

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

Dr Rob Cutting – Consultant Haematologist
Dr Ruth Medlock – Consultant Haematologist
Lee Wilson – Consultant Pharmacist

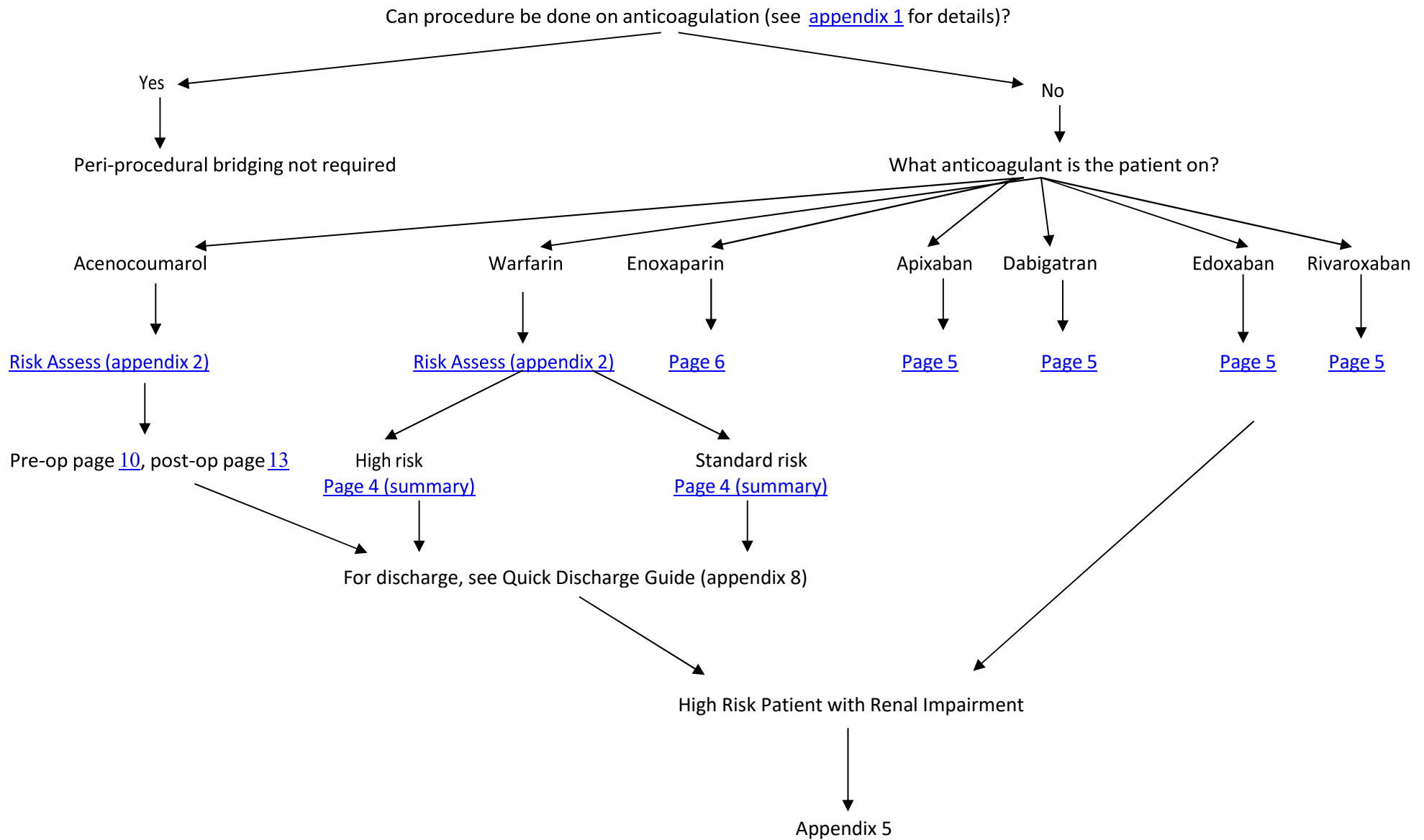
(With thanks to colleagues at Sheffield Teaching Hospitals NHS FT on whose guidance this guideline is heavily based)

Issued – August 2026
Review Date – August 2029

Table of contents

Flow Chart for Anticoagulation Management	3
Summary of Bridging Anticoagulation for Patients on Warfarin	4
Summary of Bridging Anticoagulation for Patients on DOACs	5
Summary of Bridging Anticoagulation for Patients on Enoxaparin	6
INTRODUCTION	7
SITUATIONS COVERED BY THIS GUIDELINE	7
PRE-OPERATIVE ASSESSMENT AND MANAGEMENT & DAY SURGERY GUIDANCE	8
Pre-op assessment	8
Determining whether a patient is in the Standard risk or High risk category	8
Patients who are at particularly high risk of thrombosis	8
Procedures which carry a very high bleeding risk	8
Patients with antithrombin deficiency	8
Patients with renal impairment	8
PRE-OPERATIVE & POST-OPERATIVE MANAGEMENT OF VITAMIN K ANTAGONISTS	10
Pre-operative investigations	10
Pre-operative management of warfarin	10
Pre-operative management of acenocoumarol	11
Pre-operative management of emergency patients taking vitamin K antagonists	11
Post-operative management	11
Post-operative summary for warfarin	12
Post-operative summary for acenocoumarol	12
PRE-OPERATIVE & POST-OPERATIVE MANAGEMENT OF PATIENTS TAKING DOACs	14
Pre-operative investigations	14
Pre-operative management of apixaban, edoxaban, or rivaroxaban	14
Pre-operative management of dabigatran	14
Pre-operative management of emergency patients taking DOACs	15
Post-operative management	15
MONITORING FOR HEPARIN -INDUCED THROMBOCYTOPENIA (HIT)	16
MANAGEMENT OF SPINAL OR EPIDURAL ANALGESIA OR ANAESTHESIA	16
DISCHARGING PATIENTS	17
REFERENCES	18
Appendix 1 - Procedures which may be performed with an INR less than 3.0	19
Appendix 2 - Assessment of thrombotic risk	20
Appendix 3 - Treatment guidelines for Standard Risk patients on warfarin	21
Appendix 4 - Treatment guidelines for High Risk patients on warfarin	22
Appendix 5 - Cancellation of surgery	24
Appendix 6 - Treatment guidelines for Standard Risk Patients (with eGFR between 15 and 29ml/min/m²)	26
Appendix 6 - Treatment guidelines for High Risk patients with CrCl between 15 and 29ml/min	26
Appendix 7 - Treatment guidelines for All Patients with CrCl less than 15 or on Dialysis	28

