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Thromboprophylaxis in adult and paediatric burn patients: A survey of practice in the United Kingdom

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ABSTRACT

Introduction: Patients with burn injuries are at an increased risk of venous thromboembolism (VTE). This predisposition is secondary to the endothelial injury, hyper-coagulable state and stasis (Virchow's triad) associated with burn injury. Although the true incidence of VTE in burn patients has not been adequately quantified, symptomatic VTE occurs in 0.2–7% of this population.

VTE prophylaxis has proven clinical effectiveness and affords a reduction in the morbidity associated with such events, but the benefits and risk of complications need to be balanced in order to provide the best quality of care.

Owing to the lack of prospective data on VTE in burns, practice varies greatly, not only internationally, but also between local burns services. Our aim was to better understand current VTE practice within United Kingdom (UK) burn care services by performing a comprehensive survey.

Methods: We contacted all the inpatient burn care services in the UK and collected data on current VTE practice via a standardised questionnaire. Services were given the choice to complete the survey by telephone or email and a follow-up plan was formulated.

Results: Twenty-five burn care services were contacted and 23 agreed to participate (92% response rate). Responding services treated adults, children or both and lead burn nurses or senior medical staff familiar with current VTE practice were interviewed.

Routine VTE prophylaxis was provided in 84% of burn services and the majority utilised a combination of chemoprophylaxis and thromboembolic deterrent stockings (TEDS). All used low molecular weight heparin (LMWH) as their choice of chemoprophylaxis. Of those treating adults, all used a VTE prophylaxis protocol, but none of these applied to children. Only 56% of services treating children had such a protocol. The majority discontinued prophylaxis once patients were mobile.

Discussion and conclusion: Although the true burden of VTE in burn patients is unknown, we recognise that they are a population at risk. In addition to changes in the inflammatory and clotting pathways associated with thermal injury, prolonged hospital stay, ventilatory support, multiple surgeries, numerous central venous cannulations and reduced mobility all multiply this risk.

The risk associated with the administration of heparin (bleeding complications and heparin-induced thrombocytopaenia) is low and can be reduced even further to 0.1% by the use of LMWH. The risk of symptomatic VTE is far greater, therefore the benefits of VTE prophylaxis

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would seem to outweigh the risks of not undertaking prophylactic measures. A higher LMWH dose and routine monitoring of anti-factor Xa levels are useful for acute burn patients.
Two previous surveys, performed in Canada and the United States of America (USA), found routine administration of VTE prophylaxis to be 50% and 76% respectively. Of the 71 centres in the USA participating in the survey, 30% used a combination of sequential compression devices (SCD) and heparin and 24% did not provide VTE prophylaxis at all.
A lack of prospective data on VTE in burn patients appears to be associated with diverse practice, and consensus on this topic could ensure that the potential morbidity caused by VTE is reduced. A clinical tool for identifying patients at risk and guidelines for management will standardise practice, which in turn should allow us to improve and maintain high quality care for burn patients.

1. Introduction

Patients with large burn injuries share many physiological responses with major trauma patients. They are at higher risk of venous thromboembolism (VTE) as they display all three components of Virchow's triad: endothelial injury, hyper-coagulopathy and stasis. In patients with burn injury, direct injury to the endothelium, activation of thrombotic and fibrinolytic pathways, ventilatory support, multiple surgeries, sepsis, multiple central line insertions and immobilisation all contribute to the increased risk of VTE [1–4]. Harrington et al. found that increasing total body surface area (TBSA) burned significantly increases the risk of VTE [5].

The incidence of VTE in burns reported in the literature varies between 0.9% and 60% if no prophylaxis was administered [3,6], and 0.25% and 23% if prophylactic measures were taken [7,8]. Prospective studies report a higher incidence when compared to retrospective reviews and raise controversy over symptomatic versus asymptomatic VTE. Symptomatic VTE occurs in 0.2–7% of patients with burns [5,9].

The international consensus statement of 2013 regarding prevention and treatment of VTE indicated that burn patients are at significantly higher risk of VTE when not receiving medical prophylaxis. The incidence across three studies was 12% (30/249, CI 8.6–16%). [10] In a large series examining the risk factors for DVT in burn patients, 0.8% of patients developed DVT and those with DVT were twice as likely to die during the admission [11].

There is extensive data to support both the clinical and cost effectiveness of routine thromboprohylaxis in trauma and surgical patients [12,13]. Unfortunately, similar data is not currently available for the burn population [8]. Standard dosing of low molecular weight heparin (LMWH) may be insufficient to achieve target anti-factor Xa levels in acute burn patients as it correlates with weight and burn area (% TBSA) [14]. A higher initial LMWH dose and routine monitoring of anti-factor Xa levels are therefore recommended [15].

