Prevalence of thromboembolic (VTE) events in a South London District hospital: a retrospective study

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ABSTRACT

Introduction: Venous thromboembolism (VTE) has been defined by many professionals as the term to describe deep vein thrombosis (DVT) and pulmonary embolism (PE). It is a condition where a thrombus (blood clot) forms in the deep veins usually the lower limbs. DVT can often propagate to the lungs causing PE which can result in significant health complications including instant fatality. The disease occurs in 1 in 20 people in the United Kingdom (UK) at some point during their lifetime. Purpose: To investigate the prevalence of VTE in a South London hospital over a period of 3 years. The objectives of the study were to explore the characteristics of VTE by examining potential correlations with demographic variables of gender, age and ethnicity. Another objective was to distinguish between hospital-associated VTE and community-associated VTE and to identify prevalent types of VTE.

Materials and methods: This was a retrospective, quantitative study using convenience sampling. Records of 1728 patients diagnosed with VTE between 1st January 2014 and 31st December 2017 were selected. The data was collected using a clinical computer system to gather patient demographics and identify whether the episode of VTE was related to a hospital admission. Data was analysed using SPSS 23 in order to create descriptive statistics. Spearman’s correlation test was carried out to assess potential correlations between incidences of VTE with age. Jonckheere trend tests were used to assess the significance of trends.

Results: The highest incidence of VTE was among the white population n=1470 (85.1%). The average age of the participants in the study was 66.96 years (standard deviation 17.8), There was a positive correlation between incidence of VTE and age (r=0.078, p=0.001). There were more females diagnosed with VTE, n=895 (51.8%) than males n=833 (48.2%). This trend was significant at 0.05.

Conclusion: VTE is a concern for the general population and is a major health problem affecting 99 people per 100,000 of the population each year. This common disease is prevalent among all individuals irrespective of age, ethnicity or gender and is not always related to episodes of hospitalization. Further research is needed to examine risk factors and rates of VTE and to establish whether individual events are triggered by transient or acquired influences and causal relationships.

Key words: Thromboembolism; hospitalised patients; prevention, anticoagulation

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INTRODUCTION

Venous thromboembolism (VTE) has been defined by many professionals as the term to describe deep vein thrombosis (DVT) and pulmonary embolism (PE). It is condition where a thrombus (blood clot) forms in the deep veins, usually the lower limbs and less commonly the upper extremities. DVT can often propagate to the lungs causing PE which can cause significant health complications including instant fatality. The disease occurs in 1 in 20 people in the United Kingdom (UK) at some point during their life time [1]. Immediate treatment involves anticoagulation medication which can cause side effects such as bleeding. However if VTE is left untreated, 1 in 10 people will die [2]. It is a significant healthcare topic due to the associated long term effects and financial burden to the National Health Service (NHS). It is estimated to cost the NHS £640 million annually [3] for diagnosis, treatment and complications such as post thrombotic syndrome – a chronic condition which causes pain, swelling, ulceration and discomfort in the limbs.

Back in the 1800’s- Rudolf Virchow discovered that PE migrated from the deep venous system and the aetiology consisted of venous stasis, vessel damage, and hypercoagulability, known today as Virchow’s triad [4]. Subsequent research highlighted hereditary and environmental factors such as thrombophilia, obesity, trauma and pregnancy [5]. However the influences of demographic variables such as gender, age and ethnicity have been underestimated and could potentially highlight new risk factors for healthcare professionals to consider.

The South London community is demographically very diverse and this provided an opportunity to examine the rate of occurrence of VTE and include insights to demographics association of the disease and hospitalisation and to differentiate between types of VTE diagnoses.

The key aim of this study was to investigate the prevalence of established diagnoses of VTE in a South London hospital over a period of 3 years. The objectives of the study were: to explore the characteristics of VTE by examining potential correlations with demographic variables of gender, age and ethnicity; to distinguish between hospital-associated VTE and community-associated VTE and to identify prevalent types of VTE.

