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ARTICLE

Venous thromboembolic events in hand surgery

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ABSTRACT

The risks of venous thromboembolism (VTE) following total hip and knee arthroplasty have been widely published. Our aim was to investigate the recorded incidence of VTE events at the time of elective and trauma hand surgery. The UK National Hospital Episode Statistics (HES) data linking VTE events with hand surgery for the financial years 2010–2012 were analysed. The local VTE rates following hand surgical procedures were also analysed. Finally, a cost assessment of VTE thromboprophylaxis was performed according to the British Society for Surgery of the Hand (BSSH) guidelines. 334,211 hand surgical procedures were performed throughout England of which there were 13 DVT and 27 PE events. These events were seen in patients with pre-existing comorbidities. The annual incidence of VTE is 0.006% at most in hand surgical patients in England. The cost of implementing mechanical VTE thromboprophylaxis to all patients having hand surgery would amount to £6,336,641 over 2 years. The cost of treatment for all VTE events would amount to £20,418. VTE prophylaxis is probably not necessary in patients undergoing isolated elective or trauma hand surgical procedures.

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Introduction

Venous thromboembolic (VTE) events comprise two pathological entities: deep venous thrombosis (DVT) and pulmonary embolism (PE). The reported annual incidence of VTE events in the general population is difficult to establish. Epidemiological studies from the Unites States estimate the annual incidence to range from 43.7 to 145 per 100,000 for DVT and 20.8 to 69 per 100,000 for PE [1–6]. The incidence has been shown to be similar in two European studies conducted in France [7] and Sweden [4]. Orthopaedic surgery and treatments that result in reduced patient mobility have been shown to increase the risk of VTE events [8].

Reilly and colleagues have demonstrated an 8.9% incidence for DVT, and 1.2% for symptomatic PE following total hip replacements (THR) and a 25.6% incidence of DVT and 2.8% for symptomatic PE following total knee replacements (TKR) at 7 days despite both chemical and physical prophylaxis. All patients had bilateral ultrasound scans following these procedures and it is not clear how many DVTs were symptomatic [9]. Bjørnarå and colleagues demonstrated the incidence of symptomatic DVT and non-life-threatening PE, to be 1.3% and 1.2%, respectively, following a THR and 1.6% and 0.65%, respectively, post TKR despite in-hospital administration of chemical and physical prophylaxis [10].

Although an increase in incidence has been established in VTE events in lower limb surgery, there have not been any epidemiological studies of VTE events after hand surgery and even those for other upper limb procedures are limited [11–13]. The risk of PE following shoulder arthroplasty has been shown to range from 0.2% to 2% with a mortality rate of 1% [14] and the risk of VTE following arthroscopic shoulder surgery is thought to be very low [15]. A review by Roberts [16] in 2014 attempted to quantify VTE rates in hand and wrist surgery by searching the literature for relevant case reports and case series. As VTE was not reported very often following hand and wrist surgery they concluded that the overall risk was likely to be very low.

Despite chemical thromboprophylaxis demonstrating a reduction in the risk of symptomatic DVT and PE following THRs, the overall benefit in reducing fatal PE and overall mortality has not been established [17]. Furthermore, VTE events still occur despite the implementation of various forms of thromboprophylaxis or adherence to national or institutional guidelines [9,13,18].

.In December 2014, the National Institute of Clinical Excellence in England issued an update to their VTE guidelines. This does not recommend the routine use of VTE prophylaxis for upper limb surgery unless patients are deemed to be at increased risk [19]. The British Society for Surgery of the Hand (BSSH) has also published guidelines for all patients undergoing hand surgery [20]. There is very limited evidence around VTEs in hand surgery and published guidelines usually use evidence from studies looking at risks from lower limb surgery [21]. The aim of our study was to investigate the recorded incidence of VTE events in elective and trauma hand surgery.

Materials and methods

Assessment of nationally reported VTE episodes following hand surgery

Data for adult patients (aged >18 years) who had been recorded as having a VTE event were collected from the administrative hospital admissions database (Hospital Episode Statistics [HES]) for the financial years of 2010/2011 and 2011/2012. This was combined with the Healthcare Resource Group (HRG) data for elective and emergency hand surgery to provide the incidence of VTE events in this group of patients.

