

# **Bridging Anticoagulation: The Peri-Procedural Management of Patients on Oral Anticoagulants**

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## INTRODUCTION

When patients on anticoagulation require surgery or an invasive procedure, the risks and benefits of stopping or continuing anticoagulation must be considered. In many cases it is necessary to stop the oral anticoagulant (most commonly warfarin) and replace it with low molecular weight heparin (LMWH) until after the procedure. This is known as “bridging anticoagulation”.

## SITUATIONS COVERED BY THIS GUIDELINE

**This guideline provides recommendations for the management of peri-procedural anticoagulation for patients on warfarin, acenocoumarol (Sinthrome®), phenindione (Dindevan®), apixaban (Eliquis®) dabigatran (Pradaxa®), edoxaban (Lixiana®), or rivaroxaban (Xarelto®), who need interruption of anticoagulant therapy (with an INR of less than 1.5 if on warfarin, acenocoumarol or phenindione) for a procedure. Additional advice may be required from a haematologist regarding acenocoumarol or phenindione.**

Management of peri-operative antiplatelet therapy is beyond the scope of this guidance but some pragmatic guidance can be found [here](#).

**This guideline does not cover the management of the following groups of patients:**

- **Pregnant patients:** advice should always be sought from an Obstetrician or Haematologist
- **Endoscopy patients:** see separate endoscopy guidance
- **Bronchoscopy patients:** see [link](#)

This document provides guidance only. In all cases, the risks of stopping anticoagulant therapy to prevent procedure related bleeding must be balanced against the risk of a further thromboembolic event. **If there are any uncertainties/concerns regarding these recommendations, discuss with a haematologist.**

Throughout this guideline, the terms “Standard risk” and “High risk” refer to a patient’s thrombotic risk.

**GPs should not be asked to prescribe or monitor bridging anticoagulation**

## PRE-OPERATIVE ASSESSMENT AND MANAGEMENT

Assessment of elective patients should be carried out at pre-operative assessment clinic. Where the procedure does not warrant a formal pre-operative assessment, the clinician ordering the procedure should ensure that the guidance is followed.

Certain procedures **may** be done whilst on therapeutic anticoagulation – see appendix 1 for further guidance.

If anticoagulation is to be interrupted, patients will need to be given clear instructions about when to take their last dose of anticoagulant.

1. **Pre-op assessment: assess whether anticoagulation needs to be interrupted for the procedure.** Certain procedures **may** be done whilst on rivaroxaban, dabigatran, apixaban and warfarin with an INR of less than 3.0 – see appendix 1 for further guidance.
2. **If anticoagulation needs to be interrupted, determine whether a patient is in the Standard risk or High risk category** (see appendix 2 for criteria for stratification of thrombotic risk).
3. **Certain patients should be discussed with senior clinicians before commencing bridging:**
  - 3.1. **Patients who are at particularly high risk of thrombosis** should be discussed with the senior clinician and anaesthetist involved:
    - 3.1.1. patients with a venous thrombosis in the last 3 months
    - 3.1.2. patients with recent stroke (within the previous 6 months)
    - 3.1.3. patients with a left-ventricular assist device
    - 3.1.4. patients within 1 month of a bare-metal stent insertion or 3 months of a drug-eluting stent insertion
  - 3.2. **Procedures which carry a very high bleeding risk:** these patients can follow the pre-operative bridging guideline but post-operative bridging may need to be individualised (e.g. spinal surgery, radical prostatectomy).
  - 3.3. **Patients with antithrombin deficiency** should be discussed with a haematologist as treatment with antithrombin concentrates may be required.
  - 3.4. Where there is uncertainty about the management of any patient, discuss with the senior clinician and anaesthetist involved.
4. Patients without any complicating factors (e.g. renal impairment, weight greater than 150kg, etc) should follow the treatment plans as described in appendix 3 (Standard risk), appendix 4 (High risk) and appendix 5 (cancellation of surgery).
5. Patients on therapeutic treatment with LMWH should have their dalteparin discontinued at least 24 hours prior to surgery.
6. **“High risk” patients who are expected to require epidural/spinal anaesthesia or analgesia for more than 48 hours post-operatively** should be considered for an alternative method of analgesia, as high dose dalteparin is incompatible with safe removal of epidural catheters. If no other mode of anaesthesia/analgesia is suitable, the patient must be discussed with a haematologist.
7. **Patients with renal impairment**
  - 7.1. **Standard risk patients should have doses reduced if eGFR is less than 20ml/min/1.73m<sup>2</sup>.**
  - 7.2. **High risk patients should use IV unfractionated heparin if their calculated creatinine clearance is less than 30ml/min/1.73m<sup>2</sup>.** These patients should be discussed with a haematologist before bridging is commenced. Renal function for high risk patients should be estimated using the following calculation:

$$(140 - \text{age}) \times \text{weight (kg)} \times 1.04 (\text{female})$$

$$\text{CrCl} = \frac{\text{-----}}{\text{Serum Creatinine (micromol/L) } \text{---}} \times 1.23 \text{ (male)} = \text{---} \text{ (mL/min)}$$

**7.3 Patients on apixaban, dabigatran, edoxaban or rivaroxaban with renal impairment should be managed according to the guidance below.**

8. Patients weighing more than 150kg should follow the treatment plans described in appendix 3 (Standard risk), appendix 4 (High risk) and appendix 5 (cancellation of surgery).
9. **If surgery is cancelled, see advice in appendix 5.** It is the responsibility of the person cancelling the patient to inform pre-assessment clinic staff as patients will need advice regarding their bridging therapy.