Literature Review

A review of literature relating to VTE was undertaken using electronic databases; Medline, PubMed, Elsevier, Wiley, BMJ journals and ProQuest Science Journals. The search was refined to English language peer reviewed journals between the years 2007-2018. The search terms used were: Venous thromboembolism, hospital associated thrombosis, gender and venous thromboembolism, ethnicity and venous thromboembolism and age and venous thromboembolism. The electronic search was accompanied by manual searches for relevant papers using article reference lists.

Incidence of VTE

The exact incidence of VTE is currently unknown because there is no compulsory national surveillance for VTE. An all-party parliamentary thrombosis group (APPTG) was set up in 2006 which works closely with the NHS England to raise awareness about the risks and management of VTE [6]. Through meetings, events and reports the APPTG aims to increase awareness of VTE and monitor the implementation of government projects for prevention and other research being undertaken [7]. APPTG also collects data from healthcare providers on compliance with national policy and reported incidence of VTE via freedom of information. However validity of the information provided is unknown due to inconsistencies in the way that healthcare providers capture their data.

Two European population based epidemiology studies reported a collective estimate of 99 cases per 100,000 of the population diagnosed with VTE each year [7,8]. Data published in England estimated that in 2013, 1 in 1000 people developed DVT and 83.6 in 100,000 were affected by PE. By 2021, the rate for PE is predicted to increase to 93.6 cases and that for DVT to 112.1 cases per 100,000 of the population [9]. This implies an increase of 7,843 cases of DVT per year adding significant health burden to patients and a financial strain on the NHS.

In 2005-2008, PE was present on the deaths certificates of 12,000-13,000 people each year but a comprehensive study [10] suggested that the true figure is likely to be considerably higher; with an estimated 60,000 deaths caused by PE each year. The Health Select Committee [11] state that hospital associated VTE is accountable for 25,000-32,000 deaths per year in England. Other reports assert that VTE is responsible for 40,000 deaths per year in England with 25,000 potentially avoidable with preventative measures such as risk assessment and thromboprophylaxis [12].

It has been reported that half of cases of VTE are associated with hospitalisation [13]. Highlighting patient risk factors for VTE is extremely important in order to prevent the disease in high risk persons. A general population study which evaluated 21,680 individuals with a diagnosis of VTE over 7.6 years demonstrated the most common risk factor was hospitalisation in 52%, followed by cancer in 48% and surgery in 42% cases [14].

These results provide important insights as to the importance of identifying risk of VTE and administering appropriate preventative measures in hospitalised patients. It has been stated [15] that 25%
of all VTE could be avoided if thromboprophylaxis was given to all hospitalised patients at risk.

VTE is often present in an individual with no signs or symptoms and therefore the reported prevalence is likely to be lower than actual incidence due to the asymptomatic nature of the disease. One study [16] asserted that 3-4 people per 10,000 of the population in the UK are diagnosed with PE annually. Primary diagnoses may be recorded on death certificates and therefore if post mortem is not carried out then VTE will not be identified. However, post mortem studies have found PE in fewer than half of people who die as a result of VTE [17]. In fact it is claimed that around two-thirds of diagnoses of VTE tend to be DVT and one third PE [18].

The risk of mortality from PE is dependent on the extent of PE and the timely efficacy of the treatment that is given. Research before 1960 published 23-87% mortality rates if PE was left untreated [2]. More recent prospective studies showed that 1 in 15-30 people (3-6%) died of PE during treatment with anticoagulation after subsequent diagnosis [19,20,21].

Ethnicity and VTE

Incidence of VTE varies widely among ethnic groups but globally it appears highest in Black population, then Caucasian and is lowest in the Asian population [22]. A study carried out in California reported that African-American populations have the highest rate of VTE and Asian groups the lowest. Caucasian groups had a 7-fold higher incidence than Asian [23]. The sample included multiple ethnic groups living in the same geographical area and therefore any environmental factors which may influence the incidence rates were minimised. These findings concurred with previously reported findings from other U.S. studies [24,25].

