

Perioperative Anticoagulation Guideline

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. Based on American College of Chest Physicians 2008 Practice Guidelines and updated 2012 Clinical Practice Guidelines, extensive literature review and examination of clinical practice guidelines, we suggest a 4 step process as outlined below. Steps 1-3 are preoperative. Step 4 is postoperative.

Step 1: Determine if anticoagulation can be continued without interruption

Consider bleeding risk of the procedure. For low bleeding risk procedures warfarin 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: Determine thromboembolic risk and need for bridging therapy

	HIGH Thrombotic Risk: Bridging Required	LOW 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) ▪ Recent (< 6 months) stroke/TIA ▪ Bi-leaflet aortic valve prosthesis with ≥ 1 stroke risk factors¹ (see below) ▪ Two or more mechanical valves 	<ul style="list-style-type: none"> ▪ Bi-leaflet aortic valve prosthesis without stroke risk factors¹ (see below)
Atrial Fibrillation (A fib)	<ul style="list-style-type: none"> ▪ CHADS2* Score 4-6 ▪ Prior stroke or TIA ▪ Rheumatic mitral valvular heart disease ▪ Cardiac thrombus 	<ul style="list-style-type: none"> ▪ CHADS2 Score 0-3 with no prior stroke/TIA
Venous Thromboembolism (VTE)	<ul style="list-style-type: none"> ▪ Recent VTE (within 6 months)^{2,3} ▪ Prior VTE and ≥ 1 other risk factor⁴ ▪ Recurrent VTE⁵ 	<ul style="list-style-type: none"> ▪ Single unprovoked VTE > 6 months ago and no other risk factors⁴

1. Stroke Risk Factors: A fib, congestive heart failure, hypertension, age ≥ 75 years, diabetes, and history of stroke or TIA.

*(These are the risk factors used for a-fib and CHAD2 stroke risk assessment: 1 point for congestive heart failure, hypertension, age ≥ 75 years, diabetes, 2 points for previous stroke or TIA)

2. Elective procedures should be postponed in patient with VTE < 3 months.

3. Patients with a single provoked VTE should not be on warfarin > 6 months.

4. VTE Risk Factors: Protein C or S deficiency, antithrombin III, antiphospholipid antibody syndrome, homozygous factor V Leiden mutation or active cancer (treated within the last 6 months or palliative care).

5. Patients with recurrent VTE > 12 months ago with no other risk factors may not need bridging with therapeutic dose of enoxaparin routinely; may consider prophylactic dose if necessary.

Step 3: Preoperative management of bridging and warfarin:

Bridging	<p>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 or 1.5mg/kg q 24hrs 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 Check INR in the morning on the day of surgery</p>
No Bridging	<p>Last dose of warfarin 6 days prior to procedure for INR<3 (INR 3-4.5: Last dose of warfarin 7 days prior to procedure) Check INR the morning of the procedure</p>

*See table “Drugs for Bridging” for alternatives.

Drugs for Bridging

Drug	Therapeutic Dose	Prophylaxis Dose	Pre-Surgery Regimen
Dalteparin (Fragmin)	200 units/kg SQ daily	5000 units SQ daily	d/c 24hr prior to surgery
Dalteparin for Obese Patients	100 units/kg SQ BID when >99kg	7500 units SQ daily when >150kg	d/c 24hr prior to surgery
Dalteparin for Renally Impaired	Monitor anti-Xa levels 4-6 hr post dose to target range of 0.5-1.5 IU/ml when CrCl < 30 ml/min	5000 units SQ daily	d/c 24hr prior to surgery
Enoxaparin (Lovenox)	1 mg/kg SQ BID or 1.5mg/kg SQ daily	30 mg SQ BID	d/c 24hr prior to surgery
Enoxaparin for Renally Impaired	1mg/kg SQ <u>daily</u> when CrCl < 30 ml/min	30mg SQ daily when CrCl < 30 ml/min	d/c 24hr prior to surgery
UFH	250 IU/kg SQ BID	5000 IU SQ BID	d/c 4hr prior/ surgery
Fondaparinux (Arixtra)	<ul style="list-style-type: none"> • 5mg SQ daily when < 50kg. • 7.5mg SQ daily when 50-100kg. • 10mg SQ daily when >100kg. 	2.5mg SQ daily	d/c 36-48hr prior to surgery
Fondaparinux for Renally Impaired	Contraindicated when CrCl < 30 ml/min	Contraindicated when CrCl < 30 ml/min	

