2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

Table 5 **Surgical risk estimate according to type of surgery or intervention**

Low surgical risk (<1%)	Intermediate surgical risk (1–5%)	High surgical risk (>5%)
• Breast • Dental • Endocrine: thyroid • Eye • Gynaecological: minor • Orthopaedic minor (meniscectomy) • Reconstructive • Superficial surgery • Urological minor: (transurethral resection of the prostate) • VATS minor lung resection	• Carotid asymptomatic (CEA or CAS) • Carotid symptomatic (CEA) • Endovascular aortic aneurysm repair • Head or neck surgery • Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy • Intrathoracic: non-major • Neurological or orthopaedic: major (hip and spine surgery) • Peripheral arterial angioplasty • Renal transplants • Urological or gynaecological: major	• Adrenal resection • Aortic and major vascular surgery • Carotid symptomatic (CAS) • Duodenal-pancreatic surgery • Liver resection, bile duct surgery • Oesophagectomy • Open lower limb revascularization for acute limb ischaemia or amputation • Pneumonectomy (VATS or open surgery) • Pulmonary or liver transplant • Repair of perforated bowel • Total cystectomy

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CAS, carotid artery stenting; CEA, carotid endarterectomy; CV, cardiovascular; MI, myocardial infarction; VATS, video-assisted thoracic surgery.
Surgical risk estimate is a broad approximation of 30 day risk of CV death, MI, and stroke that takes into account only the specific surgical intervention, without considering the patient's comorbidities.
Adapted from data in Glance *et al.*, Muller *et al.*, Bendixen *et al.*, and Falcoz *et al.*[18–23]

Table 9 **Bleeding risk according to type of non-cardiac surgery**

Surgery with minor bleeding risk	Surgery with low bleeding risk (infrequent or with low clinical impact)	Surgery with high bleeding risk (frequent or with significant clinical impact)
• Cataract or glaucoma procedure • Dental procedures: extractions (1–3 teeth), periodontal surgery, implant positioning, endodontic (root canal) procedures, subgingival scaling/cleaning • Endoscopy without biopsy or resection • Superficial surgery (e.g. abscess incision, small skin excisions/ biopsy)	• Abdominal surgery: cholecystectomy, hernia repair, colon resection • Breast surgery • Complex dental procedures (multiple tooth extractions) • Endoscopy with simple biopsy • Gastroscopy or colonoscopy with simple biopsy • Large-bore needles procedures (e.g. bone marrow or lymph node biopsy) • Non-cataract ophthalmic surgery • Small orthopaedic surgery (foot, hand arthroscopy)	• Abdominal surgery with liver biopsy, extracorporeal shockwave lithotripsy • Extensive cancer surgery (e.g. pancreas, liver) • Neuraxial (spinal or epidural) anaesthesia • Neurosurgery (intracranial, spinal) • Major orthopaedic surgery • Procedures with vascular organ biopsy (kidney or prostate) • Reconstructive plastic surgery • Specific interventions (colon polypectomy, lumbar puncture, endovascular aneurysm repair) • Thoracic surgery, lung resection surgery • Urological surgery (prostatectomy, bladder tumour resection) • Vascular surgery (e.g. AAA repair, vascular bypass)

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AAA, abdominal aortic aneurysm.
Adapted from Steffel *et al.*[240]

