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.*

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Note:

- **Recommendations for hold strategy are based on current guidelines and estimated half-life of each anticoagulant**
- Moderate bleeding risk procedures need 2-3 drug half-lives between the last dose and procedure; aim for mild to moderate residual anticoagulant effect at surgery < 12% - 25
- High bleeding risk procedures need 4-5 drug half-lives between the last dose and procedure; aim for minimal residual anticoagulant effect at surgery < 3% - 6%

Peri-Procedure Management of Anticoagulants

PRESENTATION
(Inpatient or Outpatient)

Patient on anticoagulant scheduled for procedure[1]

- If possible, delay elective procedures for 1 month after acute proximal lower extremity DVT or PE or ischemic stroke
- For patients with recent ischemic stroke, consult Neurology for further recommendations as indicated
- Retrievable inferior vena cava (IVC) filter for patients with recent (within 1 month) proximal lower extremity DVT or PE if procedure cannot be delayed and anticoagulation is expected to be on hold for > 5 days. Benign Hematology consultation recommended.

EVALUATION

Urgent/ emergent procedure?

Yes

- Consider anticoagulant reversal if indicated (see Appendix C)
- In patients with new onset atrial fibrillation/atrial flutter who have been on anticoagulation for < 1 month, consider TEE to rule out cardiac thrombus prior to holding anticoagulant therapy
- For restart recommendations, refer to management based on procedure:
  - Interventional spine and pain procedures, see Appendix D
  - Neurosurgery procedures, see Appendix E
  - Interventional radiology procedures, see Appendix F
  - Other procedures: see Appendix G for prophylaxis dose; see Appendix H for parenteral agents; see Appendix I for DOACs; see Appendix J for Warfarin

No

MANAGEMENT PRE- AND POST-PROCEDURE

Interventional spine and pain **or** neurosurgery **or** interventional radiology procedures

To determine bleeding risk and for management of anticoagulants based on bleeding risk see:
- Appendix D for interventional spine and pain procedures
- Appendix E for neurosurgery procedures
- Appendix F for interventional radiology procedures

Patients who are likely candidates for regional anesthesia[2] → See Page 3

Other procedures → Low bleeding risk procedure[3]?

Yes → Do NOT interrupt anticoagulant

No → See Page 3

DOACs = direct oral anticoagulants
DVT = deep vein thrombosis
PE = pulmonary embolism
TEE = transesophageal echocardiogram
VTE = venous thromboembolism

[1] For patients on antiplatelet therapy, see Peri-Procedure Management of Antiplatelet Therapy algorithm
[2] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement
[3] See Appendix A for Procedural Bleeding Risks based on type of procedure

Department of Clinical Effectiveness V8
Approved by the Executive Committee of the Medical Staff on 07/15/2025

Peri-Procedure Management of Anticoagulants

PRESENTATION
(Inpatient or Outpatient)

EVALUATION

MANAGEMENT PRE- AND POST-PROCEDURE

- Candidates for regional anesthesia[1]
- Patients undergoing the following high bleeding risk procedures:
  - Colorectal surgery
  - Hepatobiliary surgery
  - Orthopedic surgery

→ Patient with low thromboembolic risk[3]?

Yes →

LOW thromboembolic risk[3]
- Do NOT bridge if patient is on warfarin or DOAC
- For patients undergoing procedures likely to require regional anesthesia, follow holding recommendations under *Regional Anesthesia* in each appendix[4]

No →

HIGH thromboembolic risk[3]
Patients with HIGH thromboembolic risk[3] are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding (see Box A below)

Other procedures with moderate or high bleeding risk[2] → Patient with low thromboembolic risk[3]?

Yes →

LOW thromboembolic risk[3]
- Interrupt anticoagulant[4]
- Do NOT bridge if patient is on warfarin or DOAC

A

No →

HIGH thromboembolic risk[3]
- Interrupt anticoagulant[4]
- Bridge if patient is on warfarin (see Appendix J)
- For moderate bleeding risk procedures, do NOT bridge if patient on DOAC
- For high bleeding risk procedures, bridge if patient on DOAC (see Appendix I for bridging considerations)

[1] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement
[2] See Appendix A for Procedural Bleeding Risks based on type of procedure
[3] See Appendix B for Thromboembolic Risks
[4] If patient is on: prophylaxis dose, see Appendix G, parenteral agents, see Appendix H; if on warfarin, see Appendix J; if on DOACs, see Appendix I

APPENDIX A: Procedure Bleeding Risk

Note: For patients who have other risk factors for bleeding (*e.g.,* recent bleeding event, thrombocytopenia) consider utilizing the management recommendations for high risk bleeding procedures.

High Bleeding Risk	Moderate Bleeding Risk	Low Bleeding Risk
General Procedures		
• Lumbar puncture with or without intrathecal chemotherapy	• Bone marrow aspiration and biopsy • Venous port placement; If high thrombotic risk (see Appendix B), treat as low bleeding risk	• Ommaya reservoir puncture • Venous port removal
Breast Surgical and Breast Radiology Procedures		
• All other Breast Surgical procedures	• Vacuum assisted breast biopsies (MRI/stereotactic)	• Core biopsy of breast and/or axillary level 1 nodal basin • Fine needle aspiration of breast, axillary nodal basins, internal mammary, and/or supraclavicular lymph nodes • Image guided pre-operative localization of the breast and axillary level 1 nodal basin • Breast skin punch biopsy in clinic
Cardiology Procedures		
• CardioMEMS™ placement • Coronary intervention • Endomyocardial biopsy • Implantable cardioverter-defibrillator/pacemaker lead extraction • Left atrial appendage occlusion device • Pericardiocentesis	• Diagnostic coronary angiography via femoral access • Electrophysiology testing and/or ablation • Pacemaker or defibrillator placement • Right heart catheterization • Supraventricular tachycardia ablation • Transvenous atrial fibrillation ablation	• Arterioventricular node ablation • Coronary artery angiography (radial approach) • Internal cardiac defibrillator implantation battery change • Permanent pacemaker implantation battery change
Dental Procedures[1]		
• Alevolar surgery (bone removal) • Apicoectomy (root removal) • Complex dental procedure/multiple tooth extraction • Dental/endosseous implant procedures • Reconstructive dental procedures	• Endodontic (root canal) procedures • Peridontal surgery, abscess incision • Soft/hard tissue intraoral biopsy • Up to 2 tooth extractions	• Dental hygiene • Minor dental procedures

[1] For moderate risk of bleeding dental procedures in patients on vitamin K antagonists (VKA), either continue VKA in combination with a pro-hemostatic mouthwash or hold VKA 2-3 days prior to procedure

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APPENDIX A: Procedure Bleeding Risk - continued

Note: For patients who have other risk factors for bleeding (*e.g.,* recent bleeding event, thrombocytopenia) consider utilizing the management recommendations for high risk bleeding procedures.