Flow Chart for Anticoagulation Management



Summary of bridging anticoagulation for patients on warfarin

Summary for patients at **high thrombotic risk**:

Pre-procedure:

Day-5	Day -4	Day -3	Day -2	Day -1	Surgery
Last dose of warfarin	Omit warfarin	Omit warfarin	Check INR: if > 1.5 give 1mg oral vit K and re-check INR on day -1 If INR <2 start on twice-daily enoxaparin	Re-check INR: if > than 1.5 on day -2 Give 1mg oral vit K if >1.5 Give last dose of therapeutic enoxaparin in the morning 24-hours pre-op	Re-check INR (only if it was >1.5 on day -1)

Post-procedure:

Surgery	Day +1	Day +2	Day +3	Day +4	Day +5	Day +6
Give prophylactic enoxaparin once 6-8 hours postop	Re-start warfarin at usual dose. Continue prophylactic enoxaparin	Give warfarin at usual dose. Continue prophylactic enoxaparin	Continue warfarin at usual dose. Increase prophylactic enoxaparin as per Appendix 4		Continue warfarin at usual dose. Increase enoxaparin as per Appendix 4. Continue enoxaparin until INR>2	

Summary for patients at **standard thrombotic risk**:

Pre-procedure:

Day-5	Day -4	Day -3	Day -2	Day -1	Surgery
Last dose of warfarin	Omit warfarin	Omit warfarin	Omit warfarin	Check INR: if >1.5 give 1mg oral vit K If INR <2, start prophylactic enoxaparin (give last dose at least 12 hours before surgery)	Re-check INR (only if it was >1.5 on day -1)

Post-procedure:

Surgery	Day +1	Day +2	Day +3	Day +4	Day +5	Day +6
Give prophylactic enoxaparin once 6-8 hours postop	Re-start warfarin at usual dose. Continue prophylactic enoxaparin	Continue warfarin at usual dose. Continue prophylactic enoxaparin until INR>2. Enoxaparin may be omitted after discharge in patients anticoagulated for atrial fibrillation who have not had a previous stroke/ TIA so long as extended prophylaxis would not otherwise be indicated (e.g. lower limb arthroplasty, fractured neck of femur, major cancer surgery in thorax, abdomen or pelvis)				

Key: > greater than; < less than

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.

After procedures with low bleeding risk, split treatment-dose enoxaparin and warfarin may be restarted at earliest 24 hours after the procedure.

Summary of bridging anticoagulation for patients taking DOACs (apixaban, dabigatran, edoxaban, rivaroxaban)

Prophylactic enoxaparin must not be given pre-operatively when DOAC is omitted.

Peri-procedural summary for patients taking DOACs undergoing procedures with a low risk of bleeding:

DOAC used:	Perioperative DOAC Management									
	Day -5	-4	-3	-2	-1	0	+1	+2	+3	+4
Apixaban Edoxaban Rivaroxaban	✓	✓	✓	✓	OMIT	Day of procedure Do not administer DOAC; consider enoxaparin as below	✓	✓	✓	✓
Dabigatran (CrCl ≥50ml/min)	✓	✓	✓	✓	OMIT		✓	✓	✓	✓
Dabigatran (CrCl <50ml/min)	✓	✓	✓	OMIT	OMIT		✓	✓	✓	✓

Key: ≥ greater than or equal to; < less than

Peri-procedural summary for patients taking DOACs undergoing procedures with a high risk of bleeding:

DOAC used:	Perioperative DOAC Management									
	Day -5	-4	-3	-2	-1	0	+1	+2	+3	+4
Apixaban Edoxaban Rivaroxaban	✓	✓	✓	OMIT	OMIT	Day of procedure Do not administer DOAC; consider enoxaparin as below	OMIT	Resume day +2 or +3		✓
Dabigatran (CrCl ≥50ml/min)	✓	✓	✓	OMIT	OMIT		OMIT	Resume day +2 or +3		✓
Dabigatran (CrCl <50ml/min)	✓	OMIT	OMIT	OMIT	OMIT		OMIT	Resume day +2 or +3		✓

Key: ≥ greater than or equal to; < less than

Give prophylactic enoxaparin on day 0, 6-8 hours post-procedure, so long as there are no bleeding concerns.

This may be omitted in day-case and out-patients whose indication for anticoagulation with DOAC is atrial fibrillation. In the out-patient setting, a decision as to whether to offer enoxaparin bridging to patients on a DOAC for VTE may be taken based on a number of factors including whether their baseline mobility/activity level has been compromised by the procedure, how recent their VTE event was, and whether they received a general anaesthetic, as well as their bleeding risk and the consequence of bleeding post-procedure.

Prophylactic doses of DOACs may be restarted 6-8 hours post procedure.

If there is concern about absorption of DOAC post-procedure, enoxaparin may be continued longer at a dose depending on the thrombotic risk.

