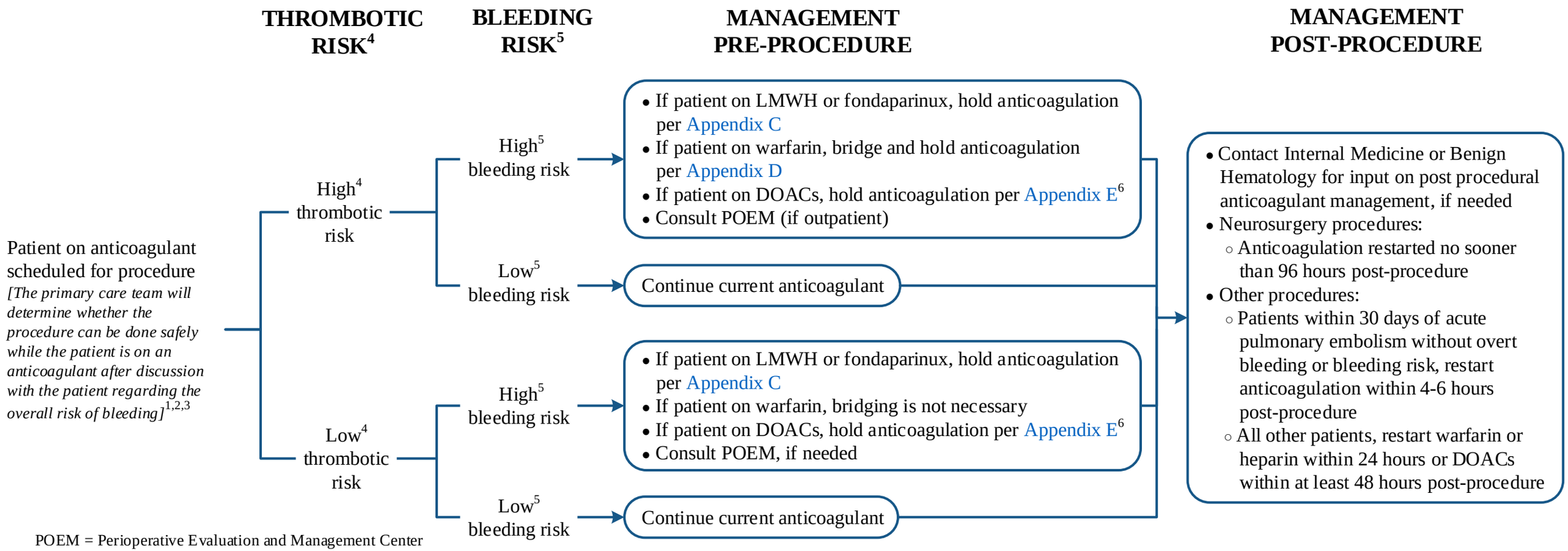
THE UNIVERSITY OF TEXAS MD Anderson Cancer Center
Making Cancer History®

Peri-Procedure Management of Anticoagulants

Disclaimer: *This algorithm has been developed for MD Anderson using a multidisciplinary approach considering circumstances particular to MD Anderson's specific patient population, services and structure, and clinical information. This is not intended to replace the independent medical or professional judgment of physicians or other health care providers in the context of individual clinical circumstances to determine a patient's care. This algorithm should not be used to treat pregnant women.*

Note: For the purpose of this algorithm, moderate and high risk categories are both considered to be high risk



POEM = Perioperative Evaluation and Management Center
DOACs = direct oral anticoagulants
LMWH = low-molecular-weight heparin

[1] For questions, call appropriate service depending on procedure (POEM or Cardiology)
[2] See internal Coagulation Reversal Recommendations (click here)
[3] For patients on antiplatelet therapy, see Management of Antiplatelet Therapy in Patients with Cardiac Stents Undergoing Procedures algorithm
[4] See Appendix A for Indications of Thrombotic Risk
[5] See Appendix B for Procedural Bleeding Risks based on type of procedure
[6] DOACs have a shorter elimination half-life than most vitamin K antagonists (VKAs); therefore, heparin bridging has no clinical benefit in patients with a short period of perioperative DOAC interruption. The situation might be different for patients with high thromboembolic (TE) risk and prolonged hold of DOAC (> 72 - 96 hours), e.g., before a neuraxial anesthesia. For prolonged hold of DOAC, when the risk of TE outweighs the risk of bleeding, patients should benefit from a multidisciplinary management to decide if heparin bridging should be prescribed in order to reduce the peri-procedural gap without anticoagulant.