We recognise that this population of patients is at high risk of VTE events and that the associated morbidity could be largely prevented. In order to better understand current practice, we performed a survey of VTE prophylaxis practices in all UK burn services.

2. Materials and methods

A questionnaire was designed in written and electronic formats, and comprised 11 questions over 3 sections. The survey addressed various aspects of practice and included patient demographics, current VTE prophylaxis practice (indications, type, agent and dosage), duration of treatment and monitoring (Appendix A).

2.1. *Survey of burn providers in the United Kingdom*

All inpatient burn services within the UK, as per the British Burn and European Burn Association websites, were contacted via telephone. A trainee burns doctor made all calls during normal working hours, Monday to Friday. The interviewee was the lead burns nurse or a haematology doctor familiar with the unit protocols, however, burns team medical staff were often consulted to ensure the accuracy of information supplied. During the initial interview, the study aims were explained and the service was invited to participate. If they agreed, they could choose to complete the questionnaire during a further telephone conversation or via email correspondence. If they chose to be contacted by telephone, a future convenient date was agreed. At the second telephone interview, a structured pro forma guiding the interview was used. If contact was not made on the initial call, a second telephone call was made, and if contact was not made after that call, the service was excluded from the survey. If the service chose to be contacted by email, a structured pro forma was sent out. Two further electronic contact attempts were made prior to exclusion from the survey.

2.2. *Data analysis*

Data was collected on a standardised pro forma and a database was created in Microsoft Excel. Data analysis was performed in Microsoft Excel.

3. Results

All 25 UK burn services were contacted between December 2013 and April 2014. A total of 23 services agreed to participate

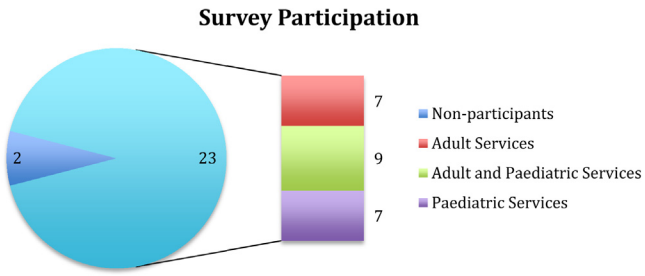

Fig. 1 – Survey participation.

in the survey, equating to a 92% response rate. Of the respondents, 7 treated adults only, 7 treated children only and 9 treated both adults and children (Fig. 1).

Routine VTE chemoprophylaxis was administered in all services treating adults only and in five of seven services treating children only. In services treating adults and children, all adults received routine chemoprophylaxis compared to only one of the nine units providing this for their paediatric patients. Enoxaparin was the agent of choice for chemoprophylaxis in 61% of services and the use of TEDS employed by 87% (Fig. 2) (Table 1).

All services treating adults had a VTE protocol (including those also treating children), however, in services solely treating children, 71% (n = 5/7) had VTE protocols. None of the VTE protocols employed were exclusive to burns. Specific criteria used to assess the risk and establish the need for VTE prophylaxis is summarised in Table 2.

Few services monitored chemoprophylaxis routinely by measuring anti-factor Xa levels: 2 adult services, 2 paediatric services and none of the services providing burn care to both adult and paediatric patients. VTE prophylaxis was discontinued on discharge in 39% (n = 9) of services, whereas 43% (n = 10) discontinued prophylaxis once patients were mobile. The remaining 4 services relied largely on the clinician's decision to terminate prophylaxis. When comparing those treating adult and paediatric patients exclusively, VTE prophylaxis was discontinued upon discharge in the majority of adult services and only when patients were mobile in the majority of paediatric services (Fig. 3).

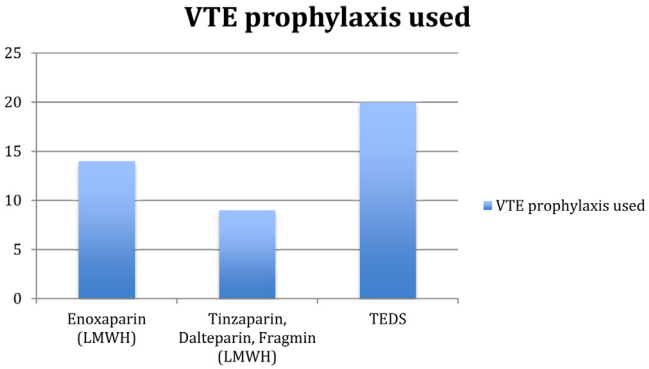

Fig. 2 – Agents used in VTE chemoprophylaxis.