## PRE-OPERATIVE & POST-OPERATIVE MANAGEMENT OF PATIENTS TAKING VITAMIN K ANTAGONISTS (warfarin, acenocoumarol (Sinthrome®) or phenindione (Dindevan®))

### Pre-Operative Management:

#### Pre-operative investigations

- A full blood count must be taken in the week prior to surgery (this may be performed at the same time as the pre-op INR). If the patient has acute or chronic thrombocytopenia (platelets less than  $100 \times 10^9/L$ ) then discussion with a haematologist is recommended.
- A U&E must be taken within 6 weeks prior to surgery. This should be repeated in the week prior to surgery for accurate assessment of renal function (calculated creatinine clearance).
- Obtain an accurate weight for the patient so that dosing can be carried out correctly.
- For those patients who are anticoagulated with warfarin, an INR will be required:

- Pre-operative management for patients at **high thrombotic risk**

| Day -5                | Day -4/-3               | Day -2                                                                                                                                                                                                                                                                                                                           | Day -1                                                                                                                                                                                                           | Surgery                                 |
|-----------------------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Last dose of warfarin | Omit warfarin until D+1 | <p>Check INR:</p> <p>If greater than 2 give phytomenadione 1mg (vitamin K) orally and recheck on day -1</p> <p>If INR is between 1.5 and 2.0 (inclusive of these levels) give phytomenadione 1mg (vitamin K) and recheck on day -1. Start on twice daily dalteparin.</p> <p>- If less than 1.5 start twice daily dalteparin.</p> | <p>Recheck INR if greater than 1.5 on day -2 and give a second dose of phytomenadione 1mg (vitamin K) orally if greater than 1.5</p> <p>Last dose of therapeutic dalteparin in the morning (24 hours pre-op)</p> | Check INR if greater than 1.5 on day -1 |

- Preoperative management for patients at **standard thrombotic risk**

| Day -5                | Day -4                  | Day -3 | Day -2 | Day -1                                                                                                                                           | Surgery                                 |
|-----------------------|-------------------------|--------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Last dose of warfarin | Omit warfarin until D+1 |        |        | <p>Check INR: if greater than 1.5 give phytomenadione 1mg (vitamin K) orally</p> <p>Prophylactic dalteparin at least 12 hours before surgery</p> | Check INR if greater than 1.5 on day -1 |

- Near patient testing is acceptable however, the patient must have a venous INR on either day -1 or -2 pre-operatively. Post operatively the patient must have venous samples undertaken whilst an inpatient but may return to near patient testing once discharged.

**Warfarin:** Patients should be instructed to take their last dose 5 days pre-operatively (i.e. 4 clear days before surgery) and attend for INR checks as appropriate. Patients should be advised that they may need to continue receiving injections of dalteparin after discharge from hospital until their INR is therapeutic. Patients or carers should be trained to inject dalteparin wherever possible.

**Phenindione (Dindevan®) and acenocoumarol (Sinthrome®):** These agents have shorter half-lives than warfarin, hence a shorter duration of action and more rapid onset of action. Patients should be advised to take their last dose 3 days pre-operatively (i.e. 2 clear days before surgery) and attend for INR checks as appropriate. As above these patients should be advised that they may need to continue receiving injections of dalteparin after discharge from hospital until their INR is therapeutic.

### Pre-operative management of emergency patients taking vitamin K antagonists

For emergency procedures consider **warfarin/acenocoumarol/phenindione** reversal with vitamin K and/or prothrombin complex concentrate (Beriplex™ - see [local guidance](#)) pre-operatively.

### Post-Operative Management:

1. **Follow the appropriate treatment plan according to the patient's thrombotic risk.**
  - 1.1. Treatment should be reviewed daily. Doses should only be escalated when haemostasis is secure. Pay particular attention if the patient is at high bleeding risk and seek advice if there are any concerns. If overt bleeding is present, stop anticoagulation and discuss with a haematologist.
  - 1.2. Dalteparin doses should be adjusted according to the patient's weight and renal function.
  - 1.3. Patients undergoing cardiac surgery should not be given dalteparin on the day of surgery.
  - 1.4. **Patients or their carers should be trained to inject dalteparin whilst they are in hospital.** Many patients are capable of self-injecting dalteparin after discharge, and failure to train them appropriately places an unnecessary burden on the community nursing service.
  - 1.5. Patients with atrial fibrillation without prior stroke/TIA or rheumatic valvular heart disease and patients with prosthetic bileaflet aortic valves and no other risk factors for stroke may be discharged before their INR is therapeutic if they are medically fit.
  - 1.6. **Post-operative summary for patients on warfarin:**

Post-operative warfarin management for patients at **standard thrombotic risk**

| Surgery                                  | D +1                                                       | D+2                                                                                                                                                                          | D+3 | D+4 | D+5 | D + 6 |
|------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-------|
| Dalteparin prophylaxis<br>6–8hrs post op | Warfarin at usual dose<br>Continue prophylactic dalteparin | Continue warfarin at usual doses <b>and</b> prophylactic dalteparin until INR is greater than 2.0 in patients with VTE, or until discharge in patients with standard risk AF |     |     |     |       |

Post-operative warfarin management for patients at **high thrombotic risk**

| Surgery                                  | D +1                                                       | D+2                     | D+3                                                                                       | D+4 | D+5                                                                          | D + 6                                  |
|------------------------------------------|------------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------|-----|------------------------------------------------------------------------------|----------------------------------------|
| Dalteparin prophylaxis<br>6–8hrs post op | Warfarin at usual dose<br>Continue prophylactic dalteparin | Warfarin at usual dose. | Warfarin at usual dose.<br>Increase prophylactic dalteparin as per Appendix 4 (high risk) |     | Warfarin at usual dose.<br>Increase dalteparin as per Appendix 4 (high risk) | Continue until INR is greater than 2.0 |

**Warfarin should be re-started at the patient's usual dose on the first day post-procedure.** It will take up to 2 weeks for the INR to become therapeutic. Additional loading or boost doses of warfarin are not recommended. Dalteparin should be continued until the INR is greater than 2 for all patients

including those with a higher INR target range. After minor procedures *with* low bleeding risk, high dose LMWH and warfarin may be restarted **at the earliest** 24 hours after the procedure.

