

PERIOPERATIVE ANTICOAGULATION GUIDELINE/DOAC MANAGEMENT

Options for anticoagulation continue to expand with the use of direct oral anticoagulants (DOACs). While the thromboembolic risk is determined by the patient's condition, the perioperative management of DOACs is vastly different and varied. **Bridging is not recommended with DOACs.**

DOAC Patient is Taking	Surgery Bleeding Risk	Preoperative DOAC Interruption Schedule					Postoperative DOAC Resumption Schedule			
		Day -5	Day -4	Day -3	Day -2	Day -1	Day +1	Day +2	Day +3	Day +4
Apixaban (Eliquis)	Mod/High	→			X	X	X	→		
	Low	→				X	X	→		
Dabigatran (CrCl>50ml/min)	Mod/High	→			X	X	X	→		
	Low	→				X	X	→		
Dabigatran (CrCl<50ml/min)	Mod/High	→	X	X	X	X	X	→		
	Low	→				X	X	→		
Rivaroxaban (Xarelto)	Mod/High	→			X	X	X	→		
	Low	→				X	→			

- **For patients undergoing neuraxial anesthesia, hold DOAC 72 hours prior to procedure.**
- X denotes patient to Hold DOAC
- Open arrow segment refers to flexibility in the timing of DOAC resumption post-surgery procedure to account for surgical hemostasis.
- For patients at low bleeding risk, DOAC was resumed within 24 hours post procedure and for patients at high bleeding risk DOAC was resumed 48-72 hours post procedure.
- See Appendix A for bleeding risk

PERIOPERATIVE ANTICOAGULATION GUIDELINE/ WARFARIN MANAGEMENT

Management of anticoagulation before and after invasive procedures requires careful, patient-specific evaluation of the risk of bleeding weighed against the patient's risk of thromboembolism. The patient's underlying disease process determines the thromboembolic risk. This patient specific risk determines the need for bridging anticoagulation therapy. Coordination between primary care, anticoagulation clinic, surgeon, anesthesiologist and when indicated, a specialist, is recommended. This updated guideline is based on extensive literature review and examination of clinical practice guidelines including American College of Chest Physicians 2012 Clinical Practice Guidelines, 2017 ACC Expert Consensus Decision Pathway for Periprocedural Management of Anticoagulation in patients with Nonvalvular Atrial Fibrillation (see reference). Section 1 addresses patients on warfarin and we suggest a 3 step process as outlined below. Steps 1-2 are preoperative. Step 3 is postoperative.

Step 1: Determine if anticoagulation is indicated (review reason for ongoing antithrombotic therapy).

Determine if anticoagulation can be continued without interruption (warfarin or DOACs)

Consider bleeding risk of the procedure. For low bleeding risk procedures anticoagulation can be continued without interruption.

Procedures that can be performed on anticoagulants*

Ophthalmic	Dental	Dermatologic	Gastrointestinal
Cataract surgery Trabeculectomy	Restorations Uncomplicated extractions Endodontics Prosthetics Periodontal therapy Dental hygiene	Mohs surgery Simple excisions	Diagnostic esophagogastroduodenoscopy Colonoscopy without biopsy Diagnostic endoscopic retrograde cholangiopancreatography Biliary stent without sphincterotomy Endoscopic ultrasonography without biopsy Push enteroscopy

Jaffer AK, Perioperative Management of Warfarin and Antiplatelet Therapy, Cleveland Clinic Journal of Medicine, Vol 76, Suppl 4, Nov 2009.

*refer to Appendix A for more extensive list

Step 2: When chronic anticoagulation will be interrupted, determine preoperative thromboembolic risk to decide if preoperative bridging is indicated. Consider the bleeding risk of the procedure when making the decision to implement bridging. If the procedure is a high bleeding risk procedure such as select neurosurgical and urologic procedures seek expert consultation (see Appendix A and B).

	MODERATE TO HIGH Preop Thrombotic Risk: Consider Bridging	LOW Preop Thrombotic Risk: Bridging <i>Not</i> Required
Mechanical Heart Valves	<ul style="list-style-type: none"> ▪ All mitral valve prosthesis ▪ Older mechanical aortic valve prosthesis (caged ball/tilting disk) ▪ Stroke/TIA ▪ Bi-leaflet aortic valve prosthesis and history of stroke ▪ Two or more mechanical valves 	<ul style="list-style-type: none"> ▪ Bi-leaflet aortic valve prosthesis without stroke ▪ On-X Valve without history of stroke
Atrial Fibrillation (A fib)	<ul style="list-style-type: none"> ▪ Prior embolic stroke ▪ confirmed TIA within 1 year ▪ Moderate to severe mitral stenosis ▪ Cardiac thrombus within 3 months ▪ Hypertrophic cardiomyopathy 	<ul style="list-style-type: none"> ▪ no prior stroke or TIA >1 year ago ▪ no moderate to high thrombotic risk conditions
Venous Thromboembolism (VTE)	<ul style="list-style-type: none"> ▪ Recent VTE within 3 months¹ ▪ Prior VTE with highly prothrombotic state² 	<ul style="list-style-type: none"> ▪ VTE more than 3 months ago no other risk factors ▪ Nonsevere thrombophilic conditions, including hereditary disorders