Post Operative Anticoagulation Algorithm

Step 4: Resume Anticoagulation

See appendix A for extensive list of procedures

	Low Bleeding Risk Procedure	Moderate Bleeding Risk Procedure	High Bleeding Risk Procedure
	Dental extraction Skin Biopsy/Mohs Cataracts Colonoscopy, no biopsy	Endoscopy with biopsy CT or US guided biopsy Most surgical procedures (i.e. cholecystectomy, orthopedic, low risk urological).	Neurosurgery (intracranial, spinal cord) High risk urological Other closed space procedures (post chamber eye)
Low risk of thrombosis Bileaflet Aortic Valve, no risk factors* Atrial fibrillation with CHADS2** ≤ 3 and no prior stroke VTE > 6 months, no risk factors***	Continue full dose anticoagulation	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)
Elevated risk thrombosis Mechanical mitral valve Older mechanical aortic valve Atrial fibrillation with CHADS2** 4-6 or prior stroke or TIA Bileaflet aortic valve, with risk factors* Recent VTE <6 months VTE>6 months and risk factors***	Continue full dose anticoagulation	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 INR ≥ 2	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 If utilized, stop LMWH when INR ≥ 2

* Risk Factors: A fib, congestive heart failure, hypertension, age ≥ 75 years, diabetes, and history of stroke or TIA.

**CHADS2 score 1 point for risk factors, congestive heart failure, hypertension, age ≥ 75 years, diabetes, 2 points for stroke or TIA

***VTE risk factors: Protein C or S deficiency, antithrombin III, antiphospholipid antibody syndrome, homozygous factor V Leiden mutation or active cancer (treated within the last 6 months or palliative care).

References for anticoagulation and antiplatelet therapy management guidelines:

- Abualsaud AO, Eisenberg MJ. Perioperative management of patients with drug-eluting stents. *J Am Coll Cardiol Interv*, 2010; 3:131-142.
- Adult Legacy Anticoagulation Clinic Guidelines for Management of Chronic Oral Anticoagulation Around Elective Invasive Procedures, The Bridging Process. Legacy Anticoagulation Clinic Bridging Recommendations, Legacy Health System Sept. 2007
- Anderson MA, et al. Management of antithrombotic agents for endoscopic procedures. *Gastrointest Endosc* 2009;70: 1060-70.
- Anticoagulation, Peri-Procedural Management. Kaiser Permanente Northwest Practice Resource Oct 2013.
- Avelyn Kwok, MBBS, FRACP and Douglass O. Fairgel, MD FACP, Management of Anticoagulation Before and After Gastrointestinal Endoscopy. *Am J Gastroenterol* 2009; 104:3085-3097.
- Baron et al. Management of Antithrombotic Therapy in Patients Undergoing Invasive Procedures. *NEJM* 2013;368:2113-24.
- Billingsley EM, Maloney ME. Intraoperative and postoperative bleeding problems in patients taking warfarin, aspirin, and non-steroidal anti-inflammatory agents: a prospective study. *Dermatol Surg* 1997; 23:381-383.
- Birkmeyer NJ, et al. Preoperative Placement of Inferior Vena Cava Filters and Outcomes after Gastric Bypass Surgery, for Michigan Bariatric Surgery Collaborative. *Annals of Surgery*, Vol. 252, Number 2, August 2010.
- Birnie DH, et al. Pacemaker or Defibrillator Surgery without Interruption of Anticoagulation. *NEJM* 2013;368:2084-2093.
- Bridging Protocol, Intermountain Health Care Chronic Anticoagulation Clinic (CAC), Revised Nov. 2008.
- Chassot P.-G, Delabays A. and Spahn, D.R. Perioperative antiplatelet therapy: the case for continuing therapy in patients at risk of myocardial infarction. *British Journal of Anesthesia* 99 (3): 316-328 (2007).
- Douketis JD, et al. The Perioperative Management of Antithrombotic Therapy. American College of Chest Physicians Evidence-Based Clinical Practice Guidelines 8th ed. *CHEST* 2008; 133 (6): 299s-339s.
- Douketis JD, et al. Perioperative Management of Antithrombotic Therapy, 9th ed. American College of Chest Physicians- Evidence Based Practice Guidelines. *CHEST* 2012; 141 (2 Suppl): e326S-e350S.
- Fang MC, Go AS, Chang Y, Borowsky L, Pomernacki NK, Singer DE, ATRIA Study Group, Comparison of risk stratification schemes to predict thromboembolism in people with nonvalvular atrial fibrillation. *J Am Coll Cardiol*. 2008;51(8):810.
- Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. *Circulation* 2014.
- Healey JS, et al; RE-LY Investigators. Periprocedural bleeding and thromboembolic events with dabigatran compared with warfarin: results from the Randomized Evaluation of Long-Term Anticoagulation Therapy (RE-LY) randomized trial. *Circulation*. 2012 Jul 17;126(3):343-8.
- Jaffer AK, et al. Variations in Perioperative Warfarin Management: Outcomes and Practice Patterns at Nine Hospitals. *American Journal of Medicine*, 2009; 123 (2), 141-149.
- Jaffer AK., Perioperative Management of Warfarin and Antiplatelet Therapy. *Cleveland Clinic Journal of Medicine*. Vol 76, Suppl 4, Nov. 2009 S37-S44. J
- January CT, Wann LS, Alpert JS, et al. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol*. Published online before print March 28, 2014. doi:10/1016/j.jacc.2014.03.022.