HES incorporates all admissions to English NHS hospitals as well as treatment centres and includes 20 diagnostic fields

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(codedby use of the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) codes). The ICD-10 codes for DVT and PE fall into the I-82 and I-26 categories respectively.

HRGs are standard groupings of clinically similar treatments which use comparable levels of healthcare resource. HRGs are used as a means of determining fair and equitable reimbursement for care services delivered by healthcare providers and supports standardised healthcare commissioning across the service. Hand trauma procedures are coded under HRG codes HA5 with elective hand surgery being coded as HB5 (Table 3).

The HES data for all patients who had undergone hand surgery over the 2 years investigated was further scrutinised to identify VTE risk factors. These consist of obesity, cancer, thrombophilia, oral contraceptive use and varicose veins. Past history of VTE, family history of VTE and blood disorders are not coded separately in HES data and therefore could not be included.

The VTE episodes and hand surgical procedures are not linked events. The VTE events recorded may therefore be unrelated to the surgical procedure. These may have occurred prior to the surgery or even several months later. An assumption that was therefore made was that the VTE events were linked and related to the hand surgical procedure.

Assessment of local VTE rates following hand surgery

The VTE data from our institution for the years 2010–2012 was obtained. This is maintained on a prospective database, which contains information on all patients referred for a suspicion of a venous thromboembolic event and maps them to the relevant HRG procedural codes the event may be related to. This thereby enabled the identification of any patients who may have had a VTE episode directly linked to hand surgical procedures, providing a local incidence of VTE events for this select group of patients.

To ensure that no patients were missed due to errors in coding, the above database was cross-referenced with an independent prospective database consisting of all elective hand surgical procedures performed within our institution. The dates of the VTE and surgery were then linked and a VTE event was coupled to the procedure only if it occurred within 90 days following the surgical procedure. This data was used to corroborate the HES data above. Diagnosis of VTE at the treating institution is made with Doppler ultrasound for DVTs and CT pulmonary angiogram for PEs.

Assessment of costs

A further assumption was such that the HRG categories for major and intermediate hand procedures were performed under a general anaesthetic and were of more than 90 min duration. According to the BSSH guidelines, this would categorise these patients as being at least of 'moderate risk' and recommend the use of 'mechanical compression devices in the operating room and until mobile'. The local costs of anti thromboembolic device stockings (TEDs) and intermittent calf compression devices (ICCDs) were applied to this group of patients, based on the HES data, to obtain the costs of implementing mechanical VTE prophylaxis. The cost of TED stockings according to NICE is £11.72 per pair. There is no costing for intermittent calf compression devices (ICCDs) provided within this document. However, the local cost in our trust for TED stockings is £3.23 per pair, and that for ICCDs are £15.73 for a medium and £19.45 for a large pair. This cost does not include the nursing cost of measuring and application of these devices.

Table 1. Unit costs for diagnostic investigations [19].

Investigation	HRG Code	£[a]
Computed tomography scan – one area with post contrast	RA09Z	108
V/Q planar scan – nuclear medicine (category 2)	RA36Z	178
V/Q SPECT scan – nuclear medicine (category 3)	RA37Z	249
X-ray – diagnostic imaging[b]	812	33
Ultrasound scan less than 20 min	RA23Z	47
Blood tests – haematology (excluding anticoagulant services)[c]	DAP823	3

[a]Tariff based on 2013/14 Road Test Tariff Information – unbundled Services (direct access services). The tariff includes the cost of reporting.
[b]National Schedule of Reference Costs Year: 2011–12 – all NHS trusts and NHS foundation trusts – outpatient attendances data.
[c]National Schedule of Reference Costs Year: 2011–12 – NHS trusts and NHS foundation trusts. Direct Access: pathology services.

Table 2. Non-elective inpatient spell tariff [19].

