Perioperative management

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- The management of anticoagulation in patients undergoing surgical procedures is challenging

- Interruption of anticoagulation temporarily increases thromboembolic risk, and continuing anticoagulation increases the risk of bleeding associated with invasive procedures

- there are few large, well-designed, randomized, placebo-controlled trials in this clinical domain

- **Estimate thromboembolic risk**
- **Estimate bleeding risk**
- **Determine the timing of anticoagulant interruption**
- **Determine whether to use bridging anticoagulation**

Estimate thromboembolic risk

Thrombotic risk	Indication for anticoagulant therapy		
	Mechanical heart valve	Atrial fibrillation	VTE
High thrombotic risk*	Any mitral valve prosthesis Any caged-ball or tilting disc aortic valve prosthesis Recent (within 6 months) stroke or transient ischemic attack	$CHADS_2$ score 5-6 CHA_2DS_2-VASc score 7-9 Recent (within 3 months) stroke or transient ischemic attack Rheumatic valvular heart disease	Recent (within 3 months) VTE Severe thrombophilia (eg, deficiency of protein C, protein S, or antithrombin; antiphospholipid antibodies; multiple abnormalities)
Moderate thrombotic risk	Bileaflet aortic valve prosthesis and 1 or more of the of following risk factors: atrial fibrillation, prior stroke or transient ischemic attack, hypertension, diabetes, congestive heart failure, age >75 years	$CHADS_2$ score 3-4 CHA_2DS_2-VASc score 4-6	VTE within the past 3 to 12 months Nonsevere thrombophilia (eg, heterozygous factor V Leiden or prothrombin gene mutation) Recurrent VTE Active cancer (treated within 6 months or palliative)
Low thrombotic risk	Bileaflet aortic valve prosthesis without atrial fibrillation and no other risk factors for stroke	$CHADS_2$ score 0-2 CHA_2DS_2-VASc score 0-3 (assuming no prior stroke or transient ischemic attack)	VTE >12 months previous and no other risk factors

- **$CHADS_2$**:
  - congestive heart failure
  - Hypertension
  - age ≥75 years
  - diabetes mellitus
  - stroke or transient ischemic attack

- **CHA_2DS_2-VASc**:
  - congestive heart failure
  - Hypertension
  - age ≥75 years (2 points)
  - diabetes mellitus
  - prior stroke or transient ischemic attack or thromboembolism (2 points)
  - vascular disease (peripheral artery disease, myocardial infarction, or aortic plaque)
  - age 65 to 74 years
  - sex category female

Estimate bleeding risk

- A higher bleeding risk confers a greater need for perioperative hemostasis and hence a longer period of anticoagulant interruption.

- Procedures with a low bleeding risk (eg, dental extractions, minor skin surgery) often can be performed without interruption of anticoagulation

❖High bleeding risk procedure (two-day risk of major bleed 2 to 4%)