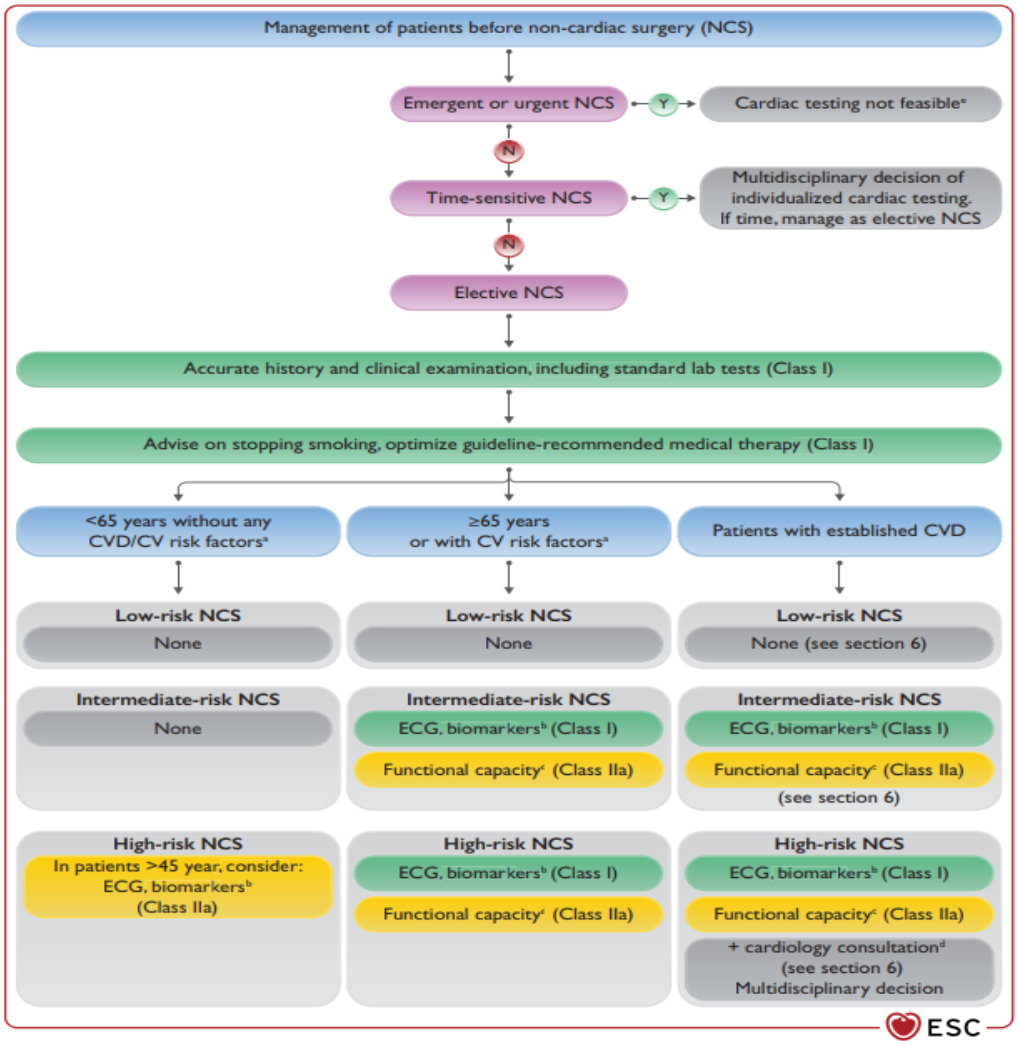

Figure 2 Pre-operative assessment before non-cardiac surgery. CV, cardiovascular; CVD, cardiovascular disease; ECG, electrocardiogram; N, no; NCS, non-cardiac surgery. Y, yes; [a]CV risk factors: hypertension, smoking, dyslipidaemia, diabetes, family history of CVD. [b]Biomarkers: hs-cTn T/I (Class I) and/or BNP/NT-proBNP (Class IIa). If pathological, consult a cardiologist. [c]Functional capacity based on Duke Activity Status Index (DASI) or the ability to climb two flights of stairs. [d]For diagnostic and therapeutic efforts to be considered, see *Section 6*. [e]Close follow-up after intervention and subsequent management of heart disease are advised.