- Kadakia SC, Angueira CE, Ward JA, Moore M. Gastrointestinal endoscopy in patients taking antiplatelet agents and anticoagulants: survey of ASGE members: American Society for Gastrointestinal Endoscopy. *Gastrointest Endosc* 1996; 44:309-316.
- Konstabtatios A. Anticoagulation and cataract surgery: a review of the current literature. *Anaesth Intensive Care* 2001; 29: 11-18.
- Lee S, Savides TJ, Review of Management of Anticoagulation Before and After Gastrointestinal Endoscopy. *AM J Gastroenterol* Mar 2010; 105 (3): 703.
- Malloy PC et al. Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis Risk in Percutaneous Image-guided Interventions. *J Vasc Interv Radiol* 2009;20:S240-S249.
- Management of antithrombotic agents for endoscopic procedures, ASGE Gastrointestinal Endoscopy Vol 70, No. 6:2009 1060-1070.
- Mehran R, Rao SV, Bhatt DL, Gibson CM, Caixeta A, Eikelboom J, Kaul S, Wiviott SD, Menon V, Nikolsky E, Serebruany V, Valgimigli M, Vranckx P, Taggart D, Sabik JF, Cutlip DE, Krucoff MW, Ohman EM, Steg PG, White H. Standardized bleeding definitions for cardiovascular clinical trials: a consensus report from the Bleeding Academic Research Consortium. *Circulation*. 2011 Jun 14;123(23):2736-47.
- Newsome LT, Weller RS, Gerancher JC, et. al. Coronary artery stents: II. Perioperative considerations and management. *Anesth & Analg*, 2008; 107:570-90.
- Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*. 2014;63:e57-185.
- Oldgren J, et al. Risks for Stroke, Bleeding and Death in Patients with Atrial Fibrillation Receiving Dabigatran or Warfarin in Relation to the CHADS2 Score: A Subgroup Analysis of the RE-LY Trial. *Ann Intern Med*. 2011;155:660-667.
- Omran H, Bauersachs R, Rübenacker S, Goss F, Hammerstingl C. The HAS-BLED score predicts bleedings during bridging of chronic oral anticoagulation. Results from the national multicentre BNK Online bRiDging REgistRy (BORDER). *Thromb Haemost*. 2012 Jul;108(1):65-73.
- Poldermans D, et al. Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery. *European Heart Journal* (2009) 30, 2769-2812.
- Popescu WM. Perioperative management of the patient with a coronary stent. *Current Opin Anaesthesiol*, 2010;23:109-115.
- Preoperative Algorithms- Antiplatelet Agents and Cardiac Stents. Legacy UHealth Preoperative Assessment Center, University of Miami. (Based on American College of Chest Physicians 2008 practice Guidelines).
- Siegal D, Yudin J, Kaatz S, Douketis JD, Lim W, Spyropoulos AC. Periprocedural heparin bridging in patients receiving vitamin K antagonists: systematic review and meta-analysis of bleeding and thromboembolic rates. *Circulation*. 2012 Sep 25;126(13):1630-9.
- Skeith et al. The equipoise of perioperative anticoagulation management: a Canadian cross-sectional survey *J Thromb Thrombolysis* (2014) 37:411–413
- Snow V, et al. Management of newly detected atrial fibrillation: a clinical practice guideline from the American Academy of Family Physician and the American College of Physicians. *Ann Intern Med* 2003; 139:1009-1017.
- Van Kuijk JP, et al. Timing of Noncardiac Surgery after Coronary Artery Stenting with Bare Metal or Drug-Eluting Stents. *Am J Cardiol* 2009; 104: 1229-1234.
- Veitch AM., et al. Guidelines for the management of anticoagulant and antiplatelet therapy in patients undergoing endoscopic procedures. *Gut* 2008; 57:1322-1329.
- Weibert RT. Oral anticoagulant therapy in patients undergoing dental surgery. *Clin Pharm* 1992; 11:857-864.
- Wysokinski WE, McBane RDII. Periprocedural bridging management of anticoagulation. *Circulation* 2012;126:1630-1639.