### 1.7. Post-operative summary for patients on phenindione (Dindevan®) and acenocoumarol (Sinthrome®):

Post-operative phenindione/acenocoumarol management for patients at **standard** thrombotic risk

| Surgery                                  | D +1                             | D+2 | D3/4/5                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------------|----------------------------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dalteparin prophylaxis<br>6–8hrs post op | Continue prophylactic dalteparin |     | <p>Restart phenindione/acenocoumarol at usual doses between day 3-5 (at earliest day 3) <b>and</b> continue prophylactic dalteparin until INR is greater than 2.0 in patients with VTE or discharge in patients with AF.</p> <p>May be restarted day +1 following <u>very minor</u> procedures (decision to be made in conjunction with the operating surgeon and haematologist)</p> |

Post-operative phenindione/acenocoumarol management for patients at **high** thrombotic risk

| Surgery                                  | D +1                             | D+2 | D3/4/5                                                                                                                                                                                                              |
|------------------------------------------|----------------------------------|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dalteparin prophylaxis<br>6–8hrs post op | Continue prophylactic dalteparin |     | <p>Increase prophylactic dalteparin as per Appendix 4 (high risk)</p> <p>Continue until INR is greater than 2.0.</p> <p>Restart phenindione/acenocoumarol at usual dose between day 3-5 (at the earliest day 3)</p> |

## PRE-OPERATIVE & POST-OPERATIVE MANAGEMENT OF PATIENTS TAKING APIXABAN (ELIQUIS®), DABIGATRAN (PRADAXA®), EDOXABAN (LIXIANA®) & RIVAROXABAN (XARELTO®)

### Pre-Operative Management:

#### Pre-operative investigations:

- A full blood count must be taken in the week prior to surgery. If the patient has acute or chronic thrombocytopenia (platelets less than  $100 \times 10^9/L$ ) then discussion with a haematologist is recommended.
- A U&E must be taken within 6 weeks prior to surgery. This should be repeated in the week prior to surgery for accurate assessment of renal function (calculated creatinine clearance).
- Obtain an accurate weight for the patient so that post-operative dalteparin dosing can be carried out correctly.

| Creatinine Clearance (ml/min)                                                                                    | Low bleeding risk procedure                                                                                              | High bleeding risk procedure (including spinal/epidural anaesthesia)                                                  |
|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <b>Apixaban/Edoxaban/Rivaroxaban:</b><br><br>>30 ml/min<br><15 - 30ml/min<br>< 15ml/min: <i>contra-indicated</i> | Omit for at least 24 hours<br>Omit for at least 48 hours<br>Discuss with Haematology                                     | Omit for at least 48 hours<br>Omit for at least 72 hours<br>Discuss with Haematology                                  |
| <b>Dabigatran:</b><br><br>>80 ml/min<br>50-80 ml/min<br>30-50 ml/min<br>< 30ml/min (contra-indicated)            | Omit for at least 24 hours<br>Omit for at least 24-48 hours<br>Omit for at least 48-72 hours<br>Discuss with Haematology | Omit for at least 48 hours<br>Omit for at least 48-72 hours<br>Omit for at least 96 hours<br>Discuss with Haematology |

### Pre-operative management of emergency patients taking DOACs:

Refer to the [Guidelines for Management of Bleeding and Excessive Anticoagulation with Oral Anticoagulation](#) and discuss with haematology.

### Post-Operative Management:

#### 2. Follow the appropriate treatment plan according to the patient's thrombotic risk.

- 2.1. Treatment should be reviewed daily. Doses should only be escalated when haemostasis is secure. Pay particular attention if the patient is at high bleeding risk and seek advice if there are any concerns. If overt bleeding is present, stop anticoagulation and discuss with a haematologist.
- 2.2. Dalteparin doses should be adjusted according to the patient's weight and renal function. High risk patients with renal impairment (CrCl less than 30ml/min) should be discussed with a haematologist

### Post-operative summary for patients on DOACs for procedures with major bleeding risk

| Surgery (D 0)                                  | D +1 | D+2 | D+3                                                                                                                                   | D+4 | D+5 | D + 6 |
|------------------------------------------------|------|-----|---------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-------|
| Dalteparin prophylaxis starting 6–8hrs post op |      |     | Restart DOAC at the earliest on day +3, depending on bleeding tendency. Check U&E/LFT and do not restart if epidural <i>in situ</i> . |     |     |       |

|  |                                                                           |
|--|---------------------------------------------------------------------------|
|  | Administer last dose of dalteparin the day <b>before</b> restarting DOAC. |
|--|---------------------------------------------------------------------------|

**Post-operative management of DOACs after minor procedures and low bleeding risk:**

- DOACs may be restarted at the earliest 24 hours post-procedure.
- If there is concern about absorption of DOAC, dalteparin may be continued longer at a dose depending on the thrombotic risk group. Dalteparin must still be discontinued 24 hours prior to resarting DOAC.

Treatment should be reviewed daily. Doses should only be escalated when haemostasis is secure. Pay particular attention if the patient is at high bleeding risk and seek advice if there are any concerns. If overt bleeding is present, stop anticoagulation and discuss with a haematologist.

**3.0 MONITORING FOR HEPARIN-INDUCED THROMBOCYTOPENIA (HIT)**

All patients receiving dalteparin must have a full blood count performed in the week prior to starting treatment. Full blood counts must be repeated every 3 to 4 days (i.e. twice weekly) for the first two weeks of treatment with dalteparin as inpatients. Patients discharged from hospital on LMWH only require HIT monitoring if they have received unfractionated heparin (prophylactic or treatment doses) within the last 100 days. If the platelet count falls by more than 30% and/or the patient develops new signs of thrombosis, suspect HIT and contact a haematologist for advice.