Investigation	HRG code	£[a]
Pulmonary embolus with major comorbidities complications (CC)	DZ09A	2861
Pulmonary embolus with CC	DZ09B	1549
Pulmonary embolus without CC	DZ09C	1549
Deep vein thrombosis	OZ20Z	554

[a]Tariff based on 2013/14 Road Test Tariff Information – admitted patient care & outpatient procedures.

The costs of the investigation for VTE and implementation of treatment, again according to HES data, was also calculated using the 'NICE support for commissioners using the quality standard for diagnosis and management of venous thromboembolic diseases' guidelines published in March 2013 (Tables 1 and 2) [22]. This enabled a cost comparison of prophylactic treatment versus therapeutic treatment of a VTE event. Institutional review board approval was not required for this study.

Results

Assessment of national reported VTE episodes following hand surgery

During the financial year of 2010/2011 and 2011/2012, 332,211 hand surgical procedures were performed. This consisted of 71,062 trauma cases (of which there were no recorded cases of DVT and 1 PE) and 262,149 elective procedures with 13 recorded DVTs and 26 pulmonary embolic events. The mean annual incidence of VTE for these two financial years in patients who underwent hand surgery is shown in Table 3 and was 0.004% for DVT and 0.008% for PE.

Of the total 334,211 hand surgical procedures performed, 245,532 patients did not have any risk factors and none of these patients had a VTE event. 82,192 patients had 1 risk factor and of these, there were 11 DVTs and 25 PEs. 6456 patients had 2 risk factors which included 2 cases of DVT and 2 cases of a PE. Finally, 31 patients had 3 risk factors of which there were no recorded episodes of a VTE event.

5507 of the 334,211 cases were coded for obesity of which there was only one case of a DVT and none of a PE. 1661 patients had a code for cancer of which there was only a single case of a PE and no DVT cases. 140 cases were coded for varicose veins of which there was 1 DVT and 1 PE.

All patients who had a VTE (13 DVT and 27 PE) over the two years investigated had an underlying medical illness consisting of an endocrine or metabolic disorder, cardiac disease and/or

respiratory disease. Table 4 demonstrates the procedures linked to a VTE episode.

Assessment of local VTE rates following hand surgery

The local VTE database failed to identify any cases of VTE events related to hand surgical procedures. When this database was cross-referenced to the elective hand surgical database for the financial years 2010/2011 and 2011/2012, of a total of 1499 elective procedures, 6 cases of DVT and 3 PE were identified. One DVT had in fact occurred before surgery and 5 DVTs more than a year following surgery. All PE events occurred more than 6 months following the surgical procedure. All VTE events in this group of patients were therefore not related to the surgical procedure.

Table 3. HRG codes for elective and trauma hand surgery along with example procedures with total number of cases and frequency of VTE events for hand trauma (HA) and elective hand (HB) surgery over the financial years 2010/2011 and 2011/2012.

HRG codes (example procedures)	Number of cases	DVT	PE
Trauma hand surgery			
HA51 (intra-articular/fracture dislocation ORIF)	8990	0	0
HA52 (reimplantation, reconstruction ligament)	3381	0	0
HA53 (amputation, repair of tendon)	20,867	0	0
HA54 (application of internal fixation)	17,873	0	1
HA55 (primary reduction ± ORIF Small bone)	11,030	0	0
HA56 (closed reduction or manipulation)	9921	0	0
Elective hand surgery			
HB51 (prosthetic replacement joint, etc.)	14,202	0	0
HB52 (synovectomy, reconstruction of joint)	3439	0	0
HB53 (palmar fasciectomy, revision carpal tunnel)	24,700	1	1
HB54 (excision of bone, carpal tunnel + co-morbidities)	29,773	2	2
HB55 (carpal tunnel, joint injection)	169,234	9	20
HB56 (Injection into tendon or bursa)	20,801	1	3

Codes ending with a 51 or 52 are for major hand procedures, 53 or 54 are for intermediate procedures and 55 and 56 for minor procedures.

Table 4. Surgical procedures linked to a VTE episode from HES data.