Treatment should be reviewed daily. Doses should only be escalated when haemostasis is secure.

Check U&E/LFT before re-starting DOAC. **Do not restart DOAC if the patient has an epidural in situ.**

Administer the last dose of enoxaparin the day before re-starting the DOAC.

If overt bleeding is present, **stop anticoagulation** and discuss with a haematologist

Summary of bridging anticoagulation for patients taking enoxaparin

Summary for patients on prophylactic doses of enoxaparin

Patients on prophylactic doses of enoxaparin (according to their weight and renal function) can have their last dose at least 12 hours before any procedure and can be re-started at earliest 6 – 8 hours postoperatively provided there is no concern about bleeding.

Summary for patients on therapeutic doses of enoxaparin who are at high thrombotic risk

Pre-operative management

Creatinine clearance	Timing of last pre-operative dose
≥30mls/min	A minimum of 24 hours pre-op
15-29mls/min and not in AKI	
Less than 15mls/min or in AKI and CrCl 15-29mls/min	Discuss with Haematology

Post-operative management

Day	0	+1	+2	+3	+4	+5	+6
Crcl ≥30mls/min	Give prophylactic enoxaparin* once 6-8 hours post-op	Continue prophylactic enoxaparin*				Check U&E/LFT Restart therapeutic enoxaparin at the earliest on day +5, depending on bleeding tendency. DO NOT restart if epidural in situ	
	*use weight-adjusted doses as per Appendix 4 for patients at high risk of thrombosis						
CrCl 15-29ml/min	Give prophylactic enoxaparin** once 6-8 hours post-op	Continue prophylactic enoxaparin **				Check U&E/LFT Restart therapeutic enoxaparin at the earliest on day +5, depending on bleeding tendency. DO NOT restart if epidural in situ	
	**use weight-adjusted doses as per Appendix 6						
CrCl <15ml/min or in AKI and CrCl 15-29mls/min	Discuss with Haematology						

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, though not all, it is necessary to stop the oral anticoagulant+ 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

- **Vitamin K antagonists:** warfarin (and acenocoumarol),
- **Direct Oral Anticoagulants:** apixaban, dabigatran, edoxaban, or rivaroxaban,
- **long-term treatment with enoxaparin**

who need interruption of anticoagulant therapy (with an INR of less than 1.5 if on warfarin or acenocoumarol) for a procedure. Additional advice may be required from a haematologist regarding acenocoumarol.

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 a 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.

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.

For patients on a vitamin K antagonist (warfarin or acenocoumarol):

- Determine whether a patient is in the standard risk or high risk category (see [appendix 2](#) for criteria for stratification of thrombotic risk)
- See Appendix 3 (standard risk) and Appendix 4 (high risk) for management of patients without any complicating factors (e.g. renal impairment, weight greater than 200kg, etc)

For patients on a DOAC, see page 14 for further guidance.

If there is any uncertainty as to which category a patient should be assigned, discuss with the stroke/ cardiology (mechanical valve patients, AF and risk factors for stroke) or haematology/acute medicine (venous thromboembolic disease patients) prior to admission. It may also be appropriate to involve a senior anaesthetist at this stage.

Certain patients should be discussed with senior clinicians before commencing bridging:

Patients who are at particularly high risk of thrombosis should be discussed with the senior clinician and anaesthetist involved; these include:

- patients with a venous thrombosis in the last 3 months
- patients with recent stroke (within the previous 6 months) or any history of cardiac thromboembolism
- patients with a left-ventricular assist device
- patients within 1 month of a bare-metal stent insertion or 3 months of a drug-eluting stent insertion

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).

Patients with antithrombin deficiency should be discussed with a haematologist as treatment with antithrombin concentrates may be required.

Where there is uncertainty about the management of any patient, discuss with the senior clinician and anaesthetist involved.

Patients at high thrombotic risk 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 enoxaparin and therapeutic doses of DOACs are incompatible with safe removal of epidural catheters. If no other mode of anaesthesia/analgesia is suitable, the patient must be discussed with a haematologist/anaesthetist.

Patients with renal impairment

Standard risk patients on enoxaparin should have the dose reduced if their eGFR is less than 30ml/min/1.73m². eGFR should only be used to dose enoxaparin for standard risk patients and must NOT be used to dose enoxaparin for high-risk patients. Dose reductions are advised in patients with eGFR 15-29ml/min/1.73m²; these are detailed in [appendix 6](#). Standard risk patients with eGFR less than 15ml/min/1.73m² should be discussed with a haematologist.

High risk patients on enoxaparin should have the dose reduced if their calculated creatinine clearance (CrCl) is less than 30ml/min.

Renal function for high-risk patients should be estimated using the following calculation:

$$\text{CrCl} = \frac{(140 - \text{age}) \times \text{weight (kg)}}{\text{serum creatinine (micromol/L)}} \times 1.04 \text{ (female) or } 1.23 \text{ (males)} = \text{_____ (mL/min)}$$

High risk patients with a creatinine clearance (CrCl) of 15-29ml/min may be managed according to guidance in [appendix 6](#). All high risk patients with a CrCl of less than 30mls/min must be discussed individually with haematology, for advice regarding anti-Xa monitoring, before bridging is commenced. Renal transplant patients, irrespective of creatinine clearance must be discussed with haematology for suitability of enoxaparin.

Patients on a DOAC who have renal impairment should be managed according to the guidance given on page 14. Renal function for all patients should be calculated using the above equation; eGFR should not be used to estimate renal function.

Patients weighing more than 200kg should be discussed with a haematologist as dose adjustments of enoxaparin and monitoring of anti-Xa activity may be required.