## MANAGEMENT OF SPINAL OR EPIDURAL ANAESTHESIA OR ANALGESIA

The risks of spinal haematoma with spinal/epidural anaesthesia are greatest at times of needle/catheter insertion and removal.

### 1.1 Patients on low dose dalteparin (i.e. any “standard risk” patients, or “high risk” patients receiving treatment on days 0, 1 or 2 post-operatively):

1.1.1 Spinal/epidural catheters must be inserted or removed at least 12 hours after the last dose of prophylactic dalteparin

1.1.2 The next dose of dalteparin must be given at least 4 hours after inserting or removing a spinal/epidural catheter

1.1.3 If a patient is on twice daily dosing of low dose dalteparin, a dose should be delayed by 4 hours to allow removal of the spinal/epidural catheter

### 1.2. Patients on high dose dalteparin (i.e. “high risk” patients from day 3 post-operatively)

If a “high risk” patient is expected to require spinal/epidural analgesia for more than 48 hours post-operatively then an alternative route of analgesia should be considered. High dose dalteparin is incompatible with safe removal of spinal/epidural catheters.

1.2.1 If a patient receiving high dose dalteparin still has a spinal/epidural catheter in situ, advice should be sought from a haematologist and anaesthetist regarding management of the patient.

1.2.2 Spinal/epidural catheters must be inserted or removed at least 24 hours after the last dose of high dose dalteparin.

1.2.3 High dose dalteparin must not be administered within 12 hours of insertion or removal of a spinal/epidural catheter.

### 1.3 Patients taking apixaban, dabigatran, edoxaban or rivaroxaban

| Creatinine Clearance (ml/min)                                 | Interval between inserting or removing spinal/epidural catheter |
|---------------------------------------------------------------|-----------------------------------------------------------------|
| <b>Rivaroxaban:</b><br>>30ml/min<br><30ml/min                 | 48 hours<br>72 hours                                            |
| <b>Apixaban:</b><br>>30ml/min<br><30ml/min                    | 48 hours<br>72 hours                                            |
| <b>Edoxaban:</b><br>>30ml/min<br><30ml/min                    | 48 hours<br>72 hours                                            |
| <b>Dabigatran:</b><br>>80ml/min<br>50-80ml/min<br>30-50ml/min | 48 hours<br>48-72 hours<br>96 hours                             |

Patients taking a DOAC should be managed according to the DOAC bridging protocol when spinal/epidural catheters are to be removed or inserted (see table above – previous page)

### 1.4 Patients taking warfarin should have an INR of 1.4 or less when epidural catheters are inserted or removed.

### 1.5 Be vigilant for the signs of spinal cord compression due to spinal haematoma: backache, leg weakness, loss of perineal and leg sensation, loss of bladder control. These must be acted upon promptly with urgent referral to the on-call anaesthetist

## DISCHARGING PATIENTS

### 1. Patients taking Warfarin:

**Standard risk patients with atrial fibrillation (without prior stroke/TIA or rheumatic valvular heart disease) can stop dalteparin on discharge provided continuing thromboprophylaxis for other reasons is not indicated. All other standard risk patients should remain on dalteparin treatment until their INR is greater than 2.0 if they are taking warfarin.**

If INR is greater than 2 at the time of discharge, patients should be referred back to their usual anticoagulation provider. Patients must have an INR check within 7 days of discharge (sooner if clinically indicated).

If INR is 2 or less, suitable discharge arrangements should be made.

- Ensure supply of dalteparin is prescribed on the TTO
- Train patient/carer to administer dalteparin wherever possible, or refer to a District Nurse
- Monitoring requirements (INR and HIT monitoring) should be considered.

Patients with atrial fibrillation without prior stroke/TIA or rheumatic valvular heart disease and patients with prosthetic bileaflet aortic valves and no other risk factors for stroke may be discharged before their INR is therapeutic if they are medically fit. The patient's warfarin should be restarted at their usual dose and they **MUST** be referred to their regular anticoagulation provider for INR monitoring. These patients do not need to be "bridged" with dalteparin on discharge from hospital.

### 2. Patients taking DOACs (apixaban, dabigatran, edoxaban or rivaroxaban):

- Patients taking DOACs should be managed according to the peri-operative guidance within this guideline.
- Dalteparin **MUST** be **discontinued** the day before rivaroxaban, dabigatran, apixaban or edoxaban is restarted.
- INR monitoring is not required in patients who are taking rivaroxaban, dabigatran, apixaban or edoxaban and there is no referral required on discharge.

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## Appendix 1

### PROCEDURES WHICH MAY BE PERFORMED ON WARFARIN WITH AN INR LESS THAN 3.0

#### Diagnostic angiographic procedures by vascular radiology:

- Check INR in pre-assessment clinic
- If INR less than 3.0, check the INR on the day-ward, proceed with angiography and discharge on usual dose of warfarin
- If the INR is greater than 3.0 and the patient is non-urgent, adjust dose accordingly and proceed when the INR is less than 3.0
- If the INR is greater than 3.0 and the patient is urgent discuss with Radiologist and a Haematologist

**Some invasive cardiology procedures may be done whilst the patient is anticoagulated on warfarin:** these patients should be discussed with the cardiology team before anticoagulation is altered.

**Minor dental, ophthalmic, (cataract surgery) and dermatological surgery:** these patients should be discussed with the relevant team before anticoagulation is altered.