Table 1 – VTE protocol and interventions.

	Adult (n = 7)	Paediatric (n = 7)	Adult and paediatric (n = 9)
VTE protocol	7	5	9
LMWH	7	7	9 adults 1 paediatric
TEDS	7	5	8
Monitoring	2	2	0

LMWH = low molecular weight heparin, TEDS = thromboembolic deterrent stockings.

Table 2 – Criteria used to establish risk and the need for VTE prophylaxis.

Criterion	Adult (n = 7)	Paediatric (n = 7)	Adult and paediatric (n = 9)
Age	7	4[a]	9
Central line	0	4[a]	2
Immobilisation	7	2 + 4[a]	9
BMI	7	2 + 4[a]	9
Past medical history	7	2 + 4[a]	9

BMI = body mass index.
[a] Used as a criterion by the treating clinician, but no formal protocol followed.

3.1. *Adult patients*

All services utilised VTE prophylaxis protocols based on calculating risk from a number of criteria, but none of the protocols were tailored to the burn patient.

TEDS were used to prevent VTE and used in conjunction with a chemoprophylactic agent in all adult services. The majority of patients received VTE prophylaxis until they were discharged (57%, n = 4/7).

3.2. *Paediatric patients*

Of the 16 services treating paediatric patients, only 2 could recall a thromboembolic event in a child. All of the 9 services treating both adult and paediatric patients had VTE protocols,

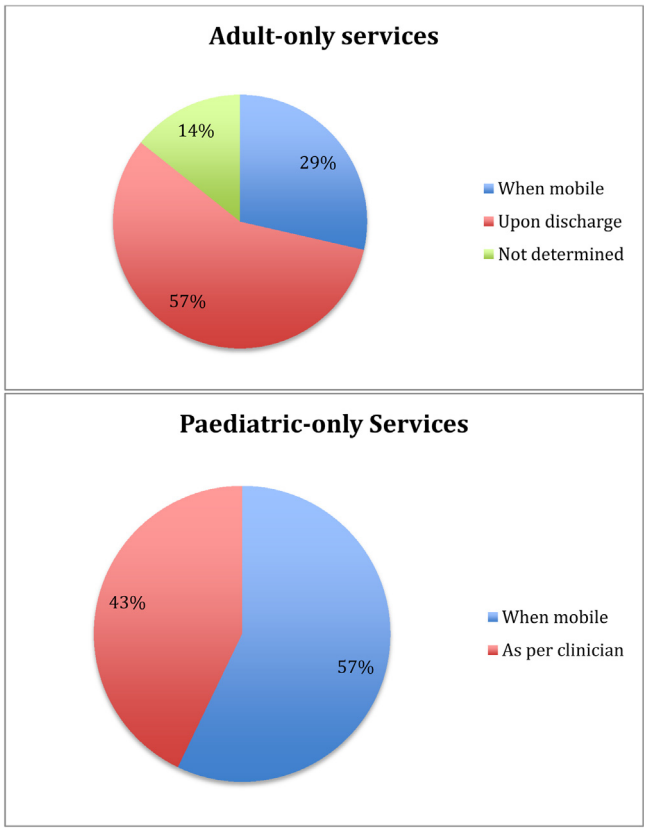

Fig. 3 – Decision to discontinue VTE prophylaxis.

but none of these were applicable to children. Seventy-one per cent (n = 5/7) of exclusively paediatric services used VTE protocols, but none of the protocols were specific to burns.

Chemoprophylaxis and TEDS were used in paediatric patients in 31% (n = 5/16) of all services providing burn care to paediatric patients (paediatric only, and adult and paediatric services). In services only caring for children, 57% (n = 4/7) discontinued VTE prophylaxis once patients were mobile.

4. Discussion

The incidence of DVT in a single centre, prospective randomised controlled study on the efficacy of LMWH thromboprophylaxis in burn patients was found to be 8% in the control arm (4/50), compared to 0% in those receiving daily chemoprophylaxis in the treatment arm (0/50). Only 2% had complications associated with the administration of LMWH. The average age of their study population was 29 years and none of the patients suffered any long-term comorbidity [16]. Due to paucity in the literature, true incidence of VTE is unknown, but we recognise that these patients are at increased risk.