High Bleeding Risk	Moderate Bleeding Risk	Low Bleeding Risk
Dermatologic Procedures		
N/A	N/A	• Dermatologic procedures • Mohs Center procedures
Gastroenterology Procedures		
• Barrett's esophagus ablation • Biliary or pancreatic sphincterotomy and/or dilation • Cystogastrostomy • Endoscopic hemostasis • Endoscopic submucosal dissection (ESD), endoscopic mucosal resection (EMR) or other polypectomy • Endoscopic ultrasound guided biliary drainage placement • Endoscopic ultrasound guided gastrojejunostomy placement • Endoscopic ultrasound with fine needle aspiration • Full thickness resection • Percutaneous endoscopic gastrostomy (PEG) placement • Pneumatic or bougie dilation • Therapeutic balloon-assisted enteroscopy • Treatment of varices • Tumor ablation by any technique	• Colonoscopy with biopsy • Diagnostic balloon-assisted enteroscopy • Endoscopic retrograde cholangiopancreatography (ERCP) with stent and/or biopsy • Esophageal or enteral stent • Gastroscopy with biopsy • Sigmoidoscopy with biopsy	• Capsule endoscopy • Colonoscopy without biopsy • Diagnostic esophagogastroduodenoscopy (EGD) • Endoscopic retrograde cholangiopancreatography (ERCP) diagnostic • Endoscopic ultrasound without fine needle aspiration • Push enteroscopy without biopsy • Sigmoidoscopy without biopsy
Gynecology Oncology Procedures		
• All other Gynecology Oncology procedures	• Cold knife conization (CKC)/loop electrosurgical excision procedure (LEEP) • Superficial wide local excisions • Brachytherapy	• Colposcopy • Dilatation and curettage • Endometrial biopsy • Exam under anesthesia • Hysteroscopy • Insertion/Removal of intrauterine device • Laser ablation of the cervix/vulva/vagina • Vulvar/vaginal/cervical biopsies

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APPENDIX A: Procedure Bleeding Risk - continued

Note: For patients who have other risk factors for bleeding (*e.g.,* recent bleeding event, thrombocytopenia) consider utilizing the management recommendations for high risk bleeding procedures.

High Bleeding Risk	Moderate Bleeding Risk	Low Bleeding Risk
Head and Neck Surgery Procedures		
• All other Head and Neck Surgery procedures	N/A	• Flexible nasopharyngeal laryngoscopy (when performed outside of the OR)
Neuro-Oncology Procedures		
• Paraspinal, Diaphragm Electromyography (EMG) • Lumbar puncture with or without intrathecal chemotherapy (performed by Acute Procedure Team)	• Deep muscle (*e.g.*, gastrocnemius, infraspinatus, supraspinatus) EMG	• Superficial muscle EMG
Neuroradiology Procedures		
• Lumbar puncture with or without intrathecal chemotherapy • Solid organ biopsies	• Deep, non-organ biopsy	• Superficial or palpable mass biopsies
Ophthalmic Procedures		
• Eye plaque brachytherapy • Orbital surgery/major eyelid surgery/lacrimal surgery/eye removal/orbital removal • Posterior eye surgery • Scleral buckle	• Conjunctival surgery • Descemet's stripping endothelial keratoplasty (DSEK) • Glaucoma procedures (*i.e.,* trabeculectomy) • Minor eyelid or pericular surgery • Penetrating keratoplasty	• Cataract surgery • Intravitreal injection of pharmacologic agent • Vitreoretinal surgery (except scleral buckle)
Orthopedic Procedures		
• Arthroplasty • Carpal tunnel repair • All other OR Oncologic Orthopedic procedures	• Arthroscopy • Shoulder, foot, and ankle tendon repair	• Joint or soft tissue injections
Plastic Surgery Procedures		
• All OR Plastic Surgery procedures • For non-OR procedures, consult Plastic Surgery for peri-operative anticoagulant management	N/A	N/A

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APPENDIX A: Procedure Bleeding Risk - continued

Note: For patients who have other risk factors for bleeding (*e.g.,* recent bleeding event, thrombocytopenia) consider utilizing the management recommendations for high risk bleeding procedures.

High Bleeding Risk	Moderate Bleeding Risk	Low Bleeding Risk
Pulmonary Procedures		
• Diagnostic bronchoscopy with cryobiopsy • Diagnostic bronchoscopy with endobronchial biopsy • Diagnostic bronchoscopy with transbronchial biopsy • Pleuroscopy, pleural biopsy • Robotic bronchoscopy • Therapeutic bronchoscopy with endobronchial tumor destruction, stenosis relief, management of hemoptysis	• Bronchial or tracheal stent placement • Chemical pleurodesis • Diagnostic bronchoscopy with endobronchial ultrasound- guided transbronchial needle aspiration • Non-tunneled chest tube placement (pleural space) • Thoracentesis • Tracheostomy • Tunneled pleural catheter placement or removal	• Diagnostic bronchoscopy airway exam without biopsy • Diagnostic bronchoscopy with bronchoalveolar lavage without biopsy
Surgical Oncology		
• All other OR Surgical Oncology procedures	• Diagnostic laparoscopy (if any open procedures are planned or possible, procedure would be considered high risk) • Incision and drainage • Superficial wide local excision • Tunneled central venous catheter placement • Venous port placement; If high thrombotic risk (see Appendix B), treat as low bleeding risk	• Femoral vein vascular access device placement • Non-tunneled central venous catheter placement or removal • Tunneled central venous catheter removal • Venous port removal
Thoracic and Cardiovascular Surgery Procedures		
• All OR Thoracic and Cardiovascular Surgery Procedures • Endoscopic mucosal resection (EMR) • For other high bleeding risk procedures, see Pulmonary Procedures section on this page	• Pericardial window • For other moderate bleeding risk procedures, see Pulmonary Procedures section on this page	• Diagnostic esophagogastroduodenoscopy (EGD) • For other low bleeding risk procedures, see Pulmonary Procedures section on this page

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APPENDIX A: Procedure Bleeding Risk – continued

Note: For patients who have other risk factors for bleeding (*e.g.,* recent bleeding event, thrombocytopenia) consider utilizing the management recommendations for high risk bleeding procedures.

High Bleeding Risk	Moderate Bleeding Risk	Low Bleeding Risk
Urology Procedures		
• All other OR Urology procedures • Prostate biopsy • Solid organ fiducial placement	• Circumcision • Endoscopic procedures for medium or large stones • Genital skin and endoscopic urinary system biopsies of small lesions • Incision and Drainage • Wide local excisions	• Cystoscopy with stent placement or exchange • Diagnostic cystoscopy or ureteroscopy • Endoscopic procedures for small stones
Vascular Access and Procedures Team		
• Lumbar puncture with or without intrathecal chemotherapy		• Non-tunneled central venous catheter placement or removal • Paracentesis • Peripherally inserted central catheter (PICC) placement • Tunneled central venous catheter removal • Venous port removal
Vascular Surgery Procedures		
• All open and hybrid Vascular Surgery procedures • Consult with Vascular Surgery for peri-operative anticoagulant management	N/A	N/A

APPENDIX B: Thromboembolic Risks

Risk	Mechanical Heart Valve	Atrial Fibrillation	Venous Thromboembolism (VTE)
High[1]	• Mitral valve WITH major risk factors for stroke[2] • Any caged-ball or tilting disc mitral/aortic valve prosthesis • Stroke or (TIA) within 3 months	• CHA_2DS_2-VASc[3] score ≥ 7 • Stroke or TIA within 3 months • Rheumatic valvular heart disease	• VTE < 3 months • Severe thrombophilia (*e.g.*, deficiency of protein C, protein S, or antithrombin, homozygous factor V Leiden or prothrombin G20210A gene mutation, double heterozygous for each mutation, or multiple thrombophilias) • Antiphospholipid antibodies
Low	• Mitral valve WITHOUT major risk factors for stroke[2] • Bileaflet aortic valve prosthesis with or without major risk factors for stroke[2]	CHA_2DS_2-VASc[3] score < 7	• VTE ≥ 3 months • Recurrent VTE • Non-severe thrombophilia (*e.g.*, heterozygous factor V Leiden or prothrombin G20210A gene mutation) • Active cancer (treated within 6 months or palliative) • VTE > 12 months previous and no other risk factors

[1] Retrievable inferior vena cava (IVC) filter for patients with recent (within 1 month) proximal lower extremity deep vein thrombosis (DVT) or pulmonary embolism (PE) if procedure cannot be delayed and anticoagulation is expected to be on hold for > 5 days. Benign Hematology consultation recommended.

