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# Marked Variation in Venous Thromboprophylaxis Management for Abdominal Aortic Aneurysm Repair; Results of Survey Amongst Vascular Surgeons in the United Kingdom

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**KEYWORDS**
Abdominal aortic aneurysm;
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DVT;
Thromboprophylaxis;
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**Abstract** *Objectives:* We aimed to survey the current management of venous thromboprophylaxis in patients undergoing elective surgery for abdominal aortic aneurysm (AAA) by vascular surgeons in the United Kingdom.
*Design:* A questionnaire was designed to investigate anticoagulation strategies in the perioperative period of elective AAA repair, both open and endovascular. This included both chemical and mechanical prophylaxis. A total of 395 questionnaires was posted to the members of the Vascular Society of Great Britain and Ireland.
*Results:* One hundred and seventy-two (44%) valid responses were received. Half of the respondents administered pre-operative chemical prophylaxis at a mean of 13 h prior to AAA surgery. There was a high level of concordance in administration of heparin during surgery and in thromboprophylaxis post-operatively, with 97% giving some form of thromboprophylaxis. However there was a variation in the dose and timing, if administered, of chemical and mechanical prophylaxis.
*Conclusion:* The survey revealed diversity in perioperative thromboprophylaxis strategies among vascular surgeons. This suggests that standardisation of pre-operative and post-operative mechanical and chemical thromboprophylaxis may be required which could potentially improve the outcomes in elective management of AAA in the UK.
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## Introduction

Abdominal aortic aneurysm surgery is being performed with progressively lower operative mortality and morbidity rates.[1] The current mortality rate in the UK is 7% which is nearly double the mortality rates in the rest of Europe.[2] The proportion of patients dying from venous thromboembolism (VTE) following AAA surgery is not known. The reported incidence of DVT in aortic aneurysm surgery varies from 2% to 24%.[3–6] There are no set guidelines regarding perioperative DVT prophylaxis, apart from use of heparin during the actual aneurysm repair procedure.[9] However there are a few studies that have looked at the incidence of DVT in AAA repair. The incidence of DVT in aortic surgery was specifically addressed by several studies, three of which were randomised.[5,7,10] Killewich et al.[5] reported an incidence of 2% in both control and anti-coagulant groups, while Belch et al.[7] estimated a DVT incidence of 24% in the control group. However, the latter study was not completed because of significant haemorrhagic complications. Both studies used ultrasound examination of legs post-operatively to identify DVT. A Cochrane analysis of all non-randomised prospective studies in aortic surgery identified an average incidence of 9.2% among patients without DVT prophylaxis.[9] The incidence was 2.6% if calf DVT was excluded. Although a reduced risk would be anticipated after EVAR, the incidence of femoral or popliteal DVT after endovascular repair was 6% among 50 patients examined by Duplex ultrasonography.[3] Consistent with these findings, de Maistre et al.[11] recently reported an incidence of lower extremity DVT of 10.2% after surgical repair and 5.3% after EVAR ($P = 0.28$), despite prophylaxis with thigh-length compression bandages or stockings, early mobilization, and daily subcutaneous injection of low-molecular weight heparin beginning in most patients within the first day after open surgical repair or EVAR.

Therefore DVT after open AAA repair perhaps appears to be underappreciated.[3]

The perceived low risk of DVT in aortic surgery has been generally attributed to the routine use of intra-operative heparin which is thought to be the peak time for any clot formation.[8,14]

Our objective was to assess the current practice among vascular surgeons on managing the risk of venous thromboembolism in patients undergoing elective surgery for abdominal aortic aneurysm.

## Methods

A self-reporting questionnaire was designed to determine the common approaches in DVT prophylaxis, alike an earlier survey.[14] The questionnaire covered pre-operative initiation, intra-operative and post-operative periods and looked at both mechanical and chemical means of thromboprophylaxes. It was mailed once without reminder to 395 practising UK members of the Vascular Society of Great Britain and Ireland (VSGBI) in November 2010.

Further details included the types of agents used, their dose and mode of administration. Responses were anonymous and the data was processed and analysed using the Statistical Package for Social Sciences (SPSS) version 17.0 (SPSS Inc. Chicago, IL, USA, 2007).