Procedure	Frequency of VTE episodes
Carpal tunnel release	14
Trigger finger release	1
De Quervain's release	1
Excision of ganglion	1
Joint aspiration	8
Dupuytren's fasciectomy	2
Washout	1
Amputation of digit	6
ORIF	1
Crush injuries	3
Miscellaneous	2

Assessment of costs

The cost of implementing mechanical VTE thromboprophylaxis at local rates quoted above to all HRG coded hand surgical procedures are shown in Table 5.

Over the two financial years, HES data identified there to be 13 DVT and 27 PE events. According to the costs provided by the NICE commissioning document (Table 1) [22], the costs of investigation and treatment of these groups of patients are demonstrated in Table 6. The total cost of treatment excluding outpatient follow up would amount to £5811 for the treatment of all the DVT events and £14,607 for the treatment of all PE events.

Discussion

The annual presence of VTE in patients who have undergone elective and trauma hand surgery is 1.94 per 100,000 for DVT and 4.04 per 100,000 for PE. Clinical practice should be evidence-based. This involves the use of the best available evidence as well as individual professional judgement to aid clinical decision making. The available evidence with regards to VTE episodes following hand surgery is absent. From local results, it is also our personal experience that the incidence of VTE events following hand surgery is negligible.

Guidelines are a valuable tool to enable standardised care to be delivered. They also protect clinicians should adverse events occur. The incidence of VTE events following hand surgery is very low and much below that of the general population as shown in epidemiological studies [1–7]. Furthermore, the majority of guidance is aimed at patients in whom mobility may be impaired. Following hand surgery, mobility is unlikely to be impaired unless in the multiple-injured patient.

Seven VTE (3 DVT and 4 PE) episodes occurred in HRG coded intermediate procedures, with the remaining 33 (10 DVT and 23 PE) in minor hand surgical procedures including carpal tunnel decompressions, trigger finger release, De Quervain's release and joint aspirations. These minor hand procedures are likely to have been performed under local anaesthesia, and therefore despite their co-morbidities, under current BSSH guidelines, no thromboprophylaxis would have been required. Comparatively fewer VTE events occurred in the intermediate group than in the minor surgery group and none occurred in the major procedure group.

Table 5. Cost of implementing mechanical VTE thromboprophylaxis based on HES data for 2010/2011 and 2011/2012.

HRG Code	Total number of patients	TED stockings	ICCD	Cost of combined mechanical VTE prophylaxis
HA51	8990	29,038	141,413	170,450
HA52	3381	10,921	53,183	64,104
HA53	20,867	67,400	328,238	395,638
HA54	17,873	57,730	281,142	338,872
HA55	11,030	35,627	173,502	209,129
HA56	9921	32,045	156,057	188,102
HB51	14,202	45,872	223,397	269,270
HB52	3439	11,108	54,095	65,203
HB53	24,700	79,781	388,531	468,312
HB54	29,773	96,167	468,329	564,496
HB55	169,234	546,626	2,662,051	3,208,677
HB56	20,801	67,187	327,200	394,387
Total	334,211	£1,079,502	£5,257,139	£6,336,641

Costs based on local prices and exclude nursing costs of measuring and application. Local cost of TED stockings £3.23 per pair and £15.73 for medium ICCD, total cost of £18.96 per case.
VTE: venous thromboembolism; HES: hospital episodes statistics; HRG: health resource group; TED: thrombo-embolic-deterrent Stocking; ICCD: intermittent calf compression device.

Table 6. Cost of treatment of the VTE event.

VTE event	No of patients	Investigations				Treatment	Total cost (£)
		Blood tests (£3)	USS (£47)	CXR (£33)	CTPA (£108)	Rivoroxaban (£397)	
DVT	13	£39	£611			£5161	£5811
PE	27	£81		£891	£2916	£10,719	£14,607
Total		£120	£611	£891	£2916	£15,880	£20,418

VTE: venous thromboembolism; USS: ultrasound Scan; CXR: chest X-ray; CTPA: commuted tomography pulmonary angiogram; DVT: deep vein thrombosis; PE: pulmonary embolism.