**Appendix A:
Bleeding Risk Associated with Different Procedure Types**

	Moderate/High Moderate Bleeding Risk unless noted as (HIGH) (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 (HIGH) 	<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} (HIGH) ▪ Valve replacement surgery^{1,2,4,5} (HIGH) 	
Cardiology - General	<ul style="list-style-type: none"> ▪ Cardiac catheterization^{1,2} ▪ Electrophysiology studies⁵ (HIGH) ▪ Coronary interventions⁵ (HIGH) 	
Cardiology - EP	<ul style="list-style-type: none"> ▪ Pacemaker implantation (HIGH) ▪ Pacemaker adjustment/battery replacement ▪ AICD implantation (HIGH) 	
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 (HIGH) ▪ 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 (HIGH) ▪ Colonoscopy with polypectomy¹ ▪ Large polypectomy (>1 cm) (HIGH) ▪ ERCP with sphincterotomy¹ ▪ Laser ablation¹ 	<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

Gastroenterology (continued)	<ul style="list-style-type: none"> ▪ 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 (HIGH) ▪ Therapeutic balloon-assisted enteroscopy⁶ ▪ Endoscopic hemostasis⁶ 	<ul style="list-style-type: none"> ▪ 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 (HIGH) ▪ 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} (HIGH) 	
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} (HIGH) ▪ Laminectomy⁴ (HIGH) 	
Ophthalmology	<p>(all posterior chamber of the eye surgeries are HIGH)</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 ▪ Blepharoplasty¹ 	<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 ▪ Cataract surgery⁵