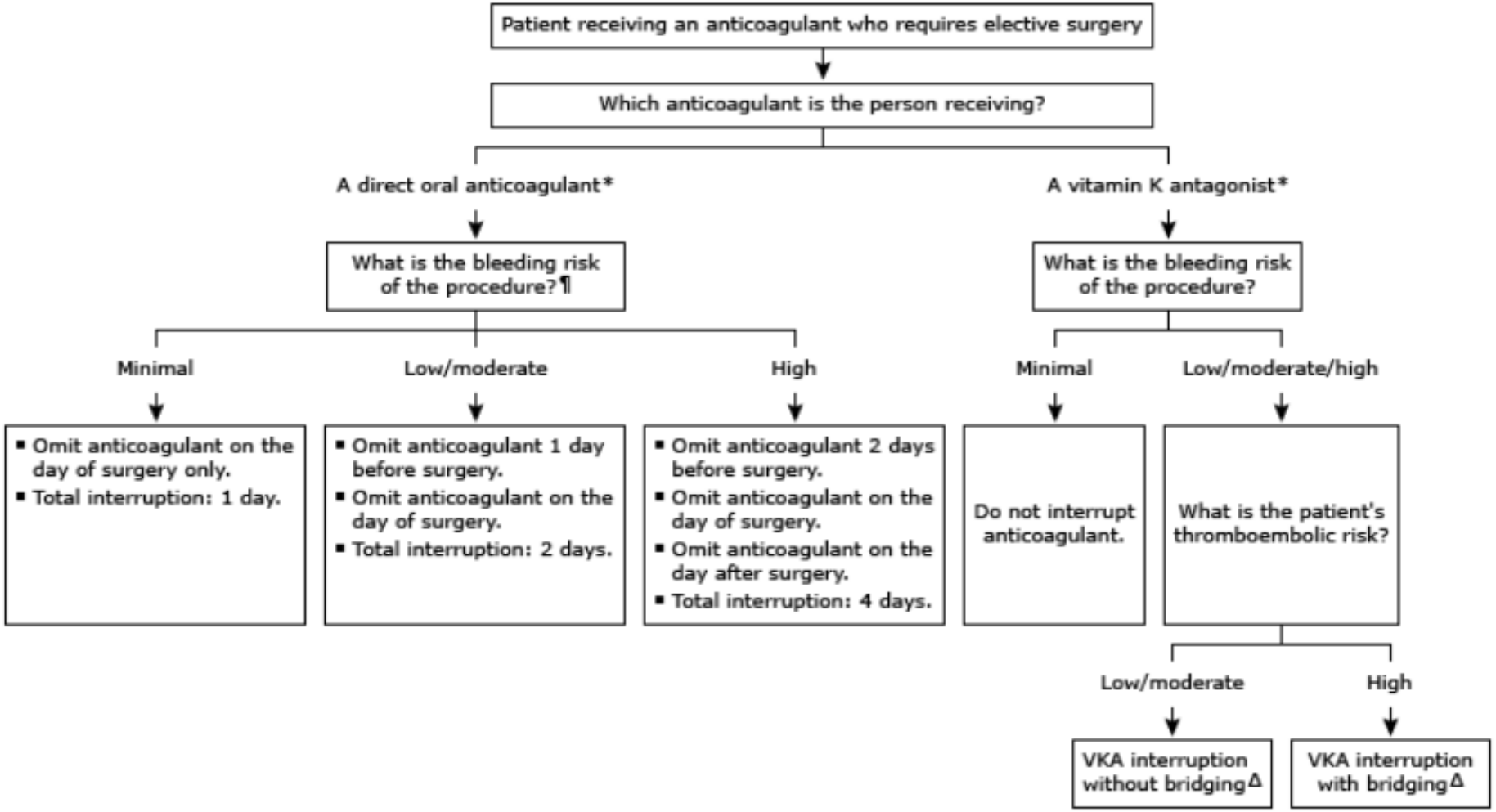
- Any major operation of duration >45 minutes
- Abdominal aortic aneurysm repair
- Coronary artery bypass
- Endoscopically guided fine-needle aspiration
- Foot/hand/shoulder surgery
- Heart valve replacement
- Hip replacement
- Kidney biopsy
- Knee replacement
- Laminectomy
- Neurosurgical/urologic/head and neck/abdominal/breast cancer surgery
- Polypectomy, variceal treatment, biliary sphincterectomy, pneumatic dilatation
- Transurethral prostate resection
- Vascular and general surgery

- Major bleeding is generally defined as bleeding that is fatal, involves:
  - critical anatomic site (eg, intracranial, pericardial)
  - requires surgery to correct
  - lowers the hemoglobin by ≥2 g/dL
  - requires transfusion of ≥2 units packed red cells

Clinical characteristics comprising the HAS-BLED bleeding risk score

	Clinical characteristic
H	Hypertension (ie, uncontrolled blood pressure)
A	Abnormal renal and liver function (1 point each)
S	Stroke
B	Bleeding tendency or predisposition
L	Labile INRs (for patients taking warfarin)
E	Elderly (age greater than 65 years)
D	Drugs (concomitant aspirin or NSAIDs) or excess alcohol use (1 point each)

DECIDING WHETHER TO INTERRUPT ANTICOAGULATION



- NSAIDs and aspirin should be avoided for routine analgesia

- In recent stroke, acute coronary syndromes, implanted coronary stent aspirin can be continued

- Delay elective surgery in:
  - Recent stroke (within the previous three months)
  - atrial fibrillation with inadequate anticoagulation (the preceding month)

- Individuals with a moderate thromboembolic risk generally can interrupt their anticoagulant for surgery without bridging.

Temporary IVC filters

- patients with a very recent (within the prior three to four weeks) acute VTE who require interruption of anticoagulation for a surgery

TIMING OF ANTICOAGULANT INTERRUPTION

- For warfarin, laboratory testing is a reliable indicator that the anticoagulant effect has resolved after discontinuation

- For direct oral anticoagulants (DOACs), well-validated and easily accessible testing is not always available

WARFARIN

- biologic half-life of warfarin is about 36 to 42 hours
- Discontinue warfarin for 5days (in this approach Vit K should be avoided)

- Check the INR one to two days before the surgery, and, if the INR is >1.5, a **low** dose of oral vitamin K (eg, 1 to 2 mg) can be given

- Resume warfarin 12 to 24 hours after surgery, typically the evening of the day of surgery

DOAC interruptions

- **Low/moderate bleed risk** – For low/moderate bleeding risk surgery, omit the DOAC one day before and resume one day (approximately 24 hours) after the procedure, provided hemostasis is secure.

