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This Medicines Information Leaflet is produced locally to optimise the use of medicines by encouraging prescribing that is safe, clinically appropriate and cost-effective to the NHS.

Management of Anticoagulation for Elective Surgery and Invasive Procedures

The perioperative/periprocedural management of patients who are receiving oral anticoagulation with warfarin or a Direct Oral Anticoagulant, DOAC (e.g. dabigatran, rivaroxaban, apixaban or edoxaban) depends on the:

1. **Underlying thrombotic risk**

Dictated by:

- indication for anticoagulation
- the time that has passed since their last venous or arterial event
- their previous thrombosis history
- their anticoagulation drug/dose/anticoagulation target range

AND

2. **The site of intended surgical intervention** and the risk of bleeding associated with the procedure.

When being assessed for their procedure, patients should be counselled that if anticoagulation is paused, there is an increased risk of thrombosis. We aim to reduce this risk through planning, assessment and MDT involvement but thrombotic events *can* still occur. Planning, discussing and anticoagulation management is the responsibility of the operating team. The haemostasis team can advise when asked. For patients with complex anticoagulation needs, an MDT approach with Consultant-led discussions is recommended.

Pre-operative planning and communication

For patients on warfarin, the pre-operative assessment team must liaise with the patient's anticoagulation service (bleep 1857 for Oxfordshire patients) for any pause to their treatment as this will affect dosing and INR testing. For patients from outside of Oxfordshire, relevant contact details are available here.

DOACs are managed by GPs and patients should be given clear written instructions about when to stop taking their medication pre-operatively by their operating team.

Identify underlying thrombotic risk

Patients with high thrombotic risk

Table 1 outlines the types of patients deemed to be at high thrombotic risk. These patients should be specifically identified in their pre-operative assessment and if necessary, their care is discussed via 'haemostasis consult' on EPR or if urgent with the haemostasis registrar (bleep 5529).

Table 1: High thrombotic risk patients

VTE	Patients with a VTE within previous 3 months. Very high risk patients such as patients with a previous VTE whilst on therapeutic anticoagulation Chronic Thrombo-embolic Pulmonary Hypertension (CTEPH) Triple positive antiphospholipid syndrome (Positive lupus anticoagulant, positive anticardiolipin and β2 GP1 antibodies)
AF	Patients with a previous stroke/TIA in last 3 months Patients with a previous stroke/TIA and three or more of the following risk factors: • Heart failure • Hypertension (greater than 140/90mmHg or on medication) • Age over 75 years • Diabetes mellitus
MHV	All mechanical heart valve patients
Cardiac thrombus	Patients with ventricular thrombus

Patients with standard thrombotic risk
Peri-operatively these patients should have a standard VTE risk assessment.

Timing of surgery
Patients with high thrombotic risk, should have as little interruption as possible to their therapeutic anticoagulation. Risk of thrombosis if anticoagulation is paused is usually highest soon after any previous thrombotic event. It is estimated that cessation of anticoagulation in the first month after an acute VTE is associated with a 40% one-month risk of recurrent VTE, and 10% for the subsequent two months. Of note, the highest risk period of recurrent thrombosis after Heparin Induced Thrombosis and Thrombocytopenia (HITT) is usually in the first 100 days post thrombosis.

Therefore, timing of elective surgery should be delayed until 3 months after an acute VTE. If this is not possible, a formal anticoagulation plan is required, and the admitting team may liaise with haematology (bleep 5529). If patients require surgery within 1 month of their thrombotic event, especially if therapeutic anticoagulation cannot recommence 48 hours post-operatively, an IVC filter may be considered. This will need to be removed once anticoagulation resumes.

Pre-operative management of anticoagulation

For procedure specific guidelines, please refer to:
- Endoscopy SOP
- Epidural Guidelines
- Interventional Radiology Guidelines

General surgical guidance
a. Warfarin: major surgery or procedure which requires the INR to be normalised
For patients who are identified as high thrombotic risk from table 1 **and** are on warfarin, bridging with full treatment dose Low Molecular Weight Heparin (LMWH) once the INR is subtherapeutic will be required. The supply of LMWH must be prescribed and supplied by the hospital. This should be discussed and arranged during the pre-operative assessment. Enoxaparin sodium is the LMWH of choice in OUH. Enoxaparin is a biological medicine and as such should be prescribed by brand; Inhixa® will be supplied for all enoxaparin prescriptions. Each reference to enoxaparin in this document relates to Inhixa®. The dose of enoxaparin recommended for bridging is:

- Enoxaparin 1mg/kg twice daily **ALL** patients with creatinine clearance over 30ml/min **except** those with a VTE within the previous 3 months (table 3)
- Enoxaparin 1mg/kg daily **ALL** patients with creatinine clearance 30ml/min or less (table 4)
- Enoxaparin 1.5mg/kg daily **ONLY** patients with a VTE within the previous 3 months (table 5)

See appendix 1 for further details.