## Results

A total of 175 completed questionnaires were received back in eight weeks, making a response rate of 44%. Three surgeons returned it unfilled because they did not perform major arterial surgeries.

The practice of VTE prophylaxis was analysed in pre-, intra- and post-operative phases. Whilst half (50%) of the respondents started patients on low-molecular weight heparin (LMWH), there was wide variation at the time of initiation prior to surgery. Eight surgeons reported admitting patients on the day of surgery as the reason for not initiating VTE prophylaxis pre-operatively. The majority (69%) use enoxaparin and further details are shown in Table 1. The majority of surgeons (48%) were found to anticoagulate their patients 12 h prior to surgery (see

**Table 1** Pre-operative coagulation prophylaxis in AAA surgery.

| | Number of respondents ($n = 172$) |
|---|---|
| | *n* (%) |
| Routinely initiate prophylaxis | 86 (50) |
| Of those who apply pre-operative coagulation prophylaxis: | |
| Drug/Dose/IU Heparin | |
| Dalteparin | 16 (19) |
| 2500 | 5 (31) |
| 5000 | 11 (69) |
| Enoxaparin | 59 (69) |
| 2000 | 11 (19) |
| 4000 | 48 (81) |
| Tinzaparin | 11 (13) |
| 3500 | 1 (9) |
| 4500 | 10 (91) |

IU = International Unit.

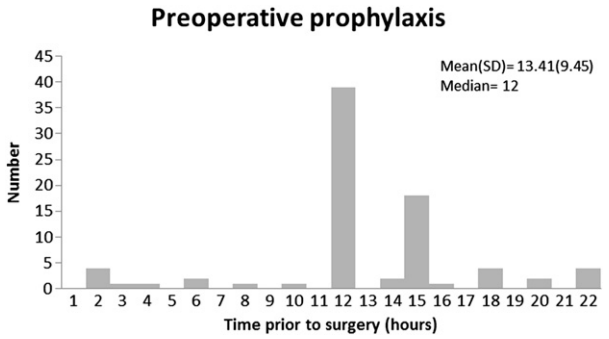


**Figure 1** Time of initiation LMWH thromboprophylaxis before surgery.

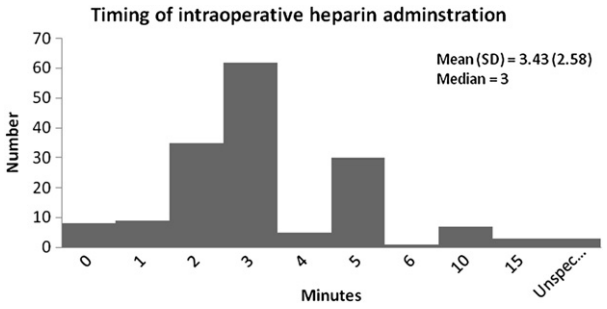


**Figure 2** Time interval between IV heparin administration and aortic cross clamping.

Fig. 1). Of the 172 surgeons who routinely perform AAA surgery, 33 (19%) apply TEDS to patients prior to AAA surgery.

Out of the 172 respondents, 164 (95%) reported that they routinely administer heparin intravenously (IV) during elective AAA open repair. 149 surgeons reported doing elective AAA endovascular repair (EVAR) in their department of whom 129 (87%) administer heparin during elective EVAR. Out of the 164 surgeons who routinely administer intravenous heparin during AAA open repair, 108 (74%) use a fixed dose of 5000 IU while 38 (26%) alter the dose according to body weight. Six surgeons did not specify the heparin dose they use. In the case of EVAR, 98 surgeons out of 129 (76%) use the 5000 IU dose open repair, with the remaining surgeons using a different dose (see Table 2). The majority of surgeons (97%) opt for the intravenous route, by requesting the anaesthetist to administer the drug. Two surgeons (1%) reported direct injection into the sac while another 2 (1%) flushes the distal vessels by direct irrigation of the common iliac arteries. One surgeon uses both the intravenous and the distal flushing technique.