When administering heparin, the risks of bleeding complications and heparin-induced thrombocytopaenia (HIT) need to be considered. Leonardi et al. performed a systematic review of bleeding complications in general surgical patients associated with VTE prophylaxis and found a rate of 0.2% for major gastro-intestinal bleeds, 2% for drain site bleeds and 5.7% for wound haematoma [17]. Burn patients are thought to be at a higher risk of developing HIT due to systemic platelet activation and local production of platelet factor 4 following thermal injury [18]. The incidence of HIT in burn patients has been reported to be between 1.6–3.1%, but this can be reduced to 0.1% by substituting LMWH for heparin [18–20].

Despite good evidence, only four of twenty-three (17%) burn services in the UK monitor anti-factor Xa in patients receiving LMWH [14,15]. There is danger therefore of administering LMWH as VTE prophylaxis without achieving effective levels. A higher than predicted dose of LMWH may be beneficial for acute burn patients, thus routine monitoring of anti-factor Xa levels is recommended.

In our survey, we found that chemoprophylaxis was given routinely by all services treating adults and in 71% of those treating paediatric patients. Only one service caring for both adult and paediatric patients administered chemoprophylaxis to paediatric patients. VTE prophylaxis protocols were available in all services treating adults and in five of seven services treating paediatric patients exclusively. Adult services consistently assessed VTE risk through identification of certain criteria (age, central venous catheter, immobilisation, BMI and past medical history), however, this practice was not replicated in paediatric services. This disparity may be due to the robust evidence available for VTE prophylaxis in adults and the lack of an equivalent evidence base for the paediatric population. None of the services that participated in the survey used VTE protocols or risk assessment tools tailored to burn patients and very few (4/23) monitored the effectiveness of chemoprophylaxis. VTE prophylaxis was discontinued on patient discharge in 9/16 of services treating adults, whereas 4/7 services treating children exclusively discontinued VTE prophylaxis when patients regained mobility.

4.1. *VTE prophylaxis in adult patients*

The clinical benefit and cost effectiveness of routine VTE prophylaxis in adults is clear from the literature, with many healthcare systems adopting simple risk assessment tools to aid decision making [10,11]. In the UK, the National Institute for Health and Care Excellence (NICE) have developed guidelines [13] based on current best evidence and national adherence is expected. Although major trauma is recognised as a special patient group, no specific guidance is available for the burn population.

4.2. *VTE prophylaxis in paediatric patients*

Paediatric VTE occurs predominantly in neonates and teenagers, with incidence rising steeply with age. It is thought that VTE in the paediatric population is rare with a reported incidence of 5.3/10 000 [21]. However, Raffini et al. found a dramatic increase in the diagnosis of VTE in children between 2001 and 2007, reporting an incidence of 58/10 000 [22]. Similarly, Sandoval et al. found an increased incidence, but also noted that clinical probability scoring alone did not correlate well with actual incidence [23]. For this reason, the true incidence of VTE in the paediatric population may be underestimated. Literature on VTE in paediatric burn patients is sparse which may account for the marked variance in VTE practice and protocols, and why guidelines for the paediatric population in the UK does not exist.

4.3. *Findings of other published surveys*

In a survey of VTE prophylaxis practice in eight of sixteen Canadian burn centres (response rate 50%), Abedi and Papp found that half of the respondents would routinely administer chemoprophylaxis (heparin or LMWH) to all admitted burn patients, regardless of their risk factors [24]. These centres continued chemoprophylaxis until patients were discharged from the unit. Just over a third of centres (n = 3/8) administered VTE prophylaxis only if risk factors were identified and prophylaxis was continued only until patients regained mobility and lower limb burns were healed. Only one unit used LMWH as the sole method for thromboprophylaxis, whilst 50% used heparin.

Ferguson et al. [25] conducted a similar survey of 71 of 84 US burn centres (response rate 85%). They found that 76% of centres provided routine VTE prophylaxis, with sequential compression devices and subcutaneous heparin being the most popular modalities. The use of a combination of sequential compression devices (SCD) and heparin was reported by just under a third of (n = 19/71) centres and only one centre combined the use of SCD and enoxaparin. They noted that nearly a quarter of centres (n = 18/71) did not provide VTE prophylaxis at all.

Neither of these surveys assessed adherence to VTE protocols or monitoring of treatment effect.