[2] Major risk factors for stroke include: atrial fibrillation, prior stroke or transient ischemic attack (TIA) during anticoagulant interruption **or** other prior stroke or TIA, prior valve thrombosis, rheumatic heart disease, hypertension, diabetes, congestive heart failure, age ≥ 75 years

[3] **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 ≥ 75 years	2
Stroke/TIA/thromboembolism history	2

APPENDIX C: Reversal of Anticoagulants

<table>
<tr><th>Anticoagulant</th><th>Recommended Treatment</th></tr>
<tr><td>Warfarin</td><td>
• Administer prothrombin complex concentrate (Kcentra®) IVPB based on INR and actual body weight:
<table>
<tr><th>INR</th><th>Dosage</th><th>Maximum Dose</th></tr>
<tr><td>2-3.9</td><td>25 units/kg</td><td>2,500 units</td></tr>
<tr><td>4-6</td><td>35 units/kg</td><td>3,500 units</td></tr>
<tr><td>> 6</td><td>50 units/kg</td><td>5,000 units</td></tr>
</table>
• Consider using ideal or adjusted body weight for obese patients
• Add vitamin K 10 mg IV at 1 mg/minute for 1 dose for prolonged reversal of warfarin
• If prothrombin complex concentrate (Kcentra®) not available, use fresh frozen plasma 15 mL/kg or if INR is not supratherapeutic (e.g., ≤ 3); may use 5-8 mL/kg for urgent reversal
</td></tr>
<tr><td>Dabigatran</td><td>
• Administer activated charcoal 25-50 grams oral or via nasogastric tube for one dose if ingested within the previous 2 hours
• Administer idarucizumab 2.5 grams IV for two doses
• Consider one repeated dose of idarucizumab if after several hours the patient rebleeds or has worsening coagulopathy in the absence of specific test to measure dabigatran plasma concentration
• Consider hemodialysis for life-threatening bleeds
</td></tr>
<tr><td>Apixaban or rivaroxaban</td><td>
• Administer activated charcoal 25-50 grams oral or via nasogastric tube for one dose if ingested within the previous 2 hours
• Andexanet alfa: If last dose of apixaban or rivaroxaban was given within 18 hours.
<table>
<tr><th rowspan="2">FXa Inhibitor</th><th rowspan="2">FXa Inhibitor Last Dose</th><th colspan="2">Timing of FXa Inhibitor Last Dose Before Andexanet Alfa Initiation</th></tr>
<tr><th>< 8 hours or unknown</th><th>≥ 8 hours</th></tr>
<tr><td rowspan="2">Apixaban</td><td>≤ 5 mg</td><td>Low dose</td><td rowspan="4">Low dose</td></tr>
<tr><td>> 5 mg/unknown</td><td>High dose</td></tr>
<tr><td rowspan="2">Rivaroxaban</td><td>≤ 10 mg</td><td>Low dose</td></tr>
<tr><td>> 10 mg/unknown</td><td>High dose</td></tr>
</table>
Low dose: 400 mg IV bolus, followed by 4 mg/minute IV infusion for up to 120 minutes
High dose: 800 mg IV bolus, followed by 8 mg/minute IV infusion for up to 120 minutes
• If last dose of apixaban or rivaroxaban given is > 18 hours, andexanet alfa may be given if compelling indication necessitating reversal is present (e.g., acute renal failure or overdose)
• If andexanet alfa is not available, administer prothrombin complex concentrate (Kcentra®) 25 units/kg (maximum dose 2,500 units) to 50 units/kg (maximum dose 5,000 units) IVPB based on actual body weight. Consider using ideal or adjusted body weight for obese patients.
</td></tr>
</table>

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APPENDIX C: Reversal of Anticoagulants - continued

Anticoagulant	Recommended Treatment
Edoxaban[1]	• Administer activated charcoal 25-50 grams oral or via nasogastric tube for one dose if ingested within the previous 2 hours • Administer prothrombin complex concentrate (Kcentra®) 25 units/kg (maximum dose 2,500 units) to 50 units/kg (maximum dose 5,000 units) IVPB based on actual body weight • Consider using ideal or adjusted body weight for obese patients
Heparin	• Administer 1 mg of protamine IV for every 100 units of IV heparin given over the last 2-2.5 hours • Single doses should not exceed 50 mg • Consider repeat dosing if continued bleeding or a prolonged aPTT
Enoxaparin or dalteparin	• Administer 1 mg of protamine IV for every 100 units of dalteparin or 1 mg of enoxaparin given within the previous 8 hours • Administer 0.5 mg of protamine IV for every 100 units of dalteparin or 1 mg of enoxaparin given in the previous 8 to 12 hours • Single doses of protamine should not exceed 50 mg • Consider coagulation factor VIIa recombinant 20 mcg/kg IV for one dose
Fondaparinux	• Administer prothrombin complex concentrate (Kcentra®) 25 units/kg (maximum dose 2,500 units) to 50 units/kg (maximum dose 5,000 units) IVPB based on actual body weight • Consider using ideal or adjusted body weight for obese patients • Consider coagulation factor VIIa recombinant 20 mcg/kg IV for one dose

[1] Not on MD Anderson Cancer Center formulary

APPENDIX D: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Spine and Pain Procedures

Procedure Bleeding Risk

High Bleeding Risk:	Moderate Bleeding Risk[1]:	Low Bleeding Risk[1]:
• Spinal cord stimulation trial and implant • Dorsal root ganglion stimulation • Intrathecal catheter and pump implant • Vertebral augmentation (vertebroplasty and kyphoplasty) • Percutaneous decompression laminotomy • Epiduroscopy and epidural decompression	• Interlaminar and transforaminal epidural steroid injections • Cervical facet medial branch nerve blocks and radiofrequency ablations • Intradiscal procedures (cervical, thoracic, lumbar) • Sympathetic blocks (stellate, thoracic, splanchnic, celiac, lumbar, hypogastric) • Trigeminal and sphenopalatine ganglia blocks	• Peripheral nerve blocks • Peripheral joints and musculoskeletal injections • Trigger point injections including piriformis injection • Sacroiliac joint injection and sacral lateral branch blocks • Thoracic and lumbar facet medial branch nerve block • Radiofrequency ablations of thoracic and lumbar facet joints • Peripheral nerve stimulator trial and implant (for locations not close to critical vessels and low-invasive procedures) • Pocket revision and implantable pulse generator/intrathecal pump replacement

[1] Patients with high risk of bleeding (*e.g.*, old age, history of bleeding tendency, concurrent uses of other anticoagulants/antiplatelets, liver cirrhosis or advanced liver disease, advanced renal disease, and patients on vascular endothelial growth factor (VEGF) inhibitor therapy) undergoing low or moderate bleeding risk procedures should be treated as moderate or high bleeding risk, respectively

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APPENDIX D: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Spine and Pain Procedures - continued

Note: Consult proceduralist if patient has recently (within the past 10 days) taken full dose thrombolytic medication (altepase).

***Prophylaxis* Dosages**	**Low Bleeding Risk**		**Moderate Bleeding Risk**		**High Bleeding Risk**	
	Hold Recommendations Prior to Procedure	**Restart Recommendations After Procedure**	**Hold Recommendations Prior to Procedure**	**Restart Recommendations After Procedure**	**Hold Recommendations Prior to Procedure**	**Restart Recommendations After Procedure**
Unfractionated heparin 5,000 units SQ every 8 hours or every 12 hours	6 hours	2 hours	6 hours	6 hours	1 day	8 hours
Unfractionated heparin 7,500 units SQ every 8 hours	6 hours	4 hours	6 hours	6 hours	1 day	8 hours
Dalteparin ≥ 30 mL/minute	12 hours	4 hours	12 hours	12 hours	12 hours	24 hours
Dalteparin < 30 mL/minute	Consult Benign Hematology	4 hours	Consult Benign Hematology	12 hours	Consult Benign Hematology	24 hours
Enoxaparin CrCl ≥ 30 mL/minute	12 hours	4 hours	12 hours	12 hours	12 hours	24 hours
Enoxaparin CrCl < 30 mL/minute	1 day	4 hours	1 day	12 hours	2 days	24 hours
Fondaparinux CrCl ≥ 30 mL/minute	2 days	6 hours	4 days	24 hours	4 days	24 hours
Fondaparinux CrCl < 30 mL/minute	Consult Benign Hematology	6 hours	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours
Apixaban CrCl ≥ 25 mL/minute Rivaroxaban CrCl ≥ 30 mL/minute	1 day	24 hours	1 day	24 hours	3 days	24 hours
Apixaban CrCl < 25 mL/minute Rivaroxaban CrCl < 30 mL/minute	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours

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APPENDIX D: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Spine and Pain Procedures - continued

Note: Consult proceduralist if patient has recently (within the past 10 days) taken full dose thrombolytic medication (altepase). If patient on betrixaban (non-formulary), consult Benign Hematology for peri-procedure management.