Department of Clinical Effectiveness V3
Approved by the Executive Committee of the Medical Staff on 09/17/2019

APPENDIX A: Indications of Thrombotic Risks

Risk	Mechanical Heart Valve in the Aortic/Mitral Position	Atrial Fibrillation	Venous Thromboembolism (VTE)
High (requires bridging if on warfarin)	• Any mitral valve prosthesis • Any caged-ball or tilting disc aortic valve prosthesis • Stroke or transient ischemic attack (TIA) within 6 months	• CHA_2DS_2-VASc[1] score ≥ 5 • Stroke or TIA within 3 months • Rheumatic valvular heart disease	• VTE within 3 months • VTE of any duration with severe thrombophilia (e.g., deficiency of protein C, protein S, or antithrombin, antiphospholipid antibodies, homozygous factor V Leiden or prothrombin G20210A, or multiple abnormalities)
Low	• Bileaflet aortic valve prosthesis	• CHA_2DS_2-VASc[1] score < 5	• VTE within the past 3-12 months • VTE with non-severe thrombophilia (e.g., heterozygous factor V Leiden or prothrombin gene mutation) • Recurrent idiopathic VTE • Active cancer (treated within 6 months or palliative) • VTE > 12 months previous and no other risk factors

[1] **CHA_2DS_2-VASc Score**

Criteria	Points
Male	0
Female	1
Congestive heart failure history	1
Diabetes mellitus history	1
Hypertension history	1
Vascular disease history	1
Age 65-74 years	1
Age greater than or equal to 75 years	2
Stroke/TIA/thromboembolism history	2

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APPENDIX B: Procedure Bleeding Risks[1]

Note: Clinical or laboratory suspicion (e.g., elevated PT/aPTT or INR) of an underlying coagulopathy unrelated to anticoagulation therapy should be evaluated prior to the procedure. Please contact Benign Hematology or General Internal Medicine for input on management.

Interventional Radiology

High Bleeding Risk:	Low Bleeding Risk:
• Transjugular intrahepatic porto-systemic shunt • Lung interventions: biopsy, drainage (parenchymal) • Solid organ biopsies • Solid organ drainage: nephrostomy, biliary, cholecystostomy • Ablations: solid organs, bone, soft tissues, lung • Transjugular liver biopsy • Tunneled central venous catheter placement or removal • Angiography, arterial intervention with access size up to 6 French • Trans-arterial embolotherapy • Venous interventions • Portal vein embolization and stenting • Non-organ biopsy (e.g., retroperitoneal, vertebral, intra-abdominal) • Non-organ drainage (e.g., abdominal or retroperitoneal abscess) • Drainage catheter exchange less than 6 weeks (biliary, nephrostomy, abscess) • Gastrostomy tube placement • Spine procedures: vertebroplasty, kyphoplasty • Tunneled drainage catheter placement (e.g., Denver catheter)	• Non-tunneled venous access • Central line removal (non-tunneled) • Inferior vena cava (IVC) filter placement or retrieval • Drainage catheter exchange > 6 weeks (biliary, nephrostomy, abscess) • Thoracentesis • Non-tunneled chest tube placement (pleural space) • Paracentesis • Intraperitoneal catheter placement • Superficial (e.g., lymph nodes) or palpable mass biopsies • Superficial abscess drainage

[1] For patients on antiplatelet therapy, see Management of Antiplatelet Therapy in Patients with Cardiac Stents Undergoing Procedures algorithm

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APPENDIX B: Procedural Bleeding Risks[1] - continued

General Procedures

High Bleeding Risk:
- Lumbar puncture
- Peripherally inserted central catheter (PICC) line placement
- All operating room procedures