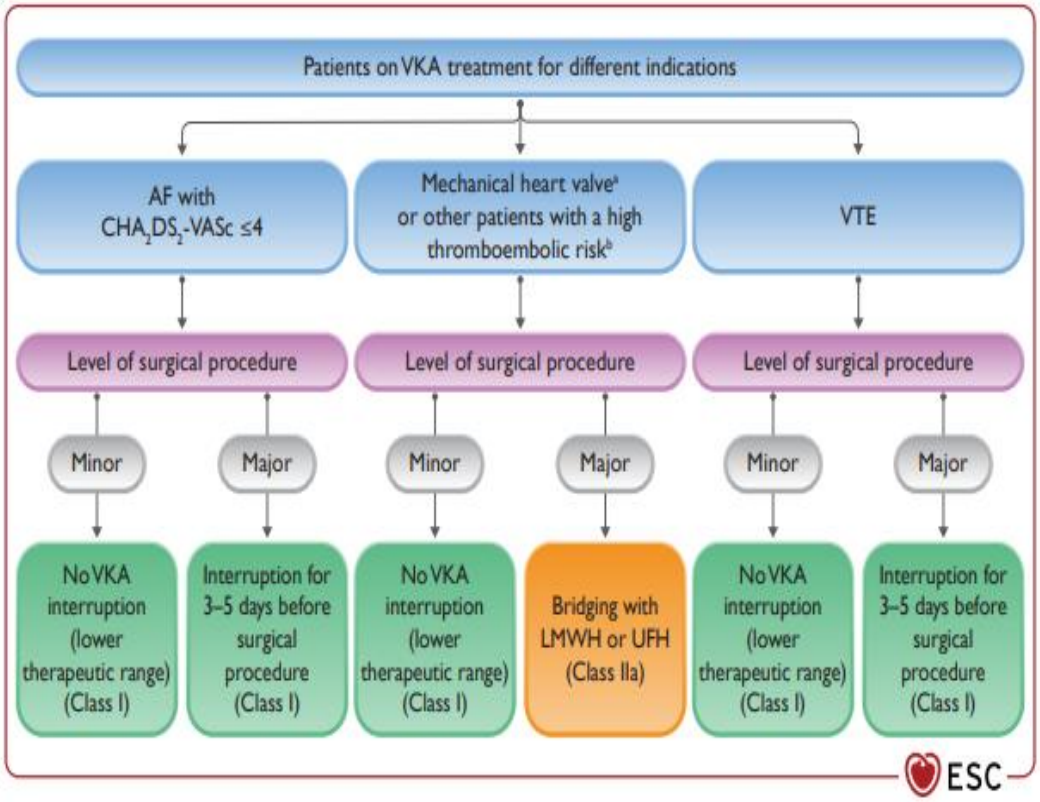

Figure S3 Management of vitamin K antagonists before non-cardiac surgery. AF, atrial fibrillation; AVR, aortic valve replacement; CHA_2DS_2-VASc, congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, stroke, vascular disease, age 65–74 years, sex category (female); LMWH, low molecular weight heparin; UFH, unfractionated heparin; VKA, vitamin K antagonist; VTE, venous thromboembolism. [a]Mechanical AVR and any thromboembolic risk factor, or an older-generation mechanical AVR, or a mechanical mitral valve replacement. [b]Recent stroke <3 months, high risk of VTE recurrences (e.g. antithrombin 3 deficiency or proteins C and/or S deficiency), LV apex thrombus, AF with a very high stroke risk.