***Treatment* Dosages**	**Low Bleeding Risk**		**Moderate Bleeding Risk**		**High Bleeding Risk**	
	Hold Recommendations Prior to Procedure	**Restart Recommendations After Procedure**	**Hold Recommendations Prior to Procedure**	**Restart Recommendations After Procedure**	**Hold Recommendations Prior to Procedure**	**Restart Recommendations After Procedure**
Unfractionated heparin SQ > 10,000 units/dose or > 20,000 units/day	At least 24 hours or when aPTT < 45 seconds	4 hours	At least 24 hours or when aPTT < 45 seconds	24 hours	At least 24 hours or when aPTT < 45 seconds	24 hours
Unfractionated heparin IV infusion	At least 6 hours or when aPTT < 45 seconds	2 hours	At least 6 hours or when aPTT < 45 seconds	24 hours	At least 6 hours or when aPTT < 45 seconds	24 hours
Dalteparin or Enoxaparin CrCl ≥ 30 mL/minute	1 day	4 hours	1 day	12 hours	1 day	24 hours
Dalteparin or Enoxaparin CrCl < 30 mL/minute	Consult Benign Hematology	4 hours	Consult Benign Hematology	12 hours	Consult Benign Hematology	24 hours
Fondaparinux CrCl ≥ 30 mL/minute	2 days	6 hours	4 days	24 hours	4 days	24 hours
Fondaparinux CrCl < 30 mL/minute	Consult Benign Hematology	6 hours	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours
Apixaban CrCl ≥ 25 mL/minute Rivaroxaban or Edoxaban[1] CrCl ≥ 30 mL/minute	1 day	24 hours	3 days	24 hours	3 days[2]	24 hours
Apixaban CrCl < 25 mL/minute Rivaroxaban or Edoxaban[1] CrCl < 30 mL/minute	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours
Dabigatran CrCl ≥ 50 mL/minute	2 days	24 hours	4 days	24 hours	4 days[2]	24 hours
Dabigatran CrCl 30-49 mL/minute	3 days	24 hours	5 days	24 hours	5 days[2]	24 hours
Dabigatran CrCl < 30 mL/minute	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours	Consult Benign Hematology	24 hours
Warfarin[3] (Coumadin®)	INR < 3	6 hours	At least 5 days **or** INR ≤ 1.2	6 hours	At least 5 days **or** INR ≤ 1.2	6 hours
Argatroban IV Infusion Bivalirudin IV Infusion	At least 4 hours or when aPTT < 45 seconds	6 hours	At least 4 hours or when aPTT < 45 seconds	24 hours	At least 4 hours or when aPTT < 45 seconds	24 hours

[1] Not on MD Anderson Cancer Center formulary
[2] For high bleeding risk procedures **and** the following thromboembolic risks: proximal lower extremity DVT or PE or stroke within 3 months, see Page 31 for DOAC bridging considerations
[3] For patients with high thromboembolic risks (refer to Appendix B), see Appendix J for hold and bridge recommendations

APPENDIX E: Procedure Bleeding Risk and Management of Anticoagulants for Neurosurgery Procedures

Procedure Bleeding Risk

High Bleeding Risk:	Moderate Bleeding Risk:	Low Bleeding Risk:
• All other neurosurgery cranial and spinal procedures	• Endovascular neurointerventional procedures • Extradural skull base procedures • Gamma knife procedures[1] • Intraventricular catheter (EVD) placement/removal • Laser Interstitial Thermal Therapy (LITT) • Lumbar drain placement/removal • Lumbar puncture with or without intrathecal chemotherapy • Ommaya reservoir placement/removal • Steriotactic biopsy • Ventriculoperitoneal (VP) shunt placement/removal	• Ommaya reservoir tap • Ventriculoperitoneal (VP) shunt tap

[1] Anticoagulation may be continued especially for patients with a high risk for thromboembolism. Consult with Neurosurgery prior to procedure.

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APPENDIX E: Procedure Bleeding Risk and Management of Anticoagulants for Neurosurgery Procedures - continued

Note: Consult Neurosurgery if patient has recently (within the past 10 days) taken full dose thrombolytic medication (altepase). Restart recommendations after neurosurgical procedures are based on hemostasis being established.

			Restart Recommendations Based on Thromboembolic Risk (refer to Appendix B for Thromboembolic Risks)	
	Bleeding Risk	**Hold Recommendations Prior to Procedure**	**High Thromboembolic Risk[1]**	**Low Thromboembolic Risk[1,2]**
Enoxaparin/dalteparin/unfractionated heparin prophylaxis dose	Moderate	1 day	1-2 days in absence of post operative bleeding	7 days
	High			14 days
Enoxaparin 1 mg/kg every 12 hours[3] CrCl ≥ 30 mL/minute ½ life: 4-7 hours	Moderate	Evening dose on day prior to procedure	3 days	7 days
	High		7 days	14 days
Enoxaparin 1.5 mg/kg every 24 hours[3] or Dalteparin daily dosing[4] CrCl ≥ 30 mL/minute ½ life: 4-7 hours	Moderate	Give ½ dose in morning of day prior to procedure	3 days	7 days
	High		7 days	14 days
Unfractionated heparin ½ life: 1-1.5 hours	Moderate	4-6 hours prior to procedure or when aPTT < 45 seconds	3 days	7 days
	High		7 days	14 days

[1] Consider left atrial appendage occlusion (LAAO) in patients with atrial fibrillation who are unable to resume anticoagulation or those with a high risk for recurrent hemorrhage
[2] Longer hold times may be needed for intraparenchymal hemorrhage, intradural spine procedures, and surgical procedures on vascular tumors (glioblastoma, renal cell, thyroid, choriocarcinoma)
[3] Enoxaparin dosing for patients with CrCl < 30 mL/minute should be 1 mg/kg every 24 hours. For moderate and high bleeding risk procedures, hold enoxaparin at least 1 day prior to procedure or consider transitioning patient to unfractionated heparin.
[4] For patients on dalteparin with CrCl < 30 mL/minute and planned moderate and/or high risk bleeding procedure, hold dalteparin at least 1 day prior to procedure or consider transitioning patient to unfractionated heparin

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APPENDIX E: Procedure Bleeding Risk and Management of Anticoagulants for Neurosurgery Procedures - continued

Note: Consult Neurosurgery if patient has recently (within the past 10 days) taken full dose thrombolytic medication (altepase). Restart recommendations after neurosurgical procedures are based on hemostasis being established.