This may in part be because the number of patients undergoing minor procedures was higher than those undergoing intermediate and major procedures. It may also be that the length of surgery may not have as large an impact on VTE risk in mobile hand surgery patients when compared to those patients undergoing lower limb surgery. The cost of implementing mechanical thromboprophylaxis for all patients in the intermediate and major procedure group was calculated as £2,236,346 with limited supporting evidence which places financial pressure on an already overburdened National Health Service in England.

If it is suggested that all patients undergoing surgery of the hand be given mechanical prophylaxis, then the cost burden would be £1,079,502 for TED stockings and £5,257,139 for medium-sized ICCDs over a period of 2 years on an incidence of VTE which is far less than that occurring spontaneously in the general population. The cost of treatment of these events, should they occur, would be £20,418 over the 2-year period.

Risk factors that are traditionally associated with VTE do not appear to be cumulative. The majority of patients who developed a VTE had only one risk factor with further risk factors not appearing to increase the prevalence of VTE events. This needs to be interpreted with caution due to the low number of VTE events in our study population. This is in contrast to the current guidelines, where the presence of more than one risk factor alongside a procedure performed under GA lasting more than 90 min places a patient as 'high risk'. We appreciate that family history and blood disorders were excluded as they are not coded on current HES data and this is an important limitation of the study. The patient-level analysis was also not possible on the national database as individual patients could not be identified.

It was noted that all patients who had a VTE event had co-existing medical problems, whether this is cardiac, respiratory, endocrine, or metabolic. It may therefore be that these co-morbidities should be given more weight when assessing the risk of VTE events as opposed to the traditional risk factors or anaesthetic regime.

Only mechanical thromboprophylaxis measures have been discussed. Chemical regimes are infrequently used in upper limb surgery unless in extremely high-risk patients. The implications of chemical thromboprophylaxis following hand surgery are not insignificant and include risk of bleeding, haematoma formation, subsequent infection, flap failures and algodystrophy. Chemical thromboprophylaxis should be approached with caution, but if it cannot be avoided then a careful risk assessment can reduce the bleeding risk.

The limitations of this study are acknowledged. The HES data analysed does not provide time references between the surgery and VTE events. It may therefore be that the VTE episodes occurred prior to the treatment in question or even several months following this. However, for the purpose of this analysis, it has been assumed that the VTE episode in these patients was related to the procedure. This is likely to exaggerate the frequency of VTE events should this not be the case. If this assumption is incorrect, then the rate of VTE events would be even lower and the findings would still be credible.

This analysis is also based on recorded data and therefore coding error would have significant implications. It has been shown that approximately 16% of hospital records are miscoded [23]. However, with the cost implications to trusts as well as the significant limitations in resources, one would hope that the coding practices are being audited and corrected. We had reviewed data of 2010/2011 and 2011/2012, with the hope that any errors in coding would have been rectified by individual trusts.

Local trust data was also scrutinised. Although VTE events were identified, these all occurred more than 6 months following the procedure. The cumulative risk for VTE following hand surgery is unknown. However, Bjørnarå et al. [10] have shown the cumulative risk of venous thromboembolism lasted up to three months following hip surgery and one month after a total knee replacement. It is therefore unlikely that the cumulative risk for hand surgery exceeds this and therefore the local VTE rates are not related to the hand operations performed.

The national data were extracted and analysed from 2010 to 2012, which was prior to the updated BSSH recommendations. The data is therefore not likely to have been affected by changes in practice as a result of the new guidelines. It is also evident from the HRG categories of patients who suffered a VTE event that most of these patients may not have been helped by their recommendations.

The data also does not allow for the assessment of what measures were implemented for VTE prophylaxis, if any, as well as the mode of anaesthetic employed during surgery. It is our hope that this study can add to the body of evidence around VTE in hand surgery and guide future development of guidelines.

The risk of a VTE event around hand surgery is likely to be very small. The duration of the procedure does not appear to be related to an increase in the incidence of VTE episodes. The current guidelines for prophylaxis in hand surgery may benefit from an update and perhaps more emphasis placed on co-morbid factors as opposed to surgical factors that may increase risk. The current evidence would suggest that VTE prophylaxis is not routinely required in patients undergoing isolated elective or trauma hand surgery, but it may be considered for those patients deemed to be at high risk.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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