Bridging	<ul style="list-style-type: none"> • Check INR 7 days prior to surgery • Last dose of warfarin 6 days prior to procedure (for INR 2-3, if INR 3-4.5, last dose warfarin 7 days prior) • If CrCl>30, initiate enoxaparin* 1 mg/kg SQ 36 hrs after last warfarin dose and continue q12 hrs If CrCl<30, initiate enoxaparin* 1 m/kg SQ 36 hrs after last warfarin dose and continue q24hr.Last dose SQ LMWH 1mg/kg 24 hours prior to procedure • Alternate dose: 1.5mg/kg SQ q24 hrs, last dose give half the total dose 24 hours prior to surgery • Check INR in the morning on the day of surgery
No Bridging	<ul style="list-style-type: none"> • Check INR 5-7 days prior to surgery • Last dose of warfarin 6 days prior to procedure for INR<3. If INR 3-4.5: Last dose of warfarin 7 days prior to procedure • Check INR the morning of the procedure

*Refer to page 4 for alternative drugs for bridging and contraindications to enoxaparin

¹ Delay elective surgery until 3 months post VTE event if possible

² Triple positive antiphospholipid syndrome, myeloproliferative neoplasm, paroxysmal nocturnal hemoglobinuria, active cancer

Post-Operative Anticoagulation Guideline

Step 3: Resume Anticoagulation

See appendix A for extensive list of procedures

	Moderate Bleeding Risk Procedure	High Bleeding Risk Procedure
	Major intrathoracic surgery Major orthopedic surgery Major intraabdominal surgery Pacemaker insertion Hernia Laparoscopic cholecystectomy Endoscopy with biopsy CT or US guided biopsy	Coronary artery bypass Cardiac valve replacement Major vascular surgery Neurosurgical procedure Major cancer surgery Prostatectomy or bladder surgery Renal biopsy, bowel polypectomy
<u>Low risk of post op thrombosis</u> Bileaflet Aortic Valve without stroke On-X valve Atrial fibrillation and no risks factors ³	Resume warfarin 12-24 hours post procedure at usual dose (no bridging therapy) once hemostasis achieved	Resume warfarin 3-7 days post procedure at usual dose (No bridging therapy)
<u>Moderate risk of post op thrombosis</u> VTE greater than 3 months ago Atrial fibrillation with additional risks factors ⁴	Start prophylactic dose LMWH, post-op day one Resume warfarin 12-24 hours post procedure at usual dose Stop LMWH when reach target INR ⁵	Consider starting prophylactic dose LMWH post-op when hemostasis achieved Resume Warfarin at usual dose once hemostasis achieved Stop LMWH when reach target INR
<u>High risk of post op thrombosis</u> Mechanical mitral valve Older mechanical aortic valve Bileaflet aortic valve, with h/o stroke Recent VTE within 3 months ⁶ Prior VTE with highly prothrombotic state ⁷ >1 unprovoked VTE	Resume full dose LMWH 24 hours post procedure (Can consider prophylactic dose LMWH for 1-3 days before initiating full dose) Resume warfarin 12-24 hours post procedure at usual dose Stop LMWH when reach target INR	Consider starting prophylactic dose LMWH post-op when hemostasis achieved and increase to full dose at surgeon's discretion (goal 48-72hrs postop) Resume Warfarin at usual dose once hemostasis achieved Stop LMWH when reach target INR

³ prior stroke or TIA, systemic embolization, moderate to severe mitral stenosis, cardiac thrombus within 3 months, hypertrophic cardiomyopathy

⁴ prior stroke or TIA, systemic embolization, moderate to severe mitral stenosis, cardiac thrombus within 3 months, hypertrophic cardiomyopathy

⁵ Refer to Appendix B

⁶ Delay elective surgery until at least 3 months post VTE event if possible

⁷ Triple positive antiphospholipid syndrome, myeloproliferative neoplasm, paroxysmal nocturnal hemoglobinuria, active cancer