Fig. 2 shows the time interval between Heparin administration and aortic cross-clamping among the 164 surgeons who administered heparin. Ninety-nine surgeons (68%) do not reverse the heparin on completion of the procedure, while 16 surgeons (11%) administer protamine routinely and 31 surgeons (21%) use reversal in cases with bleeding. Of the 164 surgeons who routinely administered heparin during elective AAA open repair, 34 (21%) apply pneumatic calf pumps during surgery. Similarly, out of the 146 surgeons who routinely administer Heparin during elective EVAR, 19 (13%) apply pneumatic calf pumps during surgery.

Post-operatively, 167 (97%) respondents routinely administered low-molecular weight heparin after surgery (Table 3). All administered the LMWH via subcutaneous route and first dose is administered at varying post-operative intervals as illustrated in Fig. 3. Five surgeons (3%) reported that they initiate Heparin at a variable time depending on the coagulation status. Out of 149 surgeons, 141 (85%) discontinue heparin at discharge while the remaining eight surgeons discontinue VTE prophylaxis 2—21 days after surgery. Mechanical prophylaxis is applied, by means of thromboembolic deterrent (TED) stockings, prior to surgery by 33 out of 172 (19%) surgeons, and this mode of VTE prophylaxis rises to 85 out of 172 (49%) post-surgery.

## Discussion

The survey reveals that there is a wide variation in the VTE prophylaxis management by the vascular surgeons in the UK. This is not confined to any particular phase of surgery. In addition to the variation in the general principles of VTE prophylaxis, details of management such as dosing, initiation time, termination time and modality & time of application of mechanical prophylaxis also vary widely. Albeit a low response rate, the survey reveals that there is

**Table 2** Coagulation prophylaxis during abdominal aortic aneurysm surgery.

| | Number of respondents ($n$ = 172) | |
|---|---|---|
| | Open repair ($n$ = 164) | Endovascular repair ($n$ = 150) |
| | $n$ (%) | $n$ (%) |
| Routinely administer IV Heparin during surgery | 164 (95) | 146 (85) |
| Dose/IU Heparin | | |
| 2000 | 4 (3) | 1 (1) |
| 3000 | 20 (14) | 20 (15) |
| 3500 | 2 (1) | 2 (2) |
| 4000 | 6 (4) | 3 (2) |
| 5000 | 108 (74) | 98 (76) |
| 6000 | 2 (1) | 2 (2) |
| 7000 | 1 (1) | — |
| Not specified | 3 (2) | 3 (2) |

**Table 3** Post-operative coagulation prophylaxis in abdominal aortic aneurysm surgery.

| | Number of respondents ($n$ = 172) $n$ (%) |
|---|---|
| Routinely administer heparin after surgery | 167 (97) |
| Drug/Dose/IU heparin | |
| Dalteparin | 32 (19) |
| 2500 | 8 (25) |
| 5000 | 24 (75) |
| Enoxaparin | 110 (66) |
| 2000 | 22 (20) |
| 4000 | 88 (80) |
| Tinzaparin | 23 (14) |
| 3500 | 4 (17) |
| 4500 | 20 (87) |
| Heparin sodium | 1 (1) |

variation in VTE prophylaxis among the respondents. There does not seem to be a selection bias related to this low response rate because the distribution of practice reported was relatively equal in pre-operative chemical prophylaxis and post-operative mechanical prophylaxis. However we accept that this cannot be confirmed without knowing what the remaining surgeons would have reported. The study however does reveal considerable variation in clinical practice in this area.

Overall, most patients undergoing EVAR can be considered at moderate to high risk for DVT, given advanced age, duration of surgery >45 min, and the increasing prevalence of obesity.[12]