GPs should not normally be asked to prescribe or monitor bridging anticoagulation. Prior to the procedure, management should be by the medical/surgical team looking after the patient (this may be via pre-op assessment clinic if applicable).

If surgery is cancelled see advice in [appendix 3](#). 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.

Guidance for pre-operative assessment clinics/waiting list staff/secretaries is in [appendix 4](#)

Periprocedural management of patients taking vitamin K antagonists (warfarin or acenocoumarol):

Pre-operative investigations & Management:

- 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).
- A weight within the 3 months prior to the procedure should be measured and documented in the patient notes. Estimated weight should not be used.
- For those patients who are anticoagulated with warfarin:
 - High risk patients: an INR will be required on day -2 (and again on day -1 if the INR on day -2 was greater than 1.5)
 - Standard risk patients: an INR will be required on day -1
 - Near patient testing is acceptable however, the patient must have a venous INR on either day -2 or -1 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 check as appropriate. Patients should be advised that they may need to continue receiving injections of enoxaparin after discharge from hospital until their INR is therapeutic. Patients or carers should be trained to inject enoxaparin whilst in hospital to avoid unnecessary burden on community nursing services.

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			Check INR: if greater than 1.5 give phytomenadione 1mg (vitamin K) orally Prophylactic enoxaparin at least 12 hours before surgery	Recheck INR (only if it was greater than 1.5 on day -1)

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	Check INR If >2 give phytomenadione 1mg (vitamin K) orally and recheck on day -1 If INR is 1.5 - 2.0. give phytomenadione 1mg (vitamin K) and recheck on day -1. Start on twice daily enoxaparin If <1.5 start twice daily enoxaparin	Recheck INR if greater than 1.5 on day -2 and repeat phytomenadione 1mg (vitamin K) orally if greater than 1.5 Give last dose of therapeutic enoxaparin in the morning	Recheck INR (only if it was greater than 1.5 on day -1)

Acenocoumarol: This agent has a shorter half-life 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 enoxaparin after discharge from hospital until their INR is therapeutic.

Pre-operative acenocoumarol management for patients at high or standard risk:

Day -3	Day -2	Day -1	Surgery
Last dose of acenocoumarol	Omit acenocoumarol	Check INR: if greater than 1.5 give phytonadione 1mg (vitamin K) orally Give prophylactic enoxaparin at least 12 hours before surgery	Recheck INR (only if it was greater than 1.5 on day -1)

Emergency pre-operative management of emergency patients taking vitamin K antagonists

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

Post-Operative Management:

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

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. Enoxaparin doses should be adjusted according to the patient's weight and renal function (see appendices).

Patients with renal impairment

Standard risk patients on enoxaparin should have the dose reduced if their eGFR is less than 30ml/min/1.73m².

Dose reductions are advised in patients with eGFR 15-29ml/min/1.73m²; these are detailed in [appendix 6](#).

Standard risk patients with eGFR less than 15ml/min/1.73m² should be discussed with a haematologist.

High risk patients on enoxaparin should have the dose reduced if their calculated creatinine clearance (CrCl) is less than 30ml/min.

Renal function for high-risk patients should be estimated using the following calculation:

$$\text{CrCl} = \frac{(140 - \text{age}) \times \text{weight (kg)}}{\text{serum creatinine (micromol/L)}} \times 1.04 \text{ (female) or } 1.23 \text{ (males)} = \text{_____ (mL/min)}$$

High risk patients with a creatinine clearance (CrCl) of 15-29ml/min may be managed according to guidance in [appendix 6](#). All high risk patients with a CrCl of less than 30mls/min must be discussed individually with haematology, for advice regarding anti-Xa monitoring, before bridging is commenced. Renal transplant patients, irrespective of creatinine clearance must be discussed with haematology for suitability of enoxaparin.

Patients or their carers should be trained to inject enoxaparin whilst they are in hospital. Many patients are capable of self-injecting enoxaparin after discharge, and failure to train them appropriately places an unnecessary burden on the community nursing service.

Patients with atrial fibrillation without prior stroke/TIA and no other risk factors for stroke do not need enoxaparin beyond discharge even if their INR is less than 2 if they are medically fit and would not otherwise be a candidate for extended thromboprophylaxis.

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

Surgery	Day +1	Day +2	Day +3	Day +4	Day +5	Day +6
Give prophylactic enoxaparin once 6–8hrs post op	Restart warfarin at usual dose Continue prophylactic enoxaparin	Continue warfarin at usual dose Continue prophylactic enoxaparin until INR >2.0 Enoxaparin may be omitted after discharge in patients anticoagulated for atrial fibrillation who have not had a previous stroke/TIA so long as extended prophylaxis is not indicated (e.g. lower limb arthroplasty, fractured neck of femur, major cancer surgery in thorax, abdomen, pelvis)				

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

Surgery	Day +1	Day +2	Day +3	Day +4	Day +5	Day +6
Give prophylactic enoxaparin once 6–8hrs post op	Restart warfarin at usual dose on day +1 Continue prophylactic enoxaparin		Continue warfarin at usual dose Increase prophylactic enoxaparin as per Appendix 4 (high risk)		Continue warfarin at usual dose Increase enoxaparin as per Appendix 4 (high risk) Continue until INR >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. Enoxaparin should be continued until the INR is greater than 2 for **all patients** including those with a higher INR target range.

After procedures with low bleeding risk, high dose enoxaparin and warfarin may be restarted **at the earliest** 24 hours after the procedure.

Post-operative summary for patients on acenocoumarol:

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

Surgery	Day +1	Day +2	Day +3/4/5
Give prophylactic enoxaparin once 6-8hrs post-op	Continue prophylactic enoxaparin		Restart acenocoumarol at usual dose between day 3-5 (earliest day 3) Continue prophylactic enoxaparin until INR is greater than 2.0 in patients with VTE or discharge in patients with AF.