**Bronchoscopy patients:** see [link](#)

**Endoscopic procedures:** see Appendix 6

### PROCEDURES WHICH MAY BE PERFORMED ON APIXABAN, DABIGATRAN, EDOXABAN OR RIVAROXABAN

Minor procedures with low bleeding risk for which clear guidelines exist to be done whilst on warfarin may also be possible to do on rivaroxaban, dabigatran or apixaban. Although this is recommended internationally (Spyropoulos 2012), evidence of safety is lacking. These procedures include:

- **Dental procedures** including minor oral surgery or up to 3 dental extractions, prosthodontics, conservation, endodontics, hygiene phase therapy and orthodontics.
- **Minor ophthalmic, (cataract surgery) and dermatological surgery.**
- **Diagnostic GI endoscopies.**

**In patients on apixaban, dabigatran, edoxaban or rivaroxaban, we suggest omitting the dose taken in the morning of the procedure and restarting/ continuing after the procedure, provided there are no concerns about bleeding.**

## BLEEDING RISK ASSOCIATED WITH PROCEDURES

Note that this list is not comprehensive and is intended as guidance only.

| Very high risk <sup>1</sup> | High risk                                   | Low risk <sup>2</sup>                                       | Procedures which may be performed on warfarin <sup>3</sup>                                                                              |
|-----------------------------|---------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Cardiac surgery             | Major orthopaedic surgery                   | Minor procedures as specified by treating surgeon/physician | Diagnostic GI endoscopic procedures ± biopsy (Veitch <i>et al</i> , 2008)                                                               |
| Neurosurgery                | Major vascular surgery                      |                                                             | Biliary or pancreatic stenting (Veitch <i>et al</i> , 2008)                                                                             |
| Spinal surgery              | Major gynaecological and urological surgery |                                                             | Diagnostic EUS (Veitch <i>et al</i> , 2008)<br>minor dermatological surgery (Douketis <i>et al</i> , 2012)                              |
| Radical prostatectomy       | Major cancer surgery                        |                                                             | Minor dental surgery (Perry <i>et al</i> , 2007)<br>Minor ophthalmological surgery (cataract extraction) (Douketis <i>et al</i> , 2012) |
|                             | Other major abdominal and thoracic surgery  |                                                             |                                                                                                                                         |
|                             | Renal biopsy                                |                                                             |                                                                                                                                         |

<sup>1</sup> Procedures with very high bleeding risk can follow this guideline pre-operatively. Post-operative dalteparin should not be escalated before day +3 and some may need an individualised decision.

<sup>2</sup> Minor procedures at low risk of bleeding but where warfarin needs to be stopped should be identified by the treating physician or surgeon. In patients with a high thrombotic risk undergoing a low risk procedure high dose dalteparin **may** be restarted **at earliest** 24 hours after the procedure. Caution may be needed with procedures that appear to have a low bleeding risk but have been associated with higher bleeding rates. These include resection of large pedunculated polyps or broad based flat (sessile) polyps requiring EMR and pacemaker or defibrillator implantation.

<sup>3</sup> Guidelines on selected procedures that may be done whilst on warfarin are available from the British Society for Gastroenterology (Veitch *et al*, 2008), ACCP (Douketis *et al*, 2012) and British Committee for Standards in Haematology (Perry *et al*, 2007) (Keeling *et al*, 2011). Other minor vascular and cardiological procedures may also be possible whilst on warfarin but should be discussed with the relevant team.

## Appendix 2

### ASSESSMENT OF THROMBOTIC RISK

| Reason for being on oral anticoagulants                                             | STANDARD RISK                                                                                                                                                        | HIGH RISK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> <b>Prosthetic heart valve</b>                              | <ul style="list-style-type: none"> <li>● Bileaflet mechanical aortic valve and no other risk factors for stroke and more than 3 months after implantation</li> </ul> | <ul style="list-style-type: none"> <li>● Any mechanical mitral valve</li> <li>● Caged ball or tilting disc aortic valve</li> <li>● Bileaflet mechanical aortic valve <b>and</b> one or more of the following stroke risk factors: <ul style="list-style-type: none"> <li><input type="checkbox"/> chronic atrial fibrillation</li> <li><input type="checkbox"/> left ventricular dysfunction</li> <li><input type="checkbox"/> age over 75 years</li> <li><input type="checkbox"/> hypertension</li> <li><input type="checkbox"/> diabetes</li> <li><input type="checkbox"/> prior stroke or TIA</li> </ul> </li> <li>● Any mechanical valve within 3 months of implantation</li> </ul> |
|                                                                                     | ● Bioprosthetic valves with no other risk factors for stroke – anticoagulation not required. Thromboprophylaxis if indicated.                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <input type="checkbox"/> <b>Chronic atrial fibrillation</b>                         | <ul style="list-style-type: none"> <li>● Atrial fibrillation without prior stroke/TIA or rheumatic valvular heart disease</li> </ul>                                 | <ul style="list-style-type: none"> <li>● Atrial fibrillation with previous stroke/TIA within the last 3 months.</li> <li>● Atrial fibrillation with previous stroke/TIA &amp; 3 or more of following risk factors: <ul style="list-style-type: none"> <li>- age &gt;75</li> <li>- congestive cardiac failure</li> <li>- hypertension (&gt;140/90mmHg or on medication)</li> <li>- diabetes mellitus</li> </ul> </li> <li>● Atrial fibrillation with rheumatic valvular heart disease</li> </ul>                                                                                                                                                                                         |
| <input type="checkbox"/> <b>Venous thromboembolism or antiphospholipid syndrome</b> | <ul style="list-style-type: none"> <li>● Previous VTE and now on long term anticoagulant therapy (target INR 2.5)</li> </ul>                                         | <ul style="list-style-type: none"> <li>● Recent episode of VTE (within 3 months) – discuss with senior clinician and anaesthetist: consider postponing surgery or placing an IVC filter</li> <li>● Antiphospholipid syndrome with a history of venous or arterial thrombosis</li> <li>● Recurrence of VTE on oral anticoagulation (target INR 3.5) <ul style="list-style-type: none"> <li>● Patients with anti-thrombin deficiency should be discussed with haematology.</li> </ul> </li> </ul>                                                                                                                                                                                         |