The VSGBI or Cochrane review does not provide any recommendations in this area due shortage of good evidence to support such recommendations. The Society of Vascular Surgery recommends DVT prophylaxis consisting of intermittent pneumatic compression and early ambulation is recommended for all patients undergoing AAA repair or EVAR.[12] The Society also incorporate guidelines suggesting patients at high risk (e.g. prior history of DVT/pulmonary embolism [PE], obesity [BMI >25], limited mobility status, malignancy) should receive either LMWH (enoxaparin 40 mg SC once a day) or unfractionated heparin (5000 IU SC two or three times a day) initiated within 24 h at the discretion of the treating surgeon. If a high-risk patient has a history of renal insufficiency, unfractionated heparin (5000 IU SC twice a day) is preferred, which is also favoured for those patients who have an epidural catheter.[12] This is in contrast to what is recommended in e.g. the summary of product characteristics for enoxaparin, which states: "In patients with a low to moderate risk of venous thromboembolism the recommended dosage is 20 mg (2000 IU) once daily by subcutaneous injection for 7–10 days, or until the risk of thromboembolism has diminished. In patients with a higher risk, such as in orthopaedic surgery, the dosage should be 40 mg (4000 IU) daily by subcutaneous injection with the initial dose administered approximately 12 h before surgery".[13]

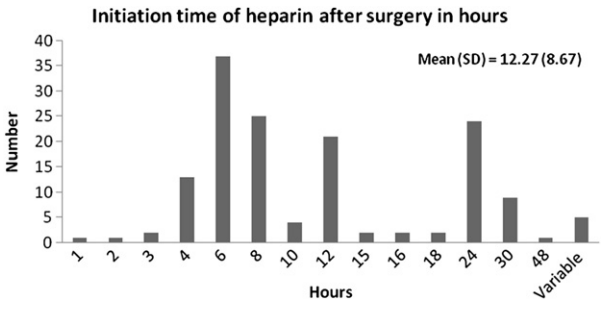


**Figure 3** Time of initiation LMWH thromboprophylaxis after surgery.

The reported incidence of DVT in orthopaedic procedures such as after total knee arthroplasty (TKA) and total hip arthroplasty (THA) without prophylaxis is 40%–84%[17] and 40%–70%, proximal DVT 8%–24%[17] and 10%-20%, clinical DVT 7%–11% and 1%-3%, non-fatal symptomatic pulmonary thromboembolism 1.2%–3% and 1%–2%, and fatal pulmonary thromboembolism 0.1%–1.1% and 0.1%–1% respectively.[18–22]

While the majority of surgeons who administer pre-operative LMWH initiate the therapy approximately 13 h prior to surgery, there are surgeons giving this within shorter time frames. DVT is believed to start in the pre-operative period especially from the time of induction and therefore post-operative initiation may not be effective as demonstrated by the study performed by de Maistre et al.[11] It is logical to think that though calf compression is effective in preventing DVT while there is sluggish venous flow in the perioperative period, its safety and effectiveness when the inflow into the legs are markedly diminished as in aortic surgery will need further study before recommendation.

In the light of evidence from various trials in different surgery specialties, mechanical thromboprophylaxis is possibly not applied optimally by vascular surgeons performing AAA surgery. A Cochrane review of eight randomised controlled trials highlighted that graduated compression stockings alone, when applied before or on day of surgery can significantly reduce the incidence of DVT from 26% to 13% as measured predominantly by $I^{125}$ uptake. However, the evidence was gathered from various types of surgery and not all studies showed a reduction in DVTs.[15] One prospective randomised trial on joint arthroplasty patients showed no reduction in DVT incidence when stockings were used,

even though stockings were worn by patients from the day before surgery.[16]

Compared to the pre-operative 50:50 split in treatment preference, there is a general agreement with the necessity of post-operative prophylaxis as 97% of repairs received LMWH, mostly enoxaparin at 4000 IU subcutaneously. However, further studies to look at the best practice in the areas of both mechanical and chemical thromboprophylaxis could potentially improve or give clarification on the likely outcomes in elective aortic surgery.

Until all these questions are answered DVT prophylaxis in vascular patients will continue to be guided by evidence of prophylaxis gained from studies of general surgical patients. Of the three phases of anticoagulation, the least concordance is present for pre-operative anticoagulation management whereas the majority of vascular surgeons take a similar approach to intra- and post-operative venous thromboprophylaxis.

There is variation in the management of VTE prophylaxis in elective AAA surgery in the UK. This may be one area needing more evidence-based practice to potentially improve the outcomes from this surgery.

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## Conflict of Interest

None of the authors have any conflicting interests to declare.

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