The reasons for different risks among diverse ethnic groups are still to be carefully investigated. This could be explained by disparity in genetic predisposition such as thrombophilic defects some of which may be currently undiscovered. Factor V Leiden and prothrombin gene mutations are two predominant thrombophilias which are uncommon in the Asian population but affect 4.4%-3.1% of the European population [26,27]. Previous studies [28] also found that Factor V Leiden and prothrombin gene mutations have a lower prevalence in non-Caucasians. Other reasons for diverse risks of VTE among ethnic groups could be environmental risk factors such as obesity and dietary differences. In a study carried out in New Zealand, European populations had a higher mean BMI than Asian populations. However, Maori and Pacific Island inhabitants had a higher mean BMI but were less susceptible [29]. It is therefore prudent to exclude BMI alone as an environmental influence for reduced incidence of VTE in non-European groups.

Studies in the United States [24,30] suggest that incidence of VTE is higher in the White population than in Asian, Pacific Islanders and Hispanics. However, it was also reported that incidence of VTE was 25% higher in African-Americans than other populations [30,31]. Potential explanation for this difference was due to use and efficacy of thromboprophylaxis as the increased risk in Black populations was greater in secondary rather than idiopathic VTE [31]. While thrombophilia has been reported as moderately rare in the African population [32], there is a similar incidence and family history of VTE as in the White population which may suggest an unidentified gene mutation which could be highly significant in the Black population. Haemostatic markers of thrombosis risk, including factor VIII, von Willebrand factor and D-dimer have been studied in the Black populations and have found that higher levels are present [33]. However explanations are yet to be uncovered.

Age and VTE

The rate of VTE substantially increases with age. The annual occurrence in people under the age of 40 years is 1 in 1000; whereas it is 1 in 100 for people over 80 years [1,34]. The reasons that the older population are predominantly at a high risk of developing VTE are not fully understood. However it is thought that presence of medical comorbidities, increase in coagulation or illness influencing formation of thrombosis could all contribute [35]. An eight year longitudinal study reported a 13-fold greater risk among individuals 85 years and older than those aged 45-55 concluding an total rate of 7 per 1000 annually for the over 85s [31]. Thrombosis may be under diagnosed in incapacitated elderly persons and therefore these figures are likely to be underestimated.

There are currently 11.6 million people living in the UK over the age of 65 years, a figure which is projected to rise by over 40% in the next 17 years [36]. The aging population in the UK reflects many other European countries and it is expected that nearly one in 5 people alive today will live to 100 [37]. Healthy life expectancy however has not increased - 16.6 million adults were admitted to hospital in 2017-2018, with around 1.8 million (7.9%) over the age of 70 [38]. Each day in hospital costs an average of £438 per patient [39]. The aging population and their increasing ailments put a massive financial strain and service demand on the healthcare service which is becoming difficult to sustain.

Gender and VTE

Studies linking the incidence of VTE and gender are deficient. Some report that gender has no association with risk of VTE while others report a
higher incidence in males. In an American study including nationwide data from inpatients, males had a higher incidence of VTE [40]. Furthermore, previous studies [41] found consistent incidence of VTE in males across all ages but much lower rates in females under 55. However the risk increased for women over 60 years old.

It is well documented that prior use of oral contraceptives leads to a pro-coagulant state during pregnancy with the risk of VTE 5-10 times greater in pregnancy than in non-pregnant state [42]. Hormone replacement therapy (HRT) has been reported to increase the risk of VTE more than 2 fold. The increased risk of VTE is more prevalent with combined HRT [43]. A systematic review of VTE literature [44] found no evidence to suggest gender as an independent risk factor for VTE but absolute risk is circumstantial and related uniquely to women in pregnancy, puerperium and those on HRT.