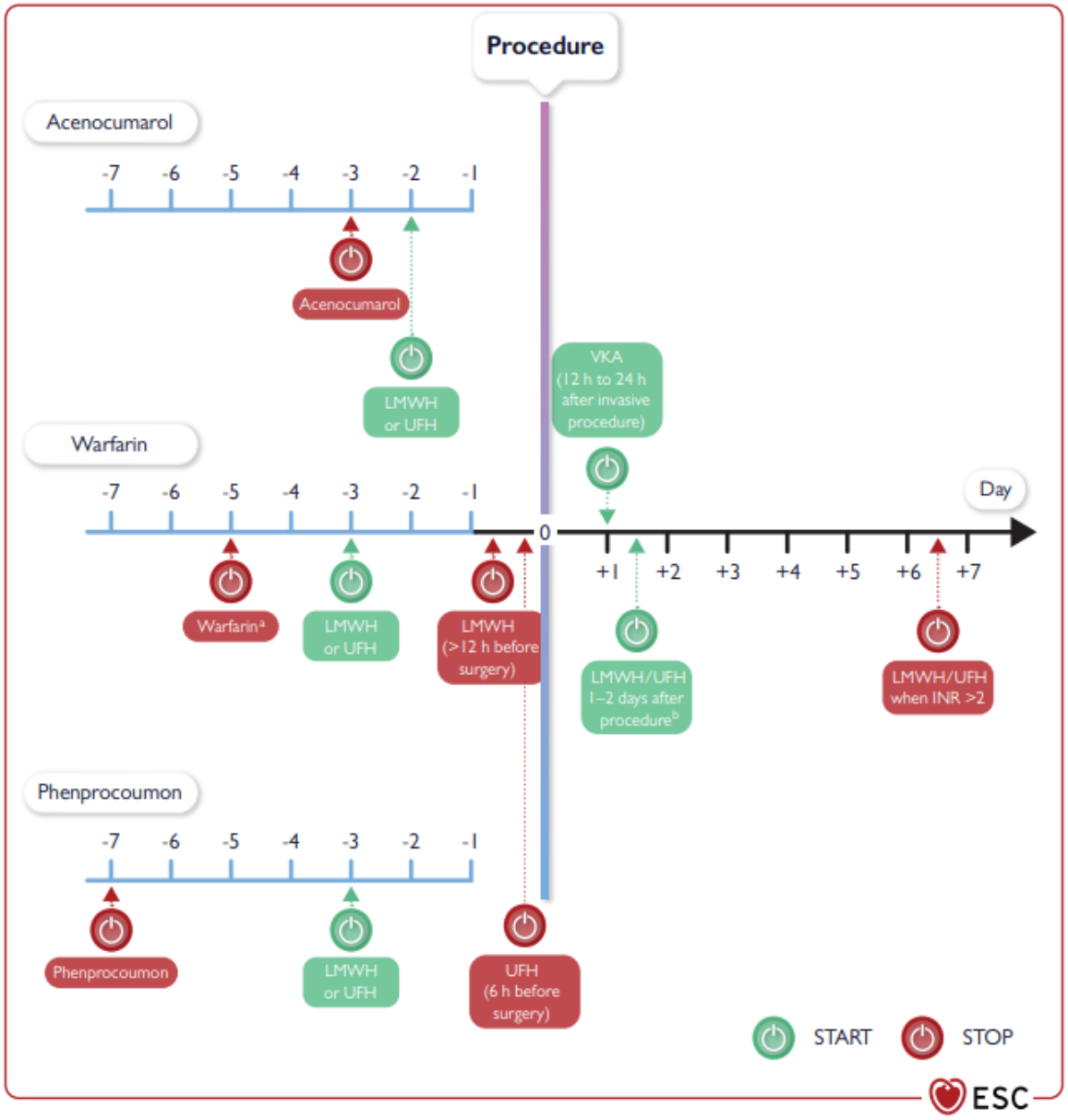

Figure S2 Vitamin K antagonists and bridging strategies. INR, international normalized ratio; LMWH, low molecular weight heparin; NCS, non-cardiac surgery; UFH, unfractionated heparin; VKA, vitamin K antagonist. [a]First day without warfarin. [b]For surgery with low bleeding risk, therapeutic-dose LMWH or UFH can usually be resumed 24 h after the procedure. For surgery with a high bleeding risk, therapeutic-dose LMWH or UFH should be delayed for 48–72 h after haemostasis has been secured.