Warfarin should be stopped 5 days before surgery. There is no need to monitor the INR in patients who are at home for the 5 days before surgery. The last dose of warfarin should be taken on the evening of day -6. LMWH if indicated (see table 1), is started on the morning of day -3 and is continued until day -1 and must be stopped 24 hours before surgery.

In all patients whose warfarin has been stopped 5 days before surgery, the INR should be measured on the day before surgery, allowing correction with oral phytomenadione (vitamin K) if it is greater than or equal to 1.5 (suggested dose 2mg). If correction with phytomenadione is required, the INR should be rechecked on the morning of surgery.

For patients stopping warfarin, planned surgery on Mondays is generally best avoided to negate the need for weekend blood tests. If this is not possible, contact the anticoagulation team to discuss further.

Patients with HITT who require invasive procedures may require alternative anticoagulation agents if bridging and intra-operative anticoagulation is required. These patients should also be discussed in a Consultant-led MDT setting.

b. Warfarin: minor surgery or procedure with low bleeding risk
For some operations the surgeon may advise that the INR need only be reduced (e.g. to 1.5-2) for the procedure in which case bridging anticoagulation may not be required. In these cases, the surgical team should liaise with the anticoagulation service in good time to make necessary dose adjustments and arrange an INR test the day before surgery as described above.

Some procedures, such as joint injections and cataract surgery, can be carried out without interrupting warfarin therapy. However, the person performing the procedure may advise that the INR is reduced to 1.5-2.

c. DOACs: major and minor surgery

The approach to the peri-operative or peri-procedure management of patients on DOACs is based on an approximate calculation of the half-life of the drug and its persistence in the circulation, considering renal function. This is combined with assessment of the bleeding risk of the proposed procedure and a clinical evaluation of the patient's individual risk factors for thrombosis and bleeding. Current strategies for elective surgery do not routinely include measurement of either non-specific or specific coagulation parameters to assist in quantification of DOAC levels.

Due to their short half-lives bridging with heparin is not required. Suggested periods for discontinuation are in table 2. Note: eGFR is a reasonable guide to GFR in most patients. However, in patients at extremes of body weight a GFR should be calculated using the Cockcroft-Gault formula. If surgery is delayed, anticoagulation needs to be regularly reviewed.

Table 2: Discontinuation of DOACs for elective procedures

Renal Function eGFR (ml/min)	Low bleeding risk procedure	High bleeding risk procedure
Dabigatran		
80 or more	24 hours	48 hours
50 to 79	24-48 hours	48-72 hours
30 to 49	48-72 hours	96 hours
Dabigatran is not licensed for use with an eGFR below 30ml/min		
Apixaban, Rivaroxaban and Edoxaban		
30 or more	24 hours	48 hours
15-29	48 hours	72 hours
Apixaban, rivaroxaban and edoxaban are not licensed for use with an eGFR below 15ml/min		

d. Patients receiving treatment dose LMWH

Treatment dose LMWH can continue until 24 hours pre-surgery. For surgery which has a high risk of bleeding, the dose of LMWH 24 hours pre-surgery can be halved.

e. Other therapeutic anticoagulants - argatroban unfractionated heparin (UFH) and fondaparinux

In patients who are receiving bridging anticoagulation with therapeutic dose intravenous UFH infusion, heparin should be stopped 4-6 hours before surgery (discuss timing with the operating surgeon). Refer to MIL vol.5 no.6 "Guidelines on when to use and how to monitor unfractionated heparin in adults".

For other anticoagulants, their specific half-life, the patient's renal and liver function, indication and surgical bleeding risk will dictate when the drug is stopped. Please discuss with the haemostasis team.

Delays in procedures and cancellation

In patients who are high risk for thrombosis, the peri-operative plan should also consider whether prophylactic anticoagulation or re-initiation of therapeutic anticoagulation is needed after a period of time if the procedure is not going ahead as planned. Where possible, it should be highlighted that delay for these patients should be avoided, if possible, due to the increased thrombotic risk. This may require Consultant level re-discussion with haematology, surgery, endoscopy, and/or radiology dependent on when the team can proceed.