Acenocoumarol may be restarted day +1 following very minor procedures (decision to be made in conjunction with the operating surgeon and haematologist)

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

Surgery	Day +1	Day +2	Day +3/4/5
Give prophylactic enoxaparin once 6-8hrs post-op	Continue prophylactic enoxaparin	Restart acenocoumarol at usual dose between day 3-5 (at the earliest day 3) Continue until INR is greater than 2.0. Increase prophylactic enoxaparin as per Appendix 4 (high risk)	

Peri-procedural management of patients taking DOACs

Pre-operative investigations & management:

- A full blood count must be taken in the week prior to surgery. If the patient has acute or chronic thrombocytopenia (platelets less than $150 \times 10^9/L$) 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).
- A weight within the 3 months prior to the procedure should be measured and documented in the patients notes. Estimated weight must not be used.

Pre-procedural summary for patients taking DOACs undergoing procedures with a **low** risk of bleeding:

DOAC used:	Pre-operative DOAC management					
	Day -5	-4	-3	-2	-1	0
Apixaban Edoxaban Rivaroxaban	✓	✓	✓	✓	OMIT	Day of procedure Do not administer any DOAC
Dabigatran (CrCl ≥ 50 ml/min)	✓	✓	✓	✓	OMIT	
Dabigatran (CrCl < 50 ml/min)	✓	✓	✓	OMIT	OMIT	

Pre-procedural summary for patients taking DOACs undergoing procedures with a high risk of bleeding:

DOAC used:	Pre-operative DOAC management					
	Day -5	-4	-3	-2	-1	0
Apixaban Edoxaban Rivaroxaban	✓	✓	✓	OMIT	OMIT	Day of procedure Do not administer any DOAC
Dabigatran (CrCl ≥ 50 ml/min)	✓	✓	✓	OMIT	OMIT	
Dabigatran (CrCl < 50 ml/min)	✓	OMIT	OMIT	OMIT	OMIT	

Key: $\geq$ greater than or equal to; $<$ less than

Prophylactic enoxaparin must **not** be given pre-operatively when DOAC is omitted.

Emergency pre-procedural management of emergency patients taking apixaban, dabigatran, edoxaban or rivaroxaban:

Please refer to [Guidelines for Management of Bleeding and Excessive Anticoagulation with Oral Anticoagulants](#) and discuss with haematology.

Post-Operative Management: Follow the appropriate treatment plan according to the procedural bleeding risk.

Post-procedural summary for patients taking DOAC undergoing procedures with a **low** risk of bleeding:

	Post-operative DOAC management				
DOAC used:	0	+1	+2	+3	+4
Apixaban, Edoxaban, Rivaroxaban	Day of procedure Do not administer DOAC; consider enoxaparin as below	✓	✓	✓	✓
Dabigatran (CrCl ≥50ml/min)		✓	✓	✓	✓
Dabigatran (CrCl <50ml/min)		✓	✓	✓	✓

Give prophylactic enoxaparin on day 0, 6-8 hours post-procedure, so long as there are no bleeding concerns. **This may be omitted in day-case patients whose indication for anticoagulation is atrial fibrillation (see appendix 2).**

DOACs can be re-started at their usual dose 24-hours post-procedure. Administer the last dose of enoxaparin the day before restarting DOAC.

Post-procedural summary for patients taking DOAC undergoing procedures with a **high** risk of bleeding:

	Post-operative DOAC management				
DOAC used:	0	+1	+2	+3	+4
Apixaban, Edoxaban, Rivaroxaban	Day of procedure Do not administer DOAC; consider enoxaparin as below	OMIT	Resume day +2 or +3		✓
Dabigatran (CrCl ≥50ml/min)		OMIT	Resume day +2 or +3		✓
Dabigatran (CrCl <50ml/min)		OMIT	Resume day +2 or +3		✓

Give prophylactic enoxaparin on day 0, 6-8 hours post-procedure, so long as there are no bleeding concerns. **This may be omitted in day-case patients whose indication for anticoagulation is atrial fibrillation (see appendix 2).**

In the out-patient setting, a decision as to whether to offer enoxaparin bridging to patients on a DOAC for VTE may be taken based on a number of factors including whether their baseline mobility/ activity level has been compromised by the procedure, how recent their VTE event was, whether they received a general anaesthetic as well as their bleeding risk and the consequence of bleeding post-procedure.

Enoxaparin doses should be adjusted according to the patient's weight and renal function – refer to appendix 4. Treatment should be reviewed daily. Doses should only be escalated when haemostasis is secure. If there is concern about absorption of DOAC post-procedure, enoxaparin may be continued for longer at a dose depending on the thrombotic risk group. Check U&E/LFT before re-starting DOAC. **Do not restart DOAC, if epidural in situ.** Prophylactic doses of (e.g. rivaroxaban 10mg OD or apixaban 2.5mg BD) may be restarted 6-8 hours post-op.

Monitoring for heparin-induced thrombocytopenia (HIT)

All patients receiving enoxaparin 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 enoxaparin as inpatients. Patients discharged from hospital on enoxaparin only require HIT monitoring if they have undergone cardiothoracic surgery or they have received unfractionated heparin (prophylactic or treatment doses) within the last 100 days. If the platelet count falls by 30-50% from baseline or to less than $150 \times 10^9/L$, and/or the patient develops new signs of thrombosis, suspect HIT: 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.