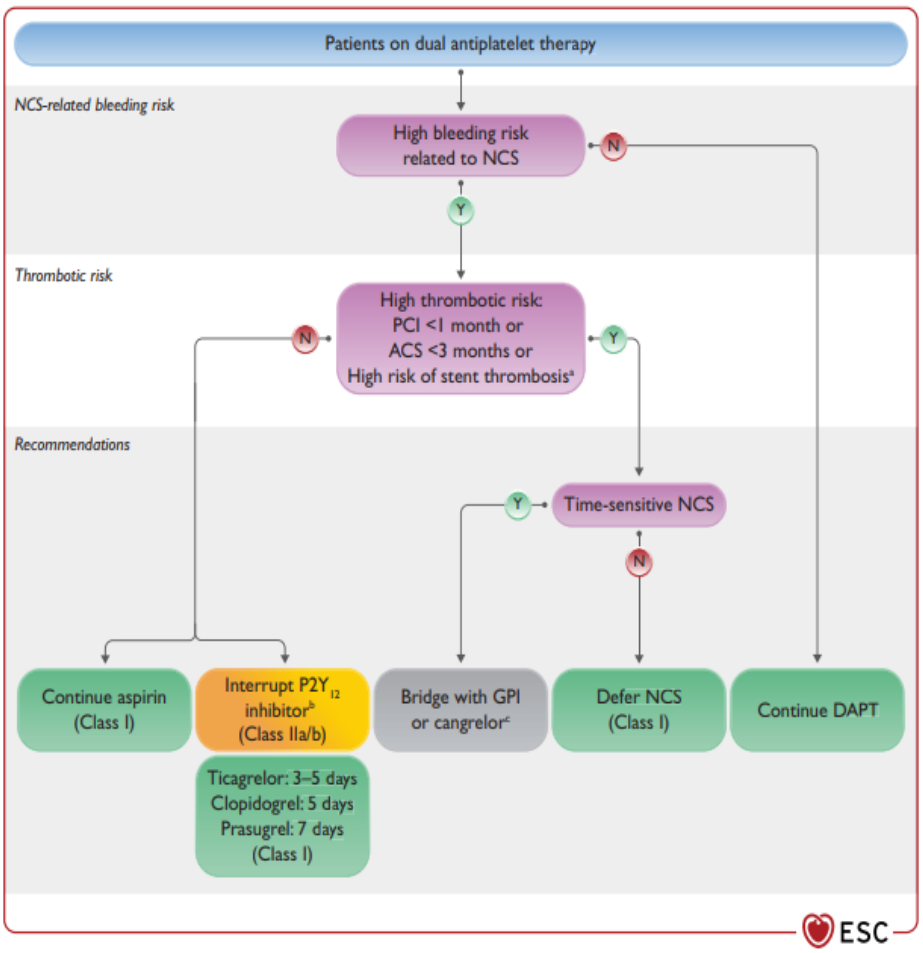

Figure 5 Recommendations for management of antiplatelet therapy in patients undergoing non-cardiac surgery. ACS, acute coronary syndrome; DAPT, dual antiplatelet therapy; GPI, glycoprotein IIb/IIIa inhibitors; PCI, percutaneous coronary intervention; N, no; NCS, non-cardiac surgery. Y, yes; [a]High risk of peri-operative stent thrombosis defined by at least one of the following: history of stent thrombosis under antiplatelet therapy, reduced left ventricular ejection fraction (<40%), poorly controlled diabetes, severely impaired renal function/haemodialysis, recent complex PCI (i.e. severely calcified lesion, left main PCI, chronic total occlusion, bifurcational/crush technique, bypass graft PCI), or stent malapposition/residual dissection. [b]Timing of resumption after interdisciplinary risk assessment as soon as possible (within 48 h) after surgery. [c]For dosing, see *Figure 7*.

Thrombotic risk, High thrombotic risk: PCI <1 month or ACS <3 months or High risk of stent thrombosis, . AF with CHA2DS2-VASc (congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, stroke, vascular disease, age 65–74 years, sex category [female]) score 6, recent cardioembolic stroke ,3 months, or high risk of VTE recurrence, weighing the risk of bleeding against the risk of thromboembolism