			Restart Recommendations Based on Thromboembolic Risk (refer to Appendix B for Thromboembolic Risks)	
	Bleeding Risk	**Hold Recommendations Prior to Procedure**	**High Thromboembolic Risk[1]**	**Low Thromboembolic Risk[1,2]**
Fondaparinux treatment dose CrCl ≥ 50 mL/minute ½ life: 17-21 hours	Moderate	2 days	3 days	7 days
	High	4 days	7 days	14 days
Fondaparinux treatment dose CrCl < 50 mL/minute	Moderate	5 days	3 days	7 days
	High	6 days	7 days	14 days
Argatroban Normal hepatic function Child-Pugh score[3] ≤ 6 ½ life: 45 minutes	Moderate	3 hours prior to procedure or when aPTT < 45 seconds	3 days	7 days
	High		7 days	14 days
Argatroban Hepatic dysfunction Child-Pugh score[3] > 6	Moderate	9 hours prior to procedure or when aPTT < 45 seconds	3 days	7 days
	High		7 days	14 days
Bivalirudin CrCl ≥ 30 mL/minute ½ life: 30 minutes	Moderate	1.5 hours prior to procedure or when aPTT < 45 seconds	3 days	7 days
	High		7 days	14 days
Bivalirudin CrCl < 30 mL/minute	Moderate	3 hours prior to procedure or when aPTT < 45 seconds	3 days	7 days
	High		7 days	14 days

[1] Consider left atrial appendage occlusion (LAAO) in patients with atrial fibrillation who are unable to resume anticoagulation or those with a high risk for recurrent hemorrhage
[2] Longer hold times may be needed for intraparenchymal hemorrhage, intradural spine procedures, and surgical procedures on vascular tumors (glioblastoma, renal cell, thyroid, choriocarcinoma)
[3] See Appendix K: Child-Pugh Score

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APPENDIX E: Procedure Bleeding Risk and Management of Anticoagulants for Neurosurgery Procedures - continued

Note: Consult Neurosurgery if patient has recently (within the past 10 days) taken full dose thrombolytic medication (altepase). Restart recommendations after neurosurgical procedures are based on hemostasis being established.

			Restart Recommendations Based on Thromboembolic Risk (refer to Appendix B for Thromboembolic Risks)	
	Bleeding Risk	**Hold Recommendations Prior to Procedure**	**High Thromboembolic Risk[1]**	**Low Thromboembolic Risk[1,2]**
Warfarin	Moderate	5 days See Appendix J for hold and bridge recommendations	3 days	7 days
	High		7 days	14 days
Apixaban CrCl ≥ 25 mL/minute Dabigatran CrCl ≥ 50 mL/minute Rivaroxaban or Edoxaban[3] CrCl ≥ 30 mL/minute	Moderate	1 day	3 days	7 days
	High	2 days See Appendix I for hold and bridge recommendations	7 days	14 days
Apixaban CrCl < 25 mL/minute[4] Rivaroxaban or Edoxaban[3] CrCl < 30 mL/minute[4]	Moderate	2 days	3 days	7 days
	High	3 days See Appendix I for hold and bridge recommendations	7 days	14 days
Dabigatran CrCl 30-49 mL/minute	Moderate	2 days	3 days	7 days
	High	4 days See Appendix I for hold and bridge recommendations	7 days	14 days
Dabigatran CrCl < 30 mL/minute[4]	Moderate	3 days	3 days	7 days
	High	5 days See Appendix I for hold and bridge recommendations	7 days	14 days

[1] Consider left atrial appendage occlusion (LAAO) in patients with atrial fibrillation who are unable to resume anticoagulation or those with a high risk for recurrent hemorrhage
[2] Longer hold times may be needed for intraparenchymal hemorrhage, intradural spine procedures, and surgical procedures on vascular tumors (glioblastoma, renal cell, thyroid, choriocarcinoma)
[3] Not on MD Anderson Cancer Center formulary
[4] Consider consult to Benign Hematology

APPENDIX F: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Radiology Procedures

Procedure Bleeding Risk

High Bleeding Risk:	Moderate Bleeding Risk[1]:	Low Bleeding Risk[1]:
• Ablations: solid organs, bone, soft tissues, lung • Angiography with arterial intervention (*e.g.,* angioplasty) with access size > 6 French • Aortic stent graft • Catheter directed thrombolysis (arterial and venous) • Gastrostomy, jejunostomy tube placement • Lung interventions: biopsy, fiducial placement, intratumoral injection, and drainage (parenchymal) • Percutaneous embolectomy, thrombectomy[2] • Portal vein embolization and stenting • Solid organ biopsies, fiducial placement, and intratumoral injection (*e.g.,* liver, prostate, cervical) • Solid organ drainage: nephrostomy, biliary, cholecystostomy • Spine procedures: vertebroplasty, kyphoplasty • Transjugular intrahepatic porto-systemic shunt (TIPS) • Venous interventions[intrathoracic, intracranial, intrahepatic, embolization, sclerotherapy, superior vena cava (SVC) stenting]	• Angiography with access size up to 6 French • Carotid stent placement • Catheter exchange < 6 weeks from initial placement (*e.g.,* biliary, nephrostomy, abscess, gastrostomy, jejunostomy) • Deep, non-organ biopsy, fiducial placement, and intratumoral injection • Non-organ drainage (*e.g.,* abdominal or retroperitoneal abscess) • Trans-arterial embolotherapy • Transjugular liver biopsy • Tunneled central venous catheter placement • Tunneled drainage catheter placement or removal • Venous interventions (peripheral) • Venous port placement; If high thrombotic risk (see Appendix B), treat as low bleeding risk	• Catheter exchange > 6 weeks from initial placement (*e.g.,* biliary, nephrostomy, abscess, gastrostomy, jejunostomy) • Diagnostic angiography (radial approach) • Intraperitoneal catheter placement • Inferior vena cava filter placement or retrieval • Joint aspirations/injections • Non-tunneled central line placment or removal • Non-tunneled chest tube placement (pleural space) • Paracentesis • Thoracentesis • Superficial (*e.g.,* lymph nodes, thyroid) or palpable mass biopsies, fiducial placement, and intratumoral injection • Superficial abscess drainage • Tunneled central venous catheter removal • Venous port removal

[1] For patients who have other risk factors for bleeding (*e.g.,* recent bleeding event, thrombocytopenia) consider utilizing the management recommendations for high risk bleeding procedures
[2] For thrombectomy, decision to hold anticoagulation is an individualized decision based on the clinical scenario. Discuss with Interventional Radiology prior to holding anticoagulants.

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APPENDIX F: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Radiology Procedures - continued

***Prophylaxis* Dosages**	Bleeding Risk	Day -5	Day -4	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2
Unfractionated heparin 5,000 units SQ every 8 hours or every 12 hours	Moderate/ High	→	→	→	→	Hold 12 hours prior to procedure		Resume 24 hours after procedure[1]	→
Unfractionated heparin 7,500 units SQ every 8 hours	Moderate/ High	→	→	→	→	Hold 12 hours prior to procedure.		Resume 24 hours after procedure[1]	→
Dalteparin 5,000 units SQ every 24 hours Enoxaparin 30 mg or 40 mg SQ every 24 hours	Moderate/ High	→	→	→	→	Hold 1 day prior to procedure		Resume 24 hours after procedure[1]	→
Enoxaparin 30 mg or 40 mg SQ every 12 hours	Moderate/ High	→	→	→	→	Hold 1 day prior to procedure		Resume 24 hours after procedure[1]	→
Fondaparinux 2.5 mg SQ every 24 hours	Moderate	→	→	→	Hold 2 days prior to procedure			Resume 24 hours after procedure[1]	→
	High	→	Hold 4 days prior to procedure						
Apixaban 2.5 mg PO every 12 hours	Moderate	→	→	→	→	Hold 1 day prior to procedure		Resume 24 hours after procedure[1]	→
Rivaroxaban 10 mg PO every 24 hours	High	→	→	→	Hold 2 days prior to procedure				

[1] For patients with high thromboembolic risk of (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist

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APPENDIX F: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Radiology Procedures - continued

***Treatment* Dosages**	Bleeding Risk	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2
Enoxaparin 1 mg/kg every 12 hours[1] CrCl ≥ 30 mL/minute ½ life: 4-7 hours	Moderate/ High	→	→	Hold evening dose on day prior to procedure		Resume 24 hours after procedure[2]	→
Enoxaparin 1.5 mg/kg every 24 hours[1] Dalteparin every 24 hours[3] CrCl ≥ 30 mL/minute ½ life: 4-7 hours	Moderate/ High	→	→	Give ½ dose in the morning on day prior to procedure		Resume 24 hours after procedure[2]	→
Unfractionated heparin IV infusion ½ life: 1-1.5 hours	Moderate/ High	→	→	Hold 4-6 hours prior to procedure or when aPTT < 45 seconds		Resume 24 hours after procedure[2]	→
Warfarin	See Appendix J						