Alternative Drugs for Bridging

Drug	Therapeutic Dose	Prophylaxis Dose	Pre-Surgery Regimen
Enoxaparin (Lovenox)	1 mg/kg SQ BID or 1.5mg/kg SQ daily	30 mg SQ BID or 40 mg SQ daily	Last dose 24hr prior to surgery
Enoxaparin for chronic kidney disease	1mg/kg SQ <u>daily</u> when CrCl < 30 ml/min	30mg SQ daily when CrCl < 30 ml/min	Last dose 24hr prior to surgery
UFH	250 units/kg SQ BID	5000 units SQ BID or 5000 units SQ TID	Last dose 8-12hr prior to procedure (depending on regimen)
Fondaparinux (Arixtra)	5mg SQ daily when < 50kg. 7.5mg SQ daily when 50-100kg. 10mg SQ daily when >100kg.	2.5mg SQ daily	Last dose 36-48hr prior to surgery

Contraindications to enoxaparin:

- Known hypersensitivity to enoxaparin, heparin, pork products, or any component of the formulation (including benzyl alcohol)
- History of HIT or presence of circulating antibodies
- Active major bleeding
- ICH < 3 months

Relative contraindications to bridging:

- High risk bleeding procedure
- Platelet Abnormality
- Prior bleed during bridging

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Appendix A:

Bleeding Risk Associated with Different Procedure Types

	Moderate/High Moderate Bleeding Risk unless noted as (usually considered as $\geq 2.0\%$ risk of major bleed or in vulnerable area)	Low (usually considered as $< 2.0\%$ risk of major bleed)
Anesthesiology	<ul style="list-style-type: none"> ▪ Neuraxial anesthesia (spinal and epidural, facet, stellate ganglion and selective nerve root blocks)⁵ 	<ul style="list-style-type: none"> ▪ Peripheral nerve blocks^{1,2} ▪ Pump refills^{1,2} ▪ Endotracheal intubation⁵
Cardiac surgery	<ul style="list-style-type: none"> ▪ Coronary bypass surgery^{1,2,4,5} ▪ Valve replacement surgery^{1,2,4,5} 	
Cardiology - General	<ul style="list-style-type: none"> ▪ Cardiac catheterization^{1,2} ▪ Electrophysiology studies⁵ ▪ Coronary interventions⁵ 	
Cardiology - EP	<ul style="list-style-type: none"> ▪ Pacemaker implantation ▪ Pacemaker adjustment/battery replacement ▪ AICD implantation 	
Dentistry	<ul style="list-style-type: none"> ▪ Extensive reconstructive procedures 	<ul style="list-style-type: none"> ▪ Simple dental extractions⁴ ▪ Tooth extractions⁵ ▪ Multiple tooth extractions⁴ ▪ Endodontic procedures (root canal)⁵
Dermatology		<ul style="list-style-type: none"> ▪ All dermatologic procedures are considered low risk including Mohs surgery and simple excisions^{1,2}
Endocrinology		<ul style="list-style-type: none"> ▪ Thyroid aspiration or biopsy^{4,7}
ENT	<ul style="list-style-type: none"> ▪ All head and neck surgeries⁴ ▪ Any sinus surgery⁵ ▪ Thyroidectomy⁵ ▪ Parathyroidectomy⁵ ▪ Nasal polyp biopsy⁵ 	<ul style="list-style-type: none"> ▪ Diagnostic sinus, laryngeal or nasopharyngeal fiberoptic exam⁵ ▪ FNA⁵ ▪ Vocal cord injection⁵ ▪ Excision of benign and malignant lesions of the face, scalp and neck