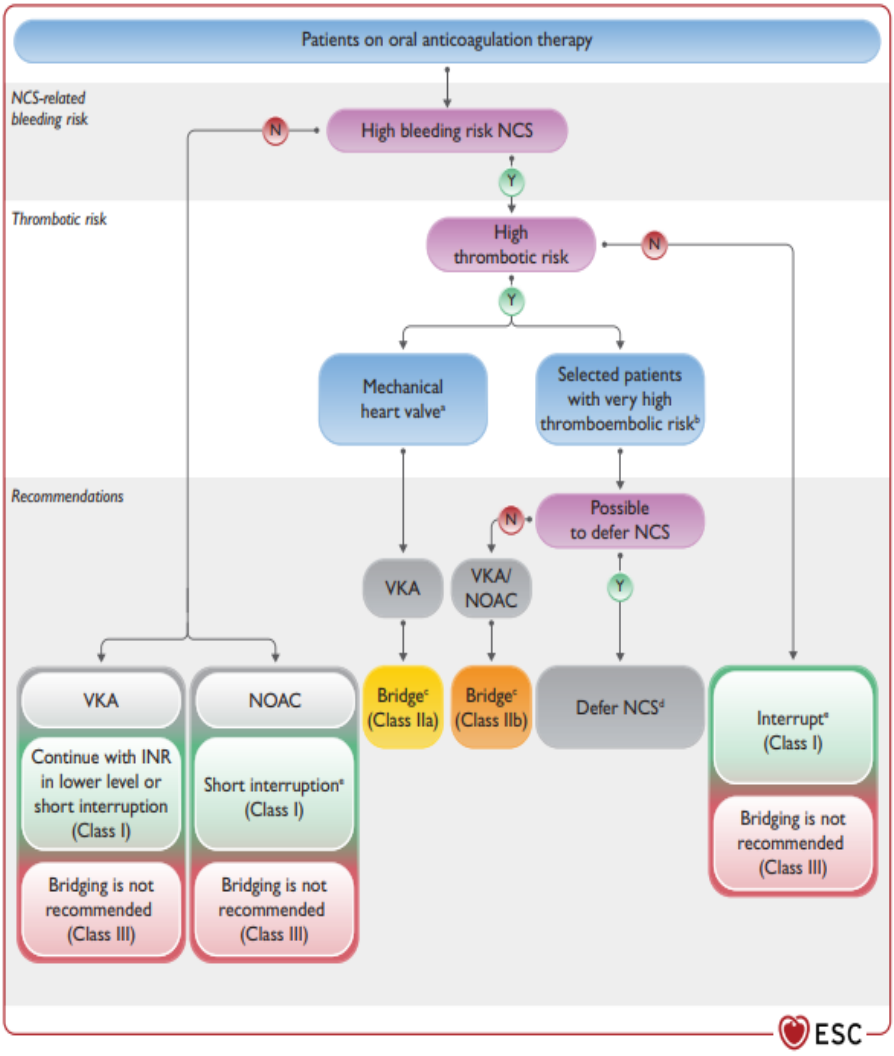

Figure 8 Recommendations for management of oral anticoagulation therapy in patients undergoing non-cardiac surgery. CHA_2DS_2-VASc, congestive heart failure, hypertension, age ≥75 years, diabetes mellitus, stroke, vascular disease, age 65–74 years, sex category (female); N, no; NCS, non-cardiac surgery; NOAC, non-vitamin K antagonist oral anticoagulant; VKA, vitamin K antagonist; VTE, venous thromboembolism. Y, yes; [a]Mechanical aortic valve replacement (AVR) and any thromboembolic risk factor (atrial fibrillation, previous thromboembolism, severe left ventricular dysfunction, hypercoagulable state), or older-generation mechanical AVR, or a mechanical mitral valve replacement. [b]Recent stroke <3 months, high risk of VTE recurrences (e.g. antithrombin 3 deficiency or protein C and/or S deficiency), left ventricular apex thrombus, atrial fibrillation with a very high stroke risk. [c]Bridging with unfractionated heparin or low molecular weight heparin. [d]E.g. >3 months after stroke/VTE. [e]For NOAC management during NCS, see *Figures 9* and *10*.

Very high thromboembolic risk: b Recent stroke ,3 months, high risk of VTE recurrences (e.g. antithrombin 3 deficiency or protein C and/or S deficiency), left ventricular apex thrombus, atrial fibrillation with a very high stroke risk.

