonged period of time. This study has several limiting factors including: only including patients from a single trust and a lack of demographic data available for patients undergoing surgery and not representing with a VTE resulting in an inability to conduct a true cohort study.

Community physicians, Emergency Department clinicians and orthopaedic surgeons should approach VTE with a high index of suspicion in any patient following an orthopaedic operation. We feel further research into this area is required to compare risk factors following orthopaedic surgery in patients who either did, or did not, develop a VTE after an extended period.

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