Patients on prophylactic enoxaparin (i.e. any “standard risk” patients, or “high risk” patients on days 0, 1 or 2 post-operatively):

- Spinal/epidural catheters must be inserted or removed **at least 12 hours** after the last dose of prophylactic enoxaparin
- The next dose of prophylactic enoxaparin must be given **at least 4 hours** after inserting or removing a spinal/epidural catheter
- If a patient is on twice daily dosing of prophylactic enoxaparin, a dose should be delayed by 4 hours to allow removal of the spinal/epidural catheter

Patients on escalating doses of enoxaparin (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. Escalating dose enoxaparin is incompatible with safe removal of spinal/epidural catheters.
- If a patient receiving escalating dose enoxaparin still has a spinal/epidural catheter in situ, advice should be sought from a haematologist and anaesthetist regarding management of the patient.
- Spinal/epidural catheters must be inserted or removed at least 24 hours after the last dose of escalating dose enoxaparin.
- Escalating dose enoxaparin must not be administered within 12 hours of insertion or removal of a spinal/epidural catheter.

Patients taking a DOAC should be managed according to the DOAC bridging protocol for **high bleeding** procedures (page 14) when spinal/epidural catheters are to be removed or inserted.

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

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

Patients taking warfarin:

Standard risk patients with atrial fibrillation (see appendix B) can stop enoxaparin on discharge provided continuing thromboprophylaxis for other reasons is not indicated. All other standard and high-risk patients should remain on enoxaparin until their INR is greater than 2.0

If the patient's INR is greater than 2.0 at the time of discharge, patients should be referred back to their usual anticoagulation provider using the DBTH Anticoagulation Referral Form. Patients must have an INR check within 7 days of discharge (sooner if clinically indicated).

If the INR is 2.0 or less, suitable discharge arrangements should be made:

- Ensure sufficient supply of enoxaparin is prescribed on the TTO and that the correct dosing of warfarin and enoxaparin are included in the discharge information.
- Train the patient/carer to administer enoxaparin (and provide a sharps bin for safe disposal). Alternatively, a district nurse referral will have to be made for administration.

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

- Patients taking DOACs should be managed according to the peri-operative guidance on page 14.
- Enoxaparin MUST be **discontinued** the day before the DOAC is restarted.
- INR monitoring is not required in patients who are taking DOACs 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: guidance given in the vascular handbook should be followed, i.e.

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.

Diagnostic GI endoscopies, biliary or pancreatic stenting and diagnostic endoscopic ultrasound:

these patients should be discussed with the relevant team before anticoagulation is altered.

PROCEDURES WHICH MAY BE PERFORMED ON THERAPEUTIC DOSES OF DOACs

Procedures with low bleeding risk for which clear guidelines exist to be done whilst on warfarin may also be possible to do on therapeutic doses of apixaban, dabigatran, edoxaban or rivaroxaban. 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 taking DOACs, 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.

Appendix 2

ASSESSMENT OF THROMBOTIC RISK

Reason for being on oral anticoagulants	STANDARD RISK	HIGH RISK
Prosthetic heart valve	● Bileaflet mechanical aortic valve and no other risk factors for stroke and more than 3 months after implantation	● Any mechanical mitral valve ● Caged ball or tilting disc aortic valve ● Bileaflet mechanical aortic valve and one or more of the following stroke risk factors: ☐ chronic atrial fibrillation ☐ left ventricular dysfunction ☐ age over 75 years ☐ hypertension ☐ diabetes ☐ prior stroke or TIA ● Any mechanical valve within 3 months of implantation
	● Bioprosthetic valves with no other risk factors for stroke – anticoagulation not required. Thromboprophylaxis if indicated.	
Chronic atrial fibrillation	● Atrial fibrillation without prior stroke/TIA or rheumatic valvular heart disease	● Atrial fibrillation with previous stroke/TIA within the last 3 months. ● Atrial fibrillation with previous stroke/TIA & 3 or more of following risk factors: - age >75 - congestive cardiac failure - hypertension (>140/90mmHg or on medication) - diabetes mellitus ● Atrial fibrillation with rheumatic valvular heart disease
Venous thromboembolism or antiphospholipid syndrome	● Previous VTE and now on long term anticoagulant therapy (target INR 2.5)	● Recent episode of VTE (within 3 months) – discuss with senior clinician and anaesthetist: consider postponing surgery or placing an IVC filter ● Antiphospholipid syndrome with a history of venous or arterial thrombosis ● Recurrence of VTE on oral anticoagulation (target INR 3.5) ● Patients with anti-thrombin deficiency should be discussed with haematology.

Pulmonary hypertension (undergoing a procedure that is <i>not</i> for investigation or management of PH)	● PH patients with chronic thromboembolic pulmonary hypertension or IVC filter in situ: discuss with PH consultants regarding risk stratification, then manage according to this guideline. ● Pulmonary hypertension patients with other risk factors: risk stratify according to the risk factors as above ● Pulmonary hypertension patients who are on warfarin for survival benefit only: anticoagulation bridging is not required.
Antithrombin deficiency	All patients with antithrombin deficiency should be discussed with a Haematologist before bridging is commenced, as some may require antithrombin replacement.