|                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><input type="checkbox"/> <b>Pulmonary hypertension</b><br/>(undergoing a procedure that is <i>not</i> for investigation or management of PH)</p> | <ul style="list-style-type: none"> <li>● <b>PH patients with chronic thromboembolic pulmonary hypertension or IVC filter in situ:</b> discuss with PH consultants regarding risk stratification, then manage according to this guideline.</li> <li>● <b>Pulmonary hypertension patients with other risk factors:</b> risk stratify according to the risk factors as above</li> <li>● <b>Pulmonary hypertension patients who are on warfarin for survival benefit only:</b> anticoagulation bridging is not required.</li> </ul> |
| <p><input type="checkbox"/> <b>Antithrombin deficiency</b></p>                                                                                      | <p><b>All patients with antithrombin deficiency should be discussed with a Haematologist before bridging is commenced, as some may require antithrombin replacement.</b></p>                                                                                                                                                                                                                                                                                                                                                    |

### Appendix 3

## TREATMENT GUIDELINES FOR STANDARD RISK PATIENTS

Use eGFR to assess renal function.

[Click here to access the online eGFR calculator](#)

| TREATMENT PLAN FOR STANDARD RISK PATIENTS<br>with eGFR 20ml/min/1.73m <sup>2</sup> or greater |                                                                                                                                                                                                                   |                                                      |                                                      |                                                      |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|
| Day                                                                                           | Under 45kg                                                                                                                                                                                                        | Weight<br>45 – 99kg                                  | Weight<br>100 – 149kg                                | 150kg or more                                        |
| -5                                                                                            | Last dose of warfarin/Vitamin K antagonist (4 clear days) – ensure patient has clear instructions                                                                                                                 |                                                      |                                                      |                                                      |
| -4                                                                                            | No warfarin                                                                                                                                                                                                       |                                                      |                                                      |                                                      |
| -3                                                                                            |                                                                                                                                                                                                                   |                                                      |                                                      |                                                      |
| -2                                                                                            |                                                                                                                                                                                                                   |                                                      |                                                      |                                                      |
| -1                                                                                            | <b>Check INR:</b> if greater than 1.5: give phytomenadione (vitamin K) 1mg orally stat and re-check INR on day 0.<br>Start dalteparin if INR is less than 2.0 (give last dose at least 12 hours before procedure) |                                                      |                                                      |                                                      |
|                                                                                               | Dalteparin 2,500 units<br><b>once daily</b> (pm)                                                                                                                                                                  | Dalteparin 5,000 units<br><b>once daily</b> (pm)     | Dalteparin 7,500 units<br><b>once daily</b> (pm)     | Dalteparin 5,000 units<br>twice daily                |
| 0<br>(day of procedure)                                                                       | Dalteparin 2,500 units<br>6–8 hours post-operatively                                                                                                                                                              | Dalteparin 5,000 units<br>6–8 hours post-operatively | Dalteparin 7,500 units<br>6–8 hours post-operatively | Dalteparin 5,000 units<br>6–8 hours post-operatively |
| +1<br>onwards                                                                                 | Dalteparin 2,500 units<br><b>once daily</b> (pm)                                                                                                                                                                  | Dalteparin 5,000 units<br><b>once daily</b> (pm)     | Dalteparin 7,500 units<br><b>once daily</b> (pm)     | Dalteparin 5,000 units<br><b>twice daily</b>         |
|                                                                                               | Restart warfarin at patient's usual dose.<br>Continue dalteparin as per day +1 until INR is greater than 2.0                                                                                                      |                                                      |                                                      |                                                      |

**Dalteparin must only be started post-operatively when haemostasis is secure.**

| TREATMENT PLAN FOR STANDARD RISK PATIENTS<br>with eGFR less than 20 ml/min/1.73m <sup>2</sup> |                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Day                                                                                           | Recommended treatment                                                                                                                                                                                                                     |
| -5                                                                                            | Last dose of warfarin/Vitamin K antagonist (4 clear days)                                                                                                                                                                                 |
| -4                                                                                            | No warfarin                                                                                                                                                                                                                               |
| -3                                                                                            |                                                                                                                                                                                                                                           |
| -2                                                                                            |                                                                                                                                                                                                                                           |
| -1                                                                                            | Check INR: if greater than 1.5: give phytomenadione (vitamin K) 1mg orally stat. Re-check INR on day 0<br>Start dalteparin 2,500 units <b>once daily</b> (pm) if INR is less than 2.0 (give last dose at least 12 hours before procedure) |
| 0<br>(day of procedure)                                                                       | Dalteparin 2,500 units 6–8 hours post-operatively                                                                                                                                                                                         |
| +1 onwards                                                                                    | Dalteparin 2,500 units <b>once daily</b> (pm)                                                                                                                                                                                             |
|                                                                                               | Restart warfarin at patient's usual dose.<br>Continue dalteparin as per day +1 until INR is greater than 2.0                                                                                                                              |

**Appendix 4**  
**TREATMENT GUIDELINES FOR HIGH RISK PATIENTS**

[Click here to access the online eGFR calculator](#)