[1] Enoxaparin dosing for patients with CrCl < 30 mL/minute should be 1 mg/kg every 24 hours. For moderate and high-risk procedures, hold enoxaparin at least 1 day prior to procedure or consider transitioning patient to unfractionated heparin.
[2] For patients with high thromboembolic risk of (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist
[3] For patients on dalteparin with CrCl < 30 mL/minute and planned moderate and/or high-risk bleeding procedure, hold dalteparin at least 1 day prior to procedure or consider transitioning patient to unfractionated heparin

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APPENDIX F: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Radiology Procedures - continued

***Treatment* Dosages**	Bleeding Risk	Day -7	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2
Fondaparinux CrCl ≥ 50 mL/minute ½ life: 17-21 hours	Moderate	→	→	→	→	→	Hold 2 days prior to procedure			Resume 24 hours after procedure[1]	→
	High	→	→	→	Hold 4 days prior to procedure						
Fondaparinux CrCl < 50 mL/minute	Moderate	→	→	Hold 5 days prior to procedure						Resume 24 hours after procedure[1]	→
	High	→	Hold 6 days prior to procedure								
Argatroban Normal hepatic function Child-Pugh score[2] ≤ 6 ½ life: 45 minutes	Moderate/ High	→	→	→	→	→	→	Hold 3 hours prior to procedure or when aPTT < 45 seconds		Resume 4-6 hours after procedure[1]	→
Argatroban Hepatic dysfunction Child-Pugh score[2] > 6	Moderate/ High	→	→	→	→	→	→	Hold 9 hours prior to procedure or when aPTT < 45 seconds		Resume 4-6 hours after procedure[1]	→
Bivalirudin CrCl ≥ 30 mL/minute ½ life: 30 minutes	Moderate/ High	→	→	→	→	→	→	Hold 1.5 hours prior to procedure or when aPTT < 45 seconds		Resume 4-6 hours after procedure[1]	→
Bivalirudin CrCl < 30 mL/minute	Moderate/ High	→	→	→	→	→	→	Hold 3 hours prior to procedure or when aPTT < 45 seconds		Resume 4-6 hours after procedure[1]	→

[1] For patients with high thromboembolic risk of (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist
[2] See Appendix K: Child-Pugh Score

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Peri-Procedure Management of Anticoagulants

APPENDIX F: Procedure Bleeding Risk and Management of Anticoagulants for Interventional Radiology Procedures - continued

- DOAC bridging considerations: For moderate bleeding risk procedures, do NOT bridge.
- For high bleeding risk procedures **and** the following thromboembolic risks: proximal lower extremity DVT or PE or stroke within 3 months, see Page 31.

***Treatment* Dosages**	Bleeding Risk	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2
Dabigatran CrCl ≥ 50 mL/minute	Moderate	→	→	→	→	→	Hold 1 day prior to procedure		Resume 24 hours after procedure[1]	→
	High	→	→	→	→	Hold 2 days prior to procedure				
Dabigatran CrCl 30-49 mL/minute	Moderate	→	→	→	→	Hold 2 days prior to procedure			Resume 24 hours after procedure[1]	→
	High	→	Hold 4 days prior to procedure							
Dabigatran CrCl < 30 mL/minute[2]	Moderate	→	→	→	Hold 3 days prior to procedure				Resume 24 hours after procedure[1]	→
	High	→	Hold 5 days prior to procedure							
Apixaban CrCl ≥ 25 mL/minute Rivaroxaban or Edoxaban[3] CrCl ≥ 30 mL/minute	Moderate	→	→	→	→	→	Hold 1 day prior to procedure		Resume 24 hours after procedure[1]	→
	High	→	→	→	→	Hold 2 days prior to procedure				
Apixaban CrCl < 25 mL/minute[2] Rivaroxaban or Edoxaban[3] CrCl < 30 mL/minute[2]	Moderate	→	→	→	→	Hold 2 days prior to procedure			Resume 24 hours after procedure[1]	→
	High	→	→	→	Hold 3 days prior to procedure					

[1] For patients with high thromboembolic risk of (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist
[2] Consider consult to Benign Hematology
[3] Not on MD Anderson Cancer Center formulary

Peri-Procedure Management of Anticoagulants

APPENDIX G: Prophylaxis Dose Anticoagulant Management

- For Interventional Spine and Pain Procedures, see Appendix D
- For Neurosurgery Procedures, see Appendix E
- For Interventional Radiology Procedures, see Appendix F

	Bleeding Risk	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2	Day +3	Day +4
Unfractionated heparin 5,000 units SQ every 8 hours or every 12 hours	Moderate/ High	→	→	Hold 12 hours prior to procedure		Resume 12-24 hours after procedure	→	→	→
	Regional Anesthesia[1]					*Regional anesthesia catheter in place:* • *Time from catheter PLACEMENT to dose: No restrictions* • *Time from last dose to REMOVING catheter: 4-6 hours* • *Restart after regional anesthesia catheter removal: No restrictions*			
Unfractionated heparin 7,500 units SQ every 8 hours	Moderate/ High	→	→	Hold 1 day prior to procedure.		Resume 12-24 hours after procedure	→	→	→
	Regional Anesthesia[1]					*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 4 hours*[2]			
Dalteparin 5,000 units SQ every 24 hours Enoxaparin 30 mg or 40 mg SQ every 24 hours	Moderate/ High	→	→	Hold 1 day prior to procedure		Resume 12-24 hours after procedure	→	→	→
	Regional Anesthesia[1]					*Regional anesthesia catheter in place:* • *Time from catheter PLACEMENT to dose: 12 hours* • *Time from last dose to REMOVING catheter: 12 hours* • *Restart after regional anesthesia catheter removal: 4 hours*[2]			
Enoxaparin 30 mg or 40 mg SQ every 12 hours	Moderate/ High	→	→	Hold 1 day prior to procedure		Resume 12-24 hours after procedure	→	→	→
	Regional Anesthesia[1]					*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 4 hours*[2]			

[1] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement. The holding recommendations are only for patients with low thromboembolism risk (see Appendix B). Patients with HIGH thromboembolic risk are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding.

[2] Restart recommendation applies only if the adequate time has passed based on the bleeding risk of the procedure

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Peri-Procedure Management of Anticoagulants

APPENDIX G: Prophylaxis Dose Anticoagulant Management - continued

	Bleeding Risk	Day -5	Day -4	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2	Day +3	Day +4
Fondaparinux 2.5 mg SQ every 24 hours	Moderate	→	→	→	Hold 2 days prior to procedure			Resume 12-24 hours after procedure	→	→	→
	High	→	Hold 4 days prior to procedure								
	Regional Anesthesia[1]	→	→	→	*CrCl > 50 mL/minute: Hold 2 days prior to procedure*			*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 6 hours*[2]			
		→	→	*CrCl 30-50 mL/minute: Hold 3 days prior to procedure*							
		CrCl < 30 mL/minute: Regional Anesthesia not recommended									
Apixaban 2.5 mg PO every 12 hours Rivaroxaban 10 mg PO every 24 hours	Moderate	→	→	→	→	Hold 1 day prior to procedure		Consider initiating prophylactic LMWH 12-24 hours after procedure	Resume 48-72 hours after procedure[2]	→	
	High	→	→	→	Hold 2 days prior to procedure						
	Regional Anesthesia[1]	→	→	→	*CrCl ≥ 30 mL/minute: Hold apixaban 2 days prior to procedure*			*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 6 hours*[2]			
		→	→	→	→	*CrCl ≥ 30 mL/minute: Hold rivaroxaban 1 day prior to procedure*					
		→	→	→	*CrCl < 30 mL/minute: Hold apixaban or rivaroxaban 2 days prior to procedure*						

[1] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement. The holding recommendations are only for patients with low thromboembolic risk (see Appendix B). Patients with HIGH thromboembolic risk are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding.