Appendix 3

TREATMENT GUIDELINES FOR STANDARD RISK PATIENTS (eGFR 30ml/min/1.73m² or greater)

TREATMENT PLAN FOR STANDARD RISK PATIENTS with eGFR 30ml/min/1.73m ² or greater				
Day	Under 45kg	Weight 45 – 99kg	Weight 100 – 149kg	150kg or more
-5	Last dose of warfarin (4 clear days) – ensure patient has clear instructions on peri-operative bridging plan			
-4	No warfarin			
-3				
-2				
-1	Check INR: if greater than 1.5: give phytomenadione (vitamin K) 1mg orally stat and re-check INR on day 0. Start enoxaparin if INR is less than 2.0 (give last dose at least 12 hours before procedure)			
	Enoxaparin 20mg EVE	Enoxaparin 40mg EVE	Enoxaparin 40mg BD	Enoxaparin 60mg BD
0 (day of procedure; *6–8 hours post-op)	Recheck INR if phytomenadione was required on day -1			
	Enoxaparin 20mg*	Enoxaparin 40mg*	Enoxaparin 40mg*	Enoxaparin 60mg*
+1 onwards	Enoxaparin 20mg EVE	Enoxaparin 40mg EVE	Enoxaparin 40mg BD	Enoxaparin 60mg BD
	Restart warfarin at patient's usual dose Continue enoxaparin as per day +1 until INR is greater than 2.0 Proceed with bridging only if there are no concerns with bleeding and review daily			

Enoxaparin dosing for standard risk patients with calculated eGFR between than 15 and 29ml/min
See Appendix 6

Appendix 4
TREATMENT GUIDELINES FOR HIGH RISK PATIENTS

TREATMENT PLAN FOR HIGH RISK PATIENTS with calculated eGFR 30ml/min or greater							
Day	< 48kg	48-73kg	74-88kg	88-109kg	110-130kg	131-159kg	160-199kg
-5	Last dose of warfarin (4 clear days) – ensure patient has clear instructions on peri-operative bridging plan						
-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. Start twice daily enoxaparin if INR is less than 2.0						
	40mg BD	60mg BD	80mg BD	100mg BD	120mg BD	150mg BD	180mg BD
-1	40mg OM	60mg OM	80mg OM	100mg OM	120mg OM	150mg OM	180mg OM
0 (day of procedure; *6-8 hours post-op)	Enoxaparin 20mg*	Enoxaparin 40mg*	Enoxaparin 40mg*	Enoxaparin 40mg*	Enoxaparin 60mg*	Enoxaparin 60mg*	Enoxaparin 80mg*
+1	Restart warfarin at patient's usual dose on day +1. Continue enoxaparin until the INR >2.0						
	20mg EVE	40mg EVE	40mg EVE	40mg EVE	60mg EVE	60mg EVE	80mg EVE
+2							
+3	20mg BD	20mg OM 40mg EVE	40mg BD	40mg OM 60mg EVE	60mg BD	80mg BD	80mg OM 100mg EVE
+4							
+5 onwards	40mg BD	60mg BD	80mg BD	100mg BD	120mg BD	150mg BD	180mg BD

Enoxaparin dosing for high risk patients with calculated eGFR between than 15 and 29ml/min
See Appendix 6

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.
- The person cancelling the surgery or procedure must inform the relevant pre-assessment clinic immediately:
- Teach patients or carers to inject enoxaparin wherever possible, to avoid unnecessary community nurse workload.
- If surgery is to be postponed for more than 1 week, take an anti-Xa level after 3 to 5 days of enoxaparin and contact haematologist with the result for advice: a decision on an individual basis should be made.

Enoxaparin dosing for HIGH RISK PATIENTS & STANDARD RISK AF PATIENTS who have been cancelled and rescheduled within 1 week with calculated Creatinine Clearance 30ml/min or greater						
Weight < 48kg	48-73kg	74-88kg	89-109kg	110-130kg	131-159kg	160-199kg
40mg BD	60mg BD	80mg BD	100mg BD	120mg BD	150mg BD	180mg BD
The last dose should be given in the morning on the day prior to procedure/surgery						

Enoxaparin dosing for HIGH RISK PATIENTS & STANDARD RISK AF PATIENTS who have been cancelled and rescheduled within 1 week with calculated Creatinine Clearance 15-29ml/min or greater						
Weight < 48kg	48-73kg	74-88kg	89-109kg	110-130kg	131-159kg	160-199kg
20mg BD	40mg am 20mg pm	40mg BD	60mg am 40mg pm	60mg BD	80mg BD	100mg am 80mg pm
The last dose should be given in the morning on the day prior to procedure/surgery						

Enoxaparin dosing for HIGH RISK PATIENTS & STANDARD RISK AF who have been cancelled with calculated Creatinine Clearance less than 15ml/min						
Discuss with a Haematologist.						

Enoxaparin dosing for STANDARD RISK PATIENTS with previous venous thrombosis with eGFR 30ml/min/1.73m² or greater who have been cancelled and rescheduled within 1 week			
Weight less than 45kg	45 – 100kg	101 – 150kg	greater than 150kg
20mg once daily in the evening	40mg once daily in the evening	60mg once daily in the evening	60mg twice daily (BD)
The last dose should be given in the evening on the day prior to procedure/surgery			

Enoxaparin dosing for STANDARD RISK PATIENTS with previous venous thrombosis with eGFR 30ml/min/1.73m² or greater who have been cancelled and rescheduled within 1 week			
Weight less than 45kg	45 – 100kg	101 – 150kg	greater than 150kg
20mg once daily in the evening	20mg once daily in the evening	40mg once daily in the evening	60mg twice daily (BD)
The last dose should be given in the evening on the day prior to procedure/surgery			

Enoxaparin dosing for STANDARD RISK PATIENTS who have been cancelled with eGFR less than 15ml/min/1.73m²	
Anti-Xa monitoring may be required: discuss with a Haematologist	

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. Enoxaparin is not necessary given the short onset of action of these drugs.