**MATERIALS AND METHODS**

This was a retrospective, quantitative study using convenience sampling. Records of 1728 patients diagnosed with VTE over a three year period between 1<sup>st</sup> January 2014 and 31<sup>st</sup> December 2017 were selected. The focus was on hospital associated thrombosis and community associated thrombosis. Hospital associated thrombosis is defined as a result of hospitalisation whereas community associated thrombosis is defined as thrombosis which was diagnosed in patients in community and was unrelated to hospital admission. Types of VTE included: Distal DVT (below knee), proximal DVT (above knee), Other VTE (upper limb, portal vein thrombosis) and PE. Exclusion criteria comprised of chronic VTE and suspected VTE without clinical diagnoses.

**Data Collection**

The data was collected by the VTE nurse using a local hospital’s clinical computer system to gather patient demographics and identify whether the episode of VTE was hospital related as a result of a recent hospital admission. The VTE nurses were informed of diagnoses of VTE through clinical coding, radiology departments, outpatient clinics and inpatient areas (Appendix 1). All data was recorded on an excel spreadsheet and later transferred to SPSS 23 [45].

**Data analysis**

Data was analysed using SPSS 23 [45] in order to create descriptive statistics of mean, median, range, standard deviation and percentages. A histogram was created to illustrate age range and Spearman’s correlation test carried out to assess potential correlations between incidences of VTE with age. Jonckheere trend tests were carried out to assess trends between incidence of VTE in hospital settings and incidence of VTE in relation to ethnicity and gender.

**Ethical consideration**

Healthcare organisations have a responsibility to ensure that their patients’ information is protected and not used for malicious purposes [46]. No patient identifiable information was present throughout the study and data was protected by computer passwords [47]. Permission to use the data was sought and granted by the head of information governance and the directorate of the hospital. Information was used in accordance with the Data Protection Act [48] and there was no adverse risk to participants was possible throughout the study. Patient experience and outcomes remained unchanged and therefore ethical approval was not deemed necessary [49].

**RESULTS**

**VTE by ethnicity**

Rates of VTE were compared with different ethnic groups of the local population to obtain an overall relational incidence of VTE. The highest incidence of VTE was among the white population n=1470 (85.1%) with a ratio of 0.98% compared with the total local white population. This was followed by other ethnic group n=26 (1.5%) with a ratio of 0.55%, Black/African/Caribbean/Black British n=28 (1.6%) with a ratio of 0.31%, Asian/Asian British group n=44 (2.5%) with a ratio of 0.22% and the lowest incidence was among mixed/multiple ethnic groups n=13 (0.8%) with a ratio of 0.18%. This trend was tested by Jonckheere test, but was not significant. The overall rate of VTE for the whole population in the study catchment area was 2.24% (Table 1).

**Table 1. Ethnicity and diagnoses of VTE *Local Population**

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>% (n) VTE diagnoses</th>
<th>LP* % (n)</th>
<th>Rate of VTE %</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>85.1 (1470)</td>
<td>78.6 (149419)</td>
<td>0.98</td>
</tr>
<tr>
<td>Mixed/multiple ethnic groups</td>
<td>0.8 (13)</td>
<td>3.8 (7224)</td>
<td>0.18</td>
</tr>
<tr>
<td>Asian/Asian British</td>
<td>2.5 (44)</td>
<td>10.4 (19770)</td>
<td>0.22</td>
</tr>
<tr>
<td>Black/African/Caribbean/Black British</td>
<td>1.6 (28)</td>
<td>4.8 (9125)</td>
<td>0.31</td>
</tr>
<tr>
<td>Other Ethnic group</td>
<td>1.5 (26)</td>
<td>2.4 (4562)</td>
<td>0.55</td>
</tr>
<tr>
<td>Unknown</td>
<td>8.5 (147)</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>100 (1728)</td>
<td>100 (190100)</td>
<td>2.24</td>
</tr>
</tbody>
</table>
**VTE by age**

The average age of the participants in the study was 66.96 years (standard deviation 17.8), median age 70 years and mode 78 years. Minimum age was 15 years and maximum age was 102. There was a positive correlation between incidence of VTE and age \( r = 0.078, p = 0.001 \) in the study population, meaning that the incidence of VTE increased with age (Table 2).