[2] Restart recommendation applies only if the adequate time has passed based on the bleeding risk of the procedure

[3] For patients with high thromboembolic risk of (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist

Peri-Procedure Management of Anticoagulants

APPENDIX H: Parenteral Anticoagulant Management (Treatment Doses)

- For Interventional Spine and Pain Procedures, see Appendix D
- For Neurosurgery Procedures, see Appendix E
- For Interventional Radiology Procedures, see Appendix F

	Bleeding Risk	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2	Day +3	Day +4
Enoxaparin 1 mg/kg every 12 hours[1] CrCl ≥ 30 mL/minute ½ life: 4-7 hours	Moderate	→	→	Hold evening dose on day prior to procedure		Resume 24 hours after procedure	→	→	→
	High						Resume 48-72 hours after procedure[3]		→
	Regional Anesthesia[2]			*Hold 1 day prior to procedure*		*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 4 hours*[4]			
Enoxaparin 1.5 mg/kg every 24 hours[1] Dalteparin every 24 hours[5] CrCl ≥ 30 mL/minute ½ life: 4-7 hours	Moderate	→	→	Give ½ dose in the morning on day prior to procedure		Resume 24 hours after procedure	→	→	→
	High						Resume 48-72 hours after procedure[3]		→
	Regional Anesthesia[2]			*Hold 1 day prior to procedure*		*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 4 hours*[4]			
Unfractionated heparin IV infusion ½ life: 1-1.5 hours	Moderate	→	→	Hold 4-6 hours prior to procedure or when aPTT < 45 seconds		Resume 24 hours after procedure	→	→	→
	High						Resume 48-72 hours after procedure[3]		→
	Regional Anesthesia[2]					*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Time from catheter PLACEMENT to dose: 1 hour* • *Restart after regional anesthesia catheter removal: 4 hours*[4]			

[1] Enoxaparin dosing for patients with CrCl < 30 mL/minute should be 1 mg/kg every 24 hours. For moderate and high-risk procedures, hold enoxaparin at least 1 day prior to procedure or consider transitioning patient to unfractionated heparin.

[2] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement. The holding recommendations are only for patients with low thromboembolic risk (see Appendix B). Patients with HIGH thromboembolic risk are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding.

[3] For patients with high thromboembolic risk (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist

[4] Restart recommendation applies only if the adequate time has passed based on the bleeding risk of the procedure

[5] For patients on dalteparin with CrCl < 30 mL/minute and planned moderate and/or high-risk bleeding procedure, hold dalteparin at least 1 day prior to procedure or consider transitioning patient to unfractionated heparin

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APPENDIX H: Parenteral Anticoagulant Management (Treatment Doses) - continued

	Bleeding Risk	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2	Day +3
Argatroban Normal hepatic function Child-Pugh score[1] ≤ 6 ½ life: 45 minutes	Moderate	→	→	Hold 3 hours prior to procedure or when aPTT < 45 seconds		Resume 12 hours after procedure	→	→
	High	→	→			Resume 24 hours after procedure	→	→
	Regional Anesthesia[2]	→	→	*Regional Anesthesia not recommended*				
Argatroban Hepatic dysfunction Child-Pugh score[1] > 6	Moderate	→	→	Hold 9 hours prior to procedure or when aPTT < 45 seconds		Resume 12 hours after procedure	→	
	High	→	→			Resume 24 hours after procedure	→	
	Regional Anesthesia[2]	→	→	*Regional Anesthesia not recommended*				
Bivalirudin CrCl ≥ 30 mL/minute ½ life: 30 minutes	Moderate	→	→	Hold 1.5 hours prior to procedure or when aPTT < 45 seconds		Resume 12 hours after procedure	→	
	High	→	→			Resume 24 hours after procedure	→	
	Regional Anesthesia[2]	→	→	*Regional Anesthesia not recommended*				
Bivalirudin CrCl < 30 mL/minute	Moderate	→	→	Hold 3 hours prior to procedure or when aPTT < 45 seconds		Resume 12 hours after procedure	→	
	High	→	→			Resume 24 hours after procedure	→	
	Regional Anesthesia[2]	→	→	*Regional Anesthesia not recommended*				

[1] See Appendix K: Child-Pugh Score

[2] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement. The holding recommendations are only for patients with low thromboembolic risk (see Appendix B). Patients with HIGH thromboembolic risk are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding.

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APPENDIX H: Parenteral Anticoagulant Management (Treatment Doses) - continued

	Bleeding Risk	Day -7	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2	Day +3	Day +4
Fondaparinux CrCl ≥ 50 mL/minute ½ life: 17-21 hours	Moderate	→	→	→	→	→	Hold 2 days prior to procedure			Resume 24 hours after procedure	→	→	→
	High	→	→	→	Hold 4 days prior to procedure						Resume 48-72 hours after procedure[2]		→
	Regional Anesthesia[1]	→	→	→						*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 6 hours*[3]			
Fondaparinux CrCl < 50 mL/minute	Moderate	→	→	Hold 5 days prior to procedure						Resume 24 hours after procedure	→	→	→
	High	→	Hold 6 days prior to procedure								Resume 48-72 hours after procedure[2]		→
	Regional Anesthesia[1]	*Consult Benign Hematology*								*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 6 hours*[3]			

[1] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement. The holding recommendations are only for patients with low thromboembolic risk (see Appendix B). HIGH thrombotic risk patients are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding.
[2] For patients with high thromboembolic risk (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist
[3] Restart recommendation applies only if the adequate time has passed based on the bleeding risk of the procedure

Peri-Procedure Management of Anticoagulants

APPENDIX I: Direct Oral Anticoagulants (DOACs) Management

- For Interventional Spine and Pain Procedures, see Appendix D
- For Neurosurgery Procedures, see Appendix E
- For Interventional Radiology Procedures, see Appendix F
- DOAC bridging considerations: For moderate bleeding risk procedures, do NOT bridge.
- For high bleeding risk procedures **and** the following thromboembolic risks: proximal lower extremity DVT or PE or stroke within 3 months, see Page 31.

	Bleeding Risk	Day -4	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2	Day +3	Day +4
Apixaban CrCl ≥ 25 mL/minute Rivaroxaban or Edoxaban[1] CrCl ≥ 30 mL/minute	Moderate	→	→	→	Hold 1 day prior to procedure		Resume 24 hours after procedure	→	→	→
	High	→	→	Hold 2 days prior to procedure				Resume 48-72 hours after procedure[3]		→
	Regional Anesthesia[2]	→	*Hold 3 days prior to procedure*				*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 24 hours*[4]			
Apixaban CrCl < 25 mL/minute[5] Rivaroxaban or Edoxaban[1] CrCl < 30 mL/minute[5]	Moderate	→	→	Hold 2 days prior to procedure			Resume 24 hours after procedure	→	→	→
	High	→	Hold 3 days prior to procedure					Resume 48-72 hours after procedure[3]		→
	Regional Anesthesia[2]	*Consult Benign Hematology*					*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 24 hours*[4]			

[1] Not on MD Anderson Cancer Center formulary
[2] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement. The holding recommendations are only for patients with low thromboembolic risk (see Appendix B). Patients with HIGH thromboembolic risk are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding.
[3] For patients with high thromboembolic risk (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist
[4] Restart recommendation applies only if the adequate time has passed based on the bleeding risk of the procedure
[5] Consider consult to Benign Hematology

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Peri-Procedure Management of Anticoagulants

APPENDIX I: Direct Oral Anticoagulants (DOACs) Management - continued

- DOAC bridging considerations: For moderate bleeding risk procedures, do NOT bridge.
- For high bleeding risk procedures **and** the following thromboembolic risks: proximal lower extremity DVT or PE or stroke within 3 months, see Page 31.