Low Bleeding Risk:
- Bone marrow aspiration and biopsy
- Ommaya reservoir puncture
- Subclavian or femoral vein catheter placement

Pulmonary Procedures

High Bleeding Risk:
- Diagnostic bronchoscopy with transbronchial biopsy
- Diagnostic bronchoscopy with endobronchial biopsy
- Therapeutic bronchoscopy with endobronchial tumor destruction, stenosis relief, management of hemoptysis
- Pleuroscopy, pleural biopsy
- Diagnostic bronchoscopy with endobronchial ultrasound-guided transbronchial needle aspiration (EBUS TBNA)
- Tunneled pleural catheter placement or removal

Low Bleeding Risk:
- Diagnostic bronchoscopy airway exam
- Diagnostic bronchoscopy with bronchoalveolar lavage (BAL)
- Thoracentesis

Gastroenterology Procedures

High Bleeding Risk:
- Biliary or pancreatic sphincterotomy
- Polypectomy
- Cystogastrostomy
- Endoscopic hemostasis
- Endoscopic ultrasound (EUS) with fine needle aspiration (FNA)
- Tumor ablation by any technique
- Pneumatic or bougie dilation percutaneous endoscopic gastrostomy (PEG) placement
- Therapeutic balloon-assisted enteroscopy
- Treatment of varices

Low Bleeding Risk:
- Capsule endoscopy
- Diagnostic (esophagogastroduodenoscopy (EGD), colonoscopy, flexible sigmoidoscopy) including biopsy
- Enteral stent deployment (without dilation)
- Enteroscopy and diagnostic balloon-assisted enteroscopy
- Endoscopic retrograde cholangiopancreatogram (ERCP) without sphincterotomy
- EUS without FNA

Cardiology Procedures

High Bleeding Risk
- Pacemaker or defibrillator placement
- Coronary intervention
- Endomyocardial biopsy

Low Bleeding Risk
- Electrophysiology testing and/or ablation
- Diagnostic coronary angiography

[1] For patients on antiplatelet therapy, see Management of Antiplatelet Therapy in Patients with Cardiac Stents Undergoing Procedures algorithm

APPENDIX C: Recommended Holding Time for LMWH and Fondaparinux Prior to Procedure

- **The following recommendations for hold strategy are based on estimated half-life of each anticoagulation. Data for hold strategy in cancer patients is very limited. Clinicians should always consider risk of bleeding versus risk of thrombosis in cancer patients in determining the hold strategy.**
- Renal function should be considered when determining appropriate hold times for anticoagulants
- Normal risk of bleeding needs 2 - 3 drug half-lives between the last dose and surgery; aim for mild to moderate residual anticoagulant effect at surgery less than 12% - 25%
- High risk of bleeding needs 4 - 5 drug half-lives between the last dose and surgery; aim for minimal residual anticoagulant effect at surgery less than 3% - 6%

Anticoagulant	Hold Parameter
LMWH [enoxaparin (Lovenox®), dalteparin (Fragmin®), tinzaparin (Innohep®)[1]]	Stop the dose 24 hours before surgery or longer in patients with renal impairment

Fondaparinux (Arixtra®)[2]		
	Days Being Held	
CrCl (mL/minute)	Normal or low risk of bleeding	High risk of bleeding
> 50	2	4
30 - 50	6	6
< 30	Contraindicated	

[1] Increased risk for death in elderly patients with renal insufficiency
[2] Full dose 48 hours (low risk) and 96 hours (high risk) prior to procedure (longer-half life)

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APPENDIX D: Recommended Holding Time and Bridge Strategy for Patients on Warfarin (should be discussed with primary physician)

Day	Heparin	Daily enoxaparin (Lovenox®) and dalteparin (Fragmin®)	Twice daily enoxaparin (Lovenox®) and dalteparin (Fragmin®)	Fondaparinux (Arixtra®)
-5	Last dose warfarin	Last dose warfarin	Last dose warfarin	Last dose warfarin
-4	Continuous infusion	No medications	No medications	No medications
-3	Continuous infusion	Weight based dose	Weight based dose	One dose if low risk of bleeding
-2	Continuous infusion	Weight based dose	Weight based dose	No medications
-1	Continuous infusion	Take ½ dose at 8AM	Take AM dose at 8AM and Hold PM dose	No medications
0	Stop 4-5 hours before procedure	No medications	No medications	No medications

Example for a patient on warfarin who will bridge with heparin infusion for a procedure scheduled for Wednesday (Day 0): patient will hold warfarin on Friday (Day -5), start continuous infusion heparin on Saturday (Day -4), and continue until 4 - 5 hours prior to procedure on Wednesday.