Post-operative management of anticoagulation

In patients undergoing a procedure which carries a high risk of bleeding, the post-op anticoagulation depends on a balance between the risk of bleeding and the risk of thrombosis.

a. LMWH post major and minor surgery

Following major surgery/procedure with a high bleeding risk, prophylactic LMWH can be used. Prophylactic LMWH can be administered 6-12 hours post-surgery provided haemostasis is secure This can be switched to therapeutic anticoagulation with LMWH (if used for bridging or as sole treatment) a minimum of 48 hours post procedure. For high bleeding risk surgery (such as spinal and cranial surgery) **prophylactic** enoxaparin should be delayed for 24-48 hours.

Instruction for the provision of post-operative LMWH is the responsibility of the operating surgeon and should be documented in the patient's notes.

b. Warfarin post major and minor surgery

Warfarin can be resumed, at the normal maintenance dose, the evening of surgery or the next day, if there is adequate haemostasis and following discussion with the operating surgeon. For patients who required bridging pre-op, LMWH should be restarted until INR is within range (see LMWH section above).

c. DOACs post major and minor surgery

Following low bleeding risk procedures, a DOAC can be recommenced once haemostasis is secured,

usually at 24 hours. Following major surgery, or procedure with high bleeding risk, a DOAC should not be re-introduced until at least 48 hours post procedure. Prophylactic LMWH should be given in the interim (provided haemostasis is secure) and stopped on resumption of DOAC.

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Appendix 1: Doses of enoxaparin for bridging in patients with high thrombotic risk

Table 3: Enoxaparin 1mg/kg twice daily for **ALL** patients with creatinine clearance over 30ml/min **except** those with a VTE within previous 3 months

Weight *	Dose of enoxaparin by subcutaneous injection using a pre-filled syringe
39kg or less	speak to haematology
40-44kg	40mg twice daily
45-54kg	60mg morning and 40mg evening
55-64kg	60mg twice daily
65-74kg	80mg morning and 60mg evening
75-84kg	80mg twice daily
85-94kg	100mg morning and 80mg evening
95-104kg	100mg twice daily
105-114kg	120mg morning and 100mg evening
115-122kg	120mg twice daily
123-132kg	150mg morning and 100mg evening
133-142kg	150mg morning and 120mg evening
143kg or more	150mg twice daily

* Doses of enoxaparin are weight-based. It is imperative that the patient is weighed and that the weight is documented on the patient's electronic record. In exceptional circumstances, when weighing the patient is not possible, the estimated weight must be documented. For patients with known fluid overload (e.g. those requiring dialysis, nephrotic syndrome, liver or heart failure), dry weight (known or estimated) should be used to dose the LMWH.

Table 4: Enoxaparin 1mg/kg daily for **ALL** patients with creatinine clearance 30ml/min or less including dialysis (for acute kidney injury or maintenance)

A switch from once daily to twice daily dosing is required from 165kg due to availability of syringes.

Weight *	Dose of enoxaparin by subcutaneous injection using a pre-filled syringe
39kg or less	Speak to haematology
40-49kg	40mg once daily
50-69kg	60mg once daily
70-89kg	80mg once daily
90-109kg	100mg once daily
110-134kg	120mg once daily
135-164kg	150mg once daily
165-189kg	100mg morning and 80mg evening*
190-209kg	100mg twice daily
210-229kg	120mg morning and 100mg evening*
230- 244kg	120mg twice daily
245-259kg	150mg morning and 100mg evening*
260-284kg	150mg morning and 120mg evening*
285kg or more	150mg twice daily

Table 5: Enoxaparin 1.5mg/kg daily **ONLY** patients with a VTE within previous 3 months

A switch from once daily to twice daily dosing is required from 110kg due to availability of syringes.

Weight *	Dose of enoxaparin by subcutaneous injection using a pre-filled syringe
39kg or less	speak to haematology
40-47kg	60mg once daily
48-59kg	80mg once daily
60-73kg	100mg once daily
74-88kg	120mg once daily
89-109kg	150mg once daily
110-125kg	100mg morning and 80mg evening
126-139kg	100mg twice daily
140-154kg	120mg morning and 100mg evening
155-162kg	120mg twice daily
163-176kg	150mg morning and 100mg evening
177-190kg	150mg morning and 120mg evening
191kg or more	150mg twice daily

* Doses of enoxaparin are weight-based. It is imperative that the patient is weighed and that the weight is documented on the patient's electronic record. In exceptional circumstances, when weighing the patient is not possible, the estimated weight must be documented. For patients with known fluid overload (e.g. those requiring dialysis, nephrotic syndrome, liver or heart failure), dry weight (known or estimated) should be used to dose the LMWH.