	Bleeding Risk	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day of Procedure	Day +1	Day +2	Day +3	Day +4
Dabigatran CrCl ≥ 50 mL/minute	Moderate	→	→	→	→	→	Hold 1 day prior to procedure		Resume 24 hours after procedure	→	→	→
	High	→	→	→	→	Hold 2 days prior to procedure				Resume 48-72 hours after procedure[3]		→
	Regional Anesthesia[1]	→	*Hold 3 days prior to procedure*						*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 24 hours*[3]			
Dabigatran CrCl 30-49 mL/minute	Moderate	→	→	→	→	Hold 2 days prior to procedure			Resume 24 hours after procedure	→	→	→
	High	→	→	Hold 4 days prior to procedure						Resume 48-72 hours after procedure[2]		→
	Regional Anesthesia[1]	→	*Hold 5 days prior to procedure*						*Regional anesthesia catheter in place:* • *Do not give unless approved by Acute Pain service* • *Restart after regional anesthesia catheter removal: 24 hours*[3]			
Dabigatran CrCl < 30 mL/minute[4]	Moderate	→	→	→	Hold 3 days prior to procedure				Resume 24 hours after procedure	→	→	→
	High	→	Hold 5 days prior to procedure							Resume 48-72 hours after procedure[2]		→
	Regional Anesthesia[1]	*Regional Anesthesia not recommended*										

[1] Regional anesthesia includes epidural catheter and deep peripheral nerve catheter placement. The holding recommendations are only for patients with low thromboembolism risk (see Appendix B). HIGH thrombotic risk patients are likely NOT candidates for regional anesthesia and should follow general holding guidelines based on moderate or high risk of bleeding.
[2] For patients with high risk of thromboembolism (see Appendix B), consider resuming anticoagulation earlier if hemostasis can be achieved and approved by proceduralist
[3] Restart recommendation applies only if the adequate time has passed based on the bleeding risk of the procedure
[4] Consider consult to Benign Hematology

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APPENDIX I: Direct Oral Anticoagulants (DOACs) Management - continued

Hold recommendations for patients on DOACs who are bridging therapy

Moderate bleeding risk procedures, do NOT bridge

High bleeding risk procedures AND the following thromboembolic risks: proximal lower extremity DVT or PE or stroke within 3 months, see bridging considerations below:

Day 0 is day of procedure

Day	Apixaban/rivaroxaban/dabigatran every 12 hour dosing[1]	Rivaroxaban/edoxaban every 24 hour dosing[1]	Patients with renal dysfunction (CrCl < 30 mL/minute or end stage renal disease on chronic hemodialyis)[1,2]
-6	DOAC at 8 am and 8 pm	DOAC at 8 pm	Last dose of DOAC
-5	DOAC at 8 am and 8 pm	DOAC at 8 pm	No anticoagulation
-4	DOAC at 8 am and 8 pm	Take last dose of DOAC at 8 pm	No anticoagulation
-3	Take last dose of DOAC at 8 am **and** Take first dose of enoxaparin 1 mg/kg subcutaneous at 8 pm	Enoxaparin 1 mg/kg subcutaneous at 8 pm	Start continuous heparin IV infusion specific to indication (consider omitting initial bolus)
-2	Enoxaparin 1 mg/kg subcutaneous at 8 am and 8 pm	Enoxaparin 1 mg/kg subcutaneous at 8 am and 8 pm	Continuous IV heparin infusion
-1	Enoxaparin 1 mg/kg subcutaneous at 8 am	Enoxaparin 1 mg/kg subcutaneous at 8 am	Continuous IV heparin infusion
0	No enoxaparin	No enoxaparin	Hold 4-6 hours prior to procedure

[1] If history of heparin induced thrombocytopenia (HIT), use intravenous direct thrombin inhibitor (see Appendix H) to bridge

[2] If creatinine clearance < 30 mL/minute, recommend consulting Benign Hematology

Restarting DOAC after bridging:

Refer to appropriate appendices for restart recommendations:

- Appendix I for Direct Oral Anticoagulants (DOACs) Management for general procedures
- Appendix D for Management of Anticoagulant for Interventional Spine and Pain Procedures
- Appendix E for restart recommendations based on thromboembolic risks for Neurosurgery Procedures
- Appendix F for Management of Anticoagulant for Interventional Radiology Procedures

APPENDIX J: Warfarin Management

Hold recommendations for patients on warfarin who are NOT bridging therapy

- Obtain INR 5-7 days prior to procedure and hold based on results:

INR results 5-7 days prior to procedure:	Supratherapeutic	Therapeutic	Subtherapeutic
When to hold warfarin:	At least 5 days before procedure	5 days before procedure	3-4 days before procedure

- Recheck INR 24 hours prior to procedure to ensure result is at desired level
- If INR still above desired level (*e.g.,* > 1.5), consider low-dose oral vitamin K (1-2.5 mg) and recheck INR just prior to procedure
- If not checking INR, discontinue warfarin 5-6 days prior to procedure

Hold recommendations for patients on warfarin who are bridging therapy

Note: Consider checking INR 5-7 days before procedure and if subtherapeutic, begin bridging medication immediately. If supratherapeutic, consider holding warfarin for more than 5 days prior to procedure. Holding warfarin for more than 5 days may also be indicated in select patient populations (*e.g.,* elderly, liver dysfunction, low warfarin dose requirements, target INR of 3-4).

Day 0 is day of procedure

Day	Unfractionated Heparin[1]	LMWH twice daily[1,2]	LMWH once daily[1,2]
-6	Last dose of warfarin	Last dose of warfarin	Last dose of warfarin
-5	Start continuous heparin infusion when INR falls below therapeutic range or on day -3 if not monitoring INR	Start LMWH when INR falls below therapeutic range or on day -3 if not monitoring INR	Start LMWH when INR falls below therapeutic range or on day -3 if not monitoring INR
-4			
-3	Continuous heparin infusion	LMWH at 8 am and 8 pm	LMWH at 8 am
-2	Continuous heparin infusion	LMWH at 8 am and 8 pm	LMWH at 8 am
-1	Continuous heparin infusion[3]	LMWH at 8 am[3]	½ dose LMWH at 8 am[3]
0	Hold 4-6 hours prior to procedure	No LMWH	No LMWH

[1] If history of heparin induced thrombocytopenia (HIT), use apixaban (see Appendix I) or intravenous direct thrombin inhibitor (see Appendix H) to bridge
[2] If creatinine clearance < 30 mL/minute, recommend using unfractionated heparin to bridge
[3] If possible, check INR and if > 1.5, give vitamin K 1 mg PO and recheck INR on the day of procedure

Restarting Warfarin

- See Appendix D for restart recommendations based on thrombotic risks for Interventional Spine and Pain Procedures
- See Appendix E for restart recommendations based on thromboembolic risks for Neurosurgery Procedures
- In most cases warfarin can be restarted 24 hours after a procedure, whether the patient is high or moderate risk of bleeding
- If patient has high thromboembolic risk (see Appendix B) and was bridged prior to procedure, restart bridging agent **and** warfarin post procedure, and discontinue bridging agent when INR is therapeutic

APPENDIX K: Child-Pugh Scoring System[1]

Chemical and biochemical parameters	Scores (points) for increasing abnormality		
	1	2	3
Encephalopathy	None	Grade 1 - 2	Grade 3 - 4
Ascites	None	Slight	Moderate
Albumin	> 3.5 g/dL	2.8 - 3.5 g/dL	< 2.8 g/dL
Bilirubin	< 2 mg/dL	2 - 3 mg/dL	> 3 mg/dL
Prothrombin time prolonged **or** INR	1 - 4 seconds < 1.7	4 - 6 seconds 1.7 - 2.3	> 6 seconds > 2.3

[1] Child-Pugh score is obtained by adding the score for each parameter
Child-Pugh class:
Class A = 5 to 6 points
Class B = 7 to 9 points
Class C = 10 to 15 points

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