Example for a patient on warfarin who will bridge with daily LMWH for a procedure scheduled for Wednesday (Day 0): patient will hold warfarin on Friday (Day -5), start full dose LMWH on Sunday (Day -3) and Monday (Day -2), and only take half dose LMWH on Tuesday morning (Day -1).

Bridging: Use of a short-acting anticoagulant to assist peri-procedure management of anticoagulation and the process for resuming the patient's appropriate therapeutic anticoagulant dosing regimen post-procedure. Consider an appointment with POEM prior to the procedure.

Note: Renal function should be considered when determining appropriate hold times for anticoagulants

APPENDIX E: Recommended Holding Time for DOACs Prior to Procedure

- **The following recommendations for hold strategy are based on estimated half-life of each anticoagulation. Data for hold strategy in cancer patients is very limited. Clinicians should always consider risk of bleeding versus risk of thrombosis in cancer patients in determining the hold strategy.**
- Renal function should be considered when determining appropriate hold times for anticoagulants
- Normal risk of bleeding needs 2 - 3 drug half-lives between the last dose and surgery; aim for mild to moderate residual anticoagulant effect at surgery less than 12% - 25%
- High risk of bleeding needs 4 - 5 drug half-lives between the last dose and surgery; aim for minimal residual anticoagulant effect at surgery less than 3% - 6%
- DOACs have a shorter elimination half-life than most vitamin K antagonists (VKAs); therefore, heparin bridging has no clinical benefit in patients with a short period of perioperative DOAC interruption. The situation might be different for patients with high thromboembolic (TE) risk and prolonged hold of DOAC (> 72 - 96 hours), e.g., before a neuraxial anesthesia. For prolonged hold of DOAC, when the risk of TE outweighs the risk of bleeding, patients should benefit from a multidisciplinary management to decide if heparin bridging should be prescribed in order to reduce the peri-procedural gap without anticoagulant.

Minimum hold days of DOACs according to creatinine clearance (CrCl) mL/minute and bleeding risk

	Dabigatran (Pradaxa®)		**Rivaroxaban (Xarelto®)**		**Apixaban (Eliquis®)**		**Edoxaban (Savaysa®)[1]**	
CrCl (mL/minute)	**Days Being Held**		**Days Being Held**		**Days Being Held**		**Days Being Held**	
	Normal or low risk of bleeding	**High risk of bleeding**	**Normal or low risk of bleeding**	**High risk of bleeding**	**Normal or low risk of bleeding**	**High risk of bleeding**	**Normal or low risk of bleeding**	**High risk of bleeding**
>80	1	2	1	2	1	2	1	2
50 - 79	2	3	1	2	1	3	1	3
30 - 49	2	4	1	3	2	3	2	3
< 30	3	5	2	3	2	4	2	4

[1] Non-formulary

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APPENDIX E: Recommended Holding Time for DOACs Prior to Procedure - continued

Sample Holding Instructions for patients on a DOAC scheduled for procedure

Patient Name:
Patient Date of Birth:
Today's date:
Anticoagulant (blood thinner/DOAC):
Creatinine clearance:

Day	Date	Instructions
- 4	***	Normal dosing
- 3	***	TAKE the LAST dose of the anticoagulant TODAY as scheduled
- 2	***	No anticoagulants (Blood thinners)
- 1	***	No anticoagulants (Blood thinners)
0	***	*PROCEDURE DAY – NO Blood thinners Your Surgical team will tell you when to restart

*Surgery is Day ZERO; please count backwards
Note: Bleeding risk and renal function should be considered when determining appropriate hold times for anticoagulants

SUGGESTED READINGS

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