| <b>TREATMENT PLAN FOR HIGH RISK PATIENTS<br/>with calculated eGFR 30ml/min or greater</b> |                                                                                                                                                                     |                                                     |                                                     |                                                     |                                                     |                                                     |
|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|
| <b>Day</b>                                                                                | <b>less than 45kg</b>                                                                                                                                               | <b>45-68kg</b>                                      | <b>69-100kg</b>                                     | <b>101-115kg</b>                                    | <b>116-140kg</b>                                    | <b>Over 140kg</b>                                   |
| <b>-5</b>                                                                                 | Last dose of warfarin/ Vitamin K antagonist (4 clear days) – ensure patient has clear instructions                                                                  |                                                     |                                                     |                                                     |                                                     |                                                     |
| <b>-4</b>                                                                                 | No warfarin                                                                                                                                                         |                                                     |                                                     |                                                     |                                                     |                                                     |
| <b>-3</b>                                                                                 |                                                                                                                                                                     |                                                     |                                                     |                                                     |                                                     |                                                     |
| <b>-2</b>                                                                                 | Check INR: if greater than 1.5: give Phytomenadione (vitamin K) 1mg orally stat and re-check INR on day -1.<br>Start twice daily dalteparin if INR is less than 2.0 |                                                     |                                                     |                                                     |                                                     |                                                     |
|                                                                                           | 5,000 units am<br>2,500 units pm                                                                                                                                    | 5,000 units<br>twice daily                          | 7,500 units<br>twice daily                          | 10,000 units<br>twice daily                         | 12,500 units<br>twice daily                         | 15,000 units<br>twice daily                         |
| <b>-1</b>                                                                                 | 5,000 units<br>in the morning                                                                                                                                       | 5,000 units<br>in the morning                       | 7,500 units<br>in the morning                       | 10,000 units<br>in the morning                      | 12,500 units<br>in the morning                      | 15,000 units<br>in the morning                      |
| <b>0</b> (day of procedure)                                                               | Dalteparin<br>2,500 units<br>6 – 8 hours<br>post-op                                                                                                                 | Dalteparin<br>5,000 units<br>6 – 8 hours<br>post-op | Dalteparin<br>5,000 units<br>6 – 8 hours<br>post-op | Dalteparin<br>5,000 units<br>6 – 8 hours<br>post-op | Dalteparin<br>7,500 units<br>6 – 8 hours<br>post-op | Dalteparin<br>7,500 units<br>6 – 8 hours<br>post-op |
| <b>+1</b>                                                                                 | Restart warfarin at patient's usual dose on day +1.<br>Continue dalteparin until the INR >2.0 on 2 consecutive days.                                                |                                                     |                                                     |                                                     |                                                     |                                                     |
|                                                                                           | 2,500 units<br>once daily                                                                                                                                           | 5,000 units<br>once daily                           | 5,000 units<br>once daily                           | 5,000 units<br>once daily                           | 7,500 units<br>once daily                           | 7,500 units<br>once daily                           |
| <b>+2</b>                                                                                 | 2,500 units<br>twice daily                                                                                                                                          | 2,500 units<br>twice daily                          | 5,000 units<br>twice daily                          | 5,000 units<br>twice daily                          | 7,500 units<br>twice daily                          | 7,500 units<br>twice daily                          |
| <b>+3</b>                                                                                 |                                                                                                                                                                     |                                                     |                                                     |                                                     |                                                     |                                                     |
| <b>+4</b>                                                                                 | 5,000 units am<br>2,500 units pm                                                                                                                                    | 5,000 units<br>twice daily                          | 7,500 units<br>twice daily                          | 10,000 units<br>twice daily                         | 12,500 units<br>twice daily                         | 15,000 units<br>twice daily                         |
| <b>+5 onwards</b>                                                                         |                                                                                                                                                                     |                                                     |                                                     |                                                     |                                                     |                                                     |

**Dalteparin must only be started or increased post-operatively when haemostasis is secure.**

| <b>Dalteparin dosing for high risk patients<br/>with calculated eGFR between than 20 and 30ml/min</b> |
|-------------------------------------------------------------------------------------------------------|
| See Appendix 6                                                                                        |

| <b>Dalteparin dosing for high risk patients<br/>with calculated eGFR less than 20ml/min</b> |
|---------------------------------------------------------------------------------------------|
| Use unfractionated heparin infusion                                                         |

## Appendix 5

### CANCELLATION OF SURGERY

#### *Patients on warfarin*

Cancellation of surgery will lead to an increased period of bridging (even if warfarin is restarted). There is the potential for patients to receive inadequate anticoagulation or no anticoagulation during this time. This would put them at increased risk of thromboembolic events.

- Cancellation should be avoided if at all possible.
- If cancellation is unavoidable, postpone the surgery or procedure for a **maximum** of 1 week.
- Teach patients or carers to inject dalteparin wherever possible, to avoid unnecessary community nurse workload.

| <b>Dalteparin dosing for HIGH RISK PATIENTS &amp; STANDARD RISK AF PATIENTS who have been cancelled and rescheduled within 1 week with calculated Creatinine Clearance 30ml/min or greater</b> |                |                 |                  |                  |                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|------------------|------------------|------------------------------|
| <b>less than 45kg</b>                                                                                                                                                                          | <b>45-68kg</b> | <b>69-100kg</b> | <b>100-115kg</b> | <b>116-140kg</b> | <b>greater than 140kg</b>    |
| 5,000 units am<br>2,500 units pm                                                                                                                                                               | 5,000 units BD | 7,500 units BD  | 10,000 units BD  | 12,500 units BD  | Discuss with a Haematologist |
| The last dose should be given in the morning on the day prior to procedure/surgery                                                                                                             |                |                 |                  |                  |                              |

| <b>Dalteparin dosing for HIGH RISK PATIENTS &amp; STANDARD RISK AF who have been cancelled with calculated Creatinine Clearance less than 30ml/min</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Discuss with a Haematologist.                                                                                                                          |

| <b>Dalteparin dosing for STANDARD RISK PATIENTS with previous venous thrombosis with eGFR 20ml/min/1.73m<sup>2</sup> or greater who have been cancelled and rescheduled within 1 week</b> |                                                         |                                                         |                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|
| <b>Weight less than 45kg</b>                                                                                                                                                              | <b>Weight 45 – 99kg</b>                                 | <b>Weight 100 – 149kg</b>                               | <b>Weight 150kg or more</b>                              |
| Dalteparin 2,500 units <b>once daily</b> in the evening                                                                                                                                   | Dalteparin 5,000 units <b>once daily</b> in the evening | Dalteparin 7,500 units <b>once daily</b> in the evening | Dalteparin 5,000 units <b>twice daily</b> in the evening |
| The last dose should be given in the evening on the day prior to procedure/surgery                                                                                                        |                                                         |                                                         |                                                          |

| <b>Dalteparin dosing for STANDARD RISK PATIENTS who have been cancelled with eGFR less than 20ml/min/1.73m<sup>2</sup></b> |
|----------------------------------------------------------------------------------------------------------------------------|
| Anti-Xa monitoring may be required: discuss with a Haematologist                                                           |
| Dalteparin 2,500 units <b>once daily</b> in the evening                                                                    |
| The last dose should be given in the evening on the day prior to procedure/surgery                                         |