The skewed histogram further illustrates the correlation between higher incidences of VTE with increase in age (Figure 1).

![Fig 1. Prevalence of VTE and age of participants](image)

**Table 2.** Spearman Correlation of VTE by Age

<table>
<thead>
<tr>
<th>Model of correlation</th>
<th>Value</th>
<th>Asymptotic Standardized Error</th>
<th>Approximate T&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Approximate Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman Correlation</td>
<td>0.078</td>
<td>0.024</td>
<td>3.236</td>
<td>0.001&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>1728</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 3.** Hospital related VTE

<table>
<thead>
<tr>
<th>VTE by Hospital/Community associated incidence</th>
<th>% (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAT / CAT / OHAT</td>
<td></td>
</tr>
<tr>
<td>HAT (Hospital Associated Thrombosis)</td>
<td>25.9 (448)</td>
</tr>
<tr>
<td>CAT (Community Associated Thrombosis)</td>
<td>72.9 (1250)</td>
</tr>
<tr>
<td>OHAT (Other Hospital Thrombosis)</td>
<td>1.2 (20)</td>
</tr>
</tbody>
</table>

Proximal DVT was the highest reported type of VTE - n=694 (40.2%) followed by PE n = 624 (36.1%) and distal DVT n=351 (20.3%), whereas the least reported type of VTE was other DVT n=59 (3.4%). There were more females diagnosed with VTE, n=895 (51.8%) than males n=833 (48.2%). This trend was significant at 0.05 significance level tested by Jonckheere trend test.
Figure 2. Type of VTE and Gender

There was a higher incidence of community associated thrombosis n=1250 (72.9%) compared with hospital associated thrombosis n=448 (25.9%). This trend was significant on Jockheere trend test. Other hospital thrombosis was reported as n=20 (1.2%) – Table 3.

DISCUSSION

This study examined the data collected over a three year period in one hospital trust, which showed 1728 diagnoses of VTE. The most common type of VTE was proximal DVT (40.2%) followed by PE (36.1%) and distal DVT (20.3%) with the least frequent other VTE (3.4%).

The nature of the inclusion criteria and the robust data collection ensured that the sample represented the population in the catchment area diagnosed with VTE. The majority of the diagnoses of VTE were community associated (72.9%) which challenges the existing research which found most VTE to be hospital associated. Since the introduction of the VTE prevention programme in England in 2010, clinicians have become more aware of the importance of VTE prevention thus prescribing and administering appropriate VTE prophylaxis in high risk hospitalised patients which contributed to a decrease in HAT. Another salient point to note is that increased awareness of VTE may have contributed to greater volume of diagnostic tests carried out for suspected VTE and subsequently an increase in diagnosis.

The data analysed was compared against ethnicity cohorts in the study catchment area which gave a representation of VTE diagnoses in different ethnic populations. The data showed that there is a higher incidence of VTE in the white population of the study catchment area 0.98% followed by other ethnic group 0.55%, Black/African/Caribbean/Black British 0.31%, Asian/Asian British 0.22% and the lowest ethnic group was mixed/multiple groups – 0.18%. These results are consistent with existing research with regards to the Asian population having a low incidence of VTE compared to other ethnic populations [26,27] however, inconsistencies in prevalence of VTE compared with other research have been found in the white population and black population [22]. The reasons for the varied incidence of VTE in different ethnic populations are currently unknown. However it could be a combination of both genetic factors and environmental influences which need to be further explored.

There was a higher incidence of VTE in females 51.8% when compared to males 48.2% in the study. There are known risk factors for VTE specifically related to women such as prothrombotic changes during pregnancy and the use of oral contraceptive pill and hormone replacement therapy but there are no known gender specific risk factors recorded in men. Some studies reported a higher incidence of VTE in men [40,41] however it is not
practical to introduce gender alone as a risk factor for VTE based on inconsistencies in research.