- **High bleed risk** – For high bleeding risk surgery, omit the DOAC two days before and resume two days (approximately 48 hours) after the procedure

- For individuals with impaired kidney function (creatinine clearance [CrCl] <30 to 50 mL/min) who are taking dabigatran, there is an additional one-day interruption before low/moderate bleeding risk procedures and an additional two-day interruption before high bleeding risk procedures. Direct factor Xa inhibitors (apixaban, edoxaban, rivaroxaban) do not require adjustments for kidney function

BRIDGING ANTICOAGULATION

- Avoid bridging in individuals who have low thromboembolic risk with anticoagulant interruption :
  - Individuals receiving a direct oral anticoagulant (DOAC), unless they have a high thromboembolic risk and a prolonged period during which they cannot take the DOAC postoperatively (eg, due to intestinal ileus)
  - Routine prophylactic anticoagulation in atrial fibrillation
  - Secondary prophylaxis following venous thromboembolism (VTE) (more than three months prior)

BRIDGING ANTICOAGULATION

- Bridging indication:
  - Mechanical mitral valve (exceptions may include those with newer-generation On-X valves or without any additional stroke risk factors)
  - Mechanical aortic valve with major additional stroke risk factors (eg, prior stroke or TIA)
  - Embolic stroke within the previous three months or very high stroke risk (eg, $CHADS_2$ score of 5 or 6)
  - VTE within the previous three months (except those with a calf deep vein thrombosis (DVT) and no evidence of DVT on repeat ultrasound, who may not require bridging)
  - Possibly in selected individuals with recent coronary stenting (eg, within the previous three months)
  - Previous thromboembolism during interruption of chronic anticoagulation

BRIDGING ANTICOAGULATION

- LMW heparins are used for bridging, as they have similar efficacy compared with UFH, are more convenient to use, and generally do not require monitoring

- Intravenous unfractionated heparin is less costly and can be reversed more rapidly than subcutaneous LMW heparin

- For dialysis patient UFH can be used more easily because dosing is unaffected by kidney function

- **Therapeutic dosing** – Therapeutic dosing (also called "full dose") is appropriate for bridging anticoagulation for individuals with a potential arterial thromboembolic source (eg, atrial fibrillation, mechanical heart valve) or VTE within the preceding month. Typical regimens include enoxaparin, 1 mg/kg subcutaneously twice daily or dalteparin, 100 units/kg subcutaneously twice daily

- **Intermediate dosing** – Intermediate-dose anticoagulation may be appropriate for individuals with atrial fibrillation or VTE within the preceding month when bridging is needed but concerns about bleeding are greater. Typical regimens include enoxaparin, 40 mg twice daily, or dalteparin, 5000 units subcutaneously twice daily

- **Prophylactic dosing** – Prophylactic-dose anticoagulation (also called "low dose") generally is not used for bridging in patients with atrial fibrillation. This dose level may be reasonable in patients who have had a VTE event within the preceding 3 to 12 months. Typical prophylactic regimens include enoxaparin, 40 mg once daily, or dalteparin, 5000 units subcutaneously once daily

- **LMW heparin:** discontinue low molecular weight (LMW) heparin 24 hours before the planned surgery or procedure, based on a biologic half-life of most subcutaneous LMW heparins of approximately three to five hours.
- If a twice-daily LMW heparin regimen is given, the evening dose the night before surgery is omitted, whereas if a once-daily regimen is given (eg, dalteparin 200 international units/kg), one-half of the total daily dose is given on the morning of the day before surgery.

- Unfractionated heparin – For therapeutic-dose unfractionated heparin, we continue the intravenous infusion until four to five hours before the procedure, based on the biologic half-life of intravenous unfractionated heparin of approximately 45 minutes

URGENT/EMERGENCY INVASIVE PROCEDURE

- **Warfarin:**
  - If semi-urgent reversal of warfarin is required (eg, within one to two days), warfarin should be withheld and vitamin K administered (eg, 2.5 to 5 mg of oral or intravenous vitamin K)
  - If immediate reversal is required this can be achieved via the use of PCCs or plasma products (eg, Fresh Frozen Plasma [FFP], Plasma Frozen Within 24 Hours After Phlebotomy [PF24]) along with vitamin K

URGENT/EMERGENCY INVASIVE PROCEDURE

- **Dabigatran:** it can be reversed by idarucizumab.

- **Rivaroxaban, apixaban, and edoxaban:** can be reversed by andexanet alfa or a PCC