*Patients on a DOAC (apixaban, dabigatran, edoxaban or rivaroxaban)*

If surgery is cancelled for patients on apixaban, dabigatran, edoxaban or rivaroxaban and either drug has been stopped, it should be re-started as soon as possible. Dalteparin is not necessary given the short onset of action of these drugs.

## Appendix 6

### TREATMENT GUIDELINES FOR HIGH RISK PATIENTS WITH CREATININE CLEARANCE BETWEEN 20 AND 30ML/MIN

[Click here to access the online eGFR calculator](#)

| TREATMENT PLAN FOR HIGH RISK PATIENTS<br>with calculated eGFR between 20 and 30ml/min |                                                                                                                                                                     |                                                     |                                                     |                                                     |                                                     |                                                     |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|
| Day                                                                                   | less than 56kg                                                                                                                                                      | 57-68kg                                             | 69-82kg                                             | 83-100kg                                            | 101-115kg                                           | 116-140kg                                           |
| -5                                                                                    | Last dose of warfarin/ Vitamin K antagonist (4 clear days) – ensure patient has clear instructions                                                                  |                                                     |                                                     |                                                     |                                                     |                                                     |
| -4                                                                                    | No warfarin                                                                                                                                                         |                                                     |                                                     |                                                     |                                                     |                                                     |
| -3                                                                                    |                                                                                                                                                                     |                                                     |                                                     |                                                     |                                                     |                                                     |
| -2                                                                                    | Check INR: if greater than 1.5: give Phytomenadione (vitamin K) 1mg orally stat and re-check INR on day -1.<br>Start twice daily dalteparin if INR is less than 2.0 |                                                     |                                                     |                                                     |                                                     |                                                     |
|                                                                                       | 5,000 units am<br>2,500 units pm                                                                                                                                    | 5,000 units<br>twice daily                          | 7,500 units am<br>5,000 units pm                    | 7,500 units<br>twice daily                          | 10,000 units<br>am<br>7,500 units<br>pm             | 10,000 units<br>twice daily                         |
| -1                                                                                    | 5,000 units<br>in the morning                                                                                                                                       | 5,000 units<br>in the morning                       | 7,500 units<br>in the morning                       | 7,500 units<br>in the<br>morning                    | 10,000 units<br>in the<br>morning                   | 10,000 units<br>in the<br>morning                   |
| 0 (day of procedure)                                                                  | Dalteparin<br>2,500 units<br>6 – 8 hours<br>post-op                                                                                                                 | Dalteparin<br>5,000 units<br>6 – 8 hours<br>post-op | Dalteparin<br>5,000 units<br>6 – 8 hours<br>post-op | Dalteparin<br>5,000 units<br>6 – 8 hours<br>post-op | Dalteparin<br>7,500 units<br>6 – 8 hours<br>post-op | Dalteparin<br>7,500 units<br>6 – 8 hours<br>post-op |
| +1                                                                                    | Restart warfarin at patient's usual dose on day +1.<br>Continue dalteparin until the INR >2.0 on 2 consecutive days.                                                |                                                     |                                                     |                                                     |                                                     |                                                     |
|                                                                                       | 2,500 units<br>once daily                                                                                                                                           | 5,000 units<br>once daily                           | 5,000 units<br>once daily                           | 5,000 units<br>once daily                           | 7,500 units<br>once daily                           | 7,500 units<br>once daily                           |
| +2                                                                                    |                                                                                                                                                                     |                                                     |                                                     |                                                     |                                                     |                                                     |
| +3                                                                                    | 2,500 units<br>twice daily                                                                                                                                          | 5,000 units am<br>2,500 units pm                    | 5,000 units<br>twice daily                          | 7,500 units<br>am                                   | 7,500 units<br>twice daily                          | 10,000 units<br>am                                  |
| +4                                                                                    |                                                                                                                                                                     |                                                     |                                                     | 5,000 units<br>pm                                   |                                                     | 7,500 units<br>pm                                   |
| +5 onwards                                                                            | 5,000 units am<br>2,500 units pm                                                                                                                                    | 5,000 units<br>twice daily                          | 7,500 units am<br>5,000 units pm                    | 7,500 units<br>twice daily                          | 10,000 units<br>am<br>7,500 units<br>pm             | 10,000 units<br>twice daily                         |

**Dalteparin must only be started or increased post-operatively when haemostasis is secure.**

- **Pre-operatively:** no anti-Xa monitoring is required provided the patient is not taking for longer than 3 days. Cancellations should be avoided in this patient cohort.
- **Post-operatively:** peak anti-Xa monitoring is required from day 5 onwards once the patient has received 3-5 doses. Samples should be taken 3 to 4 hours post-dose. Discuss levels with haematology. Warfarin should be restarted at the patient's usual dose on day +1.
- **PATIENTS UNDERGOING MINOR BLEEDING RISK PROCEDURES:** Pre-operatively follow the advice of patients undergoing major surgery as above. Post-operatively day +5 doses may be commenced 24 hours post-procedure with anti Xa levels after 3-5 doses.

| Dalteparin dosing for high risk patients<br>with calculated eGFR less than 20 ml/min |
|--------------------------------------------------------------------------------------|
| Use unfractionated heparin infusion                                                  |