4.4. *Comparison with UK survey*

In contrast, 91% (n = 21/23) of both adult and paediatric UK burn services have VTE protocols in place and provide some form of prophylaxis. With regards to duration of treatment, more than a third of services (n = 9/23) discontinued VTE prophylaxis on discharge, whilst the majority discontinued once patients were mobile. Most units had a protocol for VTE prophylaxis, however, in units treating adults and children, these protocols were not applicable to children. In addition, none of these protocols were designed specifically for use in the burn patient population. Abedi and Papp's survey of 2011 noted that only one Canadian burn unit used LMWH [24]. Ferguson et al. performed their survey between 2003 and 2004, and observed 21% of US burn centres used LMWH as the choice of chemoprophylactic agent [25]. In the UK, all burn services used LMWH, which is most likely due to NICE guidance and the significant decrease in risk of HIT when LMWH is used. In the UK, combination VTE prophylaxis (TEDS and LMWH) seems to be the mainstay of treatment (90%, n = 19/21), compared to 30% of centres in the US, who combined SCD and sub-cutaneous heparin.

We accept that VTE practice in some services may have been updated since this survey was performed.

5. Conclusion

This study is the first published survey assessing VTE practice in burn patients in the UK, with a response rate of 92%—higher than any similar published surveys. Reviewing previous work, we noted that those using telephone interviews, rather than written questionnaires, tend to attract a higher response rate: 93% and 84% in our survey and that of Ferguson et al. [25] respectively, compared to 50% in Abedi and Papp's survey [24].

Despite the paucity in the literature, the majority of burn services in the UK acknowledge that burn patients are a special population at risk of VTE and therefore routinely administer VTE prophylaxis to their patients. Due to good evidence for VTE prophylaxis in the general adult inpatient population and published NICE guidance, all hospitals treating adult patients have generic VTE risk assessment tools and protocols for prophylaxis. We believe that these protocols are transferred and applied to adult burn patients in these hospitals where burn services are present. With less evidence for routine VTE prophylaxis in the paediatric population, risk assessment and treatment protocols are less common and this may be why fewer paediatric-only burn services have their own VTE protocols. However, we are aware of an increase in the incidence of VTE in the general paediatric inpatient population [22,23] and note the need to develop an evidence based risk assessment tool that will aid in identification of patients at risk and could guide implementation of a treatment protocol.

There is diverse practice with regards to VTE in the burn population and a lack of consensus between burn services nationally and internationally. This is particularly relevant to services treating children. This diversity may lead to greater morbidity with underestimation of the true risk of a complication where simple measures could significantly reduce probability. The recently published ISBI guidelines for burn care makes recommendations on deep venous thrombosis [26]. Their vision is that these guidelines will provide the best and most cost-effective methods of burn care throughout the world.

We suggest that an evidence based risk assessment tool and associated treatment protocols will aid in the identification of patients at risk, and administration and monitoring of VTE prophylaxis in the UK. Consensus on standards of care will enable burn services to establish and monitor the effectiveness and efficacy through clinical governance pathways. In turn, this will lead to standardisation of practice that may reduce the risk of patients developing VTE and so lessen the significant associated morbidity, and improve the quality of care delivered to patients who have suffered a burn injury. We hope that our findings provide information to the international community who may be considering a more protocolised approach, appropriate to local conditions and circumstances.

Declaration of interest

None.

Acknowledgements

We are grateful to all services that contributed and the high response rate represents nearly all burn services in the UK. This has provided valuable information with regards to current VTE practice in burn patients.

Appendix A. Survey pro forma

Appendix : Survey pro forma

Thromboprophylaxis in adult and paediatric burn patients: A survey of practice in the United Kingdom

Centre: Auditor:
1st phone call:
2nd phone call: Date Assessed:
Interviewee: Position:

Demographic

1. Burns patients managed: Adult / Paediatric / Both
2. Can you recall a VTE event in a paediatric burns patient in your centre? Yes / No

Current practice

3. Protocol for VTE prophylaxis: Yes / No
   a. Does it apply to paediatric patients: Yes / No
   b. Burn specific: Yes / No
4. Criteria used to establish risk and need for VTE prophylaxis:
   a. Age
   b. TBSA burned
   c. Central lines
   d. Prolonged immobilization
   e. BMI
   f. Pre-existing medical conditions
5. Administration of LMWH: Adult / Paediatric / Both
6. Chemoprophylaxis prophylaxis used (agent):
7. Calculation of dosage:
8. TEDS used:

Duration of treatment and monitoring

9. Monitoring regimen
10. Routine monitoring of coagulation factors in patients on VTE prophylaxis: Yes / No
11. VTE prophylaxis– decision to discontinue:

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