Ophthalmology (continued)	<ul style="list-style-type: none"> ▪ Entropion/Ectropion Repair¹ ▪ All Orbital Surgery¹ ▪ Dacryocystorhinostomy (DCR) ¹ ▪ Periorbital surgery⁵ ▪ Vitreoretinal surgery⁵ 	<ul style="list-style-type: none"> ▪ Intraocular injections⁵
Orthopedics	<ul style="list-style-type: none"> ▪ Total joint replacement surgeries – hip, knee, or shoulder^{1,2} (HIGH) ▪ Fracture repair in femur, humerus or pelvis^{1,2} ▪ Arthroscopy⁵ ▪ Shoulder, foot or hand surgery⁴ ▪ Arthroscopic surgery⁴ ▪ Carpal tunnel repair⁴ 	<ul style="list-style-type: none"> ▪ Joint, bursa, and tendon sheath aspirations and injections¹ ▪ Athrocentesis⁵
Plastic Surgery	<ul style="list-style-type: none"> ▪ Major reconstructive plastic surgeries¹ 	<ul style="list-style-type: none"> ▪ Some small office procedures
Podiatry	<ul style="list-style-type: none"> ▪ Surgical osteotomies¹ ▪ Open reduction/internal fixation foot and ankle fractures/dislocations¹ ▪ Soft tissue/mass excision¹ ▪ Arthrodesis of the toes/foot/ankle¹ ▪ Arthroscopy-foot/ankle¹ ▪ Removal foreign body (deep) ¹ ▪ Tendon repair¹ ▪ Neuroma/neurectomy¹ ▪ Closed reduction – in case need to¹ convert to an open reduction; hence patients will need to be off warfarin ▪ Biopsies-skin (deep), fascia, muscle bone¹ 	<p>Office procedures are low risk including:</p> <ul style="list-style-type: none"> ▪ Nail procedures^{1,2} ▪ Wart removal^{1,2} ▪ Foreign body (superficial)^{1,2} ▪ Skin biopsy (superficial)^{1,2} ▪ Removal external fixation¹
Pulmonology	<ul style="list-style-type: none"> ▪ Chest tube placement ⁵ ▪ Transbronchial biopsy ⁵ ▪ Stricture dilation ⁵ ▪ Thorocentesis^{5,7} ▪ Endobronchial FNA ⁵ ▪ Airway stent placement ⁵ ▪ Bronchoscopy with or without biopsy^{4,5} 	<ul style="list-style-type: none"> ▪ Central venous line removal⁴
Radiology	<ul style="list-style-type: none"> ▪ Epidural steroid injection^{1,2} ▪ Disc procedures^{1,2} ▪ Liver/kidney biopsy^{5,7} (HIGH) ▪ TIPS^{5,7} ▪ Percutaneous nephrostomy^{5,7} ▪ Percutaneous transhepatic cholangiography⁵ 	<ul style="list-style-type: none"> ▪ Trigger Point Injection^{1,2} ▪ Peripheral injections^{1,2} ▪ Sacroiliac joint injection^{1,2} ▪ Pump refills^{1,2} ▪ Joint, bursa or tendon sheath aspirations/injections² ▪ Simple catheter exchange in non-

Radiology (continued)	<ul style="list-style-type: none"> ▪ Aggressive manipulation of percutaneous drains⁷ ▪ Aspiration abdominal or 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 (HIGH) ▪ Tunneled central venous catheter⁷ ▪ Subcutaneous port placement⁷ ▪ Intra abdominal, chest wall or retroperitoneal drainage or biopsy⁷ ▪ Lung biopsy⁷ ▪ Percutaneous liver biopsy⁷ (HIGH) ▪ 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"> vascular tract (PEG tube, nephrostomy tube)^{5,7} ▪ PICC^{5,7} ▪ IVC filter^{5,7} ▪ 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} (HIGH) ▪ Transurethral resection of the bladder for tumor^{1,4} (HIGH) ▪ Kidney, prostate or bladder biopsy^{1,2} (HIGH) ▪ Partial nephrectomy¹ (HIGH) ▪ 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} (HIGH) ▪ Peripheral bypass surgery^{1,2,4,5} (HIGH) ▪ Carotid endarterectomy⁵ (HIGH) ▪ Angiogram with or without intervention 	

1. Kaiser Permanente Northern California guidelines 2. Kaiser Permanente Northwest current guideline 3. Birnie D.H., Healey J.S., Wells G.A., et al. N Engl J Med 2013; 368:2084-2093. Finding: “Clinically significant device-pocket hematoma occurred in 12 of 343 patients (3.5%) in the continued-warfarin group, as compared with 54 of 338 (16.0%) in the heparin- group.” 4. UptoDate. Accessed May 30, 2013. Based on individual subspecialty society recommendations. 5. Management of Antithrombotic Therapy in Patients Undergoing Invasive Procedures. Todd H. Baron, M.D., Patrick S. Kamath, M.D., and Robert D. McBane, M.D. N Engl J Med 2013; 368:2113-2124. 6. Management of antithrombotic agents for endoscopic procedures. ASGE Standards of Practice Guidelines. Gastro Endo 2009; 70:1060-1070. 7. Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis in Percutaneous Image-Guided Interventions. Patrick C. Malloy, Clement J. Grassi, Sanjoy Kundu et al. J Vasc Interv Radiol 2009; 20:S240-S249.