Gastroenterology	<ul style="list-style-type: none"> ▪ EGD with variceal procedures¹ ▪ Colonoscopy with polypectomy¹ ▪ Large polypectomy (>1 cm) ▪ ERCP with sphincterotomy¹ ▪ Laser ablation¹ ▪ Pneumatic or bougie dilation^{1,4,6} ▪ Percutaneous endoscopic gastrostomy (PEG)^{1,4,5,6} ▪ Procedures with biopsies^{2,4} ▪ Polypectomy^{2,4,6} ▪ Variceal procedures^{4,6} ▪ Variceal banding (controversial)⁵ ▪ EUS with FNA or needle biopsy^{5,6} ▪ Liver biopsy⁵ ▪ Therapeutic balloon-assisted enteroscopy⁶ ▪ Endoscopic hemostasis⁶ 	<ul style="list-style-type: none"> ▪ Flex sigmoidoscopy^{2,6} ▪ EGD with or without biopsy^{4,6} ▪ Colonoscopy without biopsy^{5,6} ▪ Biliary/pancreatic stent placement⁴ ▪ EUS without biopsy⁴ ▪ ERCP without sphincterotomy^{5,6} ▪ Non-thermal snare removal of small (< 6 mm) polyp⁵ ▪ Self-expanding luminal stents without dilatation (controversial)^{5,6} ▪ Paracentesis^{5,7} ▪ Capsule endoscopy⁶
General surgery	<ul style="list-style-type: none"> ▪ Major thoracic, abdominal or pelvic surgery ▪ Other internal procedures (e.g., hernia repair, cholecystectomy) 	
Gynecology	<ul style="list-style-type: none"> ▪ Laparoscopic surgery ▪ BTL ▪ hysterectomy 	<ul style="list-style-type: none"> ▪ Vulvar biopsy¹ ▪ Laser of vulva, vagina¹ ▪ Leep of cervix¹ ▪ D and C^{1,4,5} ▪ Hysteroscopy, diagnostic¹ ▪ Colposcopy, diagnostic⁵ ▪ IUD placement⁵ ▪ Ablation- HTA or thermachoice only (not resectoscopic)¹
Nephrology	<ul style="list-style-type: none"> ▪ Kidney biopsy^{1,2,4} 	
Neurology	<ul style="list-style-type: none"> ▪ Lumbar puncture⁵ 	<ul style="list-style-type: none"> ▪ Needle electromyograph
Neurosurgery	<ul style="list-style-type: none"> ▪ Any intracranial and spine surgeries^{1,2,4,5} ▪ Laminectomy⁴ 	
Ophthalmology	<p>(all posterior chamber of the eye surgeries are)</p> <ul style="list-style-type: none"> ▪ Trabeculectomy with/without cataract extraction¹ ▪ Trabectome Surgery¹ ▪ Bleb revision¹ ▪ Glaucoma Tube Shunt Implants¹ ▪ Ahmed Implant¹ ▪ Baerveldt Implant¹ ▪ All Oculoplastic/Reconstructive¹ 	<ul style="list-style-type: none"> ▪ Cataract extraction with IOL implantation¹ ▪ Endocyclophotocoagulation¹ ▪ Glaucoma laser / other lasers¹ ▪ Refractive Laser Surgeries¹ ▪ LASIK, PRK¹ ▪ Corneal Surgeries¹ ▪ Cornea Transplant¹ ▪ DSEK, DLEK¹ ▪ Cataract and non-cataract surgery⁴

	<ul style="list-style-type: none"> pelvic abscess⁵ ▪ Dilation of percutaneous tracts⁵ ▪ Biliary interventions (new tract)⁷ ▪ Radiofrequency ablation (complex)⁷ ▪ Angiography up to 7F⁷ ▪ Venous interventions⁷ ▪ PEG⁷ ▪ Chemoembolism⁷ ▪ Transjugular liver biopsy⁷ ▪ Tunneled central venous catheter⁷ ▪ Subcutaneous port placement⁷ ▪ Intra abdominal, chest wall or retroperitoneal drainage or biopsy⁷ ▪ Lung biopsy⁷ ▪ Percutaneous liver biopsy⁷ ▪ Percutaneous cholecystostomy⁷ ▪ Spine procedures (vertebroplasty, kyphoplasty, lumbar puncture, epidural injection, facet block – moderate but high in all other guidelines)⁷ ▪ Renal cryoablation ▪ Vertebral/spine bone biopsy 	<ul style="list-style-type: none"> ▪ Temporary dialysis catheter placement⁵ ▪ Dialysis catheter interventions⁷ ▪ Venography⁷ ▪ Superficial chest wall or abdominal wall biopsy or drainage procedure ▪ Central line removal⁷ ▪ Thoracentesis, paracentesis⁷ ▪ Superficial aspiration or biopsy (thyroid, lymph nodes)⁷ ▪ Superficial abscess drainage⁷
Urology	<ul style="list-style-type: none"> ▪ Transurethral resection of the prostate^{1,2,5} ▪ Transurethral resection of the bladder for tumor^{1,4} ▪ Kidney, prostate or bladder biopsy^{1,2} ▪ Partial nephrectomy¹ ▪ Ureteroscopy¹ ▪ Lithotripsy⁵ ▪ Hydrocele repair⁴ 	<ul style="list-style-type: none"> ▪ Cystoscopy with or without biopsy ▪ Circumcision
Vascular Surgery	<ul style="list-style-type: none"> ▪ Aortic aneurysm repair^{1,2,4,5} ▪ Peripheral bypass surgery^{1,2,4,5} ▪ Carotid endarterectomy⁵ ▪ Angiogram with or without intervention 	

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