It is particularly evident from the data in this study that incidence of VTE increases with age (r=0.078, p=0.001). National research concurs that incidence of VTE increases with age [1,34] and the reasons for this are due to increased morbidity in the older population, fragility and immobility. The mean age of participants in the study population was 67 years old (SD = 17.8), mode age 78, maximum 102 and minimum 15 which represents a vast variation in age and evidence that VTE does not just affect the older population.

Strengths and Limitations

The primary strength of this study was data capture and the use of an extensive search method of cases of VTE through clinical coding, radiology, bereavement, inpatient and outpatient areas. This method enabled the identification of as many cases of VTE as possible. In addition, data capture was only carried out by a specialist nurse in VTE and therefore expert knowledge and consistency was maintained throughout the study. The study was defined to one geographical area and included both inpatients and outpatients. Data collection over a three-year period enabled the capture of a substantial amount of VTE diagnoses allowing results to be generalised to the wider population.

The key limitation to the study was the nature of retrospective data being used and therefore it was not possible to collect any additional categories and consequently to provide any unique insights. There was the possibility of human error when entering data onto the spreadsheet and also dependency on the hospital’s computer system to contain the correct patient demographics. There was also no procedure for identifying false positive cases of VTE. Another limitation was the reliance on the literature which was mainly from American studies, therefore the findings and recommendations need to be considered with caution when comparing previous findings with the UK systems and populations.

Implications for practice

This study provides an insight into the current health burden of VTE in the local population that it represents. The findings from the study have implications for the local area, local practice and also for health prevention. In order to deal with the burden of VTE, it will be useful to continue regular data collection as well as introduce more thorough risk assessment in community as the findings indicate greater incidence of VTE in community and as a result, following implications for practice include:

- Implementation of VTE risk assessment for individuals in the community and VTE prevention methods for patients identified at high risk of VTE
- Recognition of age and ethnicity when risk assessing individuals for VTE
- Thorough investigation of individuals diagnosed with VTE including identification of transient and genetic risk factors.
- Compulsory collection and analysis of data on the prevalence and management of DVT and PE including both acute and community settings.

Conclusions and recommendations for future research

VTE is a worrying concern for the general population and is a major health problem affecting 99 people per 100,000 of the population each year. This common disease is prevalent among individuals irrespective of age, ethnicity or gender and is not always related to episodes of hospitalization and the evidence from this study shows that there was a greater incidence in community associated VTE. Therefore the key recommendation is a better risk assessment of people in community and in particular those over 65 who maybe more sedentary as a result of other comorbidities. Furthermore, the study identified a positive correlation between age and increased incidence of VTE and reported a higher incidence in females than males as well as a higher incidence in the white population. Further research is needed to examine risk factors and rates of VTE and to establish if individual events are triggered by transient or acquired influences and causal relationships. This will enable identification of individuals at an increased risk of VTE and potential new preventative measures for VTE, ultimately improving patient morbidity and mortality.

Limited local and national data on the incidence of DVT and PE may obstruct the availability and delivery of healthcare services relating to VTE. The value of regularly obtained data must not be ignored as the evidence from the data will enable a positive interrogation with other data sources and the literature. Diagnoses of VTE and deaths from PE should therefore be accurately recorded and coded to gain a better understanding of the extent of VTE nationally in order assess patient need in their local area and to put service provisions into place.
Appendix 1

The process of data collection

1. Radiology send VTE nurses a list of all diagnostic procedures carried out for suspected VTE
2. Radiology send patient details to designated email for all confirmed cases of VTE
3. Outpatient clinics and ward staff notify VTE nurses of any confirmed cases of VTE

VTE nurses check hospital records to determine if VTE is hospital associated (HAT)

Hospital associated thrombosis is defined as VTE diagnosed during inpatient admission or within 90 days of discharge.

1. VTE nurses report all cases of HAT on hospital incident database and request a thorough investigation from medical team
2. VTE nurses document all cases of VTE on excel spreadsheet and include patient age, ethnicity, type of VTE, hospital or community associated

VTE – Venous thromboembolism
HAT – Hospital associated thrombosis

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Conflicts of interest
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