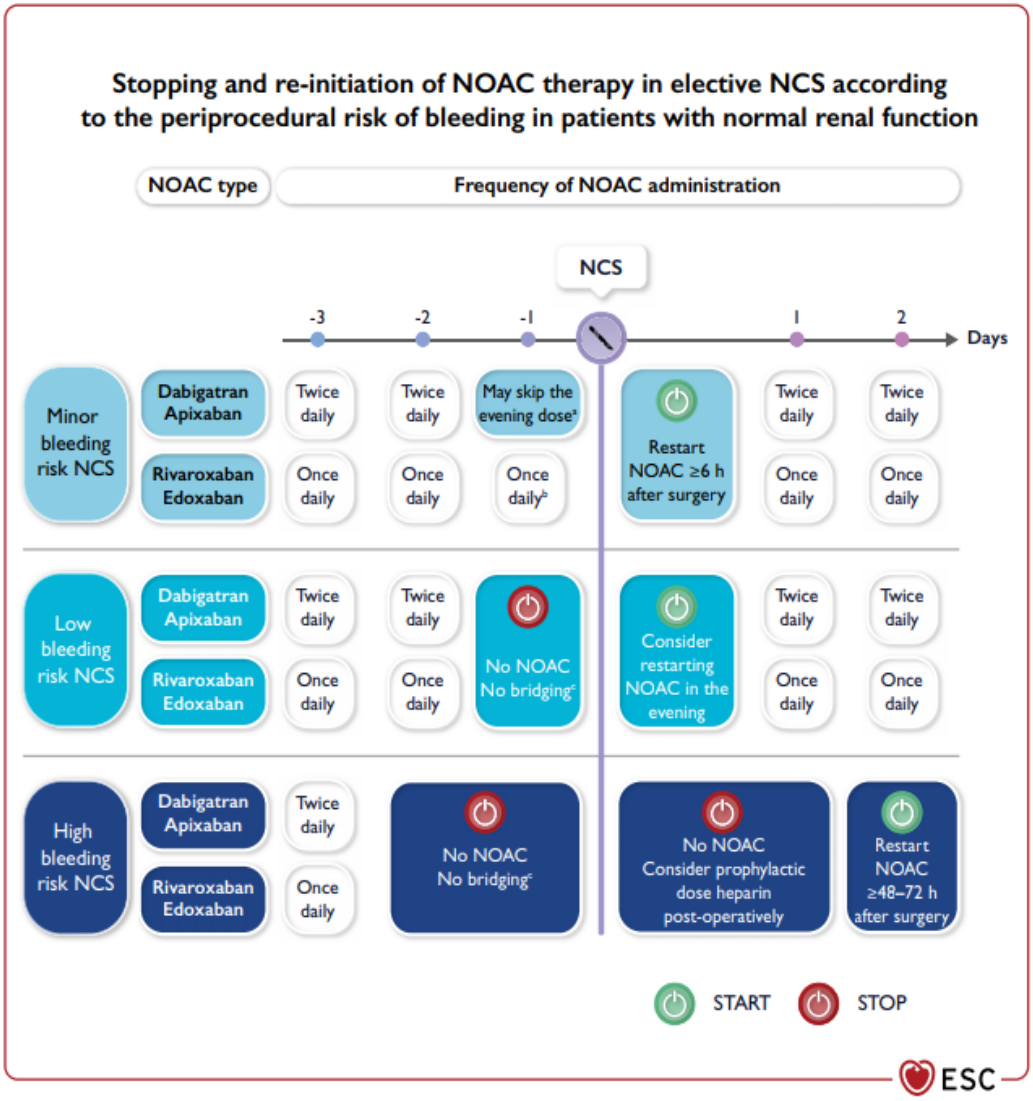

Figure 9 Peri-operative management of non-vitamin K antagonist oral anticoagulant according to the periprocedural risk of bleeding. NCS, non-cardiac surgery; NOAC, non-vitamin K antagonist oral anticoagulant. [a]In patients/circumstances favouring NOAC accumulation (e.g. renal dysfunction, older age, concomitant medication), the NOAC should be paused 12–24 h earlier. [b]In patients on rivaroxaban or edoxaban taking the dose in the evening, the evening dose may be skipped. [c]NOACs have predictable weaning of the anticoagulant effect. Owing to the increase in bleeding risk associated with bridging, it is generally not recommended to use bridging in patients taking NOACs. Very few circumstances when bridging with heparin may be considered in patients taking a NOAC include high thromboembolic risk conditions, such as: 1) patients with a recent (within 3 months) thromboembolic event (stroke, systemic embolism, or VTE); 2) patients who experienced a thromboembolic event during previous interruption of NOAC therapy.