Appendix 6
TREATMENT GUIDELINES FOR STANDARD RISK PATIENTS (WITH eGFR 15-29ml/min/1.73m²)
OR HIGH RISK PATIENTS (WITH CREATININE CLEARANCE BETWEEN 15-29ml/min)

PATIENTS AT HIGH RISK OF THROMBOSIS AND CREATININE CLEARANCE 15-29ml/min:

TREATMENT PLAN FOR HIGH RISK PATIENTS with calculated CrCl between 15 and 29ml/min (low risk of bleeding)							
Day	< 47kg	48-73kg	74-88kg	89-109kg	110-130kg	131-159kg	160-199kg
-5	Last dose of warfarin (4 clear days) – ensure patient has clear instructions on peri-operative bridging plan						
-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. Start twice daily enoxaparin if INR is less than 2.0						
	20mg BD	40mg OM 20mg EVE	40mg BD	60mg OM 40mg EVE	60mg BD	80mg BD	100mg OM 80mg EVE
-1	20mg OM	40mg OM	40mg OM	60mg OM	60mg OM	80mg OM	100mg OM
0 (day of procedure; *6-8 hours post-op)	20mg OD*	20mg OD*	20mg OD*	40mg OD*	40mg OD*	40mg OD*	60mg OD*
+1	Restart warfarin at patient's usual dose on day +1. Continue enoxaparin until the INR >2.0						
	20mg OD	20mg OD	20mg OD	40mg OD	40mg OD	40mg OD	60mg OD
+2	The following doses may be started 24 hours post-procedure if haemostasis is secure. Monitor peak anti-Xa levels from day +5 onwards.						
	20mg BD	40mg OM 20mg EVE	40mg BD	60mg OM 40mg EVE	60mg BD	80mg BD	100mg OM 80mg EVE

Patients who weigh more 200kg or more should be discussed with haematology.

TREATMENT PLAN FOR HIGH RISK PATIENTS with calculated CrCl between 15 and 29ml/min (high risk of bleeding)							
Day	< 47kg	48-73kg	74-88kg	89-109kg	110-130kg	131-159kg	160-199kg
-5	Last dose of warfarin (4 clear days) – ensure patient has clear instructions on peri-operative bridging plan						
-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. Start twice daily enoxaparin if INR is less than 2.0						
	20mg BD	40mg OM 20mg EVE	40mg BD	60mg OM 40mg EVE	60mg BD	80mg BD	100mg OM 80mg EVE
-1	20mg OM	40mg OM	40mg OM	60mg OM	60mg OM	80mg OM	100mg OM
0 (day of procedure; *6-8 hours post-op)	20mg OD*	20mg OD*	20mg OD*	40mg OD*	40mg OD*	40mg OD*	60mg OD*
+1	Restart warfarin at patient's usual dose on day +1. Continue enoxaparin until the INR >2.0						
	20mg OD	20mg OD	20mg OD	40mg OD	40mg OD	40mg OD	60mg OD
+2	20mg OD	20mg OD	20mg OD	40mg OD	40mg OD	40mg OD	60mg OD
+3	20mg OD	20mg BD	20mg BD	40mg BD	40mg BD	40mg BD	60mg BD
+4	20mg OD	20mg BD	20mg OM 40mg EVE	40mg BD	40mg OM 60mg EVE	60mg BD	60mg OM 80mg EVE
+5	20mg BD	40mg OM 20mg EVE	40mg BD	60mg OM 40mg EVE	60mg BD	80mg BD	100mg OM 80mg EVE

- **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. Samples should be taken 3 to 4 hours post-dose and levels discussed with haematology.

PATIENTS AT STANDARD RISK OF THROMBOSIS:

Weight-based thromboprophylactic dosing of enoxaparin for patients with eGFR 15-29ml/min/1.73m²:

Weight	Less than 45kg	45-99kg	100-149kg	150kg & greater
Enoxaparin Dose	20mg OD	20mg OD	40mg OD	60mg OD

Appendix 7
TREATMENT GUIDELINES FOR ALL PATIENTS WITH CREATININE CLEARANCE
LESS THAN
15ml/min OR ON DIALYSIS:

TREATMENT PLAN FOR ALL PATIENTS with calculated CrCl less than 15ml/min or on dialysis (low risk of bleeding)							
Day							
-5	Last dose of warfarin (4 clear days) – ensure patient has clear instructions on peri-operative bridging plan						
-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. Admit patient and start unfractionated heparin if INR is less than 2.0						
-1	Recheck INR only if INR is greater than 1.5 on day -2 and give further oral vitamin K if INR > 1.5. If INR less than 2.0, start unfractionated heparin.						
Day/weight	< 47kg	48-73kg	74-88kg	89-109kg	110-130kg	131-159kg	160-199kg
0 (day of procedure; *6-8 hours post-op)	Stop unfractionated heparin 6 hours before the procedure						
	20mg OD*	20mg OD*	20mg OD*	20mg OD*	40mg OD*	40mg OD*	40mg OD*
+1	Commence unfractionated heparin until INR > 2.0 Restart warfarin at patient's usual dose on day +1.						

Patients who weigh more 200kg or more should be discussed with haematology.

TREATMENT PLAN FOR PATIENTS with calculated CrCl less than 15ml/min or on dialysis (high risk of bleeding)							
Day							
-5	Last dose of warfarin (4 clear days) – ensure patient has clear instructions on peri-operative bridging plan						
-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. Admit patient and start unfractionated heparin if INR is less than 2.0						
-1	Recheck INR only if INR is greater than 1.5 on day -2 and give further oral vitamin K if INR > 1.5. If INR less than 2.0, start unfractionated heparin.						
Day/weight	< 47kg	48-73kg	74-88kg	89-109kg	110-130kg	131-159kg	160-199kg
0 (day of procedure; *6-8 hours post-op)	Stop unfractionated heparin 6 hours before the procedure						
	20mg OD*	20mg OD*	20mg OD*	20mg OD*	40mg OD*	40mg OD*	40mg OD*
+1	Restart warfarin at patient's usual dose on day +1.						
+2	20mg OD	20mg OD	20mg OD	20mg OD	40mg OD	40mg OD	40mg OD
+3	Commence unfractionated heparin until INR > 2.0						