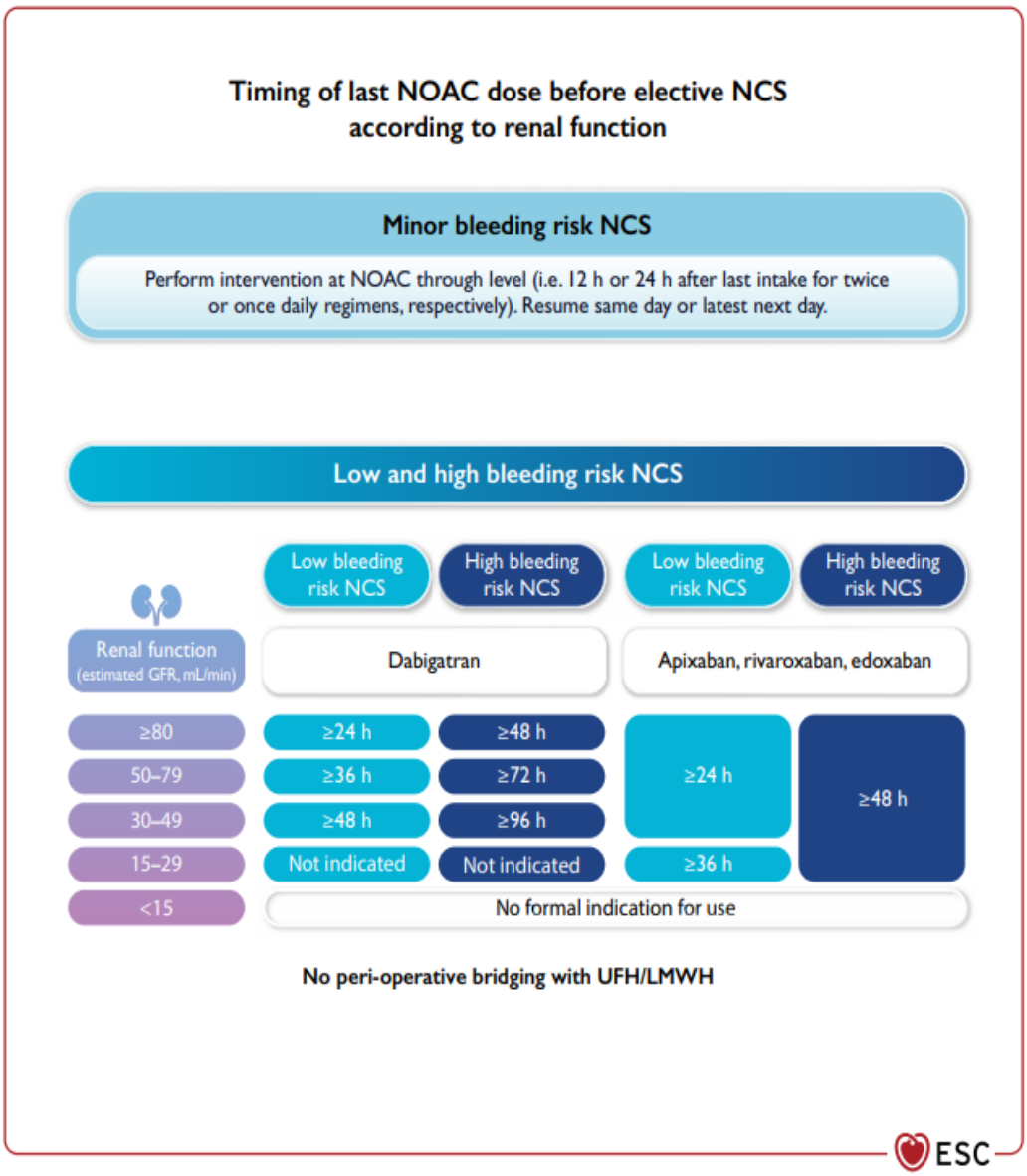

Figure 10 Timing of last non-vitamin K antagonist oral anticoagulant dose before elective NCS according to renal function. GFR, glomerular filtration rate; LMWH, low molecular weight heparin; NCS, non-cardiac surgery; NOAC, non-vitamin K antagonist oral anticoagulant; UFH, unfractionated heparin.